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CONTENTS

Research Papers

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IMPACT OF INCIVILITY IN THE BEHAVIOR AND WORKING ATTITUDE OF EMPLOYEES

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ABSTRACT
This paper reveals the investor strategies, incivility behavior and working attitude of employees in sunrise industries. Constant updates of each product pressurize the manufacturer to set new business trends which help to avoid market competition and glut. This force the organizations to re-think about its strategically appropriate requirement for its HRD uniqueness with insulated HR Training and development right from the recruitment process. Today Companies focus on improving turn-over rate. They concentrate on Human resource administrators rather than on employees. The employees are recruited only when the modules are assembled to be a finished product and the secret of production process are kept confidential by means of splitting the entire process into smaller modules. Major parts are outsourced for production in other reputed institutions. Recruiting and weeding process are carried out yearly without much legal consequences. Employee's knowledge about their work nature is kept minimum. Comparative cost advantage is analyzed in every module of production process. Major companies focus on their customer satisfaction and investors profit to run the business successfully. Thus present strategic HRD Policies of companies are framed on the basis of restricting communistic trends among the employees. Keywords: Incivility, off-shoring, Module, Attrition, Glut.

India with its huge youth population stand at a point of emerging as an economic super power. The versatility of today labour marks the growth of economy towards secondary and tertiary sectors. Currently the share of employment in this sectors is less than thirty percent but their contribution to the GDP as a whole is almost double. Since they are labour intensive in nature they create more job opportunities. This situation can be prolonged only when country moves on the path of new labour reforms. Several economists criticize the present rigidity of labour laws followed in our country .They believe that this inflexible regulations followed in the country are the reasons behind creation of new employment opportunities and can even become an obstacle to the recently launched "Make in India" campaign.

IMPORTANT LABOUR LAWS GOVERNING INDIAN INDUSTRIES
The Factories Act 1948 –Protect workers Health, Safety, proper working hours and shift system Payment of gratuity act 1972, EPF Act 1952, Payment of bonus act 1965, Industrial disputes act 1947, Equal remuneration act 1965, etc. Also govern our Indian industries During the beginning of Industrial revolution even though the labour laws governed the labour market, the labour forces are not educated beyond the required level. Their work load and family pressure regulated the employee not to go beyond his daily work schedule, which never hindered the employers profit. The employers never thought of other side of labour intensive production process. After the introduction of technical education, today labour market is well cherished by accruing knowledge, but irrelevant to their profession which guides the labour force against the employer and companies welfare. This leads to incivility among the employees which increases the cost of production leading to huge economic losses and increased labour disputes. Competitive market price fixation and increased labour cost leads to periodic agitation in business sector and lowers the investment capacity. Many companies fell sick and seize to function. This is largely because of equilibrium theories of trade and labour being poorly integrated [2].

Flows of inputs across geographic boundaries: In western countries, Arm's trade has grown fast. And many studies have documented the growth of this international vertical specialization, as reflected in the flows of inputs across national borders for future processing and final assembly [3]. These trends are closely related to the growing fragmentation of production, in which multinational corporations play an important role. Technological change such as Computer- Aided Design (CAD) and Computer –Aided Manufacturing (CAM) contribute to this process. And the same technological changes also contributed to growing outsourcing industries within and across national borders [4].In addition to the above broad trends, new data sets enable researchers to uncover previously unobserved patterns of trade and FDI flows. Especially a systematic relationship exists between the characteristics of business firms and their participation in foreign trade and investment. Globalized labour cost due to off-shoring, low returns in other sectors and migration towards prosperity (bargaining with the attitude on comparative standard of living) shows how trade liberalization affects the productivity, distribution of firms by selection of efficient firms into export business and inefficient firms to exit out of race and this selection process enjoys massive empirical support.

ISSN 2394 - 7780

GOVERNMENT INITIATES LABOUR REFORMS TO ACCELERATE INVESTMENTS

Our Indian Government plans to introduce new labour bills replacing existing one. The bills are namely the Industrial relations code bill 2016, wage code bill 2016, the small factories (Regulation of employment and conditions of services) bill, the shops and establishments (Amendment) bill, and Employees provident fund and miscellaneous provisions (Amendment) bill. The government intends to club the present forty existing labour laws into five acts. All wage-related laws will be made part of the wage code and industrial relations laws. Once passed, the industrial relations code will facilitate easier hiring and retrenchment across industries. A previous draft of the proposed law suggested that companies need not seek prior approval for retrenching up to 300 employees incase of an emergency or accumulated losses [5]. The wage code and industrial relations code will also club nearly 10 existing laws, including the factories Act, 1948 and the industrial disputes Act, 1947 into two. The legislation will make compliance with the labour laws less stringent for employers. The Employees provident fund and miscellaneous provisions (Amendment) bill seeks to position the New pension system (NPS) as an alternative to Employee's provident fund(EPF) Similarly, the wage code bill seeks to offer health insurance as an alternative to Employees state insurance corps and provide health facilities for all workers. Greater women participation in the workforce will also get facilitated by the small factories bill which allows women to work on night shifts. Business establishments will be allowed to open round the clock under the new shops and establishments (Amendment) bill, which improves economic activities and generates huge employment opportunities in our nation.

OFF-SHORING MODULE AS A NEW BUSINESS MODEL

Investors in India and FDI are not happy about the present India platform for doing business, as it is highly inconsistent and labour oriented. Make in India campaign will be more successful only when investors get more returns for their investments either through domestic or FDI route. Even a successful project in a place may struggle in other place due to its socio-economic conditions or other externalities. With our nation venturing into a new industrial revolution, business in recent times highly depend upon reliable source of information for carrying out large scale business transactions. Business is moving societies towards prosperity when production is made as mass production employing cost cutting techniques. At the time of early industrial revolution, the mass production had labour issues. Karl marx postulates that production process involve four factors of production namely – Land, Labour, Capital and organization. Here the rewards for the factors were classified as rent, wage, interest and profit. According to Marx labour plays an active role in production. Unlike animals, human beings sense timely requirement. Accordingly among the various factors of production, labour plays a critical role and he argued that entire profit should be divided into two, one for labour and other for capitalist. This theory impacted the labour law which results in diminishing the investment capacity of the capitalist. karl marx focus only was on the accumulated capital and he fails to see other factors involved in production process like cost, risk and time involved on other production factors. As by his theory, labour react timely but modern business focus on new technologies and the comparative cost advantages play a major portion in revenue generation. Capitalist rather than establishing a firm in a full furnished manner bypasses permanent labour, maintenance, and the capital consuming module in the process and out-sources production. This economic globalization module affects the resources and constraints trade unions to articulate work place-based demands. From this perspective, it is not simply a matter of tipping the balance of power between employers and employees, but a qualitatively different shaping of political spaces, which encourages new forms of collective action and discourages others. Within this new political spaces, the resources for articulating workplace-based demands centered on the identity of ''worker'' which have been dislocated by a set of interrelated processes and discourses [6]**.** Sustainability has extended regulatory systems for quality and safety beyond a minimum set of deliverables. Diversifying out from the traditional domain of managing risk, quality standards are increasingly used as a means of creating and organizing interaction and trust within global production networks [7]. Ultimately investors keep his investment on a ongoing basis. Investors always compare the comparative profit advantage in reallocation of their investments by studying the market with the ingained available knowledge, expertise and resources at their disposal. In this process investors also believe on a bench marked company which is a fraction among multiple producers and tend to avoid loss and business risks. Investors calculate a business projects returns on the basis of total resources invested and its cost, benefit, time required between investment and income generated, legal formalities and other externalities, market scope in future, and loss involved in switching business to new areas. This is done in short and on long term basis.

CONCLUSION

To conclude to be competitive in this knowledge era, capital needs to be accumulated in the shortest period of time. So in the present context, for India to make effective of its demographic advantages to the maximum and to emerge on top globally, there is a dire need to make labour reforms more proactive keep in need of our

ISSN 2394 - 7780

domestic needs and international trends. The present movement of capital, technology and managements to distant geographies in search of more profits and markets, the skilled and unskilled laboures are still being held under the influence trade unions with a Marxian perspective. The permanent nature of employment no longer exist and remains as a challenge and threat to the changing investment patterns. So for initiating labour reforms in our nation across sectors, making them competitive to survive and prosper in the changing international business scenario we need more investments to create better employment opportunities to satisfy the employment needs of our educated, skilled and unskilled labour force. Moreover for the success of all the new initiatives like Make in India, Start up India, Digital India the working attitude of our labour force also needs to be change according to the ground realities for our nation to succeed and prosper. Production process in coming years will be replaced by new technologies like Block chain, Artificial intelligence, machine learning and so on. We need to skill our nation, particularly our youth for emerging as a major economic power with the available resources at our disposal. Political leadership, policy makers, industrialists should create a favorable investment environment coupled with new regulatory mechanisms for creation of world class industries across sectors for generating more employment opportunities in the best interest of our nation.

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EFFECT OF SOIL APPLICATION OF DIFFERENT BORON FERTILIZERS ON THE PERFORMANCE OF TOMATO

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ABSTRACT
Pot experiments were conducted at Department of Soil Science and Agricultural Chemistry to evaluate response level of tomato to soil application of different sources of boron. The treatment details include B_0L_0 – Control, B_1L_1 – CBH, 0.5 mg kg^{-1}, B_1L_2 – CBH 1.0 mg kg^{-1}, B_1L_3 – CBH 1.5 mg kg^{-1}, B_2L_1 – Boric acid 0.5 mg kg^{-1}, B_2L_2 – Boric acid 1 mg kg^{-1}, B_2L_3 – Boric acid 1.5 mg kg^{-1}, B_3L_1 – Boron 0.5 mg kg^{-1}, B_3L_2 – Boron 1 mg kg^{-1}, B_3L_3 – Boron 0.5 mg kg^{-1}, B_4L_1 – Polybor 0.5 mg kg^{-1}, B_4L_2 – Polybor 1.0 mg kg^{-1}, B_4L_3 – Polybor 1.5 mg kg^{-1}. The yield components fruit set percentage (3 g), single fruit weight (100 g), total fruit yield per plant (940 g pot^{-1}) and stover yield (366 g $plant^{-1}$). It was concluded that soil application of calcium boro humate 1.5 mg kg^{-1} was the optimum dose to improve the yield and yield attributes of tomato.Keywords : Tomato, Calcium Boro humate,Boric acid,Boron, Polybor (Disodium octaborate tetrahydrate).

INTRODUCTION
Tomato (*Lycopersicon esculentum* L.) assumes great significance due to its nutritional excellence. Boron nutrition of soil and crops has assumed greater importance in view of low boron status of soil of intensive agricultural areas of Tamil Nadu coupled with use of high analysis fertilizers and higher demand of boron by high yielding crops. The boron nutrition of vegetable crops, particularly yield of tomato, has greater importance as it is a major vegetable crop grown in Tamil Nadu.

Shorrock (1993) categorized the water soluble boron in soils as very low (<0.25 □g g^{-1}), low (0.25-0.5 □g g^{-1}), medium (0.51-1.0 □g g^{-1}), high (1.1-2.0 □g g^{-1}) and very high (>2.0 □g g^{-1}). It is evident from the above classification of water soluble boron in soil that in general >0.5 □g g^{-1} of boron in soil is sufficient for the normal growth of most crop plants (Cox and Kamprath, 1972).

Humic substances can supply growing plants with nutrients, make the soil more fertile and productive and increase its water holding capacity (Mostafa Rady, 2011).

Calcium is considered to be an important factor for the maintenance of cell membrane integrity and the regulation of ion transport. Ca^{2+} ions are essential for K^+ vs. Na^+ ion selectivity and membrane integrity (Mostafa Rady and Ashraf Osman, 2011).

In order to minimize the cost as well as to improve the availability of complex boron fertilizers, humic acid based boron complex, calcium boro humate (CBH) which improves the use efficiency of boron is used in the study with the following objectives.

To compare the performance of calcikum boro humate complex (CBH) with the commercially available boron fertilizers in improving the yield of tomato.

MATERIALS AND METHODS
Calcium boro humate (CBH) preparation
Extraction of humic acid
Lignite is available in abundance in Neyveli lignite mines of Tamilnadu. The C:N ratio of lignite is about 70:1. This organic material after grinding to pass through 0.5 mm sieve was used in the preparation of humic acid. Humic acid was extracted in accordance with the fractionation procedure given by Stevenson (1965). The fine sieved lignite powder was dissolved in a 0.5 NaOH. The dark brown coloured liquid was filtered through Whatman No. 1 filer paper. Filtrate was collected and acidified with concentrated HCl to pH 1.0. After half an hour, precipitated humic acid had settled at bottom and the supernatant liquid was siphoned off. The humic acid was dried and ground to a fine powder.

Preparation of calcium boro humate complex
Five g humic acid powder was dissolved in small quantity of 0.1 N KOH and diluted to 1000 ml. Five g of boric acid and 2.5 g of calcium chloride were added to the humic acid solution and the pH was adjusted to 7.0. The solution was shaken in horizontal shaker for 30 minutes and allowed to stand over night. Next day the supernatant solution was filtered through Whatmann No. 42 filter paper till the filtrate runs free of chloride. The calcium boro humate complex retained in the filter paper was dried and ground to a fine powder. Thus obtained calcium

ISSN 2394 - 7780

boro humate is utilized for the experiment. The boro humate complex was digested using diacid HNO_3 and $HClO_4$ (4:1) and analyzed for its B content by colorimetry. The boron content is given in Table 1.

Boric acid (H_3BO_3)
The boron content is given in Table 1.

Borax ($Na_2B_4O_7.10H_2O$)
The boron content is given in table 1.

Polybor (Disodium octoborate tetra hydrate ($Na_2B_8O_{13}.4H_2O$)
The boron content is given in table 1.

Collection of soil sample
The soil samples were collected from Poondiyangukppam village (*Typic Orthent*) Cuddalore district,Tamil Nadu to pot experiment.

The pot experiments were conducted at pot culture yard in the Department of Soil Science and Agricultural Chemistry, Annamalai University, Annamalainagar, using the light textured soils collected from Poondiyankuppam village respectively. The performance of calcium boro humate complex with the commercially available boron fertilizers in improving the yield of tomato were evaluated. The soils used for pot experiments were initially analyzed for the physico-chemical properties.

Treatment details
B_0L_0 – Control

B_1L_1 – Calcium Boro Humate 0.5 mg kg^{-1}

B_1L_2 – Calcium Boro Humate 1.0 mg kg^{-1}

B_1L_3 – Calcium Boro Humate 1.5 mg kg^{-1}

B_2L_1 – Boric acid 0.5 mg kg^{-1}

B_2L_2 – Boric acid 1 mg kg^{-1}

B_2L_3 – Boric acid 1.5 mg kg^{-1}

B_3L_1 – Boron 0.5 mg kg^{-1}

B_3L_2 – Boron 1 mg kg^{-1}

B_3L_3 – Boron 0.5 mg kg^{-1}

B_4L_1 – Polybor 0.5 mg kg^{-1}

B_4L_2 – Polybor 1.0 mg kg^{-1}

B_4L_3 – Polybor 1.5 mg kg^{-1}

Crop	:	Tomato hybrid variety GS - 3440
Duration	:	120 days
Design	:	Fractional complete randomized design (FCRD)
Replication	:	3

RESULTS AND DISCUSSION
Effect of different boron fertilizers on yield attributes (Table 2, 3, 4).

Addition of increased levels of born from 0 to 1.5 mg kg^{-1} significantly increased the number of fruits $plant^{-1}$, fruit set per cent and single fruit weight $plant^{-1}$ (g). The highest number of fruits $plant^{-1}$ (17.6), fruit set per cent (35.3%) and single fruit weight $plant^{-1}$ (94.3 g) in the treatment B_1L_3 receiving calcium boro humate @ 1.5 mg kg^{-1}.

Application of boron to tomato significantly increased the yield components like number of fruits per plant, single fruit weight and fruit yield. Among the four sources tested calcium boro humate excelled the other three sources *viz.*, borax, boric acid and polybor. Regardless of its source, application of increasing levels of boron increased the fruit yield and yield components of tomato in both the soils.

ISSN 2394 - 7780

Application of boron @ 1.5 mg kg^{-1} through calcium boro humate recorded highest number of fruits per plant, single fruit weigh and fruit yield. It was observed that soil application of calcium boro humate @ 1.5 mg kg^{-1} enhanced the flower bud initiation and fruit setting. Similar observations were made by Sathya *et al.* (2010).

The increase in fruit weight may be due to the fact that boron plays an important role in carbohydrate metabolism and influences the production in tomato for both the soils (Fig. 8). The results obtained in this study are in accordance with Hamsaveni (2002).

Application of calcium boro humate @ 1.5 mg kg^{-1} increased fruit yield and its attributes may be due to significant increse in growth parameters such as plant height, number of branches per plant which are grown by adequate supply of plant nutrients. More number of branches per plant provide more space to produce high number of flowers. Higher fruit set may be due to adequate plant nutrients availability which contributed more towards fruit yield (Fig. 9). Similar results are observed by Kiran (2006).

All the four sources of B increased the fruit yield significantly over control. Application of boron through CHB registered the best performance in terms of fruit weight as compared other three sources. Based on their efficiency in improving fruit weight, the four sources are arranged in descending order as CBH > Polybor > boric acid > borax.

Effect of different boron fertilizers on the fruit yield and stover yield of tomato (Table 5 and 6)
Boron fertilization to tomato showed a significant improvement in fruit yield.

Application of calcium boro humate @ 1.5 mg kg^{-1} (B_1L_3) recorded highest fruit yield pot^{-1} (862 g pot^{-1}) and stover yield plant (356 g $plant^{-1}$).

The findings may be attributed to the slow and steady supply of N from potassium humate, boron and calcium particularly at the highest rate, met the N requirements of plant. Potassium humate act as a nutrient reservoir and upon decomposition produce organic acids. The absorbed ions are released slowly over the entire growth period, leading to higher fruit yield. This corroborates the findings of Mostafa M. Rady (2011).

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Table 1. Nutrient content of boron

Source of boron	Boron content (%)
Calcium boro humate	9.0
Boric acid (H_3BO_3)	17.0
Borax ($Na_2B_4O_7H_2O$)	15.0
Polybor (Disodium tetrahydrate octoborate ($Na_2B_8O_{13}.4H_2O$)	14.0

ISSN 2394 - 7780

Table 2. Effect of different boron fertilizers on the number of fruits plant^{-1}

L / B	(*Typic orthent*)			
	L_1	**L_2**	**L_3**	**Mean**
B_1	15.2	18.4	19.2	17.6
B_2	12.6	15.4	16.4	14.8
B_3	11.2	14.4	16.4	14.0
B_4	14.8	17.2	18.2	16.7
Mean	13.4	16.3	17.5	15.7
Control (B0L0) : 10.2				
	SE_D		**CD (p=0.05)**	
Control Vs Rest	0.4		0.9	
L	0.2		0.6	
B	0.3		0.7	
L × B	0.5		1.2	

Source: B Source ; L – Levels, B_0 – No boron fertilizer, B_1 – CBH, B_2 –Boric acid, B_3 – Borax, B_4 – Polybor, L_0 – B @ 0. mg kg^{-1}, L_1 – B @ 0.5 mg kg^{-1}, L_2 – B @ 1.0 mg kg^{-1}, L_3 – B @ 1.5 mg kg^{-1}

Table 3. Effect of different boron fertilizers on the fruit set (per cent) of tomato

L / B	(*Typic orthent*)			
	L_1	**L_2**	**L_3**	**Mean**
B_1	30.0	38.1	38.0	35.3
B_2	24.5	28.9	32.0	28.4
B_3	24.0	28.0	33.1	28.3
B_4	28.2	36.4	37.0	33.8
Mean	26.6	32.8	35.0	31.4
Control (B0L0) : 10.2				
	SE_D		**CD (p=0.05)**	
Control Vs Rest	0.7		1.6	
L	0.4		1.0	
B	0.5		1.2	
L × B	1.0		2.2	

Source: B Source ; L – Levels, B_0 – No boron fertilizer, B_1 – CBH, B_2 –Boric acid, B_3 – Borax, B_4 – Polybor, L_0 – B @ 0. mg kg^{-1}, L_1 – B @ 0.5 mg kg^{-1}, L_2 – B @ 1.0 mg kg^{-1}, L_3 – B @ 1.5 mg kg^{-1}

Table 4. Effect of different boron fertilizers on the single fruit weight plant^{-1} (g) of tomato

L / B	(*Typic orthent*)			
	L_1	**L_2**	**L_3**	**Mean**
B_1	85.0	98.0	100.0	94.3
B_2	67.1	82.0	85.0	78.0
B_3	65.7	83.4	84.0	77.7
B_4	68.7	92.0	94.0	84.9
Mean	71.6	88.8	90.7	83.7
Control (B0L0) : 10.2				
	SE_D		**CD (p=0.05)**	
Control Vs Rest	1.5		3.1	
L	1.0		2.1	
B	1.1		2.4	
L × B	2.0		4.3	

Source: B Source ; L – Levels, B_0 – No boron fertilizer, B_1 – CBH, B_2 –Boric acid, B_3 – Borax, B_4 – Polybor, L_0 – B @ 0. mg kg^{-1}, L_1 – B @ 0.5 mg kg^{-1}, L_2 – B @ 1.0 mg kg^{-1}, L_3 – B @ 1.5 mg kg^{-1}

Table 5. Effect of different boron fertilizers on the fruit yield (g pot^{-1}) of tomato

L / B	(*Typic orthent*)			
	L_1	**L_2**	**L_3**	**Mean**
B_1	1292	1803	1920	1671
B_2	845	1262	1394	1167

ISSN 2394 - 7780

B_3	934	1200	1377	1170
B_4	1016	1582	1710	1436
Mean	1021	1461	1600	1361
Control (B0L0) : 10.2				
	SE_D		**CD (p=0.05)**	
Control Vs Rest	12.5		26.	
L	8.2		17.6	
B	0.9		20.2	
L × B	17.6		36.4	

Source: B Source ; L – Levels, B_0 – No boron fertilizer, B_1 – CBH, B_2 –Boric acid,
B_3 – Borax, B_4 – Polybor, L_0 – B @ 0. mg kg^{-1}, L_1 – B @ 0.5 mg kg^{-1}, L_2 – B @ 1.0 mg kg^{-1}, L_3 – B @ 1.5 mg kg^{-1}

Table 6. Effect of different boron fertilizers on stover yield (g $plant^{-1}$) of tomato

L / **B**	**(*Typic orthent*)**			
	L_1	**L_2**	**L_3**	**Mean**
B_1	350	353	366	356
B_2	293	311	327	310
B_3	298	304	329	310
B_4	335	340	354	343
Mean	319	327	344	329
Control (B0L0) : 10.2				
	SE_D		**CD (p=0.05)**	
Control Vs Rest	31.2		65	
L	20.5		44	
B	22.2		50.5	
L × B	44		91.0	

Source: B Source ; L – Levels, B_0 – No boron fertilizer, B_1 – CBH, B_2 –Boric acid,
B_3 – Borax, B_4 – Polybor, L_0 – B @ 0. mg kg^{-1}, L_1 – B @ 0.5 mg kg^{-1}, L_2 – B @ 1.0 mg kg^{-1}, L_3 – B @ 1.5 mg kg^{-1}

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INFLUENCE OF BIO-REGULATORS ON CERTAIN GROWTH AND FLOWERING CHARACTERS OF AFRICAN MARIGOLD (TAGETES ERECTA L.)

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ABSTRACT
The present investigation on the "Influence of bio-regulators on certain growth, flowering characters of African Marigold (Tagetes erecta L.) was carried out in the Department of Horticulture, Faculty of Agriculture,Annamalai University, Annamalinagar. The experiment was laidout in RBD with twelve treatments. The twelve levels of bio-regulators include T_1 -Gibberellic acid @300ppm; T_2 -Panchagavya @ 3%; T_3 -Humic acid @ 3000ppm; T_4 -NAA @100ppm; T_5 -Brassino Steroids @ 100ppm; T_6 -Panchagavya @ 3% + Humic acid@ 3000ppm; T_7 -Panchagavya @ 3% + NAA @ 100ppm; T_8- Panchagavya @ 3%+ Brassino Steroids @ 100ppm; T_9 -Gibberellic acid @ 300ppm + Humic acid @3000ppm; T_{10} -Gibberellic acid @ 300ppm + NAA @ 100ppm; T_{11} –Gibberellicacid @ 300ppm + Brassino Steroids @ 100ppm; T_{12} -Control.The treatments are evaluated based on their influence on growth and flowering characters viz. plant height, leaf area, internodal length, days to first flowering, flower diameter and stalk length. Out of the twelve bio-regulators treatments, the maximum values were observed in plants sprayed with a combination of panchakavya @ 3% with humic acid @ 3000ppm (T_6).Key Words: Marigold, bio- regulators, humic acid, gibberellic acid , growth and flowering.

INTRODUCTION
Marigold is native to South and Central America especially Mexico (Kaplan, 1960). Bailey (1963) mentioned that French marigold was put in to cultivation in 1573 and African marigold in 1596 in Europe. In India, it is thought to be introduced by Portuguese in 1502 (Mehra, 1966). It is one of the most popular and commercial flowering annuals cultivated in most of the states in India. Flowers are important for their economic use as well as aesthetic value. Among the flowers grown by farmers, marigold has its own importance. It has gained popularity among flower growers because of its easy cultivation and wide adaptability. The growers are attracted towards marigold flower as it has a habit of free flowering, short duration to produce marketable flowers of attractive colors and good keeping quality. Marigold flower has more demand during festival period especially on Diwali and Dashehara. There is a constant demand for these flowers throughout the year for various functions, festivals and floral decorations.The uses of marigold are many fold, often referred to as, “Versatile crop with golden harvest”. Marigold produce thiopenes, which are toxic to nematodes and used as trap crop in tomato, brinjal, tobacco etc (Raghava, 2000). Marigold, not only cultivated as ornamental cut flower and landscape plant but also a source of carotenoid pigment for poultry feed to intensify yellow colour of egg yolks and broiler skin. Apart from poultry industry, marigold dye is also used in textile,pharmaceutical industries, food supplements, cosmetics etc., as they offer several advantages over synthetic dyes from natural point of view, safety and eco-friendly in nature (HemlaNaik*et al*., 2004).The use of bio-regulators of growth, yield and quality by externally supplied chemicals is one of the most exciting research areas of the recent times. They are effective in several crops to balance the source and sink ratio for increasing the yield (Cheema*et al*., 1987). Pandita*et al.*, (1974) reported that application of plant growth regulators for improving the yield and quality of many flower crops. Biostimulants have been shown to influence several metabolic processes such as respiration, photosynthesis, nucleic acid synthesis and ion uptake. It is not meant to correct a severe nutrient deficiency, but is mixtures of one or more things such as microorganisms, trace elements, enzymes, plant hormones and seaweed extracts.

MATERIALS AND METHODS
The present research work was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar.The experiment was laid out in RBD with three replications which consisting twelve treatments of various bio-regulators as shown in table .1and 2.The experimental area was ploughed thoroughly with a tractor drawn disc plough and cultivator to bring in to the fine tilth. The total area of experimental field of 4 cents was laid out into 36 treatment plots. Each treatment plot was laid out with 9 pits in the spacing of 45cm×35 cm. The 25 days old seedlings were transplanted in to experimental field. The spray of bio-regulators was given according to the treatment schedule.The treatments were imposed as foliar spray on 30^{th}, 60^{th} and 90^{th} days after transplanting at respective concentration during early morning hours. Observations recorded periodically on plant height, leaf area, intermodal length, days to first flowering, flower diameter and stalk length. The data were statistically analysed (Panse and Sukhatme,1978)

ISSN 2394 - 7780

RESULTS AND DISCUSSION

The results of the present investigation presented in growth characters *viz.*, plant height, number of branches per plant, leaf area and length of the internodes were significantly influenced by the bioregulators. Among the different treatments, the maximum values in plant height ,number of branches leaf area and intermodal length were observed in T_6 (Panchagavya @ 3% + Humic acid @ 3000ppm), which was followed by T_9 (Gibberellic acid @ 300ppm + Humic acid @ 3000ppm). The lowest values on growth characters were recorded in T_{12} (Control). The increased plant height, number of branches and leaf area was due to availability of humic acid for longer periods might be responsible for increasing photosynthetic activity, which in turn increased the above growth aspects. Similar finding are reported by Ahmad Ali *et al.* (2015) in tulips.Improvement in growth characters as a result of foliar spray of T_6 (Panchagavya @ 3% + Humic acid @ 3000ppm) showed the maximum inter nodal length which was followed by T_9 (Gibberellic acid @ 300ppm + Humic acid @ 3000ppm) and the minimum values in T_{12} (Control).The highest values in inter nodal length was due to the application of panchagavya which enhances the photosynthetic activity, N metabolism and protein synthesis of plant. Similar findings were reported by Fan *et al*., (2014) in chrysanthemum.

A perusal of the data (Table .2) indicated that foliar spray of T_6 (Panchagavya @ 3% + Humic acid @ 3000ppm) remarkably took minimum days for flower appearance were observed in different treatments. Significantly minimum days taken for flower initiation were registered in the plants sprayed with Panchagavya @ 3% + Humic acid @ 3000ppm (34.28 days). It was followed by T_9 (Gibberellic acid @ 300ppm + Humic acid @ 3000ppm) (37.05 days). This might be due to synergetic effect of auxins with gibberellins generally obtained in short day plants. The results are in line with the findings of EhsanMohammadipour*et al.* (2012) in marigold.The highest flower diameter and length of the flower stalk were recorded in foliar application of T_6 (Panchagavya @ 3% + Humic acid @ 3000ppm). It might be due to the application of humic acid which response the increase the permeability of plant membrane resulting in higher metabolic activity and also it enhances the cell division and cell elongation which leads the increment in flower diameter, flower stalk length.The treatment T_6 followed by T_9 was due to the application of gibberellic acid which initiates the early flowering, stem elongation, enzyme induction and the minimum flower diameter. Then the application of panchagavya increases the auxin activity in the floral buds. Similar results are found by Renukardhya *et al*., (2011) in carnation and Shrikant and Jawaharlal (2014) in gerbera.

Table.1. Effect of bio-regulators on growth characters of African marigold (TageteserectaL.)

T.No.	Treatments	Plant height(cm)	Number of branches	Leaf area (cm^2)	Internodal length (cm)
T_1	Gibberellic acid @ 300ppm	71.22	17.76	34.76	4.27
T_2	Panchagavya @ 3%	75.35	19.32	38.84	4.54
T_3	Humic acid (@ 3000ppm	72.60	18.28	36.12	4.36
T_4	NAA @100ppm	68.45	16.73	32.05	4.08
T_5	Brassinosteroids @ 100ppm	65.67	15.69	29.33	3.90
T_6	Panchagavya @ 3% + Humic acid @ 3000ppm	89.16	24.51	52.42	5.40
T_7	Panchagavya @ 3% + NAA @ 100ppm	83.63	22.42	46.99	5.05
T_8	Panchagavya @ 3% + Brassinosteroids @ 100ppm	79.50	20.86	42.91	4.79
T_9	Gibberellic acid @ 300ppm + Humic acid @ 3000ppm	86.39	23.46	49.71	5.22

ISSN 2394 - 7780

T_{10}	Gibberellic acid @ 300ppm + NAA @ 100ppm	82.25	21.90	45.62	4.96
T_{11}	Gibberellic acid @ 300ppm+ Brassinosteroids @ 100ppm	78.11	20.35	41.55	4.71
T_{12}	Control	62.91	14.65	26.62	3.73
S.Ed.		**1.37**	**0.51**	**1.24**	**0.08**
C.D (p=0.05)		**2.75**	**1.03**	**2.56**	**0.16**

Table.2. Effect of bio-regulators on flowering characters of African marigold (TageteserectaL.)

T.No.	Treatments	Days taken to first flowering	Flower diameter (cm)	Stalk length (cm)
T_1	Gibberellic acid @ 300ppm	52.25	5.53	6.51
T_2	Panchagavya @ 3%	48.12	5.97	7.10
T_3	Humic acid (@ 3000ppm	50.88	5.68	6.70
T_4	NAA @100ppm	55.02	5.25	6.12
T_5	Brassinosteroids @ 100ppm	57.78	4.96	5.72
T_6	Panchagavya @ 3% + Humic acid @ 3000ppm	34.28	7.40	9.10
T_7	Panchagavya @ 3% + NAA @ 100ppm	39.81	6.83	8.31
T_8	Panchagavya @ 3% + Brassinosteroids @ 100ppm	43.95	6.40	7.70
T_9	Gibberellic acid @ 300ppm + Humic acid @ 3000ppm	37.05	7.12	8.71
T_{10}	Gibberellic acid @ 300ppm + NAA @ 100ppm	41.19	6.69	8.11
T_{11}	Gibberellic acid@300ppm+Brassinosteroids @ 100ppm	45.34	6.25	7.49
T_{12}	Control	60.56	4.67	5.31
	S.Ed.	**1.32**	**0.13**	**0.19**
	C.D(p=0.05)	**2.75**	**0.27**	**0.38**

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FACTORS INFLUENCING TECHNOLOGICAL NEEDS OF FARM WOMEN IN PADDY CULTIVATION

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ABSTRACT
The involvement of women in agriculture is as old as the advent of agricultural practices in the world. Women are intensively involved in all the farm operations. However, women's involvement and participation are not always 'visible' as compared to the 'visibility' of men. Moreover, the technologies are said to be gender neutral. Few research studies have shown that most of the technologies in agriculture are not suitable to farm women. The study was taken up with the objective to study the association and contribution of characteristics of wet land farm women with technological needs in paddy cultivation. Sample size of 60 wet land farm women were selected using proportionate random sampling technique. For studying the association and contribution of independent variables towards dependent variables, the statistical tools namely zero order correlation, multiple regression analysis and step down regression analysis were employed.Out of sixteen variables considered for the study, four variables viz., farming experience (X_6), information seeking behaviour(X_8), risk orientation (X_{10}) and scientific orientation (X_{13}) had shown positive and significant association with technological needs of wet land farm women in paddy cultivation at one per cent level of probability. The variables economic motivation (X_{12}) and time management (X_{14}) also had significant association at five per cent level of probability.
Key words: Farm women ,paddy farming ,correlation, regression, multiple regression and step down regression

INTRODUCTION
Technological base for improving productivity and income of the rural population in the field of agriculture has broadened with the success of Green revolution that the country witnessed during mid sixties. Various technological innovations have been released claiming spectacular yield potential at research stations. As a result of this research and transfer of technology programmes, the production has increased over time in the decades, thus balancing the population growth and food production of our country. However, the benefits of the new production technology have accrued mostly to male farmers while the women farmers have been bypassed in the development process.

The involvement of women in agriculture is as old as the advent of agricultural practices in the world. Agriculture is considered as one of the most primitive and oldest forms of human economic activity primarily based on land. Women in the past were intensively involved in all the farm operations. However, women's involvement and participation were not always 'visible' as compared to the 'visibility' of men. The situation has not improved much, even today. Social and institutional setup is unable to take into cognisant the role played and contribution made by women in any areas of economic activity including their participation in agriculture and dairy management.Barker (1997) opined that appropriateness should be defined within the scope of what is technically feasible, economically feasible, socially acceptable, environmentally safe and sustainable.

The present situation demands active participation of women along with men in all walks of life to have better life. Involvement of women in all development activities again demands a proper understanding to assess their needs and extent of fulfilment. With this background and in the absence of empirical evidence, to study the association and contribution of characteristics of wet land farm women with technological needs in paddy cultivation

METHODOLOGY
The study was taken-up in Nagapattinam district in Tamil Nadu which comprised of maximum area under wet land farming system. A sample size of 60 wet land small farm women was considered for analysing the association and contribution of characteristics of wet land farm women with technological needs in paddy cultivation Ex Post Facto research design was used in the study.Sixteen independent variables were selected based upon judges opinion. The required data was collected by utilising a well structured and pre-tested interview schedule. For studying the association and contribution of independent variables towards dependent variables, the statistical tools namely zero order correlation, multiple regression analysis and step down regression analysis were employed.

ISSN 2394 - 7780

FINDINGS AND DISCUSSION

Association and contribution of characteristics of wet land farm women with technological needs in paddy cultivation

An attempt has been made with the specific objectives to identify the association of characteristics of farm women with technological needs of wet land farm women in paddy cultivation. The results are presented in Table-1.

Table-1 Association and contribution of characteristics of wet land farm women with technological needs in paddy cultivation(n=60)

Var. No	Variables	'r' value	Standardised regression co-efficient	Standard error	't' value
X_1	Age	0.140 NS	0.169	1.928	0.725 NS
X_2	Educational status	0.127 NS	1.252	2.627	0.572 NS
X_3	Occupational status	0.174 NS	0.986	1.526	0.625 NS
X_4	Family type	-0.026 NS	0.660	2.085	0.408 NS
X_5	Family size	0.006 NS	1.106	2.232	0.962 NS
X_6	Farming experience	0.347**	1.362	2.938	2.586**
X_7	Social participation	0.177 NS	0.625	0.892	1.001 NS
X_8	Information seeking behaviour	0.372**	1.211	0.459	2.638**
X_9	Livestock possession	0.162NS	2.126	3.001	1.482NS
X_{10}	Risk orientation	0.362**	1.020	1.234	1.586 NS
X_{11}	Credit orientation	0.189 NS	0.327	0.782	1.109 NS
X_{12}	Economic motivation	0.259*	1.778	0.562	1.712*
X_{13}	Scientific orientation	0.363**	2.179	0.682	2.865**
X_{14}	Time management	0.267*	1.862	0.362	1.706*
X_{15}	Decision-making	0.212 NS	0.089	0.552	0.162 NS
X_{16}	Empowerment	0.139 NS	1.785	2.183	0.818 NS

a = 18.54, R^2 = 0.620, F=14.862**

** - Significant at 0.01 per cent level probability

* - Significant at 0.05 per cent level probability

NS – Non-significant

Association of characteristics of wet land farm women with technological needs in paddy cultivation

Correlation analysis was performed to find out the association of independent variables with the dependent variable technological needs in paddy cultivation and the results are presented in Table-1.

The results in Table-1, exhibited that out of sixteen variables considered for the study, four variables viz., farming experience (X_6), information seeking behaviour(X_8), risk orientation (X_{10}) and scientific orientation (X_{13}) had shown positive and significant association with technological needs of wet land farm women in paddy cultivation at one per cent level of probability. The variables economic motivation (X_{12}) and time management (X_{14}) also had significant association at five per cent level of probability. The correlation values for the rest of the ten variables showed non-significant associationwith the technological needs of wet land farm women.

Farming experience had shown positive and significant association at 0.01 per cent level of probability. A majority of the farm women were having medium level of farming experience. This might have influenced them to realise higher technological needs in paddy farming activities. It may be stated that more experience in paddy farming would have enhanced the technological needs of farm women. This finding is in conformity with the findings of Arul raj(2013).

There was positive influence of information seeking behaviour with the technological needs of farm women of wet land. To gain knowledge about a technology, one has to expose herself to different experiences provided by information providing sources. Hence, the information seeking behaviour would have shown positive and significant association at 0.01 per cent level of probability. This finding derives support from the findings of Vengatesan and Santhagovind(2015).

ISSN 2394 - 7780

The variable risk orientation had showed positive association with technological needs at 0.01 per cent level of probability. Most of them had medium level of risk orientation. High risk bearing tendency would have increased the technological needs of farm women in farm for getting higher production and also to reduce physical strain on the part of the doers. Thus, it may be stated that the individuals with high degree of risk taking behaviour would aspire for more technological needs in paddy cultivation.

The positive and significant relationship of the other variables like scientific orientation, economic motivation and time management with technological needs of farm women needs no explanation. It is generally acceptable that these characteristics will help an individual to get additional information about the things which are required for their development. A women possessing high degree of scientific orientation wants to become popular by adopting new technologies ahead of others in her social system. This finding is in line with the findings of Kasidurai(2017).

Further, the farm women with high degree of economic motivation and time management ability would possess the skill to identify their needs as they spent more time in the field. All these tendencies would have created an urge among the farm women to know new things which are required to satisfy their inner needs.

CONTRIBUTION OF CHARACTERISTICS OF FARM WOMEN TOWARDS TECHNOLOGICAL NEEDS OF WET LAND FARM WOMEN IN PADDY FARMING

Correlation analysis will explain only the nature of association of characteristics of the farm women with their technological needs. In order to find out the relative contribution of each variable towards technological needs in paddy farming, multiple regression analysis was performed and the results are presented in Table-1.

A perusal of regression co efficient and 't' value given in Table indicates, that out of the sixteen characteristics, only five variables namely farming experience (X_6), information seeking behaviour (X_8), economic motivation (X_{12}), scientific orientation (X_{13}) and time management (X_{14}) had contributed towards the technological needs of wet land farm women.

Among the five variables, three variables had shown significant and positive relationship at one per cent level of probability. They were farming experience (X_6), information seeking behaviour (X_8) and scientific orientation (X_{13}). Another two variables viz., economic motivation (X_{12}) and time management (X_{14}) contributed significantly and positively at five per cent level of probability towards the technological needs of wet land farm women in paddy farming.

The predictive power of the linear multiple regression was estimated with the help of the co-efficient of multiple determination (R^2=0.620). The R^2 value indicated that all the sixteen variables taken together explained as much as 62.00 per cent of variation in the technological needs of farm women. The 'F' value was found to be significant at 0.01 per cent level of probability. Hence, the higher R^2 value might be due to the significant and positive correlation co-efficient of farming experience, information seeking behaviour, economic motivation, scientific orientation and time management.

It can also be inferred that when all other variables were kept at constant level, a unit increase in farming experience, information seeking behaviour, economic motivation, scientific orientation and time management *ceteris paribus* would result respectively in an increase of 1.362, 1.211, 1.778, 2.179 and 1.862 units of technological needs of farm women in paddy cultivation. This meant that the farm women who had more farming experience, information seeking behaviour, economic motivation, scientific orientation and time management would have higher level of technological needs in paddy cultivation. This finding is in accordance with that of Guna(2016).

Hence, it may be concluded that farming experience, information seeking behaviour, economic motivation, scientific orientation and time management were the crucial variables influencing the technological needs of wet land farm women in paddy farming.

The other variables did not show significant effect on the technological needs of farm women in farm activities.

The prediction equation is as follows.

Y = 18.54+ 0.169 + 1.252 + 0.986 + 0.660 + 1.106 + 1.362 + 0.625 + 1.211 + 2.126 + 0.327 + 1.020 + 1.778 + 2.179 + 1.862 + 0.089 + 1.785.

Step down regression analysis

Though the multiple linear regression analysis revealed the joint influence of all the independent variables on technological needs of wet land farm women, it was considered to have a simple model in which there is lesser

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number of predictors in explaining the relationship. Hence, to obtain the best set of predictors of technological needs of farm women, step down regression analysis was done.

The results on the step down regression on technological needs of wet land farm women with selected independent variables are presented in Table-2.

Table-2.Step down regression analysis of selected independent variables towards technological needs of wet land farm women in paddy cultivation

Step. No.	Variables included	Correlation co-efficient (R)	R^2	'F' value
1.	Scientific orientation (X_{13})	0.363	0.217	61.12**
2.	Scientific orientation (X_{13}) Farming experience (X_6)	0.389	0.261	59.01**
3.	Scientific orientation (X_{13}) Farming experience (X_6) Information seeking behaviour (X_8)	0.427	0.320	54.27**
4.	Scientific orientation (X_{13}) Farming experience (X_6) Information seeking behaviour (X_8) Livestock possession (X_9)	0.472	0.364	48.42**
5.	Scientific orientation (X_{13}) Farming experience (X_6) Information seeking behaviour (X_8) Livestock possession (X_9) Risk orientation (X_{11})	0.512	0.396	46.27**
6.	Scientific orientation (X_{13}) Farming experience (X_6) Information seeking behaviour (X_8) Livestock possession (X_9) Risk orientation (X_{11}) Economic motivation (X_{12})	0.563	0.446	39.01**

** Significant at 0.01 per cent level of probability.

It could be observed from Table-2, that in the first step, scientific orientation alone explained 21.70 per cent of the variation in the technological needs, followed by 26.10 per cent of the variation explained by scientific orientation and farming experience. Another six per cent of the variation increased, when information seeking behaviour was included along with those two variables. In the fourth step, four variables included explained 36.40 per cent of the variation in the technological needs. Those four variables were scientific orientation, farming experience, information seeking behaviour and livestock possession. In the fifth step, another three per cent of the variation increased when risk orientation was included along with those four variables. In the last step, six variables included explained 46.60 per cent of the variation in the technological needs. Those six variables were scientific orientation, farming experience, information seeking behaviour, livestock possession, risk orientation and economic motivation. The 'F' value in all the steps were statistically significant at 0.01 per cent level of probability.

CONCLUSION

The diagnosis of gender difference in agricultural activities and constraints should be improved and extension messages and delivery modified accordingly. Further, monitoring and evaluation should routinely be on a gender disaggregated basis. The variables viz., information seeking behaviour, risk orientation, economic motivation, scientific orientation and time management were found to influence the technological needs of farm women of varied farming systems in the farm technologies. Further, the variables information seeking behaviour, livestock possession and economic motivation were found to influence the technological needs of farm women in varied farming systems in the off-farm technologies. Hence, the extension agencies should considered these characteristics, while selecting the trainees for training.

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CONSTRAINTS IN THE UTILIZATION OF ECO-FRIENDLY AGRICULTURAL PRACTICES IN ERODE DISTRICT

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ABSTRACT
An eco-friendly technology may be defined as the use of knowledge and resources in a systematic way to produce desired output without harming the environment. The term "eco-agriculture" was coined by Charles Walters, economist, author, editor, publisher and founder of Acres Magazine in 1970 to unify under one umbrella the concepts of 'ecological' and 'economical' in the belief that unless agriculture was ecological it could not be economical. This belief becomes the motto of the magazine: "To be economical agriculture must be ecological."Eco-agriculture is both a conservation strategy and a rural development strategy. A study was conducted in Erode district to study the constraints in the utilization of eco-friendly agricultural practices in Erode District. The findings shows that Four-fifth of the respondents (80.00 per cent) had suggested that they need guidance and regulated market for marketing of the produce. Marketing is the most important place for selling their eco-friendly produce with reasonable price. Hence, marketing channel and price are needed by the respondents. In addition to that source regulated markets for the procurement and essential for the farmers to sell their quality produces. Introduction of more eco-friendly farming practices suggested by nearly four-fifth (77.50 per cent) of the respondents. They need a quality of crops and increase the market value of the agricultural produce.

INTRODUCTION
An eco-friendly technology may be defined as the use of knowledge and resources in a systematic way to produce desired output without harming the environment. The term "eco-agriculture" was coined by Charles Walters, economist, author, editor, publisher and founder of Acres Magazine in 1970 to unify under one umbrella the concepts of 'ecological' and 'economical' in the belief that unless agriculture was ecological it could not be economical. This belief becomes the motto of the magazine: "To be economical agriculture must be ecological." Eco-agriculture is both a conservation strategy and a rural development strategy. Eco-agriculture recognizes agricultural producers and communities as key stewards of ecosystems and biodiversity and enables them to play those roles effectively. Eco-agriculture applies an integrated ecosystem approach to agricultural landscape to address all the three pillars – conserving biodiversity, enhancing agricultural production and improving livelihood – driving the divers' elements of production and conservation management systems. The core of this ecological-based farming is ensuring that business or agricultural activity is consistent with the natural functions of ecosystems, where for instance, the cycle of soil nutrients and biodiversity structure are maintained so as to create a system of agriculture that is resistant to pests and has self-maintained natural soil nutrients. Thus, farmers will no longer depend on costly chemicals and artificial pest control.

METHODOLOGY
The Constraints faced by the respondents during the utilization of eco-friendly farming practices were listed during the pilot survey. The constraints were classified under four sub-headings namely physical constraints, communication constraints, personal constraints, socio-economic constraints. The respondents were asked to report the constraints as listed in the schedule.

FINDINGS
This section deals with the constraints as experienced by the paddy, banana and sugarcane farmers for their non-utilization of eco-friendly farming practices.

In accordance with the objectives, the constraints experienced by the respondents of various locations are presented under five heads namely, (a) physical constraints, (b) communication constraints, (c) personal constraints, (d) socio-economic constraints, (e) technological constraints, The results are presented in Table-1.

1. Physical constraints
Regarding the physical constraints, labour scarcity (95.83 per cent) was the primary constraint expressed by most of the respondents and ranked first followed by poor quality of inputs (93.33 per cent) and lack of advanced and non availability of inputs (87.50 per cent), planning about the purchase and application of inputs (84.00 per cent). Agriculture labourers being seasonal, there is a shortage of labour during peak season. The migration of the labour from agriculture to other

ISSN 2394 - 7780

Table-1. Constraints faced by the respondents in utilization of recommended eco-friendly farming practices (n=120)

S. No.	Constraints	Number of respondents	Per cent	Rank
I.	**Physical constraints**			
1.	Labour scarcity	115	95.83	**I**
2.	Non-availability of inputs	105	87.50	**III**
3.	Poor quality of inputs	112	93.33	**II**
4.	Lack of advanced planning about the purchase and application	100	83.33	**IV**
II.	**Communication constraints**			
1.	Lack of training	110	91.66	**I**
2.	Inability to attend training programmes	93	77.50	**IV**
3.	Lack of information from change agent	100	83.33	**II**
4.	Weak extension service	98	81.66	**III**
5.	Details given by change agent could not be understood	69	57.50	**V**
III.	**Personal constraints**			
1.	Lack of knowledge to identify bio-agents	112	93.33	**I**
2.	Not convinced with the practice	100	83.33	**II**
3.	Lack of knowledge to identify pest & diseases	96	80.00	**III**
4.	Difficulty in using organic manure	81	67.50	**IV**
IV.	**Socio-economic constraints**			
1.	Lack of credit facilities	115	95.83	**I**
2.	High cost of labour	105	87.50	**III**
3.	High rate of interest	98	81.66	**IV**
4.	High cost of inputs	110	91.66	**II**
V.	**Technological constraints**			
1**.**	Lack of technical guidance	105	87.50	**I**
2.	Difficulty in using botanical pesticide	88	73.33	**II**
3.	Difficulty in maintaining traps	62	51.67	**III**

occupations and to other sectors has also contributed the labour problem. Hence, majority of the respondents have ranked it as the most serious constraints.

2. Communication constraints

Lack of training (91.66 per cent) was the most seriously felt communication constraints expressed by majority of respondents followed by lack of information from change agent (83.33 per cent), weak extension service (81.66 per cent , inability to attend training programmes (77.50 per cent) and details given by change agents could not be understood (57.50 per cent).

Lack of information from change agent was the another most important communication constraint. Majority of the respondents expressed that they did not come across any extension worker from the government development department. Some of the respondents had occasions to meet the extension personnel of agricultural department their office rarely. Lack of adequate staff and their occasional visits to the villages would have made the respondents to report this as one of the major constraints.

3. Personal constraints

Lack of knowledge to identify the bio-agents (93.33 per cent) was the foremost personal constraint expressed by majority of the farmers followed by not convinced with the practice (83.33 per cent), lack of knowledge to identify the pest and diseases (80.00 per cent) and difficulty in using organic manure (67.50 per cent). This is in line with the findings of Suji (2003). Majority of the respondents had lack of knowledge on the bio-control agents and no proper orientations by way of training have been given for their benefit. Eco-friendly agriculture mainly depends on the locally available practices with the use of locally and freely available raw material and inputs. Eco-friendly approaches took greater gestation periods and with hidden benefits. So, majority of the

ISSN 2394 - 7780

yield of paddy, banana and sugarcane may reduce and given a great economic loss to the farmers. So, they are not convinced about the eco-friendly practices. This might be the reason for lack of conviction about the eco-friendly agricultural practices.

Eco-friendly agriculture inputs like organic manure, green manure, green leaf manures are required in large quantities, when compared to chemical fertilizer create the problem of difficulty in using organic manure by the trained paddy farmers.

4. Socio-economic constraints

Lack of credit facilities (95.83 per cent) was the major socio-economic constraint followed by high cost of inputs (91.66 per cent), high cost of labour (87.50 per cent). High rate of interest (81.66 per cent) were felt as the other socio-economic constraints by the respondents.

Most of the paddy farmers who are in need of money for paddy, banana and sugarcane cultivation. They obtained the money from moneylenders and from big farmers only. Absence of adequate institutions like agricultural banks, co-operative society etc., and rigid rules and regulations might be the reason why farmers could not get money when they need.

Labour scarcity was a very serious constraint in the locale particularly during agricultural operation like transplanting and harvesting. The farmers therefore have to hire labourers at any cost demanded by them, which often matched those wages provided in the secondary and tertiary sectors. This may be the reason for the high cost of labour being felt as the major socio-economic constraint.

5. Technological constraints

Lack of technical guidance (87.50 per cent) difficulty in using botanical pesticides (73.33 per cent) and difficulty in maintaining traps (51.67 per cent) were the major technological constraints expressed by majority of the farmers. Inadequate visits by the extension workers might have been the reason for lack of technical guidance. The farmers have developed some wrong notions about bio-agents and their effectiveness when compared to chemical control methods. Further, technologies become manifest only after 3-4 years of farming.

Suggestion for the increase use efficiency of eco-friendly farming practices

The suggestions that were expressed by the respondents will be helpful to overcome the constraints. They were grouped and the percentage analysis was worked out. The results furnished in table 2

Table-2. Suggestion expressed by the respondents for enhanced utilization of eco-friendly farming practices

Sl. No.	Suggestions	Number of Respondents	Per Cent
1.	Provision of credit facilities	104	86.66
2.	Introduction of more eco-friendly farming practices	93	77.50
3.	Trainings and demonstrations on eco-friendly farming practices	109	90.83
4.	Input supply	115	95.83
5.	Proper guidance and market for procurement of eco-friendly agricultural produce	96	80.00
6.	Creating awareness about bio-pesticides	114	95.00
7.	More technical guidance	110	91.66
8.	More information on radio, television and newspaper	112	93.33
9.	Formation of eco-clubs	78	65.00
	Mean		**86.20**

The suggestion mean value of eco-friendly farming practices was 86.20. Majority of the respondents (95.83 per cent) had expressed that timely and adequate quantity of inputs such as seeds, bio-fertilizers, bio-pesticides, farm implements etc., are the most important factors in contributing eco-friendly agriculture. Hence, the respondents suggested that government and development organizations should supply the required inputs in time.

Creation of awareness about bio-pesticides and bio-agents through campaign is necessary for the control of pest and disease. Thus, majority of the respondents (95.00 per cent) suggested it.

Making more publicity through radio, television and newspaper practices and the harmful effects of pesticides and chemicals on soil and its environment is one of the suggestions offered by majority (93.33 per cent) of the

ISSN 2394 - 7780

respondents. This type of publicity is needed to motivate the farmers to take part in eco-friendly agricultural programmes and make to do eco-friendly agriculture.

Technical guidance was considered as one of the suggestions expressed by majority (91.66 per cent) of the respondents. Because of the medium level of education, majority of the respondents expressed their difficulty in understanding the eco-friendly practices like bio-agents and also to clarify their doubts, they need more technical guidance.

Adequate training programmes and demonstrations were suggested by majority (90.83 per cent) of the respondents regarding the eco-friendly cultivation of crops. Most of the respondents did not know the actual potentiality and utility of the programmes. So, it is suggested to give adequate training on nursery practices, fertilizer application and plant protection practices etc. This may increase their knowledge and skill on latest technologies/ practices and this make them to go for utilization.

Provision of credit facilities was suggested by 86.66 per cent of the respondents. This might be due to lack of institutions like co-operative societies, banks in the study area. This could be considered while evolving the government policy.

Four-fifth of the respondents (80.00 per cent) had suggested that they need guidance and regulated market for marketing of the produce. Marketing is the most important place for selling their eco-friendly produce with reasonable price. Hence, marketing channel and price are needed by the respondents. In addition to that source regulated markets for the procurement and essential for the farmers to sell their quality produces.

Introduction of more eco-friendly farming practices suggested by nearly four-fifth (77.50 per cent) of the respondents. They need a quality of crops and increase the market value of the agricultural produce.Formation of eco-clubs was suggested by 65.00 per cent of the respondents. They felt that eco-clubs would be useful to get information about eco-friendly agricultural and their sustained effect i

CONCLUSION

Four-fifth of the respondents (80.00 per cent) had suggested that they need guidance and regulated market for marketing of the produce. Marketing is the most important place for selling their eco-friendly produce with reasonable price. Hence, marketing channel and price are needed by the respondents. In addition to that source regulated markets for the procurement and essential for the farmers to sell their quality produces. Introduction of more eco-friendly farming practices suggested by nearly four-fifth (77.50 per cent) of the respondents. They need a quality of crops and increase the market value of the agricultural produce.

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EFFECT OF CLIMATE CHANGE ON EVAPOTRANSPIRATION IN KUMARATCHI BLOCK OF CUDDALORE DISTRICT, TAMILNADU

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ABSTRACT
Water is the source of existence for all living beings in the world. The major portion of water is used by humans for agricultural activities. Due to Anthropogenic activities, several climatic factors are drastically affected one among them is agriculture. This study aims about the effect of climate change on Agriculture. Evapotranspiration is the key element in hydrologic cycle. The efforts are to be taken to meet the future demand of water is done majorly by estimating the evapotranspiration. The higher Efficiency in irrigation and crop water demand can be achieved by forecasting the evapotranspiration. The hot and humid coastal location in Tamilnadu state namely Kumaratchi, Chidambaram is taken as study area. In this study, the estimation of evapotranspiration and trend analysis is done by using FAO-56 Penman Monteith Method.

Keywords: Evapotranspiration, Climate change, Anthropogenic activity, FAO-56 Penman Monteith method.

INTRODUCTION
Global warming is due to green house gases. The man made activities produce enormous green house gases which allow the sun light directly into the earth surface. It is then reradiated to atmosphere and become warmer. It is called Global Warming. The climate of our globe has been changing over time. The above phenomenon is called Climate Change. The Impact of Climate Change in India is experienced in various domains such as Agriculture and Food Security, Water Insecurity, Raising Sea Levels, Eco System and Human Health. The global average temperature has increased by 0.6^0C over the last 100 years (IPCC, 2007). Even through increase in temperature produced the largest increase in evaporation, each of the other climate variables acted to reduce evaporation, thereby resulting in overall reduction in evaporation (Donahue et al., 2010). The factors influencing crop water need is climate, crop type and growth on stage. The factors influencing evapotranspiration is based on Water Availability, Stand Density, Soil Character, Salinity, Depth of Ground Water and most importantly the Weather Condition.

TERMINOLOGY
- **Evaporation** is the process of losing moisture content from the soil and water bodies by the action of sun during which liquid changes into gas. It is the important process in the hydrologic cycle.
- **Transpiration** is the process of evaporation takes place by the helps of plants via stomata cavities which are essential for its growth.
- **Evapotranspiration (ET)** is the sum of quantities of water required for transpiration, moisture held in the plant tissue and evaporation takes place from the soil.
- **Reference Evapotranspiration (ET_0)** is the estimation of ET from the reference surface which is a grass crop of uniform height 0.12 m fully shading the ground along with well watered area.
- **Potential Evapotranspiration (PET)** Penman (1947) defined as the ET from actively growing short green vegetation completely shading the ground and never short of moisture availability.Hornthwaite (1948) defined as the ET from large vegetation covered land surface with adequate moisture at all times.The Complete Evaporation from the soil and Transpiration from the plants is the Evapotanspiration (ET).

NEED AND OBJECTIVE
- The Main objective of this study is to estimate crop Evapotranspiration. This will help to manage and find long term availability of water.
- To find water stress by comparing the estimated Evapotranspiration with crop water requirement. This will allow achieving higher efficiency of irrigation.

STUDY AREA
Kumaratchi block is situated at the Southern Part of Cuddalore District. The block is surrounded by Kattumannarkoil block at the South, Parangipettai block at the East, Keerapalayam Block at the North and the Kattumannarkoil at the West. The total extent of block is 21715 hectares. The total Village Panchayats are 57. There are two town panchayats, 1) Lalpatai and 2) Annamalai Nagar. There are 89 Revenue Villages in the

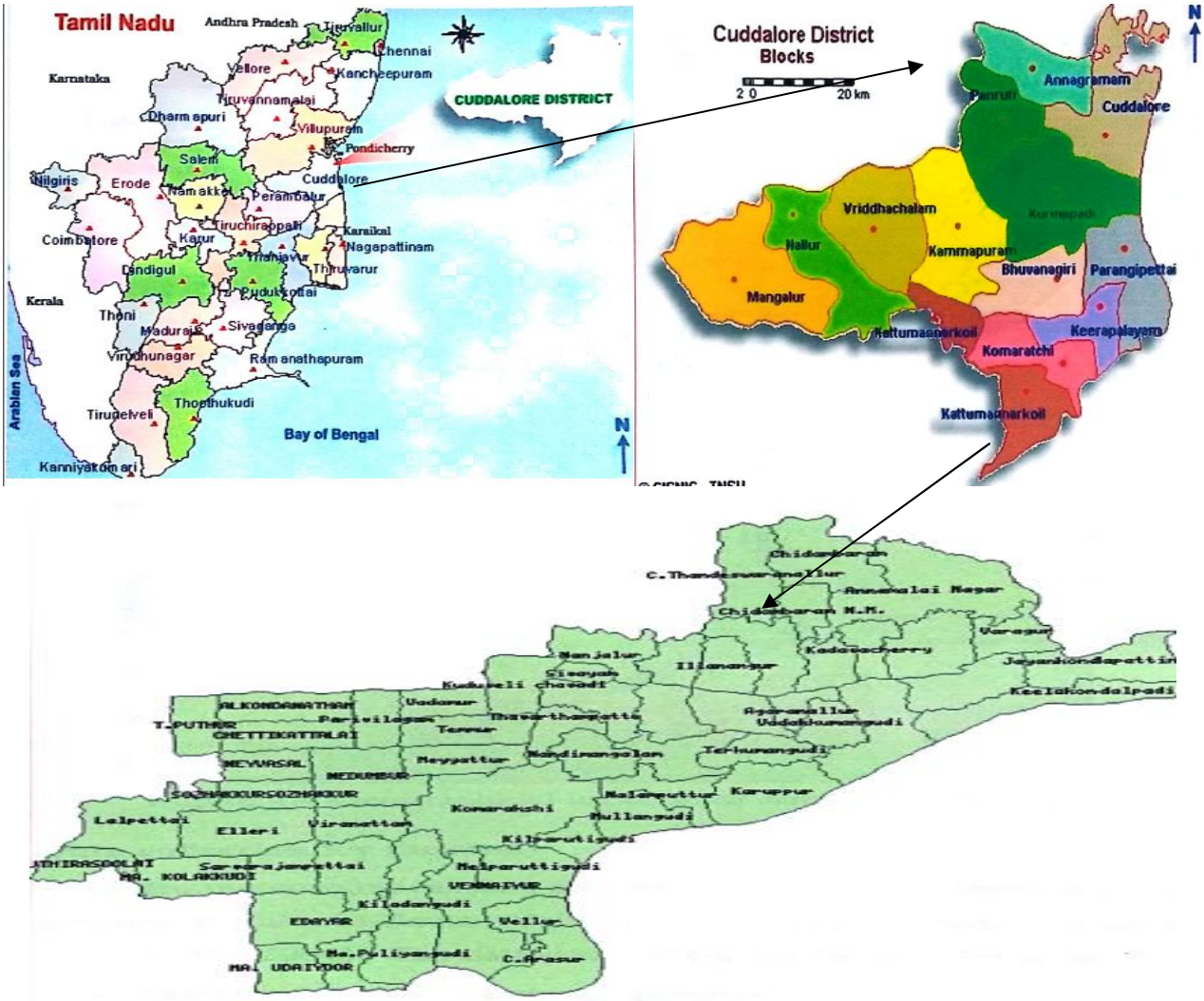
ISSN 2394 - 7780

Kumaratchi Block of which 63 Villages in KattumannarkoilTaluk and remaining 26 villages in ChidabaramTaluk. In this block, 80% people involved in agricultural activities. The main agricultural crops are Paddy, Blackgram, Greengram, Sugarcane, Groundnut, Banana and Betel Leaf. Annamalai Nagar (Latitude 11º 24' N and Longitude 79º 44' E) is only India Meterological observatory in Kumaratchi Block. Annamalai Nagar situated in Cuddalore District, Tamil Nadu, India.

- Area cultivated under first crop - 10230 Hectares
- Area cultivated more than one - 910 Hectares
- Total area cultivated under all Crops - 11140 Hectares

Table 1 Crop cultivated in the study area

CULTIVATED CROP DERAILS	AREA IN HECTARES
Paddy	
• Kuruvai	1332
• Samba	9340
• Navarai	15
Sugar Crops	134
Banana	82
Groundnut	8



ISSN 2394 - 7780

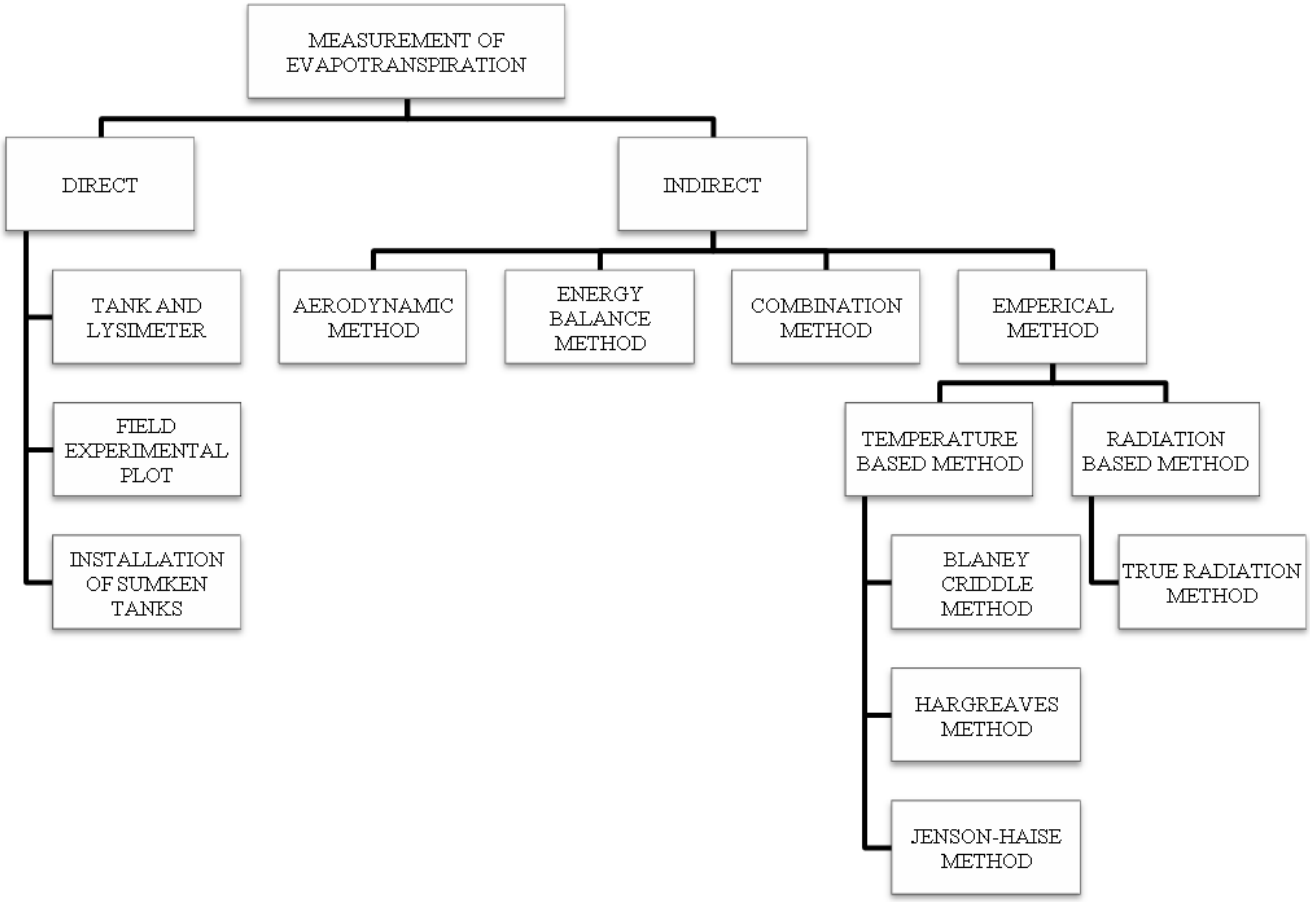


Figure 1 Study Area Map

MATERIALS AND METHODS

Penman Monteith Method (FAO-56)

The Penman-Monteith method has been regarded as a global standard method for computation of ET0 by Food and Agricultural Organization of the United Nations (FAO). In the FAO PM equation, the dominant factors affecting the calculation of ET_0 are the weather variables such as maximum and minimum air temperature, wind speed, sunshine duration and relative humidity measured or estimated at the meteorological stations for a specific location, in addition to latitude and altitude of the place that represent the geographic and climate characteristics of the study location. However, the FAO PM equation has been confirmed to be superior in comparison with other techniques that are often used as reference equations (Allen et al. 1998).

In this method, ET_0 can be expressed as follows:

$$ET_0 = \frac{\left[\left[0.408\ \Delta\left(Rn - G\right)\right] + \left[\gamma\ \frac{900}{(T + 273)}\left[Uz\ (es - ea)\right]\right]\right]}{\left[\Delta + \left[\gamma\ (1 + 0.34\ Uz)\right]\right]}$$

Where

ET_0	=	Reference Crop EVP (mm / day)
R_n	=	Net Radiation at the Crop Surface (M J m^{-2} day)
G	=	Soil Heat Flux Density (M J m^{-2} / day)
T	=	Mean Daily Temperature (^0c)
U_z	=	Wind Speed at 2 m Height (m s^{-1})
e_s	=	Saturation Vapour Pressure (k Pa)
e_a	=	Actual Vapour Pressure (k Pa)
Δ	=	Slope of Vapour Pressure Curve (k Pa $^0c^{-1}$)
γ	=	Psychrometric Constants (k Pa $^0c^{-1}$)

ISSN 2394 - 7780

COLLECTED DATA

Table 2 Details about the collected data

Symbol	Expansion	Unit	Day 1
Tmax	Temperature Maximum	˚c	29.3
Tmini	Temperature Minimum	˚c	21.2
Rhmax	Relative Humidity Maximum	%	96
Rhmini	Relative Humidity Minimum	%	66
n	Sunshine hour	-	4.7
U_z	Wind speed	km/h	9.7

The above data are collected from Indian Meteorological Department (IMD), Chennai for the period of 25 years (1990 – 2016).

SAMPLE CALCULATION

Inverse Relative Distance Earth-Sun (D_r)

dr = 1+0.033*COS*(2л*J/365)

Where

J=No.of days between 1(1st JAN) to 365(31st DEC)

= 1+ 0.033*COS*(2л*1/365)

= 1.03300

Solar Declination (Δ)

δ = 0.409SIN(2л*J/365-1.39)

= 0.409SIN(2л*1/365-1.39)

= -0.401

Sunset Hours Angle (ωs)

ω_s = acos[-tan(φ)*tan(δ)]

Latitude 11º 24' change to radiance (φ) = (11+(24/60))*(л/180) = (11.4)*(л/180) = 0.1990

= acos[-tan(0.1990)*tan(-0.401)]

=1.485

Extraterrestrial Radiation (R_a)

Ra = [24(60)/л]*Gsc*dr{ωs sin(φ) sin(δ) + cos(φ) cos(δ) sin(ωs)}

where,

Ra = Extraterrestrial radiation [MJ m-2 day-1]

Gsc = Solar constant = 0.0820MJ m-2

dr = Inverse relative distance Earth-Sun =1.033

ωs = Sunset hour angle [red]

φ = Latitude {red]

δ = Solar decimation [red]

= [24(60)/л]*0.082*1.033*{1.485sin(0.199) sin(-0.401) + cos(0.199) cos(-0.401) sin(1.485)}

= 30.449

Solar Radiation(R_s)

Rs={as+bs*(n/N)}*Ra

ISSN 2394 - 7780

where,

Rs = Solar or shortwave radiation [MJ m-2 day-1]

as = Angstrom constant

bs = Angstrom constant

n = Actual duration of sunshine [hours]

N = Maximum possible duration of sunshine or daylight [hours] =(24/л)*ωs

n/N = Relative sunshine duration

Ra = Extraterrestrial radiation [MJ m-2 day-2]

= {0.230+0.540*(9.700/11.341)}*30.449

= 21.066

Clear Sky Solar Radiation (R_{so})

Rso = (0.75+2z/10^5)*Ra

where,

Rso= Clear sky Radiation [MJ m-2 day-1]

Z = Station elevation above sea level [5.79m for annamalainagar]

= (0.75+2*5.79/10^5)*30.449

= 22.840

Net Solar Or Net Shortwave Radiation (R_{ns})

Rns = (1-α)Rs

where,

α = Albedo or canopy reflection coefficient, which is 0.23 for hypothetical grass reference crop [-]

Rs = Solar or shortwave radiation [MJ m-2 day-1]

= (1-0.23)*210.66

= 16.221

Mean Saturation Vapour Pressure (e_s)

$e_s=(e^o(T_{min})_+e^o(T_{max}))/2$

where,

$e^o(T_{max})$ = Saturation vapoure pressure at daily maximum temperature [kPa]

$e^o(Tmax)=0.6108*Exp((17.27*Tmax)/(Tmax+237.3)$ = 4.076

$e^o(T_{min})$ = Saturation vapoure pressure at daily minimum temperature [kPa]

$e^o(Tmin)=0.6108*Exp((17.27*Tmin)/(Tmin+237.3)$ = 2.518

= (4.076+2.518)/2

= 3.297

Actual Vapour Pressure (e_a)

$e_a=\{e^o(T_{min})*\%Rh_{max}+e^o(T_{max})*\%Rh_{min}\}/2$

where,

$\%Rh_{max}$= percentage of maximum relative humidity [%]

$\%Rh_{min}$= percentage of minimum relative humidity [%]

= {(2.518*0.96)+(4.076*0.66)}/2

ISSN 2394 - 7780

= 2.553

Net Longwave Radiation (R_{nl})

$R_{nl} = \sigma[T_{max\,K}^4 + T_{min\,K}^4/2](0.34 - 0.14\sqrt{e_a})(1.35\ R_s/R_{so} - 0.35)$

Where,

σ = Stefan-Boltzmann constant[$4.903\ 10^{-9} MJK^{-4}m^{-2}\ day^{-2}$

T_{maxK} =maximum absolute temperature during the 24-hour period [K=˚C + 273.16]

T_{minK} = minimum absolute temperature during the 24-hour period [K=˚C + 273.16]

$= 4.9E\text{-}09[(302.46^4+294.36^4)/2](0.34\text{-}0.14\sqrt{2.553})[1.35*(21.066/22.84) - 0.35]$

= 4.051

Net Radiation (R_n)

$R_n = R_{ns}\text{-}R_{nl}$

= 16.221 – 4.051

= 12.169

Psychrometric Constant (γ)

$\gamma = (C_P*P)/(\varepsilon\lambda)$

where,

C_P = Specific heat at constant pressure $1.013x10^{-3}$ [MJ kg^{-1}˚c]

P = Atmospheric pressure = $\{101.3((293\text{-}0.0065z)/293)^{5.26}$

ε = Ratio molecular weight of water vapour / day air = 0.622

λ = Latent heat of vaporization,2.45 [MJ kg^{-1}]

Z = Station elevation above sea level [5.79m for annamalainagar]

= (0.001*101.232)/1.524

= 0.0673

Wind Profile Relationship (u)

$u_2 = u_z*(4.87/LN(67.8z\text{-}5.42))$

where,

u_2= wind speed at 2m above ground surface [m s^{-1}]

u_z = Measured wind speed at z 'm' above ground level(Z = 3m)

= 1.306*(4.87/LN(67.8*3-5.42))

= 1.202

Mean Temperature(T)

$T = (T_{max} + T_{min})/2$

= (29.3+21.2)/2

= 25.25

Delta (Δ) - Solar declination

$\Delta = 4098(0.6108EXP(17.27T/T+237.3))/(T+237.3)^2$

$= 4098(0.6108EXP(17.27*25.25/25.25+237.3))/(25.25+237.3)^2$

= 0.191

Reference Evapotranspiration (E_{to})

ISSN 2394 - 7780

$$ET_0 = \frac{\left[\left[0.408\ \Delta\ (Rn\ -\ G\ )\right] + \left[\gamma\ \frac{900}{(T\ +\ 273\ )}\left[Uz\ (es\ -\ ea\ )\right]\right]\right]}{\left[\Delta\ +\ \left[\gamma\ (1\ +\ 0.34\ Uz\ )\right]\right]}$$

ET_0 = 3.954

RESULT AND DISCUSSION

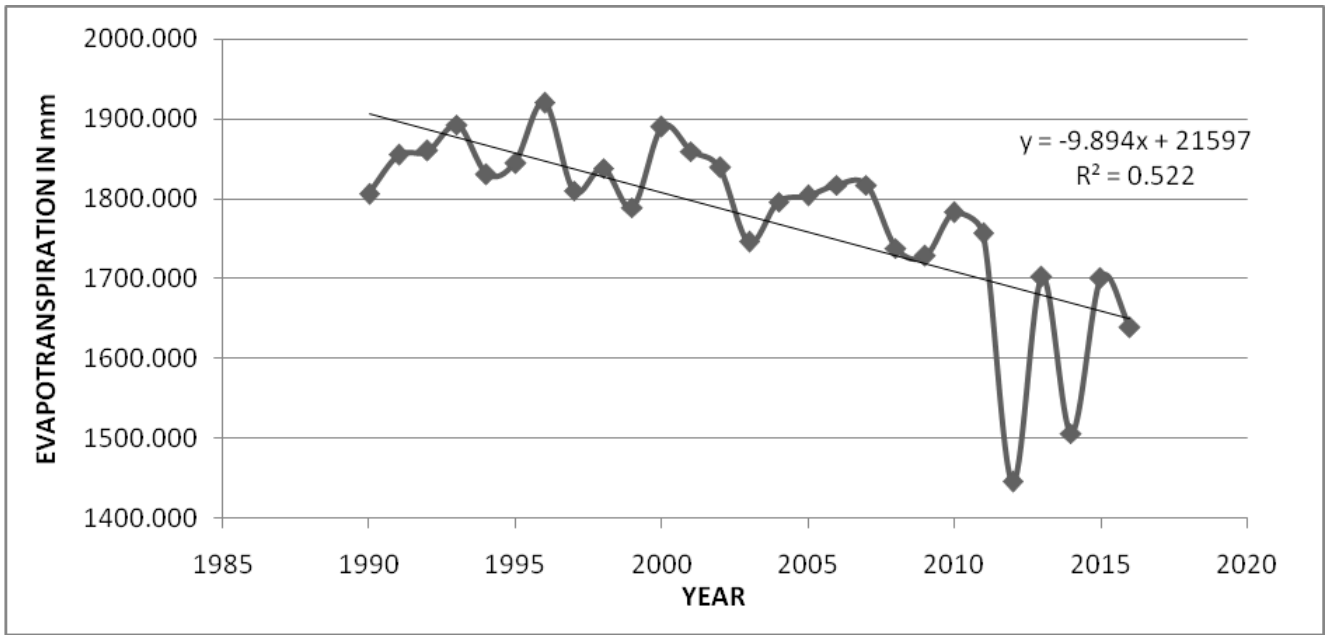


Figure 2 Annual Evapotranspiration over period of 1990 – 2016

From the study period (1990 – 2016), the results showed that the maximum and minimum ET_0 values are 1920 and 1506 mm respectively. It shows a decreasing trend at a rate of 9.89 mm / year. From the calculated value, it is projected for the upcoming decades for predicting ET_0. By the same way, the inputs for ET_0 such as mean temperature, sunshine hours, wind speed, relative humidity also projected up to 2050. This study shows that, the ET0 projected from Penman – Monteith FAO 56 method is more accurate than the process of projecting each parameter.

Table 3 Linear Equations for monthly Et_0

	LINEAR EQUATIONS	**VALUE OF R^2**
January	y = -0.2482x + 612.63	R² = 0.0797
February	y = -0.1711x + 466.2	R² = 0.032
March	y = -0.2971x + 751.52	R² = 0.0784
April	y = -0.7963x + 1767.7	R² = 0.2711
May	y = -1.3344x + 2874.7	R² = 0.2334
June	y = -1.5101x + 3219.6	R² = 0.2383
July	y = -1.3781x + 2936.9	R² = 0.393
August	y = -1.656x + 3485.3	R² = 0.5225
September	y = -0.7595x + 1670.4	R² = 0.1945
October	y = -1.0084x + 2141.8	R² = 0.4553
November	y = -0.5246x + 1146.4	R² = 0.1363
December	y = -0.2108x + 524.05	R² = 0.024

ISSN 2394 - 7780

Table 4 Projected values of Et_0

YEAR/ MONTH	2020	2030	2040	2050
January	111.266	108.784	106.302	103.820
February	120.578	118.867	117.156	115.445
March	151.378	148.407	145.436	142.465
April	159.174	151.211	143.248	135.285
May	179.212	165.868	152.524	139.180
June	169.198	154.097	138.996	123.895
July	153.138	139.357	125.576	111.795
August	140.180	123.620	107.060	90.500
September	136.210	128.615	121.020	113.425
October	104.832	94.748	84.664	74.580
November	86.708	81.462	76.216	70.970
December	98.234	96.126	94.018	91.910
Total	1610.108	1511.162	1412.216	1313.270

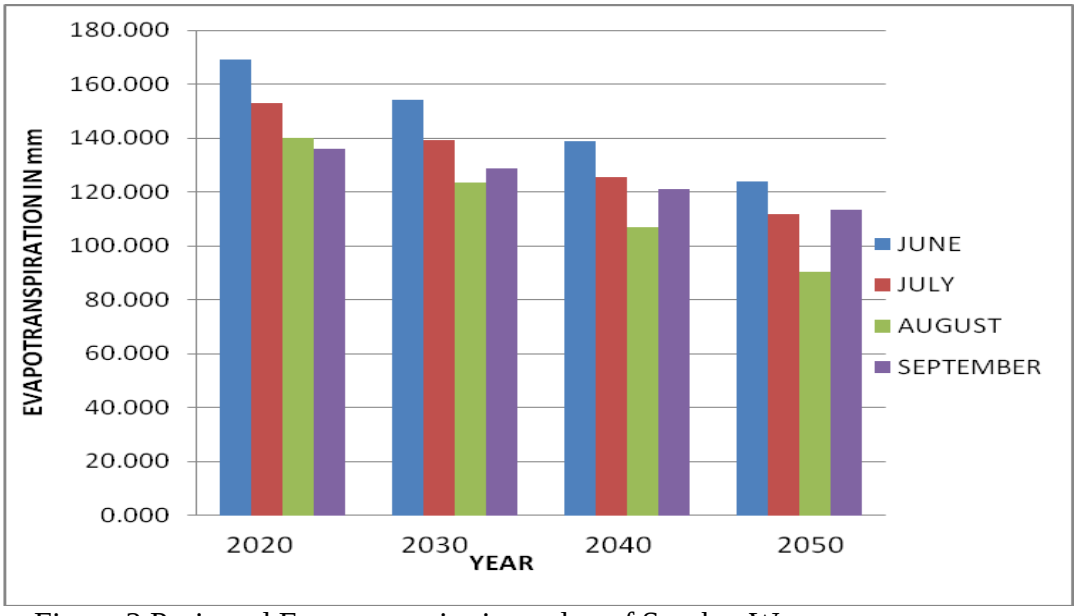


Figure 2 Projected Evapotranspiration value of South – West monsoon season.

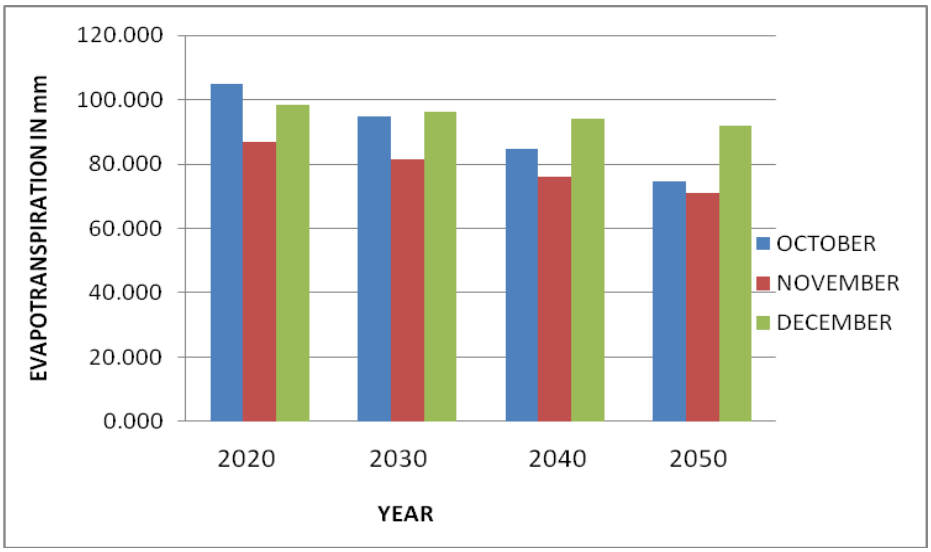


Figure 3 Projected Evapotranspiration value of North – East monsoon season

ISSN 2394 - 7780

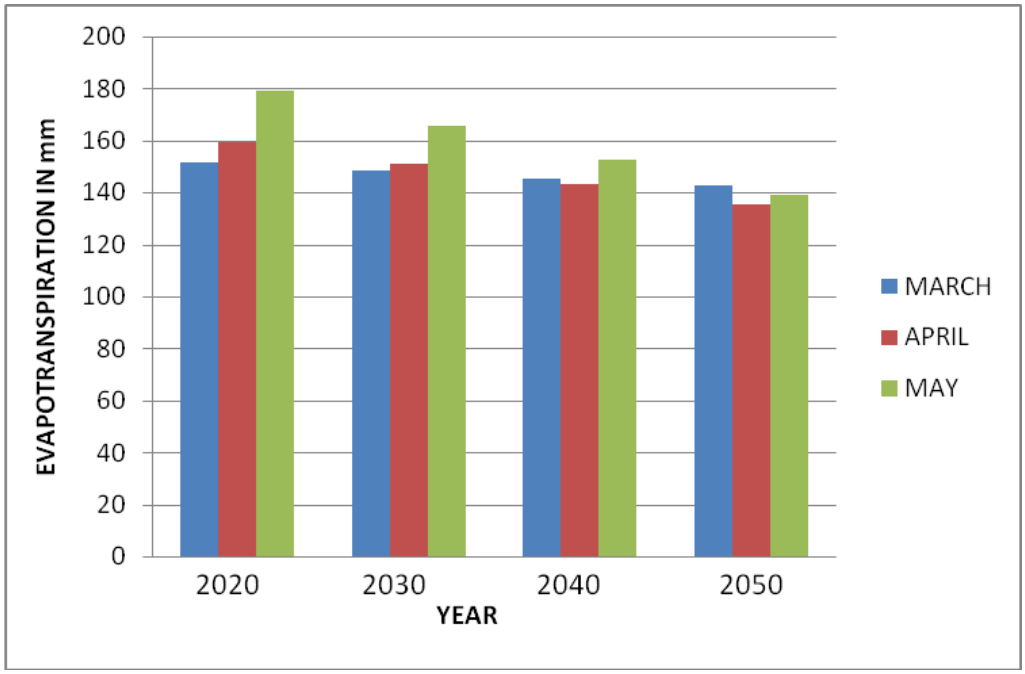


Figure 4 Projected Evapotranspiration value of summer season

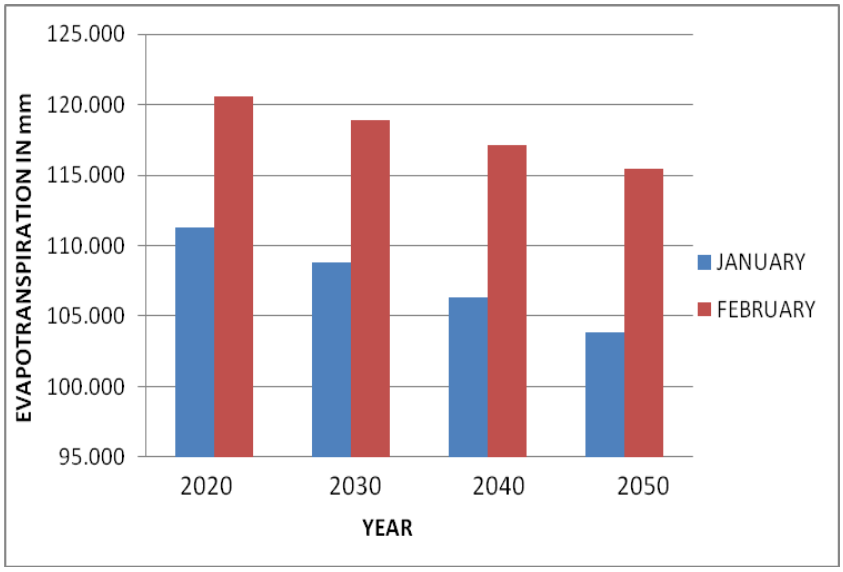


Figure 5 Projected Evapotranspiration value of winter season

CONCLUSIONS

In this study, the results of Linear Regression Analysis established that the rate of evapotranspiration follows a decreasing trend for Kumaratchi block. The rise of global temperature due to global warming, it may be expected that rise in evapotranspiration. In humid region, air is close to saturation so it will reduce ET_0 rateand higher in arid region. It is also absorbed that evapotranspiration rate is higher in summer season and lower in winter season.

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ENVIRONMENTAL CARING AND PRACTICES AMONG YOUNG STUDENTS

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ABSTRACT
This paper for the most part centered around natural mindfulness and practices identified with different components like reasons for contamination, preservation of soil, backwoods, air, and so forth., vitality protection, protection of human wellbeing, preservation of untamed life and creature cultivation. It additionally talks about natural practices among youthful understudies with respect to the utilization of plastic and its transfer, elective for plastic, can use, its utilization in the development of saplings, water reaping and furthermore their interest in condition related projects. The objective was youthful understudies on the grounds that natural training is a piece of their educational modules; they can actualize what they realized. This examination will bolster the individuals who are working with/for the earth related cases. The investigation is quantitative in nature. It uncovers that the dimension of mindfulness is high among the respondents regardless of sex distinction yet practically speaking dimension there is contrast between sexual orientations for example guys rehearsing more than females. This investigation additionally proposes a few suggestions to defend nature in India.

Keywords: Students, Environmental Awareness, Conservation

INTRODUCTION
The developing worry with ecological issues and their effect on general mindfulness is a standout amongst the most detectable marvels of the most recent two decades. Increment in financial exercises in creating nations results in more vitality and utilization request which by and large prompts natural corruption. There is a customary conviction that such natural debasement would resolve when these nations develop financially, since that would empower them to manage the cost of ecological benevolent innovation just as star natural guidelines and arrangements. In any case, a few investigations showed that many creating nations officially outfitted with natural strategies, legitimate structures and financial instruments, which are viewed as profoundly advanced by universal principles (Huber et al., 1998) but then face the compounding of ecological conditions. Significant challenges these nations stand up to are not just the absence of lawful and financial structure for ecological insurance, yet additionally absence of support among overall population in professional natural practices. A portion of the ecological issues which are basic at the present are reasonably broadly known on account of the developing consciousness of all dimensions of society, including governments, overall population and established researchers. Be that as it may, the present examination is attempting to talk about the ecological mindfulness and practice among understudies in Tamil Nadu. The way that individuals from various societies act with a nationalistic mindfulness, which is viewed as one of the most concerning issues of globalization, is contemplated. It will be inescapable for us to confront the way that it would not be anything but difficult to discover an answer for natural issues. India has over 40% of youngsters on the planet. The refinements and routine with regards to ecological way is will improve the present natural conditions.

ENVIRONMENTAL STATUS IN TAMILNADU
With regards to Tamil Nadu in India, the proficiency rate is expanding over numerous years. It prompted the foundation of many number of schools all over Tamil Nadu, yet the nature of training isn't sufficient. Plus, the understudies concentrating in schools ought to have social measurements. In this angle, natural mindfulness and practice are given nowadays. So as to have adroit learning on undergrad's disposition towards natural mindfulness and practice, this examination was embraced. Social laborers can sharpen the general population about the significance of ecological information and master conduct for supportable condition. This should be possible by making mindfulness among the understudies through various media and make various ways and energize them for safe practices. Condition incorporates all living and non-living articles. We live in the earth and utilize the ecological assets like air, land and water to address our issues. Improvement additionally implies addressing the requirements of the general population. While meeting the regularly developing needs, we put weight on the earth. At the point when the weight surpasses the conveying limit of the earth to fix or supplant itself, a major issue of natural debasement occurs. In the event that we utilize any natural asset, for example, ground water past its farthest point of substitution, we may lose it until the end of time. Subsequently, there is a need to make 'learning' about Environmental assurance. In the previous two decades, Environment has pulled in the consideration of school and understudies in India.

ISSN 2394 - 7780

In this manner, it is critical to know the information of ecological mindfulness among the future age and their present practice towards natural assurance which leads for manageable advancement. This present examination is planned to comprehend the natural mindfulness and practice status among the youthful understudies.

MATERIALS AND METHODS

The point of the paper is to gauge the dimension of ecological mindfulness and routine practices towards condition among the under alumni standard understudies with unique reference to Arts and Science schools in Karur locale, Tamil Nadu.

DESTINATIONS OF STUDY

- To measure the ecological mindfulness level among the undergrads

Karur is a modern town situated on the banks of the stream Amaravathi. It is situated at 10.95o N, 78.08o E and 396 km from Chennai on southwest course. Amaravathi stream is a tributary to the waterway Kavery. It is junctures with waterway Kavery at around 12 km downstream of Karur. Amid the most recent four decades, the town rose as a noteworthy material focus with its 1000 odd power loom and handloom color units creating comforters, towels and outfitting. There are around 1000 units along a 17 km stretch on the banks of waterway Amaravathi, which attempt dying, coloring, weaving, fitting, sewing, tying, pressing, transporting and exchanging. There are 487 material handling units in capacity and discharge around 14,610 kilo liters for each day of treated emanating into the stream, Amaravathy (Shanmugapriya et al., 2017).

The essential and auxiliary information has been gathered. The optional information were gathered from different sources, for example, books, reports and enactments. To gather essential information, the scientist received Standardized scale on Environmental Awareness Ability Measure (EAAMJPK English to Tamil) and self arranged survey on ecological practices were utilized for gathering essential information. In this examination work multi arrange testing strategy was pursued for choosing the respondents from study zone. In the first stage rundown of subsidiary schools of karur region working under bharadhidsan University (A State University of Tamil Nadu), In the 2 nd stage, from the recorded schools, just the schools began amid the scholastic year of 2014 - 2015 was chosen. On that premise five universities were chosen. In the third stage methodical arbitrary testing (hard numbers has been taken) was utilized to choose 3 schools out of 5 universities. The all out quality of the chose 3 universities was 559 understudies. In light of the accessibility of understudies just first year understudies were chosen. In these 3 universities there were 244 first year understudies, yet 210 understudies were accessible amid the time of information accumulation, all the 210 understudies were chosen dependent on enumeration technique in the fourth phase of examining.

RESULTS AND DISCUSSION

The researcher presented the collected data with the help of tables. This also intends to do appropriate statistical test over the data to validate the statistical hypothesis which helps in interpreting data, to explain the relationship between gender and environmental awareness as well as correlation between gender and practice which means friendly practice and unsociable practice.

S.No	Gender	Environment Awareness			Total
		Low	Moderate	High	
1.	Male	0	12(12.76%)	82(87.24%)	94(100%)
2.	Female	0	8(6.89%)	108(93.10%)	116(100%)
	Total	0	20(9.52%	190(90.47)	210(100%)

CONCLUSION

The authour finishes up this paper with following suggestion. This investigation can be additionally extended to do look into on creating and utilizing unique contemporary condition mindfulness bundles for the understudies through NSS (or) by framing separate office for moderating condition. The specialist prescribes that natural examination ought to be incorporated into school educational modules and ought to be shown all understudies independent of their sexual orientation. It tends to be incorporated into their examination by including increasingly functional arranged projects. They can be sharpened by commending extraordinary day like world natural day, untamed life day, world water day, woodland protection day and so on., and furthermore learning about choices for plastic ought to be conferred and advanced among understudy populace. It ought not be simple an investigation, rather it ought to turn out to be a piece of their life.

Every one of these discoveries encourage the need to endeavor endeavors to give the vital offices to advancing condition mindfulness and benevolent way to deal with shield the earth. This examination concentrated on different parts of condition, fundamentally natural mindfulness and practice among youthful understudies. This

ISSN 2394 - 7780

paper finishes up with connection among sexual orientation and ecological dimension of mindfulness and practice level, dimension of mindfulness is high yet practice level is moderate and there are a few contrasts among sex and practice level among youthful understudies.

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EFECT OF PLANT GROWTH REGULATORS ON ROOTING OF HARDWOOD CUTTINGS IN GUAVA (Psidium guajava.L) cv. LUCKNOW-49

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An experiment was carried out to study the effect of plant growth regulators on rooting of hardwood cuttings in guava (Psidium guajava.L) cv. Lucknow-49. The treatments comprised of using three growth regulators like IBA, IAA and NAA with four different concentrations of 1000, 2000, 3000 and 4000 ppm. The guava cuttings were dipped in the growth regulators for twenty minutes and then planted in the poly bags were kept in the mist chamber. The results of the experiment revealed that the root parameters like rooting percentage (87.83%), number of roots per cutting (11.02) and shoot parameters like number of sprouts per cutting (2.77) and survival percentage of rooted cuttings (90.59 %) were observed the highest in the treatment where IBA @ 3000 ppm was used. It was followed by the treatment tested with IBA @ 4000 ppm. The least parameters were observed in the control.

Keywords: Guava, IBA, IAA, NAA, growth regulators

INTRODUCTION

Guava is called as Apple of the tropics and it belongs to the family Myrtaceae. Guava fruits are used for both fresh consumption and processing. It is one of the richest sources of vitamin C, containing 2 to 5 times more than that in oranges. Propagation through air layering in guava is a time consuming and hence necessitated a search for alternate but effective means of vegetative propagation. Of late, several woody perennials are successfully and rapidly propagated through use of cuttings. In this context, rapid method of propagation become very important when planting material is limited due to scarcity of a clone or varieties or due to sudden expansion in acreage. Thus it leads to an idea about the rapid propagation of guava by cuttings. To improve the rooting, different growth regulators at different concentrations was used. With this objective the present investigation was carried out to study the effect of plant growth regulators on rooting of hardwood cuttings in guava (*Psidium guajava.*L) cv. Lucknow-49.

MATERIALS AND METHODS

An experiment was carried out in the University orchard, Department of Horticulture, Faculty of Agriculture, Annamalai University. Guava cv. Lucknow-49 was used for the experiment. The experiment was laid out in Randomized Block Design with thirteen treatments and three replications. The treatments comprised of using three growth regulators like IBA, IAA and NAA with four different concentrations of 1000, 2000, 3000 and 4000 ppm. The guava cuttings were dipped in the growth regulators for 20 minutes and then planted in the poly bags was kept in the mist chamber. The observations on rooting percentage, number of roots per cutting, number of sprouts per cutting and survival percentage of rooted cuttings were recorded. The data were analysed statistically following the method suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Root and shoot parameters are considered to be the important factors to judge the rooting of a crop. The data on the root and shoot parameters are presented in the Table 1.

Among the treatments tested, the treatment IBA @ 3000 ppm increased the rooting percentage (87.83%). Similar findings on increased rooting percentage due to the soaking of cuttings in IBA were reported by Husen and Pal, 2007. They reported that the increased percentage of rooting in cuttings treated with plant growth regulators over control has been considered to be due to the fact that hardwood cuttings contains more starch content which in turn bring about favourable conditions for root initiation and more rooting percentage coupled with positive response of combination of IBA and NAA attributed to their synergistic effect. The treatment where IBA @ 3000 ppm used recorded the maximum number of roots per cutting (11.02). This was followed by the treatment where IBA @ 4000 ppm was used which recorded 10.93 number of roots per cutting. The reason for the better rooting and increase in root growth with various auxins treatment might be due to maximum utilization of sugar and starch after hydrolysis (Singh, 2001).

The treatment where IBA @ 3000 ppm used recorded the highest number of sprouts per cutting (2.77). It was followed by the treatment where IBA @ 4000 ppm was used which recorded (2.38) number of sprouts per cutting. The development of dormant bud into sprout is directly associated the breakdown of reverse food and its mobilization in the growing region and auxin involved in the process. The auxins activated shoot growth which have resulted in elongation of stems and length of sprout through cell division accounting in higher

ISSN 2394 - 7780

number of sprouts (Mukhtar et al., 1998) in guava. The rooted cuttings obtained by the treatment with IBA @ 3000 ppm recorded the highest survival in the field (90.59%) followed by the treatment IBA @ 4000 ppm which recorded 86.30%. The survival percentage of rooted cuttings was recorded the least (30.09%) in control. Noor Rahman et al., (2004) in guava reported that higher concentration of auxin included maximum number of roots which has direct relationship with the survival percentage. Fachinello et al., (2005) reported that hardwood cuttings for presenting regions show constant metabolic activity and continuous development are the stakes that generally have greater survival percentage to hardwood cuttings, when using growth regulators.

Hence, the results of the experiment revealed that the root parameters *viz.*, rooting percentage, number of roots per cutting and shoot parameters *viz*., number of sprouts per cutting and survival percentage of rooted cuttings were recorded the highest when IBA @ 3000 ppm was used.

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Table 1. Effect of plant growth regulators on root and shoot parameters in guava

Treatment Details	Root parameters		Shoot parameters	
	Rooting Percentage (%)	Number of roots cutting^{-1}	Number of sprouts cutting^{-1}	Survival percentage of rooted cuttings (%)
T_1- IBA @ 1000 ppm	73.69	10.59	2.30	83.41
T_2- IBA @ 2000 ppm	70.29	10.02	2.17	68.01
T_3- IBA @ 3000 ppm	87.83	11.02	2.77	90.59
T_4- IBA @ 4000 ppm	83.08	10.93	2.38	86.30
T_5- IAA @ 1000 ppm	72.64	10.32	2.28	73.49
T_6- IAA @ 2000 ppm	62.25	9.81	2.00	51.38
T_7- IAA @ 3000 ppm	75.29	10.65	2.32	85.20
T_8- IAA @ 4000 ppm	57.84	9.77	1.95	50.41
T_9- NAA @ 1000 ppm	53.62	9.59	1.68	46.90
T_{10}- NAA @ 2000 ppm	42.01	8.65	1.23	40.17
T_{11}- NAA @ 3000 ppm	65.05	9.93	2.09	55.49
T_{12}- NAA @ 4000 ppm	44.86	9.02	1.43	43.30
T_{13}- Control (Distilled water)	37.67	6.23	0.87	30.09
S.Ed	2.02	0.19	0.07	2.44
CD(p=0.05)	4.18	0.39	0.15	5.00

IBA- Indole-3- Butryic acid, IAA- Indole-3- Acetic acid, NAA- Naphthalene Acetic acid Soaking time of growth regulators is 20 minutes uniformly for all the treatments except control

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A STUDY ON ENVIRONMENTAL AWARENESS AND RELATED PRACTICES AMONG THE HIGH SCHOOL STUDENTS AT KARUR DISTRICT, TAMIL NADU

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ABSTRACT
The Environmental issues are major worldwide issue of significant concern. Because of expanding human populace and improvements in each part, the ecological related issues are increasing in the ongoing years with a decent variety of issues centering a definitive requirement for option supportable innovations to defend our earth. The human's craving to present day innovations and changing way of life designs present genuine danger on nature and because of the reality, the contamination levels are disturbing step by step. The Schools are where various youthful personalities are instilled estimations of instruction and related practices to create future mindful residents. In India, Karur is one of the significant social legacies of the south India. The city is confronting various improvements due to over populace and opposite side there is an absence of mindfulness on condition. The Amaravathi stream coursing through karur confronting extreme dry season as it is a noteworthy hotspot for horticultural water supply in the region. The present investigation centers around the examination of dimension of ecological mindfulness among the school understudies in Karur locale and significant requirements for appropriate natural inviting practices among the school understudies towards ideal utilization of assets in order to build up the awareness of other's expectations towards eco-advancement and maintainability. The youth can cooperate to accomplish the greening of Karur through a few inventive manageable practices and spreading mindfulness among people in general for elective assets of vitality and assurance of condition for the future needs.

Keywords : Environment, population, pollution and sustainability .

INTRODUCTION
The effects of the ecological issues are influencing not just at the nearby dimension and it is worldwide issue of significant marvels. Numerous modern and infrastructural improvements, human populace development and urbanization, plastic use, electronic squanders, vehicular emanations, consumption of biodiversity, sullying of contaminations in the water bodies, soil and barometrical contamination have crushed the common habitat causing serious sick wellbeing consequences for people. Many created nations are gradually finding a few option and inventive advancements to limit the impacts of contamination and ideal use of the characteristic sources. In the ongoing years, a few places far and wide have been crushed because of catastrophic events, substantial floods and outrageous environmental change impacts have influenced a few lives. The understudies ought to be instilled the successful and ideal utilization of our common assets and vitality to defend our the compelling force of nature and furthermore to return to the conventional practices in preserving our assets so as to achieve manageability in all dimensions and solid component. There is a desperate need of ecological mindfulness on each part of the earth and protection of common assets and biodiversity in order to create socially capable natives of the tomorrow. The present investigation has endeavored the need of the natural mindfulness among the school understudies at the Karur region of Tamil Nadu to make better and economical ecologically solid practices in the general public as the Karur is one of the old legacy and social city in the southern piece of Tamil Nadu. The greening of the city and its towns around can contribute massively to diminish the carbon content in the barometrical air consequently may bring about shortening atmosphere changes and better filtration of air. Further two waterways and water bodies around Karur are confronting serious dry season and ground water level is disturbing, because of unreasonable utilization. So as to bring back the innovation of condition in Karur area, part of endeavors should be set up at all dimensions. Making better natural practices among the school understudies is one of such activity to accomplish ecological insurance by instilling moral qualities and supportable practices among them to create as good example in the general public.

OBJECTIVE OF THE STUDY
Effects of globalization have a wide scope of ecological issues, including environmental change, biodiversity, mechanical contamination and waste administration. The goal of this examination encourages creative procedures and takes a stab at the improvement of another age of ecological neighborly natives that will convey spirit to the general public to help natural mindfulness. Coming up next are the target of the investigation.

- To assess the Environmental Awareness potential of the students on the basis of different environmental problems.

ISSN 2394 - 7780

- To suggest proactive roles of National Green Corps, Eco clubs, Green clubs and other similar innovative measures in schools in building environmental awareness and sustainable action in the society to solve the environmental problems

REVIEW OF LITERATURE

Many research thinks about have as of now proclaims there is hugeness distinction between the ecological information and recorded conduct of the school understudies at different spots. The exponential blasting of ventures, swarmed urban communities, overwhelming vehicular blockages and open transfer and consuming of garbages are combining to make our urban areas most dirtied these days. Such huge numbers of kids are confronting lung sicknesses due to inhale of dirtied harmful air. The open sewerages, dumping of plastics and sustenance squanders are disturbing substantial contamination impacts on people specifically at urban regions. The effect of environmental change is very much reflected because of the loss of biodiversity, depleting of streams, shortage of water assets and wetlands.

The meetings on EE held at Belgrade (1975) and Tbilisi (1977) has focused on the need of creating fundamental ideas, ecological information, demeanor and ability situated investment. As indicated by Indian setting, the first International gathering on EE was held at New Delhi in 1980 and from that point second meeting in 1985. As indicated by Sharma (2004), the EE at the dimension of Higher optional school arrange will be powerful instructing, handy field situated for digestion of information, distinguishing proof of the issue prompts activity situated abilities. Ecological mindfulness infers learning about condition and teaches esteems and expected abilities to comprehend natural issues and it is an underlying advance prompting convey dependable citizenship conduct (Sengupta, Das and Maji, 2010).

RESEARCH DESIGN AND FRAMEWORK

The research work aimed to assess the level of environmental awareness and the existing environmental friendly activities among the students of High Schools. The study is primarily based on the field level survey from the students in the predefined questionnaire on different environmental issues. Among the whole district, about eight schools were selected for such purpose and 200 students were covered from each school for the study. The below table-1 displays the summary of data obtained from schools at Karur District.

The responses of the students were collected in the predefined questionnaire consisting 15 topics of environmentally sound nature to assess the awareness of the students and each topic has five sensitive type questions of local environmental issues and also global issues with the responses in form of YES, NO and Not Decided tick mark options. The below listed topics were suitably covered in the questionnaire to elicit the option of students on environmental problems and the nature of response to be taken towards sustainable future.

TABLE- 1

S. No	Name of School	Class of Study	Number of samples	
			Boys	Girls
1.	Municipal Higher Secondary School, Karur.	VIII	100	100
2.	Government Higher Secondary School, Elavanur.	IX	100	100
3.	Government Higher Secondary School, Thumbivadi	XI	100	100

DISCUSSION ON THE RESULTS

From the outcomes VIII standard, it is gathered that there is no noteworthiness distinction between the young men and young ladies in water, sanitation and water collecting, air contamination and environmental change, preservation of vitality and reusing of squanders, condition and wellbeing, plastics and its belongings, clamor contamination, an Earth-wide temperature boost and ozone consumption, vermicomposting and strong waste administration, deforestation and urbanization, catastrophe the executives, ecological training for supportability, NGC/Eco-clubs and mindfulness through activity and Eco neighborly exercises in school and home. There is an importance contrast among young men and young ladies at 0.001 dimensions in Environmental mindfulness for young ladies and at 0.01 dimension of centrality in Biodiversity and green gardens for young ladies.

IX standard, it is derived that there is no noteworthiness contrast among young men and young ladies in water, sanitation and water reaping, biodiversity and green greenhouses, protection of vitality and reusing of squanders, condition and wellbeing, commotion contamination, deforestation and urbanization, calamity the board, NGC/Eco clubs and mindfulness through activity and Eco benevolent exercises in school and home.

ISSN 2394 - 7780

There is an importance distinction among young men and young ladies at 0.001 dimension in ecological mindfulness for young ladies, there is a noteworthiness contrast among young men and young ladies at 0.05 dimension in Air contamination and environmental change for young ladies. Further, there is essentialness contrast among young men and young ladies at 0.01 dimension in plastics and its belongings for young ladies and hugeness distinction among young men and young ladies at 0.05 and 0.01 dimension in a worldwide temperature alteration and ozone consumption and in vermicomposting and strong waste administration for young ladies. Similarly there is a critical contrast among young men and young ladies at 0.001 dimensions in ecological training for supportability for young ladies.

XI standard, demonstrates that there is no hugeness contrast among young men and young ladies in water, sanitation and water gathering, air contamination and environmental change, preservation of vitality and reusing of squanders, plastics and its belongings, deforestation and urbanization, catastrophe the board, ecological instruction for maintainability, NGC/Eco clubs and mindfulness through activity and Eco well disposed exercises in school and home. There is a much hugeness distinction among young men and young ladies at 0.001 dimensions in natural mindfulness for young ladies and 0.01 dimension of noteworthy contrast among young men and young ladies in biodiversity and green gardens for young ladies. In like manner, there is a critical distinction among young men and young ladies at 0.05 dimensions in condition and wellbeing, commotion contamination, a worldwide temperature alteration and ozone exhaustion and vermicomposting and strong waste administration in each individually for young ladies.

CONCLUSION AND RECOMMENDATIONS

The above research think about shows that among the school understudies from VII, VIII and IX class chose for reviewing their natural mindfulness dimensions of neighborhood issues and worldwide issues, the young ladies understudies commitment to mindful of learning on ecological issues are all the more high contrasted with young men understudies. By and large, the young ladies are progressively mindful of sick wellbeing impacts of plastics, air contamination, water contamination and open sanitation. Despite the fact that ecological training has been injected in the school educational modules, there is a critical need of useful situated ways to deal with the understudies network to create feasible practices like tree ranch, vermicomposting of squanders at school grounds, elective for the utilization of plastics, need of protected and clean drinking water and furthermore advancement of natural mindfulness among people in general by support in revives, walkathon, commending world natural day, water day, untamed life day and so on. The endeavors can be better accomplished by taking participation of neighborhood NGOs, town people groups, undergrads and so on. Further, the exploration sharpens that the ecological mindfulness and practices on everyday existence of youthful understudies makes them social duty in greening the nature and protection of biodiversity. The present National Green Corps, Eco-clubs and other comparative clubs in schools need to fortified for better practices and ecological worry by designating at any rate one natural master as educator in each school, this will empower to prepare the understudies progressively self centered towards ecological issues and tending to the issues with cautious options in their day by day life. The investigation expounds there is better extension for ecological insurance exercises among the school understudies the same number of schools have been advancing green greenhouses, nature strolls, patio cultivating, Vermicomposting of nourishment and natural strong squanders in schools, thoughtfulness to advance welfare on creatures and safe transfer of natural and inorganic waste materials including plastics. The commitment of youth volunteers, nearby NGOs are up and coming for helping mass ecological mindfulness through school understudies in the general public. The successful preparing on the understudies for Vermicomposting, Solid waste transfer and waste paper banking and so forth at the school level will yield better outcomes and make them to pursue such practice as normal in schools and their homes for manageability.

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CONSTRAINTS FACED BY THE FARMERS IN THE ADOPTION OF ORGANIC FARMING PRACTICES

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ABSTRACT
Green revolution in India has witnessed a jump in agricultural production with the introduction of high yielding varieties of various crops and by following intensive cultivation practices with the use of fertilizers, pesticides and other inorganic inputs. Organic agriculture is a holistic food production system works with the sustainable use of locally available natural resources. The need to adopt a comprehensive approach for the promotion of organic agriculture by taking cooperation of all stakeholders, environmental friendly technologies, marketing infrastructure and financial support environmentally friendly for quality and quantity organic food production. An environmentally sustainable system of agriculture like organic agriculture will be able to maintain a resource balance, avoid over exploitation of resources, conserving soil natural quality and soil health and biodiversity. Biological research into soil and soil organisms has proven beneficial to organic farming. Varieties of bacteria and fungi break down chemicals, plant matter and animal waste into productive soil nutrients. In turn, they produce benefits of healthier yields and more productive soil for future crops. Keeping in mind the study was undertaken to assess the constraints faced by the farmers in the adoption of organic farming practices in Krishnagiri district of Tamil Nadu state. Results indicated that among the physical constraints, the foremost physical constraints expressed by vast majority of the respondents was inundation due to labour scarcity (80.00 per cent). Among the communication constraints, the foremost communication constraints expressed by most of the respondents where lack of training (85.00 per cent).

INTRODUCTION
Agriculture in developing countries must undergo a significant transformation in order to meet the related challenges of achieving food security and responding to climate. Projections based on population growth and food consumption patterns indicate that agricultural production needs to increase by at least 70 percent to meet demands by 2050.Most estimates also indicate that climate change is likely to reduce agricultural productivity, production stability and incomes in some areas that already have high levels of food insecurity. In this scenario organic farming is thus considered to achieving future food security.

Organic farming "is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic agriculture systems rely upon crop rotations, crop residues, animal manure, legumes, green manure, off-farm organic wastes, mechanical cultivation, mineral bearing rocks, and aspects of biological pest control to maintain soil productivity, tilt, to supply plant nutrients, and to control insects, weeds, and other pests". (USDA,1980).

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including bio-diversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using wherever possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system.

Organic farming system in India is very old and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by the use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio fertilizer) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment. Some of organic farming practices are (i) application of bio-fertilizer like rhizobium, azospirillum, BGA, etc.., (ii) green manure like sunhemp, daincha, (iii) vermicompost (vi) crop rotation, mixed farming, (v) FYM application (Ajithkumar 2000).

METHODOLOGY
The present study was undertaken to assess the constraints faced by the farmers in the adoption of organic farming practices in Krishnagiri district of Tamil Nadu state. A sample size of 120 respondents were fixed for the study considering the limitations of time and other resources of the student researcher. List of farmers in the ten selected villages were obtained from the office of the Assistant Director of Agriculture, Bargur. A total number of 120 respondents were identified from the selected 10 villages by using proportionate random sampling method. The constraints faced by the farmers during the adoption of organic farming practices were listed during the pilot survey. The constraints were classified under four sub-headings namely physical

ISSN 2394 - 7780

constrains, communication constraints, personal constraints and socio-economic constraints. A well structured interview schedule was used for the collection of data.

FINDINGS AND DISCUSSION

This section deals with the constraints as experienced by the farmers for their non-adoption of organic farming practices in crop cultivation.

In accordance with the objectives, the constraints experienced by the respondents in the adoption of organic farming practices are presented under four heads namely, (a) physical constraints, (b) communication constraints, (c) personal constraints, (d) socio-economic constraints, The results are presented in Table 1.

PHYSICAL CONSTRAINTS

Regarding the physical constraints, labour scarcity (80.00 per cent) was the primary constraint expressed by most of the respondents and ranked first followed by the non availability of inputs (78.00 per cent), poor quality of inputs (70.00 per cent) and planning about the purchase and application inputs (67.00 per cent).

Agriculture labourers being seasonal, there is a shortage of labour during peak season. The migration of the labour from agriculture to other occupations and to other sectors has also contributed the labour problem. Hence, majority of the respondents have ranked it as the most serious constriaint. The findings derived from the findings of Sathish Kumar (2015).

Table 31. Constraints faced by the farmers in the adoption of organic farming practices (n=120)

S. No	Constraints	Per cent	Rank
I.	**Physical constraints**		
1.	Labour scarcity	80	I
2.	Non-availability of inputs	78	II
3.	Poor quality of inputs	70	III
4.	Lack of advanced planning about the purchase and application	67	IV
II.	**Communication constraints**		
1.	Lack of training on organic farming.	85	I
2.	Inability to attend training programmes	85	II
3.	Lack of information from change agents	81	III
4.	Weak extension service	76	IV
5.	Details given by change agents could not be understood	40	V
III.	**Personal Constraints**		
1.	Lack of knowledge to identify bio-agents	88	I
2.	Not conviced with the practices	79	II
3.	Lack of knowledge to identify pest and diseases	75	III
4.	Difficulty in using organic manure	66	IV
IV.	**Socio-economic constraints**		
1.	Lack of credit facilities	81	I
2.	High cost of labour	60	III
3.	High rate of interest	44	IV
4.	High costs of inputs	83	II

COMMUNICATION CONSTRAINTS

Lack of training on organic farming (85.00 per cent) was the most seriously felt communication constraints expressed by majority of respondents followed by inability to attend training programmes (85.00 per cent), lack of information from change agents (81.00 per cent), week extension service (76.00 per cent) and details given by change agent could not be understood (40.00 %)

Lack of training was the most important physical constraint. Trainings on purely organic farming were less.

Only few trainings were conducted by state department of Agriculture in the village itself, majority of the programmes were held at distance places and also involvement in field operations due to lack of labour, coinscidence of training with peak season etc., would have made it difficult for majority of the respondents to attend the training programmes.

ISSN 2394 - 7780

Lack of information from the change agent was the another major communication constraint. Majority of the respondents expressed that they did not come across any extension worker from the government development department. Lack of adequate staff and their occasional vists to the villages would have made the respondents to report this as one of the major constraints.

PERSONAL CONSTRAINTS

Lack of knowledge to identify bio-agents (88.00 per cent) was the foremost personal constraints expressed by majority of the farmers followed by the constraints such as not convienced with the practice (71.00 per cent) and lack of knowledge to identify the pest and diseases (75.00 per cent) were the personal constraints reported.

Majority of the respondents had lack of knowledge on the bio-control agents and no proper orientation by way of training have been given for their benefit. Organic farming depends more on the locally available practices with the use of locally and freely available raw materials and inputs. Organic approaches took greater gestation periods and with hidden benefits. So, the yield of crops may reduce and given a great economic to them. So, they are not having conviction about the organic farming practices.

Organic farming inputs like organic manure, green manure, green leaf manure are required in large quantities, when compared to chemical fertilizers and this creates the problem of difficulty in using organic manure by the trained organic farmers.

SOCIO-ECONOMIC CONSTRAINTS

High cost of inputs (83.00 per cent) was the major socio-economic constraint followed by lack of credit facilities (81.00 per cent). High cost of labour (60.00 per cent) and high rate of interest (44.00 per cent) were felt as the socio-economic constraints by the respondents.

Most of the organic farmers who are in need of money for crop cultivation, obtained money from moneylenders and from big farmers only. Absence of adequate institutions like agricultural banks, co-operative society etc., and rigid rules regulations might be the reasons why farmers could not get money needed.

CONCLUSION

Among the physical constraints, the foremost physical constraints expressed by vast majority of the respondents was inundation due to labour scarcity (80.00 per cent). Among the communication constraints, the foremost communication constraints expressed by most of the respondents where lack of training (85.00 per cent). Among the personal constraints, the foremost personal constraints expressed by most of the respondents were lack of knowledge to identify bio-agent (88.00 per cent). Among the socio-economic constraints, the foremost socio-economic constraints expressed by majority of the respondents was high cost of inputs (83.00 per cent). The effective utilization of mass media like radio, television, news paper and farm magazines is extent there for creating wider dissemination of the organic farming practices.

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PRESSURES AND BARRIERS EXPERIENCED BY RURAL WOMEN ENTREPRENEURS ENGAGED IN POULTRY FARMING

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ABSTRACT
A study was conducted to determine the pressures and barriers experienced by the rural farm women associated with poultry farming in Namakkal district of Tamil Nadu. Ex-post facto research design was used for the investigation. Out of the seven taluks viz. Namakkal, Rasipuram, Tiruchengode, Paramathi Velur, Kolli Hills, Senthamangalam and Komarapalayam in Namakkal district, Namakkal taluk was purposively selected based on maximum number (368) of poultry units. A total sample of 120 women poultry farmers was randomly selected through Simple Random Sampling (SRS) technique. Combining raising of home and business is stupendous task, high death rate at outbreak of diseases, shortage of labours, high rate of labours and high rate of poultry feed were felt as the main pressures and barriers experienced by the women poultry entrepreneurs.

Keywords: Women Poultry Farmers / Poultry Farm Women / Women Poultry Entrepreneurs, Pressures and Barriers

INTRODUCTION

Agriculture and livestock enterprises are two main supports on which the entire structures of rural life rest in India. Indian agriculture has been dominated by the belief that its base is crop production. After achieving self-sufficiency in cereal production, attention is now needed to be given on nutritional security and economic access to food. Also the focus should be shifted from the quantity to quality in the daily diet by enhancing the intake of animal protein which is the major source that is rich in milk, egg and meat.

Now people are realising that the poultry is not only the important from the nutritive value in human diet but it also provides additional income and job opportunity to a large number of rural population. During the past decades, our poultry has transformed from a backward activity into a modern, scientific and vibrant industry driven by technology. At present, India has emerged as the fifth largest egg producer in the world.

States of Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and western region of Maharashtra account for more than 56 per cent of total national egg production in the country. Tamil Nadu holds the lions share by being second in the country's egg production by producing about 4400 million eggs per annum. Though the male members are concentrating on the poultry, the efforts taken by the female members are noteworthy and to be applauded. However, there are certain pressures and barriers that could nullify the efforts of these women entrepreneurs to reach the higher level of performance. Keeping the above facts in view, the present study was carried out.

RESEARCH METHODOLOGY

The present study was carried out in Namakkal district of Tamil Nadu. Namakkal district comprises of seven taluks namely Namakkal, Rasipuram, Tiruchengode, Paramathi Velur, Kolli Hills, Senthamangalam and Komarapalayam. Out of these, Namakkal taluk (368 poultry units, as per 2011 census) alone having the maximum poultry units was selected. Namakkal in Tamil Nadu, the egg town has an area around 200 sq.km, glisten well by contributing 80 % to the egg production. Namakkal accounts for 90 % of the total egg exports from the country. Thus, this area alone has an overall daily turnover of Rs.170 to 200 million (US$3.4 to 4.0 million) from poultry industry. One lakh people are employed either directly or indirectly in this industry.

Through the list obtained from the Tamil Nadu Egg Poultry Farmers Federation (TNEPFF), Namakkal a total sample of 120 rural women poultry entrepreneurs engaged in

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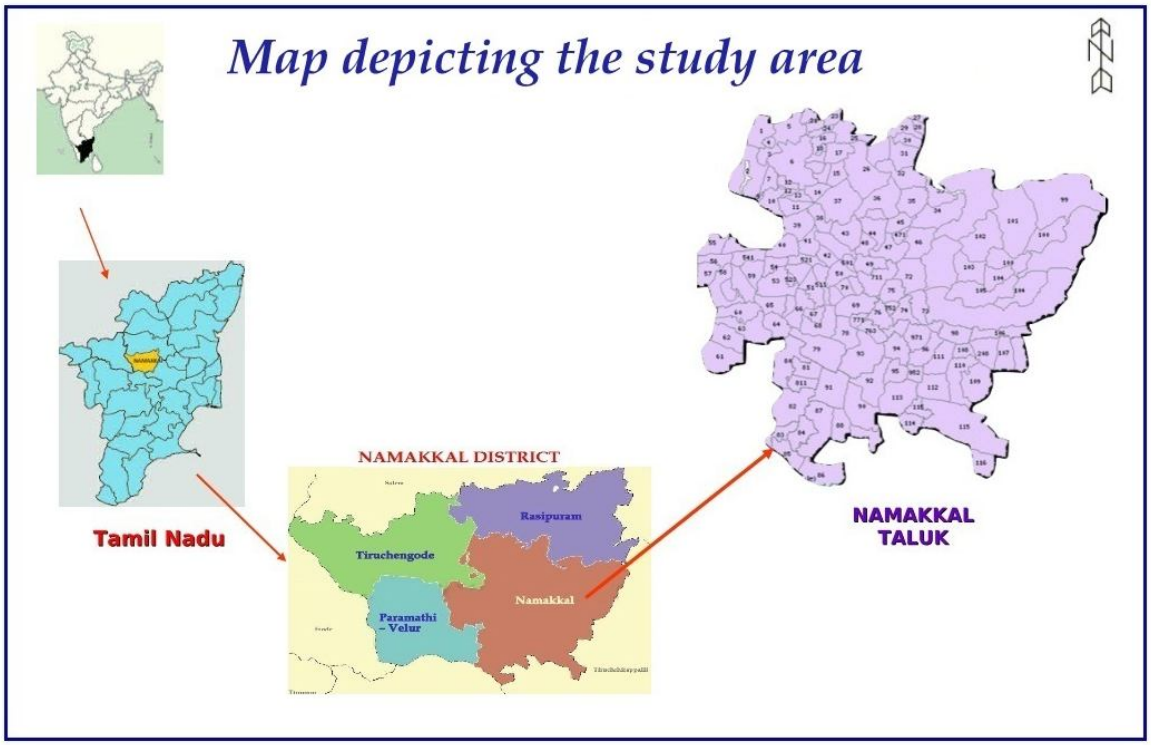

layer poultry farming were randomly selected. Their responses were collected through pre-tested well structured interview schedule. The respondents were contacted at their home or at their poultry farm. The data of this study were collected through personal interview. The collected data were classified, tabulated, analyzed and interpreted in order to make the findings meaningful.

The pressures and barriers experienced by the respondents while managing the poultry enterprise were collected. The frequency and percentages were calculated for each pressure and barrier. Considering the pressures and barriers faced by the women poultry farmers in operating poultry enterprise, the respondents were asked to give their valuable suggestions for each barrier. Their responses regarding each suggestion were recorded and presented with the help of frequency and percentage. Then those percentages were ranked according to their influence. Ex-post-facto research design was applied for the study. The statistical tool arithmetic mean was used for ranking the pressures and barriers.

FINDINGS AND DISCUSSION

The pressures and barriers faced by the women poultry entrepreneurs are given in Table 1.

It could be seen from the Table 1 that major constrains faced by the women poultry farmers were: 'combining raising of home and business is stupendous task (3.60)', 'high

Table 1: Distribution of respondents according to their pressures and barriers experienced in poultry farming (n=120)

Sl. No.	Pressures and barriers	Mean score	Rank
1.	Combining raising of home and business is stupendous task	3.60	I
2.	High death rate at outbreak of diseases	3.58	II
3.	Shortage of labours	3.50	III
4.	High rate of labours	3.45	IV
5.	High rate of poultry feed	3.42	V
6.	Limited mobility	3.40	VI
7.	Lack of high producing breeds	3.38	VII
8.	Lower and fluctuating price of eggs	3.36	VIII
9.	Discrimination from the society	3.35	IX
10.	High cost of poultry implements	3.32	X
11.	Lack of self confidence	3.30	XI
12.	Unavailability of diseases resistant breeds	3.28	XII

ISSN 2394 - 7780

13.	High interest on bank loans	3.25	XIII
14.	High cost of day old chick	3.20	XIV
15.	Water scarcity	3.15	XV
16.	Limited managerial ability	3.10	XVI
17.	Insufficient knowledge of poultry production technology	3.05	XVII
18.	High rate of vaccine and medicines	3.00	XVIII
19.	Inferior quality of poultry feed	2.95	XIX
20.	Low prices of cull birds	2.92	XX

death rate at outbreak of diseases (3.58)', 'shortage of labours (3.50)', 'high rate of labours (3.45)', 'high rate of poultry feed (3.42)', 'limited mobility (3.40)','lack of high producing breeds (3.38)', 'lower and fluctuating price of eggs (3.36)', 'discrimination from the society (3.35)', 'high cost of poultry implements (3.32)', 'lack of self confidence (3.30)', 'diseases resistant breeds (3.28)', 'high interest on bank loans (3.25)', 'high cost of day old chick (3.20)', 'water scarcity (3.15)', 'limited managerial ability (3.10)', 'insufficient knowledge of poultry production technology (3.05)', 'high rate of vaccine and medicines (3.00)', 'inferior quality of poultry feed (2.95)' and 'low prices of cull birds (2.92)'.

In nutshell, combining raising of home and business is stupendous task, high death rate at outbreak of diseases, shortage of labours, high rate of labours , high rate of poultry feed , 'limited mobility and lack of high producing breeds were the major constrains faced by the women poultry farmers. More or less similar findings were reported by Patel *et.al.* (2017).

SUMMARY AND CONCLUSION

From the above study, it could be summarized that the major pressures and barriers experience by the women poultry farmers were: combining raising of home and business is stupendous task, high death rate at outbreak of diseases, shortage of labours, high rate of labours and high rate of poultry feed with mean scores of 3.60, 3.58, 3.50, 3.45 and 3.42, respectively, which could be overcome by obtaining suitable suggestive measures from them.

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A STUDY ON THE UTILIZATION BEHAVIOUR OF ECO-FRIENDLY AGRICULTURAL PRACTICES IN PADDY AND BANANA IN ERODE DISTRICT

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ABSTRACT
An eco-friendly technology may be defined as the use of knowledge and resources in a systematic way to produce desired output without harming the environment. The term "eco-agriculture" was coined by Charles Walters, economist, author, editor, publisher and founder of Acres Magazine in 1970 to unify under one umbrella the concepts of 'ecological' and 'economical' in the belief that unless agriculture was ecological it could not be economical. This belief becomes the motto of the magazine: "To be economical agriculture must be ecological."Eco-agriculture is both a conservation strategy and a rural development strategy. A study was conducted in Erode district to study the utilization of eco-friendly agricultural practices. The findings shows that the mean value of eco-friendly farming practices in harvest was 85.83.Majority (90.00 per cent) of the respondents had utilized right stage of harvesting and more than four fifth (81.66 per cent) of the respondents utilized the practices of harvesting at 80 per cent grain maturity.

INTRODUCTION
An eco-friendly technology may be defined as the use of knowledge and resources in a systematic way to produce desired output without harming the environment. The term "eco-agriculture" was coined by Charles Walters, economist, author, editor, publisher and founder of Acres Magazine in 1970 to unify under one umbrella the concepts of 'ecological' and 'economical' in the belief that unless agriculture was ecological it could not be economical. This belief becomes the motto of the magazine: "To be economical agriculture must be ecological." Eco-agriculture is both a conservation strategy and a rural development strategy. Eco-agriculture recognizes agricultural producers and communities as key stewards of ecosystems and biodiversity and enables them to play those roles effectively. Eco-agriculture applies an integrated ecosystem approach to agricultural landscape to address all the three pillars – conserving biodiversity, enhancing agricultural production and improving livelihood – driving the divers' elements of production and conservation management systems. The core of this ecological-based farming is ensuring that business or agricultural activity is consistent with the natural functions of ecosystems, where for instance, the cycle of soil nutrients and biodiversity structure are maintained so as to create a system of agriculture that is resistant to pests and has self-maintained natural soil nutrients. Thus, farmers will no longer depend on costly chemicals and artificial pest control.

METHODOLOGY
In the present study extent of utilization pattern of eco-friendly farming practices of paddy, banana, and sugarcane crops by the farmers in their own field. An index was developed to determine the extent of utilization pattern in relation to eco-friendly farming practices by the farmers. The index consisting of 48 statements which cover all the important components of eco- friendly farming practices namely soil conservation, water conservation, seed management, integrated weed management, integrated disease and pest management and integrated nutrient management practices. The maximum obtainable score was 96 and minimum score was 48. The responses of respondents were asked to give name of practices used by them. On the basis of score obtained by them, respondents were categorized in to three categories viz low, medium and high based on the cumulative frequency.

FINDINGS
Results of distribution of respondents according to their overall utilization of eco-friendly farming practices are presented in following Table-1.

Table-1.Distribution of respondents according to their overall utilization level of eco-friendly farming practices (n=120)

S.No	Category	Respondents	
		Number	Per cent
1.	Low	32	26.67
2.	Medium	52	43.33

ISSN 2394 - 7780

3.	High	36	30.00
Total		**120**	**100.00**

The Table-1 shows that nearly half (43.33 per cent) of the respondents had medium level of utilization pattern of eco-friendly farming practices. The respondents under high and low levels of utilization category were (30.00 per cent) and (26.67 per cent), respectively. The reason for the respondents under medium level of utilization may be due to the effect of training programme conducted by state department of agriculture which might have motivated the respondents to utilize the eco-friendly farming practices.

DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR PRACTICEWISE UTILIZATION OF ECO-FRIENDLY FARMING PRACTICES IN PADDY CULTIVATION

Results of distribution of respondents according to their practicewise utilization of eco-friendly farming practices in paddy cultivation are given in Table-2.

Table-2.Distribution of respondents according to their practicewise utilization of eco-friendly farming practices in paddy cultivation (n=120)

S. No	Eco-friendly farming practices	Number of respondents	Per cent
I	NURSERY MANAGEMENT		
1.	Quantity of farmyard manure/compost	66	55.00
2.	Separation of quality seeds	100	83.33
3.	Breaking seed dormancy	36	30.00
4.	Keeping seeds in wet gunny bags in darkness for 24 hours to facilitating for seeds sprouting	44	36.66
5.	Sun drying of seeds	98	81.66
6.	Seed treatment with azospirillum	62	51.66
7.	Seed treatment with pseudomonas	56	46.66
8.	Flooding of nursery field to control nursery pests.	90	75.00
	Mean		57.49
II	MAIN FIELD		
A	Transplanting		
9.	Transplanting seedlings at the right age	84	70.00
10.	Quantity of azospirillum for seedling treatment	56	46.66
11.	Spacing in transplanting	62	51.66
12.	Transplanting of the seedlings at the same day of picking the seedlings.	68	56.66
	Mean		56.24
B	Bio –fertilizers		
13.	Seedling dip with azospirillum /5 packets (200 gm each) per hectare	46	38.33
14.	Azospirillum broadcast/10 packets (200g)/hectare	52	43.33
	Mean		40.83
C	Organic Manure		
15.	Application of FYM/ compost 12.5 tonnes per hectare	56	46.66
16.	Application of green manure /6.25 tonnes per hectare	52	43.33
17.	Integrated nutrient management	36	30.00
	Mean		39.99
D	Water management		
18.	Maintaining 1.5 – 2.5 cm water depending on seedling height	54	45.00
	Mean		45.00
E	Weed management		
19.	Summer ploughing	74	61.66
20.	Proper composting	82	68.33

ISSN 2394 - 7780

21.	Usage of clean seeds	114	95.00
22.	Trimming and plastering of bunds	88	73.33
	Mean		74.58
F	Eco–friendly pest and disease management		
	1) Mechanical practices		
23.	Alternate wetting and drying	64	53.33
24.	Use of pheromone trap	22	18.33
25.	Trimming and plastering of bunds	88	73.33
	Mean		48.33
	2) Biological pest control		
26.	Use of Trichogramma chinensis	26	21.66
27.	Use of Trichoderma viride	28	23.33
	Mean		22.49
	3) Neem products		
28.	Neem oil spray at 3 per cent	46	38.33
29.	Neem kernel extract at 5 per cent	54	45.00
	Mean		41.66
G	Rodent management		
30.	Tanjore trap	44	36.66
31.	T-shaped bird perches	54	45.00
	Mean		40.83
H	Harvest		
32.	Right stage of harvesting	108	90.00
33.	Harvesting at 80 per cent grain maturity stage	98	81.66
	Mean		85.83

I. NURSERY MANAGEMENT

The mean value of eco-friendly farming practices in nursery management was 56.29.Majority (83.33 per cent) of the respondents had highly utilized the separation of quality seeds followed by sun drying of seeds (81.66 per cent), flooding of nursery field to control nursery pests (75.00 per cent), quantity of farmyard manure/compost (55.00 per cent), seed treatment with azospirillum (51.66 per cent), seed treatment with pseudomonas (46.66 per cent), use of recommended quantity of seeds (46.66 per cent), keeping seeds in wet gunny bags in darkness for 24 hours to facilitate sprouting of seeds (36.66 per cent) and breaking seed dormancy (30.00 per cent).Majority of the respondents had highly utilized the separation of quality seeds (83.33 per cent). This might be due to fact that availablility of quality seeds in the state department of agriculture and private dealers may be the reason for higher level of utilization pattern.

II. MAIN FIELD

TRANSPLANTING

The mean value of eco-friendly farming practices in transplanting was 56.24. Majority (70.00 per cent) of the respondents had utilized the transplanting seedlings at the right age, transplanting of the seedlings at the same day of picking the seedlings (56.66 per cent), spacing in transplanting (51.66 per cent) and quantity of azospirillum for seedling treatment (46.66 per cent).More than two-third (70.00 per cent)of the respondents had utilized transplanting seedlings at the right age because the respondents were aware about this practice.

BIO –FERTILIZERS

The mean value of eco-friendly farming practices in bio-fertilizers was 40.83.More than two-fifth (43.33 per cent) of the respondents had highly utilized azospirillum broadcast 10 packets (200 gm each) per hectare and seedling dip with azospirillum 5 packets (200 gm each) per hectare (38.33 per cent). The bio-fertilizers are easily available on near by agriculture office. The assistant agricultural officer provide the bio-fertilizer directly on the farmers field.

ORGANIC MANURE

The mean value of eco-friendly farming practices in organic farming was 39.99.Nearly half(46.66 per cent)of the respondents had highly utilized application of FYM/ compost 12.5 tonnes per hectare, application of green manure 6.25 tonnes per hectare (43.33 per cent) and integrated nutrient management (30.00 per cent). This might be due to fact that the respondents were little aware about soil and environmental health may be the reason for moderate level of utilization.

ISSN 2394 - 7780

WATER MANAGEMENT

The mean value of eco-friendly farming practices in water management was 45.00.Nearly half (45.00 per cent) of the respondents had utilized maintaining 1.5 – 2.5 cm water depending on seedling height. This is in line with the findings of Suji (2012).

WEED MANAGEMENT

The mean value of eco-friendly farming practices in weed management was 74.58. Majority (95.00 per cent) of the respondents had utilized usage of clean seeds followed by (73.33 per cent) trimming and plastering of bunds, proper composting (68.33 per cent) and summer ploughing (61.66 per cent). This might be due to fact that most of the respondents were literate and known the advantage of summer ploughing and usage of clean seeds so that weed infestation can be controlled may be the reason for higher level of utilization.

ECO–FRIENDLY PEST AND DISEASE MANAGEMENT

MECHANICAL PRACTICES

The mean value of eco-friendly farming practices in mechanical practices was 48.33. Nearly three-fourth(73.33 per cent)of the respondents had highly utilized trimming and plastering of bunds followed by alternate wetting and drying (53.33 per cent) and use of pheromone trap (18.33)to control the pests in the paddy field.

BIOLOGICAL PEST CONTROL

The mean value of eco-friendly farming practices in biological pest control was 22.49.Nearly one fourth (23.33 per cent) of the respondents had highly utilized use of Trichoderma viride and use of Trichogramma chinensis (21.66 per cent). This may be due to the reason that the respondents were aware about the biological pest control practices. This awareness is created by the state department of agriculture.

NEEM PRODUCTS

The mean value of eco-friendly farming practices in neem products was 41.66.Nearly half (45.00 per cent) of the respondents had utilized Neem kernel extract at 5 per cent and Neem oil spray at 3 per cent (38.33 per cent). Now a days most of the farmers were aware about the consequences of chemical pesticides and they are changing the life style of food habits So the respondents utilized the neem based products.

RODENT MANAGEMENT

The mean value of eco-friendly farming practices in rodent management was 40.83.Nearly half (45.00 per cent) of the respondents had highly utilized T-shaped bird perches and Tanjore trap (36.66 per cent).The T-shaped bird perches are easy to use and very less expense could be the reason for the utilization of bird perches and they easily and quickly control the rodents in paddy field This may be the reason for more number of farmers utilized this practice.

HARVEST

The mean value of eco-friendly farming practices in harvest was 85.83.Majority (90.00 per cent) of the respondents had utilized right stage of harvesting and more than four fifth (81.66 per cent) of the respondents utilized the practices of harvesting at 80 per cent grain maturity.

Distribution of respondents according to their practicewise utilization level of respondents on eco-friendly farming practices in banana cultivation

Results of distribution of respondents according to their practice wise utilization of eco-friendly farming practices in banana cultivation are given in Table-3.

It could be noted from Table-3 that the utilization level of eco-friendly farming practices of banana mean value was 45.66. Around three-fifth(60.00 per cent)of the respondents utilized the farming practice of banana suckers are allowed to wilt in the shade for few days before planting for good germination, the utilization behaviour of different eco-friendly farming practices in banana are as follows castor cake is applied 3-4 weeks before harvesting which improves the size, weight and luster of the fruits (50.00 per cent), the banana bunches are arranged in compact manner in a room with fumigation for quick ripening (48.33 per cent), for getting yellow coloured banana, bunches are treated with ash and water (40.00 per cent), and about two to three weeks before harvesting, a tin filled with castor oil is kept over the water channel in such a fashion that drops of oil fall into running water supplied to the banana trees improve the soil and weight and luster of the fruits (30.00 per cent).Banana suckers are allowed to wilt in the shade for few days before planting for good germination (60.00 per cent) because the farmers are highly aware and continuously practicing this practice now a days.

ISSN 2394 - 7780

Table-3.Distribution of respondents according to their practicewise utilization of eco-friendly farming practices in banana cultivation (n=120)

S. No	Eco-friendly farming practices	Number of respondent	Per cent
1.	Banana suckers are allowed to wilt in the shade for few days before planting for good germination.	72	60.00
2.	Castor cake is applied 3-4 weeks before harvesting which improves the size, weight and luster of the fruits.	60	50.00
3.	For getting yellow coloured banana, bunches are treated with ash and water.	48	40.00
4.	The banana bunches are arranged in compact manner in a room with fumigation for quick ripening.	58	48.33
5.	About two to three weeks before harvesting, a tin filled with castor oil is kept over the water channel in such a fashion that drops of oil fall into running water supplied to the banana trees improve the size, weight and luster of the fruits.	36	30.00
	Mean		**45.66**

CONCLUSION

This study clearly shows that majority of the farmers possess medium level of utilization of eco-friendly practices. This study has clearly indicated that the significant gain in utilization on eco-friendly technologies on account of the trainings.

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AN ECONOMIC ANALYSIS ON TECHNICAL EFFICIENCY OF GROUNDNUT FARMS IN THIRUVANNAMALAI DISTRICT OF TAMIL NADU

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ABSTRACT
Groundnut being one of the traditional oilseed crop showing declining trend in area .In this situation, attaining self-reliance in the groundnut sector is paramount importance. At this juncture,this study was undertaken with the following specific objectives: (i) to examine the production efficiency of groundnut farms in the study area and (ii)to offer policy suggestions based on the study. Thiruvannamalai district of Tamil Nadu was selected purposively because of its highest position (1st rank) in area and production of groundnut among all the districts of Tamil Nadu. From this district, two blocks one with maximum productivity (Pudupalayam block) and another block with minimum productivity (Cheyyar block) were selected for the study. Five villages were selected from each block at random keeping total sample size as 120 for each block, the sample farmers were selected using probability proportionate random sampling technique from the selected villages. The estimated mean technical efficiency (MTE) of irrigated groundnut in Pudupalayam block and Cheyyar block were 83 per cent and 79 per cent respectively. It indicated that the sample farms, on an average could increase the output of irrigated groundnut by 17 per cent in Pudupalayam block and 21 per cent in Cheyyar block through the proper adoption of technology without the additional use of resources. The estimated mean technical efficiency (MTE) of rainfed groundnut in Pudupalayam block and Cheyyar block were 80 per cent and 78 per cent respectively. It indicated that the sample farms, on an average could increase the output of rainfed groundnut by 20 per cent in Pudupalayam block and 22 per cent in Cheyyar block through the proper adoption of technology without the additional use of resources. The study showed that the education level and extension agency contact of irrigated and rainfed groundnut farmers in both the blocks were influenced the technical efficiency of the sample farmers in the study area which would indicate that the frequent contact with extension agencies might increase the yield of groundnut. Further, it could be observed that educated farmers are more efficient than other farmers.

Keywords: Economic analysis,Irrigated Groundnut, Mean technical efficiency, Rainfed groundnut, Production efficiency.

INTRODUCTION
Groundnut is called as the “King of oil seeds”. It is one of the most important food and cash crops of our country. While being a valuable source of all the nutrients, it is a low-priced commodity. Groundnut is also called as wonder nut and poor men’s cashew nut. India is the second largest producer of groundnut after China. Groundnut is the largest oil seed in India in terms of production. Gujarat was the largest groundnut producer followed by Tamil Nadu. Cost of cultivation of groundnut was very high in Tamil Nadu compared to other major groundnut producing states. Groundnut being the major oilseed crop in Tamil Nadu covers 0.69 million hectares of land with an out turn of 1.09 million tonnes .Tamil Nadu ranks first in the productivity of groundnut in India (1784 kgs/ha).In Tamil Nadu, the maximum area under groundnut was in Thiruvannamali District (94763 ha) followed by Villupuram (59000 ha) and Vellore (56000 ha).

Groundnut being one of the traditional oilseed crop showing declining trend in area. It was found that groundnut area drastically reduced with an overall growth rate of -0.26, The studies showed that trade liberalization affects domestic price structure through price transmission and it affects our farmers drastically. In this situation, attaining self-reliance in the groundnut sector is paramount importance. To achieve the self-reliance in this sector in the coming years, this study was undertaken with the following specific objectives: (i) to examine the production efficiency of groundnut farms in the study area and (ii)to offer policy suggestions based on the study.

The hypothesis framed for the respective specific objective is

(i) There is high variation in technology adoption in groundnut cultivation among the farmers of the study area.

ISSN 2394 - 7780

SAMPLING DESIGN

SELECTION OF THE STUDY AREA

Thiruvannamalai district of Tamil Nadu was selected purposively because of its highest position (1st rank) in area and production of groundnut among all the districts of Tamil Nadu. Having selected the district purposively, all the 18 blocks in the district were arranged in the descending order based on yield per hectare of groundnut. Out of this, two blocks one with maximum productivity (Pudupalayam block) and another block with minimum productivity (Cheyyar block) were selected for the study. Five villages were selected from each block at random keeping total sample size as 120 for each block, the sample farmers were selected using probability proportionate random sampling technique from the selected villages.

COLLECTION OF DATA

A pilot survey of the groundnut farmers selected for this study was undertaken with a view to gain an insight into the physical and economic environment. Subsequently, the survey schedule was prepared, pre-tested for its adequacy to collect the needed data and then adopted. Survey method of data collection was followed to gather the needed information from sample farmers.

TOOLS OF ANALYSIS

The collected data were coded, classified, processed and presented in order to bring out generalization of facts from which meaningful inference could be drawn.

TECHNICAL EFFICIENCY

Aigner, Loveall and Shemidt (1977) and Meeusen and Van den Broeck (1977) independently proposed the estimation of a stochastic frontier production function, where noise is accounted for by adding a symmetric error term (u_i) to the nonnegative term to provide,

$$L_n(Y_i) = f(X_i;\beta) + \varepsilon_1;$$

$$\varepsilon_i = V_i - U_i; i = 1, N.$$

Where Y_i denotes production level, Xi is input and β is a vector of unknown parameter to be estimated. ε_i is the composed error term. V_i is independentely and identically distributed random error $N(0,\sigma_v^2)$. These are the factors outside the control of the firm. U_i is non-negative random variables which are independently and identically distributed as $N(0,\sigma_U^2)$. i.e., the distribution of U_i is half normal. $|U_i|>0$ reflects the technical efficiency relative to the frontier. $|U_i|=0$ for a firm whose production lies on the frontier and $|U_i|<0$ for a firm whose production lies below the frontier.

RESULTS AND DISCUSSION

CROPPING PATTERN OF THE SAMPLE FARMS

Any effort undertaken to increase productivity of crops would ultimately reflect in the cultivation aspects. Hence, the particulars of crops cultivated in the sample farms were analysed to find out the economic efficiency in the groundnut production. The normal cropping pattern followed by the sample farmers is given in Table.1.

Table.1 Cropping Pattern of the Sample Farms (Area in hectares)

Sl.No.	Crops	Pudupalayam Block		Cheyyar Block	
		Gross Area	Percentage to Total Area	Gross Area	Percentage to Total Area
1.	Groundnut	167.1	57.79	121.6	50.4
2.	Paddy	67.5	23.32	62.2	25.8
3.	Sugarcane	36.0	12.46	38.3	15.9
4.	Gingelly	10.6	3.68	11.0	4.6
5.	Others	8.0	2.75	8.3	3.4
	Total	289.2	100.00	241.3	100.00

A glance at the above table would reveal that groundnut was the major crop and occupied 57.79 per cent of the total area in Pudupalayam block and 50.40 per cent of the total area in Cheyyar block.

It could also be seen that Paddy and sugarcane also occupied considerable area to the total cultivated area. The percentage of area occupied by Paddy and sugarcane were 23.32 and 12.46 per cent respectively in Pudupalayam block where as they were 25.80 and 50.90 per cent respectively in Cheyyar block. Gingelly occupied 3.68 per cent area in Pudupalayam block and it was 4.60 per cent in Cheyyar block. Other crops

ISSN 2394 - 7780

including coconut, Sunflower, Grams etc. occupied 2.75 per cent area in Pudupalayam block and it was 3.4 per cent in Cheyyar block.

The Maximum likelihood estimates of the Cobb – Douglas model for the irrigated and rainfed groundnut farms in Pudupalayam and Cheyyar blocks are presented in Table .2 and 3.

Table.2. Maximum Likelihood Estimates of Stochastic Frontier Production Function of Irrigated Groundnut

Variables	Maximum Likelihood Estimates	
	Pudupalayam Block	Cheyyar Block
Constant (β_0)	4.9201 (1.9416)	4.7623 (1.8283)
Seed (β_1)	0.3215* (0.0426)	0.2912* (0.0439)
Human Labour (β_2)	0.1134** (0.0426)	0.0989** (0.0398)
Bullock Labour (β_3)	0.0211** (0.0621)	0.0203** (0.0421)
Machine Labour (β_4)	0.0081 (0.2319)	0.0062 (0.1387)
Manures and Fertilizers (β_5)	0.2148* (0.0182)	0.2067** (0.0208)
Plant Protection Chemicals (β_6)	0.0984** (0.0388)	0.0927** (0.0124)
$\sigma^2 = \sigma^2 u + \sigma^2 v$ (Total Variability)	0.22	0.16
$\sigma^2 u$ (Farmer Variability)	0.16	0.13
$\sigma^2 v$ (Random Variability)	0.08	0.05
Lamda = $\sigma u/\sigma v$	2.25	2.38
Gamma = $\sigma^2 u/\sigma^2$ (Variance ratio)	0.72	0.82
Log likelihood function	-79.21	-80.26
MTE= $\left[1 - \sigma u\left(2/3 .14\right)^{0.5}\right]$	83.28	79.14

Figures in parentheses indicate standard errors

** Significant at 5 per cent level

* Significant at 1 per cent level.

It could be observed from the table.2. that all the independent variables in the model for irrigated groundnut in both the blocks had positive coefficient and statistically significant except the machine labour which had positive coefficient but not statistically significant.

This would indicate that the increment of seed by one per cent would increase the output by 0.32 per cent in Pudupalayam block and 0.29 per cent in Cheyyar block. Similarly the increment of human labour and bullock labour by one per cent would increase the output by 0.11 per cent and 0.021 per cent in Pudupalayam block and 0.09 per cent and 0.02 per cent in Cheyyar block respectively.

Manures and fertilizers had good impact on yield in both the blocks. The increment of meanures and fertilizers by one per cent would increase the output by 0.21 per cent in Pudupalayam block and 0.20 per cent in Cheyyar block. Similarly the increment of plant protection chemicals by one per cent would increase the output by 0.1 per cent in Pudupalayam block and 0.09 per cent in Cheyyar block.

The estimated values of $\sigma^2 u$ and $\sigma^2 v$ were 0.16 and 0.08 for Pudupalayam block and they were 0.13 and 0.05 for Cheyyar block. These values indicated that the difference between observed output and frontier output was due to technical inefficiency of farms and not due to statistical variability.

The estimate of gamma, which measures the effect of technical inefficiency in output variation, was 0.72 per cent in Pudupalayam block and 0.82 per cent in Cheyyar block. The gamma values indicated that dominance of

ISSN 2394 - 7780

technical inefficiency over random effect, which attributed for the yield variation from the frontier output. The gamma value was high in Cheyyar block than Pudupalayam block. This revealed that the technical inefficiency was attributed as major reason for lesser productivity in Cheyyar block compared to Pudupalayam block.

The estimated mean technical efficiency (MTE) of irrigated groundnut in Pudupalayam block and Cheyyar block were 83 per cent and 79 per cent respectively. It indicated that the sample farms, on an average could increase the output of irrigated groundnut by 17 per cent in Pudupalayam block and 21 per cent in Cheyyar block through the proper adoption of technology without the additional use of resources.

Table.3.Maximum Likelihood Estimates of Stochastic Frontier Production Function of Rainfed Groundnut

Variables	Maximum Likelihood Estimates	
	Pudupalayam Block	**Cheyyar Block**
Constant (β_0)	5.2871 (1.8327)	5.0281 (1.3964)
Seed (β_1)	0.3817* (0.0761)	0.3918* (0.0619)
Human Labour (β_2)	0.1523** (0.0246)	0.1286** (0.0149)
Bullock Labour (β_3)	0.0281** (0.014)	0.0394** (0.0108)
Machine Labour (β_4)	0.0026 (0.0246)	0.0048 (0.2119)
Manures and Fertilizers (β_5)	0.2248** (0.1767)	0.2311** (0.0291)
$\sigma^2 = \sigma^2 u + \sigma^2 v$ (Total Variability)	0.26	0.25
$\sigma^2 u$ (Farmer Variability)	0.19	0.20
$\sigma^2 v$ (Random Variability)	0.03	0.07
Lamda = $\sigma u/\sigma v$	1.98	1.84
Gamma = $\sigma^2 u/\sigma^2$ (Variance ratio)	0.74	0.81
Log likelihood function	-78.21	-78.25
MTE = $\left[1 - \sigma u\left(\frac{2}{3}.14\right)^{0.5}\right]$	80.15	78.21

Figures in parentheses indicate standard errors

** Significant at 5 per cent level

* Significant at 1 per cent level.

It could be seen from the Table.3. that all the independent variables in the model for rainfed groundnut in both the blocks had positive coefficient and statistically significant except the machine labour which had positive coefficient but not statistically significant.

This would indicate that the increment of seed by one percent would increase the ouput by 0.38 per cent in Pudupalayam block and 0.39 percent in Cheyyar block. Similarly the increment of Human labour and bullock labour by one per cent would increase the output by 0.15 per cent and 0.03 per cent in Pudupalayam block and 0.13 per cent and 0.04 per cent in Cheyyar block respectively.

The increment of measures and fertilizers by one per cent would increase the output by 0.22 per cent in Pudupalayam block and 0.23 per cent in Cheyyar block.

The estimated values of $\sigma^2 u$ and $\sigma^2 v$ were 0.19 and 0.03 for Pudupalayam block and they were 0.20 and 0.07 for Cheyyar block. These values indicated that the difference between observed output and frontier output was due to technical inefficiency of farms and not due to statistical variability.

The estimate of gamma, which measures the effect of technical inefficiency in output variation was 0.74 per cent in Pudupalayam block and 0.81 per cent in Cheyyar block. The gamma values indicated that dominance of technical inefficiency over random effect, which attributed for the yield variation from the frontier output. The

ISSN 2394 - 7780

gamma value was high in Cheyyar block than Pudupalayam block. This revealed that technical inefficiency was attributed as major reason for lesser productivity in Cheyyar block compared to Pudupalayam block.

The estimated mean technical efficiency (MTE) of rainfed groundnut in Pudupalayam block and Cheyyar block were 80 per cent and 78 per cent respectively. It indicated that the sample farms, on an average could increase the output of rainfed groundnut by 20 per cent in Pudupalayam block and 22 per cent in Cheyyar block through the proper adoption of technology without the additional use of resources.

CONCLUSION

The study showed that the education level and extension agency contact of irrigated and rainfed groundnut farmers in both the blocks were influenced the technical efficiency of the sample farmers in the study area which would indicate that the frequent contact with extension agencies might increase the yield of groundnut. Further, it could be observed that educated farmers are more efficient than other farmers.

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EVALUATION OF SEEDLING CHARACTERS IN COTTON (Gossypium hirsutum L.) GENOTYPES UNDER SALINE CONDITION

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ABSTRACT
An experiment was carried out to investigate the germination and seedling characteristics of 10 cotton genotypes in Plant Breeding Farm during 2019. Observations were recorded on germination percentage, root and shoot length, fresh weight of seedlings, vigour index I, dry matter production and vigour index II were measured. Germination percentage was reduced by (43%) in SVPR 5 whereas higher percentage was recorded in SVPR 3 (85%). The characters like total seedling length, fresh weight and dry matter production showed maximum values in SVPR 2. Genotypes, SVPR 2 and CO 14 registered the maximum value for vigour index I and vigour index II. Cotton plants at emergence and young seedling stage are more sensitive to salt stress than at other stages, thus more attention should be paid to stand establishment, especially at the seedling stage when growing cotton on a saline soil. Hence, seed treatment with chemicals or biological agents also an effective alternative in improving salt tolerance in cotton.

Keywords: Salinity, Cotton genotypes , seedling characters.

INTRODUCTION
Cotton is one of the important cash crop in India and plays a dominant role in the industrial and agricultural economy of the country. Gujarat is the largest cotton producing state in India with a production of 125 lakh bales. In India, states of Maharashtra (26.63%), Gujarat (17.96%) and Andhra pradesh (13.75%) and Madhya pradesh are the leading cotton producing states (FAO STAT,2012). Most of cotton textile industry developed in Uttar Pradesh. Salinity is the common environmental problem in irrigated lands in arid and semi arid regions which results in poor or little crop production (Abrol, 1998). Salt and osmotic stresses are responsible for inhibition or delayed seed germination and seedling establishment (Almansouri *et al*., 2001). Germination is one of the salt sensitive plant growth stages and severely inhibited with increasing salinity (Sosa *et al*., 2005) while rapid seed germination and emergence is an important factor in crop establishment (Harris *et al*., 2000). The present study performed to investigate the effect of salinity on germination and seedling characteristics of fuzzy cotton seeds.

MATERIALS AND METHODS
An experiment was carried out to investigate the germination and seedling characteristics of cotton seeds in Plant Breeding Farm, Faculty of Agriculture, 2019 where soil is saline with electrical conductivity (EC) of 2.1 dsm^{-1} and pH 8.5. Genotypes *viz*., SVPR 3, MCU 7, SURAJ, SVPR 2, MCU 9, CO 14, MCU 5, SVPR 4, MCU 13 and SVPR 5 were taken as study materials and the fuzzy seeds of each genotype were sown at the rate of three seeds per hill with three replications. On 14^{th} day after sowing the evaluation was made with the following seedling characteristics:

Seed germination percentage
At the end of the germination period, the number of normal seedlings ,were counted and expressed as seed germination percent (ISTA, 2007).

Shoot and root length
In each of the treatments and replications,ten seedlings were selected at random and measured for root length (the length between the collar region to the tip of primary root in centimeter) and shoot length (the shoot length from the collar region to tip of the true leaves in centimetre)

Dry matter production
The seedlings used for measuring shoot and root length were shade dried and then dried in a hot air oven at 80±2°C for 24 hours and cooled in dessicators containing calcium carbonate and weighed in mg and reported as dry weight of ten seedlings.

Seedling vigour index
Vigour index values were computed adopting the following formula given by Abdul Baki and Anderson (1973) and the values were reported as whole number without unit.

Seedling vigour index I
$$Seed\ germination\ (\%) \times Total\ seedling\ length\ (cm).$$

ISSN 2394 - 7780

Seedling vigour index II

$$Germination\ (\%) \times Dry\ matter\ production.$$

STATISTICAL ANALYSIS:

The experimental design followed always completely randomized design with required replication for laboratory experiment and pot culture experiment respectively; whenever necessary the values expressed in percentage were transferred into Arc Sin values before analysis.The critical difference (CD) was worked out at 5% (P=0.05) level and whenever f value is non significant ,it is denoted by "NS".

RESULTS AND DISCUSSION

The effect of salinity on various seedling characters in cotton genotypes are presented in Table 1 and briefly discussed below:

Table 1: Effect of salinity on various seedling characters in cotton (*Gossypium hirsutum* L.) genotypes.

Variety	Germination (%)	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Fresh weight (gm)	Dry matter production ($gseedling^{-10}$)	Vigour index I	Vigour index II
SVPR 3	85	3.3	5.65	9	0.61	0.42	765	35.7
MCU 7	70	3.3	5	8.3	1.09	0.69	581	48.3
SURAJ	70	3.6	4.5	8.1	1.34	0.81	567	56.7
SVPR 2	79	3.6	6.83	10.5	1.54	1.00	829.5	79
MCU 9	58	1.6	7.3	9	1.06	0.77	522	44.66
CO 14	79	2.6	7.8	10.5	1.41	0.95	829.5	75.05
MCU_5	84	3.0	5.6	8.6	1.22	0.82	722.4	68.88
SVPR 4	73	2.0	4.16	6.16	0.87	0.62	449.68	45.26
MCU 13	58	1.6	5.5	7.16	1.21	0.87	415.28	50.45
SVPR 5	43	1.6	5.3	7	0.85	0.61	301	26.23

Germination percentage decreased by salinity upto 43% was noticed in SVPR 5 may be resulted from decreasing osmotic potential of salinity, increasing toxic ions and changing in the remobilization balance of seed reservoirs. This was in accordance with Xiao- Fang *et al*., 2001). Highest germination percentage was noticed in SVPR 3. Increased in shoot length was noticed in SVPR 2 whereas maximum shoot length was noticed in CO 14. At the same time seedling length was higher in two genotypes *viz*., SVPR 2 and CO 14 (10.5 cm) followed by MCU 9 (9cm). Parameters like fresh weight, dry matter production, vigour index I and vigour index II recorded maximum values in SVPR 2 followed by CO 14. The increase in root to shoot ratio may be due to higher cell wall extensibity and higher metabolic processes of roots at saline condition (Afzal *et al*., 2002).

Genotypes like SVPR 2, CO 14 and SVPR 3 registered the maximum value for almost all the seedling characters studied. Hence, these genotypes could be recommended for crop improvement under saline condition.

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INFLUENCE OF HERBICIDES ON GROWTH, YIELD, NUTRIENT UPTAKE AND ECONOMICS OF RICE CULTIVATION (Oryza sativa. L)

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ABSTRACT
Field experiments was conducted to evaluate the performance of integrated weed management practices in growth, yield, nutrient uptake and economics on transplanted rice (Oryza sativa. L) during Navarai and Kuruvai season 2014 at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University and at farmer's field Peruvarapur Village, Virudhachalam Taluk, Cuddalore District. The experiments consisted of fifteen treatments adopting in randomized block design and replicated thrice. The results revealed that early post emergence of Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT recorded higher plant height, LAI ,DMP, grain yield, straw yield and nutrient uptake by crop and lower uptake by weeds. The net return and benefit-cost ratio were also higher under the application of early post emergence of Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT .

Keywords : Rice crop, IWM, Growth ,Yield, Nutrient uptake, and Economics.

INTRODUCTION
Rice is one of the most important staple food crop of India which is cultivated under various ecosystems, *Viz*., transplanted, direct sown and rainfed situations. To meet the future food requirements of ever increasing population and maintain self sufficiency, the estimated rice production in India should be 350 million tonnes by 2020 AD. In transplanted rice, weed infestations not only reduce the grain yield up to 45% but also the quality of grain is also impaired. Mukherjee *et al*., (2008) noticed that 20-40 DAT were the most critical period of crop-weed competition and found that weedy situation throughout the crop growth caused yield reduction to the tune of 57 to 61% in transplanted rice.

Weed free period during the critical period of competition is essential for obtaining optimum rice yield. This can be achieved by removing weeds manually, mechanically and through chemical sprays or by their combinations. This can be achieved by removing weeds manually, mechanically and through chemical sprays or by their combinations. Manual weeding is although an effective and most common method, however, scarcity and high wages of labour particularly during peak period of agricultural operations make this method uneconomic. Further, mechanical method of weed management is also time consuming, cost intensive, much tedious and also does not remove all the weeds. Weed management through herbicide application may be the best suited option. It also saves valuable time by covering more area in short period and is also cost effective. Raising cost of labour and their reduced availability has led to search for alternative methods such as herbicide use either alone or in combination with manual or mechanical weeding. The integration of chemical followed by mechanical weeding are cheaper and effective than hand weeding alone (Ali and Bhanumurthy, 1985). The integrated weed management (IWM) thus can play a vital role in transplanted rice cultivation, in order to reduce dependence on excessive chemical use, avoid environmental pollution and reduce weeding costs.

MATERIALS AND METHODS
Experimental Site, Design and Layout
Field experiments were conducted during two seasons, *Viz*., Navarai and Kuruvai at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University and at farmer's field Peruvarapur Village, Virudhachalam Taluk, Cuddalore District with clayey loam soil having the pH of 7.5 and 6.7 in Navarai and Kuruvai seasons, respectively. The experiment was laid out in a randomized block design and replicated thrice.

Weed control treatments
The treatments were T_1 - Bispyribac sodium 100g / LSC 20g a.i. ha^{-1} 20 DAT, T_2 - Bispyribac sodium 100g / LSC 20g a.i. ha^{-1} + 1 Hand weeding at 40 DAT, T_3 - Bispyribac sodium 100g / LSC 20g a.i. ha^{-1} + TRRW at 40 DAT, T_4-Metsulfuron methyl + Chlorimuron ethyl @ 4g a.i. ha^{-1} 20 DAT, T_5 - Metsulfuron methyl + Chlorimuron ethyl @ 4g a.i. ha^{-1} + 1 Hand weeding at 40 DAT, T_6 - Metsulfuron methyl + Chlorimuron ethyl @ 4g a.i. ha^{-1} + TRRW at 40 DAT, T_7-Bensulfuron methyl + Pretilachlor @ 60g a.i. ha^{-1} 3 DAT, T_8 - Bensulfuron methyl + Pretilachlor @ 60g a.i. ha^{-1} + 1 Hand weeding at 40 DAT, T_9 - Bensulfuron methyl + Pretilachlor @ 60g a.i. ha^{-1} + TRRW at 40 DAT, T_{10} - Pyrazosulfuron ethyl @ 30g a.i. ha^{-1} 3 DAT, T_{11} - Pyrazosulfuron ethyl @ 30g a.i.

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ha^{-1} + 1 Hand weeding at 40 DAT, T_{12} - Pyrazosulfuron ethyl @ 30g a.i. ha^{-1} + TRRW at 40 DAT. T_{13} - Hand weeding Twice at 20 and 40 DAT, T_{14} - Two Row Finger Type Rotary Weeder (TRRW) at 15, 25, 40 DAT, T_{15} - Unweeded Check. In manual method weeds were either pulled directly with hand or cut with sickle close to the ground surface. Mechanical hoeing was done with two row finger type rotary weeder. All the pre-emergence, early post emergence and post emergence herbicides were sprayed on 3 DAT and 20 DAT, respectively with adequate soil moisture. Knapsack hand sprayer fitted with T-jet nozzle was used for spraying herbicides.

Crop husbandry

The land was prepared by giving two ploughings each followed by planking with the help of a tractor drawn cultivator to achieve the fine seed bed. A fertilizer dose of 120: 38: 38 kg N.P.K. ha^{-1} in the form of urea, single super phosphate and sulphate of potash was applied to each experimental unit. The P and K with 1/3rd of N was applied at sowing while the remaining dose of N was applied in two splits i.e., 30 and 55 days after sowing. Zinc sulphate (20%) was applied @ 25 kg ha^{-1}. Seed rate of rice was 80 kg $ha^{-1}$was followed. The seeds were treated with carbendazim @ 2 g kg^{-1} of seeds. After 24 hours the seeds were treated with *Azospirillum* @ 600 g ha^{-1} of seeds. The seed was soaked in water for 24 hours before sowing and then kept under shade in the form of a heap covered with a gunny bag for 36 hours and for allowed sprouting. Spacing of 22.5 X 22.5 cm was adopted. First irrigation was given at 4 days after seeding and the same interval was maintained until two weeks after sowing. Subsequently, the irrigation was applied after weekly interval. The crop was harvested at full physiological maturity, sun-dried for a week and threshed manually.

RESULTS AND DISCUSSION

Nutrient removal by weeds (kg ha^{-1})

Among the various herbicides tested, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) recorded the lowest nutrient removal by weeds of 12.86, 7.34 and 9.18 kg N, P and K ha^{-1} during Navarai 15.10, 9.44 and 15.20 kg N, P and K ha^{-1} during Kuruvai, respectively. The highest amount of nutrient removal by weeds (49.36, 19.78, 31.42 and 52.67, 21.36 and 39.14 kg N, P and K ha^{-1}) during Navarai and Kuruvai, respectively was observed under unweeded control (T_{15}). The pattern of nutrient removal by weeds showed that where ever effective weed control was possible, the nutrient loss due to weeds was minimum. The loss of nutrients by weeds varied with intensity of weeds and weed dry matter accumulation. The nutrient removal by weeds was maximum under unweeded control due to higher weed population and weed biomass accumulation. However, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20 g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder (TRRW) registered lesser nutrient removal. Rana and Angiras (1999) confirmed that N, P and K removal by weeds was limited in herbicide applied plots when compared to unweeded control. Due to uncontrolled weed growth, the removal of N, P and K by the weeds was the highest in the unweeded check which resulted in increased drymatter production of weeds.

Table – 1. Effect of weed management practices on nutrient removal by weeds (kg ha^{-1})

Treatment	Nutrient removal by weeds					
	Navarai *Season*			Kuruvai *Season*		
	N	P	K	N	P	K
T_1	38.19	15.53	25.49	41.98	17.63	31.75
T_2	17.68	9.68	13.36	20.81	12.18	18.97
T_3	12.86	7.34	9.18	15.10	9.44	15.20
T_4	40.48	16.15	26.90	44.63	18.30	33.31
T_5	26.99	13.15	19.85	31.39	14.92	25.36
T_6	29.28	13.73	21.25	34.03	15.59	26.95
T_7	42.80	16.75	28.29	47.25	18.98	34.92
T_8	20.00	10.30	14.75	23.46	12.84	20.52
T_9	22.30	10.91	16.13	26.10	13.50	22.10
T_{10}	45.10	17.34	29.70	49.88	19.61	36.51
T_{11}	31.59	14.33	22.67	36.66	16.22	28.53
T_{12}	33.86	14.94	23.98	39.28	16.91	30.10
T_{13}	24.57	11.40	17.54	28.70	14.18	23.70
T_{14}	15.24	8.05	11.57	17.97	10.32	17.32

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T_{15}	49.36	19.78	31.42	52.67	21.36	39.14
S.Ed	1.08	0.29	0.66	1.24	0.32	0.75
CD(P=0.05)	2.33	0.63	1.43	2.67	0.70	1.62

Nutrient uptake by crop (kg ha^{-1})

Among the various treatments, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) recorded the highest nutrient uptake by rice crop of 105.12, 45.53 and 98.56 kg ha^{-1} N, P and K during Navarai and 102.28, 41.58 and 94.42 kg ha^{-1} N, P and K ha^{-1} during Kuruvai season, respectively. The lowest nutrient uptake by rice crop was recorded in unweeded control treatment with the values of 72.24, 26.23 and 71.30 kg N, P and K ha^{-1} in Navarai and 70.18, 25.04 and 70.14 kg N, P and K ha^{-1} in Kuruvai, seasons, respectively. . Balasubramanian *et al.*, (1996) stated that unweeded control caused significant higher nutrient drain, which might other wise utilized by the crop. This was due to poor crop stand in the initial stages and decreased tiller production.

Table – 2. Effect of weed management practices on nutrient uptake by rice (kg ha^{-1})

Treatment	Nutrient uptake by rice					
	Navarai *Season*			Kuruvai *Season*		
	N	P	K	N	P	K
T_1	82.37	32.10	80.43	80.97	30.34	78.56
T_2	100.37	42.69	94.36	97.92	39.28	91.15
T_3	105.12	45.53	98.56	102.28	41.58	94.42
T_4	80.15	30.78	78.76	78.88	29.29	76.99
T_5	91.34	37.42	87.35	89.46	34.58	84.87
T_6	89.17	36.10	85.64	87.38	33.63	83.33
T_7	77.92	29.47	77.10	76.77	28.22	75.43
T_8	98.13	41.38	92.63	95.83	38.22	89.61
T_9	95.94	40.09	90.91	93.72	37.17	88.08
T_{10}	75.73	28.18	75.38	74.69	27.14	73.89
T_{11}	86.93	34.79	83.95	85.27	32.55	81.79
T_{12}	84.74	33.51	82.27	83.15	31.49	80.21
T_{13}	93.72	38.81	89.18	91.63	36.11	86.51
T_{14}	102.76	44.12	96.18	100.11	40.45	92.78
T_{15}	72.24	26.23	71.30	70.18	25.04	70.14
S.Ed	1.05	0.62	0.81	0.99	0.51	0.73
CD(P=0.05)	2.27	1.35	1.76	2.14	1.10	1.59

Post harvest soil available nutrients (N, P and K kg ha^{-1})

Among the various treatments tested, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) recorded highest available nutrients in the post harvest soil *viz.*, 235.64, 19.54 and 296.44 kg N, P and K ha^{-1} during Navarai and 206.41, 13.24, and 224.58 kg N, P and K ha^{-1} during Kuruvai season, respectively. The lowest available nutrients in the post harvest soil were recorded in unweeded control (T_{15}) with value of 215.21, 11.78 and 268.34 kg N, P and K ha^{-1} in Navarai and 184.65, 6.15 and 200.05 kg N, P and K ha^{-1} in Kuruvai season, respectively.

Table-3. Effect of weed management practices post harvest soil available nutrients (kg ha^{-1})

Treatment	Post harvest soil available nutrients (kg ha^{-1})					
	Navarai *season*			Kuruvai *season*		
	N	P	K	N	P	K
T_1	219.90	14.11	276.66	191.01	8.19	207.74
T_2	232.34	18.27	292.31	203.20	12.11	221.06
T_3	235.64	19.54	296.44	206.41	13.24	224.58
T_4	218.25	13.63	274.75	189.51	7.71	206.08

ISSN 2394 - 7780

T_5	226.17	16.17	284.47	197.10	10.15	214.37
T_6	224.63	15.68	282.56	195.61	9.70	212.73
T_7	216.72	13.16	272.83	187.99	7.23	204.43
T_8	230.81	17.78	290.40	201.71	11.62	219.41
T_9	229.38	17.31	288.48	200.22	11.15	217.75
T_{10}	215.21	12.67	270.92	186.50	6.76	202.80
T_{11}	223.10	15.20	280.63	194.10	9.23	211.11
T_{12}	221.58	14.73	278.71	192.58	8.77	209.45
T_{13}	227.84	16.83	286.54	198.71	10.69	216.10
T_{14}	234.01	18.91	294.38	204.83	12.68	222.78
T_{15}	215.21	11.78	268.34	184.65	6.15	200.05
S.Ed	0.73	0.25	0.91	0.71	0.23	0.78
CD(P=0.05)	1.59	0.55	1.99	1.54	0.51	1.69

Effect of herbicides on Growth and yield attributes on rice

Plant height

Among the various treatments, early post emergence herbicide application of Bispyribac sodium 100g/LSC 20g a.i. ha 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly registered the tallest plant height of 55.50, 78.95, and 96.98 cm on 30, 60 DAT and at harvest stages during Navarai and 53.70, 75.99 and 94.36 cm at respective stages of crop growth during Kuruvai seasons, respectively. The least values of plant height were recorded in unweeded control (T_{15}) at all the stages of crop growth. This might be due to better weed control throughout growth stages of rice and better availability of all resources *viz.*, light, moisture, space and nutrients to rice crop.

Leaf area index

The treatments altered the leaf area index at flowering of crop significantly during the both the seasons. Application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly registered the highest leaf area index of 6.90 in Navarai and 6.48 during Kuruvai seasons, respectively. The least LAI was noticed in unweeded control plot (T_{15}) with least LAI of 3.12 and 3.05 at flowering stage, respectively.

Number of tillers $hill^{-1}$

Among the various treatments, the application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly recorded the highest number of tiller $hill^{-1}$ (18.86 in Navarai and 16.96 in Kuruvai). The lower number of tillers $hill^{-1}$ (9.10 and 10.15, respectively) was recorded under unweeded control (T_{15}).

Dry matter production (kg ha^{-1})

Application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly recorded the highest crop dry matter production of 6968, 10895 and 13521 kg ha^{-1} during Navarai and 6869, 10780 and 13390 kg ha^{-1} during Kuruvai on 30, 60 DAT and at harvest, respectively. The lowest dry matter production of 1310, 4030, and 7151 kg ha^{-1} on 30, 60 DAT and at harvest was recorded during Navarai and 1240, 4011 and 6897 kg ha^{-1} on 30, 60 DAT and at harvest during Kuruvai were recorded in unweeded control treatment. Higher nutrient removal reduced the tiller numbers resulting in the lowest dry matter production of crops under unweeded check. This observation was in accordance with the reports of Singh *et al.,* (2004).

Effect of weed management practices on Yield attributes

Number of panicles m^{-2}

Among the different weed management practices, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly registered the highest number of panicle m^{-2} (526 in Navarai and 516 in Kuruvai). The lowest number of penicles (330 and 315 m^{-2}) was recorded in Navarai and Kuruvai season, respectively, in unweeded control treatment (T_{15}). Similar results of higher yield attributes of transplanted rice under bispyribac-sodium application were reported by Yadav *et al*., (2009).

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Number of filled grains panicle^{-1}

Application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly registered the maximum number of filled grains panicle^{-1} (80.31 in Navarai and 76.22 in Kuruvai, respectively). The minimum number of filled grains panicle^{-1} of 56.02 and 55.40 was registered during both the seasons, respectively.

Table – 4. Influence of weed management practices on growth components on 60 DAT

Treat Ments	Growth components					
	Navarai *season*			Kuruvai *season*		
	Plant height	LAI	DMP	Plant height	LAI	DMP
T_1	58.33	4.21	6135	56.48	4.11	6058
T_2	74.51	6.16	9925	71.95	5.91	9838
T_3	78.95	6.90	10895	75.99	6.48	10780
T_4	56.44	3.99	5664	54.51	3.93	5599
T_5	66.45	5.15	8026	64.28	5.05	7996
T_6	64.50	4.93	7557	62.31	4.85	7539
T_7	54.39	3.78	5195	52.63	3.71	5142
T_8	72.51	5.97	9454	70.10	5.72	9381
T_9	70.55	5.79	8984	68.22	5.52	8923
T_{10}	52.33	3.57	4728	50.74	3.51	4684
T_{11}	62.48	4.74	7085	60.42	4.66	7079
T_{12}	60.51	4.56	6619	58.55	4.45	6619
T_{13}	68.61	5.57	8517	66.33	5.34	8464
T_{14}	76.78	6.57	10408	73.99	6.20	10310
T_{15}	49.21	3.12	4030	47.88	3.05	4011
S.Ed	0.97	0.11	220	0.92	0.11	214
CD (P=0.05)	2.10	0.25	478	1.98	0.23	461

Grain yield (kg ha^{-1})

Among the treatments, application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly registered the maximum grain yield of 5716 kg ha^{-1} during Navarai and 5606 kg ha^{-1} during Kuruvai. The lower grain yield of 2400 kg ha^{-1} and 2295 kg ha^{-1} was recorded in unweeded control treatment (T_{15}) at Navarai and Kuruvai seasons, respectively. This was attributed to efficient and broad spectrum of weed control and favourable condition created through the efficient weed control that resulted in lesser weed competition between the crops and weeds. Murali *et al.*, (2012) obtained similar grain yield of transplanted rice under bispyribac-sodium at both the doses of 50 and 35 g/ha.

Table – 5. Effect of weed control treatments on grain yield and straw yield (kg ha^{-1})

Treat Ments	Yield components					
	Navarai *season*			Kuruvai *season*		
	No.of panicles	Grain yield	Straw yield	No.of panicles	Grain yied (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	388	3613	5921	381	3518	5492
T_2	485	5120	6812	478	5065	6782
T_3	526	5716	7416	516	5606	7191
T_4	377	3504	5413	373	3405	5321
T_5	438	4398	6210	428	4269	6201
T_6	429	4214	6118	420	4116	6003
T_7	365	3401	5316	362	3312	5203
T_8	478	4908	6705	469	4878	6610
T_9	469	4805	6614	458	4751	6532
T_{10}	356	3310	5225	352	3215	5010

ISSN 2394 - 7780

T_{11}	419	4103	5921	415	3910	5806
T_{12}	407	3915	5808	406	3821	5698
T_{13}	461	4700	6515	449	4601	6405
T_{14}	505	5413	7110	500	5337	6987
T_{15}	330	2400	4250	315	2295	4120
S.Ed	6.97	137	108	6.51	123	103
CD (P=0.05)	15	282	222	14	265	201

Straw yield (kg ha^{-1})

Straw yield was significantly influenced by various treatments. The application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) significantly recorded higher straw yield of 7416 kg ha^{-1} during Navarai and 7191 kg ha^{-1} during Kuruvai seasons, respectively. The lowest straw yield of 4250 kg ha^{-1} and 4120 kg ha^{-1} was recorded in unweeded control treatment (T_{15}) in Navarai and Kuruvai seasons, respectively.

Economics

Application of early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) registered the maximum net income of Rs 54427 ha^{-1} and return rupee^{-1} invested of 2.64 during Navarai and net income of Rs 51857 ha^{-1} and return rupee^{-1} invested of ` 2.53 during Kuruvai. The unweeded control recorded the minimum net income Rs 6745 ha^{-1} and Rs 4340 ha^{-1} and return rupee^{-1} invested 1.21 and 1.13 during Navarai and Kuruvai, seasons respectively. The unweeded control registered the lowest net income and return rupee^{-1} invested due to poor grain yield and experienced severe weed competition throughout the crop growth period.

Table – 6. Economics of rice

Treatments	Navarai *Season*		Kuruvai *Season*	
	Net income (Rs. ha^{-1})	BCR	Net income (Rs. ha^{-1})	BCR
T_1	23879	1.73	21315	1.63
T_2	44640	2.31	42871	2.23
T_3	54427	2.64	51857	2.53
T_4	22694	1.71	20411	1.62
T_5	34779	2.05	31995	1.94
T_6	32950	2.02	30658	1.92
T_7	19339	1.57	17175	1.49
T_8	40598	2.16	39033	2.08
T_9	39904	2.17	32261	2.09
T_{10}	19662	1.61	17312	1.52
T_{11}	30232	1.91	26447	1.77
T_{12}	28326	1.87	26095	1.78
T_{13}	38755	2.15	36126	2.04
T_{14}	50621	2.56	48629	2.47
T_{15}	6745	1.21	4340	1.13

CONCLUSION

Based on the above results of the experiment, it can be concluded that, early post emergence herbicide Bispyribac sodium 100g/LSC 20g a.i. ha^{-1} on 20 DAT followed by two row finger type rotary weeder at 40 DAT (T_3) proved practically more convenient and economically best feasible integrated weed management practices for transplanted rice.

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SUSTAINABLE AGRICULTURE AND RURAL LIVELIHOODS SECURITY IN INDIA

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ABSTRACT
Indian as well as global agriculture will face several challenges over the coming decades because it must produce more food to feed affluent and growing populations. Improving agricultural productivity while conserving and enhancing natural resources is also another problem in Indian agriculture. The solution of aforesaid problem in changing scenario is sustainability in agriculture production. In India, rural economy suffers from poverty, unemployment, anutrition, limited diversification of farming and degradation of natural resources such water, land and forest. Livelihood diversification is essential for poverty reduction, food security, rural livelihood security and improved income for rural farming community. This study paper mainly focused on organic farming in agriculture, its roles in rural livelihood security, and major issues in sustainable agriculture, finally it discussedthe government policies and institutions for securingthe rural livelihood. The purpose of this paper is to explore how sustainable agriculture policies can better serve the goal of poverty reduction as well as rural livelihood security. The efforts to stimulate and support to the sustainable agricultural growth are essential for the rural livelihood security and rural development in India.

Keywords: Sustainable Agriculture, Livelihood Diversification, Poverty Reduction and Rural Livelihood Security.

INTRODUCTION

The majority of the people in India makes outtheir existence directly or indirectly from farm relatedeconomic activities because agriculture is an integral partof everyday life in Indian sub-continent, not only for itemploys about 70 percent of workforce of the country, butalso for it provides food to the population, raw materialsfor the industries, wood for fuel and shelter, herbs formedicines, and above all means of sustenance andlivelihoods.Agriculture sector for developingeconomies likeIndia is primarysource of livelihood inboth farm and non-farm sectors and sustainability inagriculture sector means boosting up the rural livelihoodsystem. Livelihood refers to adequate stock andflow offood and cash with an individual to meet their basic needsand livelihood security means secured ownership of,access to, resources and income earning actives,including reserves andassets tooffset risk, ease shocksand meet contingencies.

A rural livelihood is defined as “the capabilities,assets and activities that rural people require for a meansof living." It is considered sustainable “when it can copewith and recover from stresses and shocks, and maintain or enhance its capabilities and assets- both now and in thefuture while not undermining the natural resource base."Sustainable agriculture and rural development are integraland necessary components of sustainable development. Sustainable agriculture involves all three pillars ofdevelopment - economic, social and environmental.

Agriculture and rural developmentare sustainable whenthey are ecologically sound, economically viable, sociallyjust, culturally appropriate humane and based on a holisticscientific approach.

(I) Production-based Livelihood - A large proportion of the small and marginal farmers gain livelihoods through production on small pieces of land. For these households, availability or access to inputs and improved methods of production are quite critical for their livelihoods.

(ii) Labor-based livelihood - Most of the smalllandholders and landless rural households derive livelihoods by selling theirlabor. For their livelihoods, demand for labor, wage rates and prices of food are the critical factors.

(iii) Exchange or Market Based Livelihood - Those rural households which produce surplus food and non-food agricultural products or non-farm goods earns their livelihoods by selling these surplusesin the market. The marketing system for these products and relative prices of what they sell and what they buy, affect their livelihoods.

(iv) Transfer based entitlements - The households without any income-earning asset or able-bodied person to work depend for their livelihoods on transfers from the government or other social organizations. Rural households get livelihoods throughagriculture, others through rural labor market, self-employment inrural non-farm economy, others through migrating to towns, cities and other countries.

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Sustainable agriculturalapproach improving agricultural productivity, while conserving and enhancing naturalresources, is an essential requirement for farmers to increase global food supplies on a sustainable basis. The success of developing countries in increasing agricultural productivity will have global implications instrengthening theresilience of foodmarkets, enhancingfood security, improving wellbeing and promoting sustainability. To buyenough food, disadvantaged men and women need adequate income. The World Bank's 2008 World Development Reportfound that agriculture'smost important contribution to food security is notsubsistence production during seasonal food shortages. Rural livelihoods are improved by but theability of the poor, particularly women, to earn money. Functioning markets support better livelihoods so poor households can grow food and generateincome tobuy affordable food, especially strengthening market function. This includeshaving the right policies and regulations in place, reducing barriers to trade, generating domestic and export market opportunities and increasing private sectorparticipation in food production. This may involvecooperation with government and civil society institutions, but direct cooperation with the private sector is often essential. Many private sector players areinvolved, including large companies, semi-subsistence farmers, the self-employed in the non-farm informaleconomy as well as micro, small and medium-sized enterprises.

ISSUES IN SUSTAINABLE AGRICULTURE AND RURAL LIVELIHOOD SECURITY

Food and Agriculture Organization (FAO) has defined sustainable agriculture as the management andconservation of resource base and the orientation of technological and institutional changes in such a manner that ensures attainment and continued satisfaction of human needs of present and future generations. It follows that sustainable agriculture is that path of agriculturaldevelopment, which is environmentally non-degrading, technologically appropriate, economically viable andsocially acceptable'.It must be recognized thatagriculture by definition is the most aggressivelymanaged ecosystem, which is closely linked to theworld's food system. If the alternative to agriculturalsustainability is the collapse ofthe world's food system, there is definitely no compromise. However, inpredominantly rural economies like India, growth ofagriculture is critical to the achievements of goals ofpoverty reduction and household food-security. This requires resolution of the issue of trade-off between sustainable agriculture and a growing agriculture. What is needed is a sustained growth of agriculture. Whilesustainable croppingand farmingsystems, recent trends in profitability of farming and some new approaches like organic farming should be discussed, there are some other areas which need increased attention for achievingsustained growth of agriculture coupled with improved livelihood systems in the country. The strategic approach to sustained growth ofagriculture that helps in improving rural livelihoods should encompass the following:

(I) The developing countries, like India, cannot andshould not ignore the fact that the priority goal ofagricultural development.

(ii) There is a debate between protagonists of agricultural development and environmentalists. While those whogive precedence to the removal of hunger and foodinsecurity suggest that irrigation facilities should be expanded further, environmentalistsargue that water use in agriculture should be brought down. However, the best course to reconcile the conflicting objectives is to adopt a strategy whichincreases water-use efficiency, measured as maximum biomass per drop of water.

(iii) Now days, itis argued that the mainproblem with current agricultural development paradigm is that it is a shift away from the traditional system of water andnatural resource management. In this context, it should not be forgotten that current socio-economic environment is distinctly different from an environment in which traditional system wasevolved and had worked. These days the conflicts in the use of natural resources likewater have increased manifold. The conflicts arisebecause the limited amount of water that has beenharnessed needs to be shared between individuals, between sectors, between states, between countries, even between man and other living animals and birds.

(vi) Consumption patterns of a large section of the population (middle and upper middle class) are changing rapidly, leading to a substantial increase in resource intensity of consumption. However, resource intensity of consumption continues to be considerably lower in India than developed countries. The per capita use of man-made energy is very low. Days of sunshine, hours of breathing in open air and per capita consumption of raw/fresh vegetables and fruits is very high in India. Nevertheless, the rising trend in resource intensity of consumption cannot be brushed aside for sustainability of natural resources.

Like price support, input subsidies also distort production. However, they can redress, at least temporarily, market failures such as the under-development of infrastructure, missing markets for credit and inputs and a lack of knowledge of the benefits of using improved seeds, animal breeds and fertilizer. To this extent, they can

ISSN 2394 - 7780

helpfarmers acquireimproved technology, and thus foster productivity, butover time they can also impede the development of private markets and do not tackle the problem of market failure directly. More generally, if support is targeted to a specific input, it can encourage an input mix that will not necessarily be economically or environmentally sustainable. For example, irrigationsubsidies canaffect sustainable water use and may not encourage the adoption of water saving irrigation systems if appropriate regulations are not in place. Providing producers, the tools they need for risk management is important for the adoption of innovation, but too much government support in risk management schemes may prevent the emergence ofmarket solutions. As seen earlier, public expenditures onagricultural R&D have positive andlarge impactson agricultural productivity, but public expenditures on extension and advisory servicesare also important and complementary as they promote the adoption of new productionsystems that enable productivity growth on a sustainable basis.

CONCLUSION

Keeping the above issues in the mind, it can conclude that sustainability in agricultureproduction is need of time for availability of food, employment togrowing populations and conservation of natural resources as well as for the securing the environment. There is need of attention by policy makers towardsthe development of infrastructure and employment opportunities inthe rural areas and improvementin the existing rural livelihood security system. Now days, there is a need to critical review the sustainability parameter in agriculture and emphasis should be given on the efficient and sustainable utilization of natural resources, protecting the environment, sustainable agricultural growth, investment in agricultural research, infrastructure development and conserve bio diversity resources of the country. The government policies and programmes should be focused on small/marginal farmers and non-farmlaborers and should made available employment opportunities which will increase their income level, livelihood security and standard of living in rural areas. Government should make investment on vulnerable areas and employment rich areas such rural infrastructure, dairy sector, poverty reduction, integrated farming and natural resourcesconservation whichhelp inrural development and livelihood security for rural India.

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STUDIES ON SURVIVAL OF PGPR CONSORTIUM WITH DIFFERENT CARRIER MATERIAL

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ABSTRACT
Plant growth promoting rhizobacteria such as Azospirillum, Pseudomonas and Bacillus isolated from tomato rhizosphere soil were screened based on their PGPR traits. The selected PGPR strains such as Azospirillum lipoferum TMAZs-13, Pseudomonas fluorescens TMPs-19 and Bacillus megaterium TMB -3 in consortium dual, as well as single inoculants prepared in liginite, alginate and vermiculite carriers. The survival was assessed upto six month storage. Among the carriers lignite was found to be the best carrier material and shelf life of six months was achieved followed by alginate beaded and vermiculite carrier.

INTRODUCTION
Bacteria that colonize the rhizosphere and plant roots and enhance plant growth by any one mechanism are referred as plant growth promoting Rhizobacteria (PGPR). PGPR is a mixture of beneficial microorganisms which can increase the crop yield, plant growth and also protect against plant pathogen (Seleim *et al.,* 2011). PGPR help in solubilization of mineral, phosphates and other nutrients, enhance resistance to stress, stabilize soil aggregates and improve soil structure and organic matter content (Al – Taweil *et al.,* 2009).

PGPR have been applied to various crops that enhance the growth, seed emergence and crop yield and some have been commercialized (Dey *et al.,* 2004; Herman *et al.,* 2008; Minorsky 2008). PGPR organisms like *Azospirillum, Azotobacter, Pseudomonas* and *Bacillus* that have been shown to colonize the roots of various plants, and to increase the height, flower number, fruit number and total weight of tomato plants (Minorsky, 2008).

India is supposed to be the largest biofertilizers producer in the globe. The creditability of carrier based biofertilizer is low among the farmers, because of some reasons like poor efficient strains, unavailability of suitable carrier for long storage and viability of strains, spurious manufactures, involvement of unqualified persons in the manufactures and lack of knowledge of the organisms.

PGPR may promote growth directly, by fixation of atmospheric nitrogen, solubilisation of minerals such as phosphorus, production of siderophores that solubilize and sequester iron, or production of plant growth regulators, phytohormones. Some bacteria support plant growth indirectly by improving growth restricting conditions either via production of antagonistic substances or by inducing host resistance towards plant pathogens. Since associative interactions of plant and microorganisms must have come into existence as result of convolution, the use of either former or latter groups as bioinoculatnts forms one of the vital components for a long-term sustainable agriculture system. In this present study, the survival of PGPR isolates was investigated by using different carrier materials.

MATERIALS AND METHODS
Based on the results of the performance of the plant growth promoting traits, three different PGPR isolates *viz., Azospirillum lipoferum* TMAzs-13, *Pseudomonas fluorescens* TMPs-19 and *Bacillus megaterium* TMB-3 were selected for further studies. The survival of the above selected PGPR isolates was estimated in different carriers such as lignite, vermiculite and in alginate beads.

Preparation of carrier based inoculants
The selected isolates were multiplied in large quantities in appropriate culture broths by incubating at 28±2ºC in an incubator shaker till they attained log phase with a cell load of $1x10^9$ cfu ml^{-1} and were used for inoculants preparation. Lignite collected from Neyveli Lignite Corporation (NLC), Neyveli, Pressmud collected from EID Parry Ltd. Nellikuppam and Vermiculite collected from Tamilnadu Minerals Ltd. Chennai were used as carriers.

The individual carrier materials were powdered and the pH was brought to neutral by adding $CaCO_3$ if necessary and sterilized at 15 PSI for 1 h and allowed to cool over night and then mixed with the log phase culture ($1x10^9$ cfu ml^{-1}) of the selected plant growth promoting rhizobacterial isolates *viz., A. lipoferum*TMAzs-13, *P.fluorescens*TMPs-19 and *B. megaterium* TMB-3 individually in separate quantities of sterile carrier in shallow trays. The moisture content was adjusted to 30-35 per cent. Curing in shallow trays for 24 h in aseptic rooms and packed in polythene bag (300 gauge) at the rate of 200 g bag^{-1} and sealed. Individual inoculants was prepared by mixing equal volumes of each culture broth with sterile carrier and combined inoculants was also

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prepared by mixing equal volumes of broth with the carrier materials. The populations of individual plant growth promoting bacteria in the inoculants carriers were assessed at monthly intervals up to six months.

Preparation of alginate beaded inoculant

The *A.lipoferum* TMAzs-13, *P.fluorescens* TMPs-19 and *B. megaterium* TMB-3 were grown in respective medium to get a population of $1x10^9$ cfu ml^{-1}. Sodium alginate beaded inoculant was prepared as per the methods described by Hegde and Brahmaprakash (1992). Two gram of sodium alginate was added to 100 ml of culture broth of agriculturally beneficial microbial isolates and it was mixed for 30 min in a magnetic stirrer. The mixture was added drop wise through a 10 ml syringe into 100 ml sterile 0.1N $CaCl_2$ to obtain uniform alginate beads. One gram of material contained 16 to 17 beads, each bead approximately weighing 60 mg. The beads were washed twice in sterile distilled water and incubated in respective broth containing agriculturally beneficial microbial isolates for seven days in a psychrotherm (model environ shaker) incubator at 28 ± 2ºC to allow agriculturally beneficial microorganisms to multiply inside the beads. The beads were again washed in sterile distilled water and air dried in laminar air flow chamber under aseptic condition. The alginate beads were then stored in polythene bags at room temperature upto 6 months.

RESULTS

Survival of plant growth promoting rhizobacteria as single, dual and consortium in lignite carrier

The survival of plant growth promoting rhizobacterial strains *viz*., *Azospirillum lipoferum* TMAzs-13, *Pseudomonas fluorescens* TMPs-19 and *Bacillus megaterium* TMB-3 in consortium, dual as well as single inoculants prepared in lignite carrier material was assessed upto six months storage .The initial population of PGPR strains in consortium (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3) was 78.85×10^8 cfu g^{-1}. While the corresponding population in the carrier prepared with single inoculant strains were 76.22×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13, 73.85×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19 and 60.22×10^8 cfu g^{-1} for *Bacillus megaterium* TMB-3.The dual inoculant strains were 74.13×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19, 73.65×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Bacillus megaterium* TMB-3 and 63.09×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3.

The surviving population of PGPR strains during 6th month of storage was 9.33×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13, 7.63×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19 and 5.88×10^8 cfu g^{-1} for *Bacillus megaterium* TMB-3 as single inoculant.

The dual inoculant strains were 712.80×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19, 11.00×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Bacillus megaterium* TMB-3 and 10.76×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3. The surviving population in consortium (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3) was 15.84×10^8 cfu g^{-1} in lignite carrier material.

The populations increased in consortium, dual and single inoculants packet was high during the initial stage of storage and there after reduced from 1st month onwards and on further storage the cell populations of different inoculants gradually decreased upto six months of storage. The shelf life of PGPR strains was satisfactory upto six months in inoculant packet containing consortium. (Table-1)

TABLE - 1 Survival of plant growth promoting rhizobacteria as single and consortium inoculant in Lignite carrier

Treatments	Storage period in months						
	Initial	1st Month	2nd Month	3rd Month	4th month	5th Month	6th Month
	Inoculant population (Number of cfu × 10^8 g^{-1} of lignite)						
A. lipoferum TMAzs-13	76.22 (9.88)	73.55 (9.86)	63.09 (9.80)	42.66 (9.63)	30.22 (9.48)	26.00 (9.41)	9.33 (8.96)
P. fluorescens TMPs-19	73.85 (9.86)	70.44 (9.84)	60.09 (9.77)	40.37 (9.60)	28.13 (9.44)	24.15 (9.38)	7.63 (8.88)
B. megaterium TMB-3	60.22 (9.77)	53.00 (9.72)	45.66 (9.65)	36.22 (9.55)	25.83 (9.41)	28.44 (9.26)	5.88 (8.77)
A. lipoferum TMAzs-13 + P. fluorescens TMPs-19	74.13 (9.87)	68.15 (9.83)	55.25 (9.74)	39.45 (9.59)	27.54 (9.43)	20.37 (9.30)	12.80 (9.10)
A. lipoferum TMAzs-13 + B. megaterium TMB-3	73.65 (9.86)	71.13 (9.85)	63.09 (9.80)	52.48 (9.72)	26.11 (9.55)	22.19 (9.34)	11.00 (9.04)

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P. fluorescens TMPs-19 + B. megaterium TMB-3	63.09 (9.80)	56.23 (9.75)	50.77 (9.70)	38.90 (9.59)	26.00 (9.41)	20.51 (9.31)	10.76 (9.03)
A. lipoferum TMAzs-13 + P. fluorescens TMPs-19 + B. megaterium TMB-3	78.85 (9.90)	75.79 (9.85)	60.25 (9.78)	48.97 (9.69)	34.67 (9.54)	27.54 (9.44)	15.84 (9.20)
SED	0.01	0.01	0.01	0.01	0.01	0.01	0.06
CD (p=0.05)	0.02	0.02	0.02	0.03	0.02	0.03	0.14

Values in parenthesis are $\log_{10}$ transformed values

Survival of plant growth promoting bacteria as single, dual and consortium alginate bead carrier

The survival of PGPR strains *viz*., *Azospirillum lipoferum* TMAzs-13, *Pseudomonas fluorescens* TMPs-19 and *Bacillus megaterium* TMB-3 in consortium, dual as well as single inoculants prepared in alginate bead carrier was assessed upto six months storage . The initial population of PGPR strains in consortium (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+*Bacillus megaterium* TMB-3) was 76.13×10^8 cfu g^{-1}. While the corresponding population in alginate beaded carrier in single inoculant preparations were 75.85×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13, 71.95×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19 and 58.62×10^8 cfu g^{-1} for *Bacillus megaterium* TMB-3 and the dual inoculant strains were 72.13×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19, 70.54×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Bacillus megaterium* TMB-3 and 62.62×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3 (Table-2)

Table- 2 Survival of plant growth promoting rhizobacteria as single and consortium inoculant in Alginate bead

Treatments	Storage period in months						
	Initial	1st Month	2nd Month	3rd Month	4th month	5th Month	6th Month
	Inoculant population (Number of cfu × 10^8 g^{-1} of Alginate bead)						
A. lipoferum TMAzs-13	75.85 (9.87)	69.18 (9.84)	61.06 (9.78)	40.09 (9.60)	28.54 (9.45)	23.12 (9.36)	8.41 (8.92)
P. fluorescens TMPs-19	71.95 (9.85)	68.28 (9.83)	57.73 (9.76)	38.01 (9.57)	22.62 (9.35)	18.84 (9.27)	6.30 (8.79)
B. megaterium TMB-3	58.62 (9.76)	50.18 (9.70)	43.06 (9.63)	33.12 (9.52)	21.31 (9.32)	15.31 (9.18)	4.00 (8.60)
A. lipoferum TMAzs-13 + P. fluorescens TMPs-19	72.13 (9.85)	69.09 (9.83)	57.54 (9.76)	41.68 (9.62)	33.88 (9.53)	18.62 (9.27)	10.58 (9.02)
A. lipoferum TMAzs-13+ B. megaterium TMB-3	70.54 (9.84)	68.11 (9.83)	54.65 (9.73)	39.81 (9.60)	30.90 (9.48)	16.89 (9.22)	12.45 (9.09)
P. fluorescens TMPs-19 + B. megaterium TMB-3	66.62 (9.79)	55.13 (9.74)	48.09 (9.68)	35.65 (9.52)	25.80 (9.41)	18.57 (9.26)	11.20 (9.05)
A. lipoferum TMAzs-13 + P. fluorescens TMPs-19 + B. megaterium TMB-3	76.13 (9.88)	73.44 (9.86)	59.79 (9.77)	46.79 (9.67)	32.60 (9.51)	25.09 (9.39)	14.48 (9.16)
SED	0.01	0.01	0.01	0.02	0.01	0.01	0.04
CD (p=0.05)	0.02	0.02	0.02	0.04	0.02	0.03	0.06

Values in parenthesis are $\log_{10}$ transformed values

Survival of plant growth promoting rhizobacteria as single, dual and consortium in Vermiculite carrier

The survival of PGPR strains *viz*., *Azospirillum lipoferum* TMAzs-13, *Pseudomonas fluorescens* TMPs-19 and *Bacillus megaterium* TMB-3 in consortium as well as single inoculants prepared in vermiculite carrier material was assessed upto six months storage . The initial population of PGPR strains in consortium (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+*Bacillus megaterium* TMB-3) was 69.85×10^8 cfu g^{-1}. While the corresponding population in vermiculite carrier in single inoculant preparation were 73.85×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13, 60.60×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19 and 58.60×10^8 cfu g^{-1} for *Bacillus megaterium* TMB-3 and the dual inoculant strains were 66.44×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19, 64.85×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Bacillus megaterium* TMB-3 and 67.13×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3 .

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During 6th month, the surviving populations were 3.73×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13, 2.00×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19 and 3.69×10^8 cfu g^{-1} for *Bacillus megaterium* TMB-3 as single inoculant. The dual inoculant strains were 12.08×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19, 10.51×10^8 cfu g^{-1} for *Azospirillum lipoferum* TMAzs-13 + *Bacillus megaterium* TMB-3 and 11.29×10^8 cfu g^{-1} for *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3. The surviving population in consortium packet (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+*Bacillus megaterium* TMB-3) was 13.00×10^8 cfu g^{-1} in vermiculite carrier. (Table: 3)

Table: 3 Survival of plant growth promoting rhizobacteria as single and consortium inoculant in vermiculite carrier

Treatments	Storage period in months						
	Initial	1st Month	2nd Month	3rd Month	4th month	5th Month	6th Month
	Inoculant population (Number of cfu × 10^8 g^{-1} of vermiculite)						
A. lipoferum TMAzs-13	73.85 (9.86)	70.13 (9.84)	39.81 (9.60)	22.19 (9.34)	18.41 (9.26)	10.63 (9.02)	3.73 (8.57)
P. fluorescens TMPs-19	60.60 (9.78)	38.23 (9.58)	34.18 (9.53)	19.94 (8.30)	12.16 (9.08)	7.18 (8.45)	2.00 (8.30)
B. megaterium TMB-3	58.60 (9.76)	35.09 (9.54)	30.77 (9.48)	24.96 (9.39)	20.98 (9.32)	12.45 (9.09)	3.95 (8.59)
A. lipoferum TMAzs-13 + *P. fluorescens* TMPs-19	66.44 (9.82)	62.44 (9.79)	35.56 (9.55)	42.38 (9.62)	34.21 (9.53)	21.41 (9.33)	12.08 (9.08)
A. lipoferum TMAzs-13+ *B. megaterium* TMB-3	64.85 (9.81)	58.85 (9.76)	38.60 (9.58)	34.11 (9.53)	26.19 (9.41)	18.41 (9.26)	10.51 (9.02)
P. fluorescens TMPs-19 + *B. megaterium* TMB-3	67.13 (9.82)	64.13 (9.80)	46.06 (9.66)	43.90 (9.64)	30.37 (9.48)	20.31 (9.30)	11.29 (9.05)
A. lipoferum TMAzs-13 + *P. fluorescens* TMPs-19 + *B. megaterium* TMB-3	69.85 (9.84)	66.13 (9.82)	48.18 (9.68)	45.91 (9.66)	32.05 (9.50)	23.23 (9.36)	13.49 (9.11)
SED	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD (p=0.05)	0.02	0.02	0.02	0.02	0.03	0.03	0.03

Values in parenthesis are $\log_{10}$ transformed values .

DISCUSSION

The surviving population per gram of lignite prepared with PGPR consortium was 78.85 $x10^8$ of (*Azospirillum lipoferum* TMAzs-13 + *Pseudomonas fluorescens* TMPs-19+ *Bacillus megaterium* TMB-3) in consortium inoculant and it was found to be the best carrier material and shelf life of six months was achieved followed by alginate beaded, pressmud and vermiculite carrier. Hence, the alginate beaded and pressmud is the next best ideal carrier for biofertilizer consortium and can be successfully employed for large scale preparation of commercial inoculants. The higher survival load in beaded and pressmud carrier is attributed to the increased surface area per unit weight of the alginate and pressmud carrier. Vermiculite maintained the required population significantly well in single inoculant preparations. However, the comparative survivals in consortium in these carriers were less than that observed with vermiculite carrier.

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INFLUENCE OF ORGANIC INPUTS AND GROWTH REGULATORS ON YIELD AND QUALITY OF GOLDENROD (Solidago canadensis L.)

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ABSTRACT
The experiment to study the influence of organic inputs and growth regulators on yield and quality of goldenrod (Solidago canadensis L.) was conducted at the Floriculture Unit, Department of Horticulture, Faculty of Agriculture, Annamalai University during2017-2018. The experiment was laid out in a randomized block design with thirteen treatments. Various organic inputs and growth regulators including panchakavya @ 3 per cent, vermiwash 1:5 dilution, humic acid @ 0.2 per cent, GA_3 @ 300 ppm, NAA @ 250 ppm were applied. The yield and quality characters were studied at different stages of crop growth. The results showed that weight of individual flower stalk, number of flower stalks per plant, yield of flower stalk per hectare and duration of flowering were found to be maximum with plants treated with NAA @ 250 ppm + panchakavya @ 3 per cent as foliar spray. The flower stalk cone length and vase life of flower stalks were also highest in the same treatment. Considering the yield and quality attributes, it was found that the treatment of NAA @ 250 ppm + panchakavya @ 3 per cent were adjudged to be the best with higher yield and quality attributes.

Keywords: goldenrod, growth regulators, vermiwash, NAA, panchakavya, yield and quality.

INTRODUCTION
Goldenrod (*Solidago canadensis* L.) belongs to the family Asteraceae which is native to North America. Goldenrods have small yellow clustered flowers, often seen in panicles, along a thin stick like stem. Some species of goldenrod produce flowers of white colour called silver rod. Goldenrod is generally used as cut flower for indoor decoration in vases and used either singly or with other flowers in flower bouquets. In India, goldenrod is cultivated in Karnataka, Tamil Nadu, Maharashtra, Punjab, Delhi, West Bengal and North Eastern states for use as cut flower, besides being grown in beds, borders, rock garden etc.

There are reports that Germens have grown this crop as a wound healing herb from ancient times. Essential oils, flavonoides, glycosides, tannins, saponins and various organic acids derived from *solidago* are used as anti-inflammatory agents in ointments for urinogenital and chronic skin problem, apart from being used as adjuvant along with other remedies for asthma, arthritis andrheumatism.

The current research work on this crop is aimed at to improve yield of flowers and the flower quality using growth regulators and organic inputs. The present investigation has been therefore taken up with the objective to fix optimum combination of organic inputs and growth regulators for maximizing yield and shelf life of goldenrod.

MATERIALS AND METHODS
The studies on "Influence of organic inputs and growth regulators on yield and quality of goldenrod (*Solidago canadensis* L.)" was carried out in the floriculture yard, Department of Horticulture, Annamalai University, Annamalainagar, Tamil Nadu from 2017 to 2018.

The experiment was laid out in a randomized block design with three replications. Three organic nutrients *viz*., humic acid and panchakavya, vermiwash and two growth regulators *viz*., gibberellic acid and NAA were used for the experiment. There were 12 treatment combinations viz., gibberellic acid @ 300 ppm (T_1), panchakavya @ 3 per cent (T_2), vermiwash1:5 (T_3), NAA @ 250 ppm (T_4), humic acid @ 0.2 per cent (T_5), gibberellic acid @ 300 ppm+ panchakavya @ 3 per cent (T_6), gibberellic acid @ 300 ppm+ vermiwash1:5 (T_7), gibberellic acid @ 300 ppm+ humic acid @ 0.2 per cent (T_8), NAA @ 250 ppm+ panchakavya @ 3 per cent (T_9), NAA @ 250 ppm + vermiwash1:5 (T_{10}), NAA @ 250 ppm+ humic acid @ 0.2 per cent (T_{11}) and control (T_{12}).

Field Preparation/ Planting
The field was prepared thoroughly and well decomposed farm yard manure was applied. A plot size of 2 x 2 m and a plant spacing is 20 x20 cm was adopted. Healthy and matured uniform suckers were used for planting.

Observations Recorded
Observations were recorded on number of flower stalks per plant, length of flower stalks (cm), weight of individual flower stalks (g), flower stalk cone length (cm) and duration of flowering (days). The estimated flower yield per ha was arrived at by counting the flower stalks produced by the plant in three major flushes over a period of 150 days, and the average was worked out. The yield per hectare was expressed in tonnes per

ISSN 2394 - 7780

hectare.

Quality Parameters

Shelf lif

The shelf life of flowers stalk was assessed by keeping the flowers in vase containing plain water under open condition. Fully opened flowers from different treatments were harvested and used for studying their response to shelf life. The total number of days for which the flower remained 50 per cent fresh was evaluated and expressed in days.

Statistical Analysis

The data recorded were subjected to statistical analysis by adopting the standard procedure of Panse and Sukhatme (1967). Critical difference was worked out 5 per cent probability for significance. The analysis was carried out using the personal computer based IRRISTAT package.

RESULTS AND DISCUSSION

Goldenrod (*Solidago canadensis* L.) is used as an important filler in all kinds of flower arrangements. It deserves greater attention to enhance so as to get maximum profit. Besides nutrient application, growth regulating substances also play a vital role in manipulating the yield and quality of this crop. The growth regulators like gibberellic acid, NAA and organic substances like humic acid, panchakavya and vermiwash have been tried by several workers to study their influence on flower yields. Plant growth regulators have a differential and definite influence on many of the functional and physiological process is in crop plants. In the present experiment, the growth promoting substances (GA_3, NAA) and organic substances were applied to elucidate information on their effect on productivity of goldenrod. The results obtained from the experiment are discussed here under.

As regard to number of flower stalk perplant, the results showed that the combined application of NAA @ 250 ppm and panchakavya @ 3 per centfoliar spray significantly increased the number of flower stalks per plant. This increase might be due to increased photosynthesis efficiency with enhanced carbohydrate fixation in NAA treated plants. These results were in accordance with findings of Ravidas *et al.* (1992) and Maurya and Nagda (2002) in gladiolus.Presence of growth promoting substances such as GA_3 and cytokinins, which are present in panchakavya, might also be responsible for increasing the number of flower stalk per plant. Bio-inoculants such as acetobacter, *Azospirillum* andphosphobacteria present in panchakavya might be responsible for increase in the number of flowers due to better nitrogen fixation from atmosphere.

Length of the flower stalk is the most important character for goldenrod as it is being used as filler for flower vases and bouquets. Adequate length will facilitate proper arrangement of flowers in vases. The length of the flower stalk was significantly increased due to the application of NAA @ 250 ppm and panchakavya @ 3 per cent. This increase might be due to increased cell division under the influence of auxin. The results of the present study confirm the results reported by Dutta *et al.* (1993 and 1995) in chrysanthemum and Maurya and Nagada (2002) in gladiolus.

Weight of individual flower stalk perplant was significantly increased due to the application of NAA @ 250 ppm and panchakavya @ per cent. The results are in agreement with findings of Thamaraiselvi *et al.* (2002) who found increased flower weight in treatment containingcombination of panchagavya in rose.Duration of flowering was also extended in the plants which received NAA @ 250 ppm and panchakavya @ 3 per cent.

The results of the present investigation showed that the plants treated with NAA @ 250 ppm and panchakavya @ 3 per cent produced the maximum number flower stalks per hectare and increased dry matter production. This increase is due to the auxin which stimulated availability of food materials and carbohydrate supply which ultimately enhance the flower production. Such response due to NAA application were reported previously by Dutta *et al.* (1993 and 1995), Kumar and Ugherja (1998) in chrysanthemum. Pandya (2000) in marigold; Maurya and Nagda (2002) ingladiolus.

Waheeduzzama (2007) in anthurium and Rajesh Bhalla*et al*. (2006) in gladiolus also reported foliar spray of panchagavya pronounced increase in yield. The increased yield might be due to sustained availability of nitrogen throughout thegrowing phase and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink (flower). The proportion and activity of beneficial microbes would be at the higher rate in panchakavya which helps in synthesis of growth promoting substances that might have increase yield of spikes and floret.

Vase life is an important parameter for all cut-flowers as withhigher vase life better will be the prices. In the present study, the longest vase life was observed with the treatment of NAA @ 250 ppm and panchakavya @ 3

ISSN 2394 - 7780

per cent. The higher effectiveness of NAA @ 250 ppm is attributed to higher auxin activity which has been reported to delay senescence and enhance the translocation ofmetabolites.Growth promoting substances like cytokinins and other promoters present in panchakavya might also be responsible for longer vase life of the flowers. These results are in agreement with Renukaradya (2005) in carnation and Rajesh Bhalla*et al*. (2006) in gladiolus. Singh *et al.* (2006) also reported that application of panchkavya recorded increased vase life in gladiolous cv. Jyothi.

Hence, it can be concluded that application of NAA @ 250 ppm+ panchakavya @ 3per cent as foliar spray be the best treatment to improve theyield and quality of goldenrod.

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Table 1. Effect of organic inputs and growth regulators on number of flower stalks/plant and length of flower stalk (cm) of goldenrod

Treatment details	Number of flower stalks/ plant	Length offlower stalk(cm)
T_1-Gibberellic acid @ 300 ppm	19.09	39.09
T_2-Panchakavya @ 3 %	16.78	33.87
T_3-Vermiwash1:5	17.55	35.61
T_4-NAA @ 250 ppm	21.40	44.31
T_5-Humic acid @ 0.2 %	18.32	37.35
T_6-Gibberellic acid @ 300ppm+ Panchakavya @ 3%	22.94	47.79

ISSN 2394 - 7780

T_7-Gibberellic acid @ 300ppm+ Vermiwash1:5	20.63	42.57
T_8-Gibberellic acid @ 300ppm+ Humic acid @ 0.2 %	19.86	40.83
T_9-NAA @ 250ppm + Panchakavya @ 3%	24.48	51.27
T_{10}-NAA @250ppm+ Vermiwash1:5	23.71	49.53
T_{11}-NAA @ 250ppm + Humic acid @ 0.2 %	22.17	46.05
T_{12}-Control	16.01	32.13
SE(d)	0.28	0.77
CD(0.05)	0.57	1.54

Table 2. Effect of organic inputs and growth regulators on weight of individual flower stalk and flower stalk cone length (cm) of goldenrod

Treatment details	Weight of individual flower stalk (g)	Flower stalk cone length (cm)
T_1-Gibberellic acid @ 300 ppm	9.37	22.79
T_2-Panchakavya @ 3 %	8.35	20.06
T_3-Vermiwash1:5	9.69	20.97
T_4-NAA @ 250 ppm	10.39	25.52
T_5-Humic acid @ 0.2 %	9.03	21.88
T_6-Gibberellic acid @ 300ppm+ Panchakavya @ 3%	11.07	27.34
T_7-Gibberellic acid @ 300ppm+ Vermiwash1:5	10.05	25.61
T_8-Gibberellic acid @ 300ppm+ Humic acid @ 0.2 %	9.71	23.70
T_9-NAA @ 250ppm + Panchakavya @ 3%	11.75	29.16
T_{10}-NAA @250ppm+ Vermiwash1:5	11.41	28.25
T_{11}-NAA @ 250ppm + Humic acid @ 0.2 %	10.73	26.43
T_{12}-Control	8.01	19.15
SE(d)	0.07	0.35
CD(0.05)	0.14	0.71

Table 3. Effect of organic inputs and growth regulators on duration of flowering (days) of goldenrod

Treatment details	Duration of flowering (days)
T_1-Gibberellic acid @ 300 ppm	112.79
T_2-Panchakavya @ 3 %	103.31
T_3-Vermiwash1:5	106.47
T_4-NAA @ 250 ppm	122.27
T_5-Humic acid @ 0.2 %	109.63
T_6-Gibberellic acid @ 300ppm+ Panchakavya @ 3%	128.59
T_7-Gibberellic acid @ 300ppm+ Vermiwash1:5	119.11
T_8-Gibberellic acid @ 300ppm+ Humic acid @ 0.2 %	115.95
T_9-NAA @ 250ppm + Panchakavya @ 3%	134.91
T_{10}-NAA @250ppm+ Vermiwash1:5	131.75

ISSN 2394 - 7780

T_{11}-NAA @ 250ppm + Humic acid @ 0.2 %	125.43
T_{12}-Control	100.15
SE(d)	1.48
CD(0.05)	2.96

Table 4. Effect of organic inputs and growth regulators on dry matter production (g) and vase life (days) of goldenrod

Treatment details	Dry matter production (g)	Vase life (days)
T_1.Gibberellic acid @ 300 ppm	10.76	4.43
T_2-Panchakavya @ 3 %	8.78	3.44
T_3-Vermiwash1:5	9.44	3.77
T_4-NAA @ 250 ppm	12.74	5.42
T_5-Humic acid @ 0.2 %	10.10	4.10
T_6-Gibberellic acid @ 300ppm+ Panchakavya @ 3%	14.06	6.08
T_7-Gibberellic acid @ 300ppm+ Vermiwash1:5	12.08	5.09
T_8-Gibberellic acid @ 300ppm+ Humic acid @ 0.2 %	11.42	9.76
T_9-NAA @ 250ppm + Panchakavya @ 3%	15.38	6.74
T_{10}-NAA @250ppm+ Vermiwash1:5	14.72	6.41
T_{11}-NAA @ 250ppm + Humic acid @ 0.2 %	13.40	5.75
T_{12}-Control	8.12	3.11
SE(d)	0.23	0.06
CD(0.05)	0.46	0.13

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EFFECT OF BIOSTIMULANTS ON PHYSIOLOGICAL AND QUALITY PARAMETERS OF CARROT (Daucus carota L.) VAR. EARLY NANTES

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ABSTRACT
A field experiment was conducted in the Kethorai village, Coonoor, The Nilgiri district of Tamilnadu, during 2017 to 2018 to study the effect of biostimulants on physiological and quality parameters of carrot. The experiment was laid out in randomized block design (RBD) with ten treatments and replicated thrice. The treatments includes various sources of biostimulants viz. Humic acid, Chitosan, Sea weed extract, Effective microorganisms and Panchagavya were given as foliar application on three stages viz., first spray on 2 leaves stage, second spray on 5-7 leaves stage and third spray on when root attains 5-6 diameters in size. The various physiological and quality parameters were recorded. The results of the experiment revealed that the physiological parameter of Chlorophyll content in leaves (mg g^{-1}) and quality parameters viz., TSS Content (° brix) and Juice yield (ml / kg) were favorably influenced with foliar application of sea weed extract at a concentration of 3ml per litre.

Keywords: Carrot, Biostimulants, TSS, Foliar spray.

INTRODUCTION
Carrots are the major single source of Vitamin A in the diets of many cultures. This is one of the reasons of widespread cultivation of this crop. They are also a good source of other vitamins, minerals and fiber. Carrots are produced for a variety of uses. Fresh market production for retail sales is still an important market. Fresh packed articles include peeled baby carrots, carrot sticks, shredded carrots and salad mixes. Processing markets include baby food production, frozen and canned products. Carrots are popular as snack foods, for deli trays, in salads, cooked in casseroles, as main vegetable dishes as well as numerous other culinary creations.

Plant biostimulants are organic materials that appear to impact several metabolic procedures such as respiration, photosynthesis, nucleic acid synthesis and ion uptake and when applied in small quantities, improve the plant growth and development or in other words, a mixture of two or more PGRs or combination of these with other substances (amino acids, nutrients, vitamins) is known as a plant growth promoter or plant biostimulant. Plant biostimulants are effective when applied in small doses, thus leads to the plant growth, and production enhancement [1] In general, they stimulate metabolic processes for more yields in plants [2].

MATERIALS AND METHODS
The experiment on "Effect of biostimulants on physiological and quality parameters of carrot" (*Daucus carota* L.) var. Early Nantes was carried out in the Kethorai village, Coonoor, The Nilgiri district of Tamilnadu. The experiment was carried out during 2017 - 2018. The treatments includes various sources of biostimulants *viz.* Humic acid, Chitosan, Sea weed extract, Effective microorganisms and Panchagavya were given as foliar application on three stages *viz.,* first spray on 2 leaves stage, second spray on 5-7 leaves stage and third spray on when root attains 5-6 diameters in size. The physiological and quality characters were recorded. The observations collected during the experiment in respect of crop were statistically analyses using the procedure given by [3]. The IRRISTAT software was used for the statistical analysis of the data.

TREATMENT DETAILS ARE GIVEN BELOW

Treatments	
T_1	Humic acid (3%)
T_2	Humic acid (2%)
T_3	Chitosan (100ppm)
T_4	Chitosan (150ppm)
T_5	Sea weed extract (3ml / litre)
T_6	Sea weed extract (2ml / litre)
T_7	Effective microorganisms (1:1000)
T_8	Panchagavya (3%)
T_9	Panchagavya (5%)
T_{10}	Control

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RESULTS

Application of various biostimulants significantly influenced the yield parameters of carrot var. Early nantes. The physiological character of chlorophyll content in leaves (mg g^{-1}) and quality parameters *viz.*, TSS Content (° brix) and Juice yield (ml / kg) *viz.*, were significantly influenced by various treatments. The highest total chlorophyll content (0.98 mg g^{-1}), juice yield (433.56 ml/kg) and total soluble solids (11.52 ° brix) were recorded in the treatment T_5 which received sea weed extract @ 3 ml. The lowest chlorophyll content (0.41 mg g^{-1}), juice yield (270.21 ml/kg) and total soluble solids (6.72 ° brix) were recorded in the treatment T_{10} – control.

DISCUSSION

The organic constituents of sea weed extract include plant hormones which elicit strong physiological responses in low doses. Application of sea weed extract produced leaves with higher chlorophyll content, this increase in chlorophyll content was a result of reduction in chlorophyll degradation, which might be caused in part by betaines in the sea weed extract. Similar results found by [4], [5], [6].

Enhanced total soluble solids in best treatment is due to carbohydrates, protein, free amino acids, polyphenols and nitrogen content in sea weed extract treated plants. Sea weed extract improved TSS by enhancing the glucose accumulation which might be due to the presence of micro elements such as zinc, manganese and copper in sea weed extract. [7], [8] plants treated with seaweed improved concentration of carbohydrates, proteins, free amino acids, polyphenols and nitrogen content while comparing with control plants. Seaweed extracts are ecologically safe, non-polluting, non-toxic, and harmless to human beings. Similar findings by [9], [10].

Table 1.Effect of biostimulants on physiological and quality parameters of carrot

S.no.	Total chlorophyll content (mg g^{-1})	Juice yield (ml / kg)	Total soluble solids (°brix)
T_1	0.49	369.53	7.34
T_2	0.46	358.54	6.60
T_3	0.89	423.34	10.79
T_4	0.68	398.29	9.07
T_5	0.98	433.56	11.52
T_6	0.71	402.54	9.30
T_7	0.58	380.19	8.07
T_8	0.80	413.09	10.05
T_9	0.60	387.74	8.29
T_{10}	0.41	270.21	6.72
S.Ed	**0.04**	**5.06**	**0.36**
CD (p=0.05)	**0.08**	**10.12**	**0.72**

CONCLUSION

Based on the present investigation, it can be concluded that foliar application of sea weed extract of 3ml/ litre can improve the physiological and quality parameters of carrot and it could be recommended to the farmers for obtaining good quality carrots.

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FACTORS INFLUENCING THE KNOWLEDGE LEVEL OF THE TRIBAL FARMERS ON INDIGENOUS CULTIVATION PRACTICES

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ABSTRACT
Indigenous cultivation practices are gradually gaining more and more attention due to they evolve in close contact with specific environmental conditions and are based on traditional societies intimate knowledge of their environment. These reasons imply that an indigenous cultivation practice is almost an essential condition for sustainable development. Keeping these view the study was taken up toasses the relationship of characteristics of tribal farmers with knowledge level on indigenous cultivation practices. The study was conducted in Namakkal district of Tamil Nadu state. Kolli Hills has been selected for the study. Kolli Hills had sixteen revenue tribal villages and five villages were purposively selected based upon its maximum tribal population. For the selection of the respondents based on the proportionate random sampling technique was followed to select a sample size of one hundred and twenty respondents. A total of 41 indigenous cultivation practices were identified for this study and they were paddy'26, tapioca'5, ragi'5 and banana'5 Indigenous cultivation practices. The study comprises of the twelve independent variables. Out of twelve variables taken for the analysis of the relationship of characteristics of respondents with knowledge level, six variables namely age, educational status, farm size, farming experiences, livestock possession and fatalism exhibited significant relationship with the knowledge level of the respondents. The study presents an understanding about attitude of tribal farmers and their indigenous technical knowledge in Kolli Hills.

Keywords: Indigenous cultivation practices, Tribal farmers, and Sustainable agriculture.

INTRODUCTION
Indigenous cultivation practices are gradually gaining more and more attention, after having often been rejected as a hindrance to development. The importance now being given to such indigenous cultivation practices is due to the fact that these emanate from the cultural context of the people concerned, and they evolve in close contact with specific environmental conditions and are based on traditional societies' intimate knowledge of their environment. These reasons imply that an indigenous cultivation practice is almost an essential condition for sustainable development. Indigenous technical knowledge refers to the knowledge of indigenous people as well as any other defined community. It is derived from the direct experience of tribals and which is limited to a particular place / location but its sustainability in other localities is not known. This has been accumulated by the people over generations by observation and experimentation and traditional wisdom in any particular human endeavour (Thomas Odhiambo, 1990)**.** The tribal development measures adopted during the second half of this century arefound to be insufficient in improving the economic conditions of the tribals. Even after the introduction of several welfare measures, the tribals are still facing several economic and social constraintsKeeping this point in mind the present study was taken up with the main objective to study the relationship with characteristics of tribal farmers towards knowledge level of indigenous cultivation practices.

RESEARCH METHODOLOGY
This study was conducted in Namakkal district of Tamil Nadu. Namakkal district is comprised of seventaluks and fifteen blocks, among the seven taluks and fifteen blocks, higher population of tribals were noticed in Kolli hills. Hence, Kolli hills was purposively selected for this present study. In Kolli hills, there were sixteen revenue tribal villages .It was decided to choose top five villages from sixteen villages based on the maximum tribal population as the criteria. The villages namely, Ariyurnadu, Valappurnadu, Peraikkarainadu, Thiruppulinadu and Gundurnaduwere selected for the present study. 120 tribal farmers were selected from the five selected villages for this study by proportionate random sampling method. Based on the rating by judges twelve independent variables were selected for this study and they wereage, educational status, occupational status, annual income, farm size, farming experience, extension agency contact, livestock possession, Cosmopoliteness, fatalism, risk orientation and scientific orientation.48 indigenous cultivation practices were selected for testing the knowledge level of the respondents and they were paddy 29, tapioca 6, ragi 6 and banana 7 indigenous cultivation practices.

FINDINGS AND DISCUSSION
The zero-order correction coefficient and multiple regression analysis were worked out to study the association and contributionof characteristics of respondents with their knowledge level on indigenous cultivation practice are presented in Table-1

ISSN 2394 - 7780

Table-1. Association and contribution analysis of characteristics of respondents with their knowledge level of indigenous cultivation practices (n = 120)

Var. No.	Variables	'r' values	Standardised regression co-efficient	Standard error	't' values
X_1	Age	0.199*	0.586	0.288	2.034*
X_2	Educational status	0.205*	1.568	0.714	2.196*
X_3	Occupational status	0.265 NS	0.420	0.500	0.840 NS
X_4	Annual income	0.079 NS	-0.089	0.091	-0.883 NS
X_5	Farm size	0.205*	0.180	0.108	1.724*
X_6	Farming experiences	0.271**	2.486	1.128	2.203**
X_7	Extension agency contact	0.102 NS	1.086	1.000	1.086 NS
X_8	Livestock possession	0.196*	0.548	0.286	1.916*
X_9	Cosmopoliteness	0.073 NS	0.019	0.079	0.178 NS
X_{10}	Fatalism	0.254*	0.496	0.248	2.000*
X_{11}	Risk orientation	0.104 NS	0.045	0.039	1.126 NS
X_{12}	Scientific orientation	0.145 NS	0.161	0.120	1.002 NS

a=7.506 R^2= 0.542 F =7.128**

* - Significant at 0.05 per cent level of probability

** - Significant at 0.01 per cent level of probability

NS - Non significant

ASSOCIATION OF CHARACTERISTICS OF THE RESPONDENTS WITH THEIR KNOWLEDGE LEVEL ON INDIGENOUS CULTIVATION PRACTICES

It could be observed from the Table-15, that all the twelve characteristics together explained the variation in the knowledge level of respondents. Out of twelve variables taken for the analysis, six variables namely age (x_1), educational status (x_2), farm size (x_5), farming experiences (x_6), livestock possession (x_8) and fatalism (x_{10}) exhibited significant relationship with the knowledge level of the respondents. Remaining variables were found to be non-significant.Among the significant variables, farming experience (x_6) were found to have positive and significant association at one per cent level of probability, where as remaining five variables viz., age (x_1), educational status (x_2), farm size (x_5), livestock possession (x_8) and fatalism (x_{10}) were found to have positive and significant association at five per cent level of probability.

Age showed a positive and significant relationship with knowledge level on indigenous cultivation practices at 0.05 per cent level probability. As older farmer had more experience on indigenous cultivation practices, they might have gained adequate knowledge level on indigenous cultivation practices. This findings is in line with the findings of Dharmendra Kumar Sariya (2015).Educational status showed a positive and significant relationship with knowledge level on indigenous cultivation practices at 0.05 per cent level probability. It is quite natural that the educated respondents might have perceived information faster than others and thus would have paved the way for better knowledge level on indigenous cultivation practices. This findings is in line with the findings of Sathish Kumar (2016).Farm size showed a positive and significant association with knowledge level on indigenous cultivation practices at 0.05 per cent level probability. As most of them were involved in farming directly as they possessed only small and marginal land holding, they would have been interested to seek and gain more knowledge level on indigenous cultivation practices. This finding coincides with the findings of Moktan and Sidhartha (2012).Farming experience showed positive and significant relationship with knowledge level on indigenous cultivation practices at 0.01 per cent level probability. High level of experience in indigenous farming would have certainly enhanced their knowledge level on indigenous cultivation practices. This finding is in line with the findings of Sathish Kumar (2016).Livestock possession showed positive and significant relationship with knowledge level on indigenous cultivation practices at 0.05 per cent level probability. Most of the farmers were engaged in dairy farming activities and majority belonged to high category of livestock possession. This would have resulted with the obtained result on livestock possession. This result is supported with the results of Ruchi and Singh (2014).Fatalism showed positive and significant relationship with knowledge level on indigenous cultivation practices at 0.05 per cent level probability. The tribal peoples are traditional bounded people and they are very much interested in their customs, norms, mores, folkways and taboos. This finding is in line with the findings of Venkatesan*et al.* (2014).

ISSN 2394 - 7780

CONTRIBUTION OF CHARACTERISTICS OF THE RESPONDENTS WITH THEIR KNOWLEDGE LEVEL ON INDIGENOUS CULTIVATION PRACTICES

Correlation analysis will explain only the nature of association of characteristics of the respondents with their knowledge level on indigenous cultivation practices. In order to find out the relative contribution of each variable towards knowledge level, multiple regression analysis was performed and the results are presented in Table-1.

The perusal of regression co-efficient and 't' value in Table-1 indicates, that out of twelve characteristics, only six variables namely age (x_1), educational status (x_2), farm size (x_5), farming experiences (x_6), livestock possession (x_8) and fatalism (x_{10}) had contributed towards the knowledge level of the respondents. Among the six variables, farming experiences (x_6), had shown significant and positive relationship at one per cent level of probability. Another five variables viz., age (x_1), educational status (x_2), farm size (x_5), livestock possession (x_8) and fatalism (x_{10}) contributed significantly and positively at five per cent of probability towards the knowledge level of indigenous cultivation practices.

The predictive power of the linear multiple regression was estimates with the help of the co-efficient of multiple determination (R^2= 0.542). The R^2 value indicated that all the twelve variables taken together explained as much 54.20 per cent of variation in the knowledge level of indigenous cultivation practices. The 'F' value was found to be significant at 0.01 per cent level of probability. Hence, the higher R^2 value might be due to significant and positive correction co-efficient of age (x_1), educational status (x_2), farm size (x_5), farming experience (x_6), livestock possession (x_8) and fatalism (x_{10}).It was also be inferred that when all other variables were kept at constant level, a unit increase in age (x_1), educational status (x_2), farm size (x_5), farming experience (x_6), livestock possession (x_8) and fatalism (x_{10}) would result respectively in an increase of 0.586, 0.568, 0.180, 2.486, 0.548 and 0.496 units of knowledge level of indigenous cultivation practices respectively. This meant that the respondents who had more age (x_1), educational status (x_2), farm size (x_5), farming experience (x_6), livestock possession (x_8) and fatalism (x_{10}) would have higher level of knowledge on indigenous cultivation practices. This finding is accordance with that of ChigasilSangma (2017).

Hence, it may be conclude that age (x_1), educational status (x_2), farm size (x_5), farming experience (x_6), livestock possession (x_8) and fatalism (x_{10}) were the crucial variables influencing the knowledge level of the respondents on indigenous cultivation practices.The other variables did not show significant effect on the knowledge level of indigenous cultivation practices.

The prediction equation is as follows.

$$Y= 7.506 + 0.586X_1 + 1.568X_2 + 0.420X_3 - 0.089X_4 + 0.180X_5 + 2.486X_6 + 1.086X_7 + 0.548X_8 + 0.019X_9 + 0.496X_{10} + 0.045X_{11} + 0.161X_{12}$$

CONCLUSION

Out of twelve variables taken for the analysis, six variables namely age, educational status, farm size, farming experiences, livestock possession and fatalism exhibited significant relationship with the knowledge level of the respondents. Remaining variables were found to be non-significant. The similar variables were contributed positively and significant with the dependent variable in leaner multiple regression analysis.

Indigenous technical knowledge have strong roots in rural culture. The study reveals that there were more than 130 indigenous technical knowledge items available related to paddy, ragi, tapioca, banana, pulses, horticultural crops and weather forecasting in agriculture, which may serve as alternatives to modern technologies. Hence, the extension workers should identify and include them in the technology transmission process for sustainable agricultural development and also coming forward to involve in participatory approach, through supplying/conducting, publications, meetings, seminars, workshops, conferences, symposium etc, to get aware of indigenous cultivation practices.

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ROLE PERFORMANCE OF FARM WOMEN IN COTTON FARMING OPERATIONS IN SALEM DISTRICT OF TAMIL NADU

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ABSTRACT
Cotton is the world's most popular textile raw material and referred to as the "King of fibers" or "White gold". Worldwide cotton is grown in over 100 countries. The cotton is grows well under (warm) tropical climate, with long dry season (over three months) followed by sufficient rains. Production wise it supplies 18.00 per cent of the world cotton, about 4,59 million tons per year. Cotton crops stand for about 14-16.00 per cent of the total crops in India and 4,5 million farmers and 60 million people in total get their income from cotton (Agarwal 2007). Women referred as 'invisible farmers' are the backbone of agricultural work force in our country. Be it in crop farming, animal husbandry, fisheries, forestry or any allied agricultural activities, women do the most tedious and strenuous tasks. That women play a significant and crucial role in agricultural development and allied fields including in the main crop production, livestock production, horticulture, post-harvest operations, agro/ social forestry, fisheries, etc. The study was conducted in Salem district of Tamil Nadu. A sample size of 120 small farm women was selected by using proportionate random sampling technique. Whereas, cent per cent of the farm women were involved in thinning, gap filling, hand weeding, pinching of terminal bud and picking the kapas.

Keywords: farm women, cotton farming and role performance.

INTRODUCTION
Cotton is an important cash crop and source of livelihood. Cotton is the world's most popular textile raw material and referred to as the "King of fibres" or "White gold". Worldwide cotton is grown in over 100 countries. The cotton is grows well under (warm) tropical climate, with long dry season (over three months) followed by sufficient rains. Cotton accounts for nearly half of the world's textile production and is a vital part of many economies (WWF 2013). Cotton production is the main source of income for approximately 100 million families in over 70 countries. However, developing countries are struggling on the cotton market. Cotton is also the first crop in India and it has 9 million hectares of land under cotton making it the country with the largest area under cotton in the world, accounting for about one fourth of the world cotton area. Production wise it supplies 18.00 per cent of the world cotton, about 4, 59 million tons per year. Cotton crops stand for about 14-16.00 per cent of the total crops in India and 4, 5 million farmers and 60 million people in total get their income from cotton (Agarwal 2007).

Women referred as 'invisible farmers' are the backbone of agricultural work force in our country. Be it in crop farming, animal husbandry, fisheries, forestry or any allied agricultural activities, women do the most tedious and strenuous tasks. Women have played and continue to play a key role in the conservation of basic life support systems such as land, water, flora and fauna. They have protected the health of the soil through organic recycling and promoted crop security through the maintenance of varietal diversity and genetic resistance. That women play a significant and crucial role in agricultural development and allied fields including in the main crop production, livestock production, horticulture, post-harvest operations, agro/ social forestry, fisheries, etc. Hence the present paper was formulated and analyses the 'role performance of farm women in cotton farming operations in Salem district of Tamil Nadu.

MATERIALS AND METHODS
The study was conducted in Salem district of Tamil Nadu. A sample size of 120 small farm women was selected by using proportionate random sampling technique. The role performance of the farm women was studied. The required data were collected by personal interview utilising a well structured and pre-tested interview schedule. Besides that the group discussion and observations were also used for data collection. The collected data were tabulated and analysed using appropriate statistical tools viz., percentage analysis.

All the identified roles in the five major areas were referred to 30 judges for assigning scores. Judges were drawn from various university scientists and extension personnel. In the first step, they were asked to allot score for the role items on a five point continuum of 'Most relevant', 'Relevant', 'Somewhat relevant', 'Least relevant' and 'Not relevant' by allotting scores of 5, 4, 3, 2 and 1 respectively. Those items whose mean score was above the overall mean score were selected.

ISSN 2394 - 7780

The performance categories varied in their efforts required on the part of the farm women to perform the role in cotton farming operations. Keeping this in mind, an arbitrary scoring was allotted as follows:

Response	Score
Self doing	3
Jointly doing	2
No participation	1

Each respondent was asked to indicate the roles performed by her. She was also requested to indicate the performance category under which, each role was performed by her. Utilising the data, percentage analysis was taken up to asses the role performance of farm women. Further, mean percentage was calculated for each of the major role area. Overall mean percentage was also worked out to make interpretations simple and easy.

RESULTS AND DISCUSSIONS

Overall role performance of farm women in cotton farming operations

The information on the overall involvement of farm women in cotton farming and the results were collected and presented in Table-1.

Table-1. Distribution of farm women according to their overall role performance in cotton farming operations. (n=120)

S.No.	Category	Number	Per cent
1	Low	40	33.33
2	Medium	60	50.00
3	High	20	16.67
Total			**100.00**

A glance at the data in Table-1, showed that half of the farm women (50.00 per cent) fell under medium level of role performance in cotton farming operations. Whereas, one-third of the farm women (33.33 per cent) came under low level. While remaining 16.67 per cent of the farm women were under high level of role performance.

From the results, it was observed that nearly seventy per cent of the farm women fell under medium to high level of role performance in cotton farming operation. This might be due to the fact that most of these technologies were women oriented operations and these technologies could be learnt easily by the farm women without any difficulty as they were involved in these technologies right from their early age days.

This finding is supported by the findings of Khatun *et al.* (2014) who also reported that majority of the farm women had medium level of role performance in cultivation of fruit trees.

Practisewise role performance of farm women in cotton cultivation

The role performance of farm women in cotton cultivation practices are carried out in the following aspects viz., land preparation, planting, inter-cultivation, harvest and marketing. The data were collected, processed and discussed in Table-2.

Table-2. Role performance of farm women in cotton cultivation (n=120)

S.No	Role items	Number	Per cent
1.	**Field preparation**		
	i) Stubble collection	61	50.83
	ii) Application of FYM	40	33.33
	iii) Cleaning the field boundaries	25	20.83
	Mean percentage		**34.99**
2	**Planting**		
	i) Selection of seeds	102	85.00
	ii) Removal of fuzz from seeds	120	100.00
	iii) Seed hardening	30	25.00
	iv) Arranging labourers	55	45.83
	v) Seed treatment with chemicals	75	62.50
	vi) Seed treatment with bio-fertilizers	90	75.00
	vii) Sowing the seeds	120	100.00
	Mean percentage		**70.47**
3.	**Inter-cultivation**		
	i) Application of fertilizers	49	40.83

ISSN 2394 - 7780

	ii) Irrigation	10	8.33
	iii) Thinning	120	100.00
	iv) Gap filling	120	100.00
	v) Hand weeding	120	100.00
	vi) Cleaning the irrigation channels	30	25.00
	vii) Earthing-up	72	60.00
	viii) Top dressing	25	20.83
	ix) Plant protection measures	10	8.33
	x) Application of growth regulators	20	16.66
	xi) Pinching of terminal bud	120	100.00
	Mean percentage		**52.72**
4.	**Harvest**		
	i) Picking	120	100.00
	ii) Shade drying	95	79.16
	iii) Cleaning the kapas	85	70.83
	iv) Grading the kapas	90	75.00
	v) Transporting to storage house	78	65.00
	vi) Bagging	100	83.33
	vii) Storing	110	91.66
	Mean percentage		**80.71**
5.	**Marketing**		
	i) Transporting to the market	30	25.00
	ii) Marketing	45	37.50
	Mean percentage		**31.25**
	Overall mean percentage		**54.02**

FIELD PREPARATION

There are three sub-practices under land preparation viz., stubble collection, cleaning the field boundaries and application of FYM. Among these roles, the farm women were involved to a greater extent in stubble collection (50.83 per cent) compared to application of FYM (33.33 per cent) and cleaning the field boundaries (20.83 per cent).

It may be observed that the task performed by the farm women of cotton farming operation under field preparation was negligible in certain activities and hence the mean percentage was also found to be only 34.99 per cent. It might be due to the fact that these activities would required arduous efforts with more physical strain on the part of the doers. Thus, the farm women would have performed this task to a lesser magnitude.

This finding is in confirmation with that of Sarita Singh (2015) who reported that most of the farm women were involved in energy saving and less drudgery involving activities.

PLANTING

It could be seen from the Table-2, that under planting operations in cotton, cent per cent of the farm women were involved in removal of fuzz from seeds and sowing the seeds. More than eighty per cent of the farm women had performed the task of selection of seeds (85.00 per cent). Three-fourth of them were (75.00 per cent) involved in seed treatment with bio-fertilizers followed by seed treatment with chemicals (62.50 per cent) and arranging the labours (45.83 per cent). One-fourth of the farm women (25.00 per cent) were involved in seed hardening.

From the perusal of the results, it may be concluded that a higher percentage of farm women were involved in planting operations. Most of the activities in planting operations is gender neutral and can be performed by women and men alike, that is why the mean percentage value was also on the increase (70.47 per cent). Farm women had jointly involved in application of fertilizers, seed hardening and treatment of seeds with chemicals and bio-fertilizers as they were men-oriented activities.

This finding corroborates with the findings of Arun Khatri (2019) who also reported that majority of farm women had greater role in planting operations.

INTER-CULTIVATION

It could be observed from the Table-2, that cent per cent of the farm women were involved in thinning, gap filling, hand weeding and pinching of terminal bud. It could be noticed that three-fifth of the women were

ISSN 2394 - 7780

involved in earthing-up (60.00 per cent) and little more than two-fifth of the farm women were engaged in application of fertilizer (40.83 per cent). Whereas, one-fourth of the farm women were involved in cleaning the irrigation channels (25.00 per cent) followed by top dressing (20.83 per cent), application of growth regulators (16.66 per cent), irrigation (8.33 per cent) and plant protection measures (8.33 per cent).

It could be concluded that the overall mean percentage value crossed more than fifty per cent (52.72 per cent) as they had played major role in thinning, gap filling, hand weeding, topping and earthing-up. Irrigation and plant protection practices involved more physical strain and required equipments for operation. Moreover, irrigation and plant protection measure being very arduous task would need strong physique to carry out these operations, which could be possible only by men folk.

This finding is in agreement with the findings of Lipishree Das (2015) who also reported that majority of the farm women had involved in thinning, gap filling and hand weeding in cotton cultivation.

HARVEST

From the data in Table-2, it could be seen that cent per cent of the farm women were engaged in picking the kapas. Most of the women were involved in storing (91.66 per cent), bagging (83.33 per cent) and shade drying (79.16 per cent). More than seventy per cent of the respondents were involved in grading the kapas (75.00 per cent) and cleaning the kapas (70.83 per cent). Nearly two-third of the farm women were involved in transporting to storage house (65.00 per cent).

A high overall mean percentage value of 80.71 was noticed under the major area of harvest as the farm women were engaged in all the sub-practices. Among them, almost all of them were involved in picking and bagging operations. Due to the possession of small sized land holdings, it is quite natural for the farm women to involve in harvesting operations, besides harvest being a traditionally adopted practice by the farm women might be the reasons for their higher involvement.

This finding is in line with the findings of Poonam Abrol *et al.* (2015) who also reported that majority of the farm women had significant role in harvesting and post harvesting operations.

MARKETING

From the Table-2, it could be observed that only little more than one-third of the farm women (37.50 per cent) were engaged in marketing and one-fourth of the farm women (25.00 per cent) had involved in transporting the produce to the markets.

It could observed that only a low overall mean percentage of 31.25 was observed as the women were involved in these activities to a lesser extent. Generally, marketing of produce was carried out by men folk. Women's dual role in farm and home activities together with their low literacy rate and social stigma prohibit the rural women's movement outside the village acted as barriers in the marketing of produce.

This finding is in agreement with the findings of Nasreen Jahan and Nilofer Khan (2016).

CONCLUSION

The role of farm women in cotton farming has always been a multi-dimensional and significant as women have performed well in case of cotton farming activities, domestic activities, marketing activities as far as labour requirement is considered. In view of this the general thought that farm women do not actively participate in decision making in the area identified cannot be agreed to and it can be carefully concluded that farm women are slowly and steadily forging ahead in taking decisions even in crop related activities which were hitherto male domains. Whereas, they contribute a higher proportion of labour in agricultural sector than men. Hence, they are performing almost all activities in farm and off-farm activities.

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STUDIES ON INFLUENCE OF INORGANIC NUTRIENTS AND GROWTH REGULATORS ON GROWTH AND FLOWER ATTRIBUTES OF CELOSIA (CELOSIA CRISTATA L.)

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ABSTRACT
A field experiment on the studies on influence of inorganic nutrients and growth regulators on growth and flower attributes of Celosia (Celosia cristata L.) was conducted in randomized block design at Floriculture unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Tamilnadu. The experiment comprised of 10 treatment combination comprised of recommended dose of fertilizer. Among the various treatments, application of 75% of recommended dose of fertilizer along with foliar spray of gibberllic acid @ 300 ppm was significantly increasing the plant growth parameters viz., plant height (cm), number of lateral shoots, stem girth (cm), internodal length (cm), number of leaves per plant, leaf area (cm^2), chlorophyll content (CCI) and dry matter production (g $plant^{-1}$). Flowering parameters viz, Days taken for first flowering (days), duration of flowering (DAT), number of flower per plant, single flower weight (g), flower head width (cm) and flowers per plant (g) was achieved in Celosia. From the experiment, T_5 with the application of 75 percent of recommended dose of fertilizer along with Gibberllic acid @ 300 ppm could adjudged as the best treatment in performance of Celosia under the open field condition.

Keywords: Vermicompost, Pressmud, Celosia cristata

INTRODUCTION
Celosia (*Celosia cirstata* L.) and is commonly known as cockscomb. It is a small genus of ornamental plants of tropical origin belongs to the Amaranthaceae family. Celosia is often grown as pot plant or as tender bedding plants. Flower heads may be used for making garland, decoration purpose, dried flowers (everlasting flowers) used for vases and in making pot-pourri. Optimum production on limited area of agriculture land is another concern by many small holders of flower cultivation farmers in most part of region. Celosia good export potential, especially to countries like Singapore and Malaysia, where it has a demand, especially during the festival occasions. And it also cultivated for the dry flower production. Healthy and vigorous ornamental plants produce more flowering branches and high yield in a shorter duration. To achieve good quality flower in Celosia, it is necessary to apply the required quantity of nutrients. Balanced nutrition is an important factor for getting higher yield and quality produce. Improper nutrition leading to nutrition imbalance in plants is one of the major factors contributing to low yield in many flower crops. Under normal agro climatic conditions, the deficiency of major nutrients namely *N*, P and K are more common and affect the growth and development of the crop plants.

Inorganic nutrients are the chemical compounds which modify or regulate physiological process in an appreciable measure in plants when used in appropriate quantities. They are readily absorbed and move rapidly through tissues when applied to the soil. (Acharya and Dashora. 2004). Hitherto, inorganic fertilizers have gained wide acceptance in many flower crops for optimizing the yield of plants by modifying growth, development and stress behavior. Hence, strategies such as application of inorganic fertilizer along with optimum quantity of growth regulator are essential to regulate the crop growth continuously. Plant growth regulators are the organic chemical compounds which modify or regulate physiological process in an appreciable measure in plants when used in small concentrations gained wide acceptance in many flower crops. (Bharathi and Kumar .2009). In light of these facts an attempt was made towards finding of the effect of inorganic nutrients and growth regulators on growth and flower attributes of Celosia (*Celosia cirstata* L.) were carried out to evolve an ideal nutrient management by the way to increase the growth and flower production through improved nutrient management techniques.

MATERIALS AND METHODS
The present investigation was under taken to study the effect of inorganic and growth regulators on growth and flower attributes of Celosia (*Celosia cirstata* L.) in the Department of Horticulture, Faculty of Agriculture, Annamalai Nagar in 2016 to 2017. The experiment was laid out in Randomized Block Design (RBD) with 10 treatments and replicated three times (Panse and Sukhatme 1985). The experiment was conducted by using with different levels of 100, 75 and 50 % of recommended dose of inorganic nutrients along with growth regulators as shown in the treatment details of Table 1. The observations are recorded on the selected five plants for a treatment in each replication and the mean data is statistically analyzed.

ISSN 2394 - 7780

Table 1: Treatment details of the experiment

No.	Treatment details
T_1	100 % RDF (100:200:100 kg ha^{-1}) + NAA @ 200 ppm
T_2	75 % RDF (75:150:75 kg ha^{-1}) + NAA @ 300 ppm
T_3	50 % RDF (50:100:50 kg ha^{-1}) + NAA @ 500 ppm
T_4	100 % RDF (100:200:100 kg ha^{-1}) + GA_3@200 ppm
T_5	75 % RDF (75:150:75 kg ha^{-1}) + GA_3@ 300 ppm
T_6	50 % RDF (50:100:50 kg ha^{-1}) + GA_3@ 500 ppm
T_7	100 % RDF (100:200:100 kg ha^{-1}) + CCC @ 200 ppm
T_8	75 % RDF (75:150:75 kg ha^{-1}) + CCC @ 300 ppm
T_9	50 % RDF (50:100:50 kg ha^{-1}) + CCC @ 500 ppm
T_{10}	Control

Table 2: Effect of inorganic nutrients and growth regulators on growth parameters of Celosia (Celosia cirstata L.)

Treatments	Plant height (cm)	No. of lateral shoots	Stem girth (cm)	Internodal length	No. of leaves $plant^{-1}$	Leaf area (cm^2)	Chlorophyll content index (CCI)	Dry matter production (g $plant^{-1}$)
T_1	58.18	13.43	3.84	5.75	89.07	16.54	9.37	27.39
T_2	55.10	10.24	2.36	4.48	83.17	12.43	8.74	17.86
T_3	54.12	12.24	3.44	5.37	79.13	15.34	7.68	22.54
T_4	52.01	10.45	2.44	4.66	81.24	13.01	9.12	24.22
T_5	59.46	14.09	4.26	6.04	97.22	17.72	10.31	29.74
T_6	53.10	11.31	3.07	4.98	85.28	14.21	9.21	25.26
T_7	50.78	9.41	1.89	4.05	75.17	11.23	8.57	22.12
T_8	48.89	7.87	1.23	3.51	69.12	9.35	8.06	20.24
T_9	51.49	8.44	1.45	1.74	71.13	10.05	8.24	20.75
T_{10}	47.87	7.05	1.05	1.17	64.85	8.26	7.74	18.76
S.Ed	0.54	0.42	0.24	0.16	2.03	0.58	0.14	0.62
CD(P=0.05)	1.08	0.86	0.48	0.32	4.06	1.17	0.28	1.24

Table 3: Effect of inorganic nutrients and growth regulators on flower parameters of Celosia (Celosia cirstata L.)

Treatments	Days taken for first flowering	Duration of flowering (days)	No. of flowers $plant^{-1}$	Single flower weight (g)	Flower head width (cm)	Number of flowers $plant^{-1}$ (g)
T_1	27.84	43.38	15.73	6.74	5.64	118.27
T_2	34.48	37.61	11.28	6.52	5.22	92.56
T_3	29.74	41.74	14.48	6.05	5.51	106.98
T_4	33.54	38.43	13.94	6.03	5.31	95.64
T_5	26.04	45.06	17.02	7.99	6.03	127.33
T_6	31.64	40.07	13.18	6.53	5.57	86.81
T_7	31.72	35.98	10.04	4.24	5.14	72.34
T_8	39.24	33.48	8.10	4.53	4.93	57.13
T_9	38.30	34.32	8.64	4.95	5.03	62.22
T_{10}	41.13	31.83	7.82	4.04	4.71	44.93
S.ED	0.92	0.79	0.60	0.22	0.05	4.01
CD(P=0.05)	1.84	1.48	1.20	0.44	0.10	8.30

RESULT AND DISSCUSSION

The research study of celosia on the use of inorganic nutrients along with growth regulators significantly influenced the growth and flowering parameters. The data and the result on the effect of these nutrients on

ISSN 2394 - 7780

growth and flower attributes of Celosia (*Celosia cirstata* L.) and their observation recorded on all growth parameters is present in (Table 2) *viz*., plant height (cm), number of laterals shoots, stem girth (cm), internodal length (cm), leaf area (cm^2), chlorophyll content (CCI) and dry matter production (g $plant^{-1}$). The plant observation on flower parameters present in (Table 3) *viz*., days taken first flowering (days), duration of flowering (days), number of flower per plant, single flower weight (g), flower head width (cm) and flowers per plant (g).

Growth parameters

In plant height which is maximum occurred (59.46 cm) in T_5 with the application of 75% recommended dose of inorganic nutrients along with foliar application of Gibberlic acid @ 300 ppm followed by treatment (T_1) (58.18 cm). It was much minimum in T_{10} control (47.87 cm). The highest number of lateral shoots (14.09), stem girth (4.26 cm), intermodal length (6.04 cm), number of leaves per plant (97.22) and leaf area (17.72 cm^2). The reason for the highest value in the best treatment (T_5) could be due to combined application of organic and inorganic nutrients. Inorganic nutrients owing to its surplus nutritive content enhanced beneficial in soil nutrients and increase the plant growth. Hence it can be used as best source of inorganic nutrients for flower productivity as reported by Rathika mittal *et al*., (2010) in African marigold, Yathindra *et al.* (2016) in Bird of paradise. This may be due to increased supply of major plant nutrients which are present in both inorganic fertilizers and growth regulators which are required in larger quantities for the growth and development of plant, the application of nitrogen at optimum level attributed to acceleration in development of growth and reproductive phases. Nitrogen which promotes cell division and cell enlargement by which it enhances all the growth parameters. Phosphorus and potassium also play important role in enhancement of more growth it has the key role in synthesis of nucleic acid (DNA or RNA), photosynthesis, proteins, lipids, respiration, sugar, amino acids, energy metabolism and regulation of enzyme.

Application of inorganic nutrients also is a reason for increased chlorophyll content (10.31 CCI) and dry matter production (29.74 g $plant^{-1}$). Application of inorganic nutrients along with gibberllic acid increased the optimum nutrients which is essential for growth of the plant and on the other hand application of other plant growth influencing substances such as plant growth hormone(Gibberllic acid)maximizing all the growth characters . This might be due to nitrogen is an essential part of nucleic acid this plays vital role in promoting the plant growth. It is obvious that phosphorus is a constituent of chlorophyll and is involved in many physiological process including cell division, development of carbohydrates, fats and proteins etc. This was supported by Dhanumjaya Rao *et al.* (2015) in Tuberose,

Flower parameters

Flower parameters *viz*., Days taken for first flowering T_5 (26.04 days), duration of flowering (45.06 days), number of flowers per plant (17.02). In the present study application of inorganic nutrients and gibberllic acid increases the flower parameters. Moreover, higher content of nitrogen might have accelerated protein synthesis, thus promoting earlier floral primordial development. This might be attributed to the enhanced vegetative growth simultaneously increase in flower and quality parameters due to the application of inorganic nutrients along with application of growth regulator. The effectiveness increased with increase in concentrations. This might be attributed to the enhanced vegetative growth in early phase attributed by exogenous application of GA_3 which would have favored the increased photo synthesis and CO_2 fixation. Further, it would have favored convenience of factors influencing floral initiation *i.e*., carbohydrate pathway and photo periodic pathway with GA_3 pathway. This may be due to the accelerated mobility of the photosynthetic from the source to the sink due to the readily available from the growth regulators. (Jinesh Patel *et al*., 2012). Effect of plant growth regulators on flowering and yield of Gladiolus (*Gladiolus grandiflorus* L.) Single flower weight (7.99 g), flower head width (6.03 cm) and flowers per plant (127.33 g) was achieved with the application of inorganic nutrients which augmented the flowering characters. The beneficial effect of inorganic nutrients on plant growth may be due to the presence of easy absorption of nutrients in which the uptake of nutrients is easier by the plants with considerable quantities. It is also the effect of nutrients produced by the inorganic fertilizer which are responsible for stimulating the plant growth. The best treatment was application of inorganic nutrients improved the flower parameters. This may be due to improvement in soil physical properties like bulk density, hardness, porosity, soil pH etc. Improvement in soil properties might have improved all the flower characters. In the present study is in closed agreement with the findings of Acharya and Dashora (2004) in African marigold, Harshavardhan *et al.* (2016) in Carnation

ISSN 2394 - 7780

CONCLUSION

Based on the present investigation it can be concluded that the treatment combination of application of 75% recommended dose of inorganic nutrients along with foliar application of Gibberlic acid @ 300 ppm is best suited to achieve good growth and flowering of Celosia (*Celosia cirstata* L.) in open field condition.

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GENETIC ANALYSIS FOR FRUIT YIELD AND ITS COMPONENT CHARACTERS IN OKRA (Abelmoschus esculentus (L.) Monech)

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ABSTRACT
A full diallel analysis involving six genotypes of okra was used to study the inheritance of fruit yield and its component characters. Data from the parents and F1 crosses were analyzed using Hayman(1954) method of diallel analysis. The estimates of D were significant for plant height, number of fruits per plant and single fruit weight. The values of $\hat{H}_1$ and $\hat{H}_2$ as well as $H_2/4H_1$ indicated that there were unequal frequencies of the alleles at all the loci. The characters viz., plant height, number of primary branches and number of fruits per plant were mostly controlled by most dominant genes. Fruit yield per plant was controlled by both dominant and recessive genes. The narrow sense heritability estimates were high for plant height, number of fruits per plant and fruit yield per plant indicating that these traits could be improved by simple selection. The narrow sense heritability estimates were low for number of branches per plant and single fruit weight indicating the necessity for progeny testing.

Keywords: Okra, fruit yield, diallel, and gene effects.

INTRODUTION
The realm of biometrical genetics has played a vital role in the crop improvement programme through plant breeding. Since majority of the agronomically important traits exhibit continuous variation and their genetical investigation essentially requires the use of biometrical genetical methods. Diallel mating design is used to estimate the genetic component of variation apart from combining ability. A working knowledge of the gene effects controlling the traits related to fruit yield per plant is desirable, before undertaking any major endeavor in okra crop improvement through plant breeding. The present communication reports the gene effects controlling fruit yield and its component characters in okra.

MATERIALS AND METHODS
Six diverse okra genotypes viz., Arka Anamika, Prabhani Kranti, Pusa Sawani, EC 112112, EC 305626 and IC 128076 were mated in a 6 x 6 diallel fashion, resulting in 30 F1 hybrids. These F1 hybrids along with their parents were grown in randomized block design with three replications. Each experimental plot compromised of a single row of 4.5 m length, with a spacing of 4.5 cm length with a row spacing of 60 cm and plant to plant spacing of 45 cm. The crop was maintained under irrigated conditions under normal fertility levels. The data were recorded on five random plants per entry per replication. The genetic parameters were estimated as per Hayman's analysis of dialled crosses (Haymen,1954).

RESULTS AND DISCUSSION
The estimates of D were significant for seven out of ten traits studied. This indicated that the component of variation due to additive genetic variance was important for days to seedling emergence, number of first fruiting node, height of first fruiting node, plant height, days to first picking, number of fruits per plant and single fruit weight (Table 1). These characters could well be improved by resorting to simple selection. The estimates of H1 and H2 were positive and significant for all the characters studied. It indicated that there were unequal frequencies of alleles *i.e.*, $u \neq v$ at all the loci, in this context, '*u*' refers to the frequency of alleles which increase the mean expression of the character and are situated at loci which exhibited dominance. On the other hand '*v*' corresponds to the frequency of alleles at loci that decreases the expression of the character. Further proof of the unequal distribution of the alleles over loci was obtained by the ratio $H_2/4H_1$, which was estimate of $\overline{uv}$. In the present study, $\overline{uv}$ estimates were in the range of 0.18 to 0.22, which is less than the maximum value of 0.25. The maximum value of 0.25 would arise, when $u=v=0.5$. If $u=v$, then $\hat{H}_1 \neq \hat{H}_2$, the increase and decreased alleles are in equal proportion in the parents.In the present study $\hat{H}_1 \neq \hat{H}_2$. The estimates of $\overline{uv}$ were very low. This indicated that positive and negative alleles at the loci exhibiting dominance were not in equal proportion of the parents of interest. However, this estimate did not permit a determination as to which type of alleles occurred more frequently.

The estimates of F was positive but not significant for, plant height , number of branches per plant and number of fruits per plant. This may indicate that the parents of interest had more recessive alleles for these characters. The estimates of F was positive and significant for fruit weight. It indicated the predominance of dominant alleles with parent, for this trait, in this generation. For fruit yield, in this generation, the estimate of F was

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negative, implying that both dominance and recessive genes contributed equally to this trait, with the parents of the present study. The observed ratio of $[(4DH_1)^{y2} + F/ (4DH_1)^{y2} - F]$ indicated that plant height, number of branches per plant, number of fruits per plant and single fruit weight may be controlled by move dominant alleles, whereas fruit yield per plant was controlled by more dominant alleles, whereas fruit yield plant was controlled by equal number of dominant and recessive genes(Table 2). The estimates of h_2 were positive and significant for fruit yield per plant. It indicated the dominance effect expressed as the algebraic sum over all loci as heterozygous phases in all the crosses.

The degree of dominance averaged over all loci $(H_1/D)^{1/2}$ was more than unity for all the traits except plant height. It indicated the presence of over dominance for these traits. Plant height was controlled by almost complete dominance. The estimates of number of effective factors (h^2/H_2) were less than unity for all the traits of interest. This underestimation may be due to the fact the dominance effect of the genes affecting these traits are not equal in size and direction or if the distribution of the genes is correlated (Mather,1949 and Jinks, 1954).

The narrow sense heritability estimates were higher plant height, number of fruits per plant and fruit yield per plant. These characters may be controlled by additive genetic variance. This indicated that the individual genotype can be evaluated readily from their phenotypic expression. Simple selection will be more effective in these sets of materials exhibiting greater additive genetic variability and desirable mean performance. Thus it merits selection in the next generation. On the other hand, the remaining traits may be largely controlled by non-additive genetic variance or these traits may be largely controlled by modifiers. The result indicated that the environmental effects were low and hence, the observed low heritability might be due to other factors other than environment. These traits are hard to improve by selection. It necessitates progeny testing.

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Table 1: Estimates of genetic parameters for ten biometrical traits

S.No	Characters	D	F	$\hat{H}_1$	$\hat{H}_2$	$\hat{h}^2$	$\hat{E}$
1.	Days to seedling emergence	0.34± 0.03**	0.32± 0.07**	0.21± 0.07**	0.13± 0.06	0.05± 0.04	0.01± 0.01
2.	Days to first flowering	2.23± 1.12	3.59± 2.74	15.49± 2.85**	9.99± 2.55**	3.98± 1.71*	0.48± 0.42
3.	Number of branches per plant	0.69± 0.48	0.68± 1.17	4.92± 1.22**	3.90± 1.09**	0.68± 0.73	0.03± 0.18
4.	Number of first fruiting node	1.01± 0.31*	1.85± 0.78*	3.34± 0.80**	1.97± 0.72*	0.17± 0.49	0.02± 0.12
5.	Height of first fruiting node	24.06± 8.15*	12.09± 19.90	61.00± 20.68*	55.49± 18.47*	5.08± 12.43	1.16± 3.08
6.	Plant height	149.27± 9.13**	41.96± 23.30	146.37± 23.17**	130.90± 20.70**	-4.61± 13.93	0.37± 0.45
7.	Days to first picking	4.95± 2.05*	7.46± 5.01	30.64± 5.21**	20.18± 4.65**	8.02± 10.20	0.22± 0.45
8.	Number of fruits per plant	22.90± 6.68**	1.05± 16.33	52.80± 16.97**	46.91± 15.16*	8.70± 10.20	0.79± 2.53
9.	Fruit weight	5.72±1.73*	9.55± 4.22	19.57± 4.39	14.01±3.92**	1.62±2.64	0.44±0.65
10.	Fruit yield per plant	4200.21± 5159.27	-3.882.87± 12604.09	44436.84± 13097.27	39437.45± 11700.12**	10563.52± 78874.95**	73.89± 1950.02

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*Significant at 5% level and ** Significant at 1% level

Table 2.Ratio of genetic parameters for ten biometrical traits

S.No	Characters	(H_1/D)	$H_2/4H_1$	$[(4DH_1)^{y2} + F/ (4DH_1)^{y2} - F]$	h^2/H_2	Heritability in narrow sense (per cent)
1.	Days to seedling emergence	0.80	0.14	4.01	-0.04	13.00
2.	Days to first flowering	2.63	0.16	1.88	0.39	25.00
3.	Number of branches per plant	2.68	0.19	1.45	0.17	23.00
4.	Number of first fruiting node	1.82	0.15	3.02	0.08	10.00
5.	Height of first fruiting node	1.59	0.23	1.37	0.09	25.00
6.	Plant height	0.99	0.22	1.33	-0.03	45.00
7.	Days to first picking	2.49	0.16	1.87	0.39	24.00
8.	Number of fruits per plant	1.52	0.22	1.03	0.18	52.00
9.	Fruit weight	1.85	0.18	2.65	0.11	06.00
10.	Fruit yield per plant	3.25	0.22	0.75	0.27	52.00

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EFFECT OF SPACING AND NITROGEN LEVELS ON FLOWERINGAND YIELD OF GOLDEN ROD (Solidagocanadensis L.)

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ABSTRACT
An experiment was conducted to study the effect of spacing and nitrogen levels on growth parameters of golden rod.The experiment was laid out in a split plot design with twelve treatment combinations which were replicated thrice. The treatments in main plot consisted of three different spacings viz., 45 x 45 cm, 45 x 30 cm and 30 x 30 cm. The sub plot treatments included four levels of nitrogen (0, 100, 150 and 200 kg ha^{-1}) as soil application.Among the interaction effects, the highest values were recorded for number of spikelets flower stalk^{-1}, weight of individual flower stalk, flower stalk length and length of rachis in M_1S_3 (45 x 45 cm spacing along with nitrogen @ 150 kg ha^{-1}). On the other hand, the flower yield hectare^{-1} was highest in M_3S_3 (30 x 30 cm spacing along with nitrogen @ 150 kg ha^{-1}). Whereas the adequate flower quality for using in bouquets and flower arrangements with commendable flower yield was obtained in M_2S_3 (45 x 30 cm spacing along with nitrogen @ 150 kg ha^{-1}).

Keywords: Golden rod, Spacing, Nitrogen

INTRODUCTION
The search for new crops to supplement the income from traditional crops has followed many routes. Cut flower cultivation is one of the alternatives being as alternate income generating activity in many parts of the world (Dufault*et al.* 1990). Golden rod (*Solidagocanadensis* L.) belongs to the family Asteraceae is one among the cut flowers which has got both domestic and export demand. It is native to North America and grows well in all types of climate and soils. It is generally used for flower arrangements and used either singly or with other flowers in flower bouquets. The flowers are also used as dry flowers. As golden rod adds beauty to fields, roadsides and marshy places they are widely used in landscape industry in all parts of the world.

This crop is cultivated in open fields in many parts of floriculture hubs exists in Karnataka, Tamil Nadu, Maharastra, Punjab, Delhi, West Bengal and North eastern states of India. Achieving lengthy spikes with compact clusters of flowers is the vital thing in production of golden rod. In open field cultivation the spike growth can be regulated with nutrients, growth regulators, spacing, weeding and other cultural practices.

The increased productivity of flower crop can appreciably be achieved through adoption of improved cultural practices. It has been established that spacing and nutrients play an important part in overall improvement of growth and yield of many flower crops. In flower crops, their successful cultivation is influenced by various agro techniques including optimum spacing (Patel *et al*., 2006). The optimum spacing helps not only in obtaining increased production of better quality but also in proper utilization of land and other inputs (Ramesh Kumar *et al*., 2003). Therefore, an effort was made to find out the suitable spacing for golden rod to achieve highest flower yield.

Among the various methods to increase productivity of flower crops, plant nutrients play a significant role in the productivity of any crop. Under normal agro-climatic conditions the deficiencies of nitrogen, phosphorus and potassium are more common and pose serious problems in flower production. The nutrient requirement is high during vigorous vegetative growth upto flower bud formation (Kasimirova, 1975). Hence, the nutrient supply should be adjusted to the specific requirements of plants during the various stages of growth to attain maximum levels of yield.

Nutrients such as nitrogen play a major role in the growth and development of plants (Scott 2008). In fact, an adequate supply of N results in vigorous growth of the plant hence yield of flowers with better quality. Thus an attempt was made to study the effect of spacing and nitrogen levels on flowering and yield of golden rod (*Solidagocanadensis* L.).

MATERIALS AND METHODS
The present experiment was conducted in the floriculture unit, Department of Horticulture, Annamalai University to study the effect of spacing and nitrogen levels on flowering and yield parameters of golden rod. The experiment was laid out in a split plot design with twelve treatment combinations which were replicated thrice. The treatments in main plot consisted of three different spacings viz., 45 x 45 cm, 45 x 30 cm and 30 x 30 cm. The sub plot treatments included four levels of nitrogen (0, 100, 150 and 200 kg ha^{-1}) as soil application.

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Locally available golden rod suckers taken from Floriculture Yard, Faculty of Agriculture, Annamalai University were used for planting. It has wide adaptability to different soils and climatic conditions. The required number of healthy, uniform suckers of golden rod was collected from previous grown crop for the experiment. The moderate irrigation was given to the plot a day before planting to keep the plot moist. Suckers were planted at a depth of five cm in each plot with different plant densities (Spacing) depending upon the treatment. Recommended dose of nutrients (N, P and K) were applied in the form of urea (46.4 % N), single superphosphate (16.5% P_2O_5) and muriate of potash (60.0% K_2O) respectively. Fertilizers were applied separately to individual plots as per the plan of treatments. Mild irrigation was given after planting.In each replication, five plants were tagged for observation leaving border rows. Various biometric observations regarding flowering and yield were recorded. The data obtained from the field observations and laboratory experiments were analysed using 'F' test for significance following the method described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The ultimate goal to be achieved in any management system is maximization of the yield. In the present study, it was observed that various levels of spacing, nitrogen and their interactions exhibited significant variation on flowering and yield parameters (Table 1). Significant differences were observed in time taken for first in flowering (earliness) and days taken for 50 per cent flowering. The plants spaced at 30 x 30 cm produced early flowering (64.28 days), while the plants spaced at 45 x 45 cm exhibited earliness in 50 per cent flowering (72.70 days). Cumulative superiority in vegetative parameters viz., plant height, number of side shoots, number of leaves and leaf area must have contributed to early flowering in wider spacings as compared to closer spacings. These results are in line with the findings of Dalvi*et al*. (2008) in gladiolus.

It was interesting to note that the time taken for flowering was earliest (60.35 days) with no application of nitrogen. On the other hand, the days taken for 50 percent flowering were earliest (71.87 days) with the application of N @ 150 kg ha^{-1}.The results are in confirmity with the findings ofGajbhiye*et al*. (2013) in gladiolus.This may be attributed to the fact that earlier plant vigour that could be stimulated by better absorption of abundant nutrients by growing plants results in advancing the flower production as suggested by Chavhan and Gupta (1973) and Mahabaleswar Hedge (1984). Further, earliness in days taken for first flowering with lower dose of nitrogen may be due to the stress created by the non-availability of sufficient quantity of nutrients which might have lead to the early conversion of vegetative phase to reproductive phase.

The results of the present study revealed that the flowers harvested from plants grown at wider spacing of 45 x 45 cm were bigger in size and it was found to decrease with increase in plant population. Other yield components like number of spikelets flower $stalk^{-1}$(59.89), weight of individual flower stalk (136.99 g), flower stalk length (72.64 cm) and length of rachis (67.18 cm) were also maximum at this wider spacing. The results are in confirmity with the findings of Osman and Sewedan (2014) in golden rod. Larger sized flowers in wider spacing could be attributed to the overall superiority of wider spacing in enhancing the vegetative parameters which was due to better utilization of light and soil moisture resulting in production of higher photosynthates and ultimately leading to increased flower size. The decrease in the yield attributing parameters in closer spacing might be due to the higher inter-plant competition which limited the availability of nutrients and light.

However, the flower yield per unit area was higher in closer spacing. The highest flower yield $hectare^{-1}$(4.03 lakh nos.) was recorded in the spacing of 30 x 30 cm when compared to wider spacing. It may be due to the more number of plant population per unit area were accommodated with closer spacing and most of them have produced flowering spikes as suggested by Patel *et al*. (2006) in tuberose. Similar results were reported by Kolodziej (2008) in golden rod.

The yield and yield components like number of spikelets flower $stalk^{-1}$(63.17), weight of individual flower stalk (145.89 g), flower stalk length (76.00 cm), length of rachis (70.77 cm) and flower yield $hectare^{-1}$(3.95 lakh nos.) were significantly influenced by the application of nitrogen @ 150 kg ha^{-1}. Improved nutritional environment for growth and development of the crop resulted in enhancing the yield parameters. The increase of number of florets $spike^{-1}$ might be due to synthesis of amino acid and chlorophyll formation and better carbohydrates transformation which resulted into better growth and better length of rachis which had ultimately produced more number of florets $spike^{-1}$.

Abundant supply of nitrogen at higher level might have accelerated the photosynthetic activities of plants and thus, more assimilates might have been available for flowers to develop, resulting in increased flower weight per plant.The results are in conformity with the findings of ShilpaKokate*et al.* (2011) and Rajput *et al.* (2014) in golden rod.

ISSN 2394 - 7780

Among the interaction effects, the yield components viz., number of spikelets flower stalk^{-1}(78.96), weight of individual flower stalk (185.96 g), flower stalk length (91.54 cm) and length of rachis (83.85 cm) were maximum in M_1S_3 (45 x 45 cm spacing along with nitrogen @ 150 kg ha^{-1}). On the other hand, the flower yield hectare^{-1} (4.73 lakh nos.) was highest in M_3S_3 (30 x 30 cm spacing along with nitrogen @ 150 kg ha^{-1}) and the lowest values for yield parameters were reported in M_1S_1 (45 x 45 cm spacing along with nitrogen @ 0 kg ha^{-1}).Whereas the adequate flower quality for using in bouquets and flower arrangements with commendable flower yield was obtained in M_2S_3 (45 x 30 cm spacing along with nitrogen @ 150 kg ha^{-1}).

CONCLUSION

In the present study, among the treatment combinations M_1S_3 (45 x 45 cm spacing along with nitrogen @ 150 kg ha^{-1}) was superior in decreasing the days to 50 % flowering and increasing number of spikelets flower stalk^{-1}, weight of individual flower stalk, flower stalk length and length of rachis. On the other hand, the flower yield hectare^{-1} was highest in M_3S_3 (30 x 30 cm spacing along with nitrogen @ 150 kg ha^{-1}). Golden rod being used mostly in flower arrangement and bouquet making should have not only more flower stalk length (>75 cm) but also the contrasting and massing qualities (25-30 percent of length with spikelets). Based on the findings of the present study, it could be concluded that planting of golden rod suckers at a spacing of 45 x 30 cm coupled with soil application of nitrogen @ 150 kg ha^{-1} can be recommended for realizing highest flower yield and quality in golden rod crop.

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ISSN 2394 - 7780

Table 1. Effect of spacing and nitrogen levels on flowering and yield of golden rod (SolidagocanadensisL.)

Treatments	time taken for first flowering	days to 50 per cent flowering	Number of spikelets flower stalk^{-1}	Flower stalk length (cm)	Weight of individual flower stalk (g)	length of rachis (cm)	Estimated flower yield ha^{-1} (lakh nos.)
MAIN (M)							
M_1	64.60	72.70	59.89	72.64	136.99	67.18	2.54
M_2	65.86	74.75	48.51	61.32	106.94	58.41	3.34
M_3	64.28	77.84	32.68	45.45	65.82	44.85	4.03
SUB (S)							
S_1	60.35	80.08	21.37	34.31	35.71	35.47	2.35
S_2	64.21	74.81	47.66	60.63	105.64	57.77	3.32
S_3	65.97	71.87	63.17	76.00	145.89	70.77	3.95
S_4	69.13	73.62	55.90	68.28	125.78	64.07	3.58
INTERACTION (MxS)							
M_1S_1	59.42	78.83	26.78	39.73	50.59	39.89	1.66
M_1S_2	62.49	72.24	60.95	73.93	140.55	68.68	2.56
M_1S_3	66.73	68.91	78.96	91.54	185.96	83.85	3.10
M_1S_4	69.78	70.82	72.88	85.37	170.88	78.83	2.84
M_2S_1	60.09	79.96	21.95	34.85	35.95	35.90	2.38
M_2S_2	64.97	74.48	49.55	62.54	110.59	59.96	3.38
M_2S_3	68.15	71.19	66.67	79.64	155.75	73.92	4.04
M_2S_4	70.24	73.37	55.88	68.28	125.48	63.89	3.56
M_3S_1	61.54	81.47	15.38	28.37	20.59	30.62	3.03
M_3S_2	65.18	77.72	32.49	45.42	65.78	44.68	4.04
M_3S_3	63.03	75.53	43.89	56.83	95.96	54.62	4.73
M_3S_4	67.38	76.67	38.96	51.19	80.98	49.49	4.34
CD (P=0.05)							
M	0.21	0.83	2.37	3.23	3.80	1.95	0.16
S	0.13	0.51	1.46	2.00	2.35	1.20	0.10
M x S	0.29	1.12	3.20	4.37	5.13	2.63	0.22
S X M	0.23	0.89	2.53	3.46	4.07	2.09	0.17

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INFORMATION ACQUISITION BEHAVIOUR OF HYBRID COTTON GROWERS OF SALEM DISTRICT

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ABSTRACT
Cotton (Gossypium) is the most widely distributed crop of the world. The is hot and moist climate is ideal for cotton farming. Cotton is a popular cash crop of India and plays a dominant role in the industries and agricultural economy of the country. Cotton is the most important fibre crop not only of India but of the entire world. It provides the basic raw materials (cotton fibre) to the cotton textile industry. Cotton in India provides direct livelihood to six million farmers and about 40-50 million people get employment in cotton trade and its processing. Cotton, one of the principle crops in of our country, play a dominant role in the Indian economy and is vital importance to the nation being provider of employment to millions of farmers. Cotton is also the main raw material for the huge domestic textile industry and hence it makes a significant contribution to our country's economy. The study was taken-up in thalaivasal block of salem district. A sample size of 120 hybrid cotton cultivating farmers were selected and eleaven socio-economic and psychological variables were selected for this study. The overall information acquition behaviour of the respondents observed as 58.33 per cent had medium level, 25.00 per cent with low level and 16.66 per cent of the respondents had high level of information acquisition behaviour. Among the various channels, Discussion with family members (50.00 per cent) and friends and relatives (45.00 per cent) under personal-cosmopolite channels, assistant agricultural officers (31.66 per cent) and agricultural officers (15.00 per cent) under impersonal-cosmopolite channels, Farm broadcast (33.33 per cent) and farm telecast (41.66 per cent) were the important channels utilized by the respondents.

Keywords: Information Management behaviour, cotton growers and channels.

INTRODUCTION
Cotton (*Gossypium*) is the most widely distributed crop of the world. The is hot and moist climate is ideal for cotton farming. Cotton is a popular cash crop of India and plays a dominant role in the industries and agricultural economy of the country. Cotton is the most important fibre crop not only of India but of the entire world. It provides the basic raw materials (cotton fibre) to the cotton textile industry. Cotton in India provides direct livelihood to six million farmers and about 40-50 million people get employment in cotton trade and its processing. Cotton is a water- thirsty crop and around 6.00 per cent of the water for irrigation in India is used for cotton cultivation. Its seed (binola) is used in vanaspati industry and can also be as part of fodder for milch cattle to get better milk. Hybrid cotton is noted for its higher yield and farmers prefer to cultivate hybrid cotton. An effective information management system aids for efficient dissemination of recommended technologies in hybrid cotton cultivation. Cotton, one of the principle crops in of our country, play a dominant role in the Indian economy and is vital importance to the nation being provider of employment to millions of farmers. Cotton is also the main raw material for the huge domestic textile industry and hence it makes a significant contribution to our country's economy. India's cotton exports are expected to jump 43.00 per cent to 10 million bales of (170 kg each) in the year 2018-2019, marketing on strong overseas demand, especially from China according to industry body CIA (Cotton Association of India). Hence, the present paper to deals with Information acquisition behaviour of hybrid cotton growers of Salem district.

METHODOLOGY
The study was taken-up in Salem district of Tamil Nadu. Out of the twenty blocks in Salem district, Thalaivasal block was selected based on the maximum area under hybrid cotton cultivation. A sample size of 120 hybrid cotton cultivating farmers were selected by using proportionate random sampling technique. Eleven socio-economic and psychological variables were selected for this study and they were measured by using appropriate tools and techniques. Information acquisition referred to all such activities performed by an individual for acquiring scientific and technical information . Accordingly, information acquisition in this study referred to all activities performed by a respondent for the acquisition of information in hybrid cotton technologies. The information acquisition behavior was measured as the regularity of contact by the respondents with the use of different channels. The following scoring procedure adopted by Satheeskumar (2013) was used in this study. An inventory on agricultural information acquisition behavior, as a dependent variable was developed and measured on a response continuum as 'Regularly', 'Frequently', 'Occasionally', 'and 'Never' with scoring 4, 3,

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2 and 1 respectively. The score obtained on various information acquisition channels were added to get total score of the respondents on this variable. The data were collected using as well as a structured interview justifiable in the study approach, containing appropriate questions for bringing the required data. Percentage analysis and cumulative frequency method were used for the analysis and interpretation of the data.

FINDNINGS AND DISCUSSION

Overall information Acquisition Behaviour

Overall information Acquisition Behaviour of the respondents are presented in Table-1

Table - 1 : Overall information acquisition behaviour of the respondents. (n=120)

S.No.	Category	Information acquisition behaviour	
		No	Per cent
1	Low	30	25.00
2	Medium	70	58.33
3	High	20	16.66
Total		**120**	**100**

It could be observed from Table-1, that more than fifty per cent of the respondents (58.33 per cent) had medium level of information acquisition behaviour followed by one-fourth of the respondents (25.00 per cent) with low level of information acquisition behaviour and 16.66 per cent of the respondents had high level of information acquisition behaviour.

INFORMATION ACQUISITION BEHAVIOUR

Personal localite channel

Information acquisition behaviour of the respondents analysed under three category based on the nature of channels available namely the personal localite, personal cosmopolite and impersonal cosmopolite channels used by farmers for the acquisition of information with regard to hybrid cotton cultivation. Hence, the respondents were enquired about their information acquisition behaviour and the results are presented in Table-2.

Table - 2 : Information acquisition through personal - localite channels by the respondents (n=120)

S. No.	Personal-localite channels	Regularity of contact							
		Regularly		Occasionally		Rarely		Never	
		No	Per cent	No	Per cent	No	Per cent	No	Per cent
1	Discussion with family members	60	50.00	40	33.33	16	13.33	14	11.66
2	Friends and relatives	54	45.00	16	13.33	38	31.66	12	10.00
3	Neighbours/fellow farmers	42	35.00	36	30.00	18	15.00	24	20.00
4	Progressive farmers	52	43.33	26	21.66	24	20.00	18	15.00
5	Private input dealers	24	20.00	24	20.00	50	41.66	22	18.33

It could be inferred from Table-2, that the respondents regularly utilised source were discussion with family members (50.00 per cent) followed by friends and relatives (45.00 per cent), progressive farmers (43.33 per cent) input dealers (41.60) and neighbours and fellow farmers (35.00 per cent). This findings revealed that most commonly used personal-localite channels for information acquisition by the respondents were family members, friends and relatives. This might be due to the close proximity and frequent interaction. And another

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possible reason is the above said sources were available in within village. The family members, friends and relatives were the foremost credible personal-localite sources of utilised by the cotton growers.

Personal-cosmopolite channels

Various personal-cosmopolite channels used by the respondents for information acquisition are presented in Table-3.

Table-3. Information acquisition through personal-cosmopolite channels by the respondents (n=120)

S. No.	Personal-cosmopolite channels	Regularity of contact							
		Regularly		Occasionally		Rarely		Never	
		No	Per cent	No	Per cent	No	Per cent	No	Per cent
1	Discussion with assistant agricultural officers	38	31.66	44	36.66	30	25.00	8	6.66
2	Discussion with agricultural officers	18	15.00	42	35.00	46	38.33	14	11.66
3	Discussion with assistant director of agriculture	2	1.66	34	28.33	44	36.66	44	36.66
4	Specialist from university	-	-	26	21.66	54	45.00	40	33.33
5	Scientist from other research station	2	1.66	26	21.66	54	45.00	38	31.66

The data in Table-3, reveals that discussion with assistant agricultural officers (31.66 per cent) were found to be regularly contacted by the respondents and discussion with agricultural officer (15.00 per cent). Whereas, nearly thirty per cent of the respondents (28.33 per cent) occasionally had discussion with assistant director of agriculture. While an equal percentage of respondents (45.00 per cent) were found to have rarely contacted specialists from university and scientist from other research station.

The findings revealed that the most commonly used sources for information acquisition by the respondents were Assistant Agricultural officers and Agricultural officer among personal cosmopolite channels. This finding indicates that there is no scope for the frequent and periodical contact by the village level and block level agriculture development workers with the farming community. This might be due to more accessibility and frequent contacts made by them. This finding is in line with the findings of AmitaHanglem*et al.* (2015).

Impersonal-cosmopolite channels

The data collected on information acquisition by the respondents through impersonal-cosmopolite channels are presented in Table-4.

Table-4. Information acquisition through impersonal-cosmopolite channels by the respondents (n=120)

S. No.	Impersonal-cosmopolite channels	Regularity of contact							
		Regularly		Occasionally		Rarely		Never	
		No	Per cent	No	Per cent	No	Per cent	No	Per cent
1	Farm broadcast	40	33.33	16	13.33	22	18.33	42	35.00
2	Farm telecast	50	41.66	26	21.66	24	20.00	20	18.00

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3	Information materials	18	15.00	4	3.33	50	41.66	48	40.00
4	Agricultural news articles in news papers	6	5.00	22	18.33	40	33.33	52	43.33
5	Agricultural flims/slides	-	-	34	28.33	46	38.33	40	33.33
6	Farm magazine	-	-	26	21.66	48	40.00	46	38.33
7	Agricultural exhibition	6	5	36	30.00	54	45.00	24	20.00
8	Tours and field trips	20	18.00	16	13.33	42	35.00	42	35.00

It is evident from the data in Table-4, that viewing farm telecasts (41.66 per cent) followed by listening to farm broadcast (33.33 per cent) and Agricultural field trips (18.00 per cent) were regularly utilized sources by the respondents for information acquisition. The respondents occasionally used agricultural flims / slides (28.33 per cent), farm magazines (21.66) and agricultural exhibitions (30.00 per cent).

Farm telecasts and farm broadcasts were the most utilised impersonal-cosmopolite sources by the respondents for acquisition of information. This might be due to greater degree of credibility attached to the farm telecast and farm broadcast sources. From the survey, it was noticed that the majority of the farmers were illiterate and who can read and write, so they are preferred to above said sources in impersonal-cosmopolite channels.

The finding derives support from that of Kalidasan and Satheeshkumar (2019) who also reported similar findings in his research study of information management behaviour in sugarcane growers.

SUMMARY AND CONCLUSIONS

Adoption of improved agricultural technology by hybrid cotton growers mainly depends on effective utilization of sources of agricultural information and channels to which they are exposed directly or indirectly. Because of lack of awareness and thorough knowledge about these technologies, it is observed that improved agricultural technologies are available but that technologies are not reaching to the hybrid cotton growers in adoptable form for better crop yield. This gap may partially to be filled by use of various sources of information viz., personal localite, cosmopoliteness, mass media exposure, commercial agencies and non-government organizations, which are chief sources to get agricultural information. It is known that, adoption of improved hybrid cotton cultivation practices varies from farmer to farmer depending upon their situation, availability of information sources and use of communication media to obtain latest information.

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IMPACT OF SOIL APPLICATION OF NEEM COATED UREA, ENRICHED PRESSMUD COMPOST AND FOLIAR SPRAY OF SEA WEED EXTRACT ON PLANT HEIGHT, NUMBER OF BRANCHES PLANT^{-1} AND SEED YIELD PLANT^{-1} OF AMBRETTE

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ABSTRACT
The present study was carried out at Farmer's Field, Sivapuri Village, Chidambaram Taluk, Cuddalore District of Tamilnadu during Kharif season of 2018. The field trial was laid out in Randomized Block Design (RBD) with eight treatments and three replications. The treatments are as follows: T_1- Absolute control, T_2- 100% RDF, T_3-75% RDF –N (NCU), T_4- 75% RDF –P (EPMC), T_5 -75% RDF –N (NCU)+ P (EPMC), T_6 - T_3+SWE, T_7- T_4+SWE, T_8- T_5+SWE. Ambrette (Abelmoschus moschatus Medic.) is an aromatic, medicinal plant grown as test crop. Based on the results of physico-chemical analysis, the initial soil of the experimental field was sandy clay loam in texture with a pH of 7.6 and EC of 0.42 dSm^{-1}. The fertility status of soil with respect to nitrogen, phosphorus and potassium availability were 241.2 (low), 10.1(low) and 323.2 (high) kg ha^{-1}, respectively. The recommended dose of N:P_2O_5:K_2O for ambrette is 120:30:40 kg ha^{-1} were applied in the form of urea, SSP and MOP, respectively. NCU, EPMC and SWE were applied as the treatments.

INTRODUCTION
Ambrette (*Abelmoschus moschatus* Medic.) is an aromatic and medicinal plant. Its fruit is a capsule or pod, oblong, lanceolate, 2- 3 inches long, containing a large number of seeds, seeds are scented. The seeds have a sweet, flowery, heavy fragrance similar to that of musk. Every part of this medicinal plant is used in one or the other way. Neem coating in urea protects the loss of nitrogen by denitrification ensuring regulated continuous availability of nitrogen for longer period as per the requirement of crop. It saves urea consumption to the extent of 30-40 per cent and also saves the ground water from unhealthy pollution by nitrate lost through leaching (Mojumder and Govil, 2010). Composting of pressmud is a biological process in which pressmud decomposed by mixed microbes, enriched with SSP and undergoes chemical and physical transformation to give a stable and humified end product is of value in agriculture both as an organic fertilizer and soil improver. Sea weed extract is a natural organic fertilizer highly nutritious, promotes faster seed germination and increase yield and resistant ability of crops. Considering the above facts, the present investigation was carried out with the objective to study the integrated effect of neem coated urea, enriched pressmud compost and sea weed extract along with inorganic fertilizers on growth and yield of ambrette.

MATERIALS AND METHODS
A field experiment was carried out at Farmer's Field Sivapuri Village, Chidambaram Taluk, Cuddalore District during *Kharif*, 2018. The initial soil was sandy clay loam in texture with a pH of 7.6 and EC of 0.42 dSm^{-1}. With respect to N, P and K availability were 241.2 (low), 10. 1(low) and 323.2 (high) kg ha^{-1}, respectively. The field trial was laid out in Randomized Block Design (RBD) with eight treatments and three replications. The treatments are as follows: T_1- Absolute control, T_2- 100% RDF, T_3-75% RDF –N (NCU), T_4- 75% RDF –P (EPMC), T_5 -75% RDF –N (NCU)+ P (EPMC), T_6 - T_3+SWE, T_7- T_4+SWE, T_8- T_5+SWE. Ambrette (*Abelmoschus moschatus* Medic.) was grown as a test crop with proper cultural practices. The recommended dose of N:P_2O_5:K_2O for ambrette is 120:30:40 kg ha^{-1} were applied in the form of urea, SSP and MOP, respectively. NCU, EPMC @ 1000 kg and sea weed extract with the trade name "Bio-force" @ 5% on 30, 60 and 90 DAS were applied as foliar spray as per the treatments. The growth paramentets *viz.*, plant height and number of branches plant^{-1} at 30, 60, 90, 120 DAS and at harvest stages were measured. Finally seed yield plant^{-1} was also recorded due to different treatments.

RESULTS AND DISCUSSION
GROWTH PARAMETERS OF AMBRETTE
Plant height (cm)
The data on plant height recorded at various growth stages (30,60,90,120 DAS and at harvest stage) as influenced by different combinations of inorganic fertilizers, neem coated urea, pressmud compostand seaweed extract are presented in table 1.

At 30DAS, significantly the highest plant height of 25.61cm was recorded with application of 75% RDF - N(NCU)+P(EMPC)+SWE (T_8) . The second highest plant height of 21.99 cm was observed with (T_6) (75%

ISSN 2394 - 7780

RDF – N(NCU)+SWE). It was on par with T_7 i.e., application of 75% RDF + P (EPMC) registered the plant height of 21.00 cm. The lowest plant height of 10.03 was observed under control(T_1).

At 60 DAS, the plant height ranged from 23.75 to 63.87 cm. Application of 75% RDF - N(NCU)+P(EMPC)+SWE (T_8) significantly increased the plant height of 63.87 cm over control recorded the lowest plant height of 23.75 cm. The treatments T_6 on par with T_7 were recorded the plant height of 56.23 and 53.99 cm, respectively.

At 90 DAS, the highest plant height of 75.61 cm was observed with T_8 which was received 75% RDF - N(NCU)+P(EMPC)+SWE. It was followed by application of 75% RDF - N(NCU)+SWE registered 71.14 cm was on par with 69.27 cm was found to be with T_7. The lowest plant height of 33.09 cm was recorded in control(T_1).

At 120 DAS,the treatment T_8 - 75% RDF – N (NCU)+P (EMPC)+SWE showed maximum plant height of 108.84 cm. The treatments T_6 and T_7, T_4 and T_3 were found to be on par with each other. The control (T_1) registered the minimum plant height of 65.38 cm.

At harvest stage, the treatments T_8, T_6, T_5 and T_4 significantly influenced the plant height of 127.91, 120.22, 111.23 and 97.92 cm, respectively. Among the treatments tried, $T_6$and T_7 , T_4 and T_3 were on par. The lowest plant height (85.36 cm) was observed under control(T_1).

The plant height at all stages progressively increased from 10.03 to 127.91 cm with the application of different combinations of inorganic fertilizers, neem coated urea, pressmud compost and seaweed extract.

The observations on plant height at different stages of growth indicated that there was a significant influence of various treatments on plant height. Similar observation was noticed by Mohammad Nader Amiry *et al.* (2017). This increase due to synergistic effect of organic manures in making available more plant nutrient by improving soil physical condition and solubilizing the nutrients. The increase in plant height with pressmud compost might be attributed to the supply of nutients by pressmud compost in more readily available form and which in turn paved a way for better uptake of nutrients from pressmud compost.

Number of branches plant^{-1}

The effect of different combinations of inorganic fertilizers, neem coated urea, pressmud compost and seaweed extract on number of branches plant^{-1} at different growth stages (30,60,90,120 and at harvest) are furnished in table 2.

At 30 DAS, application of 75% RDF – N (NCU)+P (EMPC)+SWE (T_8) recorded the highest number of branches plant^{-1} (6.13). The next highest number of branches plant^{-1} of 5.50 and 5.49 were found to be with T_6 and T_7, respectively. These two treatments were statistically on par with each other. The lowest number of branches plant^{-1} (2.83) was observed under control treatment(T_1) which received no organic manures and inorganic fertilizers.

At 60 DAS, the highest number of branches plant^{-1} of 10.49 was found to be with 75% RDF – N (NCU)+P (EMPC)+SWE (T_8). It was followed by 9.69, 9.39, 8.83 and 8.62 were observed in the treatments T_6, T_7, T_5 and T_2, respectively. However, the lowest number of branches plant^{-1} registered in T_1 was 6.22. At 90 DAS, among the different treatments tried, application of 75% RDF – N (NCU)+P (EMPC)+SWE in T_8 recorded significantly highest number of branches plant^{-1}(13.40) over control (7.02). application of 100% RDF (T_2) registered the number of branches plant^{-1} of 10. 62was on par with T_5 (10.40).

At 120 DAS, significantly highestnumber of branches plant^{-1}(18.55) was recorded with application of 75 percent recommended dose of N(NCU)+P(EMPC)+ SWE. Application of 75% RDF- N (NCU)(T_3) and 75% RDF- P (EPMC)(T_4) registered the number of branches plant^{-1} of 11.80 and 12.14, respectively. The lowest number of branches plant^{-1}(9.08)was observed under control (T_1).

At harvest, application of 75%RDF - N(NCU)+P(EMPC)+SWE recorded significantly the highest number of branches plant^{-1}(20.82) compared to control registered the number of branches plant^{-1}(10.25). application of T_6 (19.13) and T_7 (19.38) were statistically on par with other which were received 75%RDF - N(NCU)+SWE and 75%RDF - P(EMPC)+SWE, respectively.

This increase in number of branches plant^{-1} due to the application of inorganic fertilizers and pressmud compost combination might be due to the involvement of nutrients in cell wall development and cell differentiation which resulted in elongation of shoot and root in plant. The enhancement in biometric parameters like plant

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height, number of branches plant^{-1} by supply of nutrients through combination of organic sources and chemical fertilizers. This was also might be because of liquid sea weed fertilizer as a foliar spray (Zopade *et al.*, 2008).

Yield

Seed yield plant^{-1}(g)

The data on seed yield plant^{-1} are furnished in table 3. The treatment T_8-75% RDF + N(NCU) + P(EPMC) + SWE recorded the highest seed yield plant-1 of 59.48 g against control registered the lowest seed yield plant-1(31.10 g). The second best value for seed yield plant^{-1} was 52.17 g found to be with T_6 which received 75% RDF + N(NCU) + SWE This was statistically on par with T_7 - 75% RDF + P(EPMC) + SWE. Application of 100% RDF registered the seed yield plant^{-1} of 44.09 g. The highest seed yield might be also by application of press mud compost along with NPK fertilizers improved nutritional environment in the rhizosphere as well as its utilization in the plant system and enhanced translocation of nutrients to reproductive structures. Application of sea weed extract improved chlorophyll content that enhanced photosynthetic parameters were positively correlated with seed yield, while antioxidant capacity was negatively correlated with photosynthesis and seed yield. These results are in agreement with the finding of El-Kaoaua *et al.* (2013).

CONCLUSION

From this field investigation, it is concluded that application of 75% RDF + N(NCU) + P(EPMC) + SWE significantly increased the plant height, number of branches plant^{-1} and seed yield plant^{-1} compared to control in sandy clay loam soil.

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Table 1. Influence of inorganic fertilizers, neem coated urea (NCU), enriched pressmud compost (EPMC) and sea weed extract (SWE) on plant height (cm) in ambrette

Treatments	30DAS	60DAS	90 DAS	120 DAS	At Harvest
T_1- Absolute control	10.03	23.75	33.09	65.38	85.36
T_2 – 100% RDF	15.98	43.04	57.14	83.87	102.85
T_3-75% RDF –N (NCU)	12.88	28.56	38.12	73.69	96.73
T_4- 75% RDF –P (EPMC)	12.91	32.94	42.11	77.05	97.92
T_5 -75% RDF –N (NCU)+ P (EPMC)	16.66	45.91	65.00	85.82	111.23
T_6 - T_3+SWE	21.99	56.23	71.14	103.84	120.22
T_7- T_4+SWE	21.00	53.99	69.27	99.89	119.01
T_8- T_5+SWE	25.61	63.87	75.61	108.84	127.91
S.Ed	1.186	1.911	1.800	1.729	0.907
CD=0.05	2.804	4.520	4.257	4.090	2.147

Table 2. Influence of inorganic fertilizers, neem coated urea (NCU), enriched pressmud compost (EPMC) and sea weed extract (SWE) on number of branches and seed yield plant^{-1} in ambrette.

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	At Harvest	Seed Yield Plant^{-1}(g)
T_1- Absolute control	2.83	6.22	7.02	9.08	10.25	31.10
T_2 – 100% RDF	4.29	8.62	10.62	14.77	18.86	44.09

ISSN 2394 - 7780

T_3-75% RDF –N (NCU)	3.51	7.23	8.95	11.80	16.7	38.25
T_4- 75% RDF –P (EPMC)	3.27	7.60	8.30	12.14	17.53	37.31
T_5 -75% RDF –N (NCU)+ P (EPMC)	4.80	8.83	10.4	14.92	18.00	44.61
T_6 - T_3+SWE	5.50	9.69	11.75	16.92	19.13	52.17
T_7- T_4+SWE	5.49	9.39	12.39	16.04	19.38	50.86
T_8- T_5+SWE	6.13	10.49	13.4	18.55	20.82	59.48
S.Ed	0.269	0.133	0.632	0.563	0.517	1.261
CD=0.05	0.621	0.314	1.495	1.331	1.222	2.522

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INFORMATION ACQUISITION BEHAVIOUR OF GROUNDNUT GROWERS IN SALEM DISTRICT

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ABSTRACT
Groundnut is called as the king of oil seeds.Groundnut seeds contain high quality of edible oil, digestible protein and carbohydrates,calcium, iron and vitamins.India is the second largest producer of groundnut in the world.Adoption of improved groundnut technology by groundnut cultivators mainly depends on effective utilization of sources of agricultural information.It is observed that improved groundnut technologies are available but that technologies are not reaching to the groundnut cultivators in adoptable form for better crop yield. This gap may partially to be filled by use of various sources of information viz., personal localite, cosmopoliteness, mass media exposure, commercial agencies and non-government organizations.The study was taken-up inSankari and Magudanchavadi block of Salem district. A sample size of 120 groundnut cultivating farmers were selected and thirteen socio-economic and psychological variables were selected for this study. The overall information acquisition behaviour of the respondents observed as 46.67 per cent had high level , 36.66 per cent with medium level and 16.67 per cent of the respondents had low level of information acquisition behaviour. Among the various channels in information acquisition process, under personal-localite channels, neighbours/ fellow members (57.50 per cent) and family members (55.00 per cent) , under personal – cosmopolite channels, assistant agricultural officers (33.33 per cent) and agricultural officer (20.83 per cent) and underimpersonal-cosmopolite channels,farm telecasts (51.67 per cent) and farm broadcast (48.33 per cent)were the important channels utilized by the respondents.

Keywords: Groundnut technology, Localite channels,Cosmopolite channels and Mass media.

INTRODUCTION
Groundnut is called as the king of oil seeds.This underground crop is important for both small and large commercial producers. It's haulms and leaves serve as a rich source of cattle feed and raw material for preparation of silage. Groundnut shell is used as fuel for manufacturing coarse boards, cork substitutes etc.Groundnut seeds contain high quality of edible oil, digestible protein and carbohydrates. They are rich in phytonutrients and essential nutrients. It is a rich source of calcium, iron and vitamin B complex like thiamine, riboflavin, niacin and vitamin A. India is the second largest producer of groundnut in the world. India is known to produce 6.6 million tones of peanuts on a yearly basis whereas china leads the list with a production of 16.5 million tones yearly.In Tamil Nadu, the area under groundnut is about 3.38 lakh hectares. They produces approximately 894.9 thousand tones of peanuts yearly.

Information management is an activity of primarily increase the knowledge level of the groundnut farmers, secondly it reduces or decreases uncertainty for decision-making process and thirdly, it can serve as representation of situation.Adoption of improved agricultural technology by groundnut cultivators mainly depends on effective utilization of sources of agricultural information and channels to which they are exposed directly or indirectly.It is observed that improved agricultural technologies are available but that technologies are not reaching to the groundnut cultivators in adoptable form for better crop yield. This gap may partially to be filled by use of various sources of information viz., personal localite, cosmopoliteness, mass media exposure, commercial agencies and non-government organizations, which are chief sources to get agricultural information.

METHODOLOGY
The study was taken-up in Salem district of Tamil Nadu. Out of the thirteen blocks in Salem district, Sankari and Magudanchavadi block was selected based on the maximum area under groundnut cultivation. A sample size of 120 groundnut cultivating farmers were selected by using proportionate random sampling technique. Thirteen socio-economic and psychological variables were selected for this study and they were measured by using appropriate tools and techniques.

Information acquisition referred to all such activities performed by an individual for acquiring scientific and technical information. Accordingly, information acquisition in this study referred to all activities performed by a respondent for the acquisition of information in groundnut technologies. The information acquisition behaviour was measured as the regularity of contact by the respondents with the use of different channels. The following

ISSN 2394 - 7780

scoring procedure adopted by Satheeskumar (2013) was used in this study.An inventory on agricultural information acquisition behaviour, as a dependent variable was developed and measured on a response continuum as 'Regularly', 'Frequently', 'Occasionally' and 'Never' with scoring 4, 3, 2 and 1 respectively.The score obtained on various information acquisition channels were added to get total score of the respondents on this variable.The data were collected by using well structured interview schedule, containing appropriate questions for bringing the required data.Percentage analysis and Cumulative frequency method were used for the analysis and interpretation of the data.

FINDNINGS AND DISCUSSION

Overall Information Acquisition Behaviour of the respondents are presented in table-1.

Table – 1 Overall Information Acquisition Behaviour of the respondents.(n=120)

S. No.	Category	Information acquisition behaviour	
		No	Per cent
1	Low	20	16.67
2	Medium	44	36.66
3	High	56	46.67
Total		120	100.00

It could be observed from the Table-1, that majority of the respondents (46.67 per cent) had high level of information acquisition behaviour followed by more than one-third of the respondents (36.66 per cent) had medium level of information acquisition behaviour and only 16.67 per cent of the respondents had low level of information acquisition behaviour.

Information acquisition behaviour

Information acquisition behavior of the respondents analyzed under three category based on the nature of channels available.Namely personal-localite, personal-cosmopolite and impersonal-cosmopolite channels used by farmers for the acquisition of information with regard to groundnut cultivation technologies. Hence, the respondents were enquired about their information acquisition behaviour and the results are presented in Table-2.

Table-2. Information acquisition through various channels.(n=120)

S. No.	Information acquisition behaviour	Regularity of contact							
		Regularly		Occasionally		Rarely		Never	
		No	Per cent	No	Per cent	No	Per cent	No	Per cent
	Personal-localite channels								
1	Discussion with family members	66	55.00	24	20.00	18	15.00	12	10.00
2	Friends and relatives	62	51.67	22	18.33	20	16.67	16	13.33
3	Neighbours/fellow farmers	69	57.50	26	21.67	17	14.16	8	6.67
4	Progressive farmers	35	29.17	46	38.33	21	17.50	18	15.00

ISSN 2394 - 7780

5	Private input dealers	30	25.00	42	35.00	26	21.67	22	18.33
	Personal-cosmopolite channels								
1	Discussion with Assistant Agricultural Officers	40	33.33	62	51.67	10	8.33	8	6.67
2	Discussion with Agricultural Officers	25	20.83	45	37.50	35	29.17	15	12.50
3	Discussion with Assistant Director of Agriculture	15	12.50	38	31.67	43	35.83	24	20.00
4	Specialist from University	4	3.33	10	8.34	46	38.33	60	50.00
5	Scientist from other research station	8	6.67	15	12.50	41	34.17	56	46.66
	Impersonal-cosmopolite channels								
1	Farm broadcast	36	30.00	58	48.33	14	11.67	12	10.00
2	Farm telecast	48	40.00	62	51.67	6	5.00	4	3.33
3	Information materials	26	21.67	50	41.67	34	28.33	10	8.33
4	Agricultural news articles in news papers	16	13.33	44	36.67	32	26.67	28	23.33
5	Agricultural flims/slides	6	5.00	18	15.00	37	30.83	59	49.17
6	Farm magazine	10	8.33	32	26.67	35	29.17	43	35.83
7	Agricultural exhibition	8	6.67	26	21.67	40	33.33	46	38.33
8	Tours and field trips	4	3.33	12	10.00	38	31.67	66	55.00

Personal-localite channels

It could be noticed from the Table-2, under personal-localite channel that, the respondents regularly utilised source were neighbours/fellow farmers (57.50 per cent) followed by discussion with family members (55.00 per cent), friends and relatives (51.67 per cent). This finding revealed that most commonly used personal-localite channels for information acquisition by the respondents were neighbours/fellow farmers, family members, friends and relatives. This might be due to the close proximity and frequent interaction.

Whereas 38.33 per cent of the respondents utilised progressive farmers and more than one-third of the respondents (35.00 per cent) acquiring information through private input dealers occasionally. This might be due to less contact with progressive farmers and long distance of private input dealers in the study area.This

ISSN 2394 - 7780

findings derives support from that of Patel *et al.* (2012) who also reported that majority of the respondents had used similar source for information acquisition.

Personal-cosmopolite channels

It is evident from the data in Table-2, underPersonal-cosmopolite channelsreveals that, assistant agricultural officers (33.33 per cent) were found to be regularly contacted by the respondents and discussion with agricultural officer (20.83 per cent). The findings revealed that the most commonly used sources for information acquisition by the respondents were assistant agricultural officer and agricultural officer among personal cosmopolite channels. This might be due to more accessibility and frequent contacts made by them. Whereas, more than one-third of the respondents rarely utilized assistant director of agriculture (35.83 per cent) and never utilized specialist from university (50.00 per cent) and followed by scientist from other research station (46.66 per cent). This might be due to less contact of assistant director of agriculture and distance location of research station and not able to interaction with scientists. This finding is in line with the findings of Kalidasan (2008).

Impersonal-cosmopolite channels

It is evident from the data in Table-2, underImpersonal-cosmopolite channels that, viewing farm telecasts (51.67 per cent) followed by listening to farm broadcast (48.33 per cent), reading information materials (41.67 per cent) and agricultural news articles in news papers (36.67 per cent) were the occasionally utilized sources by the respondents for information acquisition. The respondents never used tours and field trips (55.00 per cent), agricultural flims/slides (49.17 per cent) agricultural exhibition (38.33 per cent) and farm magazine (35.83 per cent) for acquiring information.

Farm telecast and farm broadcast were the most utilised impersonal-cosmopolite sources by the respondents for acquisition of information. This might be due to greater degree of credibility attached to the farm telecast and farm broadcast sources. Availability of the relevant literature and information in newspaper are also important impersonal cosmopolite source for the farmer in groundnut cultivation. The rest of the impersonal cosmopolite are very rare and never to the respondents in seeking of information regarding groundnut cultivation.The finding derives support from that of Sridharan (2011) who also reported that similar findings in his research study of information management behaviour of groundnut growers.

SUMMARY AND CONCLUSIONS

Adoption of improved groundnut cultivation practices varies farmer to farmer depending upon their situation, availability of information sources and use of communication media to obtain latest information. Therefore, the present study has been undertaken to know various sources utilized by groundnut growers to get agricultural information. With this in view the present investigation was carried out and the salient findings are presented below.

The Overall Information acquisition behaviour of groundnut growers with the following results that, Majority of the respondents (46.67 per cent) had high level of information acquisition behaviour followed by more than one-third of the respondents (36.66 per cent) had medium level of information acquisition behaviour and only 16.67 per cent of the respondents had low level of information acquisition behaviour.

Among the various channels in Information acquisition process, under Personal-localite channels the results may be depicted asMajority of the respondents regularly utilised source were neighbours/fellow farmers (57.50 per cent), discussion with family members (55.00 per cent) and) followed by friends and relatives (51.67 per cent). Whereas 38.33 per cent of the respondents utilised progressive farmers and more than one-third of the respondents (35.00 per cent) acquiring information through private input dealers occasionally.Under Personal-cosmopolite channels, majority of the respondents reveals that assistant agricultural officers (33.33 per cent) were found to be regularly contacted by the respondents and discussion with agricultural officer (20.83 per cent). Whereas, more than one-third of the respondents rarely utilized assistant director of agriculture (35.83 per cent).Under Impersonal-cosmopolite channels, majority of the respondents that viewing farm telecasts (51.67 per cent) followed by listening to farm broadcast (48.33 per cent), reading information materials (41.67 per cent) and agricultural news articles in news papers (36.67 per cent).

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INFLUENCE OF INTEGRATED NUTRIENT MANAGEMENT PRACTICE AND FOLIAR NUTRITION ON YIELD MAXIMISATION OF BABY CORN (Zea mays L.)

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ABSTRACT
Field experiments were conducted to study the effect of graded levels of inorganic nitrogen in combination with various sources of organic manures and panchagavya foliar spray on hybrid baby corn G-5414 at the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu. The treatments were tested in RBD and replicated thrice. The effect of application of 100 % recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sprays of 3 % panchagavya favourably influenced the yield parameters of baby corn culminating in the highest baby corn yield per hectare, which was higher than that of the control. The economic analysis of various treatments imposed revealed that application of 100 % recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sprays of 3 % panchagavya recorded the highest gross and net return of Rs.147400 and Rs.98287 which ultimately resulted in registering the highest net rupee invested as 3.00.

Keywords: Integrated Nutrient Management,Growth and Yield Maximization, Baby corn.

INTRODUCTION
Baby corn (also known as young corn, mini corn or candle corn) is the ear of maize (*Zea mays* L.) plant harvested young especially when the silks have either not emerged or just emerged and no fertilization has taken place. The Baby corn hybrid G-5414, is a high yielding male sterile with uniform sized creamy ears and they are in light yellow colour with regular row arrangement, 10 to 12 cm long and a diameter of 1.0 to 1.5 cm arrangement are preferred in the market. It is a highly nutritive value crop, for every 100 gram of edible portion; it contains 88.10 per cent moisture, 8.20 g carbohydrates, 1.90 g protein, 0.20g fat, 28.00 mg calcium, 86.00 mg phosphorus, 0.10 mg iron, 0.50 mg thiamine, 0.08 g riboflavin and 11.00 mg of ascorbic acid. The entire miniature ear of baby corn is edible. Baby corn can be eaten raw or cooked. It is used in variety of traditional and continental dishes besides being canned. Due to its high succulence, palatability and digestibility, it is considered to be an ideal fodder crop and it can be used at any stage of its growth. Its green fodder is especially suited for milch cattle as it has lactogenic properties. Baby corn cultivation provides tremendous avenue for diversification, value addition and revenue generation. In the light of recently liberalized policy of government to boost export trade and food industry development, baby corn production on maize belts of India stands better promise for export trade, high income generation and for creation of employment in agriculture sector through canning and dairy industries. For better utilization of resources and to produce crops with less expenditure, INM is the best approach. The combined use of organic and inorganic sources of plant nutrient not only pushes the production and profitability of baby corn, but also it helps in maintaining the permanent fertility status of the soil.

MATERIALS AND METHODS
Field experiments were conducted in the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar with Baby corn Hybrid G-5414. The treatments comprised of an absolute control **T_1** with no application of organics and inorganics.

T_2 – 100 % RDN + 3 sprays of 3% panchagavya

T_3 – 75 % RDN + poultry manure @ 5t ha^{-1} + 4 sprays of 4% panchagavya

T_4 – 100 % RDN +poultry manure @ 5t ha^{-1} + 3 sprays of 3% panchagavya

T_5 – 75 % RDN + FYM @ 10 t ha^{-1} + 4 sprays of 4% panchagavya

T_6 – 100% RDN + FYM @ 10 t ha^{-1} + 3 sprays of 3% panchagavya

T_7 – 75% RDN + EFYM @ 750 kg ha^{-1} + 4 sprays of 4% panchagavya

T_8 – 100% RDN + EFYM @ 750 kg ha^{-1} + 3 sprays of 3% panchagavya

T_9 – 75 % RDN + EPC @ 750 kg ha^{-1} + 4 sprays of 4% panchagavya

T_{10} – 100 % RDN + EPC @ 750 kg ha^{-1} + 3sprays of 3% panchagavya

ISSN 2394 - 7780

T_{11} – 75 % RDN + vermicompost @ 5 t ha^{-1} + 4 sprays of 4% panchagavya

T_{12} – 100% RDN + vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya

Table 1 : Important nutrients present in various organic sources

Organic sources	Nutrients		
	Nitrogen (N) in %	Phosphorus (P_2O_5) in %	Potassium (K_2O) in %
Farmyard Manure (FYM)	0.69	0.62	0.51
Enriched FYM	1.20	3.03	0.52
EPC	2.1	3.0	0.5
Poultry manure	2.48	1.80	1.40
Vermicompost	1.86	1.30	0.55
Panchagavya	4.46	0.33	0.89

*EPC-Enriched Press mud compost

Table 2 :Effect of IPNSS on Yield attributes and yield of baby corn G-5414.

Treatments	Cob length (cm)	Cob diameter (cm)	No of cobs per plant	Cob yield (Kg ha^{-1})	Stover yield (Kg ha^{-1})
T_1	13.57	2.62	1.13	2640	12.17
T_2	19.82	4.77	2.27	5071	18.41
T_3	19.05	4.45	2.13	4448	16.43
T_4	20.68	5.04	2.51	5693	19.13
T_5	15.99	3.32	1.33	3582	13.28
T_6	20.27	4.89	2.40	5402	18.86
T_7	18.49	3.92	1.45	3868	14.37
T_8	21.20	5.19	2.64	6493	20.20
T_9	18.63	4.35	1.95	4163	15.52
T_{10}	21.05	5.17	2.63	6341	20.06
T_{11}	19.44	4.63	2.15	4751	18.12
T_{12}	22.43	5.32	2.81	6845	21.00
SEd	0.173	0.043	0.014	135.00	125.36
CD (P=0.05)	0.36	0.09	0.03	280	260

RESULTS AND DISCUSSION

The beneficial influence of organic and inorganic fertilizer on the growth attributes *viz*., plant height, leaf area index, DMP and stem girth of baby corn was observed to be significant when compared to other treatments. The combined application of organic sources along with inorganic fertilizer assumes higher crop and soil productivity on baby corn.

The enhanced plant height, LAI, DMP and stem girth were favorably influenced by the integrated application of 100% RDN + vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya (T_{12}). This treatment projected the maximum values for plant height which could be the possibility to supply mineral N, which was dominant at early stage of crop growth and its rapid nutrient availability and supply to the crop. The nitrogen from fertilizer helped in the promotion of growth during the early stages and while organic sources of nutrients improved crop growth during later stages. The favourable effect of vermicompost on growth might be attributed to presence of relatively readily available plant nutrients, growth enhancing substances and number of beneficial organisms like nitrogen fixing, phosphate Solubilising, cellulose decomposing and other beneficial microbes as well as antibiotics, vitamins and hormones etc. (Nehra *et al.*, 2001). Moreover, vermicompost has narrow C: N ratio less than 20:1 which enhances release of nutrients availability to root. Nitrogen is an essential constituent of proteins, enzymes and chlorophyll and has been observed to influence the leaf growth and its expansion, resulting in increased leaf area index. Availability of adequate phosphorus in plant results in proper leaf expansion, increase in leaf surface area and number of leaves and results in better efficiency of chlorophyll during photosynthesis and this overall improvement gets translocated into better growth of the plant and hence by assimilation of source to sink (Gunjal *et al.*,2017).

ISSN 2394 - 7780

Foliar application of panchagaya along with other organic manures enhanced the production of more number of leaves this may be due to the fact that the chemolithic autotrophic nitrifiers in panchagavya contributed to vegetative growth directly and indirectly by increasing the ammonium uptake, thus enhancing the total N supply (Papen *et al*., 2002) leading to increased number of leaves, maximum leaf area and leaf area index. Moreover, panchagavya also contained microbial metabolites in appreciable amount that helped in maintaining the opening of stomata for longer period both in optimum and adverse condition during the crop growth which led to increased production of more leaves, leaf area and leaf area index providing stronger source for sink (Xu *et al.*, 2001). Improved nutrition may enable greater leaf area production that results in greater interception of light thereby increasing dry matter production (source to sink) (Kumawat *et al.*, 2009). The less response of baby corn to other organic manures could be attributed to slow mineralization of organically bound nutrient and low population of beneficial microbes. The integrated effect of organic and inorganic fertilizers increased the plant height, leaf length, which ultimately favoured to higher DMP. These results are in accordance with the finding of (Thavaprakash *et al.,* 2005).

The results of the experiments revealed that the application of 100 % recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sparys of 3 % panchagavya favourably influenced the yield parameters *Viz.,* cob length, cob diameter, number of cobs per plant in baby corn, cob yield, stover yield. The above treatment also projected an increased cob yield over the control.

The results of the experiment revealed that organic manures with inorganic fertilizer distinctly influenced the yield attributes of baby corn than control. Application of 100 % recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sparys of 3 % panchagavya exhibited an accelerated effect on yield attributes which is mainly due to addition of mineral nitrogen along with the vermicompost influenced the stalk thickness of the plants more positively than just a standalone application of vermicompost. This effect could be attributed to the fact that the addition of mineral fertilizer accelerated mineralization processes in the soil and, therefore, was able to release enough and easily available nutrients of vermicompost. (Maria Kmetova and Peter Kovacik, 2014). Enhanced N, P and K uptake in this treatment could be attributed to increased dehydrogenase activity and higher nutrients supplied by vermicompost along with inorganic NPK. This in turn increased their availability in the form of NH_4-N, NO_3-N, orthophosphates and potassium and their uptake by crop. Similar finding was reported by Arancon *et al.* (2006).

The slowly mineralisable nitrogen from integrated sources ensures adequate availability at greater level of absorption and translocation to the plant parts during growing period thereby increased quantities of N in cob and stover. Similarly, the organic sources of N made P and K in available forms for longer period in soil which improved P and K uptake of N P K by maize with enhanced levels of nutrient supply. Higher values for the uptake of N P K by maize with enhanced levels of nutrient supply were also evidenced by earlier researchers (Massey and Gaur, 2006, Singh and Yadav, 2007, Sunitha and Mahesheswara Reddey, 2012).

The improvement in soil both direct effect of nutrient present in the organic, inorganic and direct effect of microbial activity and mineralization of native nutrients. The present result in agreement with the report of Swarup (1991). Highest cob yield and Stover yield also was recorded in the treatment (T_{12}) might be the abundant supply of nutrients which might have increased the protoplasmic constituents and accelerate the process of cell division and elongation. This in turn resulted in increased yield. Yield increases in (T_{12}) was due to the hormonal substances present in *panchagavya* especially cytokinin which plays a vital role in vegetative plant parts with nutrient partitioning while in reproductive parts, high levels of nutrient mobilization. Increase in yield was also be due to fact that cow dung in *panchagavya* act as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth (De Britto and Girija, 2006; Patil *et al.,* 2012).

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ISSN 2394 - 7780

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ASSOCIATION AND CONTRIBUTION CHARACTERISTICS OF THE FARMERS WITH THE UTILIZATION PATTERN OF MOBILE AGRO ADVISORY SERVICE

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ABSTRACT
The mobile telephony has been most recent and widely accepted mode of delivering information not only in India but throughout the world. Increasing mobile phone and its services help in improving awareness, education, better adoption of technology, better health and efficiency, reduced transaction costs, better market efficiencies, etc. These in turn will catalyse the rural agricultural sector development and economic growth. In the perspective of the mobile phones, farmers can directly communicate with buyers and customers for selling their produce at good price. Mobile phone technologies have provided a good platform for farmers to share their knowledge and information among each other in time such as market rates, new varieties and weather information etc., Hence, keeping this in mind, a study was taken up to assess the relationship of characteristics of the respondents with utilization pattern of mobile agro advisory service. The research study was conducted in Kanchipuram district with the sample of 120 registered farmers under mobile advisory service was selected by using random sampling technique. Data were collected with the help of a well structured and pre tested interview schedule. The data collected were scored, tabulated and analysed using the statistical tools viz., zero order correlation co-efficient and multiple regression analysis.

INTRODUCTION
Information and Communication Technologies can help small holder farmers to maximize the return on agriculture outputs, by providing timely and relevant information. In recent years, there has been a rapid increase in mobile phone subscription in India and is one of the fastest growing industries in the world. The advent of mobile has changed the era of Information Technology (Ahmed and Laurent, 2009). A simple mobile has plenty of features to communicate the information across the world within a time. The device does not require many supported elements like personal computer, regular power supply and internet service to have a communication facility. The rapid growth of mobile telephone as compared to fixed line telephone and the recent introduction of mobile-enabled information services provide a means to overcome the existing information asymmetry. It also helps to bridge the gap between the availability and delivery of agricultural inputs and agriculture infrastructure.

Rizvi (2010) observed that access to mobile based advisory services can help to reach poor farmers in remote rural areas. Over the past few years, India witnessed several experiments on agro-advisory service delivery through mobile phone. Agro based advisory service is a service that provides information about agriculture and related matters through mobile phones. The policy framework for agricultural extension (Ministry of Agriculture, Government of India, 2000) highlights the opportunity for information and communication technology (ICT) to improve the quality and accelerate the transfer and exchange of information to farmers, and ICT is consequently given a high priority, particularly as a tool for improving the marketing aspects of farm enterprises.

Digital India is an ambitions mission of the Government of India (GOI) which seeks to transform India into digitally empowered society and knowledge economy. The vision areas of digital India include universal access to mobile connectivity and public internet access are among the essential pillars of this programme. Indian telecommunication revolution that too wireless connectivity made it possible to reach to unreachable located consumers through m-Services. During the present decade, India has seen an exponential growth in the telecom particularly in wireless. The Indian telecommunication sector has grown rapidly in the last few years. India now has the second largest network in the world, next to China. India crossed the landmark of one billion telephone subscribers in the year 2015-16, and the total subscription now stands at 1209.96 million as on 2017. Out of this 502.50 million connections are in rural areas and 707.46 million in the urban areas. Wireless telephone constitute 98.04 per cent (1186.21 million) whereas landline telephony at only 1.96 (23.75 million) TRAI (2017).

There have been quite a few studies that explored how mobile phones impact livelihoods of farmers and agriculture. In recent years, there has been a rapid growth of mobile phone networks in developing countries. Currently mobile telephony is the predominant mode of communication in the developing world. However, short message service (SMS) and voice record have given improvements in social relations. In the context

ISSN 2394 - 7780

mobile phone has also given a good benefit to farmers for getting better market information when negotiating with merchants over the price of their produce.

METHODOLOGY

The research study was conducted in Kanchipuram district. The study was taken up in eight villages which were selected based on the highest number of registered farmers under Farmer Producer Organization (FPO). A sample of 120 registered farmers under mobile advisory service was selected by using random sampling technique. Sixteen independent variables were selected based upon judges opinion. Data were collected with the help of a well structured and pre tested interview schedule. The data collected were scored, tabulated and analysed using the statistical tools viz., cumulative frequency, percentage analysis, zero order correlation co-efficient and multiple regression analysis. Correlation and multiple regressions co-efficient were worked out to find out the association of characteristics of the respondents with the utilization pattern of mobile agro advisory service.

FINDINGS AND DISCUSSION

Association and contribution of characteristics of the respondent with the utilization pattern of mobile agro advisory service

Correlation and multiple regressions co-efficient were worked out to find out the association of characteristics of the respondents with the utilization pattern of mobile agro advisory service. The results are presented in Table 1.

CORRELATION ANALYSIS

It could be seen from the Table 1, that out of 16 independent variables studied three variables namely educational status (X_2), occupational status (X_3) and social participation (X_7) had shown a positive and significant association with the utilization pattern of mobile advisory service at 0.05 per cent level of probability, while the variables age (X_1), annual income (X_5), ownership of ICT gadgets (X_6), information sharing behaviour (X_9), attitude towards mobile phone (X_{13}) and achievement motivation (X_{15}) had positive and significant association with utilization pattern of mobile advisory service at 0.01 per cent level of probability. The remaining variables viz., farm size (X_4), training undergone (X8), credibility of mobile advisory service (X_{10}), portability (X_{11}), appropriateness of information (X_{12}), extension agency contact (X_{14}) and scientific orientation (X_{16}) did not show any significant with utilization pattern of mobile advisory service. The significant variables only was considered for discussion.

Table 1. Correlation and multiple regression analysis of characteristics of respondents with the utilization pattern of mobile agro advisory service

Var.No.	Variables	'r' value	Regression co-efficient ®	Standard error	't' value
X1	Age	0.291**	0.183	0.086	0.972NS
X2	Educational status	0.526*	0.255	0.099	4.261**
X3	Occupational status	0.543*	0.367	0.163	2.252*
X4	Farm size	0.204NS	0.206	0.140	1.469NS
X5	Annual income	0.348**	0.933	0.420	2.245*
X6	Ownership of ICT gadgets	0.317**	0.213	0.161	2.324*
X7	Social participation	0.462*	0.088	0.048	0.184NS
X8	Training undergone	0.209NS	0.206	0.140	1.429NS
X9	Information sharing behaviour	0.318**	0.*367	0.163	2.252*
X10	Credibility of mobile advisory service	0.204NS	0.206	0.140	1.469NS
X11	Portability	0.159NS	0.181	0.137	0.418NS
X12	Appropriateness of information	0.173NS	0.279	0.123	0.682NS
X13	Attitude towards mobile phone	0.312**	0.255	0.099	4.241**
X14	Extension agency contact	0.196NS	0.103	0.064	1.602NS

ISSN 2394 - 7780

X15	Achievement motivation	0.310**	0.367	0.163	2.247*
X16	Scientific orientation	0.179NS	0.181	0.137	0.518NS

R^2=0.67

F=10.22

* - Significant at 0.05 per cent level

** - Significant at 0.01 per cent level

NS- Non Significant

DISCUSSION

Age had shown a positive and significant relationship with the utilization pattern of mobile advisory service at 0.01 per cent level of probability. It might be due to the fact that young in age would have increased their utilization pattern, due to more experience and utilization of mobile agro advisory service. This finding is in line with the findings of Kavaskar (2009). Educational status had significant relationship with utilization pattern of mobile advisory service at 0.05 per cent level of probability. This means that education is directly proportional to the utilization of respondents. This finding is in line with the findings of Akoijam (2015)

Occupational status had shown positive and significant relationship with the utilization pattern of mobile advisory service at 0.05 per cent level of probability. Majority of the respondents belonged to young and middle age category and practicing agriculture as a traditional occupation for several generations. Hence, it is quite natural for the respondents to be more enthusiastic in gathering information so as to utilize the information to a higher extent. This finding is in line with the findings of Donovan (2011).

A positive and highly significant relationship exist between annual income and utilization pattern of mobile advisory service at 0.01 per cent level of probability. Farmers with medium to large size land holdings might have automatically attained increase level of annual income and better standard of living. Hence, annual income might have a positive and highly significant association with utilization pattern of the respondents. This finding is in line with the findings of Kavaskar (2009).

Ownership of ICT gadgets had significant relationship with the utilization pattern of mobile advisory service at 0.01 per cent level of probability. This means that ownership of ICT gadgets is directly proportional to the utilization of respondents. Social participation exhibited a positive and significant contribution towards the utilization pattern of mobile advisory service at 0.05 per cent level of probability. Social participation helps to bring the farmers to in an atmosphere of broader perspective where there is better scope for them to exchange ideas, facts, feelings etc., among group of farmers with in the local setting and also educate the farmers about technology disseminated through mobile advisory service. This finding is in line with the findings of Akoijam (2015).

There was a positive influence of information sharing behaviour with the utilization of mobile advisory service of the respondents. In order to gain knowledge, one has to expose himself to different experience provided by information providing sources. Hence, the variable information sharing behaviour might have shown positive and significant relationship at 0.01 per cent level of probability. This finding is in line with the findings of Ganesan *et al*., (2013).

Attitude towards mobile phone had significant relationship with the utilization pattern of mobile advisory service at 0.01 per cent level of probability. This means that attitude towards mobile is directly proportional to the utilization of respondents. This finding is in line with the findings of Rakesh (2013). Achievement motivation was found to have positive and significant relationship with utilization pattern of mobile advisory service at 0.01 per cent level of probability. This finding is in line with the findings of Shivappa (2014).

MULTIPLE REGRESSION ANALYSIS

Multiple regression analysis was carried out to find out the relative contribution of each variables towards the utilization pattern of mobile advisory service. It could be observed from Table 32, that all the 16 independent variables taken together explained (67.00 per cent) variation in the utilization pattern of mobile advisory service

The 'F' value (10.22 per cent) was found to be significant. The liner regression equation fitted was as follows

$$Y_2 = 4.338 + 0.972X_1 + 4.261X_2 + 2.252X_3 + 1.469X_4 + 2.245X_5 + 2.324X_6 + 0.184X_7 + 1.429X_8 + 2.252X_9 + 1.469X_{10} + 0.418X_{11} + 0.682X_{12} + 4.241X_{13} + 1.602X_{14} + 2.247X_{15} + 0.518X_{16}$$

Out of the 16 variables, educational status (X_2), attitude towards mobile phone (X_{13}) had contributed significantly at 0.01 per cent level of probability. Occupational status (X_3), annual income (X_5), ownership of

ISSN 2394 - 7780

ICT gadgets (X_6), information sharing behaviour (X_9) and achievement motivation (X_{15}) had contributed significantly at 0.05 per cent level of probability. The remaining variables namely age (X_1), farm size (X_4), social participation (X_7), training undergone (X_8), credibility of mobile advisory service (X_{10}), portability (X_{11}), appropriateness of information (X_{12}), extension agency contact (X_{14}) and scientific orientation (X_{16}) did not show any significant contribution towards utilization pattern of mobile advisory service.

Thus, it concluded that educational status and attitude towards mobile phone had shown positive and significant association with the utilization pattern of mobile advisory service. It is also fundamental to the understanding of the usage. Information sources utilization leads to a tendency towards high utilization pattern of FPO members. This finding is in line with the findings of Akoijam (2015).

CONCLUSION

The variable age showed a positive relationship with the utilization pattern of mobile advisory service. Generating awareness among young and middle aged farmers about the availability of mobile and other ICT services is the first step to be considered to increase the farmers participation in ICT initiatives. Old aged farmers should be brought into the chain of ICT networks at a later stage. The characteristics viz., age, educational status, occupational status, annual income, ownership of ICT gadgets, social participation, information sharing behaviour, attitude towards mobile phone and achievement motivation showed a positive relationship with the utilization pattern of mobile agro advisory service. Hence, these characteristics may be considered while the targeting the beneficiaries of mobile advisory service.

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EFFECT OF BIO REGULATORS ON THE GROWTH AND YIELD OF CHILLI (Capsicum annuum L.)

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ABSTRACT
Chilli (Capsicum annuum L.) is an important spice crop, which is extensively grown for its pungent fruits and is an indispensable adjunct in every house of the tropical part of the world as a spice. Organic farming worldwide is undergoing dramatic growth and change driven by imperatives of quality, demand, export focus and desire to produce clean and fresh edibles. Simultaneously, the demand for organic food is steadily increasing both in the developed and developing countries with an annual average growth rate of 20-25 %. Hence an investigation was carried out to study the influence of some bio regulators on the growth and yield of chilli. The experiment was laid out in a randomized block design with 9 treatments. The foliar organic nutrients viz., Seaweed extract (2.5 % and 5%), Panchakavya(3 % and 4 %), Vermiwash(1:3 and 1:5 dilution), EM(Effective microbes)(1:500 and 1:1000 dilution) were tried along with a water spray as control. 4 sprays of the foliar organic nutrients were given at 20 days interval commencing from 30th day after transplanting. The results revealed that growth and yield characters were maximum under the treatment of Seaweed extract @ 5 % concentration given as foliar spray followed by 2.5 % concentration of seaweed extract. Application of 2.5 % of seaweed extract was on par with the application of panchakavya @ 4 % .

Keywords : Seaweed extract, Chilli, Panchakavya

INTRODUCTION
Chilli (*Capsicum annuum L.)* is an important spice crop which is extensively grown for its pungent fruits and is an indispensable adjunct in every house of the tropical part of the world as a spice. Organic cultivation is native to India and it is our contribution to the world. Organic cultivation promises a balanced environment and quality food to people. Organic vegetable production is now a commercial venture, on a small scale in several developed countries. With an increasing demand for organic produces, especially in Europe, U.S and Japan, many countries are making an onset in the development of organic produces. India, backed by the legacy of organic farming has a potential to make a mark in the international market. Organic farming worldwide is undergoing dramatic growth and change driven by imperatives of quality, demand, export focus and desire to produce clean and fresh edibles. Simultaneously, the demand for organic food is steadily increasing both in the developed and developing countries with an annual average growth rate of 20-25 %. Hence an investigation was carried out to study the influence of some bio regulators on the growth and yield of chilli.

MATERIALS AND METHODS
The experiment was laid out in a randomized block design with 9 treatments and 3 replication. The foliar organic nutrients *viz.*, Seaweed extract (2.5 % and 5%), Panchakavya(3 % and 4 %), Vermiwash(1:3 and 1:5 dilution), EM(Effective microbes)(1:500 and 1:1000 dilution) were tried along with a water spray as control. 4 sprays of the foliar organic nutrients were given at 20 days interval commencing from 30th day after transplanting. Hot peppr cv. K2 was used for this study. The observations viz., plant height at flowering and at harvest, number of branches at flowering and at harvest, number of fruits and fruit set percentage, dry fruit yield per plant were recorded and estimated fruit yield was calculated.

RESULTS AND DISCUSSION
The results revealed that growth characters such as plant height at flowering and at harvest, number of branches at flowering and at harvest and yield characters such as number of fruits and fruit set percentage, dry fruit yield per plant and estimated fruit yield were maximum under the treatment of Seaweed extract @ 5 % concentration given as foliar spray followed by 2.5 % concentration of seaweed extract. This was comparable with Panchakavya 4 % as foliar application(Table 1 & 2).

The results might be due to the presence of all the macro and micro nutrients in readily available form in sea weed extracts. Plants might have readily absorbed the nutrients such as water soluble potash other minerals and trace elements present in the marine algae and these nutrients must have cured the deficiency of nutrients. Sea weed contains 60 trace minerals and ready to use nutrients including nitrogen, phosphorus, potash and magnesium. Moreover sea weed extracts contains hormones to encourage plant growth. Seaweed extracts have been shown to increase the crop yield, improve growth, induce resistance to frost, fungal and insect attacks. This might have been the reason for improved growth and yield of hot pepper. These results are a in agreement

ISSN 2394 - 7780

with Zahid(1999). It was also reported that Sea weed extracts enhanced plant nutrient uptake and it might be the reason for enhancing the growth and yield of the plants(Zodape, 2001).

Beneficial and proven biofertilizers such as azotobacter, *Azospirillum* and phosphobacteria and plant protection substances like *Pseudomonas* and saprophytic yeasts detected in panchakavya can be attributed to its efficacy as organic foliar nutrient that might have in turn, stimulated the growth, resulting in increased plant height and number of branches as reported by Somasundaram *et al*.(2004). The present findings on improved growth parameters of hot pepper due to application of panchakavya is in line with Archana (2008) in bitter gourd.

Thus it was concluded that growth and yield characters were maximum under the treatment of Seaweed extract @ 5 % concentration given as foliar spray followed by 2.5 % concentration of seaweed extract. Application of 2.5 % of seaweed extract was on par with the application of panchakavya @ 4 % concentration.

Table 1. Effect of bio regulators on the growth characters of chilli

Treatments	Plant height at flowering (cm)	Plant height at harvesting (cm)	Number of primary branches at flowering	Number of primary branches at flowering
T_1- Control	27.46	50.70	2.99	7.90
T_2- Vermiwash(1:3 dil)	48.95	86.29	7.20	14.32
T_3- Seaweed Extract@5 % conc.	56.46	97.02	8.42	16.26
T_4-EM(1:500 dil.)	44.60	80.19	6.78	13.64
T_5- Panchakavya- 4 % conc.	53.61	93.98	8.01	15.60
T_6- EM(1:1000 dil.)	42.68	77.09	6.76	13.58
T_7- Panchakavya- 3 %	51.78	90.41	7.32	15.00
T_8- Seaweed Extract@2.5 % conc.	53.65	94.01	8.03	15.65
T_9 -Vermiwash(1:5 dil)	46.57	83.32	7.18	14.29
SEd	0.89	1.44	0.16	0.29
CD(p=0.05)	1.79	2.90	0.33	0.58

Table 2. Effect of bio regulators on the yield characters of chilli

Treatments	Number of fruits	Fruit set percentage	Dry fruit yield per plant(g)	Estimated yield per hectare(Kg ha^{-1})
T_1- Control	44.34	43.47	11.42	540.25
T_2- Vermiwash(1:3 dil)	91.06	55.39	32.03	1577.01
T_3- Seaweed Extract@5 % conc.	104.75	58.50	39.53	1927.43
T_4-EM(1:500 dil.)	86.93	54.58	29.95	1454.30
T_5- Panchakavya- 4 % conc.	100.00	57.50	37.43	1824.65
T_6- EM(1:1000 dil.)	83.18	53.93	27.91	1353.56
T_7- Panchakavya- 3 %	95.89	57.02	34.01	1655.00
T_8- Seaweed Extract@2.5 % conc.	100.21	57.74	37.45	1823.64
T_9 -Vermiwash(1:5 dil)	90.77	55.28	30.00	1457.01
SEd	1.81	0.22	0.97	46.77
CD(p=0.05)	3.60	0.44	1.55	94.02

ISSN 2394 - 7780

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MARKETING BEHAVIOUR OF MANGO GROWERS IN VALUE ADDITION

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ABSTRACT
Mango is the world's most popular fruit and is referred to as the 'King of Fruits'. Worldwide mangoes are grown in over 60 countries and half of the produced and traded tropical fruits are mango. Mangoes are excellent sources of vitamins A, C and fibre. Indian mangoes come in various shapes, sizes and colours with a wide variety of flavour, aroma and taste.India is one of the top mango producing countries of the world. Tamil Nadu state accounted for 6.00-7.00 per cent of the total Indian mango production. The mango pulp industry in Krishnagiri district of Tamil Nadu is the second largest exporter of pulp in the country, generates between rupees 400 to 500 crores of foreign exchange annually. The study was conducted in Krishnagiri district of Tamil Nadu state. Data were collected from both the mango growers and mango processors. Three hundred mango grower respondents and forty mango processors were identified and data were collected from them using well-structured and pre-tested interview schedules. More than half of mango growers were medium to high level of marketing behaviour in value addition in mango cultivation.

Keywords: Mango growers, Marketing behaviour and Value addition.

INTRODUCTION
Mango is the world's most popular fruit and is referred to as the King of Fruits. Worldwide Mangoes are grown in over 60 countries and half of the produced and traded tropical fruits are mango. The mango fruit grows well under tropical (warm) climate, with long dry season (over three months) followed by sufficient rains. Originally from India, mangoes have been around for over 5,000 years. Mangoes are excellent sources of vitamins A, C and fiber. Indian mangoes come in various shapes, sizes and colours with a wide variety of flavour, aroma and taste. Tamil Nadu accounted for 6-7 per cent of the total Indian mango production in recent years. Krishnagiri, Dindugal, Theni and Dharmapuri are the major districts producing mango in Tamil Nadu. The important commercial varieties in Tamil Nadu are Alphonso, Totapuri, Banganapalli Neelum and Sendura. Bangladesh, Arab countries and Kuwait are the main importers of fresh mango from Tamil Nadu. "Krishnagiri mango pulp has already created a niche for itself in the international market. It is believed that the establishment of an Agricultural Export Zone (AEZ) would go a long way in marketing the products in the domestic and international market, thereby attracting foreign buyers in Krishnagiri. Thirty per cent of the total mango pulp exported from the country is being extracted at the 52 mango pulp units in Krishnagiri region. Considering the above facts in mind, an attempt has been made to study about the marketing behaviour of mango growers in value addition.

RESEARCH METHODOLOGY
The study was conducted in Krishnagiri district of Tamil Nadu. The lists of mango growers in the selected 20 villages were obtained from the office of the Assistant Director of Horticulture, Krishnagiri. From the list, three hundred respondents were selected based on proportionate random sampling techniques. From the items related for adoption and value addition were finalized in consolation with scientist. There were 10 major inclusive of value addition selected for the adoption study. Two score were assigned if adopted and 'one' score was assigned for non-adoption. The scores of all the sub items under main items were summed up for each respondent and the adoption score was arrived at. The respondents were categorized as low, medium and high using cumulative frequency.

FINDING AND DISCUSSION
Market perception
The results on distribution of respondents according to their market perception is presented in Table 1.

Table 1. Distribution of respondents according to their market perception

S. No.	Category	Mango growers (n = 300)		Mango processors (n = 40)	
		No.	%	No.	%
1.	Low	76	25.30	5	12.50
2.	Medium	164	54.70	23	57.50
3.	High	60	20.00	12	30.00
Total		**300**	**100.00**	**40**	**100.00**

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It could be observed from Table 1, that majority of respondents (54.70 Per cent) had medium level of market perception followed by low (25.30 Per cent) and high (20.00 Per cent) levels. The medium level of mass media exposure and low level of social participation might be the reasons for medium level of market perception among majority of the respondents.

It could be seen from Table 16 that slightly more than half (57.50 Per cent) of the processors had medium level of market perception followed by high (30.00 Per cent) and low (12.50 Per cent) levels of market perception.This finding is in accordance with the findings of Jansirani (2005).

MARKET ORIENTATION

The results on distribution of respondents according to their market orientation is presented in Table - 2.

Table - 2. Distribution of respondents according to their market orientation

S. No.	Category	Mango growers (n = 300)		Mango processors (n = 40)	
		No.	%	No.	%
1.	Low	58	19.33	4	10.00
2.	Medium	77	25.67	9	17.50
3.	High	165	55.00	27	67.50
Total		**300**	**100.00**	**40**	**100.00**

It could be seen from Table – 2, that slightly more than half of growers (55.00 Per cent) had high level of market orientation followed by medium (25.67 Per cent) and low (19.33 Per cent) levels of the market orientation.

With regard to processors, more than two-third of the processors (67.50 Per cent) had high level of market orientation followed by medium (17.50 Per cent) and low (10.00 Per cent) levels of the market orientation. This finding is contradictory to the findings of Robinson (1997).

SUMMARY AND CONCLUSION

The marketing behaviour of mango grower in value addition was found to be Medium to high. Hence, it is necessary to improve their marketing behaviour by designing Training programme suitable for mango growers in district of Tamil Nadu. While organising extension programmes for encourage the farmers to adopted production of value added techniques.

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GENE ACTION AND VARIANCE OF COMBINING ABILITY ANALYSIS FOR VEGETABLE COWPEA [VIGNA UNGUICULATA (L.) WALP.]

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ABSTRACT
The present investigation was carried out in the Department of Horticulture, Pandit Jawaharlal Nehru college of Agriculture and Research Institute, Karaikal, UT of Puducherry with six lines, four testers and their 24 hybrids obtained through line x tester mating design to evaluate the performance of the parents as well as F_1 hybrids by assessing mean performance, gene action, combining ability. The genetic architecture of the economically important traits and the intensity and direction of relationship among them were also studied. The genotypes were evaluated for 13 characters viz., plant height, number of primary branches, days to 50 per cent flowering, number of days to first picking, number of pods plant^{-1}, number of pods cluster^{-1}, pod length, individual pod weight, number of days to last picking, number of seeds pod^{-1}, pod yield plant^{-1}, crude protein content and crude fibre content.

Keywords: Pod yield, gene action, variance and combining ability.

INTRODUCTION
Cowpea is an important legume rich in protein, used mainly for its green immature pods as pulse and fodder. In the cultigen cowpea, four sub species have been identified, of which unguiculata the dual type and sesquipedalis, the yard long bean (vegetable type) are most commonly cultivated. In fresh form the young leaves and the immature pods are used as vegetable. The succulent immature green pod of vegetable cowpea has equivalent nutritional composition as other beans. All the plant parts used for food are nutritious, providing proteins, vitamins and minerals. In Tamil Nadu, more grain cowpea varieties are available than the vegetable cowpea (Sharma et al., 2011). Therefore, developing vegetable cowpea varieties becomes the need of the hour.

The combining ability analysis provides information about the general combiners for yield and its components as well as the gene action involved in the expression of various quantitative characters thus helping in deciding the breeding procedure for genetic improvement of such traits (Singh and Narayanan, 2013). In a self-pollinating crop like cowpea, variability is often created through hybridization between carefully chosen parents. The scope of exploitation of hybrid vigour would depend on the direction and magnitude of heterosis and the type of gene action involved. The information of such estimates is essential to plan an efficient breeding programme for the improvement of the crop. Although the hybrid vigour cannot be exploited commercially in highly self-pollinated crops like cowpea due to absence of male sterility and efficient pollinating system, the estimates of heterosis will help to identify crosses, which can lead to superior transgressive segregants in advance generations (Patel et al., 2009).

MATERIAL AND METHODS
A total of 10 genotypes collected from different sources were used as study material. The parental lines were selected based on earliness and other yield contributing traits viz., pod length, number of pods plant-1, high crude protein content as well as wider adaptability. Six lines and four testers were selected based on their per se performance for hybridization. The lines used were Kadappa Local (L1), Anaswara (L2), Kashi Nidhi (L3), Kashi Kanchan (L4), Arka Suman (L5), CO 2 (L6) and the testers were Pusa Sukomal (T1), Kashi Unnati (T2), Arka Garima (T3), and Arka Samrudhi (T4). The selected lines and testers were crossed to produce 24 hybrids by employing Line x Tester mating design. Staggered sowing of the parents was taken up in order to have synchronization in flowering. A total of 24 F1 hybrids and their respective parents were evaluated in a randomized block design with two replications maintaining 20 plants in each parent and hybrid. Biometrical observations were recorded from five the tagged plants in each replication.

RESULTS AND DISCUSSION
The analysis of variance for combining ability in respect of 12 characters. Partitioning of variance due to crosses into interaction components was significant for all the characters under study. Thus the significance of mean squares due to lines and testers as well as crosses for most of the characters were conformed. The mean squares due to parents vs. hybrids showed significance for majority of the characters, excluding number of primary branches plant-1, individual pod weight and crude fibre content.

The combining ability can give useful information on the choice of parents in terms of expected performance of the crosses and their progenies as the genetic worth of the parents is decided on the basis of its combining

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ability. Also the parents having high general combining ability (gca) could prove useful for producing transgressive segregants from advance generations. The estimates of general combining ability effects of lines and testers.

The genotypic variance was partitioned into those due to parents, hybrids and parents Vs. hybrids using line x tester analysis. The mean squares due to parents and hybrids were found significant for all the characters studied. General combining ability effects of the parents (*gca*) and specific combining ability effects of the hybrids (*sca*) were estimated for all the thirteen characters studied. The three types of heterosis *viz.*, relative heterosis (heterosis over mid-parent), heterobeltiosis (heterosis over better parent) and standard heterosis (heterosis over standard check variety) were also studied.

In the present investigation, the line Anaswara (L_2) recorded high mean values for pod length, individual pod weight and number of seeds pod^{-1}. The line Kashi Nidhi (L_3) recorded minimum days to first picking, maximum pod length and pod yield plant^{-1}. Among the testers, Pusa Sukomal (T_1) and Kashi Unnati (T_2) recorded the lowest plant height. Kashi Unnati (T_2) recorded minimum number of days to first picking, whereas it registered maximum pod length, number of seeds pod^{-1} and pod yield plant^{-1}. Maximum crude protein content was recorded in Arka Garima (T_3). Hence, combining ability assumes greater importance to assess the genetic potentialities of the genotypes. The general combining ability studies of the parents in the present investigation has revealed that the parents possessed high *gca* effects for different characters and could be used for producing transgressive segregants as reported by Dhillon (1975).

The line Kashi Nidhi (L_3) recorded low *gca* value for plant height, days to 50 per cent flowering and number of days to first and last picking but it also has recorded maximum value for pod length and number of seeds pod^{-1}. The line Anaswara (L_2) had higher *gca* for productive traits *viz.*, number of pods cluster^{-1}, number of pods plant^{-1}, pod length, individual pod weight and number of seeds pod^{-1}. Among the testers, Pusa Sukomal (T_1) and Arka Garima (T_3) showed minimum plant height with more number of primary branches plant^{-1}. Number of days to first picking was early in Pusa Sukomal (T_1) and Arka Garima (T_3). Crude fibre was minimum, whereas crude protein was higher in Arka Samrudhi (T_4).Among the lines, Anaswara (L_2) and Kashi Nidhi (L_3) and the testers Pusa Sukomal (T_1) and Arka Garima (T_3) may be considered as best general combiners for yield contributing and quality characters.

Hence, these lines and testers can be utilized in breeding programmes for the improvement of the respective characters. As a whole, the lines Anaswara (L_2) and Kashi Nidhi (L_3) and the testers Kashi Unnati (T_2) and Arka Garima (T_3) showed desirable mean performance for most of the yield contributing and quality traits. The hybrids Anaswara x Pusa Sukomal recorded the highest heterosis for number of pods cluster^{-1}, number of pods plant^{-1}, individual pod weight, number of days to last picking, number of seeds pod^{-1}, pod yield plant^{-1} and crude protein content whereas, it recorded minimum value for plant height and number of days to first picking. The hybrid Kadappa Local x Pusa Sukomal recorded the highest value of heterosis for the traits, number of primary branches plant^{-1}, pod length, number of pods plant^{-1}, individual pod weight, number of days to last picking, number of seeds pod^{-1}, pod yield plant^{-1}, crude protein content and lowest heterosis for crude fibre content. The hybrid Kashi Nidhi x Pusa Sukomal recorded the lowest heterosis for days to 50 per cent flowering.Though mean and heterosis were found to be better criteria than *sca* to select hybrids for heterosis breeding, the mean is the phenotypic value and the heterosis is the derived value from this phenotypic value. Therefore, choice of hybrids merely based on mean and heterosis would be genetically inadequate.

Since *sca* reflects the non-additive genetic portion of hybrid variance which normally decides the extent of heterosis, evaluation of hybrids based on mean and heterosis along with *sca* effect would be more meaningful in selecting hybrids for heterosis breeding (Varshney, 1985). Hybrids were evaluated based on their mean performance, *sca* effects and standard heterosis and the hybrid Kadappa Local x Arka Garima and Kashi Nidhi x Pusa Sukomal were the best, since they had desirable performance for the traits *viz.*, plant height, number of primary branches plant^{-1}, number of days to first picking and number of pods cluster^{-1} and can be utilized for heterosis breeding. The hybrids Arka Suman x Kashi Unnati, Kadappa Local x Arka Samrudhi and Kashi Kanchan x Arka Samrudhi with significant *gca* effects and non significant *sca* effects could be utilized for recombination breeding.

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Analysis of variance for combining ability of parents and hybrids in vegetable cowpea

S.No.	Character	Mean squares		GCA/SCA	Gene action
		GCA	SCA		
1	Plant height (cm)	8.742	205.354	0.0425	Non - additive
2	Number of primary branches plant^{-1}	0.0296	1.2068	0.0245	Non - additive
3	Days to 50 per cent flowering	0.176	2.998	0.0587	Non - additive
4	Number of days to first picking	2.457	86.825	0.0282	Non - additive
5	Number of pods cluster^{-1}	0.009	0.912	0.0098	Non - additive
6	Number of pods plant^{-1}	5.724	144.088	0.0397	Non - additive
7	Pod length (cm)	1.409	23.603	0.0596	Non - additive
8	Individual pod weight plant (g)	0.235	4.470	0.0525	Non - additive
9	Number of days to last picking	0.479	16.801	0.0285	Non - additive
10	Number of seeds pod^{-1}	0.035	1.984	0.0176	Non - additive
11	Pod yield plant^{-1}	8.254	1549.845	0.0053	Non - additive
12	Crude fibre content in pods (per cent)	-0.014	0.275	-0.0509	Non - additive
13	Crude protein content in pods (per cent)	-0.025	8.302	-0.0030	Non - additive

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INTEGRATED SULPHUR MANAGEMENT ONHYBRID SUNFLOWER

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ABSTRACT
Field investigations were carried out during March 2012 and August 2012 at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, to study the effect of Integrated sulphur management practices on the growth, yield,quality, nutrient uptake and nutrient availabilityof hybrid sunflower cv.sunbred. The experiments were laid out in randomized block design and replicated thrice. The experiment consisted of eleven treatments viz., T_1 – No sulphur / RDF alone (control), T_2 – 45 kg S ha^{-1} through gypsum, T_3 - 45 kg S ha^{-1} through vermicompost, T_4 - 45 kg S ha^{-1} through poultry manure, T_5 - 45 kg S ha^{-1} through lignite flyash , T_6 - 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through vermicompost, T_7 - 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through poultry manure, T_8 - 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through lignite flyash, T_9 – 50 % S ha^{-1} through gypsum + 50 % S ha^{-1} through vermicompost, T_{10} – 50% S ha^{-1} through gypsum + 50% S ha^{-1} through poultry manure and T_{11}- 50% S ha^{-1} through gypsum + 50 % S ha^{-1} through lignite flyash. The results of the experiments revealed that application of 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through vermicompost (T_6) significantly influenced the growth, yield,quality, nutrient uptake and nutrient availability in sunflower. This treatment recorded maximum values for growth attributes viz.,plant height (152.37 and 154.38 cm), LAI (6.90 and 6.97 cm at flowering stage), DMP (4225.72 and 4328.81 kg ha^{-1}) at harvest stage, chlorophyll content (2.28 and 2.31 mg g^{-1})at flowering during first and second croop, respectively. This treatment also recorded higher values for yield attributes viz., total number of seeds $head^{-1}$ (778.06 and 815.26), number of filled deeds $head^{-1}$(634.45 and 672.28), seed filling percent (83.04 and 84.26 %), seed yield (1825.46 and 1927.39 kg ha^{-1}) and stalk yield (3800.63 and 3898.59 kg ha^{-1}) in both the crops. This treatment recorded maximum N,P,K and S uptake, maximum oil content, oil yield and crude protein content in both the crops. This was followed by T_7 (75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through poultry manure) in both the crops. The lowest values for growth, yield,quality, nutrient uptake and nutrient availability were recorded in T_1-No sulphur / RDF alone (control) in both the crops. T_1 recorded Maximum N,P,K and S availability in both the crops.

INTRODUCTION
The oilseeds form essential part of human diet, besides it produces basic raw materials for agro-based industries. Sunflower has large acreage under various oilseeds in different agro-climatic zones of this country. The average Indian consumer uses relatively lesser quantities of edible oil, no doubt influenced by this modest level of income. Sunflower (*Helianthus annus* L.) holds great promise as an oilseed crop because of its short duration, photo- in – sensitivity and wide adaptability to different agro-climatic regions and soil types. Sunflower seed contains about 48-53 percent edible oil, sunflower oil is a rich source of linoleic acid (64%) which is good for heart patients. The oil is also used for manufacturing hydrogenated oil. It can be grown at any time of year and can serve as an ideal catch crop during period when the land is otherwise fallow. The existing yield is very low, mainly because of the suboptimal soil fertility. After N,P and K, S is the fourth nutrient, whose deficiency is widespread in India (Yadav*et al*., 2000; Sakal*et a*l., 2001). Sulphur application has many advantages for sunflower regarding growth parameters and yield and quality. Each unit of fertilizer sulphur generates 3-5 units of edible oil, a commodity needed by every family. Sulphur can be rightly called as fourth major element of the plant because it is a constituent of three amino acids *viz.*, Cysteine, Cystine and Methionine which are the building blocks of protein and helps in the formation of chlorophyll and synthesis of oils. Sulphur improves protein and oil percentage in seeds. Sing (1999) reported that application of sulphur increased the uptake of various macro and micro nutrients in groundnut. Sulphur is required to attain high yield, biological yield, harvesting index and oil content, as affected by biofertilizers and sulphur application. Application of 2 kg S ha^{-1} increased seed yield by 38%.

Ever since the role of soil fertility in crop production has been recognized, the use of organic manures has become an imperative need for successful farming. It is a known fact that organic matter provides considerable amount of both macro and micronutrients. It improves soil structure through increased aggregation, which favorably influences the tilth, water infiltration, moisture retention, drainage, aeration, temperature and root penetration besides prevention of crusting. Utilization of all possible sources of organic matter such as vermicompost, FYM, poultry manure helps in improving the soil fertility status and also enhances the yield of

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oilseed crops. In addition, integration of organics with inorganic improves the physiological system of crop growth, provides adequate growth regulating substances, modifies physic-chemical properties of soil and thus augmenting crop yields. With this background the investigation was carried to increase sunflower yield and quality through integrated sulphur management.

MATERIAL AND METHODS

Field investigations were carried out during March 2012 and August 2012 at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar. The soil of experimental field was clay loam in texture. The soil was low in available Nitrogen, medium in available Phosphorous, high in available Potassium and low inavailableSulphur.The sunflower cv.Sunbredwaschosen for the study. The experiment was laid out in Randomized block design with three replications. The experiment consisted of eleven treatments *viz.*, T_1 – No sulphur / RDF alone (control), T_2 – 45 kg S ha^{-1} through gypsum, T_3 - 45 kg S ha^{-1} through vermicompost, T_4 - 45 kg S ha^{-1} through poultry manure, T_5 - 45 kg S ha^{-1} through lignite flyash , T_6 - 75 % S ha-1 through gypsum + 25 % S ha^{-1} through vermicompost, T_7 - 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through poultry manure, T_8 - 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through lignite flyash, T_9 – 50 % S ha^{-1} through gypsum + 50 % S ha^{-1}through vermicompost, T_{10} – 50% S ha^{-1} through gypsum + 50% S ha^{-1} through poultry manure and T_{11}- 50% S ha^{-1} through gypsum + 50 % S ha^{-1} through lignite flyash.The recommended dose of 60:90:60 kgs of NPK $ha^{-1}$was applied in the form of urea, DAP and muriate of potash. Sulphur @ 20 kg ha^{-1} was applied through Gypsum as per the treatments.

RESULTS AND DISCUSSION

Growth attributes (Table 1)

The integrated sulphur management practices significantly influenced the growth attributes viz., plant height, LAI, DMP and chlorophyll content. All the sources of sulphur *viz.*, gypsum, poultry manure, lignite fly ash alone and in integration with gypsum had marked influence on the growth attributes of hybrid sunflower over no S application.

Among the integrated sulphur management practices tried, application of 75% S through gypsum + 25 % S ha^{-1} through vermicompost(T_6) resulted in tallest sunflower plants, increased LAI, DMP and chlorophyll content at all the stages of crop growth. This was evidenced through the studies of Intodia and Tomar (1997) and Raja *et al*. (2007). Presence of higher amount of readily available N in vermicompost and numerous active substances like enzymes and vitamins secreted by microbes in vermicompost (Jeyabal, 1996) might have exerted a positive effect on metabolism of sunflower crop at early growth stage leading to higher growth components. Increased plant height, LAI, DMP due to integrated application of sulphur are in concordance with the reports of Vetrimurugan (2002) and Menaka (2004). This is due to sulphur applied through gypsum along with RDF increased the availability of other nutrients and enhanced the growth attributes of sunflower in both the crops (Vaiyapuri*et al*., 2004) This was followed by application of 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through poultry manure and 75 % S ha^{-1} through gypsum + 25 % S ha^{-1} through lignite flyash, the lowest growth attributes was observed under T_1(Nosulphur) in both the crops. This is due to less of availability of sulphur which reduced the availability of other nutrients and finally resulted in lesser values for growth attributing characters.

Yield attributes (Table 2)

The integrated sulphur management practices significantly influenced the yield attributes viz., head diameter, total number of seeds $head^{-1}$, number of filled seeds $head^{-1}$, seed filling percent and 100 seed weight in both the crops.

Application of 75% S through gypsum + 25 % S ha^{-1} through vermicompost(T_6) significantly increased the head diameter, total number of seeds $head^{-1}$, number of filled seeds $head^{-1}$, seed filling percent and 100 seed weight and seed and stalk yield over the other treatments. Sulphur is known to play a vital role in the formation of aminoacids. It had favourable effect on yield attributes due to proper partitioning of photosynthates from source to sink. These findings were earlier reported bySyed ShajatHussain*et al.*(2011).The least values for yield attributes were recorded under T_1 (No sulphur – RDF alone), could be due to poor availability of Sand other nutrients. These findings were earlier reported by Poonkodi and Poomurugesan (2005). The increase in yield under this treatment might be due to significant increase in yield attributes leads to seed and stalk yield. This might be due to the influential role played by sulphur in increasing both growth yield attributes. Supply of S in addition to N,P and K might bethe lifting factor behind the increased seed and stalk yield (Kapilashekahwat and Shivay, 2008). T_1 (Control) recorded lesser seed and stalk yield in both the crops. This might be due to absence of sulphur resulted in reduced growth and yield attributing characters timely seed and stalk yield. These finding are in line with Ravikumar (2001).

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Yield (Table 2)
All the integrated sulphur management practices significantly influenced the seed and stalk yield of sunflower in both the crops over sulphur without integration of organics. Among the treatments tried, T_6(75% S through gypsum + 25 % S ha^{-1} through vermicompost) significantly recorded higher seed yield of 1825.67 and 1927.39 kg ha-1 and stalk yield of 3800.63 and 3898.59 kg ha^{-1} in first and second crop respectively. This treatment registered higher seed yield over no sulphurapplication(T_1) and the yield increase being 44.18 and 48.01 per cent respectively in first and second crop respectively. Sulphur application increased the chlorphyll content in leaf and gave a significant positive correlation between chlorophyll content in leaf and crop yield (Sinha*et al*., 1995).control treatment T_1 (No sulphur – RDF alone) recorded lesser seed and stalk yield in both the crops. These findings are in line with Ravikumar*et al.* (2001).

Quality characters (Table 3)
The integrated sulphur management practices significantly increased the oil content, oil yield and crude protein content. The maximum oil content of 38.42 and 38.65 percent was recorded with 75% S through gypsum + 25 % S ha^{-1} through vermicompost (T_6) and least value was recorded under no S applied plot (T_1). Increase in oil content by sulphur application might be attributed to involvement of sulphur in the biosynthesis of oil (Mudd, 1967). Lowest values of oil and protein content in sunflower seeds was observed in the treatment T_1(Nosulphur) in both the crops. This might be due to lesser availability and uptake of nutrients for the oil and protein synthesis in the crop. Similar view was expressed by Renugadevi and Balamurugan (2002).

Nutrient uptake (Table 3)
In both the crops, N,P,K and S uptake were significantly influenced by integrated sulphur management practices. Among the treatments tried, T_6registered the higher amount of N,P,K and S uptake in both the crops respectively. This might be due to optimum rate of 'S' application through gypsum along with vermicompost increased the uptake of N,P,K & S and ultimately more utilization of these nutrients, which in turn enhanced their concentration and uptake (Bhagat *et al.,* 2003). Increase in the uptake of N,P and K, S by sunflower with gypsum application was due to the combined effect of increase in yield and nutrient content in plants. Similar results were earlier reported by Devakumar and Gajendra Giri (1990). T_1 recorded minimum values for N,P, K & S uptake due to lesser availability of nutrients in both the crops.

Post harvest soil available nutrient status (Table 4)
The integrated sulphur management practices influenced the post harvest nutrient status viz., N, P, K & S over the treatments received sulphur without organics. Among the various practices tried, T_1 recorded higher values for soil available N,P, K & S in both the crops. This might be due to poor uptake of nutrients by the crop as result of lesser foraging capacity. Similar results were also reported by Kalaiyarasan (2000). N,P, K & S were low in T_6due to more uptake of nutrients by the crop (Gandhi, 2011).

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ISSN 2394 - 7780

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Table - 1: Effect of integrated sulphur management on growth attributes of sunflower

Treatments	Plant height (cm)		LAI at flowering stage		DMP (Kg ha^{-1}) (at harvest)		Total Chlorophyll (mg g^{-1})	
	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop
T_1	117.32	123.17	4.49	4.52	2816	3447	1.23	1.25
T_2	135.27	136.59	4.96	5.00	3737	3829	1.90	1.94
T_3	132.23	133.47	4.84	4.89	3659	3752	1.88	1.91
T_4	129.22	129.98	4.73	4.79	3579	3665	1.87	1.90
T_5	126.20	126.78	4.64	4.68	3512	3588	1.85	1.88
T_6	152.37	154.38	6.90	6.97	4226	4329	2.28	2.31
T_7	148.39	150.12	6.44	6.51	4103	4206	2.12	2.15
T_8	141.93	143.13	5.87	5.90	3878	3977	2.06	2.10
T_9	145.12	146.48	6.15	6.20	3980	4087	2.09	2.12
T_{10}	139.58	141.52	5.26	5.32	3871	3968	1.97	2.00
T_{11}	138.55	139.27	5.14	5.20	3810	3906	1.93	1.96
S.Ed	1.40	1.46	0.125	0.14	33.61	37.15	0.05	0.07
CD (P = 0.05)	2.80	2.92	0.25	0.28	67.23	74.31	0.11	0.15

ISSN 2394 - 7780

Table - 2: Effect of integrated sulphur management on yield attributes and yield of sunflower

Treatments	Head Diameter		Total No. of Seeds head^{-1}		No. of filled seeds head^{-1}		Seed filling %		100 seed at (g)		Seed yield (Kg ha^{-1})		Stalk Yield (kg ha^{-1})	
	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
T_1	12.60	13.42	489.47	534.35	310.35	337.28	63.40	63.86	3.83	3.90	1266	1302	2872	2957
T_2	14.50	15.32	608.39	628.31	442.17	460.11	72.67	73.22	4.85	4.92	1514	1560	3489	3564
T_3	14.27	15.11	579.27	585.25	405.15	421.13	69.94	71.95	4.68	4.68	1467	1511	3431	3499
T_4	13.98	14.81	545.14	550.16	371.12	390.07	68.07	70.90	4.45	4.43	1399	1435	3385	3435
T_5	13.50	14.45	515.12	523.08	342.07	361.03	66.40	69.02	4.20	4.21	1371	1403	3327	3371
T_6	18.67	19.72	860.58	934.37	714.68	787.35	83.04	84.26	6.20	6.42	1825	1927	3800	3898
T_7	17.45	18.53	778.06	815.26	634.45	67.2.28	81.54	82.15	5.74	5.87	1765	1850	3735	3805
T_8	15.50	16.58	677.38	705.23	520.19	548.12	76.79	77.72	5.33	5.36	1656	1721	3602	3683
T_9	16.37	17.44	725.16	757.21	568.27	601.21	78.36	79.39	5.52	5.60	1702	1780	3668	3746
T_{10}	14.85	15.77	658.47	687.25	500.47	525.29	76.00	76.43	5.28	5.32	1601	1654	3590	3662
T_{11}	14.68	15.56	642.99	673.19	486.25	512.18	75.62	76.08	5.16	5.14	1555	1613	3540	3595
S.Ed	0.30	0.36	7.75	7.92	7.59	8.42	0.20	0.22	0.08	0.09	24	35	27	31
CD (P = 0.05)	0.61	0.73	15.50	15.84	15.18	16.85	0.41	0.45	0.16	0.19	48	25	55	62

Table - 3: Effect of integrated sulphur management of Quality parameters and Nutrient uptake of sunflower

Treatments	Oil Content (%)		Crude Protein Content (%)		Nutrient uptake (kg ha^{-1})							
					N		P		K		S	
	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
T_1	37.15	37.21	20.48	21.37	67.52	68.43	14.33	15.42	61.48	62.27	6.71	7.38
T_2	37.63	37.69	22.58	23.44	71.34	72.23	15.89	16.79	64.77	65.46	7.93	8.61
T_3	37.50	37.55	22.25	22.86	70.88	71.66	15.67	16.49	64.29	65.25	7.63	8.36
T_4	37.38	37.41	21.39	22.47	70.29	71.36	15.39	16.21	63.86	64.75	7.33	8.16
T_5	37.22	37.27	21.67	21.99	69.86	70.92	15.12	15.94	63.37	64.22	7.12	7.95
T_6	38.42	38.65	27.53	28.39	77.62	78.32	19.42	20.21	70.45	71.27	11.47	12.25
T_7	38.27	38.32	26.21	27.29	76.35	77.23	18.37	19.20	69.31	70.19	10.38	11.21
T_8	38.07	38.21	24.19	25.22	74.16	75.20	16.50	17.30	67.18	68.17	8.73	9.28
T_9	38.16	38.15	25.18	26.23	75.25	76.13	17.42	18.25	68.29	69.18	9.54	10.18
T_{10}	37.35	37.78	23.68	24.55	72.68	73.36	16.41	17.22	65.78	66.47	8.58	9.10
T_{11}	37.76	37.67	23.52	24.41	71.87	72.63	16.14	17.05	65.26	66.16	8.22	8.87
SEd	0.05	0.06	0.07	0.08	0.43	0.43	0.17	0.18	0.38	0.39	0.20	0.21
CD (P = 0.05)	0.10	0.13	0.15	0.17	0.86	0.86	0.35	0.36	0.76	0.78	0.41	0.42

Table - 4: Effect on integrated sulphur management of nutrient availability on sunflower

Treatments	Nutrient availability (Kg ha^{-1})							
	N		P		K		S	
	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
T_1	237.20	241.22	22.45	27.61	343.64	349.70	22.60	29.15
T_2	224.26	227.29	20.49	24.31	338.31	335.41	19.40	25.30
T_3	226.15	230.42	2021	25.21	339.25	338.22	20.35	26.27
T_4	229.21	233.31	21.45	26.32	340.42	342.19	21.41	27.10
T_5	230.13	239.28	21.20	27.15	342.27	345.23	22.27	28.23
T_6	191.50	201.20	15.28	20.40	305.11	310.23	13.08	17.22
T_7	197.37	207.31	16.19	21.37	315.21	313.32	14.20	19.31
T_8	205.29	213.39	17.21	22.30	320.29	319.29	15.31	21.20
T_9	213.19	219.28	18.32	21.42	329.27	322.30	16.42	22.19
T_{10}	222.69	221.19	19.46	22.37	334.35	325.41	17.29	23.31
T_{11}	223.48	225.31	20.29	23.25	335.22	330.28	18.37	24.28
SEd	0.53	0.49	0.55	0.30	0.53	0.48	0.78	0.78
CD (P = 0.05)	1.12	1.03	1.15	0.64	1.10	1.01	1.64	1.64

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PHENOTYPIC ASSESSMENT OF RICE (Oryza sativa L.) GENOTYPES FOR GENETIC VARIABILITY AND VARIETAL DIVERSITY UNDER NATURAL SALINE CONDITION

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ABSTRACT
The study on variability and diversity of sixty genotypes of rice (Oryza sativa L.) under natural saline condition revealed significant variability at 5% level among the genotypes for all the characters. High level of broad sense heritability was observed for all the traits studied, but maximum values was recorded by days to first flower followed by grain yield per plant. Genetic divergence analysis using Mahalanobis's D^2 statistic grouped into six clusters. The cluster I had maximum number (53) of genotypes. Maximum into cluster distance was found between cluster IV and VI. However, India cluster distance was maximum in cluster IV. The genotypes from diverse clusters viz NDR59 and Basmatis SPS could be recommended for inclusion in hybridization programme for breeding under saline condition.

Keywords: Saline Soil Genetic divergence, Rice, Varietal diversity.

INTRODUCTION
Genetic variation is the spice of plant breeding programme as it widens the scope of selection. Therefore, estimation of extent and nature of diversity in the germplasm accessions for yield and other economic traits is critical. The exploitable variability is judged through simple measure of variability through D^2 statistics. Estimates of heritability and genetic advance help in understanding the nature of gene action affecting the concerned trait (Sravan *et al*., 2012).

Genetic diversity and the diverse gene pools is lifeline of any breeding programme that provides opportunity for identification of traits that offer substantial scope for improvement through selection if higher level of productivity is to be achieved and sustained. Genetic divergence is an outcome of several factors such as exchange of breeding material, genetic drift, natural variation and artificial selection other than ecological and geographical diversification (Sirohi and Dar, 2009). The greater the diversity among the parents higher is the chances of achieving heterotic progeny and a broad spectrum variability in segregating generations. Thus, assessment of genetic diversity for different traits in the germplasm is essential for the identification of suitable parents in the hybridization programme (Sharma *et al*., 2008). In view of the saline situation in most of the rice growing areas in East Costal we have taken up this experiment to judge the inter-trait variability and varietal diversity in rice genotypes under natural saline condition to screen the genotypes that can be used as cultivar or surrogate parent in hybridization programs for saline stress regime.

MATERIALS AND METHODS
The present investigation was conducted at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India during the year 2013-14. Observations were made on 60 rice genotypes for eight characters and the data were subjected to D^2 analysis. Seeds of sixty rice genotypes collected from various places were utilized for the study. The details of the materials are presented in Table 1. Seeds of the sixty genotypes were sown in raised nursery beds during December, 2013. The 25-days old seedlings were transplanted to the main field. These genotypes were grown in saline soil with electrical conductivity (EC) of 3.83 dsm^{-1}. The experiments were conducted at the experimental Farm of Plant Breeding (11°245 N latitude and 79 °44' E longitude, + 5.79 m ASL), Annamalai University, Tamil Nadu, India. The experiment was laid out in a Randomized Block Design with three replications, using 20 × 20 cm spacing. Eight yield and its component characters were recorded on single plant baiss in ten randomly selected plants of the each genotype per replication. The mean data were utilized for the statistical analysis. Observation were recorded days to first flower, plant height, no. of tillers per plant, number panicles per plant, panicle length, no. of grains per panicle, thousand grain weight and grain yield per plant.

Statistical tools like analysis of variance (Panse and Suthmate, 1967), coefficient variability (Burton 1952), heritability (Lush 1949), genetic advance (Robinson et al., 1949) and D^2 statistics (Mahalanobis (1936) were used for analysis.

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Table -1: List of genotypes selected for study

SL. No.	Name of Genotype	Origin
1.	CARI 1	CIARI, Andaman, India
2.	CARI2	CIARI, Andaman, India
3.	CARI 3	CIARI, Andaman, India
4.	CARI 4	CIARI, Andaman, India
5.	CARI 5	CIARI, Andaman, India
6.	ANR 16	CIARI, Andaman, India
7.	ANR21	CIARI, Andaman, India
8.	ANR 37	CIARI, Andaman, India
9.	ADT36	TRRI,TN, India
10.	ADT37	TRRLTN, India
11.	ADT38	TRRI,TN, India
12.	ADT43	TRRI,TN, India
13.	ADT45	TRRI,TN, India
14.	Bora	Landrace, Assam, India
15.	Shali	Landrace, Assam, India
16.	Porimol	Landrace, Assam, India
17.	Sampada	Landrace, Assam, India
18.	Chhatoki	Landrace, Assam, India
19.	Shabagidhan	Landrace, Assam, India
20.	Burma Dhan Black	CIARI, Andaman, India
21.	CSR10	CSSRI, Karnal, India
22.	CSR36	CSSRI, Karnal, India
23.	CSR43	CSSRI, Karnal, India
24.	Co 43	AC & RI, Coimbatore, India
25.	Co 47	AC & RI, Coimbatore, India
26.	Ranjith	CRRI, Cuttack, India
27.	Gayathri	CRRI, Cuttack, India
28.	Swarna	CRRI, Cuttack, India
29.	Jaya	DRR, Hyderabad, India
30.	C 14-8	CIARI, Andaman, India
31.	PY 1	Regional Research Station, Paiyur, TN, India
32.	BPT 5204	Agricultural college, Bapatla, AP, India
33.	MTU 1010	A.N.G.R.A.U. Research station, AP, India.
34.	IR64	IRRI, Philippines
35.	CR 1009	CRRI, Cuttack, India
36.	NDR59	NDUAT, Kumarganj, India
37.	Basmati SPS	CSSRI, Karnal, India
38.	Pusa Basmati 1	CSSRI, Karnal, India
39.	Pusa Basmati 1121	CSSRI, Karnal, India
40.	Supermoti	CSSRI, Karnal, India
41.	STBN1	DRR, Hyderabad, India
42.	STBN2	DRR, Hyderabad, India
43.	STBN3	DRR, Hyderabad, India
44.	STBN4	DRR, Hyderabad, India
45.	STBN5	DRR, Hyderabad, India
46.	STBN6	DRR, Hyderabad, India
47.	STBN7	DRR, Hyderabad, India
48.	STBN8	DRR, Hyderabad, India
49.	STBN9	DRR, Hyderabad, India
50.	STBN 10	DRR, Hyderabad, India
51.	STBN 11	DRR, Hyderabad, India
52.	STBN 12	DRR, Hyderabad, India
53.	STBN 13	DRR, Hyderabad, India

ISSN 2394 - 7780

54.	STBN 14	DRR, Hyderabad, India
55.	STBN 15	DRR, Hyderabad, India
56.	STBN 16	DRR, Hyderabad, India
57.	STBN 17	DRR, Hyderabad, India
58.	STBN 18	DRR, Hyderabad, India
59.	STBN 19	DRR, Hyderabad, India
60.	Pokkali	Kerala, India

RESULTS AND DISCUSSION

The analysis of variance for different characters are presented in Table 2. The mean sum of square due to genotypes showed significant differences for all eleven characters under study at 5 per cent level of significant suggesting that the genotypes selected for the present study were genetically divergent. This indicates that there is ample scope for selection of promising varieties from the present gene pool for yield and its components.

Employing Mahalanobis generalized distance, the divergence in 60 genotypes of rice were estimated for yield characters under natural saline condition.

Sixty genotypes of rice were grouped into six clusters using clustering technique based on the relative magnitude of D^2 values. The compositions of different clusters are presented in Table 3. Cluster I comprised of fifty genotypes whereas cluster II had four genotypes. The clusters IV and V had two genotypes each while cluster III and VI are monogenotypic in nature.

The intra and inter cluster distances among the six clusters were determined and are presented in Table 4. The intra cluster distance ranged from 0.00 to 283.21. The cluster III and VI showed minimum intra cluster distance (0.00) since each contained single genotype and maximum intra cluster distance was exhibited by cluster IV (283.21) followed by cluster II (251.14). The inter cluster distance varied from 354.34 to 7925.46. Highest inter cluster distance was observed between clusters III and VI (7925.46). This was followed by clusters I and VI, clusters II and VI (5433.60), clusters III and V (2568.53). Lowest inter cluster distance was recorded between clusters I and II (354.34) followed by clusters II and III (421.09) and clusters IV and V (688.36).

Variability was measured by estimation of mean, coefficient of variation such as phenotypic coefficient of variation, genotypic coefficient of variation, heritability (broad sense) and genetic advance. Environment plays an important role in the expression of phenotype and genotype facts which are inferred from phenotypic observations.

The phenotypic coefficient of variation ranged from 10.12 to 39.98 per cent for grain breadth and grain yield per plant respectively. Higher magnitude of phenotypic coefficient of variation (PCV) was recorded for grain yield per plant (39.98 per cent), number of grains per panicle (32.48 per cent) and number of panicle per plant (20.96 per cent). Moderate PCV was observed for grain breadth (10.12 per cent), panicle length (10.36 per cent), grain length (13.29 per cent), grain L/B ratio (15.01 per cent), number of tillers per plant (15.96 per cent), plant height (16.79 per cent), days to first flower (17.89 per cent), and thousand grain weight (19.67 per cent).

The genotypic coefficient of variation (GCV) is higher than phenotypic coefficient of variation (GCV) for all the traits studies. A wide range of genotypic coefficient of variation (GCV) was observed for traits ranging from 10.68 to 40.84 per cent for grain breadth and grain yield per plant respectively.

High GCV was observed in grain yield per plant (40.84 per cent), number of grains per panicle (33.85 per cent), number of panicles per plant (23.97 per cent), number of tillers per plant (21.35 per cent) and thousand grain weight (21.35per cent) while moderate estimates of GCV was recorded for grain breadth (10.68 per cent), panicle length (13.07 per cent), plant height (17.35 per cent) and days to first flower (18.22 per cent).

Heritability is a measure of the extent of phenotypic variation caused by the action of genes. The heritability values ranged from 55.86 to 97.78 per cent for number of tillers per plant and grain length respectively. High heritability was observed for traits viz; grain length (97.78 per cent), days to first flower (96.47 per cent), grain yield per plant (95.84 per cent), plant height (93.72 per cent), number of grains per panicle (92.06 per cent), thousand grain weight (84.83 per cent), number of panicles per plant (76.47 per cent) and panicle length (62.91 per cent). Number of tillers per plant (55.86 per cent) recorded moderate heritability.

A perusal of genetic advance as per cent of mean for all the eleven characters under study was varied from 16.97 to 80.64 per cent for panicle length and grain yield per plant respectively. High genetic advance as per cent of mean was observed for grain yield per plant (80.64 per cent), number of grains per panicle (64.20 per cent), number of panicles per plant (37.76 per cent), thousand grain weight (37.32 per cent), days to first flower

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(36.21 per cent), plant height (33.50 per cent) and number of tillers per plant (24.57 per cent). Panicle length (16.94 per cent) showed moderate estimate of genetic advance as per cent of mean.

The analysis of variance revealed presence of significant differences among all the genotypes for eight characters studied and indicated considerable amount of variability in the genotypes. Significant variability due to treatment for all the characters was also confirmed by Rajasekaran (2006) and Sabesan *et al.,* (2009).

In the present investigation the 60 genotypes were grouped into 6 clusters. The clustering pattern of the genotypes indicated that there was little parallelism between geographical origin and genetic diversity. Similar results were reported by many workers (Nayak *et al.,* 2004).

Cluster I encompasses the largest number of 50 genotypes followed by clusters II with four genotypes. The clusters IV and V had two genotypes each. The clusters III and VI are solitary in nature.

The intra cluster distance varied from 0.00 (cluster III and VI) to 15.84 (cluster II). Inter cluster distance was maximum between III and VI (89.02) followed by clusters I and VI (76.57) and cluster II and VI (73.71) suggesting wider distance to get more variability and high heterotic effect. This clearly indicates that the genotypes included in these clusters are having broad spectrum of genetic diversity. Minimum inter cluster distance existed between cluster I and II (18.82) followed by II and III (20.52) and IV and V (26.23) reflecting minimum diversity among the genotypes within the respective cluster. It is therefore suggested that the superior genotypes from different clusters may be used in a hybridization programme.

The genotypes of clusters III and VI are most diverse may be selected as donor parents in formulating breeding programme which could be utilized for getting desirable segregants and high heterotic response. This is in conformity with the findings of Venkatesan (2004), *Sabesan et al.,* (2009).

The clustering pattern of genotypes revealed that the genotypes from different centres or states were clubbed together or genotypes originated from same centre or states were distributed in different cluster. The genotypes included in cluster I originated from different origin indicating that there was no parallelism between clustering pattern and geographic distribution of genotypes Nayak *et al.,* (2004). The distribution of genotypes also indicated that the genotypes from Andaman were distributed in different clusters. Therefore the kind of diversity belonging to same geographic origin might be due to difference in adoption, selection criteria, selection pressure in environmental conditions (Shanmugasundaram *et al.,* 2000; Sandeep *et al.,* 2013).

The analysis of variance for various characters, gave a clear picture of the existence of wide genetic variability among the genotypes chosen for the study, as indicated by the significant differences at genotypic level. In the present investigation, genotypic coefficient of variation (GCV) was higher than the phenotypic coefficient of variation (PCV). High GCV estimates were recorded for the characters viz., number of panicles per plant, number of grains per panicle and grain yield per plant indicating their greater role of contribution to the variability among the genotypes. Similar observations were observed by Satheesh Kumar and Saravanan, 2012. Moderate GCV estimates were registered for the traits namely days to first flower, plant height, number of tillers per plant, panicle length and thousand grain weights. This is in conformity with the findings of Mulugeta Seyoum *et al.,* 2012.

A high estimate of PCV and GCV recorded for number of panicles per plant, number of grains per panicle and grain yield per plant and this is agreement with the findings of Chanbeni *et al.,* 2012. A moderate estimate of PCV and GCV was recorded by days to first flower, plant height and panicle length. This is in uniformity with the findings of Pratap *et al.,* 2012 for days to first flower, plant height and panicle length and Satheesh Kumar and Saravanan, 2012 for grain length and grain breadth.

A narrow difference between PCV and GCV values suggestive of the fact that the characters studied indicated that these traits are less susceptible to the environment condition and therefore selection for such traits will be rewarding as the genetic factors play the greater role in determining the variability for these characters. Such recommendations are also made by Karuppaiyan *et al.,* (2013).

High heritability was recorded for all the characters except number of tillers per plant. Characters such as days to first flower, plant height, number of panicles per plant, number of grains per panicle, thousand grain weight and grain yield per plant expressed both high heritability and high genetic advance as per cent of mean. These characters were mostly controlled by additive gene action, hence it could be inferred that direct selection based on phenotypic observations may be effective for improvement of these traits. Similar findings were also reported by Kulanthaivel and Sabesan (2014), Ashok Kumar Tuwar *et al*. (2013).

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Panicle length and grain breadth was accompanied by moderate estimate of genetic advance as per of mean and high estimate of heritability, which indicated preponderance of non- additive gene action hence selection cannot be rewarded which was also agreed by Mulugeta Seyoum *et al., (*2012) and Yadav *et al.,* (2011).

Table - 2 : Analysis of variance for eleven characters in rice genotypes

SI. No.	Source	df	Days to first flower (days)	Plant height (cm)	No. of tillers per plant	No. of panicles per plant	Panicle length (cm)	No. of grains per panicle	Thousand grain weight (g)	Grain yield per plant (g)
			MSS							
1	Replication	2	17.67	16.21	20.68	1.72	12.05	216.72	6.34	1.64
2	Genotype	59	634.8**	967.18**	32.53**	13.17**	24.11**	4252.59**	36.95**	160.14**
3	Error	118	7.65	21.13	6.78	1.23	3.96	118.78	2.08	2.41

** significant at 1% level.

Table – 3: Distribution of rice genotypes in different clusters based on D^2 analysis

Cluster No.	Number of Genotypes	List of the genotypes
I	**50**	CARI 1, CARI 2, CARI 3, CARI 4, CARI 5, ANR 16, ANR.21, ANR 37, ADT 36, ADT 37, ADT 38, ADT 43, ADT 45, Shali, Porimol, Sampada, Shabagidhan, CSR 10, CSR 36, CSR 43, Co 43, Co 47, Ranjith, Gayathri, Swarna, Jaya, PY 1, BPT 5204, MTU 1010, CR 1009, STBN 1, STBN 2, STBN 3, STBN 4, STBN 5, STBN 6, STBN 7, STBN 8, STBN 9, STBN 10, STBN 11, STBN 12, STBN 13, STBN 14, STBN 15, STBN 16, STBN 17, STBN 18, STBN 19, Pokkali.
II	**4**	Bora, Chhatoki, Pusa Basmati, Supermoti
III	**1**	IR64
IV	**2**	NDR 59, Basmati SPS
V	**2**	Burmadhan Black, C 14-8
VI	**1**	Pusa Basmati 1121

Table - 4: Intra (bold) and inter cluster (unbold) distances of various clusters in rice

Cluster No.	I	II	III	IV	V	VI
I	214.34	354.34	1859.22	1426.62	2235.09	5864.49
II		251.14	421.09	887.08	1858.61	5433.60
III			0.00	1203.73	2568.53	7925.46
IV				283.21	688.36	1955.16
V					200.10	1444.63
VI						0.00

ISSN 2394 - 7780

Table – 5 : Magnitude of variability for eleven characters in rice genotypes

S. No.	Characters	Grand mean	Range	PCV	GCV	Heritability (%) h^2	Genetic advance as percent of mean
1	Days to first flower (days)	80.77	57.33 – 99.33	17.89	18.22	96.47	36.21
2	Plant height (cm)	105.70	65.67 – 172.00	16.79	17.35	93.72	33.5
3	No of tillers per plant	18.35	13.00 – 26.00	15.96	21.35	55.86	24.57
4	No. of panicles per plant	9.51	4.67 – 14.00	20.96	23.97	76.47	37.76
5	Panicle length (cm)	24.99	18.33 – 29.67	10.36	13.07	62.91	16.94
6	No of grains per panicle	114.28	41.67 – 196.33	32.48	33.85	92.06	64.2
7	Thousand grain weight (g)	17.33	12.30 – 28.07	19.67	21.35	84.83	37.32
8	Grain yield per plant (g)	18.64	3.85 – 29.93	39.98	40.84	95.84	80.64

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ASSESSEMENT OF GENETIC PARAMETERS AND DETERMINATION OF YIELD COMPONENTS IN RICE (Oryza sativa L.) UNDER NATURAL SALINE CONDITION

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ABSTRACT
The study was carried out in an effort to assess the extent of genetic divergence, variability, character association and path-coefficient analysis in 40 genotypes of rice for 8 characters viz., days to first flower, plant height, number of tillers per plant, number of panicles per plant, panicle length, number of grains per panicle, thousand grain weight and grain yield per plant. The analysis of variance indicated considerable amount of variability in all genotypes. Based on D^2 analysis six clusters were formed indicating that there were no association between eco-geographical distribution of genotypes and genetic divergence. Based on the inter and intra cluster distances, the genotypes belonging to clusters II, IV, V and VI could be used for hybridization programme. The characters namely grain yield per plant, number of panicles per plant, number of tillers per plant and number of grains per panicle recorded high PCV and GCV. High heritability coupled with high genetic advance as percent of mean was observed for number of grains per panicle, plan height, thousand grain weight, number of tillers per plant, grain yield per plant and number of panicle per plant. The genetic correlation revealed that grain yield per plant had strong positive and significant association with number of panicles per plant, number of tillers per plant, number of grains per panicle and thousand grain weight. Path coefficient analysis indicated that maximum direct effect on grain yield per plant was through number of panicles per plant, number of grains per panicle and thousand grain weight.

Keywords: Genetic divergence, variability, correlation, path analysis.

INTRODUCTION
Rice (*Orzya sativa* L. 2n=2x=24) is the world's largest food crop, providing the calorific needs of millions of people daily and cultivated in many parts of the world. The genus *Oryza* belonging to the family Poaceae. Globally, rice is cultivated on 154 million hectares with annual production of around, 600 million tonnes and average productivity of 3.9 tons/ha. Rice is differentially affected by salinity at different stages. Rice is moderately susceptible to salinity, since most rice plants are severely injured at an EC 8-10 dS/m and yield reduction is estimated at 30-50 percent (Babu *et al.*, 2005). Variation among crop species is the gift of nature. Genetic variability is a prerequisite for response to selection in respect of any biological population, it would be appropriate to consider variability inconsonance with genetic diversity. The increase in productivity is mainly depending on exploitation of genetic resources already present in the ecosystem. The success of any plant breeding programme largely depends on the diversity exist among the genotypes (Allard, 1960). Only 15% of the genetic diversity has been utilized so far. The "morphism" was used by Huxley (1955) for genetic diversity implying "genetic polymorphism" which means the coexistence of distant genetic forms in population. Thus, the variability could be estimated by studying the existence of genetic divergence among the rice genotypes under natural saline condition before embarking upon hybridization and selection.

MATERIALS AND METHODS
The material for the present investigation consisted of 40 rice genotypes. The experiment was conducted at the Plant Breeding Farm (11º24' N latitude and 79º 44' E longitude, +5.79MSL), Faculty of Agriculture, Annamalai University, Annamalai nagar, Tamil Nadu, India during the year 2016-17. The experiment was laid out in a Randomized Block Design with three replications, using 20 x 20 cm spacing. These genotypes were grown in natural saline soil with electrical conductivity(EC) of 3.83 dS/m. All there commended agronomical practices and plant protection measures were followed to ensure normal crop. Observations were recorded on ten randomly selected plants for all 8 characters *viz.*, days to first flower, plant height, number of tillers per plant, number of panicles per plant, panicle length, number of grains per panicle, thousand grain weight and grain yield per plant. The analysis of variance was performed as per the standard statistical procedures (Singh and Chaudhary, 1985). The Mahalanobis D^2 distance was calculated to estimate the genetic divergence (Mahalanobis, 1936). The intra and inter cluster distance was calculated as per Singh and Chaudhary (1985). Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), was estimated, broad senseheritability (h^2) and geneticadvance as per cent of mean by Singh and Chaudhary (1985). The genotypic and phenotypic correlation co-efficient were worked out following Aljibouri

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et al., (1958). The direct and indirect effect of yield attributing traits were calculated through path co-efficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

GENETIC DIVERGENCE

The analysis of variance for different characters are presented in table 1. It revealed presence of significant differences among all the genotypes for all eight characters under study at 5 per cent level of significant suggesting that the genotypes selected for the present study were genetically divergent. This indicates that there is ample scope for selection of promising varieties from the present genepool for yield and its components. Significant variability due to genotypes for all the characters was also confirmed by Nayak *et al.,* (2004) and Sabesan *et al.*,(2009). The 40 genotypes were grouped into 6 clusters (Table 2). The clustering pattern of the genotypes indicated that there was little parallelism between geographical origin and genetic diversity. Similar results were reported by many workers (Nayak *et al.,* 2004). Cluster I encompasses the largest number of 20 genotypes followed by clusters III with eight genotypes and clusters IV had six genotypes. Cluster V comprise of three genotypes, clusters II had two genotypes and cluster VI was monogenotypic cluster.

The intra and inter cluster distances of various characters are tabulated in table 3. The intra cluster distance varied from 0.00 (cluster VI) to 13.01 (cluster V). Inter cluster distance was maximum between II and VI (16.31) followed by clusters I and VI (16.17) and cluster III and VI (15.98) suggesting wider distance to get more variability and high heterotic effect. This clearly indicates that the genotypes included in these clusters are having broad spectrum of genetic diversity. Minimum inter cluster distance existed between cluster 11 and IV (9.29) followed by I and II (10.54) and I and V (11.94) reflecting minimum diversity among the genotypes within the respective cluster. This is in conformity with the findings of Venkatesan (2004). The genotypes included in cluster I originated from different origin indicating that there was no parallelism between clustering pattern and geographic distribution of genotypes Nayak *et al.*, (2004). The kind of diversity belonging to same geographic origin might be due to difference inadoption, selection criteria, selection pressure in environmental conditions (Maurya and Singh, (1977), Shanmugasundaram *et al*, (2000), Sandeep *et al*., (2013).

VARIABILITY STUDIES

Variability available in a population is an asset to a plant breeder in any crop improvement programme (table 4). A high estimate of PCV and GCV recorded for grain yield per plant (35.68 & 33.04), number of panicles per plant (31.64 & 28.32), number of tillers per plant (28.28 & 26.58) and number of grains per panicle (21.23 & 20.53) and this is similar with the findings of Augustina *et al*., 2013. A narrow difference between PCV and GCV values suggestive of the fact that the characters studied indicated that these traits are less susceptible to the environment condition and therefore selection for such traits will be rewarding as the genetic factors play the greater role in determining the variability for these characters.

High heritability and genetic advance as percent of mean was recorded for all the characters. Characters suchas number of grains per panicle (93.97 & 41.04), plant height (93.78 & 30.13), thousand grain weight (93.53 & 30.31), number of tillers per plant (88.29 & 51.35), grain yield per plant (85.77 & 63.13) and number of panicles per plant (80.58 & 52.44) expressed both high heritability and high genetic advance as per cent of mean. These characters were mostly controlled by additive gene action, hence it could be inferred that direct selection based on phenotypic observations may be effective for improvement of these traits. Days to first flower and panicle length was accompanied by moderate estimate of genetic advance as percent of mean and high estimation of heritability, which indicated preponderance of non-additive gene action hence selection cannot be rewarding which was also agreed by Berhanu *et al*., (2013) and Aishwarya Singh Rajput *et al.,* (2014).

CORRELATION STUDIES

The genotypic correlation coefficient was higher in magnitude than the corresponding phenotypic correlation coefficient in general for most of the characters(table 5). This is possibly due to the linkage or modifying effect of the gene and environment in genetic association between characters. There were strong positive and significant phenotypic and genotypic correlation between grain yield per plant and number of panicles per plant (0.69 & 0.65) followed by number of tillers per plant (0.61 & 0.62), number of grains per panicle (0.34 & 0.45) and thousand grain weight (0.37 & 0.36). This positive association of these yield contributing characters with grain yield per plant was also reported by Kannan and Sarvanan, (2013).

PATH COEFFICIENTANALYSIS

Path analysis furnishes a method of partitioning the correlation coefficients into direct and indirect effects and measures the relative importance of the casual factors involved. Here the residual effect was 0.1784341. The

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maximum direct effect of number of panicles per plant (0.918) was noted over grain yield per plant, followed by number of grains per panicle (0.637) and thousand grain weight (0.478). Almost similar results were reported by Ramesh Babu and Raghava Reddy (2006). In addition to its direct effect, indirect effect of number of tillers per plant via number of panicles per plant was high (0.879) and positive on grain yield per plant (0.633). The indirect effect of thousand grain weight was positive via days to first flower (0.004), number of tillers per plant (0.007) and panicle length (0.000). The character days to first flower, panicle length, number of tillers per plant and plant height exhibited variable performance for direct and indirect effect and more similarly for correlation coefficient. Hence, selection of such characters could be postponed to later generations until there is favorable and constant association of genes controlling the characters.

The superior genotypes of cluster II may be crossed with any superior genotypes cluster VI to produce good segregants with more suitable traits for higher yield. The narrow difference between PCV and GCV values is suggestive of the fact that phenotypic variation was determined by large by genotype with negligible influence of extraneous factors and therefore selection for such traits will be rewarding. For association analysis, direct yield contributing characters, namely, number of panicles per plant, number of grains per panicle and thousand grain weight showing positive association with grain yield per plant reflected that these characters can be enhanced simultaneously to improve grain yield per plant.

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Table – 1: Analysis of variance for eight characters in rice genotypes

Source	Df	Days to first flower (days)	Plant height (cm)	No. of tillers per plant	No. of panicles per plant	Panicle length (cm)	No. of grains per panicle	Thousand grain weight (g)	Grain yield per plant (g)
		MSS							
Replication	2	47.18	28.33	4.11	6.58	1.38	1.31	1.26	26.94
Genotype	39	77.04**	506.59**	54.70**	38.81**	16.73**	2190.41**	26.50**	312.89**
Error	78	8.44	10.93	2.82	2.91	1.62	46.01	0.57	16.27

**significant at 1 per cent level

Table – 2: Distribution of rice genotypes in different clusters based on D^2 analysis

Cluster no.	Number of genotypes	List of the genotypes
I	20	ADT 36, ADT 37, ADT 39, ADT 41, ADT 42, ADT 43, ADT 45, ADT 46, ADT 47, ADT 48, ADT 49, ADT 50, CO 49, CO 50, IR 64, IR 72, ASD 16, TRY 2, GAYATHRI
II	2	VIJAY MASOORI, JAI SHRIRAM
III	8	TRY 3, TKM 9, PMK 3, AD 06207, TPS 5, ANNA 4, MDU 4, MTU 1010
IV	6	NLR 34449, RNR 1446, BPT 5204, MTU 1001, JAI JAILU, SWARNA
V	3	TN 1, UMA, ASD 19
VI	1	PY 3

Table – 3: Intra and inter cluster distances of various characters in rice

Cluster No.	I	II	III	IV	V	VI
I	**10.66**	10.54	12.74	12.04	11.94	16.17
II		**4.13**	14.53	9.29	12.13	16.31
III			**12.56**	14.92	12.58	15.98
IV				**10.45**	12.08	15.33
V					**13.01**	15.41
VI						**0.00**

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Table 4. Magnitude of variability, heritability and genetic advance as per cent of mean.

Characters	Coefficient of variation		Heritability (%)	Genetic advance asper cent of mean
	Phenotypic (%)	Genotypic (%)		
Days to first flower (days)	8.75	7.44	73.07	13.17
Plant height (cm)	15.61	15.10	93.78	30.13
Number of tillers per plant	28.28	26.58	88.29	51.35
Number of panicles per plant	31.64	28.32	80.58	52.44
Panicle length (cm)	11.55	10.04	75.44	17.87
Number of grains per panicle	21.23	20.53	93.97	41.04
Thousand grain weight g)	15.71	15.25	93.58	30.31
Grain yield per plant (g)	35.68	33.04	85.77	63.13

Table – 5 : Phenotypic and genotypic correlation coefficients among yield attributing characters in rice genotypes

Characters		Days to first flower (days)	Plant height (cm)	No. of tillers per plant	No. of panicles per plant	Panicle length (cm)	No. of grains per panicle	Thousand grain weight (g)	Grain yield per plant (g)
Days to first flower (days)	P	1.00	0.16	0.06	0.15	0.03	0.14	0.02	0.28
	G	1.00	0.19	0.15	0.23	-0.03	0.17	0.07	0.34**
Plant height (cm)	P		1.00	0.09	0.08	0.25	0.00	0.07	0.07
	G		1.00	0.09	0.09	0.31	-0.00	0.07	0.08
Number of tillers per plant	P			1.00	0.94**	0.04	-0.13	-0.05	0.61**
	G			1.00	0.98**	0.05	-0.15	-0.05	0.62**
No. of panicles per plant	P				1.00	0.07	-0.15	0.00	0.69**
	G				1.00	0.07	-0.15	-0.00	0.65**
Panicle length (cm)	P					1.00	-0.04	0.02	0.05
	G					1.00	-0.05	0.05	0.05
No. of grains per panicle	P						1.00	-0.27	0.34*
	G						1.00	-0.27	0.45**
Thousand grain weight (g)	P							1.00	0.37*
	G							1.00	0.36*
Grain yield per plant (g)	P								1.00
	G								1.00

*significant at 5 per cent level, **significant at 1 per cent level
P- Phenotypic correlation coefficient, G- Genotypic correlation coefficient

ISSN 2394 - 7780

Table – 6 : Path coefficients analysis showing direct and indirect effects of yield attributing characters in rice genotypes

Characters	Days to first flower (days)	Plant height (cm)	No. of tillers per plant	No. of panicles per plant	Panicle length (cm)	No. of grains per panicle	Thousand grain weight (g)	Grain yield per plant (g)
Days to first flower (days)	**0.041**	-0.007	-0.023	0.191	-0.000	0.123	0.037	0.367
Plant height (cm)	0.005	**-0.038**	-0.018	0.092	0.009	-0.000	0.034	0.098
Number of tillers per plant	0.003	-0.002	**-0.160**	0.879	0.000	-0.073	-0.018	0.633
No. of panicles per plant	0.008	-0.006	-0.151	**0.918**	0.003	-0.089	-0.000	0.659
Panicle length (cm)	-0.003	-0.013	-0.004	0.054	**0.024**	-0.021	0.020	0.051
No. of grains per panicle	0.006	0.000	0.018	-0.124	-0.000	**0.637**	-0.115	0.431
Thousand grain weight(g)	0.004	-0.004	0.007	-0.001	0.000	-0.158	**0.478**	0.341

Residual effect = 0.1784341

Direct effect - diagonal bold values

Indirect effect - un bold values

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GENETIC DIVERGENCE ANALYSIS FOR YIELD AND QUALITY TRAITS IN RICE (Oryza sativa L.)

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ABSTRACT
The investigation was evaluated at plant breeding Farm, Department of Genetic and Plant Breeding, Faculty of agriculture, Annamalai University during 2016-2018. A set of 40 rice genotypes were subjected to Mahalanobis D^2 analysis to assess the genetic diversity. All these genotypes were grouped into eighteen clusters with maximum inter cluster distance between cluster VIII and XVII (33.29) and minimum inter cluster distance between cluster V and Cluster VII (4.69). Among the eleven characters studied grain yield per plant contributed maximum towards genetic divergence (50.00 per cent) followed by hundred grain weight (12.26 per cent).

Keywords: Oryza sativa L., genetic divergence, D^2 analysis, clustering pattern.

INTRODUCTION
Rice (*Oryza Sativa L.*2_n=2*x*=24) is the most important cereal crop. Genus Oryza includes 24 species of which only two species viz, *Oryza sativa* and *Oryzaglaberrima* are cultivated. Rice,with 1,20,000 varieties, has the richest gene bank in the plant kingdom and feeds more than one half of the world's population. In India, the overall rice production by the year 2015-2016 was 104.4 million tons whereas productivity as 2391kg ha-1 under 44.1 million ha (India Stat, 2017).

Genetic diversity is a powerful tool to determine the genetic discrimination among the genotype which can be used to select appropriate parental genotype for hybridization to develop high yielding potential variety (Bhatt, 1970). Diversity not only results in including genetic variation but also provides new recommendation of genes in gene pool. Using advanced biometric technique such as multivariate analysis based on Mahalanobis D^2 statistic (Mahalanobis, 1936), it has now become possible to quantity the degree of genetic divergence amongst biological population and assuming the relative contribution of various desirable attributes of breeding and agronomic value to the total divergence. The investigation was about estimation of magnitude of genetic divergence of 40 rice genotypes and to identity diverse genotypes for the future study.

MATERIALS AND METHODS
The experimental material for the study comprised of 40 genotypes laid in Randomized Block Design (RBD) with three replication at experimental farm of plant breeding (11°24'N latitude and 79°44E longitude, + 5.79MSL), Annamalai University, Tamil Nadu, India. In each genotype, one seedling per hill was transplanted in the main field after 25 days with spacing of 20cm×20cm. Standard agronomic practices and plant protection measures were taken as per schedule. Observations were recorded on five randomly selected plants per replication for days to first flower, (days) plant height (cm), number of tillers per plant, number of panicles per plant, number of grains per panicle, panicle length (cm), hundred grain weight(g), kernel length (mm), kernel breadth(mm), kernel L/B ratio and grain yield per plant. The analysis of genetic divergence was done using Mahalanobis (1936) D^2 statistics. The genotypes were grouped into different clusters, inter and intra clusters distances and mean performances for characters were also computed.

RESULTS AND DISCUSSION
Analysis of variance for different characters are presented in Table 1. The high degree of diversity was identified by the grouping of genotypes into many clusters. Similar findings was reported by (Kumar *et al*, 2014; Ahmed *et al*, 2014; Sandhya *et al*, 2015). Based on the relative magnitude of D^2 values, 40 genotypes were grouped into eighteen clusters (Table 2). The cluster I was the biggest consisting of 7 genotypes followed by cluster II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV, XV, XVI and XVII had two genotypes. Cluster XVIII had only one genotype indicating that there was no parallelism between clustering pattern and geographic distribution of genotypes (Nayak*et al*, 2004).

Intra (bold) and inter cluster (unbold) D^2 values and D (unbold) values in rice were tabulated in Table 3 and 4 and in Figure 1. The highest intra cluster distance was recorded in cluster XVII (17.04) followed by cluster 1 (9.68) and cluster XVI (9.66) indicating the existing divergence among the germplasm lines within these clusters. This could be made use for yield improvement in rice through recombination breeding. Cluster mean showed a wide range of variation for all the trait under study (Table5). Cluster III showed early flowering and might be utilized as a suitable source for incorporation of earliness trait. Cluster III had the maximum cluster mean value for grain yield per plant. Hence the genotypes in this cluster could be utilized in yield improvement

ISSN 2394 - 7780

breeding programmes. The relative contribution of each characters towards D^2 depends upon the inter cluster distance in all combinations (Table 6). The selection and choice of parents mainly depends upon contribution of characters towards divergence. In the present investigation, the relative contribution towards genetic divergence was exhibited by grain yield per plant (50.00 per cent) followed by hundred grain weight (12.26per cent). So grain yield and hundred grain weight should be given more importance during selection for choice of parents for hybridization programme.

Table – 1: Analysis of variance for eleven characters in rice genotypes

S.No	Source	df	Days to first flower	Plant Height	No of tillers per plant	No. of Productive tillers per plant	No. of Grains per Panicle	Panicle length	100 seed weight	Kernel length	Kernel Breadth	Kernel L/B ratio	Grain yield per plant
1	Replication	2	4.98	34.72	0.91	0.81	246.81	0.28	0.02	0.01	0.02	0.08	4.66
2	Genotype	39	191.10	653.10	28.70	24.66	804.04	55.53	0.31	1.28	1.82	3.59	55.44
3	Error	78	7.31	19.20	1.95	1.69	127.34	1.78	0.02	0.08	0.08	0.30	6.69

Table 2. Distribution of rice genotype in different clusters based on D^2 analysis

Cluster No.	Number of genotypes	List of the genotypes
I	7	AURC1, AURC2, AURC3, AURC4, AURC5, AURCl5, AURC16.
II	2	AURC11, AURC14
III	2	AURC22, AURC23
IV	2	AURC9, AURC33
V	2	AURC30, AURC16
VI	2	AURCl2, AURC38
VII	2	AURC26, AURC32
VIII	2	AURC13, AURC28
IX	2	AURC29, AURC34
X	2	AURAC21, AURC27
XI	2	AURC31, AURC39
XII	2	AURC35, AURC40
XIII	2	AURC17, AURC37
XIV	2	AURC18, AURC25
XV	2	AURC7, AURC24
XVI	2	AURC10,AURC20
XVII	2	AURC8,AURC19
XVIII	1	AURC6

The least intra distance was revealed in cluster II (2.72) indicating the homogenous nature of the genotypes with less deviation between the genotypes. Similar findings were reported by (Nirosha *et al*, 2016; MamtaKumari *et al*, 2016 and Hossain *et al*, 2015). Longest inter cluster distance was found between cluster VIII and Cluster XVII (33.29) followed by cluster VII and XVIII (32.44) and cluster XIV and XVIII (32.27). The selection of genotypes from the above clusters would produce a broad spectrum of variability for yield which may enable further selection and genetic improvement. The minimum inter cluster distance was found between cluster V and VII (4.69). The inter cluster distance were greater than intra cluster indicating wide genetic diversity among genotypes. Similar results were reported by (Banumathy *et al*, 2010; Toshimenla*et al* 2016;VijayKumar 2015; Chamundeswari 2016 and Nirosha*et al* 2016).

The overall clustering pattern indicated that genotypes developed in some geographical region were distributed in different clusters. Shanmugan and Rangasamy (1982) reported that grouping of material of same geographical origin into different clusters was an indication of the broad genetic base of genotypes belonging to that origin. Similar results of non-association of geographical region with the genetic diversity were reported by Mohan et al (2015); Vijay Kumar (2015); Toshimenla *et al* (2016); Chamundeswari *et al* (2016) and Thippeswamy *et al* (2016).

ISSN 2394 - 7780

Table – 3 : Intra (bold) and inter cluster (unbold) D^2 values of various clusters in rice

Cluster No.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
I	**93.66**	55.55	272.58	78.00	91.36	87.50	99.77	109.88	153.09	72.54	77.27	84.18	82.15	120.09	115.82	244.71	169.65	1059.39
II		**7.41**	237.55	32.98	33.31	23.22	60.92	93.79	92.89	34.44	48.45	30.06	45.14	102.98	58.59	201.02	125.17	943.87
III			**10.72**	119.56	394.19	231.96	466.52	159.36	75.34	226.53	352.56	326.056	203.04	129.45	275.86	73.93	245.54	992.74
IV				**11.61**	106.29	39.07	150.20	66.84	38.32	48.63	103.92	74.96	35.75	69.81	96.20	133.29	119.49	976.77
V					**12.50**	54.25	21.94	172.01	190.20	61.79	35.39	36.01	113.33	187.77	58.10	306.82	182.78	1038.15
VI						**17.07**	91.71	144.73	72.20	53.86	89.24	25.85	49.85	132.22	76.46	213.33	143.58	958.47
VII							**17.26**	209.23	257.91	85.99	29.95	54.79	134.84	223.73	94.94	372.94	208.45	1052.24
VIII								**22.95**	117.56	70.24	127.19	166.93	109.96	43.06	133.84	149.66	203.04	1108.04
IX									**24.72**	113.25	202.09	135.37	91.49	85.59	139.20	112.19	157.27	951.87
X										**25.47**	52.65	56.86	63.78	94.57	64.28	177.84	179.55	994.52
XI											**25.66**	70.24	108.35	152.43	76.70	281.07	170.27	1027.70
XII												**31.80**	66.10	162.84	84.42	279.22	182.64	1028.78
XIII													**49.51**	115.68	144.18	220.20	153.17	966.62
XIV														**58.51**	133.73	130.99	183.28	1041.35
XV															**81.43**	189.52	183.28	1002.40
XVI																**93.38**	253.67	896.83
XVII																	**290.26**	944.69
XVIII																		**0.00**

Table – 4: Average intra (bold) and inter cluster D (unbold) values in rice

Cluster No.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIU
I	**9.68**	7.45	16.51	8.83	9.56	9.35	9.99	10.48	12.37	8.52	8.79	9.18	9.06	10.96	10.76	15.64	13.03	32.56
II		2.72	15.41	5.74	5.78	4.82	7.81	9.69	9.64	5.87	6.96	5.48	6.72	10.15	7.65	14.18	11.19	30.72
III			**3.27**	10.93	19.85	15.23	21.60	12.62	8.68	15.05	18.78	18.06	14.25	11.38	16.61	8.60	15.67	31.51
IV				**3.53**	10.31	6.25	12.26	8.18	6.19	6.98	10.19	8.66	5.98	8.36	9.81	11.56	10.93	31.25
V					**3.53**	7.37	4.69	13.12	13.79	7.87	5.95	6.00	10.65	13.70	7.62	17.52	13.52	32.22
VI						**4.13**	9.58	12.03	8.50	7.34	9.45	5.08	7.06	11.50	8.74	14.61	11.98	30.96
VII							**4.16**	14.47	16.06	9.27	5.48	7.40	11.61	14.96	9.74	19.31	14.44	32.44
VIII								**4.80**	10.84	8.38	11.28	12.92	10.49	6.56	11.57	12.23	14.25	33.29
IX									**4.97**	10.64	14.22	11.63	9.57	9.25	11.80	10.59	12.54	30.85
X										**5.05**	7.26	7.54	7.99	9.73	8.02	13.34	13.40	31.54
XI											**5.07**	8.38	10.41	12.35	8.76	16.77	13.05	32.06
XII												**5.63**	8.13	12.76	9.19	16.71	13.51	32.08
XIII													**7.04**	10.76	12.01	14.71	12.38	31.09
XIV														**7.65**	11.56	11.45	13.54	32.27
XV															**9.02**	13.77	13.54	31.66
XVI																**9.66**	15.93	29.95
XVII																	**17.04**	30.74
XVIII																		**0.00**

ISSN 2394 - 7780

Table – 5: Cluster means of rice genotypes for different traits

Clusters	Days to first flower	Plant Height	No of tillers per plant	No. of Productive tillers per plant	No. of Grains per Panicle	Panicle length	100 seed weight	Kernel length	Kernel Breadth	Kernel L/B ratio	Grain yield per plant
I	101.71	110.08	12.24	10.48	1116.48	27.64	2.50	6.29	2.27	2.85	24.41
II	99.33	111.80	11.17	9.83	109.33	24.73	2.46	6.78	2.31	3.12	24.36
III	86.00	138.60	19.83	18.17	144.33	32.38	3.09	7.68	1.61	4.88	31.17
IV	94.50	123.80	12.83	11.17	129.17	26.26	2.76	6.96	2.20	3.42	28.16
V	103.50	100.52	10.67	9.50	117.17	20.49	2.21	6.57	2.29	2.97	20.98
VI	94.83	122.82	12.00	10.67	115.67	21.90	2.32	6.66	2.33	2.89	20.58
VII	108.83	98.69	11.18	10.00	116.67	21.65	2.15	5.85	2.56	2.30	19.71
VIII	91.18	98.36	11.83	10.67	142.00	31.70	3.05	6.71	2.24	3.04	29.34
IX	87.17	132.49	15.17	14.17	137.67	26.92	2.56	7.44	2.01	3.79	22.95
X	93.00	102.47	12.00	10.67	122.00	24.07	2.76	6.03	2.54	2.40	25.47
XI	107.00	96.82	12.17	11.67	135.00	24.02	2.54	5.94	2.49	2.42	24.19
XII	96.50	115.21	10.50	9.17	111.33	21.78	2.11	6.21	2.39	2.60	19.12
XIII	95.67	126.49	9.83	8.67	117.67	26.30	2.73	6.08	2.56	2.40	26.60
XIV	91.17	108.97	14.50	12.83	147.50	32.45	2.72	6.83	2.14	3.32	20.68
XV	97.83	99.28	15.00	13.17	122.00	22.58	2.35	7.14	1.91	3.94	19.75
XVI	87.17	120.47	18.50	16.50	134.50	29.62	2.84	7.89	1.30	6.09	28.65
XVII	109.83	127.78	15.17	13.50	134.50	26.97	2.71	7.35	1.97	4.02	24.50
XVIII	97.00	130.56	14.00	12.33	99.33	23.77	2.98	6.42	6.50	0.99	27.36

Table 6. Relative contribution of different characters to genetic divergence

S.No.	Character	Percent contribution
1	Days to first flower	9.36
2	Plant height	15.90
3	Number of tillers per plant	3.46
4	Number of productive tillers per plant	0.00
5	Number of grains per panicle	0.51
6	Panicle length	21.79
7	100 seed weight	5.64
8	Kernel length	10.51
9	Kernel breadth	5.13
10	Kernel L/B ratio	26.41
11	Grain yield per plant	1.28

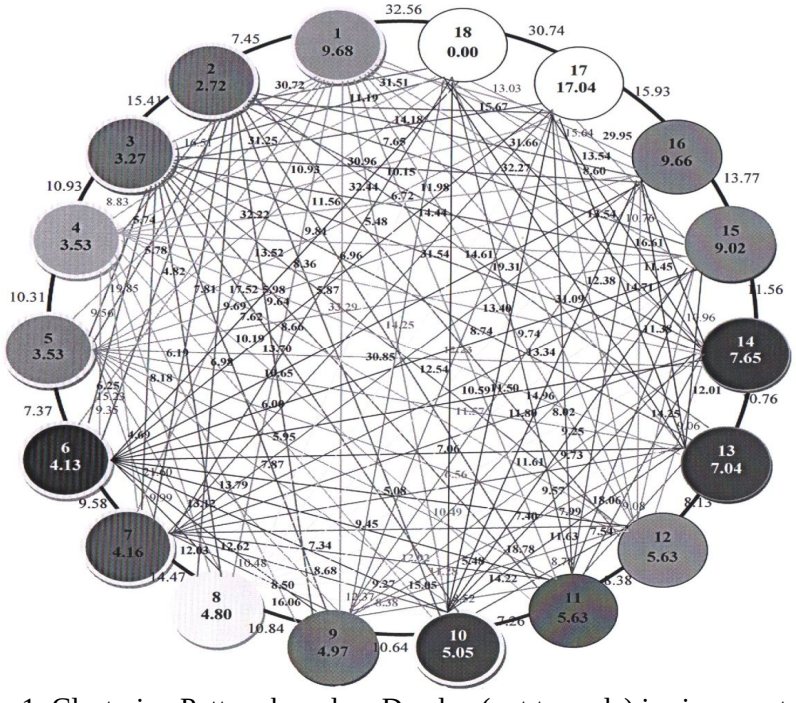

Fig. – 1: Clustering Pattern based on D value (not to scale) in rice genotypes

ISSN 2394 - 7780

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EFFECT OF STORAGE AND SEED TREATMENTS ON THE GERMINATION AND SEEDLING VIGOUR OF AMBRETTE (Abelmoschus moschatus Medic.)

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ABSTRACT
Ambrette is one of the medicinal and aromatic crop belongs to the family Malvaceae and it is popularly known as Musk mallow. The oil extracted from this crop has a great national and international demand. This increasing demand has motivated the farmers to cultivate this important medicinal crop in fairly large areas. With this background in view an investigation was undertaken to study the effect of storage and seed treatments on the germination and seedling vigour of Ambrette (Abelmoschus moschatus Medic.).The experiment was laid out in completely randomized block design in three replications. The treatments consisted of storage of seeds for different periods viz., 0,3,6,9 and 12 months and treatment of stored seeds with different seed treatment chemicals like GA_3 (100 ppm and 200 ppm), Thiourea (1 % and 2 %) and KNO_3 (1% and 2%). The results of the study revealed that seeds stored for 6 months and treated with GA_3 100 ppm registered the highest germination percentage. The seedling characters like shoot length, root length and vigour index were also significantly influenced by this treatment when compared to the other treatments.

INTRODUCTION
Medicinal and aromatic plants cultivation is on the rise in both developing and developed countries due to their growing recognition in pharmaceutical, cosmetic, agricultural and food industries. The demand as well as price of herbal products and essential oils are increasing consistently in national and international markets. Among the aromatic crops, Ambrette (*Abelmoschus moschatus*), a close relative to Okra is a popular Horticultural crop. It belongs to the family Malvaceae and it is popularly known as Musk mallow. Among the farmers, the popularity of the medicinal crop - Kasturi Bhindi (*Abelmoschus moschatus*) is increasing day by day (Srivastava, 1996). The seeds yield an essential oil and give a strong flowery musky brandy – like odour of remarkable tenacity because of the presence of ambrettolide, a macrocyclic lactone in the seed coat. It is native to India and grows throughout the tropical regions of the country.

Seed dormancy is the most limiting factor for germination. Physical dormancy or hard seed coat occurs in Malvaceae family, hence seeds are impermeable to water (Baskin *et al*., 2006). Dormancy may be due to the presence of thick seed coat that prevents water and oxygen from reaching and activating the embryo or the presence of germination-inhibitor chemical compounds and they require specific treatments for breaking dormancy. With this background in view, the present investigation was undertaken to study the effect of storage and seed treatments on the germination and seedling vigour of Ambrette (*Abelmoschus moschatus* Medic.).

MATERIALS AND METHODS
The trial was carried out during January – December, 2014 in a factorial completely randomized design with seven treatments in three replications. The seeds of ambrette were stored under ambient conditions for different periods *viz*., 0, 3, 6, 9, and 12 months. Then the stored seeds were treated with seed treatment chemicals *viz*., GA_3, Thiourea and KNO_3 for 30 minutes and sown in polyethylene bags filled with pot mixture containing 1:1:1 ratio of sand, red earth and FYM. For each treatment 30 polythene bags were maintained and two seeds were sown per polythene bag. The treatment details are as follows *viz*., T_1 – GA_3 100 ppm; T_2 – GA_3 200 ppm ; T_3 – Thiourea 1% ; T_4 –Thiourea 2 % ; T_5 – KNO_3 1 %; T_6 – KNO_3 2 % and T_7 – Control. The observations regarding germination percentage, shoot length of seedling, root length of seedling and vigour index were recorded and analysed statistically (Panse and Sukhatme, 1978).

RESULTS AND DISCUSSION
Significant differences in the germination percentage was observed among the various combination of treatments (Table 1). Seeds stored for 6 months and treated with GA_3 100 ppm registered the highest germination percentage (85.12 %) followed by seed storage for 9 months and treated with KNO_3 1 per cent (80.51 %) and GA_3 100 ppm (80.12 %) which were on par with each other. The germination percentage was the least (40.00 %) in the seeds stored for 0 months (fresh seeds) without any treatment (control) and it was on par with thiourea 1per cent (T_3). The increase in germination percentage due to treatment with GA_3 may be attributed to the fact that GA_3 stimulates seed germination by formation of α-amylase enzyme which converts insoluble starch into soluble sugars and it also initiates the radical growth by removing some metabolic blocks as suggested by Gillard and Walton (1973). Germination improvement by GA_3 treatment might also be due to the activity of GA_3 as a-denovo synthesis which also helps in dormancy breaking action. The growth

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regulator treatments through enzymatic and hormonal mechanism stimulated metabolic processes such as sugar mobilization, protein hydrolysis, oxidation etc. as suggested by Jagadish (1993). These results are in agreement with the findings of Sivakumar (2005) in ambrette, Shankargouda Patil *et al*. (2007) in ashwagandha and Venkatesan and Arumugam Shakila (2008) in medicinal solanum.

Poor germination percentage registered in the control in the present study might be due to the presence of inhibitory substances in the seeds as well as mucilaginous layer of glycoalkaloids present around the seed coat which is known to inhibit germination (Savita Borse and Dhumal, 2001). Further, seed dormancy is also one of the most limiting factor for germination owing to the presence of thick seed coat that prevents water and oxygen from reaching and activating the embryo or the presence of germination-inhibitor chemical compounds as opined by Ameer Junaithal Begum *et al*. (2013).

Interactive effects of duration of seed storage and seed treatment and indicate significant variations for shoot length of seedlings (Table 2). Among the various combination of treatments, shoot length was highest (20.33 cm) in seeds stored for 6 months and treated with GA_3 100 ppm followed by seeds stored for 6 months and treated with KNO_3 1 per cent (19.01 cm). The control (fresh and untreated seeds) registered the least value (7.32 cm) for shoot length. Greater shoot length in GA_3 treatment might be due to the increased cell division and cell elongation as opined by Devlin and Witham (1986). Further, the beneficial effect of GA_3 on shoot length can be attributed to the cell elongation and quick cell multiplication. This appears the most probable reason for increase in shoot length. Furthermore, GA_3 has been shown to cause cell elongation or enlargement and accelerate the cell division in cambium or other tissues. The elongation of tissues or cells may be brought about either through greater turgor pressure or by the growth of enclosing cell wall, which by stretching is increased to a certain degree without any increase in turgor pressure. It is also probably due to quick establishment of stimulation of growth processes in meristematic tissues that the seedlings from seeds treated with GA_3 may show better growth as compared to those from untreated seeds as reported by Patil and Patel (2010) in okra. Application of GA_3 at different concentrations might have enhanced the shoot length of the seedlings by increasing the internodal length as a result of increased cell elongation and faster cell division as suggested by Disha Patil *et al*. (2016).

The interaction effect of duration of seed storage and seed treatment on root length of seedlings was found to be significant (Table 3). Among the various combination of treatments, seeds stored for 6 months and treated with GA_3 100 ppm registered the highest value for root length (10.35 cm) followed by seeds stored for 9 months and treated with GA_3 100 ppm (9.55 cm). Root length was the least (4.33 cm) in the control in which seeds were stored for 0 months (fresh and untreated seeds). Vigorous shoot growth due to seed treatment with GA_3 might have resulted in more production of photosynthates and their translocation through phloem to the root zone, which might be responsible for improving the root growth. The increase in root length due to various treatments could be attributed to the beneficial effects in uniform germination, intensified hydrolytic process, better uptake of nutrients and soil moisture, thereby imparting stimulation for better establishment of seedlings as suggested by Kattimani *et al*. (1999). Similar results have been reported by Harakumar *et al*. (1999) in gymnema and Revathi (2001) in *Phyllanthus amarus*.

The vigour index of seedlings also showed significant variations among the different storage periods (Table 4). The seedling vigour index was highest (1849.28) in seeds stored for 6 months followed by seeds stored for 9 months (1601.27). The vigour index of seedlings was the least (754.70) in seeds stored for 0 months (fresh seeds). The increase in the vigour index may be attributed to the increased seed germination percentage, seedling length due to seed treatment with GA_3. Similar results were obtained by Maheswari and Gupta (2000) in sarpagandha. Furthermore, the increase in vigour index due to GA_3 treatment might also be due to the enhanced germination percentage along with greater seedling weight which was brought about by the better utilization of stored food reserves. The results of this study are in agreement with those of Suryawanshi *et al*. (2001) who observed increased vigour index of several medicinal crops due to seed treatment with growth regulators.

Based on the findings of the present study, it can be concluded that seeds stored for 6 months and treated with GA_3 100 ppm registered the highest germination percentage and vigour index when compared to the other treatments.

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Table – 1: Effect of storage and seed treatment on germination percentage in ambrette

Treatments/Storage period (months)	Germination (%)					Mean
	0	3	6	9	12	
T_1 - GA_3 100 ppm	55.01 (47.88)	63.45 (52.80)	85.12 (67.31)	80.12 (63.52)	75.41 (60.27)	71.82 (58.36)
T_2 - GA_3 200 ppm	48.05 (43.88)	55.31 (48.05)	74.10 (59.41)	71.25 (57.58)	68.10 (55.61)	63.36 (52.91)
T_3 - Thiourea 1 %	42.00 (40.40)	49.30 (44.60)	66.15 (54.42)	62.35 (52.15)	60.35 (50.97)	56.03 (48.51)
T_4 - Thiourea 2 %	48.31 (44.03)	53.41 (46.96)	60.21 (50.89)	58.31 (49.78)	56.05 (48.47)	55.26 (48.03)
T_5 - KNO_3 1 %	51.25 (45.72)	58.35 (49.81)	80.51 (63.80)	75.31 (60.21)	70.21 (56.92)	67.13 (55.29)
T_6 - KNO_3 2 %	45.35 (42.33)	50.23 (45.13)	70.00 (56.79)	68.55 (55.89)	64.10 (53.19)	59.65 (50.67)
T_7 - Control	40.00 (39.23)	45.12 (42.20)	55.12 (47.94)	50.31 (45.18)	48.13 (43.93)	47.74 (43.70)
Mean	47.14 (43.35)	53.60 (47.08)	70.17 (57.22)	66.60 (54.90)	63.19 (52.77)	

	Treatments (T)	Storage period (S)	T x S
SED	0.49	0.42	1.12
CD (p=0.05)	0.99	0.84	2.22

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Table – 2: Effect of storage and seed treatment on shoot length (cm) of seedlings in ambrette

Treatments/ Storage period (months)	Shoot length of seedlings (cm)					Mean
	0	3	6	9	12	
T_1 - GA_3 100 ppm	12.25	14.11	20.33	18.10	17.55	16.47
T_2 - GA_3 200 ppm	11.00	12.75	18.41	16.12	15.40	14.74
T_3 - Thiourea 1 %	10.04	11.00	17.01	15.05	14.12	13.45
T_4 - Thiourea 2 %	10.00	10.54	15.43	14.33	13.25	12.71
T_5 - KNO_3 1 %	11.45	13.12	19.01	17.25	16.11	15.20
T_6 - KNO_3 2 %	10.21	11.33	18.00	16.00	15.00	14.11
T_7 - Control	7.32	8.41	12.11	10.65	10.05	9.71
Mean	10.18	11.61	17.19	15.36	14.50	

	Treatments (T)	Storage period (S)	T x S
SED	0.01	0.01	0.03
CD (p=0.05)	0.02	0.02	0.05

Table – 3: Effect of storage and seed treatment on root length (cm) of seedlings in ambrette

Treatments/ Storage period (months)	Root length (cm) of seedlings					Mean
	0	3	6	9	12	
T_1 - GA_3 100 ppm	6.31	7.65	10.35	9.55	9.21	8.61
T_2 - GA_3 200 ppm	5.96	6.84	9.00	8.58	8.41	7.76
T_3 - Thiourea 1 %	5.20	6.00	8.50	8.00	7.84	7.12
T_4 - Thiourea 2 %	5.00	5.72	8.00	7.58	7.34	6.73
T_5 - KNO_3 1 %	6.00	7.11	9.23	9.10	9.00	8.09
T_6 - KNO_3 2 %	5.71	6.31	8.81	8.35	8.00	7.44
T_7 - Control	4.33	4.98	7.01	6.55	6.00	5.77
Mean	5.50	6.37	8.70	8.24	7.97	

	Treatments (T)	Storage period (S)	T x S
SED	0.04	0.03	0.09
CD (p=0.05)	0.08	0.07	0.18

Table – 4: Effect of storage and seed treatment on vigour index of seedlings in ambrette

Treatments/ Storage period (months)	Vigour index					Mean
	0	3	6	9	12	
T_1 - GA_3 100 ppm	1020.99	1380.67	2611.48	2215.32	2017.97	1849.29
T_2 - GA_3 200 ppm	814.93	1083.52	2031.08	1759.88	1621.46	1462.17
T_3 - Thiourea 1 %	640.08	838.10	1687.49	1437.17	1325.29	1185.63
T_4 - Thiourea 2 %	724.65	868.45	1410.72	1277.57	1154.07	1087.09
T_5 - KNO_3 1 %	894.31	1180.42	2273.60	1984.42	1762.97	1619.14
T_6 - KNO_3 2 %	721.97	886.06	1876.70	1669.19	1474.30	1325.64
T_7 - Control	466.00	604.16	1053.89	865.33	772.49	752.37
Mean	754.70	977.34	1849.28	1601.27	1446.94	

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CORRELATION AND PATH ANALYSIS IN RICE (Oryza sativa L.) UNDER COASTAL SALINE CONDITION

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ABSTRACT
The study was carried out in an effort to assess the correlation and path coefficient analysis in thirty seven genotypes of rice for eleven characters viz., days to first flower, plant height, number of productive tillers per plant, panicle length, boot leaf length, number of grains per panicle, grain length, grain breadth, grain L/B ratio, 100 grain weight and grain yield per plant. The genetic correlation revealed that grain yield per plant had strong positive and significant association with number of productive tillers, panicle length, number of grains per panicle and 100 grain weight. Path coefficient analysis indicated that very high direct effect on grain yield per plant was through grain L/B ratio and grain breadth. Therefore, these traits can be enhanced simultaneously to improve grain yield per plant.

Keywords: Rice, correlation, saline condition, path analysis.

INTRODUCTION
Rice (*Oryza sativa* L.) (2n=24) is the one of the most important cereals in the world ensuring world food security as it is stable food near about 50% of the total world's population with the third-highest worldwide production, after sugarcane and maize (FAOSTAT, 2015). More than 90 per cent of the world's rice is grown and consumed in Asia, known as rice bowl of the world, where 60 per cent of the earth's people and two third of world's poor live (Khush and Virk, 2000). Development of high yielding varieties requires information on association of characters contributing to yield in addition to their direct and indirect effects towards yield. This kind of analysis could help the breeder to design his selection strategies to improve grain yield. In this context the present investigation was carried out with the objective of studying the character association and path effects of yield components on grain yield in rice varieties for their yield improvement.

MATERIALS AND METHODS
The present investigation was carried out during 2015 at Genetics and Plant Breeding, Annamalai University, Tamil Nadu, India. The soil of the experimental site reported with EC 2.1 dsm^{-1} and pH 8.5. The experimental material for the present investigation was comprised of 37 genotypes laid in Randomized Block Design (RBD) with three replications. Each genotype was grown by transplanting single seedling per hill in single row plots of 3m length following inter-row and intra-row spacing of 20cm and 15cm, respectively. Observations are recorded on five randomly selected plants per replication for eleven characters *viz.*, days to first flower, Plant height, number of productive tillers per plant, panicle length, boot leaf length, number of grains per panicle, grain length, grain breadth, grain L/B ratio, 100 grain weight and grain yield per plant. Recommended agronomic practices and plant protection measures were taken for the betterment of crop growth. Standard statistical procedures were used for the correlation and path coefficient analysis suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULT AND DISCUSSION
The ultimate aim of any crop improvement programme is yield improvement. Since yield is a complex trait, knowledge of association of different yield components with yield and inter correlations among themselves are important. A study of phenotypic correlation is adequate while correlation coefficients are based on the heritable part of the values (genotypic correlation) provide a dependable basis for selection. Estimation of phenotypic and genotypic correlations between the response variable (yield) and the predictor (yield components) and among the yield components themselves, may provide information for the breeding programme when selection is based on two or more characters simultaneously.

In this study correlation analysis indicated that grain yield per plant exhibited significant positive correlation with number of productive tillers per plant, panicle length, number of grains per panicle, number of grains per panicle and 100 grain weight reflected that these characters can be enhanced simultaneously to improve grain yield per plant. This positive association of these yield contributing characters with grain yield per plant was reported by Mulugeta Seyoum *et al*., (2012).

While the trait days to first flower registered positive and non significant association with grain yield per plant. This could be considered for selection criteria for earliness (Table 1).

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Path co-efficient analysis provides an efficient means of finding out the direct and indirect causes of association and presents a critical examination of the specific forces acting to produce a given correlation and also measures the relative importance of each casual factor, hence the study of direct and indirect effects of yield components on grain yield was undertaken in the present investigation are presented in Table 2.

In the present investigation, the residual effect was 0.0289. The maximum direct effect of grain L/B ratio was noted over grain yield per plant, followed by panicle length, number of grains per panicle and grain breadth. (Table 2) Characters like days to first flower and plant height showed positive direct effect on grain yield per plant.

In addition to the direct effect, indirect effect of 100 grain weight via grain breadth was high and positive on grain yield per plant. Such type of results were also reported by Javed *et al.,* (2010). In general, the characters grains per panicle and number of panicles per plant recorded positive significant correlation and high direct effect with grain yield per plant. Hence, these traits can be used for selection criteria in breeding programme to develop high yielding new plant type rice varieties.

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Table – 1: Genotypic and Phenotypic correlation among various morphological characters in rice genotypes

		Days to first flowering	Plant height	No of productive tillers per plant	Panicle length	Boot leaf length	No. of grains per panicle	Grain length	Grain breadth	Grain L/B ratio	100 grain weight	Grain yield per plant
Days to first flowering	G	1.000	0.366*	-0.150	0.375*	0.262	0.020	0.015	0.155	-0.151	0.071	0.002
	P	1.000	0.300	-0.110	0.270	0.221	0.023	0.044	0.142	-0.121	0.030	-0.016
Plant height	G		1.000	0.191	0.723**	0.763**	0.322*	0.027	0.272	-0.197	0.076	0.136
	P		1.000	0.165	0.623**	0.682**	0.028	0.022	0.265	-0.174	0.074	0.136
No of productive tillers per plant	G			1.000	0.190	0.171	-0.038	0.175	-0.052	0.159	0.042	0.356*
	P			1.000	0.151	0.140	-0.035	0.157	-0.053	0.113	0.035	0.345*
Panicle length	G				1.000	0.697**	0.138	0.331*	0.306	-0.079	0.072	0.520**
	P				1.000	0.589**	0.117	0.288	0.288	-0.070	0.041	0.520**
Boot leaf length	G					1.000	0.179	0.063	0.230	-0.118	0.028	0.096
	P					1.000	0.173	0.074	0.208	-0.095	-0.176	0.072
No. of grains per panicle	G						1.000	0.214	-0.093	0.176	-0.177	0.482**
	P						1.000	0.201	-0.088	0.136	0.017	0.475**
Grain length	G						0.173	1.000	0.068	0.548**	0.018	-0.101
	P							1.000	0.068	0.496**	0.502**	-0.088
Grain breadth	G								1.000	-0.782**	0.477**	0.231
	P								1.000	-0.692**	-0.313	0.226
Grain L/B ratio	G									1.000	-0.266	-0.236
	P									1.000	1.000	-0.214
100 Grain weight	G										1.000	0.378*
	P											0.420**
Grain yield per plant	G											1.000
	P											1.000

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Table – 2: Path co-efficient analysis depicting the direct, indirect effects and genotypic correlations of various morphological characters on grain yield per plant in rice genotypes

Effect of character	Days to first flowering	Plant height	No of productive tillers per plant	Panicle length	Boot leaf length	No. of grains per panicle	Grain length	Grain breadth	Grain L/B ratio	100 grain weight	Grain yield per plant
Days to first flowering	**0.009**	0.016	0.002	0.199	-0.144	0.006	-0.039	0.538	-0.560	-0.026	0.002
Plant height	0.003	**0.045**	-0.002	0.384	-0.422	0.010	-0.069	0.946	-0.731	-0.027	0.136
No of productive tillers per plant	-0.001	0.008	**-0.013**	0.100	-0.094	-0.012	-0.030	-0.179	0.592	-0.015	0.356
Panicle length	0.003	0.033	-0.002	**-0.531**	-0.385	0.044	-0.453	1.066	-0.293	-0.026	0.520
Boot leaf length	0.002	0.035	-0.002	0.370	**0.553**	0.057	-0.162	0.801	-0.437	-0.014	0.096
No. of grains per panicle	0.000	0.001	0.000	0.073	-0.099	**0.321**	-0.210	-0.325	0.654	0.065	0.482
Grain length	0.000	0.001	-0.002	0.175	0.034	0.068	**-2.579**	0.237	2.037	-0.006	-0.101
Grain breadth	001	0.012	0.000	0.162	-0.127	-0.030	-0.176	**3.481**	-2.909	-0.185	0.231
Grain L/B ratio	-0.001	-0.009	-0.002	-0.041	0.065	0.056	-1.413	-2.723	**3.718**	0.115	-0.236
100 grain weight	0.000	0.003	-0.000	0.038	-0.022	-0.056	-0.042	1.848	-1.022	**-0.369**	0.378

Residual effect = 0.0289

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EFFECT OF BIO-STIMULANTS ON COB YIELD, STOVER YIELD, DRYMATTER PRODUCTION AND NUTRIENT UPTAKE OF BABY CORN (Zea mays L.)

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ABSTRACT
The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar. A field trial was conducted in a Randomized Block Design with nine treatments in three replications. The treatments consisted of two organic manures (enriched farmyard manure and vermicompost), along with four organic foliar nutrients (panchagavya @ 3%, sea weed extract @ 3%, humic acid @ 0.2 % and effective micro organism 1: 1000 dilution) were sprayed at fortnight intervals.The results of the study revealed that soil application of vermicompost 5 t ha^{-1} + foliar application of panchagavya @ 3 per cent resulted in maximize the yield and yield attributes viz., number of cobs $plant^{-1}$,length of cob, girth of cob, individual cob weight, cob yield $plant^{-1}$, cob yield $plot^{-1}$, stover yield $plant^{-1}$, stover yield $plot^{-1}$, dry matter production and nutrient uptake of baby corn.

Keywords: Baby corn, Enriched farmyard manure, Vermicompost, Panchagavya, Sea weed extract, Humic acid and Effective Micro Organism (EMO)

INTRODUCTION
Baby corn (*Zea mays*) refer to the young, fresh corn ear just before or within two to three days after silking but prior to pollination and fertilization, which upon dehusking and desilking is used as vegetable. Babycorn ears are light yellow in colour with regular row arrangement; 10-12 cm long and a diameter of 1.0-1.5 cm are preferred in the market. It is a highly nutritive crop. For every 100 g of edible portion, it contains 88.10 percent moisture, 8.20 g carbohydrates, 1.90 g protein, 0.20 g fat, 28.00 mg calcium, 86.00 mg phosphorus, 0.10 mg iron, 0.50 mg thiamine, 0.08 mg riboflavin and 11.00 mg of ascorbic acid.

Organic cultivation is a conventional method, without the use of chemicals and it keeps the soil alive and in good health without affecting the growth of the plant and also take care of ecological aspect. Organic inputs are the cheap source of nutrients, which are available in enormous quantity as biological waste. These wastes can be recycled and put to productive use in horticultural production, thereby reducing the resource constraints, reducing the budget on chemical fertilizers and increasing the use efficiency of nutrients. In organic farming, the soil maintains its fertility naturally in accordance with the orderly cycle of plant and animal life.

The organic manure, composed of complex chemical compounds may take more time for their complete decomposition and as a result, the nutrients are released slowly and steadily. Those applied organic manures are not exhausted of their entire nutrient reserve to the first crop itself. They are beneficial to residual crops with the available nutrients. Under the present circumstances of creative awareness in the organic farming practices, this study brings effectiveness on utilization of different organic input both soil and foliar application in babycorn production.

MATERIALS AND METHODS
The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. A field trial was conducted in a Randomized Block Design with nine treatments in three replications. The treatments consisted of two organic manures (enriched farmyard manure and vermicompost), along with four organic foliar nutrients (panchagavya @ 3%, sea weed extract @ 3% , humic acid @ 0.2 % and effective micro organism 1: 1000 dilution) were sprayed at fortnight intervals. The treatments comprised of two organic nutrients *viz.,* enriched farmyard manure and vermicompost which were incorporated in the soil at the time of last ploughing as per the treatments and four organic foliar nutrients *viz.*,panchagavya @ 3percent,Humic acid @ 0.2 per cent, Sea weed extract @ 3 per cent and effective microorganism (1:1000 dilution) .There were applied in three sprays at fortnight intervals. The half dose of N and full dose of P and K recommended dose of fertilizer were applied at the time of field preparation and the remaining half dose of N was top dressed at 15 DAS. As per the treatment schedule, NPK were given in the form of Urea, Single Super Phosphate and Murriate of Potash respectively. The observation on yield and yield attributes *viz*., number of cobs $plant^{-1}$, length of cob, girth of cob, individual cob weight, cob yield $plant^{-1}$, cob yield $plot^{-1}$, stover yield $plant^{-1}$, stover yield $plot^{-1}$, dry matter production and nutrient uptake. The observations were recorded and the data were analysed statistically (Panse and Sukhatme, 1985).

ISSN 2394 - 7780

RESULTS AND DISCUSSION

The results pertaining to the effect of organic inputs on the yield and yield attributes furnished in Table 1 revealed that significant variations existed among the various treatments. The treatment T_4 (Vermicompost 5 t ha^{-1} + Panchakavya 3 per cent foliar spray at fortnight intervals) recorded the maximum number of cobs $plant^{-1}$ (3.02), the maximum length of cob (11.53 cm), the maximum Cob girth (7.72 cm), The maximum individual cob weight of 24.37 g, the highest cob yield $plant^{-1}$ (73.59 g) , cob yield $plot^{-1}$ (2.21 kg) and cob yield ha^{-1} (5.45 t). The next best treatment was T_1 (100 per cent Recommended dose of fertilizers) which registered the values of 2.98; 11.49cm; 7.61cm; 24.03g; 71.61g; 2.12 kg $plot^{-1}$ and 5.30 t ha^{-1} respectively. The treatment T_4 lied on par with T_1 and T_6 while, T_8 and T_2 ; T_5 and T_7 ;T_9 and T_3 were found to be on par with each other. The least yield and yield attributes were registered in T_3 (Enriched Farm Yard Manure 750 kg ha^{-1} + humic acid 0.2% spray at fortnight intervals) with the values of 1.62; 8.26 cm;5.16 cm; 15.98 g; 25.88 g; 0.78 kg and 1.92 t. respectively.

Yield is a complex character which is influenced by the interaction of many factors and the ultimate goal of any scientific crop production is to achieve the highest possible yield. It was observed in the present investigation that application of vermicompost 5 t ha^{-1} + panchakavya 3 per cent proved to be the best treatment in enhancing the production of more cobs $plant^{-1}$, maximum cob length, cob girth and cob yield. This might be due to the fact that vermicompost provided better nutrition as it contains all major nutrients besides micro-nutrients, it also has some beneficial micro-organisms which results into improved chemical, physical and biological properties of soil. Moreover increased nutrient availability from the organic manures might have increased various endogenous hormonal levels in the plant tissue, which might be responsible for enhanced pollen germination and pollen tube growth, which ultimately increased the cob production resulting in higher yield as suggested by Vimalendran and Wahab (2013) in babycorn. This is in agreement with the findings of Kaur *et al.*(2015) in various vegetable crops and Gopinathan and Prakash (2014) in tomato.

Furthermore, foliar spray of panchakavya facilitates greater uptake of nutrients and increased synthesis of cytokinin and auxin in the root tissue by their enhanced activity due to the application of panchakavya and their simultaneous transport to the axillary buds would have resulted in a better mobilization of assimilates from the source to the sink at a faster rate which in turn, would have helped in the early transformation from the vegetative phase to reproductive phase. The induction of cob formation might have been influenced by the triggering of such metabolic processes and narrowing of carbon: nitrogen ratio by the significant accumulation of carbohydrates, which leads to the enhanced vegetative growth coupled with adequate reserve food material promotes the maximum number of cobs per plant.The results of the present study are in accordance with the findings of Vimalendran and Wahab (2013) in baby corn.

It is evident from the data furnished in Table 2 that the stover yield and total dry matter production were influenced significantly due to application of organic nutrient and various bio stimulants

The highest stover(forage) yield (257.54g $plant^{-1}$,7.73kg $plot^{-1}$ and 19.07 t ha^{-1}) and the maximum dry matter production (82.78 g $plant^{-1}$,2.49 kg $plot^{-1}$ and 6.13 t ha^{-1}) were recorded in T_4 (Vermicompost 5 t ha^{-1} + Panchakavya 3 per cent foliar spray at fortnight intervals) followed by T_1 (100 per cent RDF) which registered the value of 252.13 g $plant^{-1}$, 7.62 kg $plot^{-1}$ and 18.67 t ha^{-1} and 80.94g $plant^{-1}$, 2.44 kg $plot^{-1}$ and 5.99 t ha^{-1}respectively. Among the treatments, T_4 was on par with T_1 and T_6 while T_8 and T_2 ; T_5 and T_7 ;T_9 and T_3 were lied on par with each other. The least stover yield (165.72 g $plant^{-1}$, 4.97 kg $plot^{-1}$ and 12.27 t ha^{-1}) and dry matter production (47.93 g $plant^{-1}$, 1.44 kg $plot^{-1}$ and 3.55 t ha^{-1}) were recorded in the T_3 (Enriched FYM 750 $kg.ha^{-1}$ + humic acid 0.2 per cent foliar spray).

The dry matter production which is an important trait in deciding the productivity of a crop was found to be significantly higher in the treatment which received combined application of vermicompost 5 t ha^{-1} + panchakavya 3 percent. The beneficial effects of vermicompost on growth and yield components could be attributed to the fact that after proper decomposition and mineralization, the manures supplied available nutrients directly to the plant and also had a solubilising effect on fixed form of nutrients in soil favoured the higher dry matter production. As suggested by Krishnamoorthy and Ravikumar (1973), higher production of dry matter by the plant could be attributed to the fact that organic manures have high amount of humus, facilitate N-fixation by microbes, regulate the nitrogen supply to the plants and also helps in the production of plant growth promoters. Organic manures might have provided a continuous supply of nutrients and might have enabled the leaf area duration to extend, thus providing an opportunity for the plants to increase the photosynthetic rates, which could have led to the higher accumulation of dry matter (Padmanaban, 2003). More the number of leaves $plant^{-1}$, greater the leaf area, which in turn produces more photoassimilates leading to higher dry matter accumulation. The presence of humic acid in vermicompost may have also encouraged greater

ISSN 2394 - 7780

uptake of nitrogen resulting in heavier total dry matter accumulation. This is in accordance with the earlier reports of Patil and Biradar (2001) and Shah and Karuppaiah (2001) in chilli. The results are in conformity with the findings of Abduli *et al.* (2013) in tomato , Rahul Verma (2012) in capsicum and Xu *et al*. 2000 in *Zea mays*. Furthermore, Sridhar (2003) opined that high organic matter content, presence of numerous active enzymes, vitamins and macro and micro nutrients in panchakavya might have contributed to the increased dry matter production.

The uptake of NPK was significantly influenced by the application of different organic nutrients and bio stimulants(Table 3). The nitrogen, phosphorus and potassium uptake was maximum in the treatment T_4 (Vermicompost 5 t ha^{-1} + Panchakavya 3 per cent foliar spray at fortnight intervals) recorded the highest uptake of 124.67 kg ha^{-1}, 26.45 kg ha^{-1} and 92.75 kg ha^{-1} respectively. This was followed by T_1 (100 per cent RDF) which registered a value of 122.62 kg ha^{-1}, 25.89 kg ha^{-1} and 91.58 kg ha^{-1} respectively. The NPK uptake was the least (82.52 kg ha^{-1}, 18.59 kg ha^{-1} and 65.37 kg ha^{-1} respectively) in T_3 (Enriched FYM 750 kg.ha^{-1}+humic acid 0.2 per cent foliar spray)

In the present investigation, the nitrogen, phosphorus and potassium uptake was maximum in the treatment in which combination of organic manures viz., vermicompost 5 t ha^{-1} along with panchakavya 3 per cent as foliar spray at fortnight intervals was applied. Organic manures like vermicompost when applied to the soil result in the breakdown of complex nitrogenous compounds by the action of microorganisms and increase its availability to the soil in the form of nitrate nitrogen as observed by Chavan *et al*. (1997).

Moreover, resistant fractions of organic matter, including the intermediate degradation products derived from organic manures would have actively absorbed the ammoniacal N, thus preventing it from volatalization and leaching losses. Similar effects were observed by Meera Nair and Peter (1990) in chilli.

Further, Budhawant (1994) found that the phosphorus uptake was increased with the application of organic manures especially vermicompost, which may be attributed to the greater solubilisation of native phosphorus from the soil due to the action of various organic acids liberated during the decomposition of vermicompost. Similar results on increase in phosphorus uptake due to application of organic manures have been reported by Kannan (2004) in tomato.

The use of a combination of organic manures increased the potassium content, which may be ascribed to its role in improving the soil properties, leading to better penetration of roots, thereby resulting in greater uptake of potassium from native source (Budhawant, 1994). Similar findings have been reported by Paul *et al.* (2004) and Prativa and Bhattarai (2011) in tomato.

Added organic manures not only acted as a source of nutrients but also had influenced their availability and the cumulative effect of these treatments along with panchakavya seemed to be adequate suppliers of nutrients slowly and steadily throughout the period of crop growth as observed by Santhanalakshmi (2006). The increased content of major nutrients could be due to the chemolithic autotropic nitrifiers (ammonifiers and nitrifiers) which colonize in the leaves leading to increased ammonia uptake and enhanced total N supply (Papen *et al.* 2002). Foliar spray of panchakavya facilitates greater uptake of nutrients This observation is also supported by the reports of Sridhar (2003) in black night shade and Arjunan (2005) in tomato.

Further, Kale *et al*. (1995) observed that vermicompost contains a good amount of macro and micro nutrients. It also serves as a very good base for establishing and multiplication of beneficial symbiotic microbes which helps in fixing nitrogen in the soil, besides enhancing the availability of phosphorus and nitrogen and uptake of phosphorus by plants. Similar effects were observed by Gopinathan and Prakash (2014) and Prativa and Bhattarai (2011) in tomato.

CONCLUSION

Based on the findings of the present study, it is concluded that combined application of vermicompost 5 t ha^{-1} + foliar application of Panchakavya @ 3 per cent at fortnight intervals has beneficial effect on the yield and yield attributes, stover yield, dry matter production and increased the nutrient uptake of baby corn (*Zea mays* L.)"

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ISSN 2394 - 7780

Table – 1: Effect of organic inputs and bio-stimulants on yield and yield attributes of baby corn (*Zea mays* L.)

Treatment	Number of cobs per plant	Cob length (cm)	Cob girth (cm)	Individual cob Weight (g)	Cob yield per plant (g)	Cob yield per plot (kg)	Estimated cob yield (t.ha^{-1})
T_1- Control (100%RDF)	2.98	11.49	7.61	24.03	71.61	2.12	5.30
T_2- Vermicompost 5t /ha + humic acid 0.2% spray	2.41	10.38	6.80	21.44	51.67	1.66	3.83
T_3- Enriched Farm Yard Manure 750kg/ha + humic acid 0.2% spray	1.62	8.26	5.16	15.98	25.88	0.78	1.92
T_4- Vermicompost 5t /ha + panchakavya 3% spray	3.02	11.53	7.72	24.37	73.59	2.21	5.45
T_5- Enriched Farm Yard Manure 750kg/ha + panchakavya 3% spray	2.15	9.55	6.12	18.88	40.59	1.37	3.01
T_6- Vermicompost 5t /ha + Sea Weed Extract 3% spray	2.87	11.36	7.44	23.80	68.31	1.99	5.06
T_7- Enriched Farm Yard Manure 750kg/ha + Sea Weed Extract 3% spray	2.02	9.39	5.92	18.63	37.63	1.22	2.79
T_8- Vermicompost 5t /ha + effective micro-organism (1:1000dilution) spray	2.48	10.44	6.87	21.76	53.96	1.73	3.40
T_9- Enriched Farm Yard Manure 750kg/ha + effective micro-organism (1:1000dilution) spray	1.71	8.35	5.30	16.26	27.80	0.89	2.06
SED	0.09	0.24	0.17	0.72	3.62	0.16	
CD (P = 0.05)	0.19	0.47	0.33	1.43	7.23	0.23	

Table – 2: Effect of organic inputs and bio-stimulants on stover yield and dry matter production of baby corn (*Zea mays* L.)

Treatment	Stover yield per plant (g)	Stover yield per plot (kg)	Estimated Stover yield t. ha^{-1}	DMP g plant^{-1}	DMP kg plot^{-1}	Estimated DMP t.ha^{-1}
T_1- Control (100%RDF)	252.13	7.62	18.67	80.94	2.44	5.99
T_2- Vermicompost 5t /ha + humic acid 0.2% spray	218.82	6.66	16.20	67.62	2.07	5.01
T_3- Enriched Farm Yard Manure 750kg/ha + humic acid 0.2% spray	165.72	4.97	12.27	47.93	1.44	3.55
T_4- Vermicompost 5t /ha + panchakavya 3% spray	257.54	7.73	19.07	82.78	2.49	6.13
T_5- Enriched Farm Yard Manure 750kg/ha + panchakavya 3% spray	201.25	5.96	14.90	60.46	1.82	4.48
T_6- Vermicompost 5t /ha + Sea Weed Extract 3% spray	244.39	7.46	18.10	78.18	2.37	5.79
T_7- Enriched Farm Yard Manure 750kg/ha + Sea Weed Extract 3% spray	194.02	5.83	14.37	57.91	1.76	4.29
T_8- Vermicompost 5t /ha + effective micro-organism (1:1000dilution) spray	224.75	6.87	16.64	69.68	2.15	5.01
T_9- Enriched Farm Yard Manure 750kg/ha + effective micro-organism (1:1000dilution) spray	172.30	5.18	12.76	49.95	1.52	3.71
SED	6.24	0.27		2.15	0.29	
CD (P = 0.05)	12.47	0.53		4.92	0.58	

Table – 3: Effect of organic inputs and bio stimulants on nutrient uptake by plant kg.ha^{-1} of baby corn (*Zea mays* L.)

Treatment	Nutrient uptake by plant kg.ha^{-1}		
	N	P	K
T_1- Control (100%RDF)	122.62	25.89	91.58
T_2- Vermicompost 5t /ha + humic acid 0.2% spray	106.47	23.29	81.89
T_3- Enriched Farm Yard Manure 750kg/ha + humic acid 0.2% spray	82.54	18.59	65.37
T_4- Vermicompost 5t /ha + panchakavya 3% spray	124.67	26.45	92.75
T_5- Enriched Farm Yard Manure 750kg/ha + panchakavya 3% spray	98.52	21.71	75.32
T_6- Vermicompost 5t /ha + Sea Weed Extract 3% spray	119.04	25.47	90.29
T_7- Enriched Farm Yard Manure 750kg/ha + Sea Weed Extract 3% spray	94.46	21.22	74.08
T_8- Vermicompost 5t /ha + effective micro-organism (1:1000dilution) spray	109.01	23.64	83.30
T_9- Enriched Farm Yard Manure 750kg/ha + effective micro-organism (1:1000dilution) spray	85.60	19.20	66.71
SED	2.97	0.53	2.66
CD (P = 0.05)	5.93	1.05	5.32

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON THE FRESH HERBAGE YIELD, DRY MATTER PRODUCTION, PHYSIOLOGICAL PARAMETERS, NUTRIENT UPTAKE AND PROFITABILITY OF MINT (*Mentha arvensis* L.)

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ABSTRACT
An experiment was carried out in the Medicinal Plant Unit, Department of Horticulture, Annamalai University to study the effect of integrated nutrient management

on the fresh herbage yield, dry matter production, Physiological parameters, nutrient uptake and profitability of mint. The experiment was carried out by following the principles of Randomized Block Design in three replications. The results of the experiment revealed that application of 100% NPK + vermicompost @ 5 t ha^{-1} + consortium of biofertilizers significantly increased the fresh herbage yield, dry matter production, Physiological parameters and nutrient uptake. However application of 75 % NPK + vermicompost @ 5 t ha^{-1} + consortium of biofertilizers resulted in the fresh herbage, dry matter production, chlorophyll content index, essential oil content and profitability when compared to the other treatments.

Keywords: Mint, FYM, vermicompost, nitrogen, phosphorus, potassium, consortium of biofertilizers and integrated nutrient management (INM)

INTRODUCTION
Mint (*Mentha arvensis* L) belonging to the family Labiatae (Lamiaceae). It is a commercially important medicinal and aromatic perennial evergreen herb, is the principal source of menthol in the world and on distillation yields essential oils containing a large variety of aroma-chemicals in varying composition. These oils and their aroma chemicals in pure form command a large and worldwide demand in trade. Menthol is used in the prescriptions of cold remedies, cough drops, dentifrices, mouth washes, cosmetics and is also used for scenting cigarettes, flavouring tobacco, pan etc. Pepper mint oil has a fine odour and has excellent carminative, anti-septic, preservative and gastro-stimulant properties. As a flavouring agent, it has a worldwide use in pharmaceuticals, confectionaries and is also used as an alcoholic drink, dental cream and mouth washes. India is the largest producer and exporter of mint oil and contributes about 80 per cent of total world production. The oil composition and yield may vary under different agro climatic conditions, soil conditions and nutrient application (Duhan *et al*., 1977).

Fertilization has played and it continues to play a pivotal role in the green revolution of Indian agriculture. Among the plant nutrients, nitrogen, phosphorus and potassium are the most important macro nutrient elements that decide the yield level of crops. With the indiscriminate use of fertilizers and chemicals there is increased risk of health hazards. Besides continuous use of chemical fertilizers has resulted in the depletion of soil health and also the increasing cost of chemical fertilizers and their ill-effects on physico-chemical properties of soil has resulted in the decline in yield after continuous cropping. Under such a condition, it has become imperative to use all the available sources of plant nutrients in a judicious way to minimize the fertilizer use and at the same time to sustain soil fertility and crop productivity on a long term basis. The integrated nutrient management system comprising of the use of fertilizers along with organic manures and biofertilizers is gaining momentum in the present day farming

situation. In this context, the present investigation was undertaken in order to study the effect of integrated nutrient management on fresh herbage yield, dry matter production, Physiological parameters, nutrient uptake and profitability of mint.

MATERIALS AND METHODS
The present investigation was carried out in the Medicinal Plant Unit, Department of Horticulture, Faculty of Agriculture, Annamalai University during. The experiment was laid out by following the principles of Randomized Block Design in three replications. The experiment consisted of 16 treatments viz., T_1- Control (without nutrients), T_2-100% NPK alone (200:50:40 kg ha^{-1}), T_3- 100% NPK + VC (5 t ha^{-1}),

T_4 - T_3 + CBF, T_5 - 75% NPK + VC (5 t ha^{-1}), T_6 – T_5+CBF, T_7- 50% NPK + VC (5 t ha^{-1}), T_8- T_7 + CBF, T_9- 100% NPK + FYM (25 t ha^{-1}), T_{10} – T_9 + CBF, T_{11}- 75% NPK + FYM (25 t ha^{-1}), T_{12}- T_{11}+CBF, T_{13}-50% NPK + FYM (25 t ha^{-1}), T_{14} – T_{13}+CBF, T_{15}-75% NPK + VC(2.5 t ha^{-1}) + FYM(12.5 t ha^{-1})+ CBF, T_{16} - 50% NPK + VC(2.5 t ha^{-1}) + FYM(12.5 t ha^{-1})+ CBF. The organic manures and consortium of bio fertilizers were

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applied 15 days before planting. 50 per cent nitrogen, full dose of phosphorus and potassium were applied as basal dose at the time of planting and remaining 50 per cent nitrogen was applied in three equal split doses at monthly intervals. Observations on fresh herbage, dry matter production, chlorophyll content index , essential oil content and nutrient uptake were recorded at 120 days after planting and the data were analysed statistically (Panse and Sukhatme, 1985). The profitability of the treatments were also worked out.

RESULTS AND DISCUSSION

The results of the study presented in Table 1 revealed that the effect of integrated nutrient management on the fresh herbage yield, dry matter production, physiological parameters was significant. Among the treatments, application of 75 % NPK (150:37.5:30 kg ha^{-1}) + vermicompost @ 5 t ha^{-1} + consortium of biofertilizers (T_6) recorded the highest fresh herbage yield (301.75 g $plant^{-1}$), estimated yield (22.35 t ha^{-1}), dry matter production (93.58 g $plant^{-1}$), chlorophyll content index (6.57) and essential oil content (0.31 %). The next best treatment was T_4 (application of 100% NPK (200:50:40 kg ha^{-1})+ vermicompost @ 5 t ha^{-1} + consortium of biofertilizers) which registered the values of 297.48 g $plant^{-1}$, 22.04 t ha^{-1}, 92.16 g $plant^{-1}$, 6.55 and 0.31 per cent respectively. The control (T_1) recorded the least values of 179.48 g $plant^{-1}$, 13.29 t ha^{-1}, 52.83 g $plant^{-1}$, 3.31 and 0.23 per cent. However the treatments T_6 and T_4; T_{15} and T_{12}; T_8 and T_{16}; T_3 and T_9; T_{11} and T_{12} ;T_7 and T_{13} were found to be on par with each other.

The highest fresh herbage yield $plant^{-1}$ and dry matter production recorded in the plants which were supplied with75 per cent NPK ha^{-1} + vermicompost @ 5 t ha^{-1} along with consortium of bio fertilizers could be attributed to the better growth of the plants as reflected in the yield contributing characters like plant height, plant spread, number of branches $plant^{-1}$, number of leaves $plant^{-1}$ and leaf area due to the application of the fertilizers and manures. Nitrogen helps the plant by promoting luxuriant vegetative growth by causing synthesized photosynthates to get metabolically converted into protein and thereby adding to production of more vegetative tissues. Phosphorus application could have helped in the better absorption and efficient utilization of phosphorus as the soil was low in available phosphorus. Phosphorus, a constituent of DNA and RNA has been reported to play a significant role in the metabolic processes of plants. Potassium aids in the effective conversion of photosynthates for the better growth and ultimately yield of the plant (Dasar, 2004).

Higher yield due to the application of vermicompost and biofertilizers may be attributed to their favourable effects in improving the physical conditions of the soil, besides supplying adequate major and minor nutrients which might have enhanced the absorption, translocation and assimilation of nutrients resulting in higher yields as suggested by Sivakumar (2004) in black night shade.

Further, it has been reported that azospirillum increased the photosynthetic rate, nitrogen reductase activity, glutamine synthetase activity and chlorophyll content (Sharma *et al.*, 2003). Phosphorus solubilization and mobilization by phosphobacteria and VAM could have increased the mineral uptake leading to highest herbage yield resulted highest oil recovery. The results of the present study are in close conformity with the findings of Sharmila *et al*. (2005) in mint, Hemalatha *et al*., (2008) in kalmegh and Senthilkumar *et al*., (2009) in davana.

The data on nutrient uptake by the plants presented in Table 2 revealed that the maximum uptake of nitrogen, phosphorus and potassium was recorded in T_4 (100% NPK + vermicompost @ 5 t ha^{-1} + consortium of biofertilizers) which registered the values of 109.73 kg, 27.54 kg and 63.85 kg ha^{-1} respectively, followed by T_{10} (100% NPK + FYM @ 25 t ha^{-1} + consortium of biofertilizers) which recorded the values of 109.15 kg, 27.37 kg and 63.27 kg ha^{-1} respectively. The least values 87.56 kg ha^{-1}, 18.92 kg ha^{-1} and 44.29 kg ha^{-1} were observed in the control (T_1). All the treatments showed significant differences over the control.

It can be observed from the present study that the nitrogen, phosphorus and potassium uptake was significantly influenced by application of higher level of fertilizers.

Significant increase in the uptake of nitrogen was observed at the highest dose of fertilizer application. Higher available nitrogen in the soil helped in the higher uptake of nitrogen in plants. Application of phosphorus also increased the nitrogen uptake to some extent in plants which may be due to synergistic effects of phosphorus that might have helped in the increased uptake of nitrogen in plants. Further, application of higher levels of phosphorus helped to increase the uptake of phosphorus from the soil medium as well as efficient translocation in the plant system (Khandelwal *et al*., 2003). The higher uptake of potassium observed in the present study may be due to better utilization of soil available potassium as suggested by Sherin (2006). In the present study compared to nitrogen and phosphorus, potassium uptake was higher in all the treatments and application of nitrogen and phosphorus increased the potassium uptake by plants. Positive effect of nitrogen application on the uptake of potassium was reported by Moula and Krishnamoorthy (1972). Enhanced uptake of NPK due to azospirillum was also reported earlier in medicinal coleus by Nageswari (1991) who suggested that application

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of azospirillum significantly increased the uptake of phosphorus which may be due to the production of enzymic complex by azospirillum, which solubilizes the unavailable phosphorus and makes it available to plants. In addition, phosphobacteria and VAM could have increased the nutrient uptake by solubilizing the unavailable phosphorus and mobilizing it to the plants through diffusion. This could have resulted in greater uptake of NPK in plants. The present study is in corroboration with the earlier findings of Thanuja (2002) in black pepper and Arpana *et al.,* (2008) in patchouli.

Any technology should be technically feasible and economically viable to reach the farmers field. Therefore, economic analysis of the results is very important. In the present study, it was observed that application of 75 per cent NPK ha^{-1} + vermicompost @ 5 t ha^{-1} + consortium of biofertilizers recorded the maximum gross returns of Rs. 2,68,222 ha^{-1} and net returns of Rs. 2,21,855 ha^{-1} when compared to the other treatment combinations. The increased gross returns and net returns in this treatment was mainly due to application of optimum dose of inorganic fertilizers, vermicompost and consortium of biofertilizers, which had a pronounced effect in registering higher yield. The least gross returns and net returns were obtained in the control.

From the results of the present study it can be concluded that application of 75% NPK + vermicompost (5 t ha^{-1}) + consortium of biofertilizer was found to be optimum for increasing the fresh herbage, dry matter production, chlorophyll content index , essential oil content and profitability of mint.

Table-1: Effect of integrated nutrient management on the fresh herbage Yield, dry matter production, chlorophyll content index and Essential oil content of Mint

Treatments	Fresh herbage yield (g $plant^{-1}$)	Estimated yield (t ha^{-1})	Dry matter production (g $plant^{-1}$)	Chlorophyll content index	Essential oil content (%)
T_1 - Control	179.48	13.29	52.83	3.31	0.23
T_2 - 100 % NPK alone (200:50:40 kg NPK ha^{-1})	209.43	15.51	62.81	4.04	0.25
T_3 - 100 % NPK + VC 5 t ha^{-1}	236.84	17.54	71.95	4.71	0.26
T_4 - 100 % NPK + VC 5 t ha^{-1} + CBF	297.48	22.04	92.16	6.55	0.31
T_5 - 75 % NPK + VC 5 t ha^{-1}	221.08	16.38	66.69	4.41	0.26
T_6 - 75 % NPK + VC 5 t ha^{-1} + CBF	301.75	22.35	93.58	6.57	0.31
T_7 - 50 % NPK + VC 5 t ha^{-1}	198.08	14.67	59.03	3.74	0.25
T_8 - 50 % NPK + VC 5 t ha^{-1} + CBF	262.79	19.47	80.59	5.39	0.27
T_9 - 100 % NPK + FYM 25 t ha^{-1}	233.26	17.28	70.75	4.07	0.26
T_{10} - 100 % NPK + FYM 25 t ha^{-1} + CBF	286.96	21.26	88.65	6.23	0.29
T_{11} - 75 % NPK + FYM 25 t ha^{-1}	212.22	15.72	63.74	4.67	0.25
T_{12} - 75 % NPK + FYM 25 t ha^{-1} + CBF	270.83	20.06	83.28	5.82	0.28
T_{13} - 50 % NPK + FYM 25 t ha^{-1}	194.15	14.38	57.72	3.71	0.25
T_{14} - 50 % NPK + FYM 25 t ha^{-1} + CBF	250.68	18.57	76.56	5.07	0.26
T_{15} - 75 % NPK + VC 5 t ha^{-1} + FYM 12.5 t ha^{-1} + CBF	273.95	20.29	84.32	5.85	0.29
T_{16} - 50 % NPK + VC 5 t ha^{-1} + FYM 12.5 t ha^{-1} + CBF	260.37	19.29	79.79	5.35	0.27
SED	3.74	-	3.67	0.09	0.005
CD	7.64	-	7.49	0.20	0.01

Table-2: Effect of integrated nutrient management on nutrient uptake and profitability of mint

Treatments	Nutrient uptake(kg ha^{-1})			Cost of cultivation	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})
	N	P	K			
T_1 - Control	87.56	18.92	44.29	27,981	1,59,532.92	1,31,551.92
T_2 - 100 % NPK alone (200:50:40 kg NPK ha^{-1})	104.37	25.57	59.18	31,558	1,86,159.96	1,54,601.96
T_3 - 100 % NPK + VC 5 t ha^{-1}	107.24	26.59	61.55	46,558	2,10,524.40	2,10,477.84
T_4 - 100 % NPK + VC 5 t ha^{-1} + CBF	109.73	27.54	63.85	46,367	2,64,426.72	2,17,168.72
T_5 - 75 % NPK + VC 5 t ha^{-1}	101.58	24.49	56.93	45,667	1,96,515.60	1,50,848.60
T_6 - 75 % NPK + VC 5 t ha^{-1} + CBF	102.01	24.54	57.62	47,258	2,68,222.20	2,21,855.20
T_7 - 50 % NPK + VC 5 t ha^{-1}	94.86	21.86	51.06	44,777	1,76,071.08	1,31,294.08
T_8 - 50 % NPK + VC 5 t ha^{-1} + CBF	96.68	22.69	52.54	45,477	2,33,591.04	1,88,114.04
T_9 - 100 % NPK + FYM 25 t ha^{-1}	105.06	25.66	59.67	36,558	2,07,342.24	1,70,784.24
T_{10} - 100 % NPK + FYM 25 t ha^{-1} + CBF	109.15	27.37	63.27	37,258	2,55,075.60	2,17,817.60
T_{11} - 75 % NPK + FYM 25 t ha^{-1}	97.22	22.88	53.17	35,667	1,88,639.88	1,52,972.88
T_{12} - 75 % NPK + FYM 25 t ha^{-1} + CBF	99.49	23.76	55.13	34,367	2,40,737.76	2,04,370.76
T_{13} - 50 % NPK + FYM 25 t ha^{-1}	89.29	19.60	46.33	34,777	1,72,572.00	1,37,795.00
T_{14} - 50 % NPK + FYM 25 t ha^{-1} + CBF	89.78	19.67	46.76	35,477	2,22,826.88	1,87,349.88
T_{15} - 75 % NPK + VC 5 t ha^{-1} + FYM 12.5 t ha^{-1} + CBF	91.78	20.75	48.88	41,367	2,43,511.08	2,02,144.08
T_{16} - 50 % NPK + VC 5 t ha^{-1} + FYM 12.5 t ha^{-1} + CBF	92.41	20.88	49.42	40,477	2,31,440.04	1,90,963.04
SED	0.67	0.26	0.60	-	-	-
CD	1.36	0.54	1.22	-	-	-

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