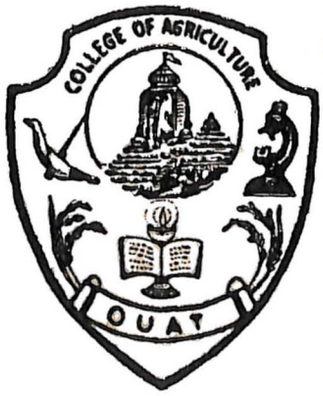
# STUDIES ON ORGANIC FARMING IN BRINJAL-OKRA CROPPING PATTERN

A
THESIS SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, BHUBANESWAR
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
( HORTICULTURE )


**BY**

*Prajna Paramita Sahoo*



Department of Horticulture
COLLEGE OF AGRICULTURE
*Orissa University of Agriculture & Technology*
**BHUBANESWAR, ORISSA**


**2002**

THESIS ADVISOR : Dr. ALOK NANDI

*Dedicated to*
*My Beloved Parents*
*& Brothers*

*Dr. Alok Nandi*
Vegetable Agronomist
All India Coordinated Vegetable Improvement Project
Department of Horticulture
College of Agriculture
Orissa University of Agriculture and Technology
Bhubaneswar-751003

# CERTIFICATE-I

This is to certify that the thesis entitled "**Studies on organic farming in brinjal-okra cropping pattern**" submitted in partial fulfilment of the requirements for the award of the degree of **MASTER OF SCIENCE IN AGRICULTURE (HORTICULTURE)** of the Orissa University of Agriculture and Technology ,Bhubaneswar ,is a record of bonafide research work carried out by **PRAJNA PARAMITA SAHOO** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma or published in any form .It is further certified that the help and sources of information during the course of investigation have been duly acknowledged .

Forwarded to
Dean, CA.

Prof. and Head 30/12/02
Department of Horticulture
College of Agriculture, O.U.A.T
Bhubaneswar.

Place: Bhubaneswar
Date :30th Dec. 2002

Dr. Alok Nandi

# CERTIFICATE - II

This is to certify that the thesis entitled **"STUDIES ON ORGANIC FARMING IN BRINJAL-OKRA CROPPING PATTERN"** submitted by **Prajna Paramita Sahoo**, Adm. No. 128HORT/2K to the Orissa University of Agriculture and Technology, Bhubaneswar in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE) IN HORTICULTURE** has been approved by the Student's advisory committee and external examiner.

**ADVISORY COMMITTEE :**

**CHAIRMAN** : **Dr.Alok Nandi**
Vegetable Agronomist
AICVIP,
Department of Horticulture
OUAT, Bhubaneswar
10.02.03

**MEMBER** : **Dr.D.P. Ray**
Professor & Head
Department of Horticulture
OUAT, Bhubaneswar
10/02/03

**MEMBER** : **Dr. S.K. Sahu**
Professor
10.02.03
Department of Agricultural Chemistry
Soil Science & Biochemistry,
OUAT, Bhubaneswar

**EXTERNAL EXAMINER :**
10.02.03

# ACKNOWLEDGEMENT

*I avail this unique opportunity to acknowledge with pride and to epitomize my profound sense of gratitude and indebtedness to Dr. Alok Nandi, Vegetable Agronomist, All India Vegetable Improvement Project, Department of Horticulture, O.U.A.T.Bhubaneswar and chairman of the advisory committee for his perspicacity, scholastic guidance, vigilant supervision, constructive criticism, instructive ideas, affectionate care and painstaking effort coupled with a great patience during the entire preparations of the manuscript.*

*I express my gratefulness to Dr. D.P.Ray, Professor and Head, Department of Horticulture, O.U.A.T. and member of my advisory board for providing me required facilities to work during the period of Investigation.*

*I express my sense of regards to Dr S.K.sahu, Professor, Department of Agricultural Chemistry, Soil Science and Biochemistry for his kind and precious suggestions, necessary help during the entire course of study.*

*I am greatly thankful to Dr. S. Mandal and Dr. V. K. Pandey of Central Horticultural Research Station,IIHR, Bhubaneswar for rendering me enough freedom for acquiring the required literature for my thesis work from their library.*

*I express my deep sense of regard and pronounced gratitude to all the respected teachers of our department for extending their counsel as and when solicited during the course of M.Sc.(Ag.) degree and dissertation work.*

*I am highly grateful to Manguli bhai for his help and cooperation throughout the entire series of my research work.*

*My heartfelt thanks to my friends Rita,Saswatee and Prajna Samal for their noble suggestions ,steadfast help, inspiration ,persistent encouragements and solace throughout my P.G. study and during the course of investigation.*

*I cordially acknowledge the encouragement and help received from the staff of Department of Horticulture .*

*I deeply appreciate the help rendered to me by my roommates Sujata and Swati during my period of study at O.U.A.T. and also during the research work.*

*Words run short to express my profound sense of gratitude and deepest regards to Aai,Mamu,Main and mausi for their love and affection which have helped me a lot to overcome the challenges and come out successfully during my study.*

*I thankfully acknowledge the help, cooperation and affection extended by all the well-wishers and my near and dear ones.*

*It is beyond my capacity to pen the inspirations, encouragements, attention, love and affection rendered by my brothers Alok and Ashisa which provided me impetus to proceed towards bright horizon.*

*Above all , I offer humble respect to my parents whose blissful blessings , unflinching inspirations, guidance, unfathomable love and scrupulous dedication despite all odds in life have made me to be so.*

*Last but not the least , I bow my head before the omnipresent sacred divine who has shown a beam of spiritual light in the darkness. I still seek his blessings to proceed further.*

Prajna paramita Sahoo

*Bhubaneswar*
*Dt. 30th Dec. 2002*

*Prajna Paramita Sahoo*

# CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF PLATES

# ABBREVIATIONS

| | | |
|---|---|---|
| % | - | Percentage |
| g | - | Gram |
| kg | - | Kilogram |
| $dSm^{-1}$ | - | desi Simon per metre |
| m | - | Metre |
| cm | - | Centimetre |
| DAS | - | Days after sowing |
| DAT | - | Days after transplanting |
| FYM | - | Farm Yard Manure |
| i.e | - | That is |
| d.f. | - | Degree of freedom |
| Fig. | - | Figure |
| et.al. | - | And others |
| C.D. | - | Critical difference |
| $^0B$ | - | Degree brix |
| SS | - | Sum of square |
| MSS | - | Mean sum of square |
| NS | - | Not significant |
| SE(m)± | - | Standard error of means |
| q/ha | - | Quintal per hectare |
| t/ha | - | Tonnes per hectare |
| Rec, NPK | - | Recommended dose of NPK through chemical fertilizers. |

# STUDIES ON ORGANIC FARMING IN BRINJAL-OKRA CROPPING PATTERN

**Student** : Prajna Paramita Sahoo
Admn. No. : 128 Hort/2K

**Advisor** : Dr. Alok Nandi
Dept. of Horticulture

## ABSTRACT

A field experiment entitled "Studies on organic farming in brinjal-okra cropping pattern" was conducted at AICVIP, Department of Horticulture, OUAT, Bhubaneswar, during August 2001 to September 2002, following randomized block design with three replications involving eight treatments such as : $T_1$-Full recommended fertilizer (control), $T_2$-FYM @ 20t/ha, $T_3$-FYM @ 10t/ha + full recommended fertilizer, $T_4$-Neem cake @ 5 q/ha + full recommended fertilizer, $T_5$- Vermicompost @ 5t/ha, $T_6$-Vermicompost @ 2.5 t/ha + full recommended fertilizer, $T_7$-Pressmud @ 10t/ha and $T_8$-Pressmud @ 5 t/ha + full recommended fertilizer.

Brinjal was taken up as the first crop in which these eight treatments were applied. Okra was taken up in the same plots after brinjal. No manure was applied to okra but recommended doses of fertilizers were used in all the plots. The different cultural practices were uniformly adopted for each crop as per the recommended package of practices. The **objective** were to (i) Study the effects of different organic amendments alone or in combination with inorganic fertilizers, on the vegetative growth, yield and yield attributes of brinjal (ii) Assess the extent of residual effects of the organic amendments on a second crop of okra, raised after brinjal (iii) Study the effects of different treatments on the quality of brinjal fruits as well as infestation of fruit borer (iv) Calculate treatment wise the economics of growing each individual crop and also that of the two crop sequence (v) Undertake initial and final soil analysis for each crop and comment on the effects of different treatments with respect to soil health or fertility.

From the results obtained in the experiment conducted, it can be concluded that the treatments involving sole application of full recommended fertilizer or in combination with FYM, resulted in superior vegetative growth and fruits per plant of brinjal. Sole vermicompost application resulted in greater weight and girth of fruit in brinjal. Early flowering and greater fruit length of brinjal was obtained when combined application of pressmud @ 5 t/ha and full recommended fertilizer was adopted. The highest fruit yield as well as cost benefit ratio was obtained with combined application of FYM @ 10 t/ha and full recommended fertilizer. Lowest incidence of fruit borer was observed with combined application of neem cake @ 5 q/ha and full recommended fertilizer.

The fruit yield derived from application of different forms of organic amendments alone were in general lower than combined application of organics and inorganics irrespective of their doses. The gross yield and benefit cost ratio of brinjal - okra sequence were relatively higher with combined application of organic manures and inorganic fertilizers than using organic amendments alone.

In the second crop of okra which was uniformly applied with only recommended fertilizers and grown after brinjal, plant height, nodes per plant, fruits per plot, fruit weight, fruit yield and benefit cost ratio were found to be relatively superior in the plots in which sole organic amendments like FYM, pressmud and vermicompost were applied to the previous crop of brinjal. The gross yield and benefit cost ratio of brinjal-okra sequence were relatively higher when inorganic fertilizers were applied alone or combined with organics, rather than using organic amendments alone.

Among the organic amendments, application of vermicompost alone @ 5 t/ha or pressmud alone @ 10 t/ha separately showed enhanced levels of available phosphorus in soil after brinjal, in comparison to the initial status.

# CHAPTER - I

# INTRODUCTION

# CHAPTER - I

# INTRODUCTION

# INTRODUCTION

The green revolution in India culminated in substantial enhancement in the production of food grains, which was achieved through the use of improved crop varieties, higher levels of fertilizers and plant protection chemicals. A quantum jump in horticultural crop production also followed suit by adopting similar strategies during the last few decades. But it has now been realised that such increase in production was achieved at the cost of soil health and that sustainable crop production at higher levels is possible only by the appropriate use of factors which will help to maintain the fertility of the soil. In fact, about 60 percent of our agricultural land currently under cultivation suffer from indiscriminate use of chemical fertilizers and irrigation water (Palaniappan and Annadurai, 1999). Wide use of high doses of chemical fertilizers and insufficient application of organics led to negative impacts such as (i) reduction in natural fertility of the soil (ii) destruction of soil structure, aeration and water holding capacity (iii) susceptibility of soil to erosion by water and wind (iv) deterioration in the natural taste of food (v) high energy use (vi) occurrence of Zn and S deficiencies in many areas (vii) adverse effects on soil biotic life, particularly if the soil is acidic (viii) pollution and health hazards for human beings.

Since the high yielding varieties of different crops were more prone to pests and diseases there was a phenomenal increase in pesticide consumption leading to further maladies such as (i) pollution due to the toxic chemicals and their production units (ii) poisoning of foods with highly toxic pesticide residues (iii) indiscriminate killing of useful insects, micro organisms and

predators that naturally check excess crop damage by insect pests (iv) evolution of more resistant and virulent species of insect pests.

In order to overcome the adverse effects of inorganic fertilizers, pesticides and other harmful chemicals, it is imperative to switch over to the alternative system of agriculture represented by organic agriculture or ecological agriculture. According to Lampkin (1990) "Organic agriculture is a production system which avoids or largely excludes the use of synthetic compounded fertilizers, pesticides, growth regulators and livestock feed additives" (Palaniappan and Annadurai, 1999). Organic farming does not totally exclude the elements of modern agriculture. Varying agroclimatic conditions do need inputs from the current technological advances. The principle elements to be considered while practising organic farming are (i) maintaining a living soil (ii) making available all the essential nutrients to crop plants (iii) organic mulching for conservation and (iv) attaining sustainable high yield. Organic farming is not mere non-chemicalism in agriculture. It is a system of farming based on integral relationship. So one should know the relationships among soil, water, plants and animal kingdom of which man is the apex animal. It is the totality of these relationships which is the backbone of organic farming. It is now widely felt that the most efficient crop production system and probably in the long run, the most economical one consists of a combination of organic and chemical fertilizers, combining the best aspects of both types of nutrient supply.

The multifarious advantages of organic farming are as follows :

1. Organic farming techniques help to increase the organic matter content of soil, thus reducing the bulk density and decreasing compaction. They produce optimal conditions in the soil for high yields and good quality crops.
2. All the nutrients required by plants can be supplied through organic farming.
3. Plant growth and physiological activities are improved.
4. There is marked improvement in the physical properties of soil such as tilth, granulation, aeration, root penetration and water holding capacity.
5. There is improvement in soil chemical proprerties such as supply and retention of soil nutrients and promotion of favourable chemical reaction.
6. The need for purchased inputs gets reduced.
7. Many organic manures are wastes or byproducts which on accumulation may lead to pollution. Pollution is minimised if they are utilised for organic farming.
8. Continuous application of chemical fertilizers makes the soil acidic. Organic matter restores the normalcy of pH.
9. Organically grown crops are believed to provide more healthy and nutritionally superior foods, for man and animals, than those grown with commercial fertilizers.
10. Organically grown plants are relatively more tolerant to diseases and insect pests and consequently only a few chemical sprays or other protective treatments are required.

11. Since organic agricultural produces are free from toxic chemical residues there is an increasing consumer demand. In developed countries consumers are willing to pay more for organic foods.

12. The possibility of chain reactions in the environment caused by chemical sprays and dusts, can be circumvented or avoided by organic farming.

13. Organic farming helps to prevent environmental degradation and can be used to regenerate degraded areas.

14. Since the basic aim is diversification of crops, much more secure income can be obtained from organic farming in contrast to dependence on only one crop or enterprise.

The components of organic farming included use of a wide array of organic manures such as farm yard manure, compost, oil cake, press mud, green manure, bio-fertilisers, straw or other crop residues and cover crops which can suitably substitute for inorganic fertilizers to maintain the environmental quality. The other components include non-chemical weed control measures and biological pest management.

Brinjal is one of the most commonly grown vegetable crops of India as well as Orissa. In fact, it has the highest acreage among the vegetable crops grown in Orissa. India ranks second only to China in respect of brinjal production (Thamburaj and Singh, 2001). Although the brinjal fruit is primarily used as a cooked vegetable for the preparation of various dishes, it

has much potential as a raw material in pickling & dehydration industries. It possesses some medicinal properties e.g. it stimulates intrapeptic metabolism of blood cholesterol helps in de-cholestralizing action, inhibits choline esterase activity of human plasma. The white type is said to be good for diabetic patients. It has recently been recognised as a mineral rich vegetable which provides calcium, magnesium, phosphorus and vitamin particularly 'B' group and 'C'. The brinjal seed oil is rich in linoleic and linolenic acids (65.10 per cent). These facts highlight the utmost importance of brinjal in the present day context.

Despite the importance of this crop and availability of relevant technologies for enhancing its production, there is indiscriminate and imbalanced use of fertilizers and pesticides at the farmers level, leading to pollution and associated maladies. A comparative account of the fertilizer recommendations of different states as reported by Thamburaj and Singh (2001) also reveal that the recommendation of 125 kg N, 80 kg $P_2O_5$ and 110 kg $K_2O$ per hectare adopted by the Orissa state for brinjal crop, is clearly on the higher side, as compared with most of the other states of India. In their bid to control the very stubborn best fruit borer, farmers also use high doses of toxic pesticides thus aggravating pollution and health hazards.

Although in Orissa, till date there is not much hue and cry against pollution, but within the next decade or so this might imperatively become a burning issue. Moreover, consumers of Orissa presently show a greater preference for organically produced vegetables owing to the better taste and safety.

In view of the above considerations, an experiment entitled "Studies on organic farming in brinjal - okra cropping pattern" was conducted with the following objectives :

1. To study the effects of different organic amendments alone or in combination with inorganic fertilizers on the vegetative growth, yield and yield attributes of brinjal.
2. To assess the extent of residual effects of the organic amendments on a second crop of okra, raised after brinjal.
3. To study the effects of different treatments on the quality of brinjal fruits, as well as infestation of fruit borer.
4. To calculate the economics of growing each individual crop and also that of the two crop sequence.
5. To undertake initial and final soil analysis for each crop and comment on the effects of different treatments with respect to soil health or fertility.

# CHAPTER - II

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

The practice of organic farming in vegetable crops increases the productivity of soil, crop yield as well as the organoleptic qualities i.e. sensory qualities and keeping quality of vegetables. It also reduces the pest infestation in some cases, improves the soil physical ,chemical and biological properties. It is also economical and ecologically viable in the long run than the conventional method of application of inorganic nutrient sources. The experimental results of different researchers are briefly dealt with this review under the following heads :

i. Effect of organic amendments on vegetative growth of crop.
ii. Effect of organic amendments on yield and yield attributing traits of crop.
iii. Effect of organic amendments on quality of vegetables.
iv. Effect of organic amendments on pest, pathogen and weed control
v. Effect of organic amendments on soil and environment health.
vi. Effect of organic amendments on economics of vegetable production.

## I. Effect of organic amendments on vegetative growth of crop.

### a. Brinjal :

Subba Rao and Ravisankar (2001) reported highest plant height when brinjal crop was applied with FYM than when applied with vermicompost, which resulted in more plant height than neem cake application. All these values were higher than when applied with inorganic source of N,P,K in the recommended dose (100:60:60 kg/ha N, $P_2O_5$ &$K_2O$ respectively). They found that number of branches per plant was similar in recommended dose of fertilsier application to that of plants applied with FYM and NPK through

chemical fertilizer. Vermicompost application resulted in lesser number of branches than FYM application. Number of leaves per plant was highest in case of FYM application followed by neem cake. The dry matter production was highest in case of application of inorganic source of nutrients control followed by vermicompost, FYM and neem cake application respectively.

**b. Other Solanaceous Vegetables :**

**Tomato**

Igbokwe *et. al.* (1996) recorded much higher plant growth in conventional system than in case of transitional followed by organic system in case of tomato crop.Barbolina and Arkhipchenko (1999) reported stimulated growth of tomato plants when bamil (Waste obtained from animal breeding farm) was applied in combination with mineral fertilizers than tomatoes receiving mineral fertilizers alone.

The findings of Stoffella and Graetz (2000) revealed that when sugarcane filter cake (waste by product of sugarcane processing) was taken as an amendment in a tomato crop (cv. Sunny) highest plant growth was observed in case of plots applied with 100% chemical fertilizer + amendment followed by 50% chemical fertilizer + amendment followed by 100% amendment alone. All were better than the control (neither amendment nor chemical fertilizer).

Renuka and Ravisankar (2001) observed that in case of tomato crop with combined application of FYM and biogas slurry, the number of branches per plant was highest, which was followed by application of biogas slurry

alone and combined application of vermicompost and FYM. Also there was similarity with application of recommended dose of chemical fertilizer with that of combined application of FYM and recommended NPK through chemical fertilizers.

**Pepper**

It was opined by Aliyu (2000) that there was excessive growth of pepper plants when combined organic and mineral fertilizers were applied than application of only mineral fertilizers.

c. **Other vegetables :**

**Okra** : Reddy *et. al.* (2001) reported that higher plant growth parameters like plant height, number of nodes of Okra crop applied with sewage sludge and urban compost in the ratio 1:1 were observed than with only sewage sludge application.

**Other** :Nirmala and Vadivel (1999) found that a combiantion of FYM and inorganic fertilizer was superior to application of FYM alone in case of vine length and leaf area in cucumber.

Yadav and Yadav (2001) found that onion plants were less taller with combined application of FYM and recommended dose of chemical fertilizer than in case of recommended dose of fertilizer alone.

## II. Effect of organic amendment on yield and yield attributing traits of crops :

### a. Brinjal

Tomar *et. al.* (1998) concluded that application of vermicompost and FYM in the ratio 1:1 gave higher yield than application of chemical fertilizers i.e. recommended dose of fertilizer in case of brinjal.Balsal and Gupta (1998) reported that brinjal yield was higher in case of urea application than application of anaerobically digested sewage sludge.

Nanthkumar and Veeraragavathatham (1999) recorded highest brinjal fruit set in case of application of 75% recommended dose of NPK along with FYM than 100% recommended dose of NPK. This also followed in case of number of flowers produced and total final yield obtained in brinjal crop.

Selvi and Perumal (2000) opined that when chemical fertilizers alongwith composted coir pith (CCP) was used, it gave 25.6% higher brinjal yield than was obtained by chemical fertilizer alone, though the highest yield was obtained in case of application of chemical fertilizers with CCP and *Azospirillum sp.* inoculation. Shelke *et. al.* (2000) reported that 60% urea replaced by poultry manure gave highest brinjal yield of 581 q/ha than FYM application or 100% urea application.

SubbaRao and Ravisankar (2001) concluded that days to 50% flowering of brinjal crop was achieved earlier in case of application of vermicompost alone followed by FYM alone but they did not vary significantly among

different treatments involving sole organics and combination of organic and inorganic sources. They also reported that fruit length was highest with combined application of chemical fertilizer and FYM followed by neem leaf application or sole application of organic sources. Number of fruits per plant was highest in case of FYM application alone followed by combined application of FYM and neem leaf. They also observed that fruit yield of brinjal was highest in case of FYM application alone than chemical fertilizer and FYM in combination, which was at par with only chemical fertilizer application. Harvest index was highest with vermicompost + FYM followed by vermicompost application only.

**b. Other Solanaceous Vegetables :**

**Tomato**

Igbokwe *et. al.* (1996) reported after three years rotation experiment that tomato fruit number and fruit weight were higher with conventional and transitional farming system than organic farming.

Gonzalez *et. al.* (1997) showed that tomato yield was higher when bioterra (maize and bean harvest residues in 3:1 ratio alongwith 2% zeolite alongwith fungal, bacterial and yeast inoculation) was applied with 50% recommended dose of chemical fertilizer than 100% recommended dose of chemical fertilizers.

Balsal and Gupta (1998) obtained higher yield of tomato cropwhen sewage sludge was applied than in case of urea application. Balsubramanium *et. al.*, (1998) observed highest yield in case of tomato (cv. Paiyur-1) plants

different treatments involving sole organics and combination of organic and inorganic sources. They also reported that fruit length was highest with combined application of chemical fertilizer and FYM followed by neem leaf application or sole application of organic sources. Number of fruits per plant was highest in case of FYM application alone followed by combined application of FYM and neem leaf. They also observed that fruit yield of brinjal was highest in case of FYM application alone than chemical fertilizer and FYM in combination, which was at par with only chemical fertilizer application. Harvest index was highest with vermicompost + FYM followed by vermicompost application only.

**b. Other Solanaceous Vegetables :**

**Tomato**

Igbokwe *et. al.* (1996) reported after three years rotation experiment that tomato fruit number and fruit weight were higher with conventional and transitional farming system than organic farming.

Gonzalez *et. al.* (1997) showed that tomato yield was higher when bioterra (maize and bean harvest residues in 3:1 ratio alongwith 2% zeolite alongwith fungal, bacterial and yeast inoculation) was applied with 50% recommended dose of chemical fertilizer than 100% recommended dose of chemical fertilizers.

Balsal and Gupta (1998) obtained higher yield of tomato cropwhen sewage sludge was applied than in case of urea application. Balsubramanium *et. al.*, (1998) observed highest yield in case of tomato (cv. Paiyur-1) plants

applied with composted coir pith alongwith chemical fertilizer followed by recommended dose of chemical fertilizer.

Reddy (1999) concluded that fruit yield of tomato increased as the amendment composted urban refuse increased, but best quality tomato considering TSS, acidity and ascorbic acid was obtained with 20 t/ha compost application among three doses of application of 10t, 20t and 30 t/ha respectively.

It is opined by Barbolina and Arkhipchenko (1999) that bamil application alongwith chemical fertilizers increased tomato yield than only chemical fertilizer application. Clark *et. al.* concluded after 4 year rotation experiment that organic system was exhibiting stable tomato yield though less than that of conventional system.

Garedal and Lunegardh (1999) reported that when tomato plants were fertilized with clover mulch they gave higher tomato yield than with grass mulch. But utilization of phosphorus and potassium was higher in case of grass mulch. Their combiend applicatin produced intermediate yield but best utilization of nitrogen, phosphorous and potassium.

Duraiswamy *et. al.* (1999) opined that rainfed tomato (cv. Paiyur 1) cultivation responded to organic manure application, the highest yield being obtained with composted coir pith followed by *Azospirillum* application. Thornsbury *et. al.* (2000) concluded that 7% higher yield was obtained taking compost than inorganic fertilizer in case of tomato crop.

Xu Huilian *et. al.*, (2000) suggested that if poultry manure or organic manure is treated with effective microorganism before application to tomato crop it results in increased photosynthesis and fruit yield.

Balsal and Gupta (2000) found that tomato yield was highest with sewage than urea application. Lin Chunhua and Huang Lianghua (2000) showed that application of poultry manure (chicken) along with chemical fertilizer resulted in highest cherry tomato yield followed by peanut cake followed by tea seed cake each alongwith chemical fertilizers. Maynard *et. al.*, (2000) observed that applying leaf compost alongwith chemical fertilizer reduced the use of fertilizer in case of tomato crop giving the same yield as in case of recommended dose of chemical fertilizer.

It was found by Quattrucci (2000) that marketable yield of tomato was significantly higher in inorganic fertilizer applciation than organic.

Siviero *et. al.* (2000) opined that application of grey card mulch resulted in higher yield of early harvesting variety of tomato crop, when raised by organic farming than conventional farming .

The findings of Stoffella and Gretz (2000) revealed that application of sugarcane filter cake as an amendment along with 50% applciation of recommended dose of fertilizer in case of tomato crop increased the fruit number as well as fruit weight and fruit size regardless of fertilizer application rate.

Renuka and Ravisankar (2001) opined that highest tomato yield was obtained taking FYM & biogas slurry followed by biogas slurry alone.

**Pepper**

Aliyu (2000) reported that when poultry manure in addition to chemical fertilizer was added it resulted in higher concentration of nitrogen, phosphorus and potassium in pepper fruits than taking FYM in combination with chemical fertilizer. Highest yield was obtained taking FYM @ 10 t/ha + poultry manure @ 5t/ha than taking recommended dose of fertilizer alone or in combination with individual organic manure.

Baquero and Pinto (2000) concluded that nutrient content in green pepper was increased by 1.2 to 2.1% with use of organic source of nutrients than using chemical source. Ribeiro *et. al.*, (2000) showed that yield of sweet pepper was more in case of organically grown than conventionally grown, but did not differ among the different sources of organic manure.

**Potato :**

Kerner (1994) concluded little variation in yield when only organic manure was applied to potato crop than that of the crop grown taking chemical fertilizers.It was observed by Warman and Havard (1994) that potato crop grown with amendments (composted poultry manure) had resulted in higher yield than the conventionally grown crop.

But, Balsal and Gupta (1998) concluded that higher potato yield was obtained with urea and oxamyl than applying sewage sludge.

c. **Other Vegetables :**

**Okra**

Sentil Kumar and Sekar (1998) found that in lignite mine soil amendment of composted coir pith along with FYM, gypsum and pressmud resulted in higher yield of okra than adding inorganic fertilizers.

Patil *et. al.* (2001) reported highest yield of okra on applying FYM, biofertilizer and inorganic sources of fertilizer (75% of recommended) followed by applying FYM, biofertilizer and 50% of recommended dose of fertilizer through inorganic sources.

Reddy *et. al.*(2001) recorded highest fruit yield of okra with sewage sludge and urban compost application in 1 :1 ratio, which was at par with okra fruit yield in case of sewage sludge and urban compost application in 1:2 ratio followed by only sewage sludge application.

**Carrots**

Kerner (1994) reported that yield of carrots were higher in case of organic farming in a four year rotation period than conventional farming.

Tomar *et. al.* (1998) showed that carrots grown by applying FYM or vermicompost as amendments increased the yield than unamended soil.

**Cucurbitaceous crops**

Nirmala *et. al.* (1999) observed that better cucumber yield attributing characteristics like the production of first female flower in earlier node, close sex ratio, large fruit size and more number of tender fruits per plant as well as highest yield when applied with FYM, *Azosprillum Sp.*,

phosphobacteria, VAM combinedly than different combination of these four sources. But the length and girth of fruits were similar with application of recommended dose of fertilizers alone or organic sources alone. They also found that combined application of organic and inorganic sources produced more fruit number as well as yield than sole application of organic sources of nutrients which supprots findings of Nirmala &Vadivel (1991).

Nanthakumar and Veeraraganathatham (1999) opined that cucumber yield when applied with FYM and 75% recommended dose of inorganic fertilizers was at par with 100% recommended dose application.

Bage *et. al.* (2000) revealed that with application of mustard cake the numebr, length, diameter and weight of fresh fruits of pumpkin were highest followed by other manures such as mahua cake, cowdung manure and suja.

Rekha and Gopal Krishnan (2001) opined that in case of bittergourd, application of dry cowdung (DCD), poultry manure and fresh cowdung slurry gave higher yield than obtained with recommended dose of fertilizer (Basal applciation of DCD and topdreessing with poultry manure and drenching with cowdung slurry).

**Onion**

Gonzalez *et. al.* (1997) showed that onion yield was higher when bioterra along with 50% of recommended dose of fertilizer was applied than 100% of recommended dose of fertilizer.

Gunderson *et. al.* (2000) recorded that in organically grown onion and peas concentration of all 63 nutrients were significantly different than grown in case of conventional method.

Yadav & Yadav (2001) reported that combined application of organic and inorganic sources of nutrients produced higher onion yield than inorganic or organic source only. They also found that sole application of organic nutrients produce less yield than inorganic source.

Sankar and Tripathi (2001) revealed that in onion, application of organic sea weed extract (from naturally grown marine plants) at 30,45 and 60 DAT respectively with chemical fertilizer increased the yield as well as yield attributing characters than only chemical fertilizer application. It was observed by Yadav and Yadav (2001) that applying NICAST (concentrated manure with crop waste of tobacco and castor) or FYM in combination with recommended dose of chemical fertiliser resulted in more bulb yield of onion than in case of sole FYM or NICAST or recommended dose through chemical fertilizer.

**Others**

Loes *et. al.*, (2000) showed that in case of beet root and cabbage the nitrogen content increased in crops when organically grown than by grown conventionally.

**Cropping pattern or combination of crops :**

Segura *et. al.*, (1999) reported that application of commercial manure (poultry manure, guano and concentrated vinassac mixture) produced higher

marketable yield of melon and tomato respectively in mellon-tomato cropping patern than FYM applciation but total yield in both the cases was similar.

Jani and Halldri (2000) found that under organic system the native cultivars of crops tomato, cucumber and melon in total gave higher yield than the high yielding varieties. But the modern cultivars gave higher yield in case of conventional system, than organic system.

Willumsen and Throup - Kristensen (2001) suggested that taking green manure corps in organically grown onion and cabbage in two consecutive years leads to sustainable rotation systems and legumes should be included if the soil has lower status of nitrogen level.

Bulluck et. al., (2002) advocated that in melon-tomato cropping pattern, though the yield of melon in the first year was not significantly different in soil amended with either synthetic or organic amendments but in second year, the yield of tomato was higher with a historyof organic amendment, regardless of soil amendment types.

## III. Effect of organic amendments on quality of vegetables

### a. Brinjal

Prasanna and Rajan (2001) reported that maximum number of unmarketable fruits were observed in the plants with inorganic fertilizer applciation alone and minimum in plants applied with organic manure alone after 5 days and 7 days of storage after harvesting of brinjal.

**b. Other solanaceous crops :**

**Tomato**

Dahlstedt and Dlouhy (1995) recorded that organically grown tomatoes had a higher calcium and sucrose content but lower pH than conventionally grown tomato. Haglund and Johansson (1995) suggested that conventionally grown tomatoes gave firmer and acidic fruits than orgnically grown crop. Duraiswamy *et. al.*, (1999) reported that organic amendment. (composted coir pith application) in case of tomato crop did not vary with that of recommended dose of chemical fertilizer application, considering the TSS and acidity.

Nanthakumar *et. al.* (1999) revealed that combined application of FYM, *Azospirillum sp.* and Phosphobacteria with 75% of recommended dose of fertilizer resulted in highest keeping quality, lowest cumulative physiological loss in weight and best general appearance of the fruit compared to the ones treated only with full dose of recommended chemical fertilizer application.

Reddy (1999) found that tomato fruit quality was best when applied with 20t of urban refuse compost per hectare from among 10t, 20t and 30t respectively. Lin Chunchu and Huang Lianghua (2000) showed that application of chicken manure, peanut cake, tea seed cake either singly or in combination increased the fruit quality of cherry tomato.

Quattrucci (2000) showed that differnt formulations of organic and organo-mineral fertilizers or traditional NPK (inorganic) sources had similar effect on tomato fruit colour and TSS. Xu Huilian (2000) found that

the concentration of sugar and inorganic acids and Vitamin C were higher in fruits of tomato plants applied with bokashi (poultry manure with or without microbial inoculation) than fruits from other treatments including chemical fertilizer treatment.

**Potato**

Warman and Havard (1994) opined that application of compost (cow dung and straw) to potato crop increased the differnt mineral and vitamin content than conventionally grown crop.

Dahlstedt and Dlouhy (1995) could find no difference in cooking quality of tubers in case of conventional and organic system of growing potatoes.

Jorhem (1995) reported that presence of heavy metal cadmium did not differ in case of organically grown and conventionally grown potato.

**c. Other vegetables :**

**Carrot**

Dahlstedt and Dlouhy (1995) found hat conventionally grown carrots had higher β- carotene but which decreased more during storage in case of organically grown carrots. But fungal attack after storage was lower in case of organically grown carrots. Haglund and Johansson (1995) opined that taste and texture were significantly different in case of organically grown carrots and conventionally grown ones, the latter being better.

Cucurbitaceous crop

Kucinskas and karbauskiene (2000) suggested that non-fractionated vermicompost application @ 10t/ha resulted in decreased nitrate content

and increased ascorbic acid content reflecting best quality fruits in cucumbers than vermicompost application @ 20 t/ha.

Bage *et. al.* (2000) observed that thicker green portion of flesh, high TSS and higher number of seeds per fruit was obtained in case of mahua cake applciation in pumpkin than other sources of oil cakes. Seed weight was highest with cow dung manure application.

**Other**

Santos *et. al.* (2001) reported that increased levels of organic compost use resulted in smaller fresh weight loss in shelf life of lettuce.

**IV. Effects of organic amendments on pest, pathogen and weed control**

**a. Brinjal**

Siddiqui and Alam (1999) opined that among oil cakes of caster,neem, groundnut,mustard and two insecticides (Carbofuran and aldicarb) neem cake could control the nematodes in brinjal crop (cv. PPL) much effectively than others and it's efficacy persisted even in the subsequent crop of tomato cv. Pusa Ruby.

Singh (2000) noted that application of neem based products like neem cake and neem oil were at par with neem based insecticide or other chemical insecticide in controlling brinjal fruit and shoot borer, but were not much more profitable than chemical insecticide.

Rao and Reddy (2001) concluded than neem cake application alongwith introduction of fungus *Glomus mosseae* with *Pacilomyces lilacinus* significantly reduced the nematode infestation (*Meloidogyne incognita*).

Chakraborti (2001) found that to control brinjal fruit and shoot borer a biorotatinal approach was the best and stable method involving application of fresh neem cake @ 3 kg/sqm at nursery bed, fresh neem cake @ 1 kg/ plant at land preparation, foliar application of NSKE @ 7 ml/lire water at 7 days interval (Starting form 32 DAT) single application of carbofuran @ 5 g a.i./plot at 30 DAT and root zone application of benzene @ 1 ml a.i./plant once every 30 days starting 30 DAT drastically reduces the pest infestation. This cuts down heavy use of synthetic chemical with much reduced infestation of insects.

b. **Other Solanacous Vegetables**

**Tomato**

McSorely *et. al.* (1999) reported that in organically grown tomato-pepper combination with pepper taking tomato in summer with soil authorisations the effective method for controlling nematode infestation.

Barbolina and Arkhipchenko (1999) found that nematode infestation in tomato crop was significantly reduced when bamil was applied (wastes of animal breeding farm) than mineral fertilizer application only.

Sipes *et. al.* (1999) suggested that a combination of nematicide along with ground sesame product and chicken manure be taken to have effective control of nematode in tomato crop.

Cucchi (2000) noted that organic sources (neem based) as amendments cut down costs of plant protection measure and also result in minimizing pest and pathogen attack in tomato.

Joshi *et. al.* (2000) concluded that tomatoes grown in nematode (M. incognita) infected soil responded to application of leaves of *Nyctanthes arborea, Annona squamosa* and neem, roots of *Tephrosia purpurea*, compost, suwdust ,fly ash in significantly controlling the nematode injury.

It was observed by Wang Ran *et. al.* (2000) that tomato plants grown with organic fertilizer exhibited higher resistance to *Phytopthora infestants* than with chemical fertilizer application as the nitrogen metabolism was such that it led to resistance. Thornsbury *et. al.* (2000) observed that organic cultivtion resulted in economic control of weeds and pests in tomato crop.

Nagesh *et. al.* (2001) revealed that supplementation of caster and neem cake with inorganic fertilizer had additive effect in mycellial growth of *Pcilomyces lilacinus* which controlled the rootnot nematode infestation in tomato.

Letourneau and Goldstein (2001) opined that orthopod damage to tomato crop was similar in organically grown and conventional system which was due to higher natural enemy and greater species richness of all functional groups of orthopods (herbivores, predator and others) in organically grown tomatoes.

**c. Other Vegetables :**

Schmalzle (1990) noted that in case of inorganic compost mulch application in carrot weed infestation was least compared to conventional agriculture.

**Chilli**

Kathikeyan *et. al.* (1994) reported that biological control of *Pythium aphanidermatum* and *Meloidogyne incognita* in chilli crop were enhanced when applied with in combination of organic amendments like FYM and neem cake.

Rajapakshe (2000) concluded that incidence of *Aulacophora sp.*, a major pest of cucurbitaceous crops was least in case of organic agriculture than in conventional agriculture.

**v. Effect of Organic amendments on economics of vegetable production :**

**Tomato**

Clark *et. al.* (1999) concluded that four years rotation crop of tomato was the more profitable economically when adopting organic system than conventional system. Duraiswamy *et. al.* (1999) found that the benefit cost ratio was highest in case of rainfed tomatoes applying 75% recommended dose with composted coir pith than applying 100% recommended fertilizer dose.

**b. Other vegetables**

**Okra**

Ushakumari *et. al.* (1999) observed that application of vermicompost or insitu application of worms significantly reduced the cost of cultivation of okra.

**Others**

Schmalzle (1990) suggested that, for large scale vegetable growing, it is better to go for organic compost mulch method which gives highest net return per unit labour input i.e. twice of normal organic or conventional method. But, Igbokwe *et. al.* (1996) reported profits from three farming systems namely organic, transitional and conventional system were comparable while taking differnt vegetable crops like cowpea, collard and tomato.

**vi. Effect of organic amendments on soil and environment health**

Stoffella and Li (2001) suggested that compost, as a soil amendment can improve physical, biological and chemical characterstic of soil, with precautions for human pathogen,heavy metals and plant phytotoxicity.

**a. Solanaceous crops :**

**Tomato**

Igbokwe *et. al.* (1996) reported that soil extractable plant nutrient content were generally highest in transitional and organic system than conventional one. Balasubramanium *et. al.* (1998) found that tomato cultivation with composted coir pith application along with chemical fertilizers favourably influenced residual soil fertility than applying chemical fertilizers only.

Cucchi (2000) suggested that proper tillage, soil amendment with organic fertilizers, choice of varieties can lead to optimum utilisation and upkeep of environmental resources like soil. Lin Chunohua and Huang Lianghua (2000) showed that nitrate content in drained water from soil was reduced when chicken manure mixed with tea seed cake was used reducing environmental pollution.

Thornsbury *et. al.* (2000) reported improved long term soil biological, chemical and physical properties particularly of infertile soil in organic farming. The environmental concerns include heavy metal or human pathogen particularly with compost derived from biosolid feed stocks. Yadav and Yadav (2001) reported that combined appication of FYM and recommended dose of NPK through chemical fertilizers had higher benefit cost ratio than sole application of FYM in cabbage and onion.It was found that Renuka and Ravisankar (2001) that pH of soil after application of organic amendments in tomato crops grown alkaline soil tended towards neutrality.

**Pepper**

Baquero and Pinto (2000) expressed that cultivtion of pepper in organic system resulted in soil favoured with higher nutrient levels of calcium, magnesium and phosphorus than in case of conventional method.

**b. Others**

Keipert *et. al.* (1990) found that when vegetable plots were applied with compost, the soil pH, organic matter,phosphorus and magnesium contents increased but potassium content decreased. Also when wheat or barley straw was used that resulted in higher biological activity and stable soil structure.

# CHAPTER - III

# MATERIAL AND METHODS

# MATERIALS AND METHODS

The materials used for the experiment and proceedures or methods adopted in course of the investigation have been described in this chapter.

**Experimental Site :**

The experiment was conducted at the All India Coordinated Vegetable Improvement Project, Department of Horticulture, Orissa University of Agriculture and Technology, Bhubaneswar, during August 2001 to September 2002. The exact site is located in the orchard premises near Khandagiri. The place is situated at $20^0$ 15' N latitude and $85^0$52'E longitude with an elevation of 25.9 m above the mean sea level and nearly 64 km west of Bay of Bengal.

**Climate and weather conditions :**

The experiment site experiences a warm and moist climate with hot and humid summer and a short mild winter. The mean monthly maximum and minimum temperature varied between 28.3°C to 39°C and 13.6°C to 26.4°C respectively during the period of study. The maximum rainfall was received in the month of August 2002 followed by August 2001 (514.4 cm and 450.6 cm respectively). There was no rainfall during December 2001 and February 2002. The bright sunshine hour was highest in February 2002 (9 hours/day). The other details of weather parameters during the period of investigation from August 2001 to September 2002 have been presented in the Appendix -I as per meteorological data recorded from crop weather observatory, OUAT, Bhubaneswar.

## Soil Characteristics

Prior to layout of the field, soil samples were collected from several randomly selected spot upto a depth of 15 cm and were mixed together to obtain a composite sample of nearly 500 g following process of quartering. After proper shade drying and processing, it was used for chemical analysis to determine pH, available phosphorus, available potassium, organic carbon and mineralizable nitrogen.

**Table - 1 : Chemical composition of Initial soil sample**

| Chemical properties | Composition | Method employed | Nutrient status |
|---|---|---|---|
| pH | 4.18 | Glass electrode Beckman's pH meter with soil : water in 1:2.5 suspension Jackson (1967) | |
| Available P (kg/ha) | 84 | Bray's 1 method Bray & Kurtz (1945) | High |
| Available K (kg/ha) | 145 | Flame photometer | Medium |
| Organic C (%)<br>(g / kg soil) | 0.202<br>2.02 | Walkely and Black's Wet oxidation method Page *et. al.* (1982) | Low |
| Mineralizable N (kg/ha) | 130.9 | Estimated from organic matter content | Low |

**Cropping history of the site :**

At the same experimental site, the previous crop grown was tomato

**Collection of planting materials :**

Seeds of brinjal and okra were collected from All India Co-ordinated Vegetable Improvement Project, Department of Horticulture, OUAT, Bhubaneswar.

**Details of experiment**

The field experiment was laid out in a Randomized Block Design (Fig. 1). The area of the experimental site was divided equally into 3 blocks representing the number of replications. Each block was divided into 8 plots in which treatments were randomly allocated.

Particulars

| | | |
|---|---|---|
| Total no.of plots | : | 24 |
| Net plot area | : | 3.0m x 2.7 m = 8.1 sqm. |
| Gross plot size | : | 3.3 m x 3.0 m = 9.9 sqm |
| Width of bund | : | 30 cm |
| Width of irrigation channel | : | 40 cm |
| Area of experimental site | : | 20.8 m x 14.4 m = 300 sq.m. |

**CROPS**

a. Brinjal

| | | |
|---|---|---|
| Spacing | : | 60 cm x 45 cm |
| No. of rows | : | 5 |

No. of plants/row : 6

No. of plants/plot : 30

b. Okra

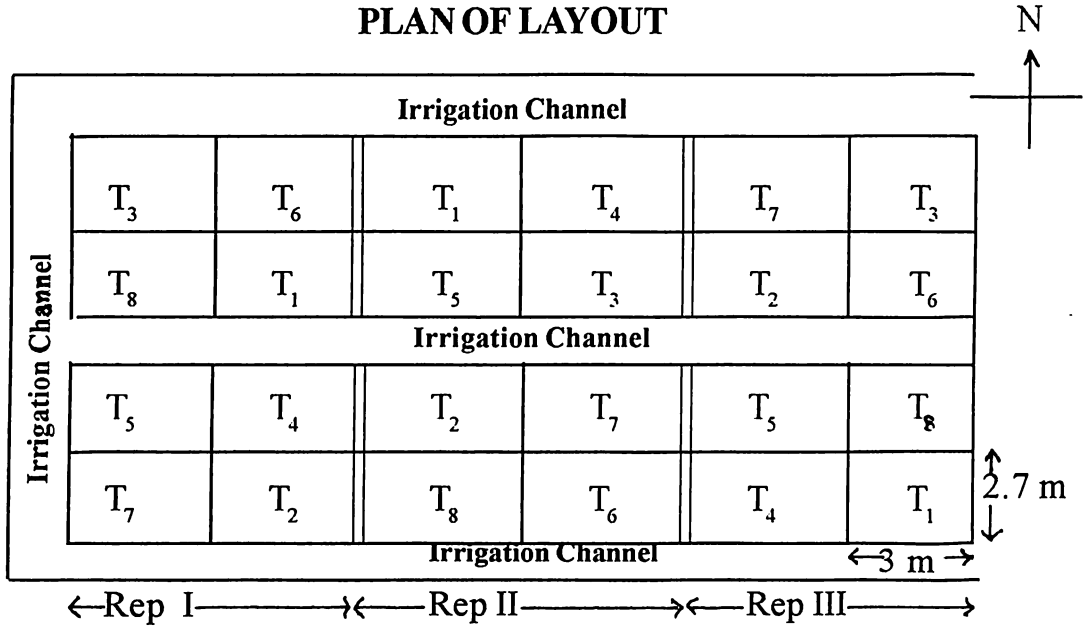
Spacing : 50 cm x 30 cm

No. of rows : 6

No. of plants/row : 9

No. of plants/plot : 54

**PLAN OF LAYOUT**




Net plot size : 3.0 m x 2.7 m

**Details of treatment combinations**

$T_1$ - Recommended dose of NPK through chemical fertilizers (Control)

$T_2$ - FYM @ 20 t/ha

$T_3$ - FYM @ 10t/ha + Recommended dose of NPK through chemical fertilizers

$T_4$ - Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers

$T_5$ - Vermicompost @ 5t/ha

$T_6$ - Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizers

$T_7$ - Pressmud @ 10t/ha

$T_8$ - Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

All these treatments were applied to brinjal crop. The okra crop was raised on the residual levels of organic amendments after the brinjal crop was dismantled, alongwith recommended dose of fertilizers for okra in the same treatment plots.

## EXECUTION OF EXPERIMENT

### A. BRINJAL CROP

### 1. Nursery bed preparation and sowing of seed :

A nursery bed of 3 m x 0.9 m size was prepared after ensuring good tilth. On first August 2001, 15 g seeds of the variety BB-44 (Utkal madhuri) were treated with Thiram @ 3g/kg of seed and then they were sown in lines at a depth of 2 cm. Seeds were covered with fine soil and straw and regularly watered with a rose can.

### 2. Land preparation :

The experiment site was brought to a good tilth by cross ploughing with tractor, levelled and divided into 24 subplots for allocation of treatments with provision of irrigation channel

## 3. Allotment of treatments to the plots :

The treaments were randomly allotted to the experimental plots in each block representing a replication, as per random table procedure.

## 4. Manures and fertilizers :

The brinjal crop was given a recommended dose of N : $P_2O_5$ : $K_2O$ @ 125 : 50 : 75 kg/ha in the form of urea, single super phosphate and muriate of potash respectively. Nitrogen was applied in 3 splits, one basal (20%) and two top dressings (40% each). Entire phosphorus was applied as basal. Potassium was applied in 2 splits, 50% each as basal and one top dressing. Entire amount of FYM, vermicompost, neem cake and pressmud were applied as basal according to the schedule of the treatments given in Table - 3. The photographs of these organic amendments have been given on Plate - I.

**Table -2 : Organic amendments used, rate of application and source**

| Manure with dose of application | Actual rate of application in the experimental plots | Source of manure |
|---|---|---|
| FYM @ 20 t/ha | 16.2 kg/plot | Purchased locally |
| FYM @ 10 t/ha | 8.1 kg/plot | Purchased locally |
| Neem cake @ 5 q/ha | 0.4 kg/plot | Purchased locally |
| Vermicompost @ 5 t/ha | 4.05 kg/plot | Regional Research and Technology Transfer |
| Vermicompost @ 2.5 t/ha | 2.05 kg/plot | Station, Central Farm OUAT, Bhubaneswar. |
| Pressmud @ 10 t/ha | 8.1 kg/plot | Shakti Sugar mills Dhenkanal, Orissa. |
| Pressmud 5 t/ha | 4.05 kg/plot | |

**5. Transplanting :**

When the seedlings were one month old, transplanting was carried out in the evening hours. The nursery bed was watered and one hour after that the seedlings were uprooted carefully and transplanted in the experimental plots.

**6. Intercultural operations :**

**a. Gap filling** : Periodical observations were carried out to detect the mortality and gap filling with plants from the nursery bed was done immediately.

**b. Hoeing, weeding and earthing up :**

The first hoeing cum hand weeding was carried out at 25 DAT. Two more hoeing cum weedings were done later as per requirement. Also two earthing up operations were done after each top dressing.

**c. Irrigation :**

At an interval of seven days irrigation was provided.

**7. Plant protection measures :**

Blitox 50 @ 4 g/litre was applied 3 times to protect the plants from phomopsis blight. One spray of endosulphan @ 0.05 % was done before flowering. Sevin was sprayed @ 3g/litre to protect the plants from fruit and shoot borer attack.

**8. Harvesting :**

When the fruits attained edible maturity but were still soft and had glossy appearance, harvesting was carried out. It was done at an interval of 7 days starting from 10th January, 2002 to 8th March, 2002.

## B. OKRA CROP

### 1. Land preparation

After the first crop of brinjal was over, the same plots were once again prepared by digging, weeding and levelling in order to raise the next crop of okra. All the original plots, with bunds and channels, were kept intact for the purpose.

### 2. Application of fertilizers

In the okra crop, fertilizers were uniformly applied to all the plots @ 80 kg N, 40 kg $P_2O_5$ and 40 kg $K_2O$ per hectare., Urea was applied in three splits out of which 20% was given as basal and rest in two equal splits of 40% each. The first and second top dressings were done at 15 and 30 DAS respectively. Full dose of recommended single super phosphate was applied as basal. Muriate of potash was applied in two splits, half as basal and half as top dressing. No manures were applied to okra in order to see the residual effect of organic amendments which were applied to the brinjal crop.

### 3. Sowing :

Seeds of okra variety Utkal Gaurav (BO-2) were sown on 24th June, 2002 after being treated with Thiram @ 3g/kg of seed. Rows were spaced at 50 cm and plants in a row at 30 cm.

### 4. Intercultural operations

a. **Hoeing, weeding and earthing up** : The okra crop was hoed, weeded and earthed up twice during the crop season and this coincided with the two top dressings.

**b. Irrigation** : Only during the rain less period the crop was irrigated at an interval of 4 to 5 days.

**5. Plant protection measures :**

To protect the plants from attack of Cercospora leaf spot disease, the crop was sprayed 3 times with carbendazim (bavistin) @ 2 g/litre of water.

**6. Harvesting**

Harvesting started at 45 DAS and was done on every alternate day to avoid fibre formation of the fruits.

**Collection of Experimental Data :**

**Sampling procedure**

Five plants at random from each plot were tagged for the purpose of recording experimental data, leaving a row of border plants on each side. The data on following characters were observed from these tagged plants.

**A. BRINJAL**

**1. Plant height :**

The heights of the sample plants of each treatment plot were measured at the time of final harvest from the ground level to the highest point of growth by a metre scale and recorded in centimetres. The average of five sample plants was calculated to get the height of plant in centimetres.

**2. Number of primary branches**

The number of primary branches arising from the main stem of the sample plants of each treatment plot were counted at the time of final harvest

of the crop and recorded. The average of the 5 sample plants was calculated to get the number of primary branches for each treatment plot.

**3. Leaf area**

Five intact, undamaged leaves were plucked from different branches being fifth from the terminal bud of the sample plants of each treatment plot at the peak growth stage. The leaf area were measured by leaf area meter and recorded in square centimetre. The average leaf area was calculated by dividing by 5 the summed up area of the five sample leaves of each plot.

**4. Days to first flowering**

The date of first flowering in each treatment plot was recorded periodically and days taken for first flowering was calculated from the date of sowing in the nursery bed.

**5. Length of fruit :**

Five random fruits that had attained edible maturity were taken from the sample plants and their lengths were measured by a slide callipers. Measurements were recorded in centimetres. The average of the recorded results was calculated for each treatment plot.

**6. Girth of fruit :**

The diameter of the five freshly plucked fruits which were used for recording fruit length were measured by a slide callipers at the point of maximum girth. Readings were calculated for each treatment plot and multiplied with Pi ($\pi$) for computation of girth of fruits of corresponding plots and the average values were estimated.

## 7. Weight of fresh fruit

The five randomly plucked fresh fruits which were used for recording length and girth of fruit were also used for observing fruit weight. The weights of these five fruits were taken by a physical balance and recorded in grams. The average was calculated for each treatment plot.

## 8. Fruit yield per plot and per hectare :

The fruits harvested periodically from each treatment plot were weighed in grams by a common balance and the yield from sample plants was added to it to get yield per plot. From the results of yield per plot taking into account the area of the plot, the estimated yield from 1 hectare was calculated by multiplying the hectare factor.

## 9. Incidence of shoot and fruit borer :

The fruits harvested periodically from each treatment plot were observed for any incidence of shoot and fruit borer. The weight of fruits showing fruit borer infestation was calculated as the percentage to total weight of fruits plucked from the plot. Thus from each treatment plot, the percentage of fruit borer incidence was recorded.

## 10. Total soluble solids (TSS)

Fruits harvested at edible mature stage were crushed using a mortar and pestle after cutting them into small pieces using a knife. The crushed material was strained using a muslin cloth to get the juice A drop of the juice was taken and TSS was observed using a refractometer and the reading was recorded in degree brix ($^0$B)

## B. OKRA

### 1. Plant height

In the similar manner as done in case of brinjal, the plant height of okra of each treatment plots was measured in centrimetres.

### 2. Nodes per plant

The number of nodes in the sample okra plants were counted at the time of final harvest of the crop and recorded. The average of the five sample plants was calculated to get the nodes per plant for each treatment plot.

### 3. Fruits per plot

The total number of fruits from each plot harvested periodically were counted and recorded each time. The sum was calculated to get the number of fruits per plot.

### 4. Weight of fruits

Ten fruits that attained edible maturity were randomly plucked for the sample plants of each treatment plot, the weight of these ten fruits were taken by a physical balance and recorded in grams. The average was calculated for each treatment plot.

### 5. Yield per plot and per hectare

The fruits harvested,. periodically from each treatment plot were weighed in grams using common balance and the yield from the sample plants were added to it go get yield per plot.

The yield from one hectare area was estimated by multiplying the yield per plot obtained as above with the hectare factor.

**C. Brinjal-Okra cropping pattern**

**Gross yield** : In order to arrive at the gross yield of the brinjal-okra cropping pattern in respect of each treatment, the individual yields of the brinjal crop and the succeeding okra crop raised in a particular plot of a specific treatment, were added. The observation which was in terms of kg/plot was converted to q/ha by multiplying the hectare factor.

**Economics in Organic Farming**

**A. Brinjal** :The cost of cultivation of brinjal crop for different treatments were estimated for 1 hectare area taking into consideration the input costs like fertilizer, manure, labour and others. The total income was also estimated for different treatments for 1 hectare area and thus benefit cost ratio for different treatments were calculated as :

$$\text{Benefit cost ratio} = \frac{\text{Gross income}}{\text{Total cost of cultivation}}$$

**B. Okra** :In similar manner as in case of brinjal, the cost of cultivation, total income and benefit cost ratio were estimated for 1 hectare area, for different treatments.

**C. Brinjal-Okra Cropping pattern** : Estimation of total cost of cultivation of the brinjal-okra cropping pattern was done by adding up the respective in put costs of brinjal and okra, for respective treatments. Similarly

the total income from the cropping pattern was also estimated as well as the benefit cost ratio.

**Laboratory Analysis of soil**

After dismantling of brinjal crop, soil samples were collected from each treatment plot in each replication following quartering method and were analysed replication wise in the same manner as was done in case of initial soil sample, the procedure of which has been described earlier in this chapter.

Again, after the okra crop was fully harvested, soil samples were collected in similar manners drawing a composite sample from three replications of each treatment and their analysis was done in the similar manner.

**Statistical Analysis :**

The experimental design adopted for this research work was randomized block design as outlined by Gomez and Gomez (1984). The analysis of variance for each character was carried out with mean values of data collected from five plants per plot and the plot means were used for partitioning of the total variance ascribed to replication, treatment and error.

The form of analysis of variance (ANOVA ) is presented in the table :

**Table- 3 :ANOVA for Randomised Block Design.**

| Sources of variation | Degrees of freedom (df) | SS | MSS=SS/df | Calculated F | Tabulated at level of significance | |
|---|---|---|---|---|---|---|
| | | | | | 5% | 1% |
| Replication | *r-1 | RSS | RMS | RMS/EMS | | |
| Treatment | *t-1 | TrSS | TrMS | TrMS/EMS | | |
| Error | (r-1)(t-1) | ESS | EMS | | | |
| Total | rt-1 | TSS | RMS | | | |

* r and t refer to the number of replications and treatments respectively.

The test of significance of difference between replications and among treatments for the characters was done by 'F' test. The significant difference between the means of two treatments was tested by 't' test and critical difference (CD) was calculated as follows :

1. $SE(m) \pm$ for treatment $= \sqrt{EMS} / r$

   where EMS = Error mean sum of square

   r = Number of replications

2. CD (at 5% level of significance) or CD (0.05) for treatment means

   $= \sqrt{2 \times SE(m)} \times t$ at 5% level at error df.


**Organic amendments used in the experiments**

**No. 1 →** **FYM (Farm Yard Manure)**
**No. 2 →** **Neemcake**
**No. 3→** **Vermicompost**
**No. 4→** **Pressmud**

# CHAPTER - IV

# EXPERIMENTAL FINDINGS

# EXPERIMENTAL FINDINGS

During the course of this investigation, observations were recorded on effects of organic amendments with or without inorganic fertilizers on different characters of brinjal and okra with respect to vegetative growth, yield and yield attributes, quality and pest incidence. In addition to these characters, soil analysis was also undertaken for estimating pH, available, phosphorus, available potassium and organic carbon content. The photographs of these treatments in the field condition are given in plates. The economics of different treatments were also estimated on the basis of relevant data. The findings are presented in the following pages, in tabular form and in graphical illustrations wherever required. The analysis of variance table for different characters are presented in Appendix-II.

## 4.1. BRINJAL

### 4.1.1 Plant height

A perusal of Table-4 & Fig. 1(a) shows that the plant heights of the different treatments ranged form 50.40 cm in case of vermicompost application @ 5 t/ha to 65.07 cm in case of application of recommended doses of NPK through chemical fertilizers. There was statistical parity between the treatments involving application of FYM @ 10 t/ha along with NPK through chemical fertilizers (61.53 cm) and application of recommended dose of NPK alone. Application of recommended doses of NPK through chemical fertilizers alone was proved to be significantly superior to all the other treatments except the one involving use of FYM @ 10 t/ha + NPK through chemical fertilizers. Again, all the treatments except

**Table - 4 : Effect of organic amendments on vegetative characters of brinjal**

| Treatments | Plant height (cm) | Number of primary branches per plant | Leaf area (sq cm) |
|---|---|---|---|
| $T_1$ (Rec. NPK) | 65.07 | 5.27 | 63.82 |
| $T_2$ (FYM @ 20 t/ha) | 51.56 | 4.13 | 44.16 |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 61.53 | 5.07 | 53.43 |
| $T_4$ (Neem cake @ 5 q/ha + Rec. NPK) | 57.15 | 4.73 | 63.58 |
| $T_5$ (Vermicompost @ 5 t/ha) | 50.40 | 3.47 | 44.45 |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 56.15 | 4.17 | 51.95 |
| $T_7$ (Pressmud @ 10 t/ha) | 51.05 | 3.95 | 49.51 |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 51.73 | 4.40 | 47.7 |
| Mean | 55.58 | 4.40 | 52.39 |
| SE(m)± | 2.6 | 0.18 | 3.32 |
| CD (0.05) | 7.95 | 0.54 | 10.06 |

application of neem cake @ 5 q/ha + NPK through chemical fertilizer (57.15 cm) were found to be significantly inferior to application of FYM @ 10 t/ha + NPK through chemical fertilizers.

### 4.1.2 Branches per plant :

It is evident from Table-4 and Fig. 1 (b) that the number of branches per plant in brinjal was the minimum in case of the treatment vermicompost application @ 5 t/ha (3.47) and maximum in case of application of recommended dose of NPK through chemical fertilizer alone (5.27). Application of recommended dose of NPK through chemical fertilizer alone was at par with the treatment involving FYM @ 10 t/ha + NPK through chemical fertilizer (5.07). These 2 treatments were significantly better than the rest. There was no significant difference in respect of branches per plant when either pressmud @ 5 t/ha or neem cake @ 5 q/ha were both used in combination with NPK through chemical fertilizers. Application of FYM alone @ 20 t/ha had the same effect (4.13) as application of pressmud alone @ 10 t/ha (3.95) or application of vermi compost @ 2.5 t/ha with full chemical fertilizer (4.17).

### 4.1.3 Leaf Area

The leaf area of different treatments [Table-4 and Fig. 1 (c)] varied form 44.16 sq cm to 63.82 sq cm. in respect to the treatments involving application of farmyard manure alone @ 20 t/ha and the treatment with recommended dose of full chemical fertilizer alone respectively. As regards statistical significance of the different treatments it was observed that application of recommended doses of NPK alone was significantly superior to all other treatments except neem cake @ 5 q/ha + recommended dose of

application of neem cake @ 5 q/ha + NPK through chemical fertilizer (57.15 cm) were found to be significantly inferior to application of FYM @ 10 t/ha + NPK through chemical fertilizers.

### 4.1.2 Branches per plant :

It is evident from Table-4 and Fig. 1 (b) that the number of branches per plant in brinjal was the minimum in case of the treatment vermicompost application @ 5 t/ha (3.47) and maximum in case of application of recommended dose of NPK through chemical fertilizer alone (5.27). Application of recommended dose of NPK through chemical fertilizer alone was at par with the treatment involving FYM @ 10 t/ha + NPK through chemical fertilizer (5.07). These 2 treatments were significantly better than the rest. There was no significant difference in respect of branches per plant when either pressmud @ 5 t/ha or neem cake @ 5 q/ha were both used in combination with NPK through chemical fertilizers. Application of FYM alone @ 20 t/ha had the same effect (4.13) as application of pressmud alone @ 10 t/ha (3.95) or application of vermi compost @ 2.5 t/ha with full chemical fertilizer (4.17).

### 4.1.3 Leaf Area

The leaf area of different treatments [Table-4 and Fig. 1 (c)] varied form 44.16 sq cm to 63.82 sq cm. in respect to the treatments involving application of farmyard manure alone @ 20 t/ha and the treatment with recommended dose of full chemical fertilizer alone respectively. As regards statistical significance of the different treatments it was observed that application of recommended doses of NPK alone was significantly superior to all other treatments except neem cake @ 5 q/ha + recommended dose of

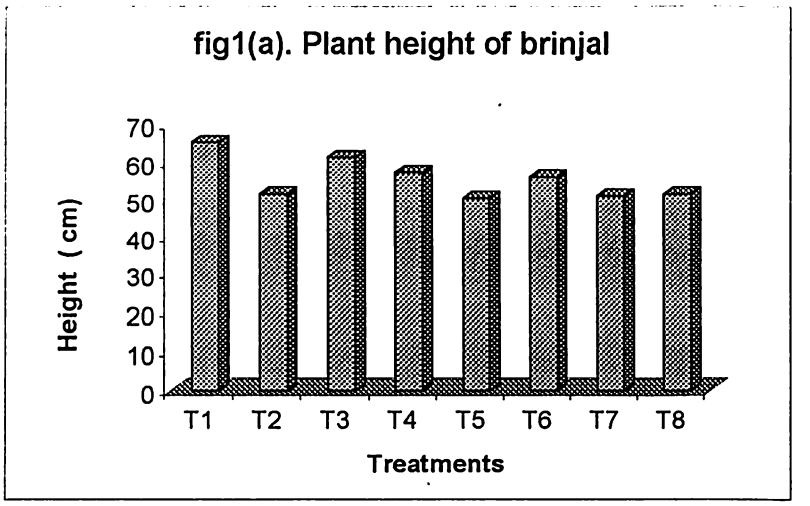


fig1(a). Plant height of brinjal
Height (cm)
70
60
50
40
30
20
10
0
T1 T2 T3 T4 T5 T6 T7 T8
Treatments

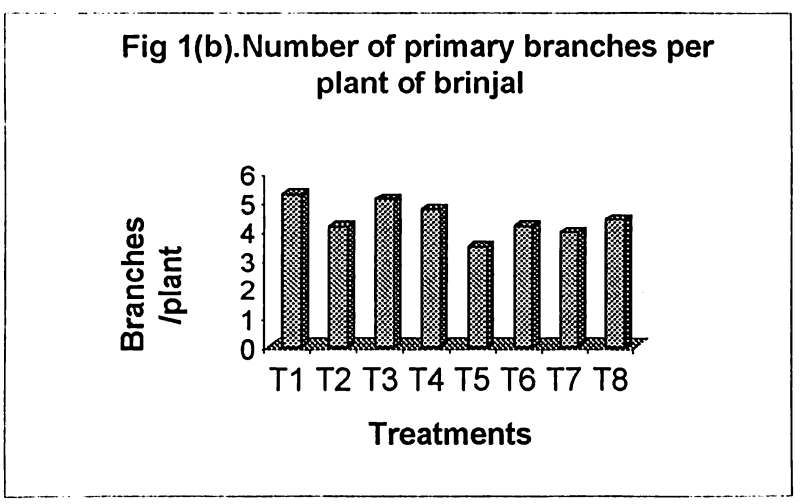


Fig 1(b).Number of primary branches per plant of brinjal
Branches /plant
6
5
4
3
2
1
0
T1 T2 T3 T4 T5 T6 T7 T8
Treatments

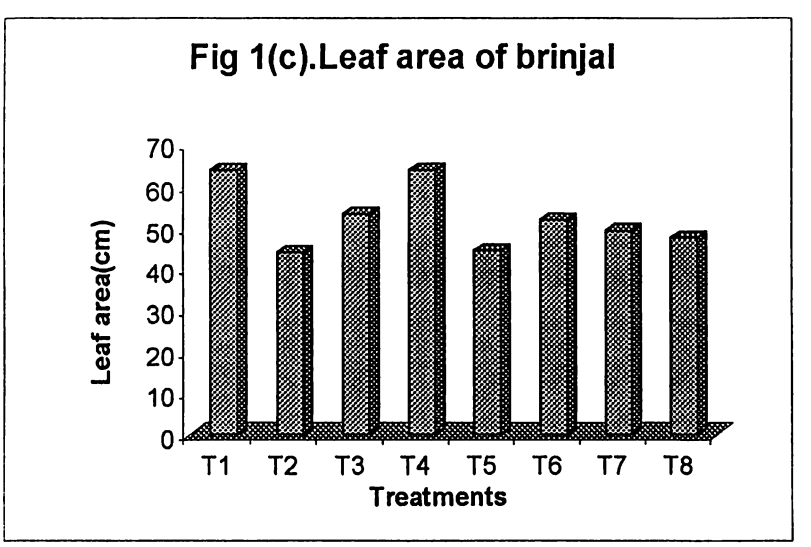


Fig 1(c).Leaf area of brinjal
Leaf area(cm)
70
60
50
40
30
20
10
0
T1 T2 T3 T4 T5 T6 T7 T8
Treatments

NPK through chemical fertilizer. The leaf area did not differ significantly irrespective of the application of FYM @ 10 t/ha or neem cake @ 5 q/ha both in combination with recommended doses of NPK through chemical fertilizers.

### 4.1.4 Days to first flowering

Flowering occurred earliest (78.67 DAS) when neem cake was applied @ 5 q/ha alongwith recommended NPK through chemical fertilizers and this treatment was at par with application of pressmud @ 5 t/ha + recommend NPK [Table-5 and Fig. 2 (a)] The treatment involving application of vermicompost @ 2.5 t/ha + recommended dose of NPK resulted in significant delay in initiation of first flower (90.67 DAS). The rest of the treatments were more or less similar in respect of first flowering.

### 4.1.5. Number of fruits per plant

The data presented in Table 5 and Fig. 2 (b) reveals that there were significant differences among treatments in respect of fruits per plant of brinjal. The best treatments which produced greater number of fruits per plant and were also at par among themselves included application of NPK through chemical fertilizers alone (10.65), FYM @ 10 t/ha + NPK through chemical fertilizer (10.59) and neem cake @ 5 q/ha + NPK through chemical fertilizer (10-18).

The treatments comprising us of organic amendments alone such as FYM @ 20 t/ha (4.64), pressmud @ 10 t/ha (4.1) and vermicompost @ 5 t/ha (1.88) produced relatively fewer number of fruits per plant than other treatments.

### 4.1.6 Length of fruit

Application of pressmud @ 10 t/ha resulted in the minimum fruit length of 8.45 cm while application of pressmud @ 5 t/ha alongwith recommended in organic fertilizers produced the longest fruits to the tune of 10.78 cm [Table-5 and Fig. 2 (c)] . Although other treatments recorded intermediate fruit lengths, the treatments involving application of FYM @ 10 t/ha + recommended dose of inorganic fertilizer (10.63 cm,) followed by the treatments of vermicompost @ 5 t/ha alone were relatively better (9.68 cm). Differences among the treatments were nonsignificant.

### 4.1.7. Girth of fruit

A reference to [Table-5 and Fig. 2 (d)] indicates that there were no significant differences among treatments in respect of the characters under consideration. However, sole vermicompost application @ 5 t/ha resulted in the maximum girth of fruit (11.48 cm) followed by the treatments involving application of recommended doses of NPK through chemical fertilizer alone (11.35 cm) followed by application of FYM alone @ 20 t/ha (11.07 cm). The minimum fruit girth of 9.72 cm was observed on application of pressmud @ 10 t/ha. The other treatments produced intermediate girth of fruits.

### 4.1.8. Weight of fruit

Significantly highest fruit weight of 67.0g was recorded in the treatment composing application of vermicompost @ 5 t/ha which was inturn on par with other treatments such as application of FYM @ 20 t/ha (65.0 g), application of FYM @ 10 t/ha + NPK through chemical fertilizers (63.33g) and application of pressmud @ 5 t/ha + NPK through chemical fertilizers

**Table - 5 : Effect of organic amendments on yield and yield attributing characters of brinjal.**

| Treatments | Days to first flowering (DAS) | No. of fruits/ plant | Length of fruit (cm) | Girth of fruit (cm) | Weight of fruit (g) | Yield (q/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 84.33 | 10.65 | 9.13 | 11.35 | 49.67 | 195.43 |
| $T_2$ | 84.33 | 4.64 | 9.35 | 11.07 | 65.0 | 110.24 |
| $T_3$ | 84.67 | 10.59 | 10.63 | 10.49 | 63.33 | 247.16 |
| $T_4$ | 78.67 | 10.18 | 9.16 | 10.8 | 50.0 | 187.28 |
| $T_5$ | 81.0 | 1.88 | 9.68 | 11.48 | 67.0 | 46.54 |
| $T_6$ | 90.67 | 6.54 | 8.79 | 10.59 | 48.67 | 113.33 |
| $T_7$ | 80.67 | 4.1 | 8.45 | 9.72 | 41.67 | 61.85 |
| $T_8$ | 78.67 | 8.21 | 10.78 | 10.77 | 61.0 | 179.01 |
| Mean | 82.88 | 7.1 | 9.49 | 10.78 | 55.79 | 142.60 |
| SE (m)± | 1.65 | 0.419 | 0.68 | 0.47 | 5.36 | 10.06 |
| CD (0.05) | 5.01 | 1.27 | NS | NS | 16.27 | 30.51 |

$T_1$ = Recommended dose of NPK through chemical fertilizers
$T_2$ = FYM @ 20 t/ha
$T_3$ = FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizers
$T_4$ = Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers
$T_5$ = Vermicompost @ 5 t/ha
$T_6$ = Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizers
$T_7$ = Pressmud @ 10 t/ha
$T_8$ = Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

Fig 2(a).Days to first flowering of brinjal

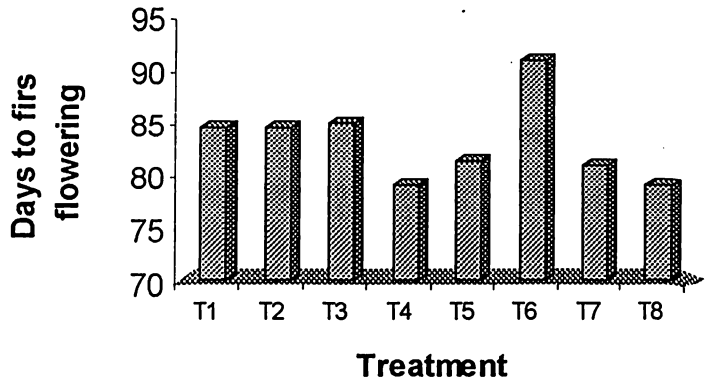



Fig 2(b).Number of fruits/plant of brinjal

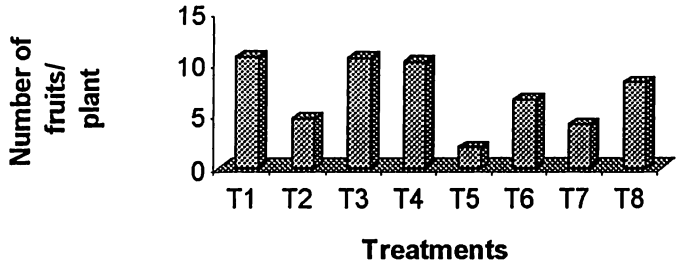



Fig 2 ( c).Length of of fruits of brinjal

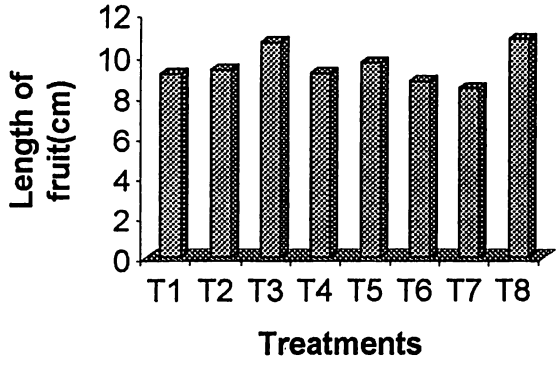


Fig.2(d).Girth of fruits of brinjal

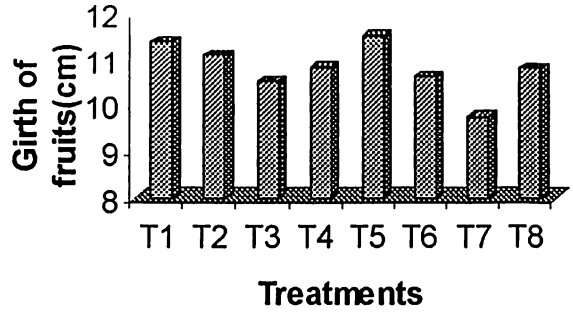



Fig.2(e).Weight of fruits of brinjal

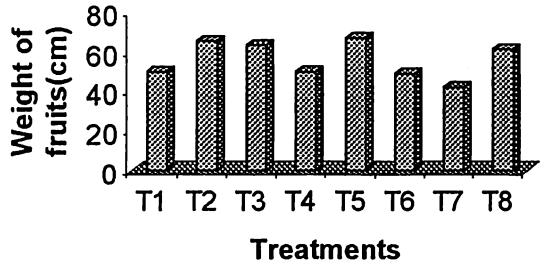



Fig.2(f).Yield of fruits of brinjal

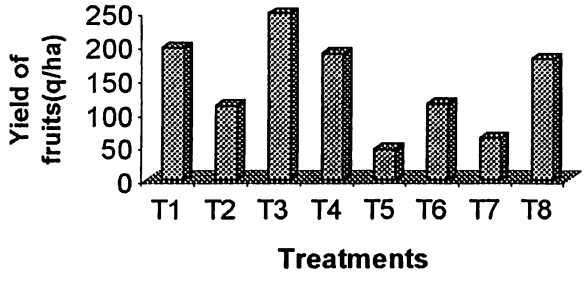
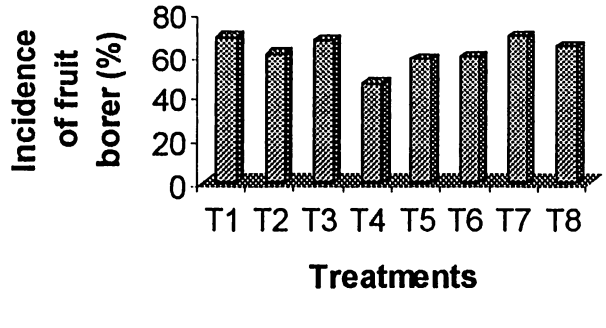



Fig.3(a).Incidence of fruit borer (% )in brinjal



(61.0 g) as evident from Table-5 and Fig. 2 (e) . The minimum fruit weight (41.67 g) was observed in the case of application of pressmud @ 10 t/ha, which was again statistically similar to other treatments such as application of vermicompost @ 5 t/ha+ NPK through chemical fertilizer (48.67 g), use of recommended dos of NPK from inorganic sources (49.67 g) and application of neem case @ 5 t/ha + NPK through chemical fertilizers (50.0g).

### 4.1.9. Yield of fruit

A perusal of Table-5 and Fig. 2 (f) is indicative of the fact that use of FYM @ 10 t/ha + NPK through chemical fertilizers produced the significantly highest fruit yield to the tune of 247.16 q/ha .It was followed by three treatments such as application of recommended NPK through chemical fertilizers (195.43 q/ha), use of neem cake @ 5 q/ha + NPK through chemical fertilizer (187.28 q/ha) and application of pressmud @ 5 t/ha + NPK through chemical fertilizer (179.01 q/ha). The last mentioned three treatments were statistically similar. The minimum fruit yield to the tune of 46.54 q/ha was produced by the treatment comprising of application of vermicompost alone @ 5 t/ha which was again at par with pressmud alone @ 10 t/ha.

### 4.1.10. Percentage incidence of fruit borer

It is observed from Table-6 and Fig. 3 (a) that there were significant differences among the treatments in respect to the percentage of fruit borer incidence by weight. Application of neem cake @ 5 q/ha + NPK through chemical fertilizers was the best treatment in this respect (46.34%) which

**Table - 6 : Effect of organic amendments on quality of vegetables and pest attack in brinjal.**

| Treatments | Total soluble solids ($^0$B) | Incidence of fruit borer in percentage |
|---|---|---|
| $T_1$ (Rec. NPK) | 4.67 | 68.71 (54.96) |
| $T_2$ (FYM @ 20 t/ha) | 3.83 | 60.82 (52.92) |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 5.00 | 67.07(54.99) |
| $T_4$ (Neem cake @ 5 q/ha + Rec. NPK) | 4.67 | 46.37 (44.04) |
| $T_5$ (Vermicompost @ 5 t/ha) | 3.83 | 58.60 (49.76) |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 4.00 | 59.63 (50.56) |
| $T_7$ (Pressmud @ 10 t/ha) | 3.67 | 69.13 (56.28) |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 4.33 | 64.15 (53.29) |
| Mean | 4.25 | 61.8 (52.24) |
| SE (m)± | 0.318 | 1.46 |
| CD (0.05) | NS | 4.44 |

(Figures in parenthesis indicate angular values)

was significantly superior to all the other treatments evaluated. Some of the other treatments which show relatively better effect in reducing the incidence of fruit borer included use of vermicompost alone @ 5 t/ha (58.6%), application of vermi compost @ 2.5 t/ha+ NPK through chemical fertilizers (59.63%) and use of FYM alone @ 20 t/ha (60.82%). The highest incidence of fruit borer was recorded in the treatment involving application of pressmud alone @ 10 t/ha. (69.13%).

### 4.1.11. Total Soluble Solids

Table-6 and Fig. 3 (b) application of FYM @ 10 t/ha + recommended dose of NPK through chemical fertilizer produced brinjal fruits with the highest total soluble solids (5.0$^0$ B) followed by application of recommended dose of NPK through chemical fertilizer (4.67$^0$B).The minimum total soluble solids was obtained in case of pressmud application @ 10 t/ha (3.67$^0$ B). Vermicompost application @ 5 t/ha as well as FYM @ 20 t/ha produced just higher level of TSS (3.83$^0$B) than sole application of pressmud @ 10 t/ha. There were no significant differences among the treaments, with respect to the character under consideration.

## 4.2 OKRA

### 4.2.1. Plant height

A reference to Table-7 and Fig. 4 (a) indicates that significantly highest plant height of okra was obtained on application of FYM alone @ 20 t/ha (66 cm) followed by the treatment comprising pressmud alone @ 10 t/ha (53.13 cm). These two treatments being significantly better than the rest of the treatments. The other treatments in descending order of performance

**Table - 7 : Effect of residual organic amendments applied to previous crop of brinjal on vegetative characters of okra**

| Treatments | Plant height (cm) | Nodes per plant |
|---|---|---|
| $T_1$ (Rec. NPK) | 31.43 | 9.0 |
| $T_2$ (FYM @ 20 t/ha) | 66.00 | 12.33 |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 34.87 | 10.33 |
| $T_4$ (Neem cake @ 5 q/ha + Rec. NPK) | 28.23 | 8.13 |
| $T_5$ (Vermicompost @ 5 t/ha) | 39.57 | 10.53 |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 32.37 | 8.87 |
| $T_7$ (Pressmud @ 10 t/ha) | 53.13 | 11.00 |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 36.13 | 9.2 |
| Mean | 40.22 | 9.925 |
| SE (m) $\pm$ | 1.89 | 1.05 |
| CD (0.05) | 5.72 | 3.05 |

**Table - 8 : Effect of residual organic amendments applied to previous crop of brinjal on yield and yield attributing characters of okra.**

| Treatments | Number of fruits/plot | Fruit weight (g) | Yield of fruit (q/ha) |
|---|---|---|---|
| $T_1$ (Rec. NPK) | 30.67 | 5.83 | 2.2 |
| $T_2$ (FYM @ 20 t/ha) | 167.00 | 10.83 | 22.28 |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 70.67 | 6.50 | 5.56 |
| $T_4$ (Neem cake @ 5 q/ha + Rec. NPK) | 25.67 | 7.50 | 2.38 |
| $T_5$ (Vermicompost @ 5 t/ha) | 61.00 | 7.67 | 5.84 |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 17.00 | 6.33 | 2.10 |
| $T_7$ (Pressmud @ 10 t/ha) | 106.33 | 9.67 | 12.75 |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 46.67 | 7.67 | 4.35 |
| Mean | 66.88 | 7.75 | 7.17 |
| SE (m) $\pm$ | 3.44 | 0.653 | 0.07 |
| CD (0.05) | 10.44 | 1.98 | 2.31 |

Fig.3(b).Total soluble solids of brinjal

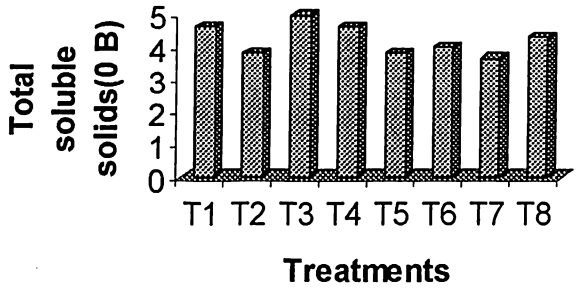



Fig.4(a)Plant height of residual okra

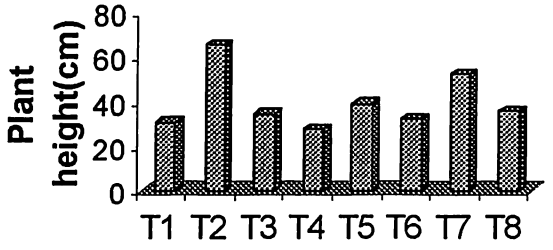
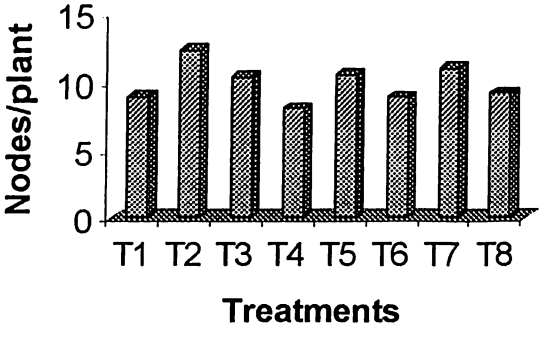



Fig.4(b)Nodes /plant of residual okra



which were also at par among themselves were vermicompost alone @ 5 t/ha (39.57 cm), pressmud @ 5 t/ha + NPK through chemical fertilizers (36.13 cm) and FYM @ 10 t/ha + NPK through chemical fertilizer (34.87 cm) . The minimum plant height of 28.23 cm was recorded in the treatment neem cake @ 5 q/ha + NPK through chemical fertilizers which was again statistically similar to application of recommended dose of fertilizers alone (31.43 cm) and vermicompost @ 2.5 t/ha + NPK through chemical fertilizers (32.37 cm).

### 4.2.2. Nodes per plant

Significant differences were recorded among treatments in respect of above mentioned character [Table -7 and Fig. 4(b)]. The significantly best treatment involved application of FYM @ 20 t/ha (12.33) followed by pressmud alone @ 10 t/ha (11.00), vermicompost alone @ 5 t/ha (10.53) and FYM @ 10 t/ha + NPK through chemical fertilizers (10.33). The least number of nodes per plant were produced in case of the treatment with neem cake @ 5 q/ha + NPK through chemical fertilizers (8.13)

### 4.2.3. Number of fruits per plot

A perusal of Table-8 and Fig. 5 (a) shows that the best treatment was obtained with use of only FYM @ 20 t/ha (167) which was significantly different from others (167). The next best treatment was the application of only pressmud @ 10 t/ha (106.33) which was also significantly different from others .The treatment involving application of FYM @ 10 t/ha alongwith recommended dose of NPK through chemical fertilizer (70.67) was statistically at par with vermicompost application @ 5 t/ha (61.00).

The minimum number of fruits was recorded with application of vermi compost @ 2.5 t/ha + NPK through chemical fertilizer.

### 4.24. Weight of fruit

In respect of the character under consideration the best treatment was found to be application of FYM @ 20 t/ha (10.83g) which was similar to use of pressmud @ 10 t/ha (9.67 g) as is evident from Table-8. These two treaments significantly superseded all the other treatments. The other treaments in descending order of importance were use of pressmud @ 5 t/ ha + NPK through chemical fertilizer (7.67 g), vermicompost alone @ 5 t/ ha (7.67 g) neem cake @ 5 q/ha + NPK through chemical fertilizer (7.5 g) and FYM @ 10 t/ha + NPK through chemical fertilizer (6.5 g). The minimum fruit weight of 5.83 g was recorded when only recommended NPK was applied through chemical fertilizers.

### 4.2.5. Yield of fruits

The highest fruit yield to the tune of 22.28 q/ha, which was significantly superior to the yield of other treatments was recorded with the sue of FYM alone @ 20 t/ha. [Table-8 and Fig. 5(b)] The next best treatments was application of pressmud @ 10 t/ha (12.75 q/ha) which again was statistically different form the other treatment .Moderate level of yields were recorded in the treaments vermi compost @ 5 t/ha (5.84 q/ha) followed by FYM @ 10 t/ha + NPK through chemical fertilizer (5.56 q/ha) and pressmud @ 5 t/ ha + NPK through chemical fertilizers (4.35 q/ha). The last mentioned 3 treatments being statistically similar.

Fig 5(a).No. of fruits/plant of residual okra

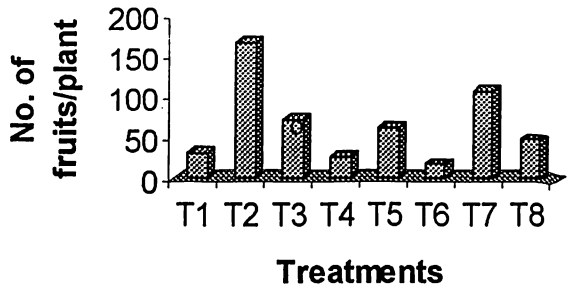



Fig 5(b ).Yield of residual okra

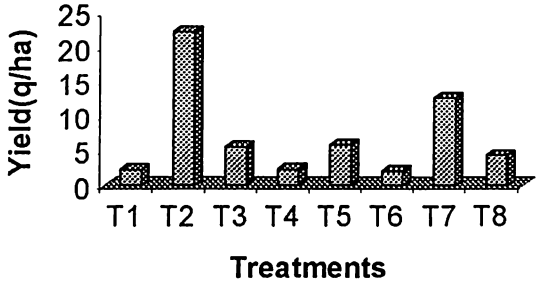



Fig6. Gross yield of brinjal-okra croping pattern

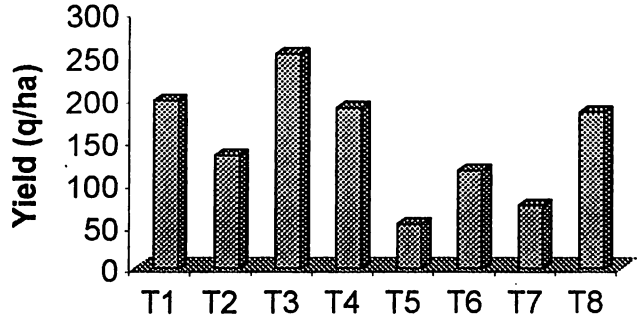


**Table - 9 : Economics of different treatments in brinjal**

| Treatments | Input costs (Rs./ha) | | | | Total cost (Rs/ha) | Total yield (q/ha) | Total income (Rs/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|---|---|
| | Labour | Fertilizer | Manure | Others | | | | |
| $T_1$ | 9550 | 2890 | 0 | 4450 | 16890 | 195.43 | 58629 | 3.47 |
| $T_2$ | 8330 | 0 | 4000 | 4450 | 16780 | 110.24 | 33072 | 1.97 |
| $T_3$ | 9550 | 2890 | 2000 | 4450 | 18890 | 247.16 | 74148 | 3.93 |
| $T_4$ | 9550 | 2890 | 5000 | 4450 | 21890 | 187.28 | 56184 | 2.56 |
| $T_5$ | 8330 | 0 | 5000 | 4450 | 17780 | 46.54 | 13962 | 0.78 |
| $T_6$ | 9550 | 2890 | 2500 | 4450 | 19390 | 113.34 | 34002 | 1.75 |
| $T_7$ | 8330 | 0 | 2000 | 4450 | 14750 | 61.85 | 18555 | 1.26 |
| $T_8$ | 9550 | 2890 | 2000 | 4450 | 17890 | 179.01 | 53703 | 3.0 |

$T_1$ = Recommended dose of NPK through chemical fertilizers
$T_2$ = FYM @ 20 t/ha
$T_3$ = FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizers
$T_4$ = Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers
$T_5$ = Vermicompost @ 5 t/ha
$T_6$ = Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizers
$T_7$ = Pressmud @ 10 t/ha
$T_8$ = Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

**Table - 10 : Economics of different treatments in Okra (as residual crop)**

| Treatments | Input costs (Rs./ha) | | | | Total cost (Rs/ha) | Total yield (q/ha) | Total income (Rs/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|---|---|
| | Labour | Fertilizer | Manure | Others | | | | |
| $T_1$ | 7000 | 2000 | 0 | 4000 | 13000 | 2.2 | 660 | 0.05 |
| $T_2$ | 7000 | 2000 | 0 | 4000 | 13000 | 22.28 | 6684 | 0.51 |
| $T_3$ | 7000 | 2000 | 0 | 4000 | 13000 | 5.56 | 1668 | 0.13 |
| $T_4$ | 7000 | 2000 | 0 | 4000 | 13000 | 2.38 | 714 | 0.05 |
| $T_5$ | 7000 | 2000 | 0 | 4000 | 13000 | 5.84 | 1752 | 0.13 |
| $T_6$ | 7000 | 2000 | 0 | 4000 | 13000 | 2.1 | 630 | 0.05 |
| $T_7$ | 7000 | 2000 | 0 | 4000 | 13000 | 12.75 | 3825 | 0.3 |
| $T_8$ | 7000 | 2000 | 0 | 4000 | 13000 | 4.38 | 1314 | 0.101 |

$T_1$ = Recommended dose of NPK through chemical fertilizers
$T_2$ = FYM @ 20 t/ha
$T_3$ = FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizers
$T_4$ = Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers
$T_5$ = Vermicompost @ 5 t/ha
$T_6$ = Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizers
$T_7$ = Pressmud @ 10 t/ha
$T_8$ = Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

**Table - 11: Economics of different treatments in Brinjal - Okra cropping pattern**

| Treatments | Total yield (q/ha) | Input costs (Rs./ha) | | | | Total cost (Rs/ha) | Total income (Rs/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|---|---|
| | | Labour | Fertilizer | Manure | Others | | | |
| $T_1$ | 197.73 | 16650 | 4890 | 0 | 8450 | 29890 | 59319 | 1.98 |
| $T_2$ | 132.52 | 15330 | 2000 | 4000 | 8450 | 29780 | 39756 | 1.38 |
| $T_3$ | 252.8 | 16650 | 4890 | 2000 | 8450 | 31890 | 75841 | 2.38 |
| $T_4$ | 189.7 | 16650 | 4890 | 5000 | 8450 | 34890 | 56910 | 1.63 |
| $T_5$ | 52.36 | 15330 | 2000 | 5000 | 8450 | 30780 | 15709 | 0.51 |
| $T_6$ | 45.44 | 16550 | 4890 | 2500 | 8450 | 32390 | 34632 | 1.06 |
| $T_7$ | 74.6 | 15330 | 2000 | 2000 | 8450 | 27780 | 22380 | 0.80 |
| $T_8$ | 183.4 | 16550 | 4890 | 1000 | 8450 | 30890 | 55017 | 1.78 |
| Mean | 149.85 | - | - | - | - | - | - | - |
| SE (m) ± | 0.83 | - | - | - | - | - | - | - |
| CD | 2.53 | - | - | - | - | - | - | - |

$T_1$ = Recommended dose of NPK through chemical fertilizers
$T_2$ = FYM @ 20 t/ha
$T_3$ = FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizers
$T_4$ = Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers
$T_5$ = Vermicompost @ 5 t/ha
$T_6$ = Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizers
$T_7$ = Pressmud @ 10 t/ha
$T_8$ = Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

### 4.3. Gross yield of brinjal - okra cropping pattern

Among the different treatments evaluated in the present experiment, [Table - 11 and Fig. 6] the gross yield of the brinjal and okra crops grown in succession each treatment were found to differ significantly. The significantly highest yield to the tune of 252.8 q/ha of fruits were obtained by applying FYM @ 10 t/ha + NPK through chemical fertilizer. There was statistical similarity among the thee treatments which involved use of chemical fertilizers alone (197.73 q/ha), application of neem cake @ 5 q/ha + NPK through chemical fertilizer (189.9 q/ha) and pressmud @ 5 t/ha + NPK through chemical fertilizer (183.4 q/ha). Gross yields were lowest when pressmud @ 10 t/ha (74.6 q/ha) or vermicompost @ 5 t/ha (52.36 q/ha) were applied alone.

### 4.4.1. Economics of treatments in brinjal

Table-9 and Fig. 7 (a) shows that the total cost of cultivation ranged between Rs. 14,750/- per ha in case of application of pressmud only @ 10 t/ha to Rs. 21890.00/ha in case of Neem cake @ 5 q/ha + NPK through chemical fertilizers. The highest gross income to the tune of Rs. 74148.00/ ha could be obtained from the treatment comprising FYM @ 10 t/ha + NPK through chemical fertilizer followed by the treatment NPK through chemical fertilizers only (Rs. 58,629/ha) and neem cake @ 5 q/ha + NPK through chemical fertilizer (Rs. 56,184/ha) The highest benefit cost ratio of 3.93 was obtained form the application of FYM @ 10 t/ha + NPK through chemical fertilizers.

This was followed by other treatments such as application of NPK through chemical fertilizers alone (3.47), pressmud @ 5 t/ha + NPK through

chemical fertilizer (3.00), neem cake @ 5 q/ha + NPK through chemical fertilizer (2.56), FYM @ 20 t/ha (1.97), vermicompost @ 25 t/ha + NPK through chemical fertilizer (1.75) and pressmud alone @ 10 t/ha (1.26).

### 4.4.2. Economics of treatments in residual okra crop

The okra crop was grown after brinjal with uniform application of recommended dose of NPK through inorganic sources, utilising the residual effect of organic amendments application to the first crop. No organics were applied to the okra crop. The total cost of cultivation was uniformly Rs. 13000/ha for all the treaments. [Table-10 and Fig. 7 (b)] The maximum gross income of rs. 6684/ha was achieved from he treatment involving application of FYM alone @ 20 t/ha. That other treaments in descending order of total income were presumed @ 10 t/ha (rs. 3825/-) and vermicompost alone @ 5 t/ha (Rs. 172/-). Relatively better benefit cost ratios were obtained in the treaments such as application of FYM alone @ 20 t/ha (0.51), pressmud alone @ 10 t/ha (0.300, vermicompost alone @ 5 t/ha (0.13) and application of FYM @ 10 t/ha + NPK through chemical fertilizers.

### 4.4.3. Economics of treatments in brinjal - okra cropping pattern

A perusal of [Table - 11 and Fig. 7 (c)] shows the combined economics of different treatments for the cropping pattern as a whole involving both brinjal and okra crops. The total cost of cultivation varied from Rs. 27,780/ ha in case of pressmud alone @ 10 t/ha to Rs. 34,890/ha in the treatment involving use of neem cake @ 5 q/ha + NPK through chemical fertilizers. The gross income cumulated over both the crops was the highest in case of FYM @ 10 t/ha + NPK through chemical fertilizer (Rs. 75816/ha followed by use of NPK through chemical fertilizer alone (Rs. 59290/ha) and neem

Fig 7(a).Economics of treatments in brinjal

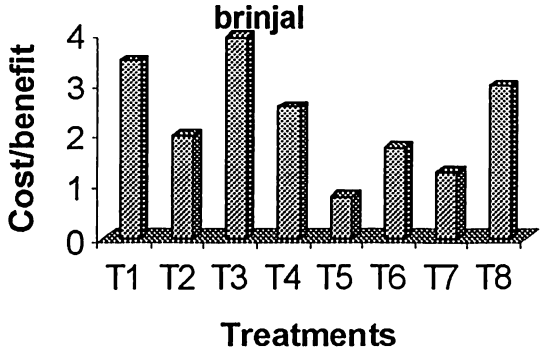



Fig.7(b).Economics of treatments in residual okra

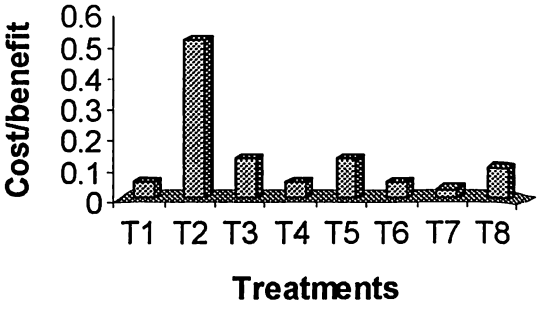
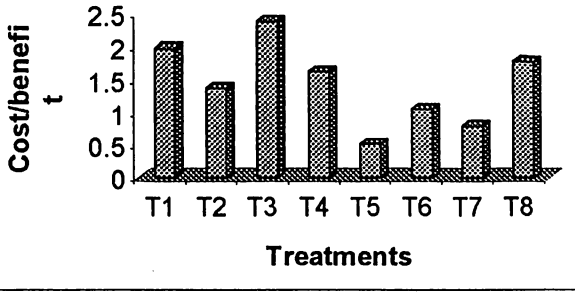



Fig 7(c ).Economics of treatments in brinjal-okra cropping pattern



cake @ 5 q/ha + NPK through chemical fertilizers (Rs. 56900/ha) The lowest gross income amounting to Rs. 15714.00/ha obtained in case of application of vermicompost alone @ 5 t/ha.

The combined benefit cost ratio of brinjal and okra revealed that the best treatment was application of FYM @ 10 t/ha + NPK through chemical fertilizer (2.38). The other treaments which performed well in respect of benefit cost ratio were application of NPK through chemical fertilizers alone (1.98), use of pressmud @ 5 t/ha + NPK through chemical fertilizer (1.78), application of neem case @ 5 q/ha + NPK through chemical fertilizer (1.63) and use of FYM alone @ 20 t/ha (1.33). Vermicompost applied @ 5 t/ha resulted in the lowest benefit cost ratio to the tune of 0.51.

## 4.5 Soil status after brinjal and okra

The soil analysis data are presented in Table 12 and Fig.8

### 4.5.1. Soil pH

After brinjal crop was over, the highest pH value was recorded in the treatment involving application of FYM alone @ 20 t/ha (6.07) followed by use of FYM @ 10 t/ha + NPK through chemical fertilizers (5.95) followed by application of pressmud alone @ 10 t/ha (5.9) and pressmud @ 5 t/ha + NPK though chemical fertilizers (5.19). These pH values were better than that recorded in the treatment involving application of inorganic fertilizers alone (4.50). The general trend also reveals higher pH values in treatments receiving organic amendments either in full on half doses. The pH values uniformly decreased after harvest of okra crop.

**Table - 12 : Effect of organic amendments on soil status in brinjal - okra cropping pattern**

| Treatments | Soil status after brinjal | | | |
|---|---|---|---|---|
| | pH | Organic 'C' (g/kg soil) | Available 'P' (kg/ha) | Available 'K' (kg/ha) |
| $T_1$ (Rec. NPK) | 4.5 | 3.6 | 99.2 | 90 |
| $T_2$ (FYM @ 20 t/ha) | 6.07 | 4.5 | 75.2 | 89.7 |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 5.95 | 4.4 | 93 | 95.3 |
| $T_4$ (Neem cae @ 5 q/ha + Rec. NPK) | 4.9 | 3.7 | 88.5 | 109.2 |
| $T_5$ (Vermicompost @ 5 t/ha) | 4.71 | 3.6 | 96.8 | 90.3 |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 4.23 | 3.4 | 92.1 | 86.3 |
| $T_7$ (Pressmud @ 10 t/ha) | 5.9 | 4.5 | 123 | 105.3 |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 5.19 | 4.0 | 114.8 | 145.7 |
| Mean | 5.18 | 4.00 | 97.8 | 101.5 |
| SE (m)± | 0.4 | 0.44 | 12.8 | 7.78 |
| CD (0.05) | 1.23 | NS | NS | 23.6 |
| Initial soil before brinjal | 4.18 | 2.02 | 84 | 145 |

| Treatments | Soil status after okra (residual organic manure) | | | |
|---|---|---|---|---|
| | pH | Organic 'C' (g/kg soil) | Available 'P' (kg/ha) | Available 'K' (kg/ha) |
| $T_1$ (Rec. NPK) | 4.3 | 2.1 | 86 | 80 |
| $T_2$ (FYM @ 20 t/ha) | 4.43 | 2.8 | 64 | 82 |
| $T_3$ (FYM @ 10 t/ha + Rec. NPK) | 4.2 | 3.0 | 59 | 94 |
| $T_4$ (Neem cae @ 5 q/ha + Rec. NPK) | 4.18 | 2.0 | 51 | 90 |
| $T_5$ (Vermicompost @ 5 t/ha) | 4.6 | 3.4 | 70 | 80 |
| $T_6$ (Vermicompost @ 2.5 t/ha+Rec NPK) | 4.4 | 2.6 | 60 | 78 |
| $T_7$ (Pressmud @ 10 t/ha) | 4.25 | 3.0 | 64 | 90 |
| $T_8$ (Pressmud @ 5 t/ha + Rec NPK) | 4.67 | 2.7 | 50 | 134 |
| Mean | 4.38 | 2.7 | 63 | 91 |

### 4.5.2. Organic carbon

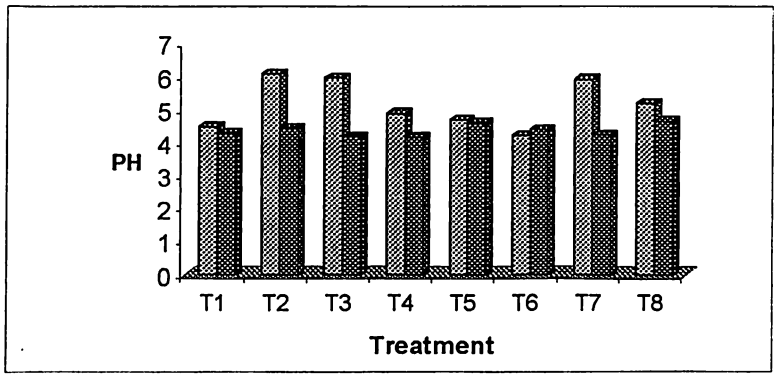
After birnjal the highest value of organic carbon to the tune of 4.5 g/kg soil was observed with the sole application of either FYM @ 20 t/ha or pressmud @ 10 t/ha to soil. The lower value of (3.6) was estimated for the treatment involving use of inorganic fertilizers alone. Generally the treatments which received either full or half doses of organic amendments showed higher organic carbon status except vermicompost application. After okra crop the organic C content declined uniformly but even then relatively superior values were recorded in the treatments receiving organic amendments alone such as FYM, vermicompost and pressmud.

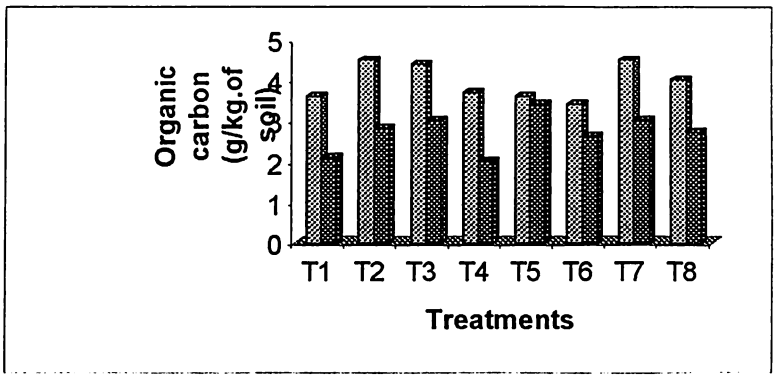
### 4.5.3. Available Phosphorus

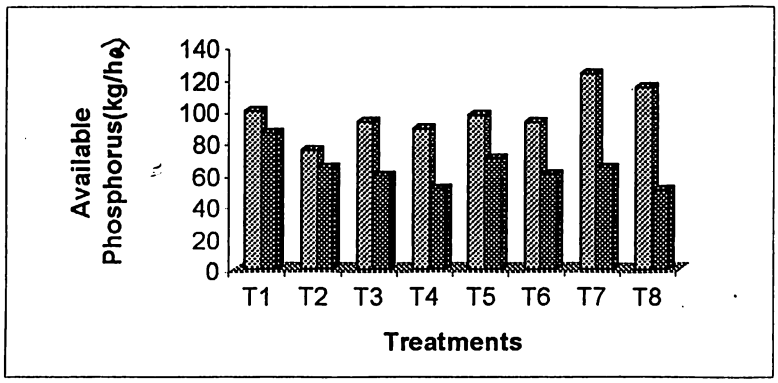
The final status of soil after brinjal crop in respect of available 'P' showed the highest value (123 kg/ha) when pressmud was applied alone and the lowest (75.3 kg/ha) value obtained with the use of FYM alone @ 20 t/ha. Sole application of inorganic fertilizers exhibited soil status of available 'P' to the tune of 99.2 kg/ha. After harvesting of okra crop there was general reduction in the status of available 'P' in the soil and it ranged from 50 kg/ha in the treatment pressmud @ 5t/ha + NPK through chemical fertilizer to 86 kg/ha with the application of inorganic fertilizers.

### 4.5.4. Available potassium

The status of available soil 'K' after harvest of brinjal revealed significant differences among the treatments. Available 'K' ranged from the highest of 145.7 kg/ha in the treatment involving use of pressmud @ 5 t/ha + full NPK to the minimum of 86.3 kg/ha when full NPK was used along with 2.5 t/ha of vermicompost. There was general reduction in potassium level after harvest of okra, but with the treatment involving pressmud @ 5 t/ha + full NPK the potassium level was markedly different from others.



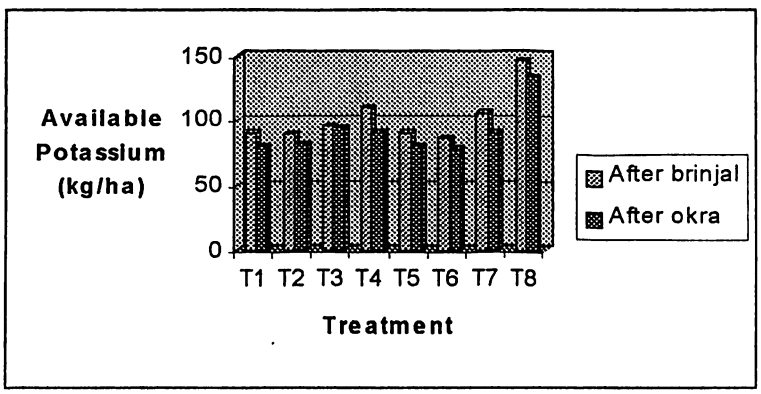




**Fig. - 8 : Soil Status after brinjal and okra**

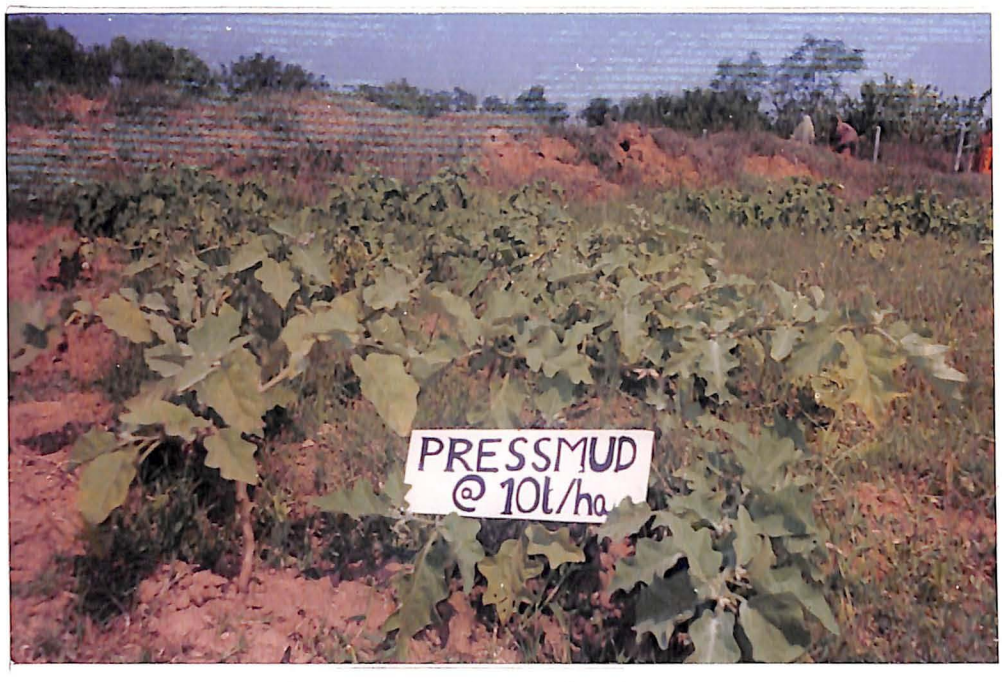

Organic farming in brinjal-okra cropping pattern


Recommended dose of NPK through chemical fertilizers

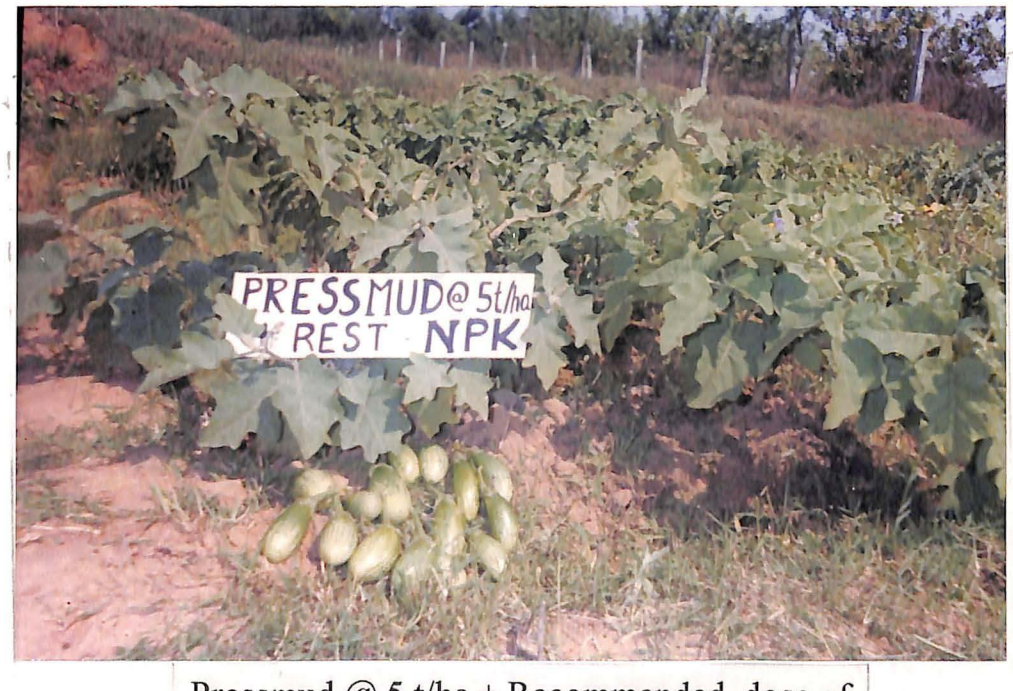

FYM @ 20 t/ha


FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizers


Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizers




Pressmud @ 10 t/ha




Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizers

# CHAPTER - V

# DISCUSSION

# DISCUSSION

The results obtained after conducting the experiment entitled "Studies on organic farming in brinjal- okra cropping pattern" have been discussed in the foregoing.

## 5.1. BRINJAL

### 5.1.1 Plant height

It is observed from the effects of organic amendments with or without fertilizers on the plant height of brinjal, that in general the heights of plant produced as a result of application of organics alone (FYM, vermicompost, and pressmud) were lesser than those obtained by applying inorganic fertilizers alone or in combination with different organics. Similar observations were made by Nirmala and Vadivel (1999) who also reported that a combination of FYM and inorganic fertilizer was superior to application of FYM alone in case of vine length in cucumber.

It is also observed that the combined application of FYM and recommended dose of chemical fertilizer produced less taller plants than incase of application of recommended doses of chemical fertilizer alone. This finding corroborates that of Yadav and Yadav (2001) who reported that onion plants were less taller when applied with FYM @ 30 t/ha along with recommended dose of fertilizer than applied with recommended dose of chemical fertilizers alone.

### 5.1.2. Branches per plant

In respect of branches per plant, three is similarity in case of application of NPK through chemical fertilizer with the application of FYM in combination with NPK through chemical fertilizers. This is in conformity with the findings of Renuka and Ravisankar (2001) and SubbaRao and Ravisankar (2001).

Considering the sole application of different sources of organic manures, branches per plant were significantly more in case of application of FYM than use of vermicompost. Similar finding was reported by Subba Rao and Ravisankar (2001).

### 5.1.3. Leaf Area

In the present experiment involving treatments with organics alone, inorganic fertilizer alone and a combination of organics and inorganic it could be generally inferred that the leaf area of brinjal were higher wherever inorganic fertilizers were used alone or in combination with different levels of organic amendments. This is in contrast to the relatively lesser leaf area derived in general with the application of organic amendments alone, irrespective of the specific types used. This finding is in consonance with that of Nirmala and Vadivel (1999) who opined that a combination of inorganic and organic sources of nutrients applied to cucumber was significantly better than use of organic amendment alone.

### 5.1.4. Days to first flowering

Flowering occured earlierst with application of neem cake pressmud combined with NPk through chemical fertilizers. Application of

vermicompost alone @ 5 t/ha resulted in earliest flowering as indicated by the observation on days to first flowering of brinjal. Other researchers (SubbaRao and Ravisankar, 2001) have also recorded similar observations of earliness to flower in brinjal as induced by the application of vermicompost alone. In the present experiment, most of the treatments were found to be more or less similar in respect of earliness to flower with the exception of the treatments involving 2.5 t/ha of vermicompost + NPK through chemical fertilizers. The findings of SubbaRao and Ravisankar (2001) also lend support to the present findings in showing that there were no significant differences among treatments in respect of earliness to flowering in brinjal.

### 5.1.5. Number of fruits per plant

A generalised pattern which emanates from the observations on fruits / plant of brinjal proves the point that use of chemical fertilizer alone or in combination the three different forms of organic amendments (FYM , Vermicompost and Pressmud) were very much superior to the treatments involving use of organic manures alone. The present findings are corroborated by the reports of Igbokwe *et al.* (1996), Nirmal *et al.* (1999) and Nirmal and Vadivel (1999).

### 5.1.6. Length of fruit

In respect of the character under consideration, the present findings reveal that the length of fruit of brinjal was on an average found to be more in the treatments involving a combination of organic amendments and

inorganic fertilizer rather than those involving use of organic amendments alone. Moreover use of pressmud or FYM both in combination with inorganic fertilizers produced longer fruits than rest of the treatments. SubbaRao and Ravisankar (2001) who had conducted research on the effects of organic amendments and fertilizers on brinjal had also indicated the superiority of the combination of FYM and NPK over organics alone in general. The above mentioned authors had reported statistical parity among the treatments evaluated by them, which once again supports the findings obtained in the present experiment. Nirmala *et al.* (1999) had also reported that the length of fruits were similar irrespective of the application of recommended doses of fertilizers alone or FYM alone.

### 5.1.7. Girth of fruit

The present experimental data reveal that there were no significant differences among the various treatments in respect of fruit girth of brinjal. This trend of finding is in conformity with those of Nirmala *et al.*, (1999) and Nirmala & Vadivel (1999) who propounded that application of FYM alone @ 30 t/ha or in combination with inorganic fertilizer did not result in significant differences between the two treatments.

### 5.1.8. Weight of fruit

Application of FYM @ 10 t/ha alongwith NPK through chemical fertilizers was found to be better than application of chemical fertilizers alone. Similar was the case of superiority of pressmud @ 5 t/ha + NPK through chemical fertilizers in relation to use of chemical fertilizer alone. These observations are in consonance with the findings of Stofella and Graetz (2000) who reported that application of sugarcane filter cake as an

amendment alongwith 50% application of recommended dose of fertilizer in case of tomato crop, increased the fruit weight regardless of fertilizer application rates.

### 5.1.9. Yield of fruit

The highest fruit yield to the tune of 247.16 q/ha was recorded on application of FYM @ 10 t/ha + NPK though chemical fertilizers, which was significantly superior to the application of NPK through chemical fertilizers alone. Similar superiority of a combination of organic amendments and chemical fertilizers over sole application of chemical fertilizers have been shown by a number of researchers (Gonzalez *et al.*, 1997; Balasubramanium *et al.*, 1998; Barbolina and Arkhipchenko, 1999; Nanthakumar *et al.*, 1999; Selvi and Perumal, 2000; Shelke, *et al.*, 2000; Lin Chunchua, 2000; Maynard *et al.*, , 2000; Stofella and Graetz, 2000; Yadav and Yadav, 2001).

It can be summarised from the yield table that, in general the fruit yields derived form the application of different forms of organic amendments alone (FYM, vermicompost and pressmud) were lesser than those obtained as a result of the combined effects of organic manures and inorganic fertilizers, irrespective of their doses. The findings of Nirmala *et al.*, (1999), Nirmala and Vadivel (1999), Renuka and Ravisankar (2001) and Yadav and Yadav (2001) were in conformity with the results obtained in the present investigation.

The general trend of performance of the different treatments reveal that, use of inorganic fertilizer alone produced higher fruit yields of brinjal than by the application of sole organic manures of different types (FYM, vermicompost and pressmud) irrespective of rate of application, in the present research work. This finding is in consonance with those of Balsal and Gupta (1998), Quattrucci (2000), Jani and Haldri (2000) and Yadav and Yadav (2001).

### 5.1.10. Percentage incidence of fruit borer

In an attempt to evaluate the effects of different organic amendments and their combinations with inorganic fertilizer on incidence of fruit borer, it was concluded that neem cake applied @ 5 q/ha + NPK through chemical fertilizer was the best treatment which significantly superseded all the other treatments in this experiment. The confirmed superiority of neem cake and neem based products in reducing the incidence of fruit borer in brinjal have also been suggested by Singh (2000), Cucchi (2000) and Chakraborti (2001).

Again, in the present experiment, it was revealed that sole application of organic manures such as FYM @ 20 t/ha or vermicompost @ 5 t/ha were significantly superior to application of NPK through chemical fertilizers alone, in respect of reducing the incidence of fruit borer in brinjal. The present observation tallies with the report of Wang Ran *et al.* (2000) and Rajapakshe (2000) who exhibited that use of organic amendments compared with inorganic fertilizers could reduce the extent of biotic stresses such as pest and disease incidence in vegetable crops.

### 5.1.11. Total soluble solids

With respect to the character under consideration, the findings obtained reveal that total soluble solids of brinjal were not significantly different for different treatments involving application of sole organic manure (amendment) or sole recommended dose of chemical fertilizers or combination of organic manure with recommended dose of chemical fertilizer. This finding corroborates that of Duraiswamy *et al.* (1999), Quattrucci (2000) and Yadav and Yadav (2001)

## 5.2. OKRA

### 5.2.1. Plant height

The okra crop which was grown after brinjal with uniform application of fertilizer to all treatments, could utilise the residual effects of organic amendments applied to the first crop. This resulted in significant difference among treatments in plant height of okra. It is interesting to note that the treatments such as application of FYM alone @ 20 t/ha, pressmud alone @ 10 t/ha and vermicompost alone @ 5 t/ha produced relatively taller plants than obtained on application of either inorganic fertilizers alone or a combination of inorganics and organics, to the first crop of brinjal. It is observed form the data on plant height of okra that the height of plants obtained an application of pressmud @ 5 t/ha + full doses of inorganic fertilizer was better to the extent of 4.7 cm than use of full dose of chemical fertilizer alone. This advantage in plant height may be pressmud to be owing to the residual effect of pressmud applied to the first crop of brinjal, in view of the fact that the yields of brinjal in respect of these two treatments were statistically at par.

In support of the fact that significant differences as observed in plant height of okra were due to residual effects of the organic amendments applied to the first crop of brinjal, there is further evidence which shows that due to a gap of three and half months between the last harvest of brinjal crop and the sowing of okra crop, possibly there may not be any residual effect of inorganic nitrogen applied to brinjal crop for being made available to the second crop of okra. Reddy *et al.* (2001) have depicted the significant enhancing effect of organics on plant height of okra.

### 5.2.2. Nodes per plant

The significantly best treatment involved application of FYM @ 20 t/ ha followed by pressmud alone @ 10 t/ha and vermicompost alone @ 5 t/ha. The present findings show that FYM applied at the present rates resulted in the highest residual effect on the succeeding crop of okra in respect of the character under consideration. Similarly, the better performance of pressmud and vermicompost alone at their respective doses were also due to good residual effects of these organic amendments applied to the brinjal crop. The sufficiently long gap of more than three months between last harvest of brinjal and sowing of okra crop is reasonably good evidence to prove that residual effect observed in okra crop must be due to organic amendments and not because of the inorganic nitrogen applied to the first crop of brinjal. Such a long gap would naturally have led to loss of mostly all inorganic sources of nitrogen.

### 5.2.3. Number of fruits per plot

In this case the best treatment was use of FYM alone @ 20 t/ha which was statistically similar to application of pressmud alone @ 10 t/ha, both

the treatments being significantly superior to the rest. Moreover, use of vermicompost alone also produced reasonably high number of fruits per plot and the average performance of the treatments comprising of the three sole organics was much better than that of combinations of organics and inorganics or sole use of inorganic fertilizers. As in the previous characters of okra, here also the residual effects of organic amendments applied to brinjal crop have significantly influenced the succeeding okra crop, in respect of the character under consideration. Those treatments in which half doses of the organic amendments had been applied to brinjal crop in combination with full doses of fertilizers, the residual effects of the respective organics as evinced from the respective data on fruits per plot, reveal a relatively poor residual effect in each case. This may be attributed to the half levels of organics applied in combination with full doses of fertilizers.

### 5.2.4. Weight of fruit

The two treatments involving application of FYM @ 20 t/ha and pressmud @ 10 t/ha were at par but significantly better than rest of the treatments. Again, the mean performance of the three types of organic amendments which were applied alone, was of a higher order than the performance of other treatments involving combination with inorganic fertilizer or sole inorganic fertilizers. Obviously, even in case of this character the distinct residual effects of the organics have led to superiority in average weight of fruits in the respective cases.

### 5.2.5. Yield of fruit

Significant differences among treatments were observed for the character under consideration. The highest fruit yield of okra to the tune of 22.28 q/ha was recorded with the application of FYM alone @ 20 t/ha followed by pressmud alone @ 10t/ha and vermicompost alone @ 5 t/ha. Despite the application of equal doses of inorganic fertilizer to the different plots of okra grown in succession after brinjal, significant differences in yield could be achieved among the various treatments evaluated in the experiment. Moreover, the superior average performance of the okra plots which had a history of application of sole organic amendments to the brinjal crop, are clearly indicative of the fact that wherever okra has given relatively better yields, it is due to the effect of organics. The present findings corroborate those of Bullock *et al.* (2002) who advocated that in melon-tomato cropping pattern though the yield of melon in the first year was not significantly different, in soil amended with either synthetic or organic amendments but in second year, the yield of tomato was higher with a history of organic amendment, regardless of soil amendment types.

Since there was a gap of about three and half months after the harvest of brinjal crop and the sowing of succeeding okra crop which presumably led to nearly total loss of any inorganic nitrogen applied to brinjal crop,it can be strongly confirmed that whatever significant treatment difference are being observed in respect of yield of okra are due to the residual effects of organic amendments applied to the first crop.

The residual crop of okra grown in the plots treated with FYM @ 10 t/ ha + chemical fertilizers, recorded only one fourth the yield obtained in the

plots receiving FYM @ 20 t/ha for the brinjal crop. Similarly there are highly significant differences in the fruit yields of residual okra crop in other cases when either vermicompost or pressmud were applied at half the rates along with recommended doses of fertilizers.

In general, the okra yields irrespectively of the different treatments are observed to be quite low.The main reason for such poor okra yields is the non application of organic manures directly to the okra crop. It is well known that okra is an exhaustive crop and thus nutritional deficiency particularly of organic sources, appear to have an extremely detrimental effect on the overall productivity.

Dhankar and Mishra (2001) opined that the per hectare uptake of okra was 95 kg N, 10 kg P and 60 kg K. They also observed that okra shows response upto 150 kg N/ha depending on genotype and soil fertility. Thus the reasons of low productivity of the residual okra crop are clearly understood.

## 5.3. Gross yield of brinjal-okra cropping pattern

A summarised concept of the gross yield of the two crops under each treatment shows that yields were distinctly better whenever either inorganic fertilizers were applied alone or combined separately with the three types of organic amendments, rather than applying organic manures alone. This is in consonance with the conclusion of Jani and Halldri (2000) who found that modern cultivars of tomato, cucumber and melon gave higher yield in case of conventional than organic system.

In the present experiment, use of pressmud @ 10 t/ha and vermicompost @ 5 t/ha produced similar gross yields of the two crops. Segura *et al.* (1999) highlighted that gross yields of melon-tomato cropping pattern using two different organic manures were similar.

## 5.4. Economics of different treatments

### 5.4.1. Brinjal

The present findings in relation to economics of different treatments in brinjal are indicative of the fact that the highest benefit cost ratio (3.93) was derived with the combination of FYM @ 10 t/ha + NPK through chemical fertilizers, which is better than NPK through chemical fertilizer (3.47). Similar finding was reported by Duraiswamy *et al.* (1999). Also the combined effect of FYM @ 10 t/ha + NPK through chemical fertilizer was better than sole application of FYM @ 20 t/ha which is inconformity with conclusion of Yadav and Yadav (2001).

### 5.4.2. Residual okra

It as evident from the results obtained in okra crop raised with residual organic manure applied to brinjal, that higher benefit cost ratios were achieved with application of organic amendments alone such as FYM @ 20 t/ha, pressmud @ 10 t/ha and vermicompost @ 5t/ha. The cost of cultivation of all the treatments being equal in case of okra, the relatively better benefit cost ratios observed in comparison to application of inorganic fertilizers alone or combinations of the two, are evidently owing to differences in the yield of different treatments.

### 5.4.3. Brinjal-okra cropping pattern

As observed form the benefit cost ratios, the best one related to use of FYM @ 10 t/ha + NPK through chemical fertilizers followed by NPK through chemical fertilizer alone. General trend indicates that whenever inorganic fertilizers were either used alone or in combination with organic amendments, the benefit cost ratios were higher than application of any one of the organics alone. This maybe correlated to the higher yields obtained in respective cases, whenever inorganic fertilizers were used. Therefore, it appears that it is somewhat mandatory to combine organics with a standardised quantity of inorganic fertilizer, in order to derive better benefit cost ratio than applying organics alone.

## 5.5. Soil status after brinjal and okra

### 5.5.1. pH :

Sole application of inorganic fertilizers to brinjal resulted in post harvest soil pH of 4.5. In contrast to this acidic pH there was an improvement in soil pH tending towards neutrality in whichever treatments organic manures such as FYM, pressmud and vermicompost were used alone or in combination with fertilizers. Keipert *et. al.* (1990) and Renuka and Ravisankar (2001) working on vegetable crops also opined that application of different forms of organic manures amends the soil pH shifting it in the direction of neutrality. The post harvest soil pH values after okra crop showed a general decline which may be due to the fact only inorganic fertilizers were applied to the okra crop, without any organic manure in combination.

### 5.5.2. Organic C

The organic carbon analysis after harvest of brinjal revealed an increasing trend with the application of organic amendments alone, in contrast to either inorganic fertilizer alone or a combination of the two. This indicates that use of organic amendments have a positive influence on soil health. The present findings are corroborated by those of Keipert *et al* (1990) and Balasubramanium (1998). The reason for the decline in organic carbon content of soil samples analysed after the okra crop, is the non-application of organic manures directly to okra crop.

### 5.5.3. Available P

After addition of FYM @ 20 t/ha to the brinjal crop, the available 'P' of the post harvest soil samples declined, but on addition of vermicompost @ 5 t/ha and pressmud @ 10 t/ha separately, the available 'P' status of post harvest soil samples showed increasing trends in comparison to initial status of 'P' in the experimental plots. Keipet *et al.* (1990) and Baquero and Pinto (2000) also reported that 'P' content of soil was enhanced by the application of organic amendments. In the present experiment, such an increase in 'P' content by addition of organic manures such as vermicompost and pressmud may have occurred owing to the generally higher 'P' contents of these two manures (Palaniappan and Annadurai, 1999). Since FYM contains less amount of 'P' our experimental findings indicate a reduced 'P' level after harvest of brinjal crop.

### 5.5.4. Available 'K'

The results show that whenever organic amendments such as FYM vermicompost or pressmud were applied to brinjal crop, the final soil analysis indicated relatively lesser content of soil 'K' than the initial status before the start of the experiment. The results are in conformity with the findings of Keipert *et al.* (1990).

# CHAPTER - VI

# SUMMARY AND CONCLUSION

# SUMMARY AND CONCLUSION

The experiment entitled "Studies on organic farming in brinjal-okra cropping pattern" was conducted at the All India Co-ordinated Vegetable Improvement Project, Department of Horticulture, Orissa University of Agriculture and Technology, Bhubaneswar during August 2001 to September 2002. The experiment was laid out in the randomized block design with three replications. The details of the treatments are given below :

$T_1$ = Recommended dose of NPK through chemical fertilizers (Control)

$T_2$ = FYM @ 20 t/ha

$T_3$ = FYM @ 10 t/ha + Recommended dose of NPK through chemical fertilizer

$T_4$ = Neem cake @ 5 q/ha + Recommended dose of NPK through chemical fertilizer

$T_5$ = Vermicompost @ 5 t/ha

$T_6$ = Vermicompost @ 2.5 t/ha + Recommended dose of NPK through chemical fertilizer

$T_7$ = Pressmud @ 10 t/ha

$T_8$ = Pressmud @ 5 t/ha + Recommended dose of NPK through chemical fertilizer

Brinjal was taken up as the first crop in which the above mentioned treatments were applied. After the harvest of brinjal crop, a second crop of okra was taken up in the same plots using only inorganic fertilizers at recommended doses. No organic manures were applied to the second crop of okra. All other cultural practices were uniformly adopted for each crop as per the recommended package of practices.

Observations were recorded on plant height, branches per plant, leaf area, days to first flowering, number of fruits/plant, length of fruit, girth of fruit, weight of fruit, number of fruits per plant, yield of fruits / plot, percentage incidence of fruit borer and total soluble solids of fruits of brinjal In case of okra, the observations were recorded on plant height, nodes/plant, number of fruits/plot, weight of fruit and yield of fruit. The gross yield of brinjal okra cropping pattern was also calculated. All observations were subjected to statistical analysis.

The economics of each individual crop as well as that of the cropping pattern were estimated. Soil samples were collected systematically before taking up brinjal and after harvest of each of the crops and were analysed for the parameters pH, organic C, available P and available K.

The **objectives** of the above mentioned investigation are as follows :

1. To study the effects of different organic amendments alone or in combination with inorganic fertilizers on the vegetative growth, yield and yield attributes of brinjal.
2. To assess the extent of residual effects of the organic amendments on a second crop of okra, raised after brinjal.
3. To study the effects of different treatments on the quality of brinjal fruits as well as infestation of fruit borer.
4. To calculate the economics of growing each individual crop and also that of the two crop sequence.
5. To undertake initial and final soil analysis for each crop and comment on the effects of different treatments with respect to soil health or fertility.

The findings which emanated after conducting the above mentioned experiment are listed below.

1. The plant height, leaf area and branches per plant of brinjal were found to be significantly more with the application of recommended NPK through chemical fertilizers alone or in combination with half doses of organic manures, than use of different organic manures (FYM, vermicompost and pressmud) alone in full doses.

2. Application of neem cake @ 5 q/ha or pressmud @ 5 t/ha combined with full doses of chemical fertilizers recorded earliest first flowering in brinjal than other treatments.

3. Use of pressmud or FYM both in combination with full inorganic fertilizers, produced longer brinjal fruits than rest of the treatments.

4. Sole application of vermicompost @ 5 t/ha resulted in maximum girth of brinjal fruits, followed by use of full chemical fertilizers alone and FYM @ 20 t/ha alone.

5. Significantly higher number of fruits per plant of brinjal were produced with the application of either sole chemical fertilizers or its combinations with FYM @ 10 t/ha or neem cake @ 5 q/ha. The above mentioned treatments markedly superseded use of each of the organic amendments.

6. The highest average fruit weight of brinjal was recorded with sole application of vermicompost, which was significantly superior to that of inorganic fertilizers alone.

7. The highest fruit yield of brinjal to the tune of 247.16 q/ha was recorded on application of FYM @ 10 t/ha + NPK through chemical fertilizers, which was significantly superior to sole application of NPK through chemical fertilizers.

It can be summarised from the yield table that the fruit yields derived from the application of different forms of organic amendments alone (FYM, vermicompost and pressmud) were in general lesser than those obtained as a result of the combined effects of organic manures and inorganic fertilizers, irrespective of their doses.

8. The significantly lowest incidence of fruit borer in brinjal was recorded with the application of neem cake @ 5 q/ha + NPK through chemical fertilizers.

9. The total soluble solids of brinjal fruit did not differ significantly among the different treatments.

10. In the residual crop of okra, the characters such as plant height, nodes per plant, fruits per plot and fruit weight showed remarkably better performance with the application of FYM @ 20 t/ha followed by pressmud @ 10 t/ha followed by vermicompost @ 5 t/ha each applied to brinjal alone, than use of chemical fertilizers alone.

11. The three top treatments in respect of fruit yield of residual okra, which significantly differed among themselves, were use of FYM, @ 20 t/ha, pressmud @ 10 t/ha and vermicompost @ 5 t/ha respectively in brinjal. These were also significantly superior to sole application of inorganic fertilizer or its different combinations with organic amendments.

12. A summarised estimate of the gross yields of the two crops under each treatment, reveal that yields were distinctly better whenever either inorganic fertilizers were applied alone or combined separately with the three types of organic amendments, rather than applying organic manures alone to brinjal crop.

13. On the basis of soil chemical analysis, it was observed that there was an improvement in soil pH from lower (acidic) values towards higher ones, in whichever treatments organic manures were used alone or in combination with fertilizers, in contrast to sole application of inorganic fertilizers.

14. The analysis of organic carbon in soil samples after harvest of brinjal showed increasing trends on application of organic amendments alone, in contrast to inorganic fertilizers alone or combinations of the two. This indicates that use of organic amendments have a positive influence on soil health.

15. Among the organic sources, addition of FYM @ 20 t/ha to the brinjal crop reduced the available phosphorus of the post harvest soil sample,

but with the use of vermicompost @ 5 t/ha and pressmud @ 10 t/ha separately, the available phosphorus status showed increasing trends, in comparison to initial status of phosphorus in the experimental plots.

16. The economics of treatments applied to brinjal crop showed the highest benefit cost ratio with the combination of FYM @ 10 t/ha + NPK through chemical fertilizers, which was better than sole application of NPK through chemical fertilizers.

17. In the residual okra crop raised after brinjal, higher benefit cost ratios were achieved with the application of organic amendments alone than other treatments, to brinjal.

18. Composite economics of brinjal-okra cropping pattern revealed that whenever inorganic fertilizers were either used alone or in combination with organic amendments, the benefit cost ratios were higher than application of any of the organics alone.

# CONCLUSION

The conclusions of the present study are enumerated below :

* The treatments involving sole application of recommended fertilizers or their combinations with either FYM @ 10 t/ha or neem cake @ 5 q/ha resulted in superior vegetative growth and fruits per plant of brinjal.

* Application of vermicompost alone @ 5 t/ha produced greater weight and girth of fruit in brinjal, than use of chemical fertilizers alone.

* Early flowering and greater fruit length of brinjal could be achieved with the use of pressmud @ 5 t/ha + Recommended NPK through chemical fertilizers.

* The highest fruit yield and benefit cost ratio of brinjal could be achieved with the application of FYM @ 10 t/ha + Recommended NPK through chemical fertilizers which was better than sole use of chemical fertilizers.

* Lowest incidence of fruit borer was observed in the treatment involving use of neem cake @ 5q/ha + NPK through chemical fertilizers.

* It can be summarised that the that fruit yields derived from the application of different forms of organic amendments alone (FYM,

vermicompost and pressmud) were in general lower than that of combined effects of organic manures and inorganic fertilizers, irrespective of their doses.

* In the second crop of okra which was uniformly applied with only recommended fertilizers and grown after brinjal, plant height, nodes per plant, fruits per plot, fruit weight, fruit yield and benefit cost ratio were found to be relatively superior in the plots in which sole organic amendments like FYM, pressmud and vermicompost were applied to the previous crop of brinjal.

* The gross yield and benefit cost ratio of brinjal-okra sequence were relatively higher when inorganic fertilizers were applied alone or combined with organics, rather than using organic amendments alone.

* Among the organic amendments, application of vermicompost alone @ 5 t/ha or pressmud alone @ 10 t/ha separately showed enhanced levels of available phosphorus in soil after brinjal, in comparison to the initial status.

## SUGGESTIONS FOR THE FUTURE

* In order to make organic farming commercially more viable, higher prices should be fixed for organically produced vegetables.
* A fool proof system of organic certification must be adopted for quality assurance.
* Efforts must be made to enhance the awareness of farmers and consumers about the drawbacks of inorganic fertilizer and pesticide application.

# LITERATURE CITED

# LITERATURE CITED


Aliyu, L. (2000). Effect of organic and mineral fertilizers on growth, yield and composition of pepper (*Capsicum annum* L.). *Biological Agriculture and Horticulture.* **18** (1) : 29-36.

Ambekar, J.S.; Pawar, A.S.; Sakhare, M.V.(2001). Bioefficacy of neem formulations and synthetic insecticide against Okra fruit borer. *Journal of Maharastra Agricultural Universities.* **25** (3) : 315-316.

Bage,J.; Ghanti, P.; Mandal, A.R.; Paria, N.C. (2000). Fruit characters of Pumpkin as influenced by organic manures. *Environment and Ecology.* **18** (4) : 952-655.

Balasubramanium, P.; Mani,A.K.; Duraiswamy,P.; Kandaswami,M. (1998). Effect of organic and inorganic nutrients on the yield and uptake of tomato (*Lycopersicon esculentum*) in alfisols. *South Indian Horticulture* **46** (3/6) : 143-147.

Balsal,O.P and Gupta, V. (1998). Effect of oxamyl, sewage sludge and nitrogen fertilizers on the yield of certain vegetables. *Clay Research.* **17** (1) : 34-42.

Baquero, C. and Pinto,M. (2000) Influence of organic and chemical fertilizer in the production of Chinese peppers in soils of Magdalena banana zone. *Suclos Ecuatriales.* **30** (1) : 8-14.

Barbolina, I and Arkhipchenko, I. (1999). Effect of biofertilizer from animal production wastes on growth, yield and nematode infection in tomato. Mechanizacyi i. *Elektryfikaigi Rolnictwa.* 15 (2) : 76-82.

Bray,R.H. and L.T.Kurtz. (1945). Determination of total, organic and available forms of phosphorus in soils. *Soil Science.* 59 : 39-45.

Bulluck, I.R.; Brosius, M.; Evanylo, G.K.; Ristaino,J.B. (2002) Orgnic and synthetic fertility amendments infleucne soilmicorbial,physical and chemical properties on organic and conventional farms. *Applied Soil Ecology.* 19 (2) : 147-160.

Chakraborti, S. (2001). A biorotational approach for the management of brinjal fruit and shoot borer, *Leucinoides orbonalis* Guen. *Journal of Entomological Research.* 25 (1) : 73-76.

Clark, S.; Klonsky,K.; Livingston,P.; Temple, S. (1999). Crop yield and economic comparison of organic, low input and conventional farming systems in California's Sacramento valley. *American Journal of Alternative Agriculture.* **14** (3) 109-121.

Cucchi, G.A. (2000). Organic cultivation of tomatoes. *Informator Agrario.* **56** (24) :43-46.

Dahlstedt, L. and Dlouhy,J.(1995).Nitrate level and other nutritional compounds in different crops such as wheat, potato, carrot and tomatoes in organic farming system. *Var Foda.* **47** (8) : 45-51.

Dhankar,B.S.and Mishra, J.P. (2001) *Text book of Vegetable, Tubercrops and Spices* (Eds Thamburaj and Narendra Singh) 222-233, ICAR, New Delhi.

Duraiswamy,R.; Mani, A.K.; Balasubramanium,P. (1999). Effect of nitrogen fertilizer, *Azospirillum* and organics on yield and nutrition of rainfed tomato. *South Indian Horticulture.* **47** (1/6) : 234-235.

Garedal, L.and Lunegardh,B.(1998). Ecological cultivation of green house tomatoes in limited beds fertilised with locally produced mulches : Effect on growth and yield. *Biological Agriculture and Horticulture.* **16** (2) : 173-189.

Gomez, A.K. and Gomez, A.A., (1984) *Statistical procedures for Agricultural Research.* 20-29, John Wiley & Sons,Singapore.

Gonzalez, W.; Hernandez, G.; Beltran, R. Breart. M.; Quicote, S.; Garcia,T. (1997). Organomineral fertilization of tomato,onion and maize. *Agroteccnia de cube.* **27** (1) : 151-153.

Gundersen, V.; Bechmann, I.E., Behrens, A.; Sturup, S. (2000). Comparative investigation of concentrations of major and trace elements in organic and conventional Danish Agricultural Crop (onion and peas). *Journal of Agricultural and Food Chemistry.* **48** (12) : 6094-6102.

Haglund. A. and Johansson,L. (1995). Sensory evaluation of carrots and tomatoes *Var. Foda.* **47** (8) : 52-55.

Haglund, A.; Johansson,L.; Berglund, L. ; Dahlstedt, L. (1998). Sensory evaluation of carrots from ecological and conventional growing systems .*Food Quality and preference.* **10** (1) : 23-29.

Igbokwe, P.; Alipoe,D.; Rizvi,M. (1996). Sustainable agriculture for vegetable production in Mississippi .*Journal of Mississippi academy of Science.* **41** (3) : 136-142.

Jackson,M.L. (1967). *Soil chemical Analysis*, Prentice-Hall of India Pvt.Ltd., New Delhi.

Jani,S. and Halldri,M. (2000) Comparision between native and medium cultivars in organic and conventional vegetable production. IFOAM 2000 : The World grows organic : *Proceedings of the 13th International Scientific Conference, Baset, Switzerland,* p. 145-149.

Jorhem, L. (1995). Cadmium in cereals, potatoes and carrots in organic agriculture. *Var Foda.* **47** (8) : 25-29.

Joshi,S.D.; Jadhav, A.S.; Patil, M.B. ; Kurundkar, B.P. (2000). Effect of organic amendment and fly ash on root knot disease of tomatoes. *Journal of Maharastra Agriculture University.* **25** (1): 84-85.

Judais, V. and Rinaldi,S. (2001). Organic fertilizers in melon : The dynamics of nitrogen. *PHM Revue horticole.* **43** (1) : 17-20.

Karthikeyan, G.; Duraiswamy, S. ; Sivkumar, C.V. (1999) Biological control of *Pythium aphenidermatum, Meloidogyne incongnita* disease complex in chilli with organic amendments. *Madras Agricultural Journal.* **86** (4/6) : 320-323.

Keipert,K.Wedler, A.; Overbeek, G. (1990). Alternative cultivation of vegetables. *Schriftnreihe der land wirtschalfskammer Rheinland* . **66**, (2) : 195-197.

Kerner, K.N. (1994). Vegetable yield under organic farming, results of yield analysis in a project. *Nors Land Bruksforsking.* **8** (2) : 177-187.

Kucinskas,J.; Karbauskiene, E. (2000) Effect of vermicompost on yield of cucumber Cv. Rodnicidk. *Sodininkyste ir Darzininkyste.* **19** (2): 73-81.

Letourneau,D.K. and Goldstein, B.(2001). Pest damage and orthopod community structure in organic versus conventional tomato production in California. *Journal of Applied Ecology.* **38** (3) : 557-579.

Lin Chunhua and Huang Lianghua (2000). Effect of formula organic fertiliser on environment, yield and quality of cherry tomato in media. *China Vegetables* No. **-1** : 11-13.

Loes,A.K.; Rilley,H.; Hansen,S; Dragland, S. (2000) . In Potassium and Phosphorus fertilization effect on soil and crops. *Proceedings of the Regional IPI Workshop, Lithunia.* p. 227-28.

Maynard,A.A. (2000). Applying leaf compost to reduce. fertilizer use in tomato. *Compost Science and Utilization.* **8** (3) : 203-209.

Mcsorley, R.; Ozores-Hampton, M.; Stanley,P.A.; Conner,J.M. (1999). Nematode management, soil fertility and yield in organic vegetable production (Double crop system with tomato & pepper) *Nemotropica.* **29** (2) : 205-213.

Nagesh, M.; Reddy, P.P.; Rama, N.(2001). Influence of oil cakes in combination with inorganic fertilizer on growth and sporulation of *Paccilomyces lilacinus* and it's antagonism on *Meloidogyne incognita* infecting tomato. *Nematologica Mediterranea.* **29** (1) : 23-27.

Nanthakumar, S. (1999) Influence of organic manures on shelf life, cumulative physiological loss in weight, general appearance and organoleptic characters in tomato. *South Indian Horticulture.* **47** (1/6) : 81-85.

Nathakumar,S. and Veeraragavathatham,D. (1999).Effect of integrated nutrient management on yield and yield attributes of brinjal (*Solanum melongena*) cv PLR-1. *South Indian Horticulture.* **47** (1/6) : 42-48.

Nirmala, R. and Vadivel, E. (1999) Effect of combined application of organic manure and biofertiolizers on grwoth and productivity of cucumber. *South Indian Horticulutre.* 47 (1/6) : 252-254.

Nirmala, R.; Vadivel,E .; Azakiamanavalan,R.S. (1999) Influence of organic manures on fruit character and yield of cucumber. *South Indian Horticulture.* **47** (1/6) : 65-68.

Page, A.L.; Miller, R.H.; Keny, D.R. (1982) Methods of soil analysis, part - II, chemical and microbiological properties, second edition No. - 9. Part-II in series, Agronomy. American Society of Agronomy, Inc. *Soil Science Society of American Inc.* Madison Wisconsin, USA.

Palaniappan, S.P. and Annadurai, K. (1999) *Organic Farming : Theory and Practice*. Scientific Publishers (India), Jodhpur.

Patil, M.B.; Jogdand, S.D.; Jadhav, A.S. (2000). Effect of organic and biofertilizer on yield and quality of Okra. *Journal of Mahasrastra Agricultural University.* **24** (3) (1/6): 240-242.

Prasanna, K.P. and Rajan,S. (2001). Effect of organic farming on storage life of brinjal fruits. *National Seminar : South Indian Horticulture* (Special). **49** : 255-257.

Quattrucci, M. (2000). Is organic or organomineral fertilizer application suitable for tomato. *Informatore Agrario.* **56** (3) : 67-73.

Rao,M.S. and Reddy, P.P. (2001). Control of *Meloidogyne incognita* on aubergine using *Glomus mosseae* integrated with *Paccilomyces sp.* and Neemcake. *Nematologica Mediterranea.* **29** (2) : 153-157.

Rajapakshe,R. (2000). The management of major insect pest *Aulacophera sp.* in organic agriculture. The BCPC conference : Pest and diseases, Volume **3.** p. 981-985, London.

Reddy,V.C. (1999) Effect of urban garbage compost on growth and yield of tomato. *Current Research.* **28** (3/4) : 43-44.

Reddy, V.C.; Yogananda, S.B; Sekar, K. (2001). Influence of Urban Compost and sewage on growth and yield of Okra. *National Seminar : South Indian Horticulture* (Special) 49 : 151.

Rekha, C.R. and GopalKrishnan, D. (2001) Effect of levels and frequencies of organic manures and inorganic fertilisers on growth and productivity of bitter gourd. *National Seminar : South Indian Horticulture* (Special) 49 : 137.

Renuka,B. and Ravisankar, C.(2001).Effect of organic manures on growth and yield of tomato. *National Seminar : South Indian Horticulture* (Special) 49 : 216.

Ribeiro, L.G.; Lopes, J.C.; Martins, F.S.; Ramalho., S. S. (2000) Effect of organic fertilizer application in sweet pepper yield. *Horticultura Brasiliera* **18** (2) 134-137.

Sankar,V. and Tripathi,P.C. (2001). Effect of organic sea weeds on growth and quality of onion. *National Seminar : South Indian Horticulture* (Special) 49 : 247.

Santos, R.H.S.; Silva, F.D.A.; Casali, V.W.D.; Conde, E. (2001). Post harvest storage of Lettuce cultivated with organic compost. *Pasquisa Agropecuaria Brasileira.* **36** (3) : 521-525.

Schmalzle, G. (1990). Weed control with compost mulch method. *Deutscher Gartenbau.* **44** (21) : 1393-95.

Segura, M.L.; Aguilar,M.I.; Sanche Z-gerrero,M.C.; Merdano, E. (1999) Organic manures in intensive horticulture. *Horticultura, Revista de frutas, Hertalizas Flores,Plantas Ornamentals y Plantas de Vivero.* 13 (8) : 17-20

Selvi,D. and Perumal, R. (2000). Effect of micronutrient fertilization on brinjal fruit yield in an alfisol. *Madras Agriculture Journal.* **87** (7/9) : 391-394.

Sentil Kumar, R. and Sekar, K. (1998).Effect of organic and inorganic amendments in bhendi in lignite mine soil. *Madras Agricultural Journal.* **85** (1) : 38-40.

Shelke, S.R.; Adsule, R.N.; Amrutsagar, V.M. (1999). Nitrogen management through organics and inorganics in brinjal. *Journal of Maharastra Agricultural University.* **24** (3) : 297-298.

Siddiqui, M.A. and Alam, M.M. (1999). Integrated management of plant nematodes with oil cakes, nematicides and ploughing. *Pakistan Journal of Nematology.* **17** (2) : 129-136.

Singh, P.K. (2000). Effect of neem products on incidence of brinjal shoot and fruit borer. *Journal of Applied zoological Research.* **11** (1) : 23-24.

Sipes, B.S.; Arakaki,A.S.; Schmitt,D.P.; Hamaski, R.I.(1999). Rootknot nematode management in tropical cropping system with organic products in tomato. *Journal of sustainable Agriculture.* **15** (2/3) : 69-76.

Siviero,P. ; Passeri,P.; Fontana, R. (2000). Efficacy of cord muclhes on organically grown tomatoes. *Informatore Agrario.* **56** ( 24) : 55-58.

Stoffella,P.J.; Greatz, D.A. (2000). Utilization of surgarcane compost as a soil amendment in tomato production system. *Compost Science and Utilization.* **8** (3) : 210-214.

Stoffella, P.J. and Li, Y.C. (2001) Organic Waste Compost Utilization in vegetable crop production systems. *Proceedings of the Interamerican Society for Tropical Hortiuclture.* **43** : 30-32.

SubbaRao,T.S.S. and Ravisankar,C. (2001). Effect of organic manure on growth and yield of brinjal. *National Seminar : South Indian Horticulture* (Special) 49 : 288.

Thamburaj, S. and Singh N. (2001) *Text Book of Vegetables Tuber Crops and Spieces.* ICAR, New Delhi.

Thornsbury, S.D.; stoffella, P.J.; Minton,T.M.E. (2000). Economics of organic waste compost utilisation in a commercial tomato production system. *Proceedings of XIVth International Symposium on Horticultural Economics Acta Horticultural.* No. 536 : 93-99.

Tomar, V.K.; Bhatnagar,R.K.; Palta,R.K. (1998). Effect of vermicompost on production of brinjal and carrot. *Bharatiya Krishi Anusandhan Patrika.* **13** (3/4) : 153-156.

Ushakumari,K.; Prabhakumari, P.; Padmaja,P.(1999). Efficiency of vermicompost on growth and yield of summer crop of Okra. *Journal of Tropical Agriculture.* **37** (1/2) : 87-88.

Wang Ran; Xu Huilian; Mridha, MD.A.U.(2000). *Phytopthora* resistance of organically fertilized tomato plants *Journal of Crop Production.* **3** (1) : 77-840.

Warman, P.R. and Havard; K.A. (1994). Yield, Vitamins and Mineral content of four vegetables grown with either composted manure or conventional fertilizer. *Journal of Vegetables crop production.* **2** (1) : 42-46.

Willumsen, J. and Throup-kristensen,K. (2001). Effects of green manure crops on soil mineral available for organic production of onion and white cabbage in two consecutive yeas. *Biological Agriculture and Horticulture.* **18** (4) : 365-384.

Xu Huiliian; Wang Ran; Mridha,M.A.U. (2000). Effect of organic fertilizers and microbial inoculant on leaf photosynthesis and fruit yield and quality of tomato plants. *Journal of crop production.* **3** (1) : 173-182. Special use : Nature farming and microbial application.

Yadav,V.S. and Yadav,B.D. (2001). Effect of NICAST (Organic Manure) in comparison to recommended doses of manure and fertilizers in Onion. *National Seminar* : *South Indian Horticulture* (Special) 49 : 160.

## APPENDIX - 1

**Weather Parameter during August 2001- October 2002**

| Months | Temperature $^0$C | | | RH in % | | | Rainfall in | | Bright sunshine hour/day | Evaporation (mm/day) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Morning | Afternoon | Mean | mm | days | | |
| August, 01 | 31.4 | 25.2 | 28.3 | 94 | 83 | 88 | 450.6 | 22 | 3.9 | 3.0 |
| Sept., 01 | 33.1 | 25.2 | 29.2 | 93 | 74 | 84 | 144.3 | 10 | 6.5 | 3.6 |
| October, 01 | 32.2 | 23.9 | 28.1 | 94 | 71 | 83 | 160.8 | 10 | 7.7 | 3.5 |
| November, 01 | 29.9 | 20.7 | 25.3 | 94 | 64 | 79 | 61.8 | 6 | 6.3 | 3.3 |
| December, 01 | 28.5 | 13.6 | 21.1 | 91 | 41 | 66 | - | - | 8.6 | 3.5 |
| January, 01 | 28.3 | 15.1 | 21.7 | 94 | 56 | 75 | 45.7 | 7 | 7.5 | 3.3 |
| February, 01 | 31.7 | 17.8 | 24.8 | 96 | 48 | 72 | - | - | 9 | 4.1 |
| March, 01 | 34.8 | 22.2 | 28.5 | 95 | 55 | 75 | 3.8 | 2 | 8.4 | 5.3 |
| April, 01 | 36.9 | 25.3 | 31.1 | 91 | 58 | 75 | 7.9 | 5 | 9.1 | 7.5 |
| May, 01 | 39.0 | 26.4 | 37.7 | 89 | 53 | 71 | 114.5 | 7 | 9.1 | 9.4 |
| June, 01 | 35.6 | 26.0 | 30.5 | 93 | 72 | 83 | 21.67 | 14 | 5.8 | 7.0 |
| July, 01 | 34.1 | 26.0 | 30.1 | 92 | 74 | 83 | 353.9 | 17 | 4.3 | 4.2 |
| August, 01 | 31.6 | 25.0 | 28.3 | 95 | 87 | 88 | 514.4 | 22 | 3.5 | 3.32 |
| Sept., 01 | 31.7 | 24.6 | 28.1 | 96 | 79 | 88 | 181.7 | 16 | 4.6 | 3.2 |
| October, 01 | 32.3 | 22.9 | 27.6 | 95 | 63 | 79 | 48.0 | 7 | 7.7 | 3.5 |

## APPENDIX-II

## ANALYSIS OF VARIANCE FOR DIFFERENT CHARACTERS SUM OF SQUARE

| Source (df)<br>Character | Replication<br>(2) | Treatment<br>(7) | Error<br>(14) | Total<br>(23) |
|---|---|---|---|---|
| **BRINJAL** | | | | |
| 1. Plant height (cm) | 406.16 | 619.67 | 288.28 | 1314.11 |
| 2. No. of primary branches / plant | 5.58 | 7.52 | 1.33 | 14.43 |
| 3. Leaf area (sq cm) | 324.22 | 1254.32 | 464.6 | 2043.18 |
| 4. Days to first flowering | 18.25 | 335.96 | 114.42 | 468.625 |
| 5. No.of fruit / plant | 4.025 | 234.46 | 7.38 | 246.12 |
| 6. Length of fruits (cm) | 2.82 | 14.34 | 19.27 | 36.43 |
| 7 Girth of fruits (cm) | 1.63 | 6.46 | 9.32 | 17.41 |
| 8. Weight of fruits (g) | 448.59 | 1847.21 | 1208.67 | 3055.96 |
| 9. Yield of fruits (q/ha) | 15.08 | 682.58 | 27.93 | 725.59 |
| 10. Total soluble solids ($^0$B) | 0.25 | 5 | 4.25 | 5 |
| 11. Incidene of fruit borer (%) | 10.84 | 347.32 | 90.13 | 448.3 |
| **OKRA** | | | | |
| 12. Plant height(cm) | 5.71 | 3479.12 | 149.4 | 3634.3 |
| 13. Nods/plant | 0.49 | 39.61 | 42.44 | 82.54 |
| 14. No. of fruits/plant | 36.75 | 49915.29 | 497.34 | 50412.6 |
| 15 Fruit weight (g) | 0.06 | 61.5 | 17.94 | 79.5 |
| 16. Yield of fruit (q/ha) | 0.01 | 6.78 | 0.16 | 6.95 |
| **BRINJAL-OKRA CROPPING PATTERN** | | | | |
| 17. Gross yieldof fruit (q/ha) | 15.98 | 634.0 | 29.29 | 679.2 |
| 18. Soil pH | 0.71 | 10.3 | 6.85 | 17.86 |
| **POST-HARVEST BRINJAL** | | | | |
| 19. Organic 'C' g/kg soil | 2.15 | 4.62 | 7.99 | 14.67 |
| 20. Available 'P' | 875 | 4733.47 | 6987.15 | 12595.7 |
| 21 Available 'K' | 67.58 | 8091.3 | 2544.1 | 10708 |