FINAL REPORT

KSCSTE PROJECT ON

PROMOTION OF ORGANICS IN VEGETABLE CULTIVATION IN KERALA

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Department of Agricultural Extension
College of Agriculture, Vellayani

KERALA AGRICULTURAL UNIVERSITY 2006

PROMOTION OF ORGANICS IN VEGETABLE CULTIVATION IN KERALA

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Submitted to

Kerala State Council for Science, Technology and Environment, Government of Kerala, Thiruvananthapuram

KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF AGRICULTURAL EXTENSION, COLLEGE OF AGRICULTURE, VELLAYANI

2006

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ACKNOWLEDGEMENT

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We also take this opportunity to specially thank the following persons:

The Associate Director, NARP(SR), College of Agriculture, Vellayani, for providing necessary support at different stages of the project.

The Dean, College of Agriculture, Vellayani for providing the needed help for the smooth functioning of the project.

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We are also indebted to the respondents of the study especially the selected vegetable growers of Pallichal, Balaramapuram, Maranalloor and Chenkal Panchayats.

Of our well-wishers, from whom the project team received valuable help in the compilation of this report, the team is indebted to the faculty members of Extension Department and to Mr. Radhakrishanan. A. G., Mr. Johny.D., Mr. Pankaj Kumar and Mr. Sujeesh.

We are also profoundly indebted to the selected farmers especially Shri. L. Vijaya Kumar, Mr. Sukumaran, Mr. Devarajan, Mr. Dorairaj, Mr. Girish Kumar and Shri. Gopinathan Nair for the conduct of field trials in different locations of Thiruvananthapuram district.

PROJECT TEAM

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PROJECT COMPLETION REPORT

1. Title of the project : **Promotion of Organics in Vegetable Cultivation in Kerala**

2. Name and Designation of the Project Team

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3. Implementing institutions and other collaborating institutions:

Kerala Agricultural University, Dept. of Agrl. Extension,
College of Agriculture, Vellayani
Kerala State Council for Science, Technology and
Environment, Government of Kerala

4. Date of commencement : 10.11.2003

5. Date of completion : 10.11.2006

6. Planned date of completion : 10.11.2006

7. Actual date of completion : 10.11.2006

8. Objectives:

a) To develop an integrated strategy for nutritional management for vegetable production in Kerala.

b) To collect and document the basic information on knowledge, attitude and adoption of the selected Integrated Nutrient Management practices.

c) To demonstrate and conduct action research on the selected technologies of Integrated Nutrient Management.

d) To refine the technologies by participatory methods and scientific interventions and to mobilize the farming community for marketing and quality assurance.

e) To work out the cost benefit ratio and to analyse the quality of the produce.

9. Deviation made from original objectives if any, while implementing the project and reasons thereof :

The group monitoring committee held during 27th and 28th May 2005 at Sasthra Bhavan, Pattom suggested to try one more treatment (100 % organic manures) without any additional financial commitment besides the already approved four treatments as envisaged in the original proposal. Accordingly treatment no. 5 (T5) was also tried in different locations of the farmers' field and the results were incorporated in the final report.

10. Project abstract (500 words)

The project was implemented mainly to develop an integrated strategy for nutritional management for vegetable production in Kerala, to collect and document the basic information on knowledge, attitude and adoption of the selected Integrated Nutrient Management practices to demonstrate and conduct action research on the selected technologies of Integrated Nutrient Management, to refine the technologies by participatory methods and scientific interventions and to mobilize the farming community for marketing and quality assurance and to work out the cost benefit ratio and to analyse the quality of the produce.

The study was a farmer-participatory approach in which an action research was conducted in selected farmers' fields from the trained group. Layout of trials in four locations was done based on the acceptance of farmers. There were four replications with five treatments for each crop comprising of 20 observations. The crops were selected based on the preferences of the farmers. The treatments were:

T1- POP practices

T2- Farmers' practices

T3- 75 % inorganic and 25 % organic

T4- 50 % inorganic and 50 % organic

T5- 100 % organic

Trials were conducted in highly demanded vegetables viz. cowpea, bitter gourd, snake gourd, cucumber and amaranthus. The farmers selected for the action research were enabled to record the observations.

A training programme was conducted on Integrated Nutrient Management for vegetable cultivation at the field centre Thembamuttom near Balaramapuram in Thiruvananthapuram District to the selected farmers. The training helped the farmers to gain more knowledge on Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) practices in vegetable cultivation.

Thiruvananthapuram district was selected purposively for the research. The study was conducted among the self-help groups of involved in vegetable production. Four panchayats were randomly selected for the study viz. Balaramapuram, Chenkal, Maranalloor and Pallichal.

The socio-economic profile characters of the vegetable growers were studied and analysed using statistical tools. Fifty-seven percent vegetable growers

were educated up to secondary level. A higher educational status of farmers is observed in this district. Majority of the vegetable growers (74 per cent) had agriculture as their full time job because this area belonged to an intensive agricultural area. A great majority of vegetable growers (70 per cent) had medium experience in vegetable cultivation. Fifty per cent had higher level of income from the farm. Majority of the farmers had medium area under vegetable cultivation (51 per cent).

Designing a suitable extension strategy to improve the efficiency of input usage in vegetable production requires a thorough understanding of the existing level of knowledge in INM. To quantify the respondents' knowledge level on selected INM practices, a simple teacher made test was used. For the purpose of the study, a list of ten key practices of INM were selected and presented to the respondents. A score of one was assigned for the correct answers. The total score of each respondent was summed up and computed for further calculations.

The respondents were grouped into low, medium and high categories based on mean (8.86) and standard deviation (2.68). It could be observed that majority of the respondents had medium level of knowledge (65 per cent) followed by low (21 per cent) and high (14 per cent) level of knowledge in INM.

Attitude is defined as one of the most important psychological determinants of the behaviour of the respondent. The attitude of an individual plays an important role in determining one's behaviour and adoption of technologies. An attempt was made to ascertain the attitude towards INM technologies by percentage analysis.

It was found that 14 percent of the respondents belonged to the low category followed by 28 percent belonging to the high category in their attitude towards INM. Majority of the respondents (58 percent) belonged to medium category. The reason behind this situation may be lack of conviction about these practices, lack of support by extension personnel on this aspect, lack of knowledge, risk aversion and marketing etc. Hence it is suggested that farmers should be exposed to rigorous training on INM and other communication media backed up by strong extension support which will remove the constraints operating in their way of acceptance of these technologies and building up their confidence in accepting these technologies. It will facilitate to create a more favourable attitude towards INM.

The data regarding the adoption level of the respondents about INM practices revealed that 64 percent of the vegetable growers had medium adoption level where as the percentage of respondents coming under high and low adoption categories were 18 percent each.

The main reason behind the finding that the majority of the respondents falling under medium level of adoption may be due to the high cost of input, transportation, labour and the risk involved in price fluctuation as perceived by the farmers in the study area. Non-availability of organic manures and bio-degradable pesticides and their lack of knowledge in using INM and IPM practices were the main reasons for partial adoption of these technologies by the vegetable growers of this study area.

A constraint analysis on organic farming revealed that the most important constraint expressed by all the respondents was inadequate market infrastructure facility. The next major constraints were higher incidence of pests and diseases, lack of guidance in INM and lack of storage facilities. The myths of this noble practice had to be removed from among the vegetable growers. The action research favours very well in these aspects. Trials were conducted in farmers' fields by substituting the inorganic nutrients with organic manures.

The salient findings in relation to the five major crops is summarized below.

In an experiment with inorganic fertilizer and organic manures like FYM, the combination of fertilizers and manures gave better results than organic manure given alone. Of the various treatments tried in farmers' fields for INM practices, 50% organically and 50 % inorganically treated plots gave the maximum yield in all the crops. The results show that the treatment T4 recorded the highest yield from among the various trials conducted. This study comes out with the results showing that the INM gave maximum net returns in 50:50 treatment plots.

Keeping quality of vegetables was found out in terms of number of days the fruits stayed fit for marketing. It was observed that the highest keeping quality was observed in T5 treatment (100 % organic) for all the crops except for snake gourd for which T4 showed the highest number of days of keeping quality.

The B: C ratio was found to have an increasing trend among the various nutrient combinations starting from T1 to T4. Among the various nutrient sources

B: C ratio was highest for T4 treatment in all the locations. It was followed by T3 treatment in all locations.

The ever- increasing costs of agricultural inputs due to excessive dependency on the external inputs, the continuing drop in prices of farm produce coupled with monsoon vagaries have made farming increasingly unprofitable. This has led the farmers to seek new ways to increase the farm returns and income in order to stay on the land. The growing consciousness of health hazards posed due to contamination of farm produce from the use of chemical fertilizers and pesticides has given a momentum to organic farming. The consumers are willing to pay a premium for environmentally responsive safe products. It is beyond doubt that a sudden transition to organic farming cannot be done with safety and precaution, so that the losses could be kept minimum. Though the returns are not immediate in chemical-free farming, there is guaranteed sustainable income with chemical free produce.

11. Key words : Vegetable cultivation, Organic manures, Integrated Nutrient Management (INM) and Integrated Pest Management (IPM)

12. Achievements :

i. (a) List of research publications

Sl. No.	Authors	Title of paper	Name of the Journal/ National Seminar/ International Seminar/ Workshop	Vol.	Page	Year
1.	Geetha G. Nath, S. Nazreen Hassan and N. P. Kumari Sushama	Bio pesticides – An alternative to conventional pesticides	Proceedings of Regional Consultative cum Workshop on technologies relevant to peninsular India in both farm and non-farm sectors held at School of Bio Sciences, Dr. G. R. Damodaran College of Science, on Sept. 15-17		125	2004
2.	S. Nazreen Hassan, Geetha G. Nath and N. P. Kumari Sushama	A multidimensional approach of farming through sustainable agriculture	Proceedings of Regional Consultative cum Workshop on technologies relevant to peninsular India in both farm and non-farm sectors held at School of Bio Sciences, Dr. G. R. Damodaran College of Science, on Sept. 15-17		142	2004

3.	S. Nazreen Hassan and N. P. Kumari Sushama	Eco-technology in vegetable production – Problems and Strategies	Kissan World	31 No.7	50-51	July 2004
4.	N. P. Kumari Sushama, S. Nazreen Hassan and C. Bhaskaran	Promotion of organics for sustained Vegetable Production	Proceedings of the Indian Environment Congress 2004		27	16-18 Nov. 2004
5.	Nazreen Hassan, S., N. P. Kumari Sushama and C. Bhaskaran	Integrated Nutrient Management for Quality Vegetables and role of extension Functioneries in the Promotion of INM to Organic Vegetable Production	Prithvi 2005 Global Economic Meet			19-28 Feb, 2005
6.	N.P, Kumari Sushama, Nazreen Hassan, S. and C. Bhaskaran	Conservation of soil fertility and cowpea enhancement go hand in hand.	XIX Annual Meeting of the Society for Conservation Biology. **University of Brasilia, Brazil**		204	15-19 July 2005
7.	N. P. Kumari Sushama , S. Nazreen Hassan and C. Bhaskaran	Market Perception and Constraints faced by farmers in Integrated Nutrient management practices (INM)	Journal of Extension Education	15 (4)	3716-3717	2004
8.	N. P. Kumari Sushama, C. Bhaskaran, Majjusha,A. R. and S. Nazreen Hassan	Ecological soundness and Economic viability through Integrated Nutrient Management practices in Bitter gourd	**National Seminar** on Extension Strategies for Fostering Knowledge Centric Agricultural Growth at Puducherry		66	2-3 Dec. 2006
9.	N.P. Kumari Sushama, and Majjusha A. R	Jaivakrishi pariposhanam Keralathilae pachakkarikalil	Yojana	35 (2)	34-36	2006

(b) Resource materials prepared as part of the project

1. Book on "Organic Vegetable Production"
2. Folder on "Jaivakrishi Pariposhanam Keralathile Pachakkarikalil"
3. CD on "Vishavimukthamaya Visudhavilavu Thedi- Pachakkarikalil Jaivakrishi Pareekshanam"

ii. **Manpower trained on the project**

a) Research Scientists or Research Associates –

Ms. Bindhu .V. S.	(Nov.2003)
Mr. Suthan. L.	(Dec 2003- Jan 2004)
Mrs. S. Nazreen Hassan	(Jan 2004 –13th Nov 2005)
Mrs. Majjusha. A.R	(15th Nov 2005–17th July 2006)
Ms. Geetha G. Nath	(18th July 2006– 9th Nov 2006)

b) No. of Ph. D produced - Nil

c) Other Technical Personnel trained - Nil

iii. **Innovations/ technology developed**

Based on the trials conducted in different farmers' field it was revealed that 50 % organic and 50 % inorganic treatments gave maximum yield. So it is not appropriate to have a sudden shift to complete organic vegetable cultivation since it will take a minimum of three years (transition period) to get a sustainable yield. So in the present scenario, inorder to get organically produced vegetables (free from chemical fertilizers and pesticides) we have to increase the quantity of organic manures gradually by reducing the use of inorganic fertilizers and pesticides.

iv. **Patents taken, if any** - Nil

v. **Application potential**

Short term:

- Higher yield
- Good quality fruits and hence higher prices
- Good economic returns
- Better shelf life and hence reduced loss due to perishability

Long term:

- Natural resource conservation like improved soil fertility and water quality
- Sustainable agriculture and environmentally friendly health production process
- Export potential
- Improves household nutrition and local food security

- Reduced dependence on high cost of external (non-renewable) inputs
- Minimize environmental pollution
- Restore and enhance ecological harmony

12. Financial details:

No.	Financial Position/Budget Head	Funds sanctioned	Expenditure	% of Total cost
I	Salaries/ Manpower costs	1, 80, 000	1,71,254	37.53
II	Equipment	90, 000	83,997	18.40
III	Consumables and Contingencies	1, 30, 000	1,49,265	32.70
V	Travel	30, 000	10,472	2.29
VI	Overhead expenses	43, 000	41,439	9.08
	Total	**4, 73, 000**	**4,56,427**	**100.00**

(The funding agency has given permission to the Principal Investigator to utilize the unspent balance under consumables for the preparation of resource materials such as documentary CD, booklet and folder without exceeding the total outlay of the project vide order No. 40/SRSAGR/2003/CSTE dtd.13.09.2006 of the Executive Vice- President, KSCSTE, Sasthra Bhavan, Pattom).

13. Procurement/ Usage of Equipment

a)

Sl. No	Name of Equipment	Make/ Model	Cost (FE/Rs)	Date of installation	Utilization Rate (%)	Remarks regarding Maintenance/ breakdown
1	Computer with accessories	IBM 8196 KAJ, 500 VA UPS, 10/100 network card	52 650	12.03.2004	100%	Working condition

2	Refrigerator	Samsung (175 litres)	8 990	05.04.2005	100%	Working condition
3.	Dot matrix printer	Epson LQ 300	9 200	30.09.2005	100%	Working condition

b) Plans for utilizing the equipment facilities in future

The equipments purchased for the project will be transferred to the Department of Agricultural Extension, College of Agriculture, Vellayani and will be utilized for the research projects being carried out in the department.

Name and Signature with

Date

a. DR. N.P. KUMARI SUSHAMA 22/12/06

(Principal Investigator)

b. (1) DR. C. BHASKARAN

(2) DR. M.S. SHEELA

(3) DR. CHANDINI. S

(4) DR. G. SOBHANA

(Co-Investigators)

Chapter 1

INTRODUCTION

Need for organic farming

The provision of adequate and healthy food for a growing world population, the alleviation of poverty and the maintenance of the quality of natural resources are arguably the foremost challenges to the humanity of the 21st century.

India has succeeded in green revolution with the introduction of high yielding varieties of various crops and by following intensive cultivation practices with the use of fertilizers, pesticides, fungicides and other inputs. In future, these inputs may not only cost heavily on our foreign exchange but also limit agricultural production. The excessive use of pesticides in vegetable cultivation not only poses serious health problems to the farmers and the soil, but the residues affect the consumers as well. In spite of using pesticides, the estimated loss in yields due to pests and diseases ranges from 20 to 40 per cent. The World Health Organization (WHO) standards of terminal pesticide residue level vary between 0.05 ppm for hard vegetables to 0.001 ppm for leafy vegetables. However, studies showed that the pesticide residue level in India is more than 0.05 ppm. It is alarming to find that most of the contaminated samples were found to be loaded with hard to degrade and highly toxic pesticides such as DDT and BHC (Brindha *et al.*, 1999). Since many of the vegetables are taken raw or half cooked, indiscriminate use of chemicals and pesticides resulting in high residues cause serious health problems.

The greatest challenge facing the nation in the coming years is to provide safe food for the growing population in the country. Global awareness on health and environmental issues are spreading fast in recent years. Sustainability in production has become the prime concern in agricultural development, Organic method of farming is the best option to ensure food, air, water and soil around us unpolluted leaving the environment safe for the present and future generation. In this regard, organic farming which is a holistic production management system for promoting and enhancing health of agro-eco system, has gained wide recognition as a valid alternative to conventional food products and ensures safe food for human. Organic farming is an age-old practice based on organic manure and

biopesticides, a combination of which has worked well to produce sufficient quantity of food for the population.

Organic farming is increasingly popular worldwide and the global demands for organic products are growing. In many ways, it is an eminently preferable model for the development of agriculture in India.

Benefits of organic farming

- Economical aspects like price premiums
- high demand for safe foods
- natural resource conservation like improved soil fertility and water quality
- prevention of soil erosion
- preservation of natural and agro-ecosystem biodiversity
- social benefits like generation of rural employment and corresponding lower rate to urban migration
- improved household nutrition and local food security
- reduced dependence on high cost of external inputs

Organic farming not only is expected to increase the income of the farmers but also help in moving towards sustainable agriculture and environmentally friendly and healthy food production process. Even though many farmers are shifting to organic farming, it is yet to be organised properly. This necessitates a thorough knowledge on the principles and scientific management including certification systems.

Organic farming plays an important role as an alternative safe food production process. It includes all agricultural systems that promote the environmentally, socially and economically sound production of food and fibres. This system assures the production of high quality food sufficient to feed all people, while protecting the soils and enhancing their fertility, minimizing environmental pollution and reduction in the non- renewable type of inputs used. Organic agriculture is becoming increasingly popular and the global demand for organic products for internal consumption as well as for export is growing rapidly.

Organic farming is the only way farmers can escape from the vicious cycle of debt and a negative economy. It is growing everywhere, because consumers

don't want to be poisoned with toxic residues from agrochemicals. It is also necessary from the point of view of small producers. Hence there is a need for organic farming mainly to avoid pesticide residues and to earn export potential, which in turn conserves the nature. Organic refers to the way agricultural products –food and fibre are grown and processed. Organic food production is based on a system of farming that maintains and replenishes soil fertility without the use of toxic and persistent pesticides and fertilizers.

Organic Agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. Organic Agriculture practices cannot ensure that products are completely free of residues; however, methods are used to minimize pollution from air, soil and water. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil, life, plants animals and people.

Organic agriculture is a unique production management system which promotes and enhances agro eco-system health, including bio- diversity, biological cycles and soil biological activity and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs (FAO, 1993).

Prevention is the organic farmers' primary strategy for disease, weed and insect control. By building healthy soils, organic farmers find that healthy plants are better able to resist disease and insects. Organic produces often select species that are well adapted for the climate and therefore resist disease and pests. When pest populations get out of balance, growers will try various options like insect predators, mating disruption, traps and barriers. If these fail, permission may be granted by the certifier to apply botanical or other non-persistent pest controls under restricted conditions. Botanicals are derived from plants and are broken down quickly by oxygen and sunlight.

Conventional agricultural methods can cause water contamination. The organic farmers' elimination of polluting chemicals and nitrogen leaching, in combination with soil building, works to prevent contamination, and protects and

conserves water resources. Organic agricultural production helps to prevent further damage to our precious water resources.

There is no conclusive evidence to suggest that organically produced foods are more nutritious. Rather, organic foods are spared the application of toxic and persistent insecticides, herbicides, fungicides and fertilizers. In the long run, organic farming techniques provide a safer, more sustainable environment for everyone.

Organic farming systems rely on large scale application of animal or FYM, compost, crop rotations, cooperative residues, green manuring, vermicompost, bio-fertilizers, bio-pesticides and biological control.

Alternatives for chemical fertilizers

In India the use of organic manures in subsistence farming is an age-old practice. Organic manures improve physical, chemical and biological properties of the soil. Addition of organic manure improves structure, aeration, water holding capacity of soils, reduces phosphorous fixation in acidic soil, forms chelates with metallic ions and reduces their toxicity in crops. For substituting the chemical fertilizers, various forms of organic manures and bio-fertilizers are explained below:

1. **FYM or cow dung:** It is an important source of plant nutrients. FYM is composed of dung, urine, bedding and straw. FYM contains approximately 5-6 Kg N, 1.5-2 Kg phosphorus and 5-6 Kg potash/ ton. It builds up soil health considerably.
2. **Green Manuring**: It is considered as a good source of nitrogen (N) and it increases the availability of Phosphorus (P), Potassium (K) and secondary and trace elements to the soil.
3. **Coir Pith**: The annual production of coir pith in India is about 7.5 million tonnes. Preferably bio-degraded and amended coir pith can serve as a substitute for FYM or similar organic manures. *Pleurotus sajorcaju*, *Aspergillus* and *Trichoderma* are found to be potent in degrading coir pith.

4. **Vermicompost**: It is 5 times richer in N, 7 times in P, 11 times in K, 2 times in Mg, 2 times in Ca & 7 times in actinomycetes than ordinary soil. It is a rich source of vitamins and growth hormones like gibberellins which regulate the growth of plants and microbes. The compost prepared by using earthworms is called vermicompost.
5. **Biofertilizers**: These are living cells of different types of micro organisms which have an ability to mobilize nutritionally important elements from non-usable to usable form. They influence the availability of major nutrients like nitrogen, phosphorus, potassium and sulphur to the plants. Rhizobium, Azotobacter, Azospirillum, Blue green algae, Azolla, Mycorrhizae, Phosphate Solubilizing Bacteria can be used as biofertilizers to increase the crop production. These micro organisms require organic matter for their growth and activity in the soil and provide valuable nutrients to the plants in the soil.

Alternative methods of pest control :

Many of the pesticide applications may be unnecessary and are economically unsound. A range of alternative methods of pest control to be used in organic farming are detailed below:

- Deep ploughing the fields during summer season help in killing pests, larval & eggs.
- Clean cultivation by destruction of weeds and other alternate hosts breaks the carry over of the pest in succession which considerably reduces the pest numbers.
- Adopting crop rotations to avoid carry over of pests from one season to next season.
- Change in time of sowing
- Draining of water out of fields at times of pests growing in number
- Use of resistant varieties
- Growing of trap crops
- Release of parasites and predators
- Use of pheromone traps and light traps

- Use of biological insecticides
- Use of mechanical weed control
- Cover cropping to control weed-seed germination

Integrated Nutrient management- Need and importance

In 1950's the total food production in India was 55-60 million tonnes and the crop yield was between 300-700 kg/ha, which was considered as below normal. With the increase in population, the demand for food increased but food production did not do so proportionately, leading to food shortage. During the early 70's, introduction of hybrids/high yielding varieties, chemical fertilizers, pesticides and weedicides resulted in the green revolution, which fulfilled the demand for food considerably. Today the food production has crossed 200 million tonnes. As per the latest census, the Indian population has crossed one billion and to feed this huge population, the food production should increase proportionately. For achieving that, a second green revolution is required. Organic farming now seems to be the best way out to achieve this because it avoids the use of chemical fertilizers, pesticides and weedicides.

> **"It is impossible for India and the world to produce the required quantity of food without the use of inorganic fertilizers."**
>
> **Dr Norman, E Borlaug, Nobel laureate in Agriculture**

Evidence to this fact is that crop yields in developed countries like Japan, USA and UK are quite high as compared to that in India, which is due to the judicious use of agrochemicals like fertilizers, pesticides and weedicides. It is also true that the use of chemicals is packed with unwanted gifts of pollution and other related problems. Excess use of agro chemicals can cause, air, water and food contamination resulting in health hazards. To overcome this problem, some farmers in developed countries have begun shifting to organic farming in a phased manner. Although the quantity of yield is less, the developed countries have counteracted this problem by selling organically grown food products at higher prices. To strengthen this system, new Agricultural Research Stations have been set up in these countries to carry out research on organic farming.

The agricultural scenario in India is quite different from that in the developed countries. Shortage of nutrients and inadequacy of plant protection measures are the major constraints. Hybrids and high yielding varieties demand more fertilizers for better yields. The nutrient requirement of any crop is measured on its yield potentiality and therefore in reality it is not possible to meet the heavy nutrient demand of the crops through organic sources alone. Organic manures like FYM, compost, green manure account to only 0.5-0.3-0.4 per cent of NPK. The nutrients in organic manure are released to the crop very slowly and over a very long period of time. Yet, organic manure improves the physical, chemical and biological properties of the soil and also provides micronutrients, which are essential for plant growth. In spite of realising the importance of organic manure, shortage of raw materials have prevented many farmers from using it in the proportion that is recommended by the Agricultural University and State Department of Agriculture.

Post the green revolution, farmers in India have opted for hybrids and high yielding varieties. This has also necessitated farmers to take up chemical control methods because of their quick action. The quantity of pesticides used in India during 98-99 was 49,150 tonnes. Although this is negligible when compared to the quantity used in the developed countries, to overcome the pollution problems due to indiscriminate use of fertilizers and pesticides a new approach is needed which is eco-friendly and cost-effective and minimises the ill effects of chemicals. Called the 'Integrated nutrient management (INM)' and 'Integrated pest management (IPM)' systems, they employ both organic and inorganic manuring to meet the nutrient requirements of the crop. In integrated nutrient management, compost, green manure, vermicompost, bio fertilizers, crop residues, neem and other oil seed cakes, are given importance, while the integrated pest management (IPM) employs cultural, biological and chemical methods. Priority is given to pest-resistant varieties of crop. Since it is relatively new concept, organisations which advocate organic farming should take up INM and IPM to the farmers and impart training to them to harvest maximum benefit.

The use of organic sources as fertilizers (nutrients) is known from the beginning of agriculture till 1952 (Gowda & Babu, 1999). India has a vast potential of manurial resources. FYM and poultry manure are commonly used organic manures. Poultry manure is a rich source of nutrients especially for

vegetable production (Jose et al., 1988). Neem cake contains the alkaloid Nimbidin and nimbin, which effectively inhibit the nitrification process (Sahrawat & Parmer, 1975). Vermicompost contains various amino acids, minerals and micro organisms which humidify the organic matter in the surrounding soil and acts as a biofertilizer for plants (Shanbhag, 1999).

As far as Kerala is concerned, the extent of cultivated land is limited and hence we should exploit the potential of vegetable production fully through proper agronomic practices. A global loss of productive cropland due to soil degradation is estimated to be 60 to 70 lakh ha each year (Misra et al., 1999). Proper soil management without impairing soil health is a pre-requisite for achieving higher productivity from agricultural lands (Anina, 1995). Here comes the importance of Integrated Plant Nutrient Management (IPNM) which is ecologically sound, economically viable and socially just. The basic concept of IPNM for sustaining yield is the maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefit from all possible sources of plant nutrient in an integrated manner (Malik, 1999).

Even though the soil and climate in Kerala are suitable for growing vegetables, more than 75 % of the requirement is procured from our neighbouring states. In a state like Kerala, where the land area is limited, supply of optimum quantity and type of nutrients is most important for improving vegetable production. The increasing trend of abundant use of inorganic fertilizers in the present intensive agricultural system poses a threat to the sustainability of our agro-eco system. The continuous indiscriminate use of chemical fertilizers leads to decline in soil fertility and productivity besides causing health hazards. Since vegetables are mostly consumed fresh or partially cooked, they should be devoid of the residual effect of chemicals. In developing countries, over 50 % increase in crop production was brought about by the use of fertilizers. So in the present scenario, where the national priority is to feed the increasing population, chemical fertilizer is unavoidable. Further, recent concern is stressing on the reduction of cost of fertilizers and improvement in the quality of agricultural produce. Hence a judicious approach to meet the objectives of the environmental care, increasing the productivity, improving the quality and reducing the cost of cultivation is needed. One way to achieve sustainability in agricultural production is to

substitute chemical fertilizer to the maximum extent possible with organic manures. The use of organic manure with inorganic fertilizers not only increases but also sustains the production and productivity of the crops as well as the soil health.

Food value of vegetables

Meeting the domestic food requirement has been the foremost social priority before India since independence. Vegetables play a vital role in the health and nutrition of people. The food experts and nutritionists have realised and appreciated the food value of vegetables because of its low calorific value, high content of proteins, vitamins and minerals. Hence vegetable is the most essential topic currently in terms of organic farming.

"It treats organic vegetable production as a serious profession, as a life's work." **- Gail Kahovic**

Vegetables are protective supplementary foods and are rich source of vitamins and minerals. They serve as roughage and improve digestion. They can supply Calcium (Ca), Phosphorus (P) and Iron (Fe) in sufficient quantities. The green leafy vegetables are rich in Vitamin A and vegetables like chilli, tomato and potato are rich in Vitamin C. The role of vegetables in human diet is cardinal to make the human healthy and wholesome.

India is the second largest producer of vegetables in the world next only to China

Chapter 2
REVIEW OF LITERATURE

2. 1 Effect of organic manures on growth, yield, quality and soil properties of vegetables

2. 1. 1 Farm Yard Manure

According to Meerabai and Raj (2001) farmyard manure, the most commonly used organic manure, is a good source of both macro and micronutrients.

2. 1. 2 Effect of FYM on growth characters

Cerna (1980) and Valsikova and Ivanic (1982) said that FYM favourably influenced the growth of dry matter increment per unit leaf area of Capsicum.

Arunkumar(1997) reported that in amaranthus, FYM application was found to be superior to vermicompost in inducing better plant height , root biomass production, leaf area index and yield.

Joseph (1998) observed that in snake gourd, growth characters viz., weight of the roots per plant and dry matter production per ha were highest in FYM treated plants as compared to poultry manure or vermicompost treated plants.

2. 1. 3 Effect of FYM on yield and yield attributes

Joseph (1998) reported that in snakegourd, yield attributing characters viz., length, weight and number of fruits per plant were highest in FYM treated plants as compared to poultry manure or vermicompost treated plants.

Senthilkumar and Sekhar (1998) reported that fruit yield per plant in bhindi was increased markedly by farmyard manure application.

2. 1. 4 Effect of FYM on quality aspects

Kansal *et al* (1981) opined that application of 20 t FYM per ha increased the ascorbic acid content in spinach leaves

2. 1. 5 Effect of FYM on soil properties

Prasad and Singh (1980) found out that in wheat-maize rotation, available N and P_2O_5 content of the soil increased with continuous use of farmyard manure.

Negi *et al* (1981) reported an increase in available potassium content of soil in FYM applied plots compared to fertilizer applied plots.

Kanwar and Prihar (1982) showed the beneficial effect of FYM in increasing the water stable aggregates.

Gupta *et al* (1988) noticed in a long – term field experiment with wheat that an increase in available N content of soils up to 20 days after FYM application and a decrease thereafter.

Sarkar *et al* (1989) suggested that continuous application of FYM increased the WHC due to improvement in porosity and soil aggregation.

Dhanokar *et al* (1994) observed that continuous use of FYM raised the available K_2O content by 1.3 to 5.4 folds over control.

2. 2 Poultry manure

Rajasree (1999) opined that poultry manure is suitable for commercial cultivation of vegetables in Kerala compared to FYM as organic source.

Channabasavanna and Biradar (2002) say that as the nutrient present in poultry manure is easily available, its effect can be noticed directly on the crop and residual effect can also be seen. Due to high content of NPK it has been proved that one tonne is equivalent to seven tones of FYM.

2. 2. 1 Effect of poultry manure on growth characters

Singh *et al* (1970) in a study on optimum level of poultry manure requirement for cauliflower, revealed progressive increase in growth and yield of cauliflower when the dose was increased from 0 to 169.6q per hectare.

Singh *et al* (1973) reported that in potato, poultry manure application exhibited better response than FYM on yield and growth attributes like height of the plant, number of shoots and number of leaves per plant.

Anita (1997) reported that in chilli various growth attributes like plant height, number of branches and dry matter production were better with poultry manure application as compared to FYM or vermicompost.

2. 2. 2 Effect of poultry manure on yield and yield attributes

Abusaleha (1981) reported early flowering and highest yield of 18.02t per ha. with the application of half of nitrogen through poultry manure in bhindi.

Anitha (1997) treated chilli plants with poultry manure and showed better yield and yield attributing characters as compared to FYM and vermicompost application.

Rekha (1999) showed maximum fruit set percentage in poultry manure treated plots and the marketable fruit yield was also the highest.

2. 2. 3 Effect of poultry manure on Quality aspects

Singh *et al* (1970) on application of poultry manure showed a slight increase in ascorbic acid content of cauliflower. The highest vitamin C content was obtained in the plots supplied with 169.6 q ha^{-1} of poultry manure.

Anitha (1997) observed that chilli plants treated with poultry manure recorded the maximum ascorbic acid content of fruit as compared to vermicompost and control treatments.

Joseph (1998) reported that in snake gourd poultry manure treated plants recorded the highest crude protein content and the lowest crude fiber content as compared to that of FYM and vermicompost treated plants.

According to Sharu (2000) poultry manure application registered maximum keeping quality of fruits compared to vermicompost, neem cake and POP recommendations.

2. 2. 4 Effect of Poultry Manure on Soil Properties

According to Bitzer and Sims (1988) poultry manure increased the levels of Boron (B), Calcium (Ca), Magnesium (Mg), Copper (Cu) and Zinc (Zn) in the soil.

Anitha (1997) observed better uptake of nitrogen in poultry manure treated chillies as compared to control.

Sharu (2000) reported that highest level of poultry manure recorded highest level of soil N compared to vermicompost, neemcake and POP recommendations.

Channabasavanna and Biradar (2002) showed that poultry manure improved the physical structure of the soil.

2. 3 Vermicompost

Shanbhag (1999) says that vermicompost plays a vital role in building of nutrients in soil and thereby sustaining the yield. Vermicompost contains various amino acids, minerals and microorganisms, which humidify the organic matter in the surrounding soil and act as a bio fertilizer for plants.

Meerabai and Raj (2001) showed the advantage of vermicompost over other organic manures in respect to quality and shelf life period.

Aswalan and Hauser (2001) say that earthworm cast is an important source that can be harnessed for increased crop production.

Rameshchandra and Nirmala Agarwal (2002) found out that vermicomposting is an efficient method to recycle the crop, farm and domestic and rural industrial organic waste into good quality manure for the crop production.

2. 3. 1 Effect of Vermicompost on Growth Characters

The use of vermicompost either as seed inoculants or as an organic source gives better result in terms of yield as well as growth characters. The quantity of fertilizer can be reduced to half when vermicompost was used as seed inoculants in cowpea.

Manonmani and Anand (2002) in a field experiment conducted at Thiruchirapalli, reported that the growth and yield of lady's finger were found to be maximum in the plot which was supplemented with vermicompost compared to the cultivation in normal soil and cultivation in soil with bio fertilizers and bio fertilizers+ vermicompost.

2. 3. 2 Effect of Vermicompost on Yield and Yield Attributes

Ismail *et al* (1993) conducted a comparative evaluation of vermicompost, FYM and fertilizer on yield of bhindi and watermelon and observed an increase in yield in all the vegetables with vermicompost.

Rajalekshmi (1996) observed higher yield in tomato and chilli by the application of vermicompost.

Arunkumar (2000) reported highest yield in amaranthus during all harvests when vermicompost was applied at 25 t ha^{-1} when compared to other organic manures like poultry manure, neem cake and FYM.

2. 3. 3 Effect of vermicompost on quality aspects

Evangelista (1986) reported that the application of pure earthworm cast showed significant effect on nitrogen, phosphorus, calcium and magnesium content of the lettuce leaves.

Tomati *et al* (1990) observed that incorporation of vermicompost increased protein synthesis in lettuce and radish by 24 and 32 percent respectively.

Joseph (1998) opined that in snake gourd, total soluble solids, vitamin C and total sugars were highest in fruits obtained from vermicompost applied plots.

2. 3. 4 Effect of vermicompost on soil properties

Haimi and Huhta (1990) found out that earthworm increased either directly or indirectly the proportion of mineral N for plants at any given time, although N was clearly immobilized in the initial stage.

Kale *et al.* (1992) noticed that vermicompost application enhanced the activity of beneficial microbes like nitrogen fixers and mycorrhizal fungi. It played a significant role in N fixation and phosphate mobilization, leading to higher nutrient uptake by plants.

2.4 Effect of combined application of organic manure and chemical fertilizers

In an experiment with inorganic fertilizer and organic manures like FYM, the mixture of fertilizers and manure gave better results than organic manure given alone (Chinnaswamy, 1967).

Doikova (1977) recommended combined application of organic and inorganic chemicals, because application of FYM alone proved less effective in increasing the dry matter content in brinjal.

Studies conducted in Kerala Agricultural University revealed that the organic and inorganic fertilizers and their combination had significant influence on vegetable productivity and higher rate of nitrogen along with FYM induced earliness and enhanced the fruit yield in clustered chilli (KAU, 1991).

2.4.1 Poultry manure and chemical fertilizers

Jose *et al.* (1988) observed an enhanced dry matter production in brinjal with the application of 50 kg N as poultry manure combined with 50 kg N as urea.

In another experiment in brinjal, Abusaleha (1981) reported the highest uptake of nutrients with the combined application of nitrogen in the form of poultry manure and ammonium sulphate which is attributed to the increased dry matter accumulation in plants.

Rekha (1999) noticed that when poultry manure was substituted with 50 percent of the recommended chemical fertilizer and used in the ratio 1:1, marketable yield was highest in brinjal when compared to the substitution with neemcake and biogas slurry.

Jose *et al.* (1988) noted that application of half (50 kg) N as poultry manure along with remaining half (50 kg) as urea increased the uptake of N, P, K, Ca and Mg in brinjal.

2.4.2 Vermicompost and chemical fertilizers

Pushpa (1996) observed that yield attributes like mean fruit weight, girth of fruits and yield were significantly influenced by vermicompost application in tomato.

Rajalekshmi (1996) observed that with regard to the yield and dry matter production of chilli crop, the treatment receiving vermicompost + NPK recorded highest yield.

The quantity of fertilizer can be reduced to half when vermicompost was used as seed inoculant (Meera, 1998).

In an experiment conducted in cowpea the treatment vermicompost (20 t /ha)+ lime + fertilizer was found to be superior with a mean grain weight of 10.91 g per plot (Bijulal, 1997)

Integrated nutrient management

Integrated nutrient management (INM) is an approach that seeks to both increase agricultural production and safeguard the environment for future generations. It is a strategy that incorporates both organic and inorganic plant

nutrients to attain higher crop productivity, prevent soil degradation, and thereby help to meet future food supply needs. It relies on nutrient application and conservation, new technologies to increase nutrient availability to plants, and the dissemination of knowledge between farmers and researchers. The success of INM will depend upon the combined efforts of farmers, researchers, extension agents, governments, and non-governmental organizations (NGOs).

The balanced supply of nutrients is a pre-requisite for successful agriculture. This can be achieved through integrated nutrient management which involves scientific use of organic manures along with chemical fertilizers for sustaining the crop productivity.

The data given by the Oman Rice, Cuu Long Delta Rice Research Institute, 2003, Dept. of Agriculture and Forestry Extension, MARD, Vietnam, showed a continuous application of 50% organic and 50% inorganic fertilizers increased the rice yield over the control by 22.5%. The combination of organic and inorganic fertilizers had the best rice yield and microbial population dynamic, suggesting that organic manure plays an important role as a nutrient supplement to chemical fertilizers.

According to Renu (2003) the highest fruit setting percentage was observed with integrated application of poultry manure and chemical fertilizer in 1:1 ratio.

The investigation of Sharu (2000) revealed that an integrated application of chemical fertilizers and organic manures was beneficial for increasing the growth, yield, and quality of chilli with reduced incidence of bacterial wilt.

Sankaran (1996) indicates that a gradual replacement of the inorganic to maximum of 40 to 50 % of total economic fertilizer level, would confer higher efficiency and effective functioning of slow release N, protection from losses and long term benefits of soil fertility build up.

Thomas (1984) reported that bitter gourd crop responded well to nitrogen application at 60 kg N per hectare along with the application of 18 t / ha FYM producing maximum yield.

Ramesh (1997) reported that poultry manure could be safely substituted for inorganic N upto 75% without any reduction in yield.

Venkatasamy (2003) says that application of composted coir pith at 50 kg per palm per year or application of composted coir pith at 25 kg per palm per year along with 50 % of recommended dose of NPK as chemical fertilizers is optimum for getting maximum nut yield in coconut with substantial improvement in soil fertility.

Chapter 3

METHODOLOGY

In accordance with the objectives of the study the research methodology adopted is presented under the following heads.

3.1 Research design

3.2 Locale of the study

3.3 Selection of respondents

3.4 Operationalisation and measurement of independent variables

3.5 Operationalisation and measurement of dependent variables

3.6 Constraints in the adoption of organic farming practices as perceived by the vegetable growers

3.7 Methods used for data collection

3.8 Statistical tools used for analysis

3.1 RESEARCH DESIGN

Research design is the entire process of planning and carrying out research. Research design is defined as the plan, structure and strategy of investigation so as to obtain answers to research questions and to control variance". The plan is the overall scheme or programme of research.

For this study, ex-post facto design was used. This is systematic empirical enquiry in which the scientist does not have direct control over the variables because their manifestations have already occurred or because they are inherently not manipulatable.

3.2 LOCALE OF THE STUDY

3.2.1 Selection of the District

Thiruvananthapuram district was selected purposively due to the following the reasons

i) Thiruvananthapuram district is one among the top districts with maximum area under vegetable cultivation. (3196 hectares, 98-99) (Source: Vegetable cell, Directorate of Agriculture, Govt .of Kerala).

ii) More number of agencies was involved in the promotion of organic farming, both technically and economically in this district.

iii) There are several progressive farmers who follow organic farming practices including those who have won the Harithamitra award for the best fruit – vegetable grower in the state.

iv) The vegetables especially from Thiruvananthapuram fetch higher price in the foreign market as per the opinion of the exporting agency.

v) The field centres of Vegetable and Fruit Promotion Council Keralam (VFPCK) are the best among the centres in the state.

vi) VFPCK is conducting several Participatory Technology Development (PTD) experiments in this district.

vii) Being the first systematic study of this kind conducted in the state, it was convenient to select an area in the vicinity of College of Agriculture, Vellayani to get the benefits of its infrastructure and other resources.

The study is being conducted among the self-help groups of Vegetable and Fruit Promotion Council Keralam (VFPCK) involved in vegetable production. From among the 195 Haritha sanghams in the 29 panchayat under VFPCK in Thiruvananthapuram District, four panchayats are randomly selected for the study. They are as follows:

1. Balaramapuram
2. Chenkal

3. Maranalloor

4. Pallichal

3.3 SELECTION OF RESPONDENTS

List of farmers who cultivated vegetables especially amaranthus, cowpea, cucumber, bitter gourd, and snake gourd was collected from the VFPCK. Farmers were selected by using random sampling method. It was decided to have the sample size of 100 respondents for the study.

Sl. No.	Krishibhavan	Selected respondents
1	Chenkal	25
2	Balaramapuram	25
3	Pallichal	25
4	Maranalloor	25

Accordingly 25 respondents from each of the four panchayats of Chenkal, Balaramapuram, Pallichal and Maranalloor were selected.

3.4. Operationalisation and measurement of independent variables

The personal and socio-psychological variables were selected with the consent of the experts in the relevant fields. The variables selected were:

1. Age
2. Education
3. Experience in vegetable cultivation
4. Area under vegetable cultivation
5. Mass media exposure
6. Extension orientation
7. Economic motivation
8. Innovativeness

9. Risk orientation
10. Market perception

3.4.1 Age

This was operationally defined as the number of years the respondent has actually completed at the time of interview.

The respondents were classified into three categories, namely, young, middle and old as followed by Sherief (1998)

Category	Age
Young	≤ 34 years
Middle	35-44 years
Old	≥ 45 years

3.4.2 Education

Education was operationalised as the extent of formal education acquired by the respondent. It was measured by assigning scores for different levels of education. The categorization of the respondents and the corresponding scores are given below as followed by Majjusha (2000).

Level of education	Score
Illiterate	0
Primary school	1
Secondary school	2
Collegiate	3

3.4.3 Experience in Vegetable Cultivation

It was defined as the total number of years the respondent has been engaged in vegetable cultivation. The scoring procedure adopted by Sreedaya (2000) was used. The scoring pattern is given below:

Sl. No.	Experience	Score
1	Upto 5 years	1
2	6 to 10 years	2
3	11 to 25 years	3
4	Above 25 years	4

3.4.4 Area under Vegetable Cultivation

This was measured as the extent of area under vegetable cultivation in cents. The scoring pattern was employed in this case as done by Fayas (2003).

Sl. No.	Size of holding	Score
1	Upto 25 cents	1
2	26 to 50 cents	2
3	51 to 1 acre	3
4	1.01 to 2 acres	4
5	Above 2 acres	5

3.4.5 Mass Media Exposure

Mass media exposure referred to the degree to which the different mass media, namely, radio, television, newspaper, magazines, bulletins, books and films were utilized by the farmers for getting information about different organic farming practices in vegetable cultivation. The scale used here was developed by Lakshmi (2000). The frequency of exposure to mass media was measured as shown below:

Frequency of exposure	Score
Regularly	2

Occasionally	1
Never	0

The score range was between 14 and 0.

3.4.6 Extension Orientation

This referred to the extent of contact, the farmer had with different extension agencies and also his participation in union activities or programmes like meetings, seminars etc. organized by these agencies and personnel. The scale used here was developed by Manoj (2000).

The response for contact of a farmer with different extension personnel was measured as follows.

Response	Score
Regularly	2
Occasionally	1
Never	0

The total score was obtained by adding up all the scores for different extension activities.

The extension participation was measured by summing up the scores obtained by a farmer for his participation in various extension activities. The scores were assigned to the respondents as follows.

Response	Score
Regularly	2
Occasionally	1
Never	0

The total score was obtained by adding up the scores for all extension activities. The scores for extension orientation for a respondent were arrived at by adding up the scores for extension contact and extension participation.

3.4.7 Economic Motivation

This referred to the extent to which a farmer was oriented towards profit maximization and relative value he places on monetary gains

The scale adopted by Sreedaya (2000) was used to measure economic motivation with slight modification. The scale consisted of six statements of which the fifth and the sixth were negative. Each statement was provided with five point continuum namely, strongly agree, agree, undecided, disagree and strongly disagree with scores of 4, 3, 2, 1 and 0 for positive statements and 0, 1, 2, 3 and 4 for negative statements. The summation of the scores for all the statements formed the score for economic motivation. The score range was between 24 and 0.

3.4.8 Innovativeness

This was defined as the degree to which the respondent was relatively earlier in adopting new ideas.

The scoring procedure followed by Priya (2003) was used to measure innovativeness with slight modification. In this procedure a question was asked as to when the farmer would like to adopt an organic farming practice. The response was scored as follows.

Sl. No.	Response	Score
1	As soon as it is brought to my knowledge	3
2	After I had seen other farmers tried successfully in their farms	2
3	I prefer to wait and take my own time	1
4	I am not interested in adopting organic farming practices	0

3.4.9 Risk Orientation

This was operationalised as the degree to which the farmer is oriented towards encountering risks and uncertainty in adopting organic farming practices and he exhibits courage to face problems of risk. The scale followed by Majjusha (2000) was used to measure risk orientation with slight modification.

The scale consisted of six statements of which two statements were negative. The respondents were rated on a five-point continuum with scores 4, 3, 2, 1 and 0 for their responses strongly agree, agree, undecided, disagree and strongly disagree respectively. For the negative statements, the scoring procedure was reversed. The scores obtained on each statement were cumulated to obtain the total score. Thus the maximum score that could be obtained by a respondent was 24 and the minimum zero.

3.4.10 Market Perception

This was defined as the capacity of the respondent to identify the market trend to sell the produce for greater returns.

The scale followed by Fayas (2003) was used to measure market perception with slight modification. The method consisted of scoring the responses obtained to selective questions presented to the respondents to elicit their perception of the market for the produce. The questions and the scoring procedure adopted were as follows.

1. Do you think that a farmer will be able to sell vegetables at a higher demand if he increases the quality by adopting organic farming practices?

   Yes – 1

   No – 0

2. How much price the vegetables cultivated following organic farming practices will fetch, compared to those raised under conventional methods?

   Low price – 0

   Same price – 1

   High price – 2

3. How difficult it will be to dispose off the vegetables cultivated following organic farming practices?

   Very difficult – 0

   Difficult – 1

   Easy – 2

Very easy – 3

The score range was between six and zero.

3.5 Operationalisation and measurement of dependent variables

3.5.1 Extent of Awareness about Integrated Nutrient Management (INM) Practices

Awareness was operationalised as the extent to which respondents were familiar with the organic farming practices in vegetable cultivation. Gangadharan (1993), Sriram (1997), Sherief (1998) and Samad (2004) measured awareness on a two-point continuum namely 'aware' and 'not aware'. In this study, the respondents were asked to indicate the degree of awareness about twenty organic farming practices on a three point continuum of not aware, partially aware and aware and scores of 0, 1 and 2 were given respectively. The awareness scores for all the organic farming practices were summed up to arrive at the overall awareness score of the respondent. Awareness index was calculated using the formula.

$$\text{Awareness Index} = \frac{\text{Respondent's score}}{\text{Maximum possible score}} \times 100$$

Awareness was also used as an independent variable for testing its relationship with knowledge, attitude and adoption.

3.5.2 Extent of knowledge about INM Practices

In the present study, knowledge refers to the extent of information possessed by the respondent about Integrated Nutrient Management (INM) practices in vegetable cultivation. .

Nachiappan and Srinivasamurthy (1976) used the teacher made test to find out the knowledge levels of small farmers with respect to farm technology. They calculated knowledge index by the following formula.

$$\text{Knowledge index} = \frac{\text{Actual score obtained}}{\text{Maximum score allotted}} \times 100$$

Gangadharan (1993) measured knowledge of the respondents about improved agricultural practices in pepper cultivation based on teacher made test.

Majjusha (2000) measured knowledge of the respondents about farmers' practices in cowpea cultivation based on teacher made test.

Similarly, teacher made test was used in this study to measure knowledge about organic farming practices in vegetable cultivation.

A set of 30 statements reflecting the knowledge of the respondents about organic farming practices were selected based on review of literature and discussion with experts in the Department of Agricultural Extension and other related fields. Sixteen statements were later discarded due to ambiquity and duplication. Finally fourteen statements were selected for the test. A score of 'one' was assigned to the correct answer and 'zero' to wrong answer. The sum of scores obtained for all items indicated the knowledge score of a respondent. Thus the maximum knowledge score that could be obtained by a respondent was 14 and the minimum zero. Based on the knowledge score, knowledge index was calculated using the following formula.

$$\text{Knowledge Index} = \frac{\text{Respondent's total score}}{\text{Maximum possible score}} \times 100$$

Knowledge was also used as an independent variable for testing its relationship with attitude and adoption.

3.5.3 Attitude towards INM Practices

The term attitude refers to the degree of positive or negative affect towards a psychological object. The focus of the study is on Integrated Nutrient Management (INM) practices in vegetable cultivation. To measure the degree of the farmer's like or dislike towards organic farming practices, an attitude scale was constructed by following the method of Likert summated ratings suggested by Edwards (1969).

a) Collection of items

All possible statements which will discriminate the positive and negative attitudes of the farmers towards organic farming practices were collected from

relevant literature and also by having discussion with experts from Kerala Agricultural University and State Department of Agriculture. The statements were edited following the procedure suggested by Edwards (1969). A total of 50 statements were selected.

b) Selection of items

These statements were given to 30 experts in Kerala Agricultural University to test their relevancy to be included in the scale. The responses were collected on a five-point continuum of most relevant, more relevant, relevant, less relevant and least relevant. The scores were given as 5, 4, 3, 2 and 1 respectively. The total score for each statement given by the expert was calculated. The statements were ranked in descending order based on their scores. From these, 30 statements with highest scores were selected and subjected to item analysis. The procedure suggested by Edwards (1969) was followed.

c) Item scoring

The statements were administered to 40 farmers of non-sample area selected randomly. They were asked to respond to each statement in terms of their own agreement or disagreements on a five point continuum, namely, strongly agree, agree, undecided, disagree and strongly disagree. The scores were given as 4, 3, 2, 1 and 0 for positive statements and reverse for the negative statements. The total score for each of the respondent was the sum of all the items.

d) Item evaluation

The subjects were then arranged in an array based on the total score obtained by them. Twenty five per cent of respondents with higher total scores and 25 per cent of respondents with lower total scores were selected from among the respondents. These two groups formed the criterion groups. To evaluate individual statement the critical ratio namely t–value which is a measure of the 't' unit to which a given statement differentiate between high and low group of respondents for each statement was calculated.

For calculation of 't' value the following formula was used.

$$t = \frac{\overline{X}H - \overline{X}L}{\sqrt{\frac{\Sigma(XH - \overline{X}H)^2 + \Sigma(XL - \overline{X}L)^2}{n(n-1)}}}$$

Where, $\Sigma (XH - \overline{X}H)^2 = \Sigma XH^2 - \frac{(\Sigma XH)^2}{n}$

$\Sigma (XH - \overline{X}L)^2 = \Sigma XL^2 - \frac{(\Sigma XL)^2}{n}$

XH = The mean score of a given statement for the high group

XL = The mean score of the same statement for the low group

n = The number of subjects

The statements with highest 't' value (*i.e.*, more than 1.75) were selected for the attitude items. Thus the attitude scale consisted of sixteen items which were finally included in the study.

Scoring Techniques

The items on the attitude scale were provided with five point continuum namely, strongly agree, agree, undecided, disagree and strongly disagree with scores of 4, 3, 2, 1 and 0 respectively for the positive statements and 0, 1, 2, 3 and 4 for negative statements. The attitude score of the respondents could be obtained by summing up the scores for all the items in the scale.

Reliability of the Scale

A scale is said to be reliable when it will consistently produce the same or similar results, when applied to the same sample at different time. Here, the reliability was tested by means of split half method.

The scale was administered to 30 non-sample respondents each and was divided into two halves based on odd and even number of statements. The total scores obtained for odd and even numbered items were subjected to correlation analysis. The correlation value obtained was 0.923, which was found to be

significant at one per cent level. Since the 'r' value was more than 0.8, the scale was considered to be reliable.

Validity of the scale

The developed scale was tested for content validity. The main criterion of content validity is how well the contents of the scale represent the subject matter under study. Since the items selected were from the universe of content, it was ensured that the items covered all aspects of organic farming practices in vegetable cultivation.

Administering the scale

The final scale which measured attitude of the vegetable growers towards organic farming practices consisted sixteen statements. Each statement was noted on a five point continuum as strongly agree, agree, undecided, disagree and strongly disagree with scores of 4, 3, 2, 1 and 0 respectively for positive statements (1,2,4,7,9,10,13 and 15). The scoring was reversed in the case of negative statements (3,5,6,8,11,12,14and16). The score was obtained for each item and summed up to get the attitude score of a farmer. The maximum score was 64 and the minimum was 0.

Attitude was also used as an independent variable for testing its relationship with the adoption.

3.5.4 Extent of Adoption of INM Practices

In this study, adoption meant the degree to which a farmer had actually adopted an INM practice. The extent of adoption of INM practices in vegetable cultivation was measured by means of an adoption index developed for the study.

Sriram (1997) and Vijayalayan (2001) used an index to measure the extent of adoption of eco-friendly agricultural practices in cotton and rice farmers respectively.

In this study, the procedure followed by Sriram (1997) was used to measure the extent of adoption of organic farming practices with slight modification. After perusal of relevant literature and based on discussion with

scientists and extension workers, 20 organic farming practices were identified in vegetable cultivation.

The practices differed in their contribution to yield and environmental safety. So equal value for all practices was not meaningful. Hence a method was adopted for assigning weightages to the practices.

The farmers' responses were divided into three categories namely, adopted, partially adopted and not adopted. The scores of 2, 1and 0 were assigned respectively to each item in accordance with the response of the farmer and they were multiplied with the respective practice weightage. The total adoption index for each farmer was calculated using the following formula.

$$\text{Adoption index} = \frac{\text{Respondent's total score}}{\text{Total possible score}} \times 100$$

Respondent's total score = Total number of practices adopted by a farmer multiplied by the respective practice weightage and summated

Total possible score = Total number of practices recommended multiplied by the respective practice weightage and summated

3.6 Constraints in the adoption of INM practices as perceived by the vegetable growers

Based on the review of relevant literature and discussions with experts of both State Department of Agriculture and Kerala Agricultural University, the constraints faced by vegetable growers were collected separately. The important constraints in the adoption of INM practices by the vegetable growers were finally selected and these constraints were enlisted in the interview schedule.

The responses to each constraint was obtained on a three point continuum, namely, most important, important and least important. In order to rank the constraints, a cumulative index was calculated. For this, weightages of 3, 2 and 1 were given to the responses most important, important and least important respectively.

The frequency of responses under each category was multiplied with the corresponding weightage and added to get a cumulative index for the particular constraint. The ratio between the cumulative index and the frequency of responses for each constraint was worked out. Based on the ratio, the constraints were ranked in each case. The solutions of the most important constraint were also recorded.

3.7 METHODS USED FOR DATA COLLECTION

Taking into consideration of the scope and objectives of the study, a draft interview schedule was prepared after perusal of available literature and through consultation with experts in the field of extension education and other related fields. After incorporating their suggestions, a well-structured interview schedule was finalized in English and translated to Malayalam for collecting data from the farmers.

Interview schedule was field tested with vegetable growers in a non-sample area by the researcher. The experiences gained by the researcher during the test were of great help in making the questions clearer, free from ambiquity and to use simple language. Necessary changes were incorporated in the interview schedule. The final version of the interview schedule is given in Appendix I. The data were collected from 100 vegetable growers through personal interview by the researcher using the final interview schedule. Non-participant observation technique was also followed for data collection.

3.8 STATISTICAL TOOLS USED FOR ANALYSIS

The data collected from the respondents were scored, tabulated and analysed using suitable statistical methods. The statistical analysis was done using computer facilities available at the College of Agriculture, Vellayani.

Keeping in view the objectives of the study and amenability, the data were subjected to different statistical tools. These tests included mean, standard deviation, percentage, coefficient of variation and critical difference, which were used in comparison of different categories and frequencies. The other statistical tools like analysis of variance, correlation coefficient and stepwise regression were also used in analysing the data. A brief description of the tools used is given below.

Mean

The mean scores for all the variables were worked out to make suitable comparisons wherever necessary.

Percentage Analysis

Percentage analysis was done to make simple comparison wherever necessary.

Analysis of Variance

The data generated for fruit yield, net returns and B:C ratio was studied under different treatments were subjected to analysis of variance. Whenever the results were significant, the critical difference was worked out at five or one per cent variability.

Chapter 4

RESULTS AND DISCUSSION

This chapter deals with the results obtained in this study and the discussion based on the results, keeping the objectives in view. The findings as well as the discussion on them are presented under the following headings.

4.1 Socio –economic and profile characteristics of vegetable growers

4.2 Knowledge of vegetable growers about selected Integrated Nutrient Management practices

4.3 Attitude of vegetable growers towards INM

4.4 Adoption of selected INM practices by vegetable growers

4.5 Constraint analysis of vegetable growers

4. 1 Socio –economic and profile characteristics of vegetable growers

The socio-economic profile characters of the vegetable growers were studied and the data are furnished in Table.1. More than half of the vegetable growers (69.0 %) belonged to middle age group. This shows that middle age people falling in between the age group of 35 and 55 have enthusiasm in vegetable cultivation.

Table 1. Socio-economic and profile characteristics of vegetable growers

(n=100)

Sl. No.	Particulars	Category	Frequency	Percentage
1.	**Age**	Young	14	14.00
		Middle	69	69.00
		Old	17	17.00
2.	**Educational status**	Illiterate	6	6.00
		Primary	21	21.00
		Secondary	57	57.00
		Collegiate	16	16.00
3.	**Occupation**	Govt. servant	1	1.00
		Part-time agriculture	25	25.00
		Full time agriculture	74	74.00

4.	**Experience in vegetable cultivation**	Low	14	14.00
		Medium	70	17.00
		High	16	16.00
5.	**Annual income**	Low	28	28.00
		Medium	22	22.00
		High	50	50.00
6.	**Area under vegetable cultivation**	Low	18	18.00
		Medium	51	51.00
		High	31	31.00
7.	**Exposure to information sources**	Low	4	4.00
		Medium	87	87.00
		High	9	9.00
8.	**Social participation**	Low	0	0
		Medium	94	94.00
		High	6	6.00
9.	**Extension Orientation**	Low	11	11.00
		Medium	55	55.00
		High	34	34.00
10.	**Economic motivation**	Low	10	10.00
		Medium	74	74.00
		High	16	16.00
11.	**Innovativeness**	Low	37	37.00
		Medium	48	48.00
		High	25	25.00
12.	**Cosmopoliteness**	Low	18	18.00
		Medium	82	82.00
		High	0	0.00
13.	**Credit Orientation**	Low	89	89.00
		Medium	11	11.00
		High	0	0.00
14.	**Risk Orientation**	Low	26	26.00
		Medium	57	57.00
		High	17	17.00

15.	**Market Perception**	Low	35	35.00
		Medium	29	29.00
		High	36	36.00

Fifty-seven percentage vegetable growers were educated up to secondary level. The higher educational status of farmers is observed in this district.

Majority of the vegetable growers (74%) had agriculture as their full time job because this area belonged to an intensive agricultural area.

A great majority of vegetable growers (70%) had medium experience in vegetable cultivation. Fifty per cent had higher level of income from the farm. Majority of the farmers had medium area under vegetable cultivation (51 %).

A great majority of the farmers had medium level of exposure to information sources (87 %). Their social participation was found to be medium. Extension orientation was also found to be falling under the medium category (55%). A majority of respondents (74 %) was found to have medium level of economic motivation.

Majority of farmers were found to have a medium level of innovativeness (48 %) and 37 per cent had low level of innovativeness.

A majority of farmers (82%) was found to have a medium level of innovativeness. Credit orientation was found to be low (89 %)

A medium level of risk orientation was found among 57 per cent of the vegetable growers. Market perception is almost found to be same in all the categories.

4.2 Knowledge of vegetable growers about selected Integrated Nutrient Management practices

Designing a suitable extension strategy to improve the efficiency of input usage in vegetable production requires a thorough understanding of the existing level of knowledge in INM. To quantify the respondents' knowledge level (dependent variable) on selected INM practices, a simple teacher made test was used. For the purpose of the study, a list of ten key practices of INM were selected and presented to the respondents. A score of one was assigned for the correct

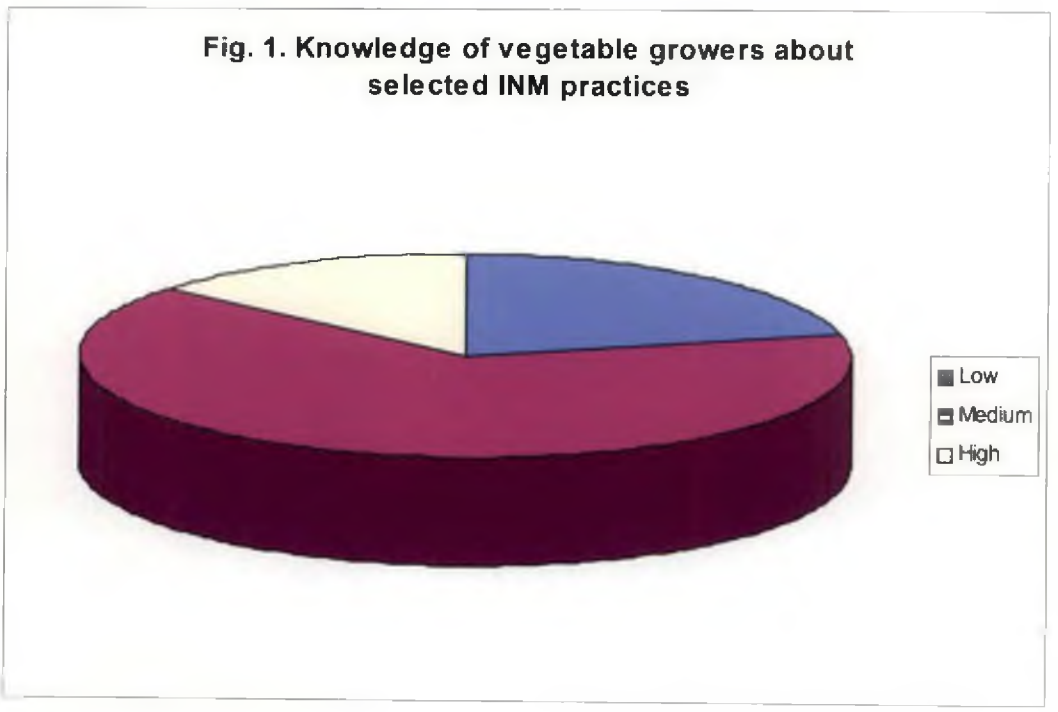
answers. The total score of each respondent was summed up and computed for further calculations.

Table 2. Knowledge of vegetable growers about selected INM practices

(n=100)

Category	Frequency	Percentage
Low	21	21.00
Medium	65	65.00
High	14	14.00

The respondents were grouped into low, medium and high categories based on mean (8.86) and standard deviation (2.68). It could be observed from the table that majority of the respondents had medium level of knowledge (65%) followed by low (21%) and high (14%) level of knowledge in INM (Table 2 & Fig. 1).



4. 3. Attitude of vegetable growers towards INM

Attitude is defined as one of the most important psychological determinant of the behaviour of the respondent. It is the degree of positive or negative effect associated with some psychological object and it will determine a person's future

acceptance of technology disseminated (Thurstone, 1946). The attitude of an individual plays an important role in determining one's behaviour and adoption of technologies. An attempt was made to ascertain the attitude towards INM technologies by percentage analysis.

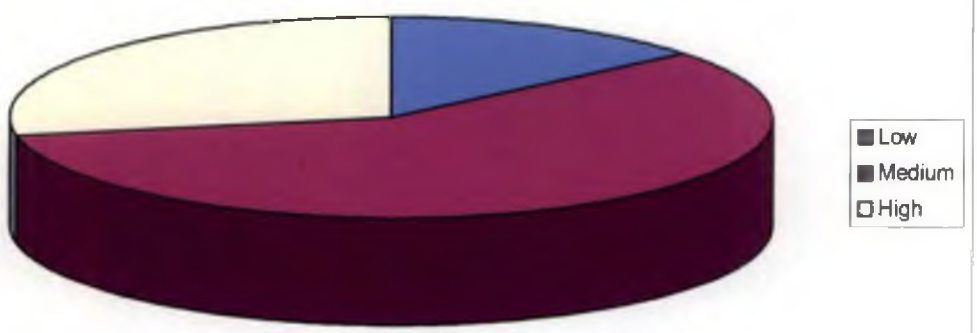
Table 3. Attitude of vegetable growers towards INM

(n=100)

Category	No.	Percentage
Low	14	14.00
Medium	58	58.00
High	28	28.00

It was found that 14 percent of the respondents belonged to the low category followed by 28 percent belonging to the higher category in their attitude towards INM. A majority of respondents (58 %) belonged to medium category (Table 3). The reason behind this situation may be due to lack of conviction about the practice, lack of support by extension personnel, lack of knowledge, risk aversion and difficulty in marketing etc. Hence it is suggested that farmers should be exposed to vigorous training on INM and other communication media backed up by strong extension support which will facilitate to remove the constraints operating in their way of acceptance of this technology and building up their confidence in accepting. It will facilitate to create a more favourable attitude towards INM.

Fig. 2. Attitude of vegetable growers towards INM



4. 4. Adoption of selected INM practices by vegetable growers

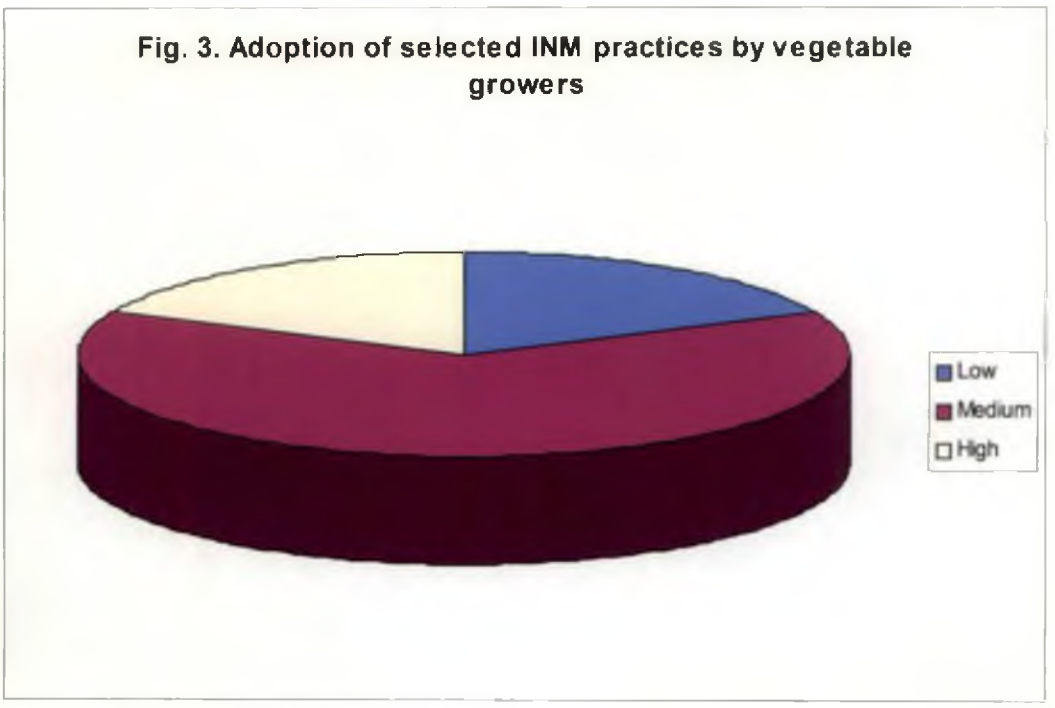
The data regarding the adoption level of the respondents about INM practices revealed that 64 percent of the vegetable growers had medium adoption level where as the percentage of respondents coming under high and low adoption categories were 18 percent each.

Table 4. Adoption of selected INM practices by vegetable growers

(n=100)

Category	No.	Percentage
Low	18	18.00
Medium	64	64.00
High	18	18.00

The main reason behind the majority of the respondents falling under medium level of adoption may be due to the high cost of input, transportation, labour and the risk involved in price fluctuation as perceived by the farmers in the study area. Non-availability of organic manures and bio-degradable pesticides and their lack of knowledge in using INM practices. These were the main reasons for partial adoption of INM by the vegetable growers of this study area.



4. 5. Constraint Analysis of Vegetable Growers

Totally 20 constraints were expressed by farmers in the adoption of INM in vegetable cultivation. The results are given in table 5.

Table 5. Constraints encountered by farmers in vegetable cultivation

(n=100)

Sl.No.	Statements	Frequency	Percentage	Rank
1	No guarantee in getting more yield	85	85	IX
2	Lack of finance facilities	64	64	XIII
3	High input cost	95	95	V
4	High seed cost	75	75	XI
5	Restricted seed supply	27	27	XVI
6	High labour cost	92	92	VII
7	Varietal susceptibility towards P&D	97	97	III
8	Higher incidence of P&D	99	99	II

9	Lack of knowledge about INM	96	96	IV
10	Lack of guidance in. INM	99	99	II
11	Weather problems	97	97	III
12	Labour scarcity	45	45	XIV
13	No timely supply of inputs	36	36	XV
14	High risk involved	79	79	X
15	Not yet convinced	68	68	XII
	Marketing Constraints			
1	Price fluctuation	97	97	III
2	Lack of storage facilities	99	99	II
3	Inadequate credit facilities in marketing	93	93	VI
4	High transport charges	90	90	VIII
5	Inadequate market infra-structure facilities	100	100	I

The most important constraint expressed by all the respondents was inadequate market infrastructure facilities. The next major constraints were higher incidence of pests and diseases, lack of guidance in INM and lack of storage facilities. This is followed by varietal susceptibility to pest and diseases, weather problems and price fluctuations. It is clear from the findings that many researchers reported these problems. Hence constraints in the adoption of INM were studied to know the importance.

Chapter 5

ACTION RESEARCH

Action research can be described as a family of research methodologies, which pursue action (or change) and research (or understanding) at the same time. In most of its forms it does this by

- using a cyclic or spiral process which alternates between action and critical reflection and
- in the later cycles, continuously refining methods, data and interpretation in the light of the understanding developed in the earlier cycles.

It is thus an **emergent** process, which takes shape as understanding increases; it is an **iterative** process, which converges towards a better understanding of what happens. In most of its forms it is also participative (among other reasons, change is usually easier to achieve when those affected by the change are involved) and qualitative.

Training on Integrated Nutrient Management

The training programme was conducted on Integrated Nutrient Management for vegetable cultivation at the field centre of VFPCK, Thembamuttom, Balaramapuram on 4th May 2004. The participants for the training programme were the selected farmers for conducting action research. The Principal Investigator Dr. N. P. Kumari Sushama, Associate Professor (Agrl Extension), Dr. G. Sobhana, Associate Professor (Training Service Scheme), Dr. S. Chandini, Associate Professor (Agronomy), Dr. M. S. Sheela, Associate Professor (Agrl. Entomology) and the research fellow S. Nazreen Hassan led the training programme.

The principal investigator gave the welcome address and also an introduction on organic farming. Dr. S. Chandini gave a brief explanation about the importance of organic farming. She gave the nutrient contents in various organic manures.

TRAINING AT VFPCK FIELD CENTRE
BALARAMAPURAM

PLATE - 1

One tonne green leaf manure = 2.5 tonnes FYM

Neem cake — 5% N, 1% P_2O_5 and 1.5 % K_2 O in addition to insecticide effect.

FYM — 1%N, 0.5% P_2O_5&1% K_2O

Poultry Manure — 1.2-1.5% N, 1.4-1.8% %P_2O_5 and 0.8-0.9% K_2 O

Bone meal — 3.5% N, 21.0% P_2O_5

The importance of bio fertilizers was also discussed in this session. Dr. M. S. Sheela discussed about Integrated Pest Management (IPM) in detail. She explained about various organic pesticides, control measures of major pests attacking vegetables including organic pest control methods.

Dr. G. Sobhana explained in detail how to conduct an action research. The trials to be carried out were explained by her. The treatments proposed to be conducted are:

T1- POP practices

T2- Farmers' practices

T3-75% inorganic and 25% organic

T4- 50% inorganic and 50% organic

T5- 100% organic

The training helped the farmers to gain more knowledge on INM and organic practices in vegetable cultivation.

Action research was conducted in selected farmers' fields from the trained group. Layout of trials in four locations was done based on the acceptance of farmers. There were four replications with five treatments for each crop comprising of 20 observations. The crops were selected based on the preferences of the farmers.

Trials were conducted for integrated nutrient management for cowpea, bitter gourd, snake gourd, cucumber and amaranthus. The study is farmer participatory in nature and the farmers had sole participation in all activities involved in production as well as observation and recording.

The results of the survey and action research are furnished under different headings.

Vermicompost was prepared in the field itself in all the locations and used for all the treatments.

Vermicompost was prepared in pits of size 1mx 2.5mx 0.3m. The pit size varied from one trial to another. At the bottom of the pit, a layer of coconut husk was spread with the concave side upwards to ensure drainage of excess water. The husk was moistened and above this bio waste mixed with cow dung in the ratio 8:1, was spread up to a height of 30 cm above the ground level. The farm residues were utilised for vermicomposting. In the study area, banana trash, pseudostem and dried leaves available in ample quantities were utilised for recycling by using worms. After 7-10 days of partial decomposition, worms were introduced @ 500g per pit. The pit was covered with coconut fronds to prevent the worms from birds. The moisture was maintained in the pits. After three months, the composted manure was made into a heap and left for two days. The manure was then removed from the top so that the worms move to the bottom. The worms can be collected and utilised for the next crop. The manure thus prepared helped to maintain the soil organic matter, conserve the soil organisms, soil structure and improved the water holding capacity of the soil.

The organic pest control measures followed commonly for all the treatments were tobacco decoction, application of neem oil emulsion, application of biocontrol agents like *Trichoderma* and *Pseudomonas.*

Tobacco decoction

This is very effective for controlling aphids and other soft-bodied insects infesting vegetable crops. Tobacco decoction can be prepared by steeping 500 g of tobacco waste in 4.5 litres of water for 24 hours. Dissolve 120 g of ordinary bar soap separately in another vessel. The soap solution is added to tobacco decoction under violent agitation. Dilute this stock solution 6-7 times before spraying.

Neem oil emulsion

Neem oil emulsion is a very good and effective repellent in vegetable crops. It is prepared by mixing one litre neem oil with 60 g bar soap. To prepare the solution the bar soap is first dissolved in 500 ml lukewarm water and then it is

VERMICOMPOST PREPARATION AT DIFFERENT LOCATIONS

PLATE - 2

PREPARATION AND APPLICATION OF BOTANICAL PESTICIDES

TOBACCO DECOCTION

NEEM OIL EMULSION

PLATE - 3

poured into the neem oil by stirring. This has to be diluted ten times before spraying. It was found to be effective in reducing mosaic disease in cowpea. This emulsion is also used as an effective control measure against American serpentine leaf miner.

Neem cake

In order to prevent root diseases neem cake was applied at the rate of 2.5 kg per cent.

Pea aphid was the major pest noticed in all the locations. For this, tobacco decoction and neemoil emulsions were alternatively used to check the aphid.

***Pseudomonas* application**

The pits were drenched with pseudomonas at the rate of 20g / lit applied at the rate of 50 ml per pit in the case of rhizoctonia rot. All these added to the yield as well as the keeping quality.

PREPARATION AND APPLICATION OF PSEUDOMONAS

PLATE- 4

COWPEA

Cowpea is a versatile leguminous crop grown in different parts of the world for vegetable, grain and fodder purposes. Among various vegetable crops grown in Kerala, cowpea occupies a prime position because it is an important protein source and hence its yield and quality are important. It provides more than half the amount of plant protein in human diet. It can be cultivated either as an upland crop during rainy season or as an irrigated crop in the summer rice fallows.

For the purpose of action research, 68 kg organic manure per cent was applied in the form of poultry manure in T1, T3 and T4 treatments. If cattle manure is used, it should be about 80 kg. In addition to this, 600g mussoriephos and 170g potash was also used. The amount of urea applied varied in the above treatments.

T1: 176g

T3: 132g + 1.7kg poultry manure

T4: 87.5g+ 3.4kg poultry manure

In T5 treatment which is 100% organic, 75kg poultry manure alone was applied.

Plant height (cm)

Effect of the dosage of organic manure and fertilizer combination on plant height was observed on participatory basis on the 15th and 45th days after sowing (DAS). The details are as follows:

Table 6. Plant height of cowpea in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	15.0	18.3	16.65	2.0	2.3	2.15
T2	16.9	18.4	17.65	2.2	2.4	2.30
T3	17.2	18.2	17.70	1.6	1.8	1.70
T4	17.1	18.1	17.60	1.0	1.4	1.20
T5	17.0	18.3	17.65	1.5	1.8	1.65

Balaramapuram						
T1	18.0	20.3	19.15	2.1	2.4	2.25
T2	17.9	20.4	19.15	1.9	2.3	2.10
T3	20.2	20.2	20.20	1.9	2.5	2.20
T4	20.1	20.1	20.10	1.7	1.9	1.80
T5	17.5	20.1	18.80	1.8	2.1	1.95
Maranalloor						
T1	15.1	15.5	15.30	2.7	2.8	2.75
T2	15.3	15.5	15.40	2.9	2.6	2.75
T3	14.8	14.8	14.80	2.7	2.5	2.60
T4	14.1	14.5	14.30	2.6	2.6	2.60
T5	14.2	14.9	14.55	2.5	2.9	2.70
Pallichal						
T1	15.4	15.2	15.30	2.6	2.7	2.65
T2	15.5	15.1	15.30	2.5	2.7	2.60
T3	15.4	15.2	15.30	1.9	2.1	2.00
T4	15.1	15.2	15.15	2.1	2.4	2.25
T5	14.9	15.5	15.20	2.2	2.7	2.45

A maximum height of 18.4 cm and 2.4 m was observed in T2 on 15th and 45th DAS in Chenkal. The lowest plant height of 15 cm in T1 and 1.0 m in T4 was observed on 15 and 45 DAS.

At Balaramapuram, a maximum plant height of 20.2 cm and 2.5 m was observed in T3 on 15th and 45th DAS. Similarly minimum plant height of 17.5 cm was found in T5 on 15 DAS, but 45 DAS a minimum plant height of 1.7 m was on T4.

A maximum height of 15.5 cm was observed in T_1 & T_2 and lowest plant height of 14.1 cm in T4 was observed on 15 DAS at Maranalloor.

At Pallichal, a maximum height of 15.5 cm was observed in T1 on 15th DAS and 2.7 m at T3 and lowest plant height of 15.1 cm in T4 and 1.9 m in T4 was observed on 15th DAS and 45 DAS respectively.

COWPEA FIELD AT DIFFERENT LOCATIONS

CHENKAL

BALARAMAPURAM

MARANALLOOR

PALLICHAL

PLATE - 5

Number of leaves

Various nutrient combinations significantly influenced number of leaves. The influence of different nutrient combinations on the number of leaves was observed. The effect of organic manures on the number of leaves was found to be significant. The treatments were comparable.

Table 7. No. of leaves in cowpea in four locations

Treatments	Maranalloor		Chenkal		Pallichal		Balaramapuram	
	15 DAS	45DAS	15 DAS	45 DAS	15 DAS	45 DAS	15DAS	45 DAS
T1	6	16	6	18	6	17	7	13
T2	6	16	7	19	6	15	6	14
T3	6	18	6	16	5	18	6	15
T4	6	17	6	14	5	13	6	13
T5	7	18	8	19	6	15	5	14

In all the four locations 6 to 8 leaves were observed at 15 DAS. The number of leaves ranged from 13 to 19 leaves at 45 DAS.

Total Fruit Yield (kg/cent)

Effect of various nutrient combinations on total fruit yield was significant. T4 recorded the maximum total fruit yield and was comparable with other treatments T3, T2 and T1.

Table 8. Fruit Yield of cowpea in four locations

Treatments	Chenkal	Pallichal	Balaramapuram	Maranalloor
T1	48.10	31.85	44.75	34.75
T2	49.50	44.15	50.20	49.15
T3	58.30	60.85	60.10	62.70
T4	71.25	72.60	72.25	71.80
T5	71.75	45.45	34.95	31.75

In T4, a maximum yield of 72.60 kg was recorded at Pallichal. Similarly 71.25 kg at Chenkal, 72.25 kg at Balaramapuram, 71.80 kg at Maranalloor. 50 percent organic and 50 percent inorganic nutrient substitution was found to be significant in all the four locations.

Keeping quality for cowpea (in days)

The keeping quality of the organically grown cowpea proved to be good in all the four locations. It was observed to be the highest in T5 treatment compared to other treatments.

Table 9. Keeping quality of cowpea in four locations

Treatments	Location			
	Chenkal	**Pallichal**	**Balaramapuram**	**Maranalloor**
T1	3	4	3	4
T2	3	3	3	3
T3	4	3	4	4
T4	4	4	4	5
T5	8	6	7	7

Net Returns from cowpea (Rs./cent)

Among the various nutrient combinations application of 50% inorganic and 50% organic produced maximum net returns in cowpea in T4 Treatment in all the four locations except in Chenkal where T5 (100 % organic) produced maximum net returns. The results are furnished in Table 10.

Table 10.. Net returns from cowpea in four locations

Treatments	Location			
	Chenkal	**Pallichal**	**Balaramapuram**	**Maranalloor**
T1	213.20	30.55	162.95	162.95
T2	236.20	143.25	234.00	218.25
T3	444.15	203.55	395.85	347.88
T4	633.30	583.70	578.45	571.70
T5	635.75	241.25	83.75	35.75

B: C Ratio of cowpea

Table 11. B/C Ratio of cowpea in four locations

Treatments	Location			
	Chenkal	**Pallichal**	**Balaramapuram**	**Maranalloor**
T1	0.42	-0.06	0.32	0.32
T2	0.45	0.27	0.45	0.42
T3	0.72	0.81	0.78	0.86
T4	1.12	1.16	1.14	1.13
T5	1.44	0.55	0.19	0.08

The B: C ratio was found to have an increasing trend among the various nutrient combinations starting from T1 to T4. Among the various nutrient sources B: C ratio was highest for T4 treatment in all the locations except in Chenkal. It was followed by T3 treatment in all locations.

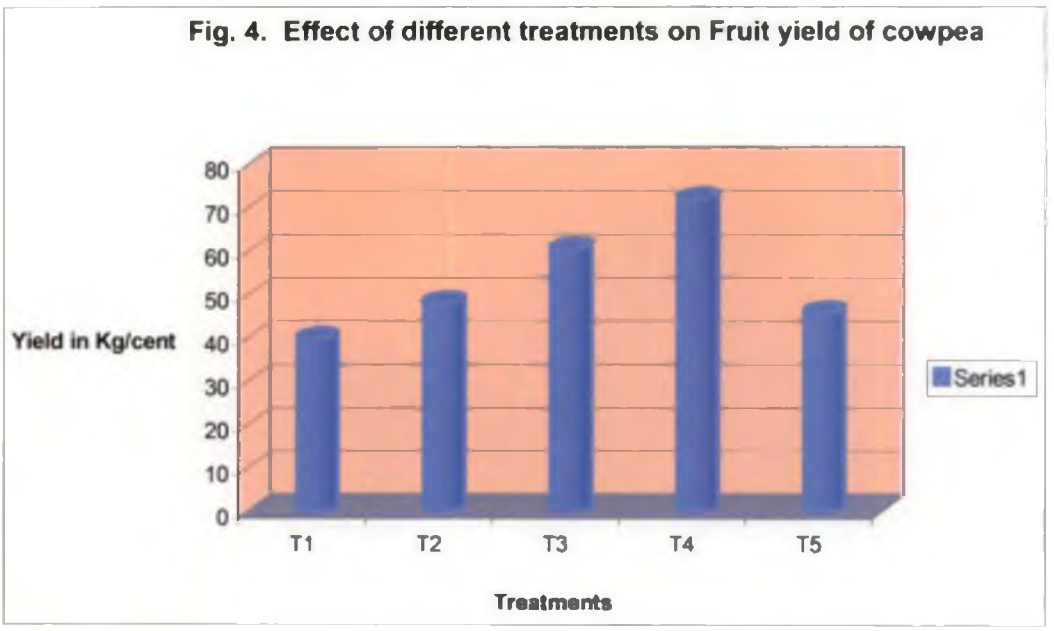
Table 12. Effect of different treatments on fruit yield of cowpea

Treatments	**Fruit yield (kg/cent)**
T1	39.86
T2	48.25
T3	60.50
T4	71.98
T5	45.98
$F_{(4,12)\text{-treatments}}$	8.700^{**}
$SE_{\text{-treatments}}$	4.356
$CD_{(0.01)\text{-treatments}}$	13.422

** significant at 1 per cent level

It is seen from Table 12 that the treatment T4 (50 % inorganic and 50 % organic) produced the maximum fruit yield of 71. 98 kg/cent, which was on par with the treatment T3 (75 % inorganic and 25 % organic) which recorded a fruit yield of 60.50 kg/cent.

The lowest fruit yield of 39.86 kg/cent was produced by the treatment T1 (POP recommendations) which was on par with the treatments T5 and T2 which recorded an yield of 45.98 kg/cent and 48.25 kg/cent respectively (Fig.4).



The results of the study revealed that the treatment T4 recorded the maximum fruit yield indicating the importance of integrated nutrient management practices for obtaining better yield in cowpea. This also reveals a positive effect of the organic manure on the yield of the crops because a gradual transition to organic farming can be achieved through Integrated Nutrient Management (INM).

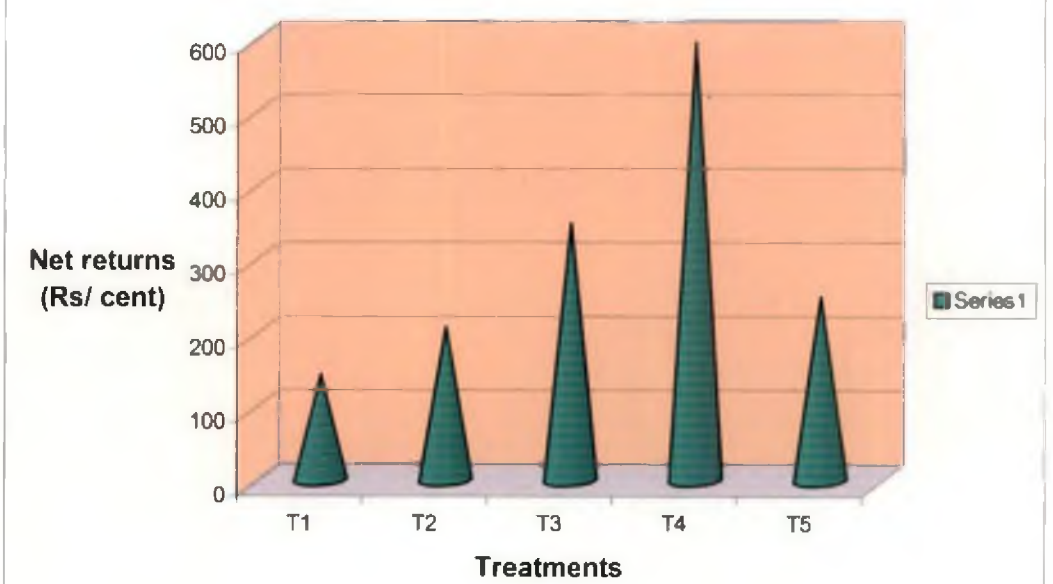
Table 13. Effect of different treatments on net returns from cowpea

Treatments	Net returns (Rs. /cent)
T1	142.41
T2	207.93
T3	347.88
T4	591.79
T5	249.13
$F_{(4,12)\text{-treatments}}$	8.620 **
$SE\text{-}_{treatments}$	59.733
$CD_{(0.01)\text{-treatments}}$	184.072

** significant at 1 per cent level

In the case of net returns also, treatment T4 (50 % inorganic and 50 % organic) recorded the maximum of Rs. 591.79 Rs./cent, which was significantly superior to all the other treatments. The lowest net return was produced by treatment T1 (POP recommendations) which was on par with the treatments T2 (Farmers' practices) and T5 (100 % organic) which recorded a net returns of Rs. 207.93/ cent and Rs. 249.13/ cent respectively (Table 13 & Fig. 5).

Fig. 5. Effect of different treatments on Net Returns from Cowpea



Effect of different treatments on BC ratio of cowpea

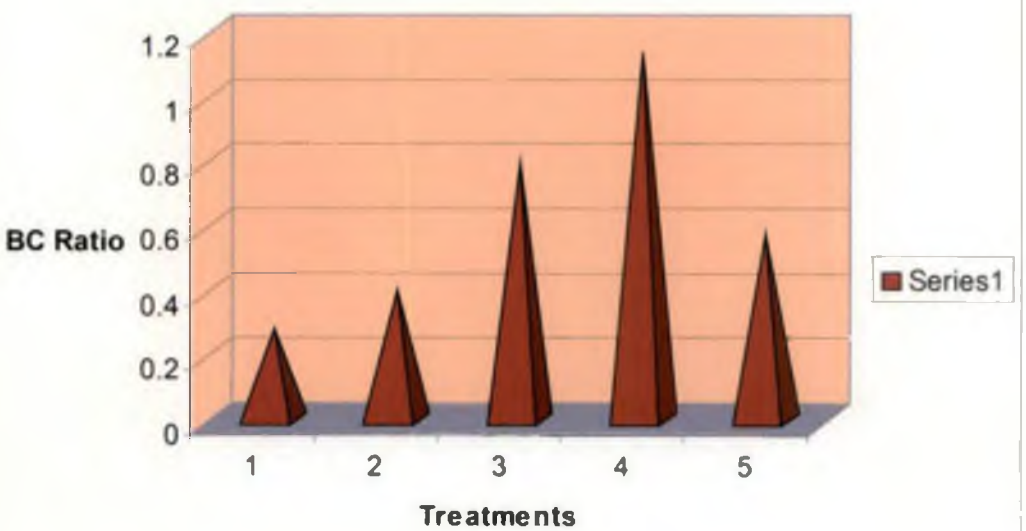
Benefit- Cost ratios as influenced by different treatments are presented in table 14.

Table 14 . Effect of different treatments on BC ratio of cowpea

Treatments	BC ratio
T1	0.28
T2	0.40
T3	0.79
T4	1.14
T5	0.57
$F_{(4,12)\text{-treatments}}$	5.626 **
$SE_{\text{-treatments}}$	0.144
$CD_{(0.01)\text{-treatments}}$	0.443

** significant at 1 per cent level

Fig. 6. Effect of different treatments on BC Ratio of Cowpea



From table 14 and fig. 6 it is seen that as in the case of fruit yield and net returns, treatment T4 (50 % inorganic and 50% organic) registered highest BC Ratio of 1.14 which was on par with the treatment T3 (75 % inorganic and 25 % organic) with a BC Ratio of 0.79. The lowest BC Ratio was recorded by the treatment T1 (POP recommendations) which was on par with the treatments T2 (Farmers' practices) and T5 (100 % organic) which recorded a BC Ratio of 0.28, 0.40 and 0.57 respectively.

BITTER GOURD

Bittergourd is one of the most nutritive and commercially important cucurbitaceous vegetables cultivated throughout Kerala for its fruits. Bittergourd is widely grown throughout Kerala. High productivity, constant demand and better market price make bittergourd a preferred crop of vegetable farmers of the State. Bittergourd is a rich source of minerals and vitamins, especially iron, phosphorus and vitamins A and C. Fruits of bittergourd is a good remedy for rheumatism and worm infestation, and it is used as a tonic, stomachic, stimulant, laxative, alternative and as a folk remedy for Diabetes. The fruits contain two alkaloids also viz. momordicine and cucurbitacine which are responsible for the bitterness.

Application of unneeded nutrients contributes to farming inefficiency. Careful use of fertilizers will save money and ensure freedom from residual accumulation. Keeping pace with the growth of organic production and the needs of individual organic growers, the overriding goal of the advanced organic vegetable production for small and large- scale growers is to promote Integrated Nutrient Management (INM) initially. INM is an integrated supply of organic manures and chemical fertilizers in required quantity. Soil organic matter applied as compost or FYM or poultry manure plays a vital role in physical, biological and chemical properties of the soil.

For the purpose of action research, 68 kg organic manure was applied as poultry manure or vermicompost, for one cent. In addition to this, 500g mussoriephos and 600 g potash was also applied per cent. The urea applied varies as follows:

T1: 610 g

T3: 457.5g+10 kg vermicompost/ poultry manure

T4: 305.g+20kg vermicmpost/poultry manure. The required N is applied at fortnightly intervals in split doses.

In T5 treatment, 92 kg poultry manure/vermicompost alone was applied since it is completely organic.

Plant height (cm)

Table 15 . Plant Height of Bitter gourd in four locations

Treatments	15 DAS			45 DAS		
	Lowest (cm)	Highest (cm)	Mean (cm)	Lowest (m)	Highest (m)	Mean (m)
Chenkal						
T1	20.50	21.30	20.90	1.60	1.80	1.70
T2	18.30	19.80	19.05	1.50	1.90	1.70
T3	19.10	19.20	19.15	1.60	1.70	1.65
T4	18.30	18.60	18.45	1.60	1.70	1.65
T5	17.80	18.90	18.35	1.50	2.00	1.75
Balaramapuram						
T1	19.10	20.10	19.60	1.87	1.98	1.93
T2	18.30	19.50	18.90	1.28	1.30	1.29
T3	14.80	15.60	15.20	1.32	1.34	1.33
T4	12.80	15.10	13.95	1.11	1.23	1.17
T5	16.50	18.20	17.35	1.08	1.34	1.21
Maranalloor						
T1	18.10	18.30	18.20	1.62	1.90	1.76
T2	18.00	18.20	18.10	1.70	1.80	1.75
T3	18.10	18.10	18.10	1.68	1.77	1.73
T4	18.00	18.10	18.05	1.73	1.81	1.77
T5	17.50	18.10	17.80	1.72	1.85	1.78
Pallichal						
T1	18.10	18.20	18.15	1.40	1.80	1.60
T2	18.10	18.30	18.20	1.40	1.70	1.55
T3	18.10	18.20	18.15	1.30	1.50	1.40
T4	18.00	18.10	18.05	1.40	1.60	1.50
T5	18.20	18.50	18.35	1.30	1.80	1.55

BITTERGOURD FIELD AT DIFFERENT LOCATIONS

PALLICHAL

MARANALLOOR

BALARAMAPURAM

CHENKAL

PLATE - 6

The study revealed that the mean highest plant height of 20.90cm was observed in T1 at Chenkal and a minimum height of 13.95 cm at Balaramapuram on 15 DAS. On 45 DAS, a maximum mean plant height of 1.93 m was observed in T1 at Balaramapuram and a minimum height of 1.17 m in T4. There was not much difference in plant height at Maranalloor and Pallichal at 15 DAS.

No. of leaves

Various nutrient combinations significantly influenced number of leaves. The influence of different nutrient combinations on the number of leaves was observed. The effect of organic manures on the number of leaves was found to be significant. The treatments were comparable.

Table 16. No. of Leaves in Bitter gourd in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	7	8	7.5	25	32	28.5
T2	6	7	6.5	28	29	28.5
T3	6	7	6.5	24	27	25.5
T4	5	7	6.0	23	27	25.0
T5	5	8	6.5	35	36	35.1
Balaramapuram						
T1	6	8	7.0	26	28	27.0
T2	6	6	6.0	28	33	30.5
T3	6	6	6.0	34	34	31.0
T4	5	6	5.5	34	34	30.5
T5	7	9	8.0	27	35	31.0
Maranalloor						
T1	8	8	8.0	22	27	24.5
T2	8	9	8.5	23	27	25.0
T3	7	8	7.5	25	28	26.5
T4	8	9	8.5	26	27	26.5
T5	6	9	7.5	23	28	25.5
Pallichal						
T1	5	7	6.0	26	28	27.0
T2	6	8	7.0	27	29	28.0
T3	6	7	6.5	28	29	28.5
T4	5	7	6.0	26	27	26.5
T5	5	9	7.0	25	31	28.0

A maximum mean no. of leaves on 15 DAS was observed in T2 and T4 treatment (8.5) in Maranalloor and on 45 DAS maximum no. of leaves were observed in T5 plot in Chenkal (35.1).

No. of flowers at 45 DAS

The number of flowers was accounted on the 45 DAS and the details are given below.

Table 17. No. of flowers in bitter gourd in four locations

Treatments	Location							
	Chenkal		**Maranalloor**		**Pallichal**		**Balaramapuram**	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
T1	17	18	8	12	18	22	9	22
T2	17	19	9	14	19	23	10	22
T3	16	17	9	11	11	23	11	23
T4	17	19	9	12	20	24	13	25
T5	15	21	10	15	13	24	9	24

The number of flowers ranged from 9 to 22 at T1, 9 to 23 at T2, 9 to 23 at T3, 9 to 25 at T4 and 9 to 24 at T5. A minimum number of flowers was noticed at Maranalloor. This may be due to variation in climate and soil conditions.

Keeping Quality (in days)

Table 18. Keeping Quality of Bitter gourd in four locations

Treatments	Location			
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**
	Highest	Highest	Highest	Highest
T1	8	6	6	6
T2	9	7	6	7
T3	9	7	7	9
T4	10	9	10	10
T5	10	10	11	12

The keeping quality of the fruits was observed to range from 6 to 12 days. The keeping quality of fruits was highest at T5 in all the locations and a minimum of 6 days was observed in T1 at Maranalloor, Pallichal and Balarampuram and also in T2 at Pallichal.

BITTERGOURD FIELD CONTD.....

PLATE - 7

Fruit yield (kg/ cent)

Table 19 . Fruit Yield of Bitter gourd in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	48.40	45.25	41.20	53.95	47.20
T2	52.80	48.30	48.90	59.80	52.45
T3	54.85	50.10	50.25	63.65	54.71
T4	58.20	52.55	56.40	64.20	57.84
T5	55.50	30.75	40.28	31.00	39.38

The mean fruit yield was found to be the maximum in T4 (57.84 kg). This was followed by T3 (54.71kg). The lowest fruit yield was recorded in T5 (39.38 kg) in the case of bitter gourd in all the four locations together.

Gross returns (Rs/cent)

Table 20. Gross returns from Bitter gourd in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	1694.00	1583.75	1442.00	1888.25	1652.00
T2	1848.00	2110.50	1711.50	2093.00	1940.75
T3	1919.75	1848.00	1758.75	2227.75	1914.94
T4	2037.00	2093.00	1974.00	2387.00	**2146.81**
T5	1110.00	615.00	805.50	620.00	787.63

The mean of gross returns from the four locations was found to be the highest in T4 (Rs 2146.81/cent). This was followed by T2 treatment, which is farmers' practice. The least mean returns were observed in T5 treatment (Rs. 787.63/cent).

Net Returns (Rs./cent)

Table 21. Net returns from Bitter gourd in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	1258.35	1148.10	1006.35	1452.60	1216.35
T2	1412.35	1622.50	1223.50	1605.00	1465.84
T3	1484.10	1268.70	1273.95	1742.95	1442.43
T4	1601.35	1655.35	1440.10	1853.10	1637.48
T5	578.25	83.25	273.75	88.25	255.88

The net return was found to be the highest in T4 (Rs. 1637.48/cent) and this is followed by T2 (Rs. 1465.84/cent). The lowest net return (Rs. 255.88/cent) was observed in T5.

B/C ratio

Table 22. B/C Ratio of Bitter gourd in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	2.88	2.63	2.30	3.33	2.80
T2	2.78	3.32	2.50	3.29	2.97
T3	2.95	2.62	2.62	3.60	2.94
T4	2.81	3.10	2.69	3.47	3.02
T5	1.09	0.16	0.51	0.17	0.48

The B/C ratio was found to be the highest in T4 plot and this was followed by T2.

Table 23. Effect of different treatments on fruit yield of bitter gourd

Treatments	Fruit yield (kg/cent)
T1	47.20
T2	52.45
T3	54.71
T4	57.84
T5	39.38
$F_{(4,12)\text{-treatments}}$	5.596**
$SE\text{-}_{treatments}$	3.061
$CD_{(0.01)\text{-treatments}}$	9.433

** significant at 1 per cent level

From table 23 and fig. 7 it is seen that the treatment T4 (50 % inorganic and 50 % organic) produced the maximum fruit yield of 57.84 kg/cent, which was on par with the treatments T3 (75 % inorganic and 25 % organic) and T2 (Farmers' practices) which recorded fruit yields of 54.71 kg/cent and 52.45 kg/cent respectively.

The lowest fruit yield of 39.38 kg/cent was produced by the treatment T5 (100 % organic) which was on par with the treatment T1 which recorded an yield of 47.20 kg/cent.

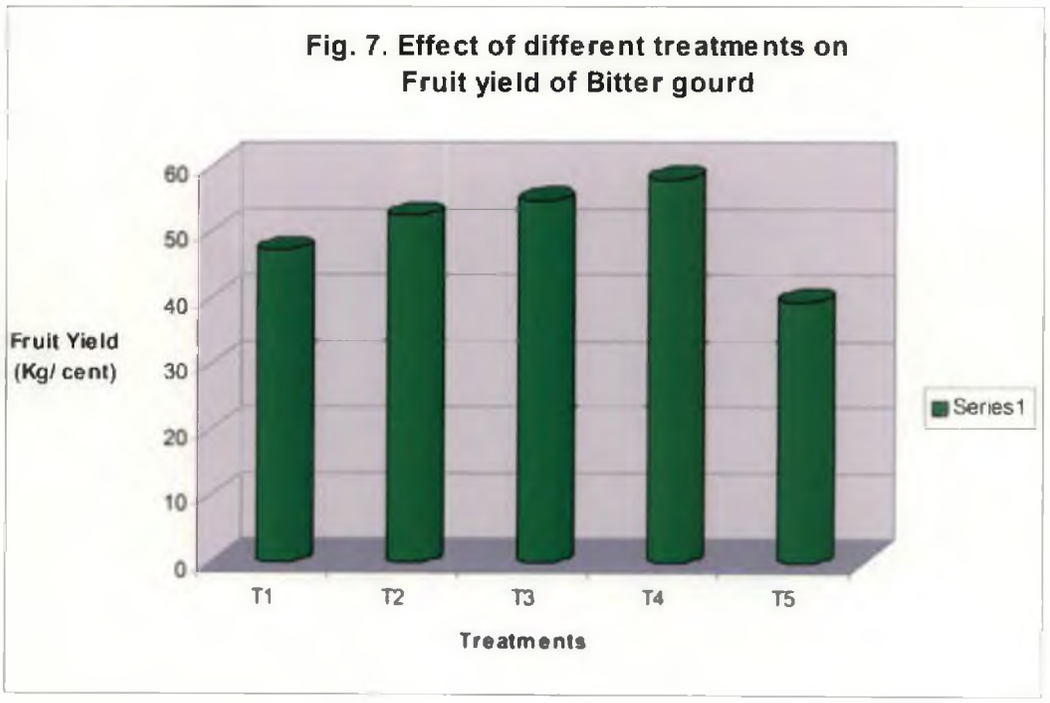


Table 24. Effect of different treatments on net returns from bitter gourd

Treatments	Net returns (Rs. /cent)
T1	1216.35
T2	1465.84
T3	1442.43
T4	1637.48
T5	255.88
$F_{(4,12)\text{-treatments}}$	41.903 **
$SE_{\text{-treatments}}$	85.049
$CD_{(0.01)\text{-treatments}}$	262.084

** significant at 1 per cent level

In the case of net returns also, treatment T4 (50 % inorganic and 50 % organic) recorded the maximum of Rs. 1637.48 Rs./cent, which was on par with the treatments T2 (Farmers' practices) and T3 (75 % inorganic and 25 % organic) having net returns of Rs. 1465.84 and Rs. 1442.43/cent respectively. The lowest net return of Rs. 255.88 /cent was produced by treatment T5 (100 % organic) which was not comparable with any other treatments. This was due to the high pest and disease incidence in completely organic bitter gourd plots (Table 24 and Fig.8).

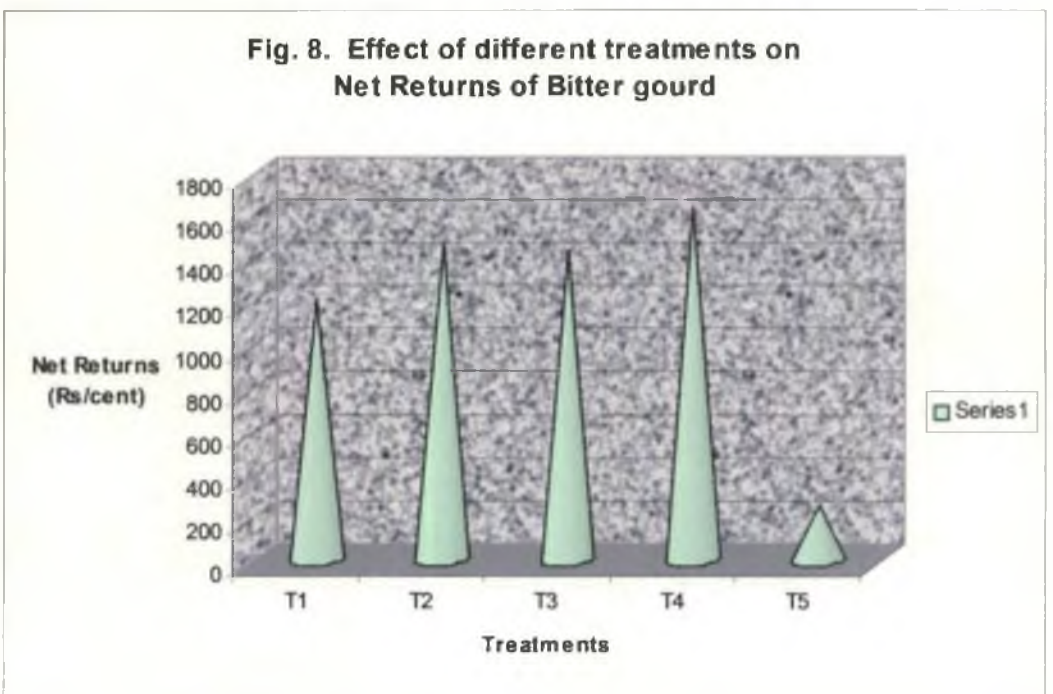
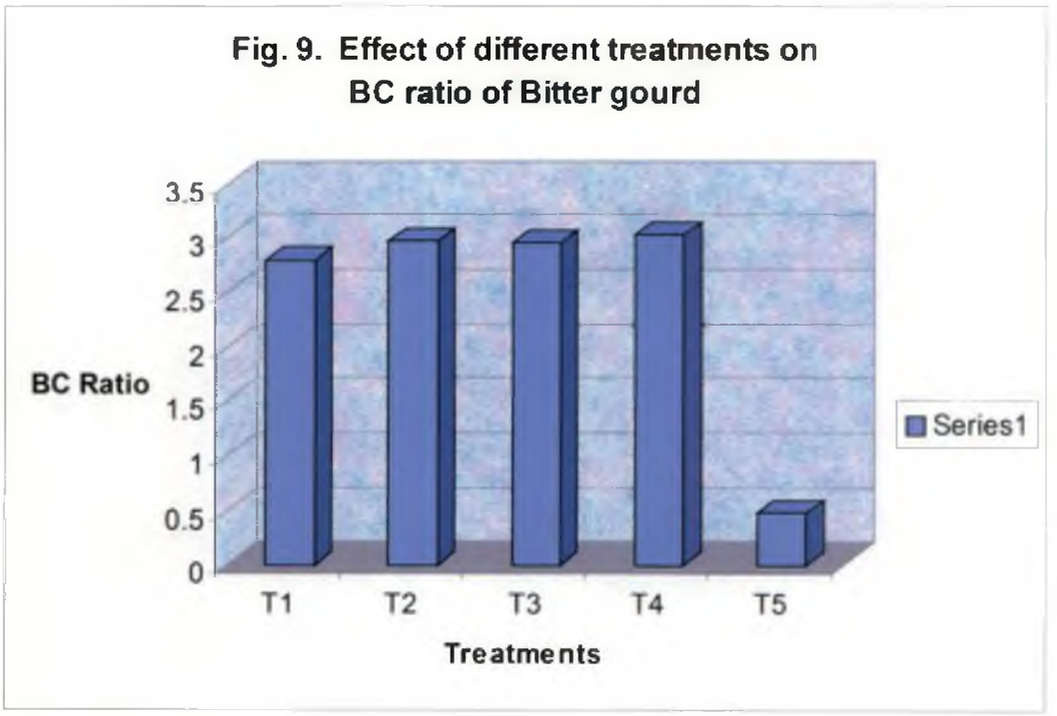


Table 25. Effect of different treatments on BC ratio of bitter gourd

Treatments	BC ratio
T1	2.79
T2	2.97
T3	2.95
T4	3.02
T5	0.48
$F_{(4,12)\text{-treatments}}$	38.000 **
$SE_{\text{-treatments}}$	0.178
$CD_{(0.01)\text{-treatments}}$	0.549



From table 25 and fig. 9 it is seen that as in the case of fruit yield and net returns, treatment T4 (50 % inorganic and 50% organic) registered highest BC Ratio of 3.02 which was on par with the treatments T1, T2 and T3 with BC Ratios of 2.79, 2.97 and 2.95 respectively. The lowest BC Ratio was recorded by the treatment T5 (100 % organic) which was significantly different from all the other treatments.

SNAKE GOURD

Snake gourd occupies a prime place among the vegetables cultivated in the State and is very common component in the diet of the people of South India. It is a nutritive exhaustive crop and responds well to applied nutrients particularly nitrogen.

The indiscriminate use of chemicals and tendency of farmers to abandon the use of FYM, compost, green manure or incorporate crop residue in the soil, lead to soil degradation. Here comes the importance of Integrated Plant Nutrient Management (IPNM) which is ecologically sound, economically viable and socially just. The basic concept of IPNM for sustaining yield is the maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefit from all possible sources of plant nutrient in an integrated manner.

For the purpose of action research, as in the case of bitter gourd, 68 kg organic manure was applied as poultry manure or vermicompost, for one cent. In addition to this 500g mussoriephos and 600 g potash was also applied per cent. The urea applied varies as follows:

T1: 610 g

T2: 1000g

T3: 457.5g+10 kg vermicompost/ poultry manure

T4: 305.g+20kg vermicmpost/poultry manure. The required N is applied at fortnightly intervals in split doses.

In T5 treatment, 92 kg poultry manure/vermicompost alone was applied since it is completely organic.

The cultivation practices in all the five treatments were exactly similar to that of bitter gourd.

Plant height (cm)

The plant height of snake gourd on the 15th and 45 days after sowing (DAS) was taken with the participation of the farmers. The lowest and the highest plant height on 15DAS and 45 DAS are given in Table 26.

Table. 26. Plant height of snake gourd in four locations

Treatments	15 DAS			45 DAS		
	Lowest (cm)	Highest (cm)	Mean (cm)	Lowest (m)	Highest (m)	Mean (m)
Chenkal						
T1	14.80	15.20	15.00	2.40	2.60	2.50
T2	14.90	15.20	15.05	2.40	2.60	2.50
T3	14.80	15.00	14.90	1.20	1.50	1.35
T4	14.80	14.90	14.85	0.80	1.10	0.95
T5	14.90	15.30	15.10	1.70	2.40	2.05
Balaramapuram						
T1	14.60	15.50	15.05	1.80	2.20	2.00
T2	14.80	15.60	15.20	1.90	2.50	2.20
T3	14.40	15.10	14.75	2.00	2.30	2.15
T4	14.20	15.20	14.70	1.90	2.20	2.05
T5	14.00	15.10	14.55	1.70	2.50	2.10
Maranalloor						
T1	15.10	15.50	15.30	2.30	2.50	2.40
T2	15.20	15.40	15.30	1.90	2.20	2.05
T3	14.80	15.30	15.05	2.20	2.40	2.30
T4	15.30	15.50	15.40	2.10	2.50	2.30
T5	14.50	15.20	14.85	1.80	2.50	2.15
Pallichal						
T1	18.10	18.20	18.15	2.80	3.00	2.90
T2	18.10	18.30	18.20	2.90	3.20	3.05
T3	18.10	18.20	18.15	3.10	3.30	3.20
T4	18.00	18.10	18.05	2.70	3.10	2.90
T5	17.90	18.20	19.13	2.50	3.30	2.90

SNAKEGOURD FIELD AT DIFFERENT LOCATIONS

MARANALLOOR

PALLICHAL

CHENKAL

BALARAMAPURAM

PLATE - 8

In T1, the mean plant height was found to be the highest at Pallichal (18.15cm) and lowest at Chenkal (15.2 cm) at 15 DAS. Similarly at 45 DAS it was highest at Pallichal (2.90 m) and lowest at Balaramapuram (2.00 m).

In T2, the maximum plant height of 18.20 cm was observed also at Pallichal and a minimum of 15.05 cm at Chenkal on 15 DAS. On 45 DAS maximum plant height was observed at Pallichal (3.05 m) and a minimum plant height of 2.05 m at Maranalloor.

In T3 plots, a maximum plant height of 18.15 cm was observed at Pallichal and a minimum 14.75 cm was observed at Balaramapuram on 15 DAS. On 45th DAS a maximum plant height of 3.2 m was observed at Pallichal and a minimum of 1.35 m at Chenkal.

In T4 plots, the minimum plant height on 15 DAS was observed at Balaramapuram (14.70 cm) and maximum plant height at Pallichal (18.05 cm). On 45 DAS a maximum plant height was observed at Pallichal (2.9 m) and a minimum plant height at Chenkal (0.95 m).

In the treatment T5, a maximum plant height of 19.13 cm was observed at Pallichal on 15 DAS whereas the minimum height observed was 14.55 cm at Balaramapuram. Similarly on 45 DAS the minimum height observed was 2.05 m at Chenkal and a maximum height of 2.90 m at Pallichal.

For all the five treatments, maximum plant height was observed at Pallichal at 15 DAS and 45 DAS.

No. of leaves

The number of leaves in snake gourd on 15 DAS and 45 DAS was observed in the four locations and the details are given below.

Table 27. No. of leaves in snake gourd in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	5	6	5.5	24	25	24.5
T2	5	6	5.5	25	26	25.5

T3	5	6	5.5	16	18	17.0
T4	6	6	6.0	12	13	12.5
T5	5	7	6.0	20	24	22.0
Balaramapuram						
T1	7	8	7.5	38	42	40.0
T2	7	8	7.5	36	45	40.5
T3	6	7	6.5	40	42	41.0
T4	6	7	6.5	36	39	37.5
T5	6	8	7.0	35	45	40.0
Maranalloor						
T1	7	8	7.5	32	40	36.0
T2	7	7	7.0	18	26	22.0
T3	8	9	8.5	35	38	36.5
T4	6	7	6.5	19	25	22.0
T5	5	9	7.0	24	32	28.0
Pallichal						
T1	8	8	8.0	24	27	25.5
T2	8	8	8.0	21	28	25.0
T3	8	8	8.0	21	27	24.0
T4	7	9	8.0	19	23	21.0
T5	6	9	7.5	20	28	24.0

A maximum mean no. of leaves on 15 DAS was observed in T3 treatment at Maranalloor (8.5) and on 45 DAS maximum no. of leaves was observed in T3 plot (41.0) at Balaramapuram. On 45 DAS, maximum no. of leaves for all the treatments were observed at Balaramapuram. The variations noticed in various locations may be due to the effect of the climate and soil conditions.

No. of flowers

The number of flowers was accounted on the 45 DAS and the details are given in Table 28.

Table 28. No. of flowers in snake gourd in four locations

Treatments	Location							
	Chenkal		**Maranalloor**		**Pallichal**		**Balaramapuram**	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
T1	13	23	10	12	12	15	13	15
T2	7	23	9	21	8	17	13	14
T3	10	20	11	23	14	18	12	14
T4	8	26	9	26	13	17	13	16
T5	12	23	11	25	7	16	11	17

The number of flowers ranged from 10 to 23 at T1, 7 to 23 at T2, 10 to 23 at T3, 8 to 26 at T4 and 7 to 25 at T5.

Keeping Quality (in days)

Table 29. Keeping Quality of Snake gourd in four locations

Treatments	Locations							
	Chenkal		**Maranalloor**		**Pallichal**		**Balaramapuram**	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
T1	5	6	5	7	4	5	5	7
T2	6	7	5	7	4	6	6	7
T3	6	9	5	8	6	8	7	8
T4	6	9	6	8	7	10	7	9
T5	5	8	6	9	5	10	6	8

The keeping quality of the fruits was observed to range from 4 to 10 days. The keeping quality of fruits was highest at T4 & T5 in all the locations and a minimum of 4 days was observed in T1 and T2 at Pallichal.

SNAKEGOURD FIELD CONTD .....

FIELD READY FOR PLANTING

FIELD AT FLOWRING STAGE

RECORDING OBSERVATION

RESEARCHER EXAMINING THE FIELD

PLATE - 9

Fruit yield (Kg/cent)

Table 30. Fruit Yield of Snake gourd in four locations

	Locations				
Treatments	**Chenkal**	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	57.75	52.50	41.20	72.75	56.05
T2	63.75	59.75	48.90	81.25	63.41
T3	84.00	83.75	50.25	83.25	75.31
T4	93.00	88.25	56.40	84.75	80.60
T5	88.00	76.50	52.75	82.00	74.81

The mean fruit yield was found to be the maximum in T4 (80.60 Kg). This was followed by T3 (75.31Kg). The lowest fruit yield was recorded in T1 in the case of snake gourd in all the four locations together.

Gross returns (Rs/cent)

Table 31. Gross returns from Snake gourd in four locations

	Locations				
Treatments	**Chenkal**	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	1039.50	945.00	741.60	1309.50	1008.90
T2	1147.50	1075.50	880.20	1462.50	1141.43
T3	1512.00	1507.50	904.50	1498.50	1355.63
T4	1674.00	1588.50	1015.20	1525.50	1450.80
T5	1584.00	1377.00	949.50	1476.00	1346.63

The mean of gross returns from the four locations was found to be the highest in T4 (Rs 1450.80/cent). This was followed by T3 treatment. The least mean return was observed in T1 treatment (Rs. 1008.90/cent).

Net Returns (Rs./cent)

Table 32. Net returns from Snake gourd in four locations

	Locations				
Treatments	**Chenkal**	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	538.28	443.78	240.38	808.28	507.68
T2	644.29	572.29	376.99	959.29	638.22
T3	1011.55	1007.05	404.55	998.05	855.30
T4	1174.32	1088.82	515.52	1025.82	951.12
T5	1052.25	845.25	417.75	944.25	814.88

The net return was found to be the highest in T4 (Rs. 951.12/cent) and this is followed by T3 (Rs. 855.30/cent). The lowest net return (Rs 507.68) was observed in T1.

B/C ratio

Table 33. B/C Ratio of Snake gourd in four locations

	Locations				
Treatments	**Chenkal**	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	1.07	0.89	0.48	1.61	1.01
T2	1.28	1.14	0.75	1.91	1.27
T3	2.02	2.01	0.81	1.99	1.71
T4	2.35	2.18	1.03	2.05	1.90
T5	1.98	1.59	0.79	1.78	1.54

The B/C ratio was found to be the highest in T4 plot. This was followed by T3.The mean values are furnished in the table below. All the results show thatT4 is significant.

Table 34. Effect of different treatments on fruit yield of snake gourd

Treatments	Fruit yield (kg/cent)
T1	56.05
T2	63.41
T3	75.31
T4	80.60
T5	74.81
$F_{(4,12)\text{-treatments}}$	9.052 **
$SE_{\text{-treatments}}$	3.331
$CD_{(0\ 01)\text{-treatments}}$	10.264

** significant at 1 per cent level

From table 34 and fig.10 it is seenthat the treatment T4 (50 % inorganic and 50 % organic) produced the maximum fruit yield of 80.60 kg/cent, which was on par with the treatments T3 (75 % inorganic and 25 % organic) and T5 (100 % organic), which recorded fruit yields of 75.31 and 74.81 kg/cent respectively.

The lowest fruit yield of 56.05 kg/cent was produced by the treatment T1 (POP recommendations) which was on par with the treatment T2 (Farmers' practices) which recorded an yield of 63.41 kg/cent.

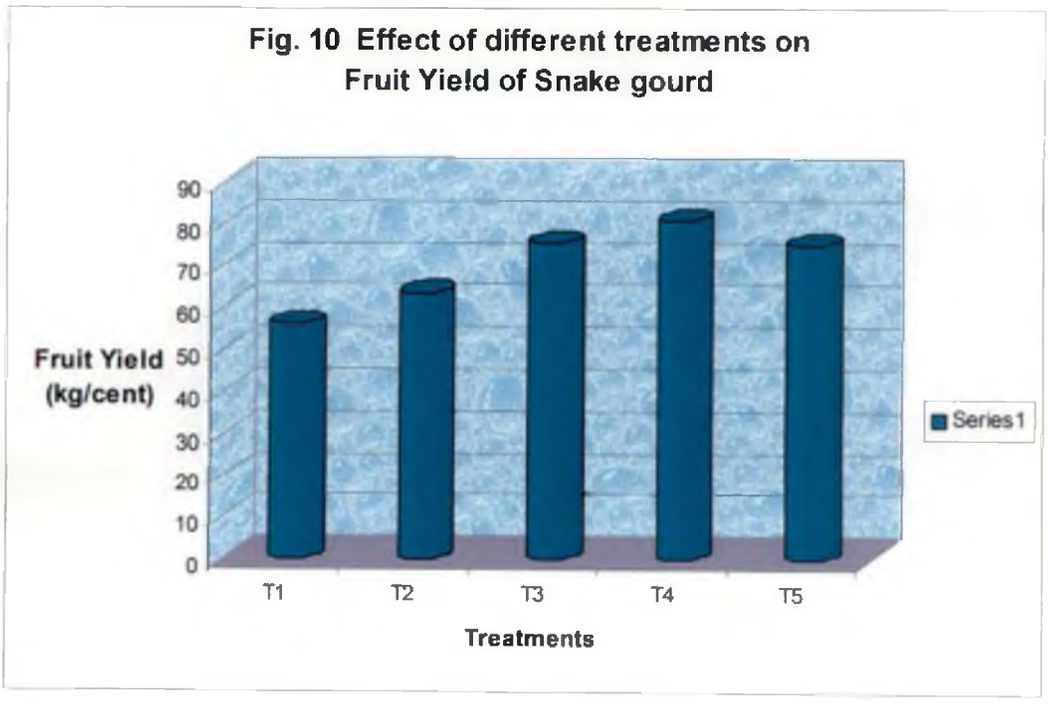


Table 35. Effect of different treatments on net returns from snake gourd

Treatments	Net returns (Rs. /cent)
T1	507.68
T2	638.22
T3	855.30
T4	951.12
T5	814.88
$F_{(4,12)\text{-treatments}}$	8.830 **
$SE_{\text{-treatments}}$	59.940
$CD_{(0.01)\text{-treatments}}$	184.711

** significant at 1 per cent level

In the case of net returns also treatment T4 (50 % inorganic and 50 % organic) recorded the maximum of Rs.951.12/cent, which was on par with the treatments T3 and T5, which registered net returns of Rs. 855.30 and Rs. 814.88/cent respectively. The lowest net return was produced by treatment T1 (POP recommendations) with Rs. 507.68/cent which was on par with the treatment T2 (Farmers' practices) which recorded a net return of Rs. 638.22/ cent

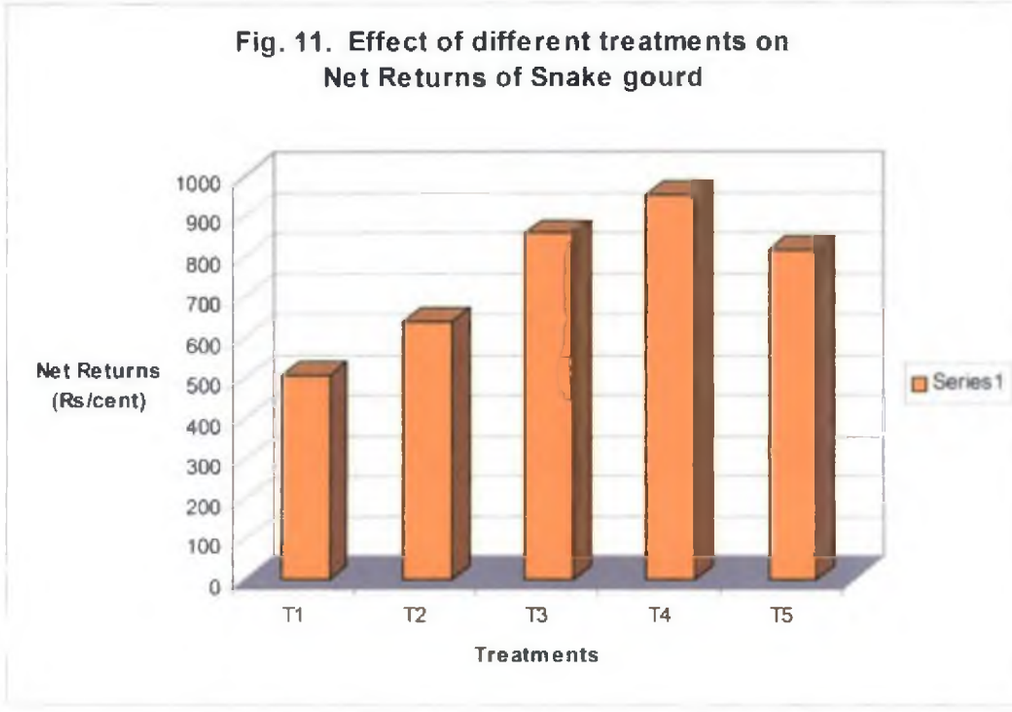
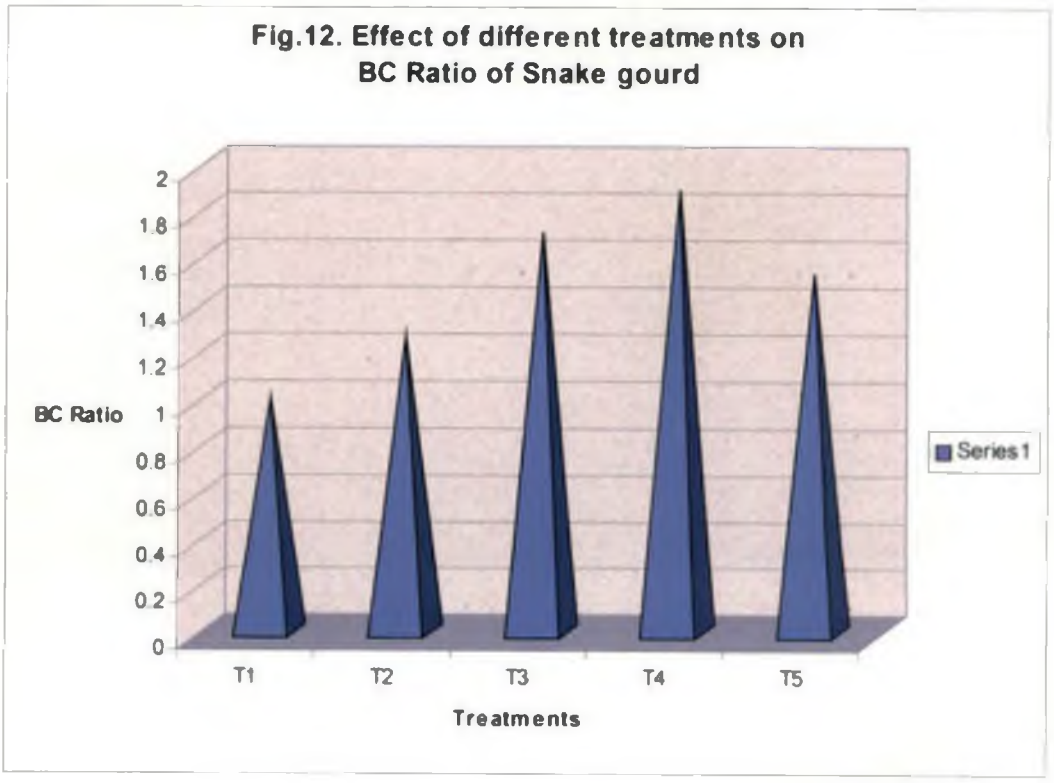


Table 36. Effect of different treatments on BC ratio of bitter gourd

Treatments	BC ratio
T1	1.01
T2	1.27
T3	1.71
T4	1.90
T5	1.54
$F_{(4,12)\text{-treatments}}$	8.792 **
$SE\text{-}_{treatments}$	0.119
$CD_{(0.01)\text{-treatments}}$	0.366

It is evident from table 36 and fig. 12 that as in the case of fruit yield and net returns, treatment T4 (50 % inorganic and 50% organic) registered highest BC Ratio of 1.90 which was on par with the treatment T3 (75 % inorganic and 25 % organic) and T5 with BC Ratios of 1.71 and 1.54 respectively. The lowest BC Ratio was recorded by the treatment T1 (POP recommendations) registering a BC Ratio of 1.01, which was on par with the treatments T2 (Farmers' practices).

Fig.12. Effect of different treatments on BC Ratio of Snake gourd



CUCUMBER

The continuous indiscriminate use of chemical fertilizers leads to decline in soil fertility and productivity besides causing health hazards. Since vegetables are mostly consumed fresh or partially cooked, they should be devoid of the residual effect of chemicals. In developing countries, over 50 % increase in crop production was brought about by the use of fertilizers. So in the present scenario, where the national priority is to feed the increasing population, chemical fertilizer is unavoidable.

Hence a judicious approach to meet the objectives of the environmental care, increasing the productivity, improving the quality and reducing the cost of cultivation is needed. One way to achieve sustainability in agricultural production is to substitute chemical fertilizer to the maximum extent possible with organic manures. The use of organic manure with inorganic fertilizers not only increases but also sustains the production and productivity of the crops as well as the soil health.

Plant height (cm)

The plant height of cucumber on the 15 and 45 days after sowing (DAS) was taken with the participation of the farmers. The lowest and the highest plant height on 15DAS and 45 DAS are given below.

Table 37. Plant height of cucumber in four locations

Treatments	15 DAS			45 DAS		
	Lowest (cm)	Highest (cm)	Mean (cm)	Lowest (m)	Highest (m)	Mean (m)
Chenkal						
T1	15.2	17.3	16.25	0.9	1.2	1.05
T2	15.8	18.0	16.90	1.5	1.9	1.70
T3	16.8	18.2	17.50	1.8	2.1	1.95
T4	17.3	18.5	17.90	1.5	2.2	1.85
T5	17.2	18.3	17.75	1.2	2.3	1.75

Balaramapuram						
T1	18.1	18.2	18.15	2.4	2.5	2.45
T2	18.1	18.3	18.20	2.4	2.6	2.50
T3	18.1	18.2	18.15	1.2	1.5	1.35
T4	18.1	18.1	18.10	0.8	1.0	0.90
T5	17.5	18.3	17.90	1.8	2.5	2.15
Maranalloor						
T1	16.7	17.3	17.00	1.6	2.1	1.85
T2	17.2	17.5	17.35	0.8	1.3	1.05
T3	16.8	18.2	17.50	1.9	2.5	2.20
T4	18.2	19.0	18.60	2.4	2.7	2.55
T5	16.5	19.2	17.85	1.8	2.6	2.20
Pallichal						
T1	14.8	16.2	15.50	0.7	1.4	1.05
T2	15.1	16.8	15.95	1.4	1.7	1.55
T3	15.6	17.1	16.30	2.1	2.3	2.20
T4	17.2	17.9	17.55	2.2	2.5	2.35
T5	15.7	17.5	16.60	1.8	2.4	2.10

In T1, the mean plant height was found to be the highest at Balaramapuram (18.15cm) and lowest at Pallichal (15.50 cm) at 15 DAS. Similarly at 45 DAS it was highest also at Balaramapuram (2.45 m) and lowest at Chenkal and Pallichal (1.05 m).

In T2, the maximum plant height of 18.20 cm was observed also at Balaramapuram and a minimum of 15.95 cm at Pallichal on 15 DAS. On 45 DAS maximum plant height was observed at Balaramapuram (2.50 m) and a minimum plant height of 1.05 m at Maranalloor.

In T3 plots, a maximum plant height of 18.15 cm was observed at Balaramapuram and a minimum 16.30 cm was observed at Pallichal on 15 DAS. On 45 DAS, a maximum plant height of 2.2 m was observed at Maranalloor and Pallichal and a minimum of 1.35 m at Balaramapuram.

GLIMPSES OF CUCUMBER

CUCUMBER SEEDS

CUCUMBER FIELD READY FOR HARVEST

PLATE -10

In T4 plots, the minimum plant height on 15 DAS was observed at Pallichal (17.55 cm) and maximum plant height at Maranalloor (18.60 cm). On 45 DAS, a maximum plant height was observed at Maranalloor (2.55 m) and a minimum plant height at Balaramapuram (0.90 m).

The mean plant height was found to be maximum at Balaramapuram (17.90 cm) and minimum at Pallichal (16.60 cm) on 15 DAS in T5 plots. On 45 DAS, the plant height was highest at Maranalloor (2.20 m) and lowest at Chenkal (1.75 m).

No. of leaves

Table 38. No. of leaves in cucumber in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	4	5	4.5	15	18	16.5
T2	3	4	3.5	18	22	20.0
T3	3	5	4.0	17	19	18.0
T4	3	4	3.5	15	23	19.0
T5	4	6	5.0	16	22	19.0
Balaramapuram						
T1	3	4	3.5	10	18	14.0
T2	4	5	4.5	15	23	19.0
T3	3	4	3.5	9	16	12.5
T4	2	3	2.5	18	24	21.0
T5	3	4	3.5	10	22	16.0
Maranalloor						
T1	3	5	4.0	19	25	22.0
T2	3	4	3.5	15	18	16.5
T3	2	3	2.5	10	14	12.0
T4	4	5	4.5	20	26	23.0
T5	3	6	4.5	16	24	20.0

Pallichal						
T1	2	4	3.0	10	16	13.0
T2	3	4	3.5	12	18	15.0
T3	4	5	4.5	19	25	22.0
T4	3	6	4.5	21	26	23.5
T5	2	5	3.5	14	24	19.0

A maximum mean no. of leaves on 15 DAS was observed in T1 treatment at Chenkal, T2 treatment at Balaramapuram, in T4 & T5 treatment at Maranalloor, in T3 and T4 treatments at Pallichal (4.5) and in T5 treatment at Chenkal (5.0). On 45 DAS maximum no. of leaves were observed in T4 plot (23.5) at Pallichal. The variations noticed in various locations may be due to the effect of the climate and soil conditions.

Fruit yield (kg/cent)

Table 39. Fruit Yield of cucumber in four locations

Treatments	Locations				
	Chenkal	Maranalloor	Pallichal	Balaramapuram	Mean
T1	78.15	65.75	73.25	70.15	71.82
T2	95.75	79.15	81.45	83.50	84.96
T3	92.18	88.55	91.35	90.75	90.71
T4	101.25	97.35	105.55	101.50	101.41
T5	91.25	82.75	75.35	87.45	84.20

The mean fruit yield was found to be the maximum in T4 (101.413 kg). This was followed by T3 (90.71 kg). The lowest fruit yield was recorded in T1 (71.82kg) in the case of cucumber in all the four locations together.

Gross returns (Rs/cent)

Table 40. Gross returns from cucumber in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	937.80	789.00	879.00	841.80	861.90

T2	1149.00	949.80	977.40	1002.00	1019.55
T3	1106.10	1062.60	1096.20	1089.00	1088.48
T4	1215.00	1168.20	1266.60	1218.00	1216.95
T5	1095.00	993.00	904.20	1049.40	1010.40

The mean of gross returns from the four locations was found to be the highest in T4 (Rs 1216.95/cent). This was followed by T3 treatment (Rs.1088.48/cent). The least mean return was observed in T1 treatment (Rs. 861.90/ cent).

Net Returns (Rs./cent)

Table 41. Net returns from cucumber in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	524.13	375.33	465.33	428.13	448.23
T2	733.29	534.09	561.69	586.29	603.84
T3	693.14	649.64	683.24	676.04	675.52
T4	802.84	756.04	854.44	805.84	804.79
T5	650.75	548.75	459.95	605.15	566.15

The net return was found to be the highest in T3 (Rs 804.79/cent) and this is followed by T3 (Rs. 675.52/cent). The lowest net return (Rs. 448.23/cent) was observed in T1.

B/C ratio

Table 42. B/C Ratio of cucumber in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	1.27	0.91	1.12	1.03	1.08
T2	1.76	1.28	1.35	1.41	1.45
T3	1.68	1.57	1.65	1.64	1.64
T4	1.95	1.83	2.07	1.96	1.95
T5	1.46	1.24	1.04	1.36	1.20

The B/C ratio was found to be the highest in T4 plot. This was followed by T3.

Table 43. Effect of different treatments on fruit yield of cucumber

Treatments	Fruit yield (kg/cent)
T1	71.82
T2	84.96
T3	90.71
T4	101.41
T5	84.2
$F_{(4,12)\text{-treatments}}$	25.942 **
$SE_{\text{-treatments}}$	2.112
$CD_{(0.01)\text{-treatments}}$	6.509

** significant at 1 per cent level

From table 43 it is seen that the treatment T4 (50 % inorganic and 50 % organic) produced the maximum fruit yield of 101.41kg/cent, which was significantly superior to all the other treatments. The lowest fruit yield of 71.82 kg/cent was produced by the treatment T1 (POP recommendations) which was significantly different fom all the other treatments (Fig. 13).

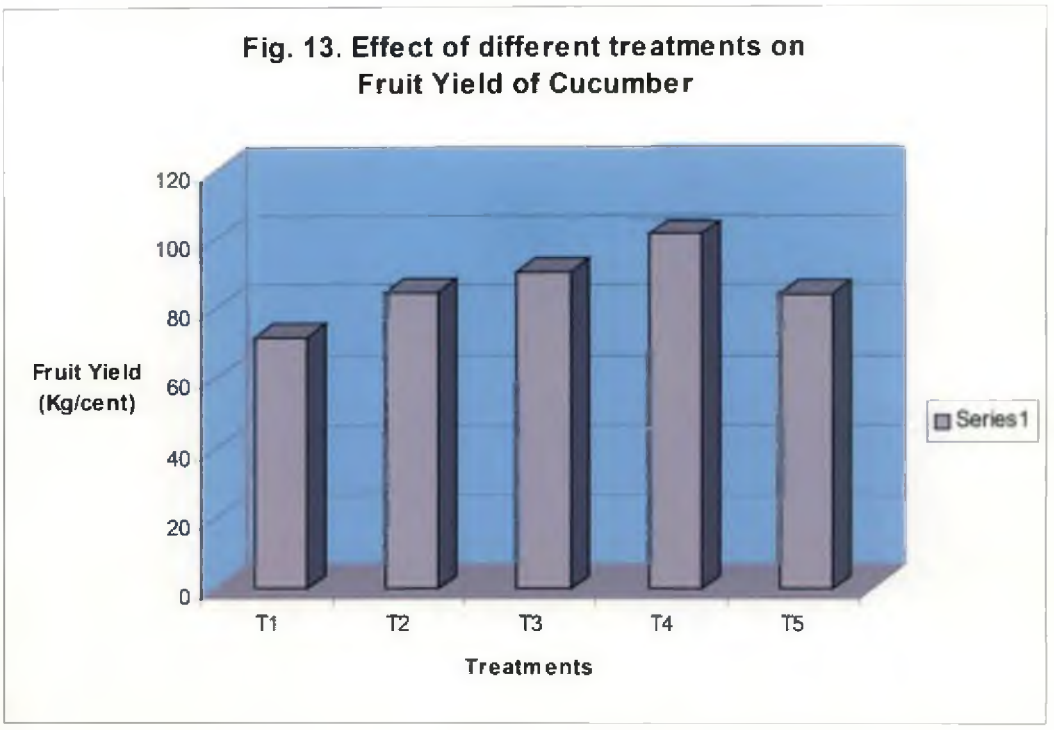


Table 44. Effect of different treatments on net returns from cucumber

Treatments	Net returns (Rs. /cent)
T1	448.23
T2	603.84
T3	675.52
T4	804.79
T5	566.15
$F_{(4,12)\text{-treatments}}$	27.202 **
$SE_{\text{-treatments}}$	25.345
$CD_{(0.01)\text{-treatments}}$	78.103

** significant at 1 per cent level

In the case of net returns also treatment T4 (50 % inorganic and 50 % organic) recorded the maximum of Rs. 804.79 Rs./cent, which was significantly superior to all the other treatments. The lowest net return was produced by treatment T1 (POP recommendations) with a net return of Rs. 448.23/cent which was significantly different from all the other treatments (Table 44 & Fig. 14).

Fig. 14. Effect of different treatments on Net Returns of Cucumber

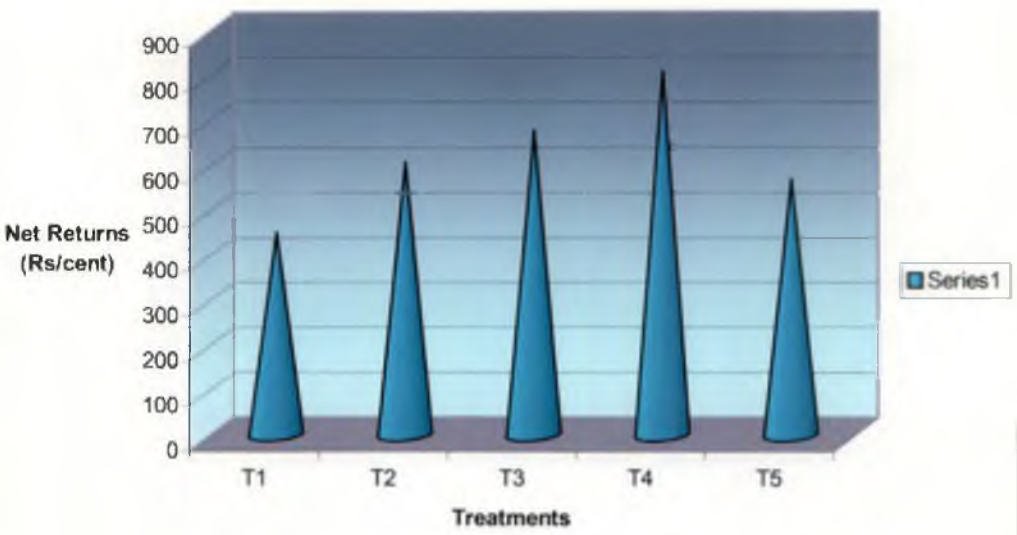
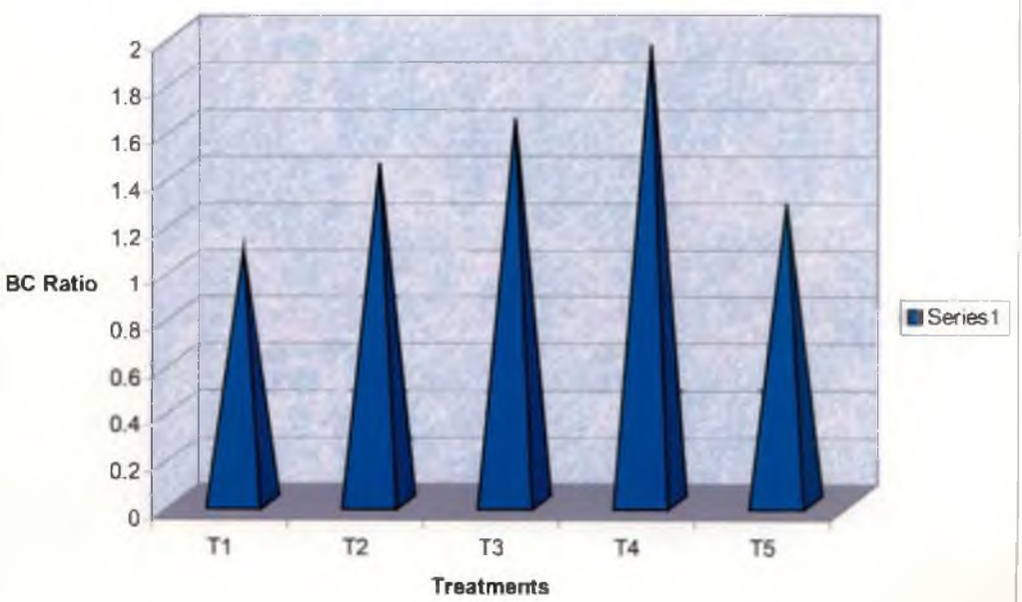


Table 45. Effect of different treatments on BC ratio of cucumber

Treatments	BC ratio
T1	1.08
T2	1.45
T3	1.64
T4	1.95
T5	1.28
$F_{4,12)\text{-treatments}}$	32.690 **
$SE_{\text{-treatments}}$	5.855 E-02
$CD_{(0.01)\text{-treatments}}$	0.180

Fig. 15. Effect of different treatments on BC ratio of Cucumber



From table 45 and fig. 15 it is seen that as in the case of fruit yield and net returns, treatment T4 (50 % inorganic and 50% organic) registered highest BC Ratio of 1.95 which was significantly superior to all the other treatments. The lowest BC Ratio was recorded by the treatment T1 (POP recommendations) with a BC Ratio of 1.08 which was significantly different from all the other treatments.

AMARANTHUS

Leafy vegetables play an important role in supplying valuable nutrients, particularly minerals and vitamins in human diet. Amaranthus being rich in protein, Vitamin A, Vitamin C and Iron is the most popular leafy vegetable grown in the homesteads of Kerala. Amaranthus being a short duration crop with high nutritional value and capable of producing several crops in a year it is more acceptable to farmers.

The major organic nutrients utilized for the study were the locally available Farm Yard Manure (FYMs), Poultry Manure (PM) and vermicompost. The nutrient N content of FYM is 1%, PM is 1.5% and vermicompost is 0.9-1.5%. Kerala Agricultural University recommendation for amaranthus is 50:50:50 kg NPK per hectare. Accordingly 870g of urea, 1000g P_2O_5 and 340g K_2O are needed. The major problem faced by the vegetable growers is the transportation of the bulk organic manures and the disposal of the farm refuses. Hence vermicompost was prepared on farm with the residues available in the farm itself and the composted manure was also applied to the crops.

For the action research, 68 kg poultry manure/vermicompost was applied as organic manure per cent. 1000 g mussoriephos and 340 g potash was also applied in addition to this. The urea applied varies as follows.

T1 : 870 g

T3 : 652.5 g + 1.97 kg poultry manure

T4 : 435 g +

The observations for plant height, no. of leaves and no. of flowers were recorded and also the yield in each of the plots. The details are given below.

Plant Height (cm)

Table. 46. Plant height of amaranthus in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	15.0	16.1	15.55	38.17	41.8	39.98

T2	14.9	16.1	15.50	42.00	43.0	42.50
T3	14.8	15.0	14.90	43.17	47.1	45.13
T4	14.7	14.9	14.80	36.17	37.1	36.63
T5	14.5	16.2	15.35	36.03	44.5	40.27
Balaramapuram						
T1	19.1	20.1	19.60	48.17	49.80	48.98
T2	18.3	19.5	18.90	42.08	43.00	45.54
T3	14.8	15.6	15.20	43.14	42.20	42.67
T4	12.8	15.1	13.95	41.11	42.30	41.71
T5	13.5	19.6	16.55	40.25	48.50	44.38
Maranalloor						
T1	20.4	21.1	20.75	43.1	43.7	43.40
T2	18.3	18.4	18.35	35.7	38.5	37.10
T3	18.1	18.8	18.45	35.6	37.5	36.55
T4	17.8	18.0	17.90	32.4	33.9	33.15
T5	17.5	20.2	18.85	35.4	39.7	37.55
Pallichal						
T1	14.9	15.3	15.10	38.2	41.4	39.80
T2	14.8	15.1	14.95	39.4	47.8	43.60
T3	14.7	15.0	14.85	41.3	43.1	42.20
T4	14.6	14.9	14.75	41.2	41.4	41.30
T5	13.8	15.2	14.50	37.1	45.6	41.35

In T1, the mean plant height was found to be highest at Maranalloor (20.75cm) and lowest at Pallichal (15.10 cm). Similarly at 45 DAS it was highest at Balaramapuram (48.98cm) and lowest at Pallichal (39.80 cm).

In T2, the maximum plant height of 18.90 cm was observed at Balaramapuram and a minimum of 14.95 cm was observed at Pallichal on 15 DAS. On 45 DAS maximum plant height was observed at Balaramapuram (45.54 cm) and a minimum plant height of 37.10cm at Maranalloor.

In T3 plots, a maximum plant height of 18.45 cm was observed at Maranalloor and a minimum of 14.85 cm was observed at Pallichal. On 45 DAS, a

CHENKAL

AMARANTHUS FIELD AT DIFFERENT LOCATIONS

BALARAMAPURAM

PALLICHAL

MARANALLOOR

PLATE - 11

maximum plant height of 45.13 cm was observed at Chenkal and a minimum of 36.55 cm at Maranalloor.

In T4 plots, the minimum plant height on 15 DAS was observed at Balaramapuram (13.95 cm) and maximum plant height at Maranalloor (17.90 cm). On 45 DAS, a maximum plant height was observed at Balaramapuram (41.71 cm) and a minimum plant height at Maranalloor (33.15 cm).

On 15 DAS, the mean plant height was found to be highest at Maranalloor (18.85 cm) and lowest at Pallichal (14.50 cm) in T5 treatment. Similarly a maximum of 44.38 cm height was observed at Balaramapuram and a minimum height of 37.55 cm at Maranalloor on 45 DAS.

No. of leaves

Table 47. No. of leaves in amaranthus in four locations

Treatments	15 DAS			45 DAS		
	Lowest	Highest	Mean	Lowest	Highest	Mean
Chenkal						
T1	4	8	6.0	32	34	33.0
T2	4	4	4.0	34	34	34.0
T3	4	6	5.0	37	38	37.5
T4	5	5	5.0	31	38	34.5
T5	5	8	6.5	30	36	33.0
Balaramapuram						
T1	6	6	6	26	28	27.0
T2	6	6	6	28	33	30.5
T3	6	6	6	28	34	31.0
T4	5	5	5	27	34	30.5
T5	4	8	6	25	32	28.5
Maranalloor						
T1	6	7	6.5	26	36	31.0
T2	6	6	6.0	28	33	30.5
T3	6	6	6.0	28	32	30.0
T4	6	6	6.0	27	32	29.5

T5	5	8	6.5	26	35	30.5
Pallichal						
T1	6	7	6.5	28	32	30.0
T2	9	9	9.0	28	31	29.5
T3	8	9	8.5	25	34	29.5
T4	6	10	8.0	26	39	32.5
T5	7	10	8.5	24	38	31.0

At 15 DAS, all the plots at Chenkal had a minimum no. of leaves. It ranged from 4 to 6.5. At 15 DAS a maximum no.of leaves was noticed in all the treatments at Pallichal. It ranged from 6.5 to 9. The variations noticed in various locations may be due to the effect of the climate and soil conditions.

Keeping Quality (in days)

Table 48. Keeping Quality of amaranthus in four locations

Treatments	Locations							
	Chenkal		**Maranalloor**		**Pallichal**		**Balaramapuram**	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
T1	1	2	1	1	1	1	1	1
T2	1	2	1	1	1	1	1	1
T3	2	1	1	2	1	2	1	2
T4	2	2	2	2	2	2	2	2
T5	2	2	1	2	1	1	1	1

The keeping quality of amaranthus in all the locations was maximum in T4 plots. The market value of the harvested amaranthus was obtained upto two days after harvest. It ranged from one to two days for T3 plots.

AMARANTHUS FIELD CONTD....

PLATE - 12

Leaf Yield (kg/cent)

Table 49. Leaf Yield of amaranthus in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	33.95	41.15	59.32	53.95	47.09
T2	39.80	50.23	58.10	59.80	51.98
T3	43.65	48.27	59.20	63.65	53.69
T4	64.20	58.10	61.80	54.25	59.59
T5	61.50	35.88	54.28	36.25	46.98

A maximum mean leaf yield of 59.59 kg was obtained in T4 plot. This further signifies the study.

Gross returns (Rs./cent)

Table 50. Gross returns from amaranthus in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	577.15	699.55	1008.44	917.15	800.66
T2	676.60	853.91	987.70	1016.60	883.70
T3	742.05	820.59	1006.40	1082.50	912.89
T4	1091.40	987.70	1050.60	922.25	1012.99
T5	1045.50	609.88	922.68	616.25	798.58

The mean of gross returns from the four locations was found to be the highest in T4 (Rs. 1012.99/cent). This was followed by T3 treatment. The least mean return was observed in T5 treatment (Rs. 798.58/cent).

Net Returns (Rs./cent)

Table No. 51. Net returns from amaranthus in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	159.75	282.15	591.04	499.75	383.17
T2	258.54	435.85	569.64	598.54	465.64
T3	325.75	404.29	590.10	665.75	496.47
T4	676.19	572.49	635.39	507.04	597.78
T5	586.25	150.63	463.43	157.00	339.33

The net return was found to be the highest in T4 (Rs 597.78/cent) and this is followed by T3 (Rs. 496.47/cent). The lowest net return (Rs. 339.33/cent) was observed in T5.

B/C ratio

Table No. 52. B/C Ratio of amaranthus in four locations

Treatments	Locations				
	Chenkal	**Maranalloor**	**Pallichal**	**Balaramapuram**	**Mean**
T1	0.38	0.68	1.42	1.20	0.92
T2	0.62	1.04	1.36	1.43	1.11
T3	0.78	0.97	1.42	1.60	1.19
T4	1.63	1.38	1.53	1.22	1.44
T5	1.28	0.33	1.01	0.34	0.74

The B/C ratio was found to be the highest in T4 plot. This was followed by T3. The mean values are furnished in the table below. All the results show that T4 is significant.

Table 53. Effect of different treatments on leaf yield of amaranthus

Treatments	Leaf yield (kg/cent)
T1	47.09
T2	51.98
T3	53.69
T4	59.59
T5	46.98
$F_{(4,12)\text{-treatments}}$	1.252 ^{NS}
$SE_{\text{-treatments}}$	4.680
$CD_{(0.01)\text{-treatments}}$	14.423

NS Not significant

It is seen from table 53 that there is no significant difference among the leaf yields obtained from different treatments. But treatment T4 (50% inorganic and 50% organic) produced the maximum leaf yield in amaranthus and treatment T5 (100% organic) produced minimum leaf yield (fig.16).

Fig. 16. Effect of different treatments on Leaf yield of Amaranthus

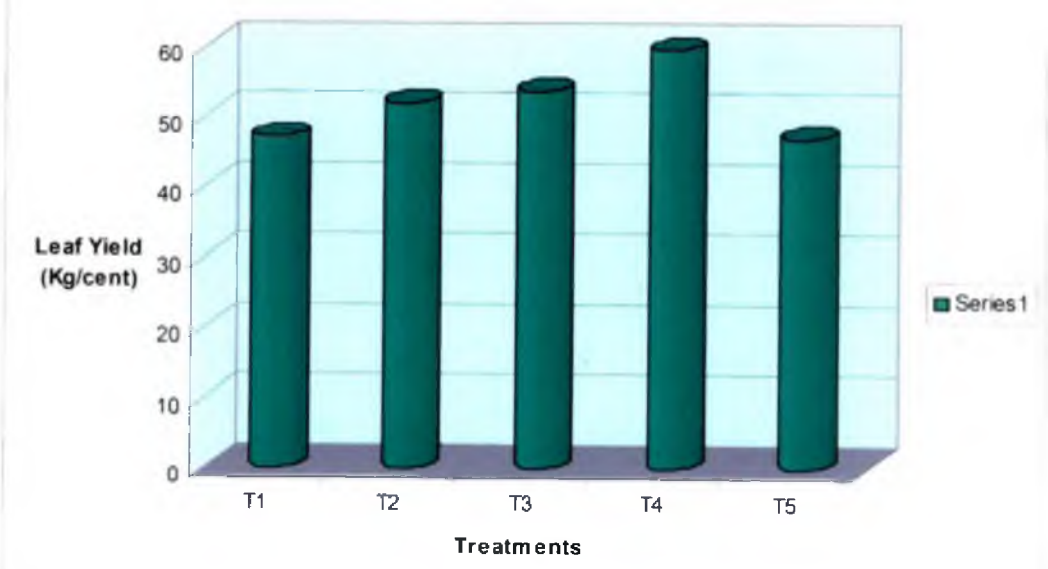


Table 54. Effect of different treatments on net returns from amaranthus

Treatments	Net returns (Rs. /cent)
T1	383.17
T2	465.64
T3	496.47
T4	597.78
T5	339.33
$F_{(4,12)\text{-treatments}}$	1.609 ^{NS}
$SE\text{-}_{treatments}$	79.569
$CD_{(0.01)\text{-treatments}}$	245.196

NS Not significant

In the case of net returns also, there is no significant difference differen treatments. Even then maximum net return of Rs. 597.78/cent was obtained fron the treatment T4 (50 % inorganic and 50% organic) followed by treatment T3 (7: % inorganic and 25% organic). Treatment T5 recorded the least net returns of Rs 339.33/cent followed by treatment T1 (Table 54 and fig.17).

Fig. 17. Effect of different treatments on Net Returns of Amaranthus

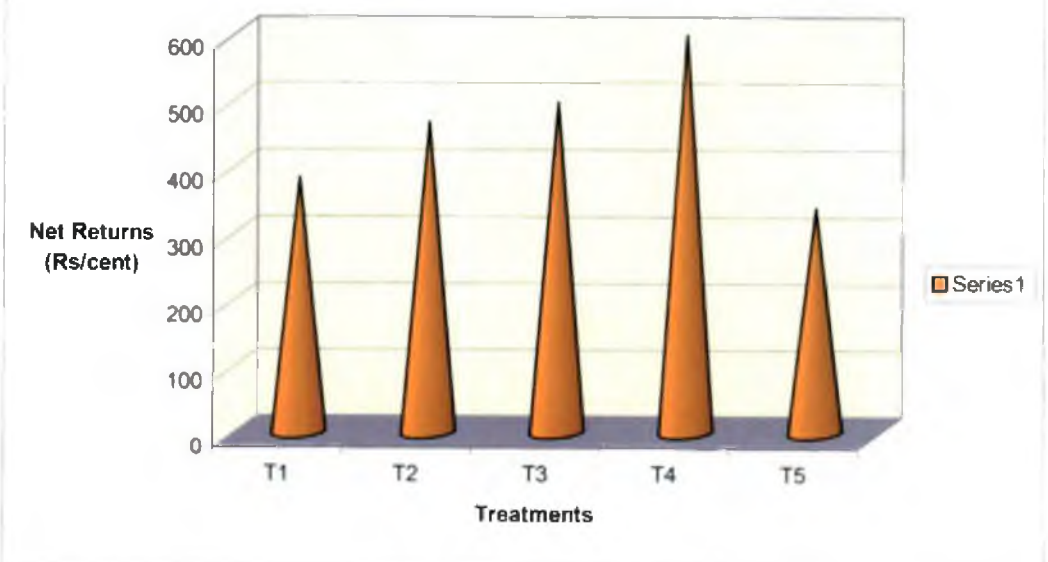
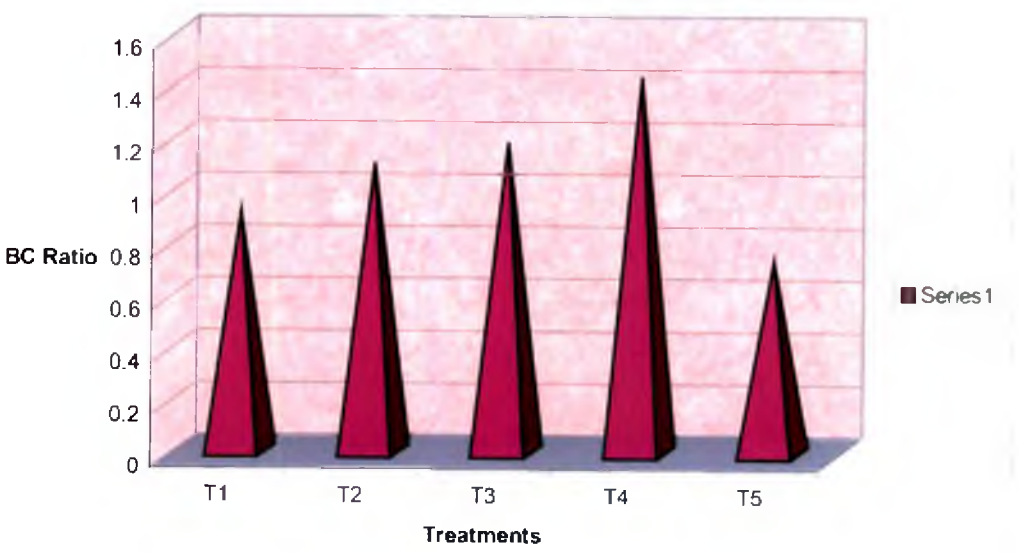


Table 55. Effect of different treatments on BC ratio of amaranthus

Treatments	BC ratio
T1	0.92
T2	1.11
T3	1.19
T4	1.44
T5	0.74
$F_{(4,12)\text{-treatments}}$	2.103 ^{NS}
$SE\text{-}_{treatments}$	0.184
$CD_{(0.01)\text{-treatments}}$	0.567

Table 55 clearly shows that there is no significant difference among the BC raios registered by different treatments. But treatment T4 (50% inorganic and 50% organic) recorded the maximum BC Ratio of 1.44 in amaranthus followed by the treatment T3 whereas treatment T5 (100% organic) recorded the minimum BC Ratio of 0.74 (Fig.18).

Fig. 18. Effect of different treatments on BC Ratio of Amaranthus



RESEARCH TEAM AT WORK

PLATE - 13

Organoleptic qualities

Organoleptic qualities play an important role in evaluating the quality of a food product. It has been recognized that enjoyment of food is a major aspect in its popularity and use. For adjudging the consumer acceptability, organoleptic evaluation of any food product is essential.

For consumers, the perceivable sensory attributes, colour, appearance, taste and texture are the deciding factors in food acceptance.

The major quality attributes includes for scoring acceptance were colour, flavour, texture and taste.

Organoleptic Parameters

Particulars	1	2	3	4	5
Colour	Excellent	Very Good	Good	Fair	Poor
Appearance	Excellent	Very Good	Good	Fair	Poor
Flavour	Excellent	Very Good	Good	Fair	Poor
Texture	Well cooked	Cooked	Partially cooked	Overcooked	Raw
Taste	Excellent	Very Good	Good	Fair	Poor

A five-point rating scale was applied for each quality as given in Appendix II.

Judges (respondents) were requested to taste the samples and mark their respective scores. Score card on these lines were prepared and distributed among the judges. Scores for overall acceptability was obtained by determining the total scores for each crop.

Organoleptic scores

Table 56. Organoleptic scores for different crops

Treatments	Cowpea	Bitter gourd	Snake gourd	Amaranthus	Cucumber
T1	13.00	13.00	11.20	10.30	12.50
T2	16.20	15.90	14.00	13.40	14.10
T3	19.70	17.50	16.40	17.70	16.90
T4	22.80	20.70	19.80	22.40	17.40
T5	25.70	23.60	20.30	23.20	18.20

It is seen from the table that the organoleptic qualities of the five crops that were taken-up for action research in farmers' field showed that the T5 plot had the highest scores. It can be interpreted from the table that the fruits that were harvested from organically treated plots had the best organoleptic qualities from among the fruits that were yielded from other treatments.

Chapter 6

CONTRIBUTIONS

Of the various crops viz. cowpea, bittergourd, snake gourd and cucumber cultivated in different locations, it was found that the fruit yield, gross returns, net returns and B: C ratio were found to be the highest in T4 treatments (i.e., 50 organic: 50 inorganic) plots.

It was also noticed that keeping quality was maximum in T5 treatment (100 % organic) in all the locations for all the crops. But as far as vegetable growers are concerned they are interested to get maximum yield for their crops. But if we are promoting 100 % organic farming, farmers may not get the desired yield. Since the field is already depleted by the adverse use of inorganic fertilizers and the field is in a transition stage, it will take minimum three years to get fruitful yield to the farmers. A transition can be considered as successfully completed when the farmer feels the yields have stabilized at an acceptable level with the new practices.

Based on the study, the following recommendations are suggested.

1. Organic farming has to be practiced without synthetic pesticides, but complete exclusion of fertilizers is not advisable under all situations. A holistic approach involving integrated nutrient management (INM), integrated pest management (IPM), enhanced input use efficiency, and adoption of region-specific promising cropping systems are the best organic farming strategy for Kerala.

2. The sustainable agriculture has to be based on site-specific balanced and adequate fertilization, and an integrated plant nutrient supply system (IPNS) involving organics, inorganics and biofertilizers for feeding the ever-increasing population of the State. There should be conjunctive use of organic and inorganic sources of plant nutrients for sustainable productivity.

4. Organic farming is a market demand driven agriculture aimed to cater to the foreign export and affluent section of the society in the country. However,

for export market, we need to develop a technology with strict quality control meeting international quality standards prescribed for organic produce.

5. The availability of organic manures in adequate amounts and at costs affordable by the farmers is a major problem. The increased mechanization has further reduced the availability of manures with the farmers and this problem will become more acute in future. In such circumstances, post harvest residues should be utilized to the fullest extent. However, to accomplish this objective, feasible technologies are needed for in-situ recycling/rapid composting of on-farm residues and wastes, in addition to extension efforts to change the mindset of the farmers. Possibilities of using non-traditional organic sources e.g., slaughter house waste, should be exploited to partly supplement plant nutrient needs of the organic farming systems.

Chapter 7

SUMMARY

The project was implemented mainly to develop an integrated strategy for nutritional management for vegetable production in Kerala, to collect and document the basic information on knowledge, attitude and adoption of the selected Integrated Nutrient Management practices to demonstrate and conduct action research on the selected technologies of Integrated Nutrient Management, to refine the technologies by participatory methods and scientific interventions and to mobilize the farming community for marketing and quality assurance and to work out the cost benefit ratio and to analyse the quality of the produce.

The study was a farmer-participatory approach in which an action research was conducted in selected farmers' fields from the trained group. Layout of trials in four locations was done based on the acceptance of farmers. There were four replications with five treatments for each crop comprising of 20 observations. The crops were selected based on the preferences of the farmers. The treatments were:

T1- POP practices

T2- Farmers' practices

T3- 75 % inorganic and 25 % organic

T4- 50 % inorganic and 50 % organic

T5- 100 % organic

Trials were conducted in highly demanded vegetables viz. cowpea, bitter gourd, snake gourd, cucumber and amaranthus. The farmers selected for the action research were enabled to record the observations.

A training programme was conducted on Integrated Nutrient Management for vegetable cultivation at the field centre Thembamuttom near Balaramapuram in Thiruvananthapuram District. The farmers for conducting action research were selected from the participants for the training programme. The importance of bio fertilizers, Integrated Pest Management, various organic pesticides and improved organic practices for controlling major pests of vegetables were discussed in the training programme. The training helped the farmers to gain more knowledge on Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) practices in vegetable cultivation.

Thiruvananthapuram district was selected purposively for the research. The study was conducted among the self-help groups of involved in vegetable production. From among the 195 'Haritha sanghams' in the 29 panchayats under VFPCK in Thiruvananthapuram District, four panchayats were randomly selected for the study. viz.,Balaramapuram, Chenkal, Maranalloor and Pallichal.

The socio-economic profile characters of the vegetable growers were studied and analysed using statistical tools. Fifty-seven percent vegetable growers were educated up to secondary level. A higher educational status of farmers is observed in this district. Majority of the vegetable growers (74 per cent) had agriculture as their full time job because this area belonged to an intensive agricultural area.

A great majority of vegetable growers (70 per cent) had medium experience in vegetable cultivation. Fifty per cent had higher level of income from the farm. Majority of the farmers had medium area under vegetable cultivation (51 per cent).

A great majority of the farmers had medium level of exposure to information sources (87 per cent). Their social participation was found to be medium. Extension orientation was also found to be falling under the medium category (55 per cent). A majority of respondents (74 per cent) was found to have medium level of economic motivation.

A majority of farmers (82 per cent) was found to have a medium level of innovativeness. Credit orientation was found to be low (89 per cent)

A medium level of risk orientation was found among 57 per cent of the vegetable growers. Market perception was almost found to be same in all the categories.

Designing a suitable extension strategy to improve the efficiency of input usage in vegetable production requires a thorough understanding of the existing level of knowledge in INM. To quantify the respondents' knowledge level on selected INM practices, a simple teacher made test was used. For the purpose of the study, a list of ten key practices of INM were selected and presented to the respondents. A score of one was assigned for the correct answers. The total score of each respondent was summed up and computed for further calculations.

The respondents were grouped into low, medium and high categories based on mean (8.86) and standard deviation (2.68). It could be observed that majority of the respondents had medium level of knowledge (65per cent) followed by low (21per cent) and high (14per cent) level of knowledge in INM.

Attitude is defined as one of the most important psychological determinants of the behaviour of the respondent. The attitude of an individual plays an important role in determining one's behaviour and adoption of technologies. An attempt was made to ascertain the attitude towards INM technologies by percentage analysis.

It was found that 14 percent of the respondents belonged to the low category followed by 28 percent belonging to the high category in their attitude towards INM. Majority of the respondents (58 percent) belonged to medium category. The reason behind this situation may be lack of conviction about these practices, lack of support by extension personnel on this aspect, lack of knowledge, risk aversion and marketing etc. Hence it is suggested that farmers should be exposed to rigorous training on INM and other communication media backed up by strong extension support which will remove the constraints operating in their way of acceptance of these technologies and building up their confidence in accepting these technologies. It will facilitate to create a more favourable attitude towards INM.

The data regarding the adoption level of the respondents about INM practices revealed that 64 percent of the vegetable growers had medium adoption level where as the percentage of respondents coming under high and low adoption categories were 18 percent each.

The main reason behind the finding that the majority of the respondents falling under medium level of adoption may be due to the high cost of input, transportation, labour and the risk involved in price fluctuation as perceived by the farmers in the study area. Non-availability of organic manures and bio-degradable pesticides and their lack of knowledge in using INM and IPM practices were the main reasons for partial adoption of these technologies by the vegetable growers of this study area.

A constraint analysis on organic farming revealed that the most important constraint expressed by all the respondents was inadequate market infrastructure facility. The next major constraints were higher incidence of pests and diseases,

lack of guidance in INM and lack of storage facilities. The myths of this noble practice had to be removed from among the vegetable growers. The action research favours very well in these aspects. Trials were conducted in farmers' fields by substituting the inorganic nutrients with organic manures.

The salient findings in relation to the five major crops is summarized below.

In an experiment with inorganic fertilizer and organic manures like FYM, the combination of fertilizers and manures gave better results than organic manure given alone. Of the various treatments tried in farmers' fields for INM practices, 50% organically and 50 % inorganically treated plots gave the maximum yield in all the crops. The results show that the treatment T4 recorded the highest yield from among the various trials conducted.

This study comes out with the results showing that the INM gave maximum net returns in 50:50 treatment plots.

Keeping quality of vegetables was found out in terms of number of days the fruits stayed fit for marketing. It was found that the keeping quality of the organically grown vegetables proved to be good in all the four locations. It was observed that the highest keeping quality was observed in T5 for all the crops except for snake gourd for which T4 showed the highest number of days of keeping quality.

The B: C ratio was found to have an increasing trend among the various nutrient combinations starting from T1 to T4. Among the various nutrient sources B: C ratio was highest for T4 treatment in all the locations. It was followed by T3 treatment in all locations.

The ever-increasing costs of agricultural inputs due to excessive dependency on the external inputs, the continuing drop in prices of farm produce coupled with monsoon vagaries have made farming increasingly unprofitable. This has led the farmers to seek new ways to increase the farm returns and income in order to stay on the land. The growing consciousness of health hazards posed due to contamination of farm produce from the use of chemical fertilizers and pesticides has given a momentum to organic farming. The consumers are willing to pay a premium for environmentally responsive safe products. It is beyond doubt that a sudden transition to organic farming cannot be done with safety and precaution, so that the losses could be kept minimum. Though the returns are not immediate in chemical-free farming, there is guaranteed sustainable income with chemical free produce.

Chapter 8

Scope for future work

The Indian farmers have immense capacity to endure natural or man-made hardships. Their farming wisdom remains unchallenged despite technological advancements. Now, the farmers are being persuaded to switch over to the age-old organic farming and thus phase out the consumption of chemical fertilisers. No doubt that organic food is the best for human health but it is not so easy for the performance-oriented farm sector to revive a conventional practice until it becomes sensitive to the ecological crises ahead.

1. The present study was confined to Thiruvananthapuram District of Kerala giving emphasis for only four major vegetable crops viz., cowpea, bittergourd, snake gourd, amaranthus and cucumber. Based on the success seen in the field trials conducted in four locations of Thiruvananthapuram District, it is of paramount importance that the technology for promoting organic vegetable production can be tried in the entire Kerala State in all the other vegetables that is being cultivated in the State.

2. Need based training programmes on the importance of "organic certification procedures" should also be given to vegetable growers to encourage them to adopt organic farming.

3. India offers tremendous scope for bio farming as it has local market potential for organic products. Absence of local markets for organic products in many of the Asian countries brightens India's chances for exporting organic food. It is now the responsibility and solemn duty of the leadership to encourage organic farming.

4. As organic farming is attracting worldwide attention, and there is a potential for export of organic agricultural produce, this opportunity has to be utilized with adequate safeguards. Organic farming can be practiced in crops, commodities and regions where the State has scope for export of quality organic products.

5. Besides fruits and vegetables, there is ample scope for the practice of organic farming in high value crops like spices, medicinal plants etc., for which R&D support is required.

6. Organic farming should not be confined to the age old practice of using cattle dung, and other inputs of organic/biological origin, but an emphasis needs to be laid on the soil and crop management practices that enhance the population and efficiency of belowground soil biodiversity to improve nutrient availability.

7. Performance of cultural techniques for weed control and bio-pesticides for pest management need to be evaluated under field conditions, preferably under cultivators' field conditions.

8. The regions suitable for the adoption of organic farming, the crops and their products should be identified which are amenable for production through organic ways and have the potential to fetch a premium price in the international organic market.

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Appendix 1

PROMOTION OF ORGANICS IN VEGETABLE CULTIVATION IN KERALA

INTERVIEW SCHEDULE

1.Name of the respondent:
2.Address:
3.Age:
4. Education:

Category	
Illiterate	
Primary	
Secondary	
Collegiate	

5. Occupation:

Category	
Govt. Servant	
Part time	
Fulltime	

6. Experience in vegetable cultivation:
7. Annual income:
\
8. Area under cultivation:

Category	
Area owned	
Area leased in	
Area under Vegetables	

9. Exposure to information sources:

Sl. No.	Information sources	Frequency		
		Never	Occasionally	regularly
	Agricultural officer			
	Agricultural assistant			
	Progressive farmer			
	Scientist			
	Family members			
	Neighbors			
	Print media			
	Radio			
	Television			
	Seminar			
	Input agencies			

10. Social participation

Sl. No.	Organization	Nature of membership			Frequency of participation		
		Member	Office bearer	CM	Regularly	Occasionally	Never
	Panchayat						
	Block panchayat						
	Co-operative society						
	Farmers organizations						
	Socio- cultural organizations						
	Others specify						

11. Extension orientation

(a) Extension Contact:

Sl. No.	Personnal	Frequency		
		Regularly	Occasionally	Never
i.	Scientist			
ii.	Agricultural Officer			
iii.	Agricultural Assistant			
Iv.	Others (specify)			
Total				

(b) Extension participation

Sl.No.	Personnel	Frequency		
		Attended when conducted	Occasionally	Never
i.	Study tours			
ii.	Seminars			
iii.	Farm fairs			
iv.	Group farming meetings			
v.	Demonstrations			
vi.	Master farmer training classes			
vii.	Exhibitions			
viii.	Others (specify0			
Total				

12. Economic motivation

Sl. No	Statements	SA	A	UD	DA	SDA
i.	A farmer should work towards large yield and economic yield					
ii.	The most successful farmer is one who makes the most profit.					
iii.	The farmer should try any new farming idea which may earn him more money					
iv.	A farmer should grow cash crops to increase monitory profits in comparison to growing of food crops for home consumption.					
v.	It is difficult for the farmer's childen to make a good start unless (s)he provides them with economic assistance.					
vi.	A farmer must earn his living, but the most important thing in life can not be defined in economic terms.					

13. Innovativeness.

When would you prefer to adopt an improved practice in farming?

a) As soon as it is brought to my knowledge
b) After I have seen some farmers using it successfully
c) Prefer to wait and take my own time

14. Cosmopoliteness.

a) Frequency of visiting nearest town/ village
   Twice or more/ once in a week/ once in a fortnight/ once in a month/ very rarely/ never
b) Purpose of visit
   All visits related to agriculture/ some related to agriculture/ personal or domestic matters/ entertainment/ others specify.

15. Credit orientation.

Give your opinion for the following statements:

a) Do you think that a farmer like you should borrow for agricultural purposes?

   ☐☐

   Yes/No

b) In your opinion, how difficult is to secure credit for agricultural purpose?

   ☐☐☐☐

   Very difficult/difficult/easy / very easy

c) How is a farmer treated when he goes to secure credit?

   ☐☐☐☐

   Very badly / badly/Fairly / very fairly

d) There is nothing wrong in taking credit from institutional sources for increasing farm production

☐☐☐☐☐

SDA/DA/UN/A/SA

e) Did you use credit during the last two years for crop production?

☐☐

Yes/No

16. Risk orientation.

Sl. No.	Statements	SA	A	UD	DA	SDA
i.	A farmer should grow large number of crops to avoid greater risks involved in growing one or two crops.					
ii.	A farmer should make more chance in making a big profit than to content with a smaller but less risky profit					
iii.	A farmer who is willing to take greater risks than an average farmer usually does better financially.					
iv.	It is good for a farmer to take risk when he knows his chance of success is fairly high.					
v.	It is better for a farmer to follow anew-farming method unless most others in the locality have used it with success.					
vi.	Trying entirely a new method infarming by a farmer involves risk but it is worth.					

17. Market Perception.

a) Do you think a farmer will be able to sell his/ her produces if (s) he increases the production by adopting INM practices?

☐☐

Yes/No

b) Do you think that produces of vegetables cultivated according to the INM produces will fetch good prices compared to the chemical Prices?.

☐☐

Yes/No

c) Do you think that there will be a demand for vegetables produced by INM method than the usual chemical methods of nutrient input?

☐☐

Yes/No

Knowledge about INM in vegetable cultivation

Sl. No.	Particulars	Yes	No
1.	Season		
2.	Varieties		
3.	Seed Rate		
4.	Spacing		
5.	Name any INM practice in vegetable cultivation a) FYM+ fertilizer b) Poultry manure + fertilizer c) vermicomposting + fertilizer Pit size		
6	Manuring a) FYM+ fertilizer+ half N+ fill P+full K b) Next half N as split application c) Application of GLM		
7.	a) Name any one bio-control agent 1) trichoderma Sp. 2) Pseudomonas sp. 3) VAM		
8.	Name any traps/ baits used in vegetable cultivation		
9.	Name any five organic pesticides a) Tobacco extract b) Neem oil emulsion c) Neem seed kernal suspension d) Kerosene emulsion e) Neem oil Garlic emulsion f) Chilli extract g) Others specify		
10.	Is the quality of organic vegetables good?		

Attitude of farmers towards INM practices

Please indicate your response by making a tick ( ) in the appropriate column.

Sl. No.	Statement	MF	F	N	UF	MUF
1	The method that our fore fathers practiced is still the best method of nutrient					

	application.					
2	Traditional methods of cultivation are very effective.					
3	It is risky to adopt organic methods alone.					
4	Application of organic manures increases P&D incidence, even then I will go for organic farming.					
5	One has to apply chemical fertilizers and nutrients to make the crop more profitable.					
6	Environmental hazards are reduced by INM practices,					
7	Application of chemical fertilizers will adversely affect the quality of vegetables					
8	One need not hesitate to apply chemical fertilizers for vegetables					
9	Proper integration of chemical and organic fertilizers is the most effective method so I will practice it					
10	It is not profitable to adopt INM in vegetable cultivation					
11	INM is a very cost effective method so I will go for INM Method.					
12	INM increases the keeping quality of the vegetables.					
13	Market value of vegetables is increased by INM practices so I will do it.					
14	The cost benefit ratio is high compared to earlier methods					
15	The growth yield & quality of vegetables are enhanced by the practice of INM					
16	Gradual changes from the existing method to organic cultivation will be definitely accepted by me					
17	INM concept is only a jurglery of scientists					
18	It is too late to switch on to INM					
19	INM is a sure way of giving returns					
20	INM is a wasteful practice					
21	INM is only possible in experimental process and in farmers fields it is mere waste of time					
22	If we do not move into INM we are answerable to our future generation.					

Adoption of selected integrated nutrient management

Sl. No.	Statement	Full Adoption	PA	NA

1.	Have you been following the package of practices as recommended by Kerala Agricultural University for vegetable cultivation?			
2.	Land preparation a) Do you apply FYM + top soil mixture in the pits? b) Others specify			
3.	Seeds and sowing a) Do you follow the required seed rate? b) How many plants do you maintain in one pit? c) Do you follow the recommended spacing? d) Do you use any HYV? e) Do you follow any seed treatment?			
4.	Manures and fertilizers a) Do you apply any organic manure as basal? b) Do you apply organic and inorganic nutrients in combination? c) Do you go for split application of nutrients? d) Do you apply vermicompost? e) Do you apply any other organic manure?			
5..	Irrigation schedule How often do you irrigate? a) 3-4 days interval b) Alternate days during flowering and fruit setting			
6.	After cultivation a) Do you follow trailing and pandal making? b) Do you follow nipping of lateral buds? c) Do you follow weeding and raking at the time of fertilizer application?			
7.	When do you go for harvesting?			
8.	Pest and Diseases a) Do you follow the Kerala Agricultural University recommendations for the control of pests and diseases? b) Do you apply any bio-control method?			

Constraints encountered by farmers in INM practices in vegetable cultivation

Sl.No.	Statements	Y	N
	Economic Constraints		
1	No.guarentee in getting more yield		
2	Lack of finance facilities		
	Input Constraints		
3	High input cost		
4	High seed cost		
5	Restricted seed supply		
6	High labour cost		
	Technological Constraints		
7	Varietal susceptibility towards P&D		
8	Higher incidence of P&D		
	Information Constraints		
9	Lack of knowledge about INM		
10	Lack of guidance in INM		
	Situational Constraints		
11	Weather problems		
12	Labour scarcity		
13	No timely supply of inputs		
	Psychological Constraints		
14	High risk involved		
15	Not yet convinced		
	Marketing Constraints		
1	Price fluctuation		
2	Lack of storage facilities		
3	Inadequate credit facilities in marketing		
4	High transport charges		
5	Inadequate market infra-structure facilities		

Appendix II

ORGANOLEPTIC SCORE CHART

Colour

Excellent	5
Very Good	4
Good	3
Fair	2
Poor	1

Appearance

Excellent	5
Very Good	4
Good	3
Fair	2
Poor	1

Flavour

Excellent	5
Very Good	4
Good	3
Fair	2
Poor	1

Texture

Well cooked	5
Cooked	4
Partially cooked	3
Over cooked	2
Raw	1

Taste

Excellent	5
Very Good	4
Good	3
Fair	2
Poor	1

Organoleptic test for T1, T2, T3, T4 and T5

Respondents	Colour Excellent Very Good Good Fair Poor	Appearance Excellent Very Good Good Fair Poor	Flavour Excellent Very Good Good Fair Poor	Texture Well cooked Cooked Partially cooked Over cooked Raw	Taste Excellent Very Good Good Fair Poor
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

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