# INDOLE ACETIC ACID OXIDASE ACTIVITY IN BRINJAL AS INFLUENCED BY FERTILISER TREATMENTS

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**THESIS**

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## DECLARATION

I hereby declare that the thesis entitled '**Indole acetic acid oxidase activity in brinjal as influenced by fertiliser treatments**' is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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## CERTIFICATE

Certified that the thesis entitled **`Indole acetic acid oxidase activity in brinjal as influenced by fertiliser treatments'** is a record of research work done independently by **Ms.Rosamma Abraham**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| IAA | - Indole acetic acid |
| TIBA | - 2,3,5-triiodo benzoic acid |
| DIBA | - 3,5 diiodo-2-hydroxy benzoic acid |
| NPA | - *N*-1-naphthylphthalamic acid |
| ppm | - parts per million |
| *M* | - molar |
| µ | - micro |
| mg | - milligram |
| l | - litre |
| DAS | - Days after sowing |
| kg | - kilogram |
| ha | - hectare |
| g | - gram |
| FYM | - Farmyard manure |
| t | - tonne |
| m | - metre |
| cm | - centimeter |
| °C | - degree celsius |
| nm | - nanometre |
| ml | - millilitre |

# Introduction

# INTRODUCTION

Auxin is the first plant hormone discovered and established. A committee of plant physiologists in 1954 defined auxin as a generic term for compounds characterized by their capacity to induce elongation in shoot cells. Indole acetic acid (IAA) is the only naturally occurring auxin, the existence of which has been established in plants. Various factors determine the amounts of this endogenous auxin in a particular part of a plant at a given time.

In general, a reasonably good correlation has been established between relative content of auxin and relative growth in various plant parts. Further, the uptake, translocation and distribution of mineral ions are affected by IAA. This auxin is also known to influence the processes of membrane transport directly.

The level of free auxin in tissues is rigidly controlled by three processes viz. regulated synthesis *in situ*, reversible and irreversible formation of bound auxin and degradation into inactive compounds. Auxin destruction in plants has been brought about by two oxidative processes, enzymatic reaction and photo-oxidation. The most important physiologically oxidative process is enzymatic destruction catalyzed by the enzyme IAA oxidase. IAA oxidase activity is accelerated by monophenols and is inhibited by ortho-diphenols. IAA oxidase preparations from different parts of an angiosperm seedling tend to reveal an inverse correlation between enzyme activity and auxin content which means that IAA oxidase activity tends to be comparatively lower in regions of high auxin content (Moore, 1980).

Many workers reported increased growth and yield in crop plants following application of IAA. Enhanced yield by organic manure and fertiliser treatments is also established beyond doubt. But the actual mechanism by which

these treatments influence the yield is not yet established. Application of IAA has been observed to increase water and nutrient uptake. Whenever plant nutrients are supplied to recover plants from nutrient deficiencies, it is reported that the level of IAA in the meristematic tissues of plant also increases along with the increased uptake of nutrients.

However, various authors have reported that the *in vivo* activity of IAA oxidase has been much less than what is observed *in vitro*. This shows that the effective role of IAA oxidase in regulating the overall growth and development of the plant still remains uncertain.

The objectives of the present study are

1. To find out the influence of IAA oxidase levels in the plant on the yield and other growth parameters using brinjal (egg plant) as the test crop.
2. To study the role of different levels of fertiliser and organic manure in maintaining the IAA oxidase activity and its influence on growth and yield.

# Review of Literature

# REVIEW OF LITERATURE

Indole acetic acid oxidase is the enzyme involved in the catabolic degradation of indole acetic acid to 3-methylene oxindole. It is the most important physiological oxidative process that regulates the *in vivo* level of auxins. The enzyme system that catalyses the oxidation of indole acetic acid (IAA) has been recognised for many years and the physiological significance ascribed to this reaction is that it regulates the biological activity of IAA (Moore, 1980).

## 1 Metabolism of indole acetic acid

### 1.1 Biosynthesis

The aminoacid tryptophan is commonly regarded as the precursor for the biosynthesis of IAA in plants. According to Moore (1980), there may be different pathways of IAA biosynthesis from tryptophan in different species. One of the proposed biosynthetic pathways according to him is the conversion of tryptophan to indole pyruvic acid via a transaminase reaction which requires an alpha keto acid and pyridoxal phosphate in addition to the enzyme. Further, Indole pyruvic acid is subsequently decarboxylated to indole acetaldehyde in a reaction requiring a decarboxylase and thiamine pyrophosphate. According to him an $NAD^+$ dependant aldehyde dehydrogenase oxidises indole acetaldehyde to IAA. The enzymatic conversion of indole acetaldehyde to IAA was studied by several workers (Larsen, 1949; Rajagopal, 1968; Rajagopal and Larsen, 1972; Bower *et al.*, 1978; Kutacek and Terziivanova-Dimova, 1991).

The second major pathway proposed by Moore (1980) involves an initial conversion of tryptophan to tryptamine and its further conversion to indole acetaldehyde through catalysis, with the help of an enzyme amine oxidase.

According to him indole acetaldehyde is further oxidized to IAA with the help of another enzyme viz. indole acetaldehyde oxidase.

## 1.2 Catabolism of indole acetic acid

Besides regulating the *in situ* synthesis of auxin and reversible and irreversible formation of bound auxin, their levels are also controlled by its degradation to inactive compounds. Auxin destruction is brought about by two basic oxidative processes (1) enzymatic reaction and (2) photoxidation (Moore, 1980). According to him, the most important physiological oxidative process is enzymatic destruction, catalysed by the enzyme indole acetic acid oxidase. Photoxidation of IAA appears to have little physiological significance.

Reinecke and Bandurski (1983) also detected uniform concentration of oxindole-3-acetic acid in maize shoot and endosperm tissue and their concentration was comparable to that of free IAA.

The catabolism of IAA in maize was studied by Nonhebel and Bandurski (1984) using labelled IAA and oxindole-3-acetic acid. According to him a catabolic sequence was involved in the oxidation of IAA to oxindole-3-acetic acid which finaly yielded 7-hydroxy indole-3-acetic acid glycoside.

According to Nonhebel (1986) the hourly rate of IAA oxidation in *Zea mays* seedlings was 1.1 pmol/plant in the shoots and 7.1 pmol/plant in the seeds, necessarily indicating higher oxidation rate of IAA in seeds.

## 2 Characteristics of indole acetic acid oxidase

According to Moore (1980) IAA oxidase is a peroxidase which acts as oxidase and the enzyme is observed to be partially independant on exogenous $H_2O_2$. This is because it carried a peroxide producing system along with it either as an impurity or as a bound flavin moiety. Also in *in vitro* assays, only about 1/10 mole of exogenous $H_2O_2$ is needed per mole of IAA oxidised and peroxidation in the strict sense that is by $H_2O_2$ in the absence of $O_2$ did not occur. The enzyme system requires $M_n^{2+}$ as cofactor.

Most of the attempts to separate the two activities (IAA oxidases and peroxidases) from plant tissues were unsuccessful as both types of activities moved together during purification (Hoyle, 1977). Nevertheless IAA oxidase was partially separated from peroxidases by Talwar *et al.* (1985) when they purified it from mung bean cotyledons. According to him, the IAA oxidation was inhibited by $H_2O_2$.

Beffa *et al.* (1990) also separated IAA oxidase partially from peroxidases of maize root apical segments and found that cofactors such as manganese ($MnCl_2$) and *p*-coumaric acid increased the *in vitro* enzymatic oxidation of IAA. But auxin oxidase activity was reduced by auxin transport inhibitors such as TIBA, DIBA and NPA.

Huang and Haard (1977) detected the presence of two forms of IAA oxidases in ripening tomato fruits of which the lower molecular weight of IAA oxidase (40,000) was more active than the higher molecular weight (2,00,000).

IAA oxidase activity was maximum in betula leaves when 2-amino-2-(hydroxy methyl) 1,3-propanediol (pH 8) was used as the buffer and Triton-x-100 as the detergent (Hoyle, 1978).

Forchetti and Tigier (1983) reported the influence of pH on IAA oxidase activity and that IAA oxidase showed a sigmoidal kinetic behaviour at pH 5.7 changing to hyperbolic at pH 4.6. Presence of cofactors like *p*-coumaric acid and $MnCl_2$ was required at pH 5.7. They also studied the activation effects of some dicarboxylic acid and found that oxalic acid was the most efficient activator particularly at pH 4.6.

## 3 Role of indole acetic acid oxidase

The physiological significance of IAA oxidase is that it controls or regulates the biological activity of IAA (Bryant and Lane, 1979). According to him nonperoxidative oxidases might play a major role in the regulation of IAA content in plants.

Chibbar *et al.* (1979) found that IAA oxidase activity increased concomitantly with root initiation showing the need for active IAA oxidase for root initiation especially when experiments were conducted in *Phasolus mungo* hypocotyl cuttings.

Ao *et al.* (1983) studied the activties of IAA oxidase and peroxidase in ripening apple fruits and fruit stalks at different times and concluded that the enzymes in the stalk modified the flow of IAA and other growth substances into the fruit. However, it was also suggested that increase in IAA oxidase and peroxidase activity might play a regulatory role in the abscission of fruits (Vizotto *et al.*, 1986).

Studies conducted by Saxena and Singh (1986) showed that IAA oxidase and peroxidase had significant, but inverse correlations with plant height at maturity.

There was some correlation between IAA oxidase activity and flowering in plants like endive (Mohamed-Yassen *et al.*, 1989). Zarsky *et al.* (1990) also reported that high IAA content in plants acted as a background inhibitor of flowering.

The increase in the IAA-oxidase activity during bud reactivation in *Kalanchoe mortagei* was detected by Jesrai *et al.* (1990) and they suggested that the role of augmented IAA oxidase activity is to lower the endogenous inhibitory level of IAA, thus producing the optimum auxin/cytokinin ratio for bud reactivation.

Nevertheless there are some reports stating that no correlation exists between growth and IAA oxidase activity (Reddy and Reddy, 1990).

## 4 Factors affecting indole acetic acid oxidase activity

### 4.1 Plant ontogeny

According to Kumar and Goswami (1985) there were two peaks of IAA oxidase activity in developing peach fruits, with the first peak occurring within two weeks of fruit set and the second one at the onset of ripening. Further they suggested that during the first peak phenolic type auxin protectors prevented IAA oxidation whereas at the second peak, concentration of auxin protectors decreased. However, both peroxidase and IAA oxidase activities were found to decrease during plant ontogeny. Also they were found to decrease acropetally along the stem during transition to flowering (Sergeeva *et al.*, 1985; Konstantinova, 1987).

### 4.2 Nutrition

#### 4.2.1 Nitrogen

Chan (1988) noted that N rate did not affect IAA oxidase activity during storage root initiation and early development of sweet potato.

### 4.2.2 Phosphorus and potassium

After studying the indoleacetic acid metabolism under different conditions of mineral nutrition, Bulatova and Pomaz (1984) found that auxin oxidase activity decreased in P deficient plants but increased in K deficient plants.

### 4.2.3 Micronutrients

A marked rise in IAA oxidase activity was found in boron deficient tomato plants (Ko, 1979). Nag *et al.* (1984) observed that peroxidase and IAA oxidase activities of rice seedlings increased in response to zinc. Peroxidase and IAA oxidase activities were also found to increase both at high and low levels of copper when cucumber seedlings were cultured in Knop solution containing 0.04-0.06 ppm Cu (Liu and Sun, 1985). Manganese application was also found to increase IAA oxidase activity in the flag leaves of wheat grown in manganese deficient soil (Kaur *et al.*, 1991).

### 4.2.4 Other elements

Experiment by Pan *et al.* (1990) showed that spraying sugarcane with rare earth elements decreased the IAA oxidase activity while it increased plant growth and the rate of photosynthesis.

## 4.3 Exogenous application of indole acetic acid

Nowakowski (1979) noticed a reduction in IAA oxidase activity in the roots and shoots of winter wheat and maize plants when their seeds were treated with $10^{-5}$ M IAA before sowing.

However, application of 10 ppm IAA to banana fruit increased the activities of hydrolytic and oxidative enzymes (Desai and Deshpande, 1979). Similarly treatment of bean stem and leaf cuttings with IAA also stimulated the auxin oxidase activity (Gus'kov *et al.*, 1980). Zieslin and Ban-Zaken (1992) also observed increased peroxidase activity in the proximal part of the flower peduncle of rose following exogenous application of 0.2 per cent IAA, while the activity was not affected by IAA application on the distal part of the peduncle.

## 4.4 Application of other growth regulators

Gaspar and Xhaufflaire (1967) showed that kinetin activated the IAA oxidases of roots in *Lens culinaris*. Later, Lee (1971) found that cytokinins when applied at lower concentrations (0.2 $\mu M$) increased the activity of IAA oxidase in *Nicotiana* callus culture, higher concentrations of kinetin (2-5 $\mu M$) decreased the activity of IAA oxidase.

Ranade and David (1985) studied the effect of quinones on growth and enzyme activity in tomato plants and found that application of naphthaquinone at $10^{-5}$ $M$ caused significant increase in growth while it decreased the activity of IAA oxidase.

## 4.5 Pests and Diseases

### 4.5.1 Pests

Bajaj *et al.* (1983) compared four tomato cultivars and found that IAA oxidase activity was higher in plant roots susceptible to nematode. However, contradictory results were obtained by Leela *et al.* (1993) who reported that inoculation with *Meloidogyne incognita* increased IAA oxidase activity in the root

knot nematode resistant *Vigna unguiculata* cv. C 152 and activity declined in susceptible cv. S 488.

### 4.5.2 Diseases

Study conducted by Kumar *et al.* (1980) revealed that IAA and 3-indole acetonitrite were 98.4 and 92.6 per cent lower in bunchy top affected mango seedlings than in healthy seedlings whereas oxidase activity was 350 per cent higher in bunchy top affected material. In the case of *Amaranthus blitum* var. *oleracea* infection by *Albugo bliti* increased the IAA oxidase activity almost four fold (Salchare and Thite, 1986). *Aspergillus niger* infection also increased the IAA oxidase activity in garlic (Prasad *et al.*, 1986) and in *Dolichos lablab* (Prasad and Prasad, 1988).

## 4.6 Other factors

### 4.6.1 Temperature and light

The temperature sensitivity of different enzymes in cucumber seedlings was studied by Omran (1980) who found an increase in IAA oxidase activity at 5°C and 85 per cent relative humidity and restoration of enzyme activity to the prechilling levels when the chilled plants were returned to 25°C.

Exposure of etiolated pea seedlings to red and white light was found to increase the peroxidase and IAA oxidase activities in the leaves (Rakitina, 1987).

### 4.6.2 Polyphenols

According to Doumenjou and Marigo (1978) feeding of tomato seedlings with quinic acid stimulated the pool of natural phenolics and slowed down the

degradation of IAA. Exogenous application of polyphenols such as caffeic acid and protocatechuic acids at different dosages viz. 25, 50 and 100 mg $l^{-1}$ in cucumber var. Long Green Kalyanpur had also resulted in inhibition of IAA oxidase activity (Sharma and Kaushik, 1983).

### 4.6.3 Monophenols

Monophenols are found to increase IAA oxidase activity. Hashim *et al.* (1978) reported that IAA oxidase activities noticed in *Hevea* leaves were stimulated by 2,4-dichlorophenol as well as naturally occurring phenolics. Sharma and Kaushik (1983) reported that treatment with *m*-coumaric acid (monophenol) decreased endogenous IAA and increased the IAA oxidase activity in cucumber var. Long Green Kalyanpur. Mitiku (1991) observed enhanced IAA degradation by *p*-coumaric acid and ferulic acid in a concentration dependant fashion from $5 \times 10^{-4}$ to $5 \times 10^{-7}$ *M* in both *in vivo* and *in vitro*.

### 4.6.4 Other chemicals

Reports of Lee (1982) showed that glyphosate application increased the IAA oxidase activity facilitating oxidative degradation of IAA.

## 5 Effects of exogenous application of indole acetic acid

Exogenous application of IAA was found to affect various parameters related to plant growth and yield.

### 5.1 Growth and yield parameters

Saito (1975) observed that treatment of egg plant seedlings with 100 ppm IAA six times at four day intervals not only retarded growth and flower bud differentiation, but also increased the number of leaves up to first flower formation

and decreased the number of flower clusters per plant. However foliar application of IAA at 15 days after transplanting reduced the time until flower bud initiation by 5-12 days and enhanced both the fruit size and yield (Maurya and Singh, 1978). Pillai (1978) indicated that foliar application of IAA at 100 ppm at flower opening stage followed by a second spray 3 weeks later in tomatoes cv. Marglobe significantly increased flower buds and number of flowers per plant resulting in higher yield.

Foliar application of IAA had resulted in increased yield in *Phaseolus vulgaris* (Koter *et al.*, 1983), peas (Dhawale, 1983), *Phaseolus aureus* (Mukherjee and Saxena, 1986) and rice (Singh *et al.*, 1984; Samantasinha and Sahu, 1990).

## 5.2 Nutrient uptake

### 5.2.1 Primary nutrients

Yakushkina and Kulakova (1979) found that application of IAA at 50 mg $l^{-1}$ resulted in increased uptake of K by *Phaseolus vulgaris* cv. Donsky Belaya.

Dhawale (1983) found that foliar application of IAA 10 mg $l^{-1}$ to peas within 35 days of anthesis increased the N and P contents in them. As per the report of Simko (1984), application of IAA did not alter the N, P and K contents in leucern plant. But such an application increased the total N yield by 8-22 per cent. Gaafar *et al.* (1984) reported that treatment with IAA either at 100 or 200 mg $l^{-1}$ resulted in increased N, P and K content in leaf and shoot. Osman *et al.* (1985) observed increased P concentration in cotton plants following IAA spray. Michalik (1986) also observed that in maize IAA stimulated P uptake by roots but retarded its translocation to shoots.

Application of two foliar sprays of IAA significantly increased N, P and K uptake in groundnut from control plots, but had no effect on crops fertilized with N, P and K (Sagar and Naphade, 1987). Similar result was obtained by Hussain *et al.* (1988) in *Leucaena leucocephala.* However, higher dosage of IAA promoted steady decrease in N, P and K uptake even to levels below that of control.

### 5.2.2 Secondary nutrients

Castro *et al.* (1984) found that spraying two week old groundnut cv. Tatu-537 with 100 ppm IAA reduced the Ca content of leaves. In leucerne, IAA application didn't alter the Ca and Na contents, increased the Mg content 8-16 per cent (Simko, 1984).

According to Gaafar *et al.* (1984), treatment with IAA at 100 or 200 mg $l^{-1}$ increased Mg content in leaves but decreased Mg in shoots. Trials conducted by Wen *et al.* (1991) revealed that application of NAA 50 ppm either as spray or root feeding of chinese cabbage increased the Ca uptake and its translocation within the plant thus altering its distribution within the plant.

Uptake of sulphate by plants was also stimulated by IAA in pea seedlings (Zholobak, 1985).

## 5.3 Endogenous IAA

Bondok *et al.* (1991) reported that application of IAA promoted endogenous auxin activities compared to control at flowering (100 DAS) and fruiting stages (120 DAS) of cotton.

## 6 Effect of nutrition on endogenous IAA

### 6.1 Nitrogen

Nitrogen application was found to increase the IAA concentration in the seedlings of *Pinus sylvestris* (Rudawska and Kieliszewska-Rokicka, 1989).

### 6.2 Micronutrients

According to Garg and Hemantarajan (1988), Fe nutrition influenced the IAA content of *Phaseolus vulgaris* plants. In *Triticum aestivum* also, Fe and Zn nutrition influenced the IAA content (Hemantarajan and Garg, 1988). Cakmak *et al.* (1989) observed that the level of IAA estimated in shoot tips and young leaves of Zn deficient plants decreased to about 50 per cent when compared to that of Zn sufficient plants and concluded that this decrease in IAA level was not brought about by impaired tryptophan synthesis.

## 7 Nutritional requirements of brinjal

The proportions of N, P and K in the soil had an appreciable effect on the total nutrient removal from the soil and on nutrient utilisation by eggplants (Nikolaeva, 1974).

### 7.1 Nitrogen

#### 7.1.1 Dose

Sutton and Albregts (1971) reported that eggplant responded well to higher levels of nitrogen application. As per the reports of Verma *et al.* (1974), the yields of eggplant cultivars viz. Pusa Purple Long, Pusa Purple Round and Pusa Kranti were linearly related to levels of applied nitrogen especially at doses up to 150 kg $ha^{-1}$. Another report by Addae-Kagya and Norman (1977) suggested that

high N level (89.6 kg $ha^{-1}$) greatly increased the vegetative growth of eggplant. According to Rajeevan and Rao (1980) highest fruitset and largest plants of eggplant cv. Eggwhite were obtained with N at 50 kg $ha^{-1}$ as basal dressing + 25 kg $ha^{-1}$ N given as one per cent foliar sprays at transplanting and flowering. In the case of eggplant cv. Violetta Lunga de Napoli, N rate did not affect the fruiting time, but the size and number of fruits increased with the amount of N applied and the effectiveness of N differed with the time of application (Duranti and Cuocolo, 1982).

### 7.1.2 Time of application

There are a few reports related to the time of N application also. Aliev (1971) found that the optimal time for N application was during flowering and fruiting. Nikolaeva (1974) also observed that N applied as top dressing was better utilised by plants than N applied as basal dressing.

## 7.2 Phosphorus

Phosphorus application was found to advance flowering appreciably (Aliev, 1971). Phosphorus applied immediately after seedling emergence stimulated growth until flowering after which it declined. Optimal time of P application was reported to be before planting.

In the case of eggplants, P nutrition was important during the entire growing season (Nikolaeva, 1974).

Crespo (1981) reported that the maximum yield of eggplant cv. Rosita was obtained with 200 kg $P_2O_5$ $ha^{-1}$.

## 7.3 Potassium

Eggplant was responsive to high levels of K application (Sutton and Albregts, 1971). According to them the content of K in fruits was not found to be influenced by fertilizer rates. Crespo (1981) reported that optimum $K_2O$ rate for eggplant cv. Rosita was 253 kg $ha^{-1}$. Another study by Hochmuth *et al.* (1993) showed that the optimum dose of K for eggplant cv. Classia in spring was 94 kg $ha^{-1}$ but 60 kg K $ha^{-1}$ in autumn. The critical K concentrations in whole leaves were estimated to be 45 g $kg^{-1}$ at first flowering, 35 g $kg^{-1}$ at early fruiting, 30 g $kg^{-1}$ during harvest and 28 g $kg^{-1}$ at the end of 7 harvests, clearly indicating a decrease in critical K levels with the advancement of growth.

# Materials and Methods

# MATERIALS AND METHODS

In order to achieve the proposed objectives of the study, an experiment was carried out in the Vegetable Research Farm, Department of Olericulture, College of Horticulture, Vellanikkara, Thrissur during the rabi season of 1996. A brief description of the materials used and methods employed are given below.

## 1 Experimental site and soil

Experiment was conducted at the Vegetable Research Farm of the Department of Olericulture located at an altitude of 22.5 m above msl and at 10° 32' N latitude and 76° 16' E longitude. The area enjoys a warm humid tropical climate. The soil was acidic in nature with medium organic carbon content. Available P and available K status were also medium (Table 2).

## 2 Planting materials

The solanaceous vegetable, brinjal (*Solanum melongena* L.) var. Surya was selected as the test crop. The seeds for this purpose were procured from the Department of Olericulture, College of Horticulture.

## 3 Fertiliser material

Commercial urea, factomphos and muriate of potash were used to supply N, P and K to test plants at the predetermined doses. Farmyard manure used in the study was procured from University Livestock Farm, Mannuthy.

## 4 Preparation of field

The entire experimental area was cleared of weeds, ploughed and levelled. Then the whole area was divided into three blocks and each block was further split into 13 plots.

## 5 Field experiment

The experiment was laid out in randomised block design with 13 treatments and three replications. The plot size selected was 4.5 x 3 m so that each plot contained 30 plants.

The allocation of various treatments to different plots was statistically done, the details of which are given in Fig.1.

There were 13 treatments the details of which are given in Table 1.

### 5.1 Agronomic practices

#### 5.1.1 Preparation of nursery and management

The soil was ploughed to fine tilth, seed beds having 15 cm height, 1 m width and 2 m length were taken. Seeds were sown on these raised beds and the beds covered with mulch till the seeds got germinated. Irrigation was provided to maintain optimum moisture level in soil. Handweeding was done to keep the beds free of weeds. In order to prevent damping off, nursery soil was drenched with Indofil-M-45. Bavistin was used to control phomopsis blight.

#### 5.1.2 Transplanting

Thirty day old healthy seedlings were transplanted to the main field at a spacing of 60 x 75 cm. Initial shading for excessive heat and irrigation for maintaining optimum soil moisture level were provided.

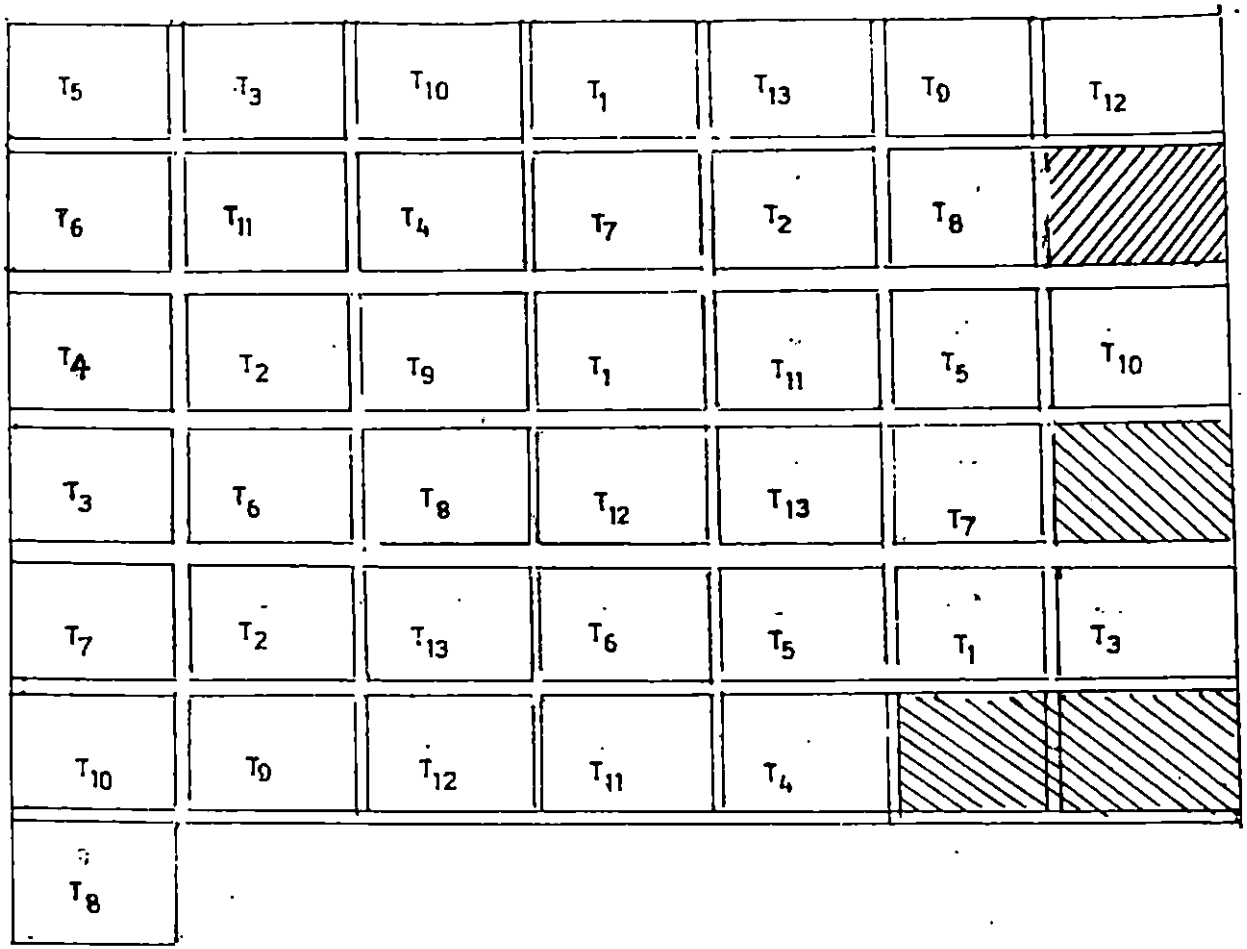


Fig. 1 LAYOUT OF THE EXPERIMENTAL FIELD

Table 1. Treatment details

| Sl. No. | Treatment | FYM t $ha^{-1}$ | N kg $ha^{-1}$ | P kg $ha^{-1}$ | K kg $ha^{-1}$ | IAA (ppm) |
|---|---|---|---|---|---|---|
| 1 | $T_1$ | -- | -- | -- | -- | (Absolute control) |
| 2 | $T_2$ | 20 | -- | -- | -- | -- |
| 3 | $T_3$ | 40 | -- | -- | -- | -- |
| 4 | $T_4$ | -- | 75 | 40 | 25 | -- |
| 5 | $T_5$ | -- | 150 | 80 | 50 | -- |
| 6 | $T_6$ | 20 | 75 | 40 | 25 | -- |
| 7 | $T_7$ | 40 | 150 | 80 | 50 | -- |
| 8 | $T_8$ | 20 | -- | -- | -- | 150 |
| 9 | $T_9$ | 40 | -- | -- | -- | 150 |
| 10 | $T_{10}$ | -- | 75 | 40 | 25 | 150 |
| 11 | $T_{11}$ | -- | 150 | 80 | 50 | 150 |
| 12 | $T_{12}$ | 20 | 75 | 40 | 25 | 150 |
| 13 | $T_{13}$ | 40 | 150 | 80 | 50 | 150 |

5.1.3 Irrigation

The crop was irrigated on alternate days so as to maintain sufficient moisture in soil.

5.1.4 Application of manures and fertilisers

During land preparation farmyard manure was applied at the required rates and was incorporated well into the soil. Half the requirement of nitrogen, full dose of phosphorus and half dose of potash were given as basal dressing before transplanting through factomphos and muriate of potash. One fourth of N and half of potash were applied one month after transplanting and the remaining quantity of nitrogen was applied one month after the first application.

5.1.5 Growth regulator application

IAA at the rate of 150 ppm was applied as foliar spray 15 days after transplanting and the spray repeated 35 days after transplanting.

5.1.6 After cultivation

The plots were kept free of weeds throughout the growing period. Need based plant protection measures were taken for the crop.

5.1.7 Harvesting

Harvesting of the fruits was done when the fruits attained vegetable maturity stage.

## 5.2 Collection of plant samples and estimation of IAA oxidase activity

Tender leaf samples were collected for analysis at three stages of growth viz., vegetative stage (20 days after transplanting), flowering stage (45 days after transplanting) and fruiting stage (75 days after transplanting) and the IAA oxidase activity was assayed in the samples as described below by the modified procedure of Bryant and Lane (1979).

For analysis, acetone powder was prepared from the frozen tissue by blender homogenizing 10 g sample in two successive 100 ml aliquots of cold acetone. The homogenate was collected by buchner filtration through Whatman No.1 filter paper. The homogenate was air dried until free of acetone. The resulting dry powder was weighed and freezer stored. Out of this, 0.5 g acetone powder was ground in two successive 10 ml aliquots of 25 m*M* phosphate buffer (pH 6.2) in a mortar chilled in an ice bath. The extract was collected by buchner filtration through Whatman No.1 filter paper. Both the filtrates were combined and diluted to 25 ml with phosphate buffer.

Two ml 0.071 *M* phosphate buffer (pH 6.2), one ml *p*-coumaric acid solution (25 mg *p*-coumaric acid dissolved in 50 ml water), 1 ml manganese chloride solution (118 mg $MnCl_2.4H_2O$ dissolved in 20 ml water) and 2 ml enzyme extract were pipetted into a test tube. The reaction was initiated by adding 4 ml IAA solution (10 mg IAA dissolved in 40 ml water) and incubated the reaction mixture in the dark with intermittant shaking at 30°C. Two ml of the mixture was withdrawn after zero and 60 min of incubation and 5.2 ml of 5 *M* perchloric acid and 0.5 ml 0.1 N ferric nitrate solution were added and finally diluted to 10 ml with distilled water. The colour was developed by incubating the mixture in the dark for 60 min and absorbance was measured at 535 nm using Spectronic-20 spectrophotometer. Protein content in the enzyme extract originally prepared from

the plant was determined colorimetrically following the method of Lowry *et al.* (1951). Then, specific activity was calculated as follows.

Enzyme activity = Absorbance at 60 min - absorbance at zero min

$$\text{Specific activity} = \frac{\text{Enzyme activity}}{\text{Protein content}}$$

5.3 Collection of plant samples and preparation for the analysis of nutrients

The entire plant material was uprooted and washed in distilled water to remove the adhering soil particles. The collected samples were dried in shade for a few days and later in an oven to constant weight at 80±5°C and the dry matter yield was determined. The dried plant material was ground to fine powder and then it was used to estimate the uptake of nutrients.

5.3.1 Nitrogen

The plant material was digested with $H_2SO_4$ and N content was determined using microkjeldahl method (Jackson, 1958).

5.3.2 Phosphorus

Diacid extract was prepared by digesting the plant sample with $HNO_3$ and $HClO_4$ in 2:1 ratio. The P content in this extract was determined colorimetrically by vanadomolybdo-phosphoric yellow colour method in $HNO_3$ system (Jackson, 1958).

### 5.3.3 Potassium

The diacid extract was suitably diluted and K content in it was read using an EEL flame photometer (Jackson, 1958).

### 5.3.4 Iron and manganese

Iron and manganese contents in the diacid extract were determined after suitable dilution using atomic absorption spectrophotometer.

## 5.4 Soil analysis

Soil samples were taken at the time of land preparation and were analysed for pH, organic carbon, available nitrogen, phosphorus and potassium.

Soil reaction was measured in a 1:2.5 soil water suspension with the help of a combined electrode assembly connected to a pH meter (Jackson,1958).

The organic carbon content was determined by Walkley and Black method as described by Jackson (1958). Available nitrogen content was estimated by alkaline permanganate method (Subbiah and Asija, 1956). Available phosphorus was extracted using the Bray No.1 extractant (0.03 N $NH_4F$ in 0.025 N HCl) (Bray and Kurtz, 1945) and the P content in the extract was estimated colorimetrically (Watanabe and Olsen,1965). For the extraction of exchangeable K neutral 1 N ammonium acetate was used and K content in the extract was determined by flame photometry (Jackson, 1958).

## 6 Biometric observations

Biometric observations were taken at three stages of growth viz., 20 days after transplanting ($S_1$- vegetative phase); 45 days after transplanting ($S_2$ - flowering stage) and 75 days after transplanting ($S_3$ - fruiting stage)

### 6.1 Plant height

Plant height was measured from the ground level to the growing tip.

### 6.2 Number of primary branches per plant

Number of primary branches was noted on four observation plants in each plot and their mean was calculated to get the number of primary branches per plant.

### 6.3 Number of fruits per plant

Number of fruits was also noted on four observation plants in each plot and their mean was calculated to get the number of fruits per plant.

### 6.4 Average fruit weight

The weight of individual fruits were recorded at all harvests and average fruit weight was calculated.

### 6.5 Yield

Yield at each harvest was taken and total yield was calculated.

## 7 Statistical analysis

Statistical analysis of the results was done by the analysis of variance method suggested by Snedcor and Cochran (1967).

# Results and Discussion

# RESULTS AND DISCUSSION

The present investigation was undertaken to study the influence of IAA oxidase on the growth and yield of brinjal grown at different levels of organic manures and fertilisers. Application of IAA was also done in order to characterise the influence of IAA on the performance of the crop. The results of the study are presented and discussed hereunder.

## 1 Characteristics of soil at the experimental site

The physico chemical characteristics of the soil at the experimental site are given in Table 2. The soil was acidic in nature (pH 5.3), with an organic carbon content lying in the medium range (0.825%). Mean values of available N, available P and available K showed that the soil of the site was low in available N, medium in available P and medium in available K.

## 2 Indole acetic acid oxidase activity

Indole acetic acid oxidase is an enzyme which helps in the oxidation of IAA and thereby reducing its concentration in plants. The enzyme activity in the leaves of brinjal as influenced by various treatments have been estimated and the results are presented in Table 3.

In control plants IAA oxidase activity was found to increase with the age of the plant from vegetative to flowering stage and then decreased at the fruiting stage. Maximum IAA oxidase activity (1.007) was observed in the flowering stage and it was the lowest (0.428) in the vegetative phase. However at the fruiting stage, the enzyme activity was found to decrease (0.658). The observed increase in IAA

Table 2. Soil characteristics of the experimental site

| | |
|---|---|
| pH | - 5.3 |
| Electrical conductivity | - 0.058 dS $m^{-1}$ |
| Organic carbon | - 0.825% |
| Organic matter | - 1.419% |
| Available N | - 172.3 kg $ha^{-1}$ |
| Available P | - 21.4 kg $ha^{-1}$ |
| Available K | - 120.1 kg $ha^{-1}$ |

Table 3. Effect of treatments on IAA oxidase activity

| Treatment | | Indole acetic acid oxidase activity | | |
|---|---|---|---|---|
| | | $S_1$ | $S_2$ | $S_3$ |
| $T_1$ | Absolute control | 0.428 | 1.007 | 0.658 |
| FYM | | | | |
| $T_2$ | FYM 20 t $ha^{-1}$ | 0.285 | 0.711 | 0.237 |
| $T_3$ | FYM 40 t $ha^{-1}$ | 0.526 | 0.964 | 0.256 |
| $T_8$ | FYM 20 t $ha^{-1}$ + 150 ppm IAA | 0.158 | 0.354 | 0.587 |
| $T_9$ | FYM 40 t $ha^{-1}$ + 150 ppm IAA | 0.219 | 0.280 | 0.824 |
| Fertiliser | | | | |
| $T_4$ | NPK 75:40:25 kg $ha^{-1}$ | 0.357 | 0.805 | 0.381 |
| $T_5$ | NPK 150:80:50 kg $ha^{-1}$ | 0.177 | 0.366 | 0.999 |
| $T_{10}$ | $T_4$ + 150 ppm IAA | 0.157 | 0.373 | 1.363 |
| $T_{11}$ | $T_5$ + 150 ppm IAA | 0.341 | 0.668 | 0.144 |
| FYM + Fertiliser | | | | |
| $T_6$ | FYM 20 t $ha^{-1}$ + NPK 75:40:25 kg $ha^{-1}$ | 0.104 | 0.434 | 0.655 |
| $T_7$ | FYM 40 t $ha^{-1}$ + NPK 150:80:50 kg $ha^{-1}$ | 0.143 | 0.515 | 0.632 |
| $T_{12}$ | $T_6$ + 150 ppm IAA | 0.209 | 0.369 | 0.739 |
| $T_{13}$ | $T_7$ + 150 ppm IAA | 0.156 | 0.259 | 0.780 |
| Mean | | 0.250 | 0.547 | 0.635 |
| CD(0.05) | | NS | NS | 0.500* |

* Significant at 5 per cent level
NS - Not significant

oxidase activity from the initial stage to flowering stage might have been due to the gradual aging of tissues which should be considered as a positive condition for flowering as presence of high IAA concentration at that stage is likely to inhibit flowering. A similar view had been expressed by Wareing and Phillips (1978).

## 2.1 Effect of Farmyard manure on IAA oxidase activity

The enzyme (IAA oxidase) activity in control plants recorded relatively higher values eventhough the differences were not statistically significant when compared with other treatments at all the three stages in the study. The relatively poor vegitative growth observed in control plants thus synchronised with a relatively high IAA oxidase activity. Application of FYM at the rate of 20 t $ha^{-1}$ ($T_2$) promoted better growth of brinjal plants when compared to control. The lower activity of enzyme recorded in $T_2$ might have indirectly helped to enhance the IAA concentration and thereby enhancing the biomass yield. Higher concentration of IAA has been reported to be associated with higher vegitative growth of plants (Moore, 1980). In general, wherever there had been independant application of FYM (irrespective of their doses), the enzyme activity was found to decrease compared to control except at the vegetative stage of $T_3$. This might have provided enhanced IAA activity probably enhancing the partitioning of photosynthates to fruits, thus enhancing the yield.

When external application of IAA at 150 ppm was combined with FYM addition at 20 t $ha^{-1}$, there had been decreased enzyme activity at the first two stages of study (vegetative and flowering stage). Such a lower activity of enzyme might have enhanced the IAA concentration in plants which is directly manifested through the biomass production at these stages (Table 6). At the fruiting stage, the observed enhancement in enzyme activity might have been for a natural regulation of IAA in

plants. A similar trend had been observed when external application of IAA had been combined with 40 t FYM $ha^{-1}$.

As regards the decrease in IAA oxidase activity at a higher level of IAA in the plant, different hypotheses have been put forward by the earlier workers. Nowakowski (1979) observed that application of IAA before sowing decreased the IAA oxidase activity in the roots and shoots of plants. Reinecke and Bandurski (1988) attributed this phenomenon to a competitive peroxidase reaction. They presumed that cofactors of mixed-function-oxygenase, peroxidase and intermolecular dioxygenase were not stimulatory to IAA oxidase activity. Menyailo and Balamaeva (1987) observed that in young pine xylem, IAA stimulated the enzymes involved in metabolism such as ß-glucosidase, acid phosphatase, malate dehydrogenase etc. These enzymes may also indirectly influence the rate of IAA oxidase activity.

There had been an observed increase in IAA oxidase activity at fruiting stage when FYM at both doses were combined with external application of IAA. Since the enzyme activity was observed 40 days after the second application of IAA, the higher IAA oxidase activity noticed at fruiting stage might have been due to a decrease in IAA concentration consequent to its translocation, degradation or utilisation by plant.

## 2.2 Effect of fertilisers on IAA oxidase activity

Normal application of fertilisers ($T_4$) as per the Package of Practice Recommendation (KAU, 1993) recorded nonsignificant decrease in IAA oxidase activity when compared to absolute control at all the three stages of the study. Doubling the dose of NPK ($T_5$) resulted in further nonsignificant decrease in enzyme activity at all stages except the fruiting stage. However, the observed

increase in enzyme activity at fruiting phase was significant when compared to that from the normal application of fertilisers.

The observed decrease in the enzyme activity at all stages of growth might have permitted enhanced IAA activity and this might be responsible for the observed increase in biomass (Table 6) for these treatments when compared to that of control plants. However, when fertiliser doses were doubled a similar trend in enzyme activity has been obtained at all stages of growth except for the fruiting stage wherein there might have been some autoregulation of enzyme activity in plants to promote enhanced growth.

The enzyme activity from $T_{10}$ (application of IAA at 150 ppm along with the recommended dose of NPK) when compared to that of control was nonsignificantly lower at vegetative and flowering stages but increased at fruiting. However, when the same dose of IAA was combined with double the dose of fertilisers ($T_{11}$) a reverse trend in enzyme activity was observed compared to that obtained when IAA was combined with the recommended dose of fertiliser. The double dose of fertiliser addition - in $T_{11}$ might be responsible for enhancing the enzyme activity in the first two stages and thereby regulating the corresponding IAA concentration in plants. Hence it should be presumed that, at the fruiting stage, the added fertilisers failed to exert its influence in enhancing the IAA oxidase activity.

2.3 Effect of combination of FYM and fertilisers on IAA oxidase activity

Normal application FYM and NPK ($T_6$) as per the package of practice recommendation recorded lower enzyme activity at all the three stages of study when compared to absolute control. Treatment $T_7$ where the dose of NPK and FYM envisaged in $T_6$ had been doubled resulted in marginal increase in enzyme activity at vegetative and flowering stages but it was marginally decreased at fruiting stage indicating that heavy doses of fertiliser and manure application enhances the

enzyme activity in plants especially at the early stages of growth and obviously retards the biomass production (Table 6).

External application of IAA at 150 ppm to plants receiving the recommended dose of FYM and NPK showed slight increase in IAA oxidase activity at vegetative and fruiting phases and slight decrease at flowering phase showing erratic behaviour of enzyme activity in plants. Application of 150 ppm IAA along with double dose of both FYM and fertiliser ($T_{13}$) also showed a similar trend.

## 3 Influence of FYM, fertiliser and their combination on IAA oxidase activity and vegetative growth of the plant

The influence of FYM, fertilizer and their combination on height and number of branches per plant had been monitored and the details are given in Table 4.

### 3.1 Height of plant

In general it is seen that height of plants increased with the advancement of growth in all the treatments. Application of FYM at the rate of 40 t $ha^{-1}$ recorded nonsignificant increase in height when compared to that recorded from the application of 20 t FYM $ha^{-1}$ at all the three stages of growth. External application of IAA combined with higher levels of FYM also could not effect an increase in plant height.

Normal fertiliser recommendation as per the package of practice recommendation of KAU ($T_4$) resulted in nonsignificant increase in the height of plants at all stages of growth. Doubling the fertiliser dose envisaged in $T_4$ decresed the plant height at all stages compared to that at the normal dose. External application of IAA at the rate of 150 ppm along with the normal recommended dose of fertilisers ($T_{10}$) resulted in a marginal decrease in plant height at the vegetative

Table 4. Effect of FYM, fertiliser and their combination on height and number of branches per plant

| Treatment | Height (cm) | | | No.of branches per plant | |
|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | $S_2$ | $S_3$ |
| $T_1$ | 5.13 | 30.42 | 49.01 | 2.08 | 4.39 |
| FYM | | | | | |
| $T_2$ | 6.46 | 30.92 | 51.89 | 2.92 | 5.78 |
| $T_3$ | 7.96 | 35.17 | 56.17 | 4.53 | 6.64 |
| $T_8$ | 7.08 | 30.67 | 59.78 | 3.67 | 5.72 |
| $T_9$ | 6.29 | 30.17 | 56.67 | 3.25 | 6.00 |
| Fertiliser | | | | | |
| $T_4$ | 7.63 | 32.64 | 56.44 | 4.25 | 6.34 |
| $T_5$ | 6.82 | 30.82 | 49.68 | 4.33 | 5.69 |
| $T_{10}$ | 6.79 | 33.33 | 55.95 | 4.67 | 6.25 |
| $T_{11}$ | 7.63 | 34.33 | 59.83 | 4.17 | 6.33 |
| FYM + Fertiliser | | | | | |
| $T_6$ | 7.57 | 31.15 | 54.31 | 3.75 | 6.30 |
| $T_7$ | 8.25 | 30.00 | 52.64 | 3.50 | 6.17 |
| $T_{12}$ | 6.08 | 30.61 | 57.22 | 3.58 | 6.11 |
| $T_{13}$ | 6.25 | 35.08 | 58.00 | 4.75 | 6.56 |
| Mean | 6.92 | 31.95 | 55.18 | 3.88 | 6.18 |
| CD(0.05) | NS | NS | NS | NS | NS |

* Significant at 5 per cent level
NS - Not significant

and fruiting stages of growth. However, there had been a marginal increase in plant height at flowering stage. IAA application along with double dose of fertiliser ($T_{11}$) could not influence the enhancement of plant height over that recorded in $T_4$ at the first stage and with the second stage there had been marginal increase in height.

Combined application of FYM and fertilisers at the recommended dose has resulted in a decrease in the height of plants at all the three stages of growth compared to application of fertiliser alone at the recommended dose. Doubling the dose of NPK and FYM increased the plant height marginally at vegetative stage, but this increase was not observed at later stages probably due to the adverse effect of excess addition of fertilisers on plants. External application of IAA along with the normal and double dose of fertilisers and FYM could not make any significant increase in plant height at all stages of growth. The enzyme activity in plants could not significantly influence the plant height in any of the treatments.

3.2 Number of primary branches per plant

The number of branches was found to increase from the flowering stage to fruiting stage in all treatments. However, there had been simultaneous increase in the number of branches and height of plant only in two treatments viz., $T_3$ and $T_{13}$ where there had been excessive addition of FYM (40 t $ha^{-1}$). This probably indicates the beneficial influence of FYM on growth and yield of crops. The enzyme activity in plants cound not significantly influence the number of branches in any of the treatments.

## 4 Influence of FYM fertiliser and their combination on IAA oxidase activity and productive characters of plant

Influence of different treatments on the number of flowers, fruits per plant and average fruit weight is presented in Table 5.

Table 5. Influence of treatments on the number of flowers and fruits per plant and fruit weight

| Treatment | Number of flowers per plant | | Number of fruits per plant | Average fruit weight (g) |
|---|---|---|---|---|
| | $S_2$ | $S_3$ | $S_3$ | |
| $T_1$ | 0.67 | 1.94 | 1.97 | 40.30 |
| FYM | | | | |
| $T_2$ | 0.75 | 2.81 | 2.86 | 40.53 |
| $T_3$ | 0.68 | 2.53 | 4.44 | 45.49 |
| $T_8$ | 0.58 | 2.17 | 4.50 | 43.27 |
| $T_9$ | 0.50 | 2.58 | 4.33 | 43.17 |
| Fertiliser | | | | |
| $T_4$ | 0.33 | 3.89 | 3.86 | 43.33 |
| $T_5$ | 0.42 | 2.22 | 3.22 | 36.43 |
| $T_{10}$ | 0.75 | 3.14 | 4.56 | 41.53 |
| $T_{11}$ | 0.42 | 3.42 | 3.53 | 39.67 |
| FYM + Fertiliser | | | | |
| $T_6$ | 1.00 | 3.31 | 3.25 | 45.45 |
| $T_7$ | 0.33 | 2.08 | 2.61 | 42.15 |
| $T_{12}$ | 0.69 | 1.99 | 4.19 | 41.19 |
| $T_{13}$ | 0.53 | 2.42 | 3.51 | 44.49 |
| Mean | 0.67 | 2.43 | 3.60 | 42.08 |
| CD(0.05) | NS | NS | NS | NS |

* Significant at 5 per cent level
NS - Not significant

### 4.1 Number of flowers per plant

Number of flowers in brinjal plants could not be influenced by FYM or fertiliser, either alone or in combination and with external application of IAA at all levels of application. The enzyme activity in plants could not significantly influence the number of flowers per plant.

### 4.2 Number of fruits per plant

Number of fruits in brinjal plants could not be influenced by the addition of FYM either alone or its combination with fertiliser or with external application of IAA at all levels of application. There was significant difference in the IAA oxidase activity of the fruiting stage but that was not reflected in the number of fruits per plant indicating that the enzyme activity in plants could not influence the number of fruits per plant.

### 4.3 Average fruit weight

Average fruit weight of brinjal was also not influenced by the addition of FYM or fertiliser either alone or in combination or with external application of IAA.

## 5 Influence of FYM, fertiliser and their combination on IAA oxidase activity and dry matter production

Table 6 depicts the dry matter yield and fruit yield of brinjal at vegetative, flowering and fruiting stages.

Table 6. Influence of FYM, fertiliser and their combination on yield and dry matter production

| Treatment | Yield kg plot$^{-1}$ | Dry matter production (g plot$^{-1}$) | | |
|---|---|---|---|---|
| | | $S_1$ | $S_2$ | $S_3$ |
| $T_1$ | 3.487 | 17.19 | 122.49 | 567.6 |
| FYM | | | | |
| $T_2$ | 4.361 | 24.30 | 214.11 | 895.8 |
| $T_3$ | 5.356 | 15.09 | 189.21 | 1132.8 |
| $T_8$ | 6.351 | 30.21 | 224.10 | 1113.5 |
| $T_9$ | 5.629 | 21.51 | 249.99 | 916.8 |
| Fertiliser | | | | |
| $T_4$ | 4.559 | 32.61 | 224.31 | 790.1 |
| $T_5$ | 4.083 | 20.40 | 245.31 | 933.0 |
| $T_{10}$ | 4.714 | 40.80 | 470.40 | 1149.9 |
| $T_{11}$ | 5.132 | 33.00 | 275.59 | 666.3 |
| FYM + Fertiliser | | | | |
| $T_6$ | 4.886 | 39.30 | 215.19 | 967.2 |
| $T_7$ | 6.008 | 33.30 | 351.60 | 849.8 |
| $T_{12}$ | 6.849 | 31.20 | 532.20 | 1397.7 |
| $T_{13}$ | 9.250 | 41.10 | 260.19 | 1532.9 |
| Mean | 5.437 | 29.20 | 275.68 | 993.3 |
| CD(0.05) | 1.600* | 9.06* | 68.64** | 157.3* |

* Significant at 5 per cent level

** Significant at 1 per cent level

NS - Not significant

## 5.1 Influence of FYM

Addition of 20 t FYM $ha^{-1}$ ($T_2$) increased the dry matter yield of brinjal at all stages of growth. The dry matter production at flowering and fruiting stages in $T_2$ are significantly higher than that observed in control. Doubling the dose of FYM ($T_3$) resulted in nonsignificant but slight decrease in dry matter yield at vegetative and flowering stages compared to $T_2$. However, nonsignificantly higher dry matter production was observed in $T_3$ at fruiting stage. This might have been due to a delay in the mineralisation of added FYM in the soil especially when the soil was acidic.

Application of IAA along with 20 t FYM $ha^{-1}$ resulted in increased dry matter production at all stages. But when IAA was applied along with 40 t FYM $ha^{-1}$, a decrease in dry matter production was observed at fruiting stage possibly indicating the enhancement of enzyme activity at fruiting stage favouring lesser dry matter production.

At vegetative stage, the lowest IAA oxidase activity was recorded by $T_8$ (FYM 20 t $ha^{-1}$ + IAA 150 ppm) which also recorded the highest dry matter production. Highest IAA oxidase activity at vegetative stage was recorded by $T_3$ (FYM 40 t $ha^{-1}$) where the dry matter production was low. At flowering stage, the lowest IAA oxidase activity and the highest dry matter production was recorded by the treatment receiving external application of 150 ppm IAA along with 40 t FYM $ha^{-1}$ ($T_9$). Application of 40 t FYM $ha^{-1}$ resulted in the highest IAA oxidase activity and the lowest ($T_3$) dry matter production. In general higher enzyme activity in plants at vegetative (Fig.2a) and flowering stages (Fig.2b) of the plant had resulted in lesser dry matter production necessitating a negative correlation between dry

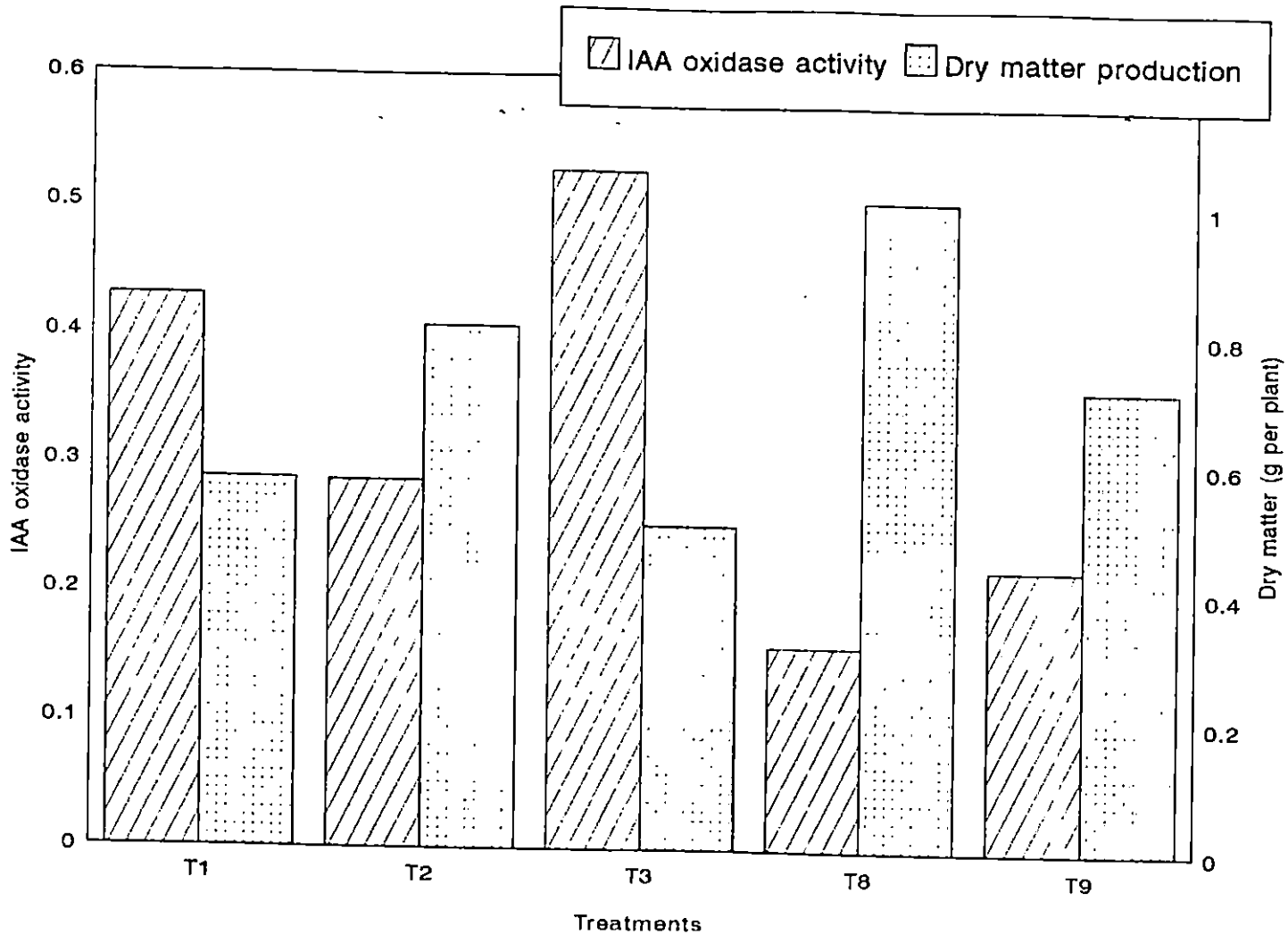


Fig.2(a). Influence of FYM on IAA oxidase activity and dry matter production at vegetative phase

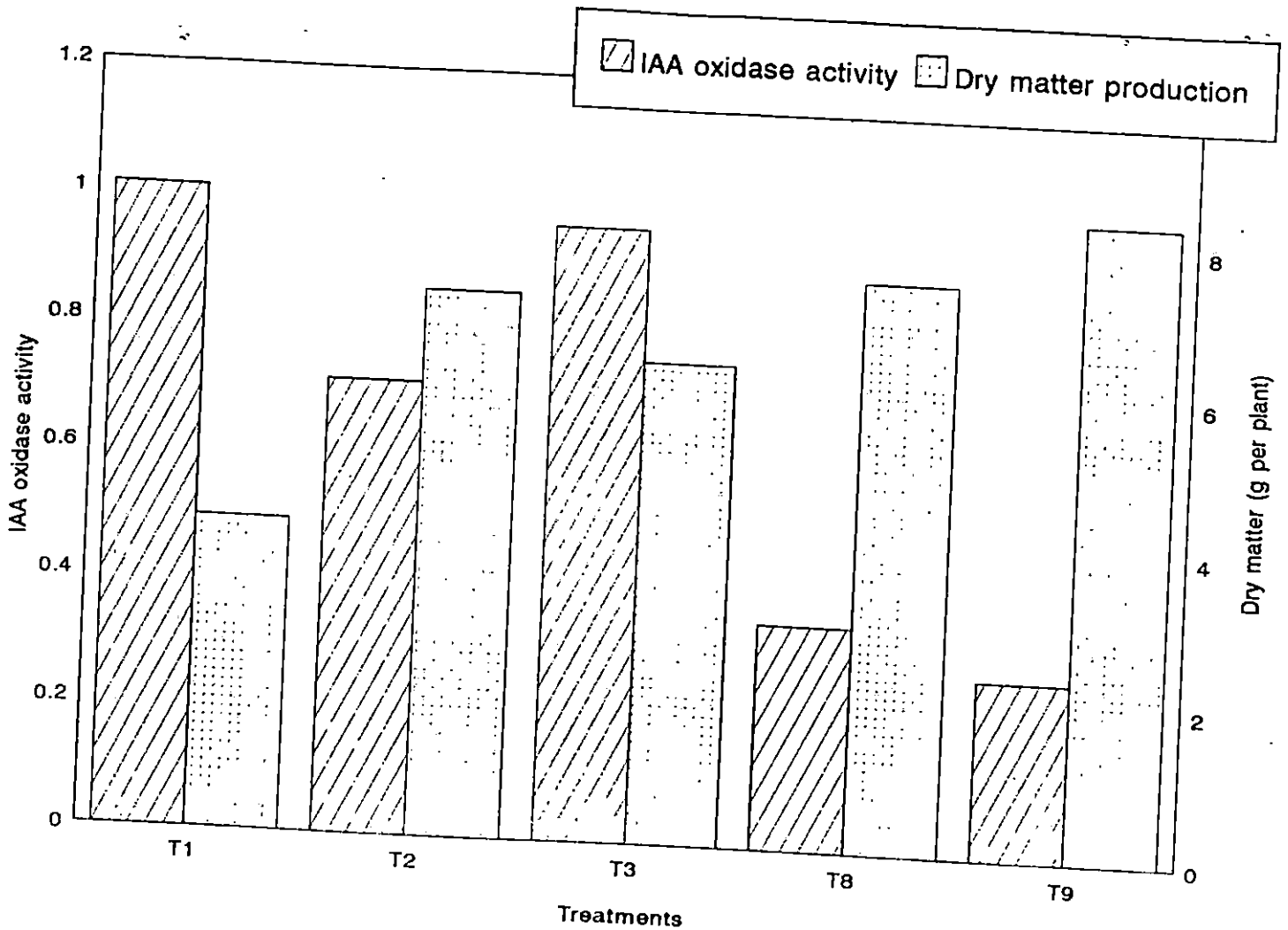


Fig.2(b). Influence of FYM on IAA oxidase activity and dry matter production at flowering phase

matter yield and enzyme activity in treatments receiving FYM. However, the enzyme activity at fruiting phase had no specific influence on dry matter production.

## 5.2 Influence of fertiliser

Application of fertiliser increased the dry matter production at all stages of growth compared to absolute control. Doubling the fertiliser dose decreased the dry matter yield at vegetative stage probably due to the adverse effect of excessive fertilisation especially at the initial stages of growth of plants. At the later stages of growth, the dry matter production increased probably offsetting the ill effects of excessive fertilisation in the course of its growth.

Application of 150 ppm IAA increased the dry matter production in fertilised plots compared to the application of fertilisers alone at the same dose at most of the stages. This might possibly be due to a direct influence of IAA in plants. The results observed at this stage are in accordance with that noted by Bhatnagar and Singh (1981). Similar view has also been reported by Garg and Kumar (1987), Stoyanov *et al.* (1987) and Ogbonna and Abraham (1989).

In the case of treatments receiving inorganic fertiliser without FYM, the observed relation between IAA oxidase actiity and dry matter production was similar to that observed in FYM applied treatments at the vegetative stage (Fig.3). But at flowering and fruiting stages, no such relation was observed.

## 5.3 Influence of combination of FYM and fertiliser

Combined application of FYM and fertiliser also increased the dry matter production significantly over control at all stages of growth. Doubling the dose of FYM and fertiliser could not enhance the dry matter production at vegetative and

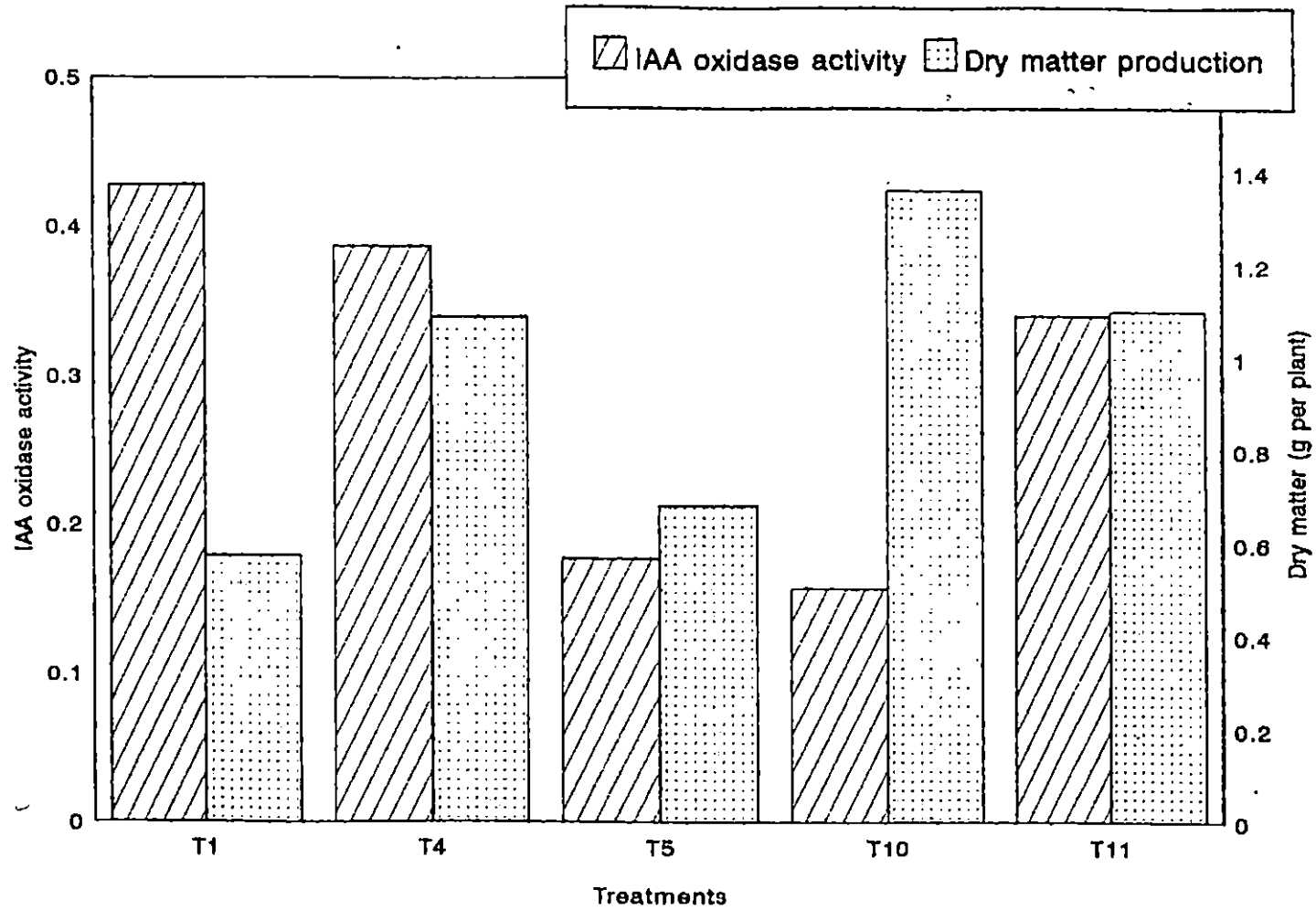


Fig.3. Influence of fertiliser on IAA oxidase activity and dry matter production at vegetative phase

fruiting stages. However, in this treatment the dry matter production increased significantly at flowering stage when compared to the corresponding stage in $T_6$ where the package of practice recommendation has been practised. There had been erratic increase in dry matter production when 150 ppm IAA was applied along with FYM and fertiliser.

Among the treatments receiving combination of FYM and fertiliser, $T_{12}$ (normal dose of FYM and fertiliser along with IAA 150 ppm) recorded the highest IAA oxidase activity and the lowest dry matter production at vegetative phase. These results also suggest a negative influence of IAA oxidase activity on dry matter production at vegetative phase (Fig.4) and supports the results obtained in FYM and fertiliser treatments. The result is in accordance with that noted by Karyagina *et al.* (1988) in sunflower.

At flowering stage, no specific relation between enzyme activity and dry matter production was observed. At fruiting phase, treatments with high IAA oxidase activity ($T_{12}$ and $T_{13}$) recorded higher dry matter production and those with low IAA oxidase activity ($T_6$ and $T_7$) recorded low dry matter production.

## 6 Influence of FYM, fertiliser and their combination on IAA oxidase activity and fruit yield

There had been significant increase in the fruit yield of brinjal in $T_3$ (FYM 40 $t^{-1}$ ha), $T_8$ (FYM 20 t $ha^{-1}$ + 150 ppm IAA) and $T_9$ (FYM 40 t $ha^{-1}$ + 150 ppm IAA) indicating the influence of either higher doses of FYM or the complimentary effect of 150 ppm IAA with lower doses of FYM.

Application of NPK fertilisers at both lower and higher doses resulted in nonsignificantly higher yield compared to control. Application of 150 ppm IAA

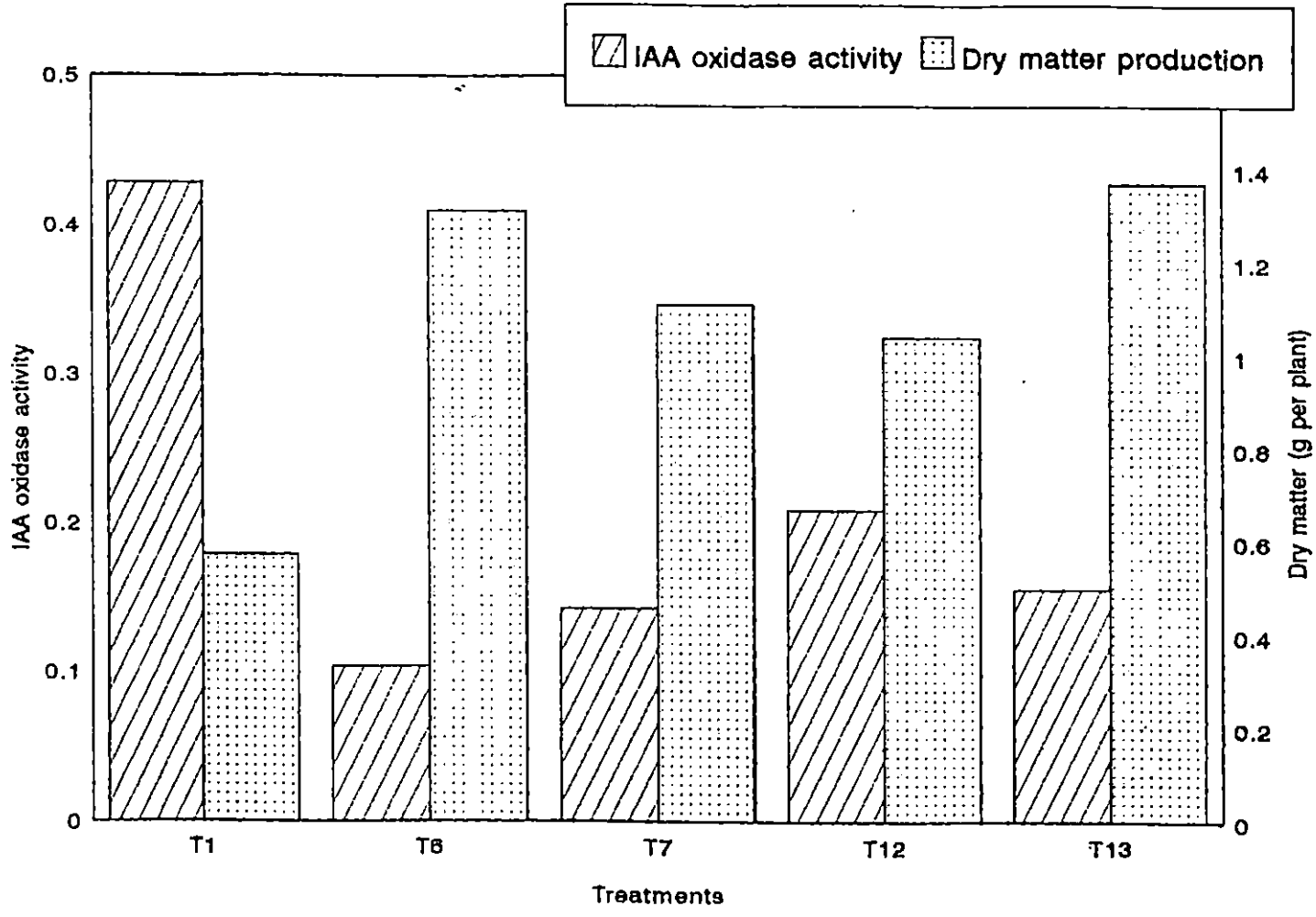


Fig.4. Influence of combination of FYM and fertiliser on IAA oxidase activity and dry matter production at vegetative phase

along with the normal recommended dose of fertiliser resulted in nonsignificant increase in yield. But when IAA was applied along with higher doses of fertiliser there had been significant increase in yield especially when the same is compared with that of absolute control.

Treatment receiving recommended dose of NPK and FYM ($T_6$) recorded nonsignificantly higher yield compared to absolute control. The failure to get significant increase in yield in different treatments especially when recommended doses are given might be due to an inherently high fertility status of the soil (Table 1). However, addition of double dose of FYM and NPK ($T_7$) was found to enhance the yield significantly over the absolute control. External application of IAA at the rate of 150 ppm in combination with the normal and double the recommended dose ($T_{12}$ and $T_{13}$ respectively) also increased the yield significantly over $T_6$ where package of practice recommendation has been practised. The yield trend observed here is in concormity with that recorded by Maurya and Singh (1978) in egg plants.

On comparing the enzyme activity and yield in treatments receiving FYM without inorganic fertilisers, it was observed that the treatment which recorded the lowest IAA oxidase activity at the vegetative stage ($T_8$) also exhibited the highest yield. At the same time $T_9$ (FYM 40 t $ha^{-1}$ + IAA 150 ppm) recorded proportionately higher enzyme activity at vegetative stage and lower yield. From this result it can be presumed that higher IAA oxidase activity at vegetative stage has got some negative effect on yield (Fig.5) in treatments which received FYM without fertiliser. However, this negative influence of enzyme activity at vegetative stage on yield was not observed in treatments receiving inorganic fertilisers either alone or in combination with FYM. At flowering and fruiting phases, enzyme activity was not found to influence the fruit yield in treatments which received FYM or fertiliser. In those treatments which received combined application of FYM and fertiliser, the

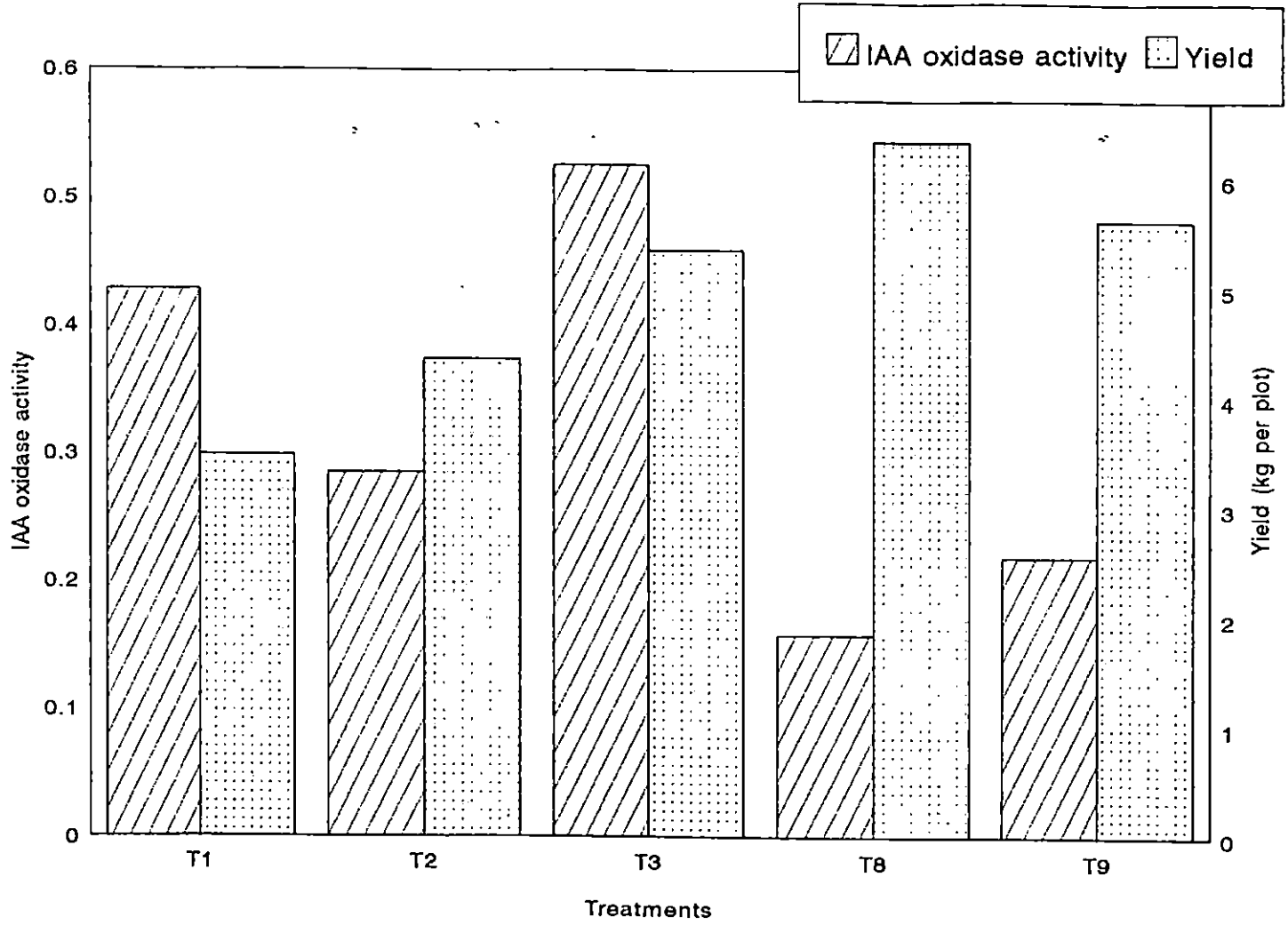


Fig.5. Influence of FYM application on IAA oxidase activity at vegetative phase and yield

enzyme activity at flowering phase was found to influence the yield negatively (Fig.6).

## 7 Content of macronutrients in the plant and IAA oxidase activity

The influence of various treatments on the content of macronutrients in the plant is depicted in Table 7.

### 7.1 Nitrogen

In all the treatments, plant nitrogen content was found to decrease at flowering phase. The possible reason could be the dilution of nutrient in the plant at this stage. The vegetative phase of the plant in general recorded higher N content as there was a steady supply of FYM and fertilisers either alone or in combination permitting readily available sources of nutrients especially N. However, there was a general increase in the N content of plant at fruiting stage. This must be due to the effect of split application of N received by the plant 60 days after transplanting. The increase in N content in plant tissue at fruiting stage in treatments receiving FYM alone might be due to a delay in the mineralisation of added FYM. The increased N content at the fruiting phase of absolute control require further investigations.

From the study it is evident that application of fertiliser either alone or in combination with FYM or with the supplementary dose of 150 ppm IAA could not make any significant increase in the N content of tissues at all stages of the crop selected for the study.

Application of FYM 40 t $ha^{-1}$ ($T_3$) recorded the highest N content and IAA oxidase activity at vegetative and flowering phases. While comparing the N

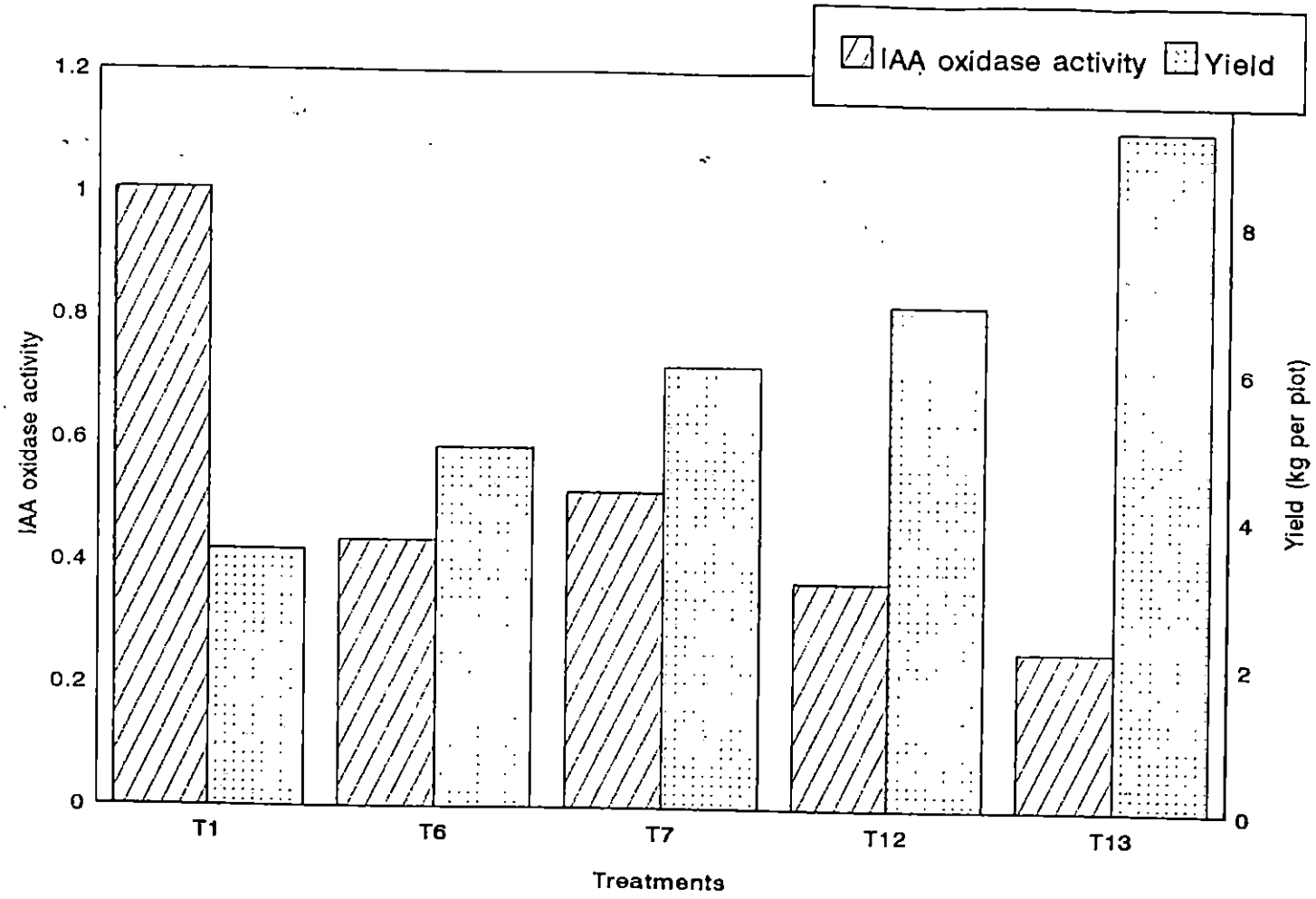


Fig.6. Influence of combination of FYM and fertiliser on IAA oxidase activity at flowering phase and yield

Table 7. Influence of treatments on N, P and K contents of the plant

| Treatment | N content (%) | | | P content (%) | | | K content (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ |
| $T_1$ | 2.5 | 1.84 | 2.80 | 0.28 | 0.29 | 0.27 | 2.31 | 1.87 | 1.63 |
| FYM | | | | | | | | | |
| $T_2$ | 2.2 | 1.75 | 2.69 | 0.25 | 0.26 | 0.26 | 2.38 | 2.37 | 1.48 |
| $T_3$ | 2.7 | 2.64 | 2.87 | 0.36 | 0.26 | 0.23 | 2.74 | 2.25 | 1.63 |
| $T_8$ | 2.4 | 1.70 | 2.26 | 0.27 | 0.24 | 0.26 | 1.94 | 2.23 | 1.65 |
| $T_9$ | 2.4 | 2.08 | 2.72 | 0.21 | 0.27 | 0.25 | 1.54 | 2.23 | 1.70 |
| Fertiliser | | | | | | | | | |
| $T_4$ | 2.4 | 2.33 | 2.73 | 0.25 | 0.28 | 0.25 | 1.88 | 1.98 | 1.59 |
| $T_5$ | 2.9 | 1.73 | 3.14 | 0.26 | 0.26 | 0.23 | 1.90 | 2.59 | 1.62 |
| $T_{10}$ | 2.5 | 1.73 | 3.07 | 0.24 | 0.24 | 0.29 | 1.88 | 2.49 | 1.48 |
| $T_{11}$ | 3.1 | 1.84 | 2.58 | 0.25 | 0.29 | 0.24 | 2.14 | 2.44 | 1.66 |
| FYM + Fertiliser | | | | | | | | | |
| $T_6$ | 2.4 | 1.66 | 2.98 | 0.23 | 0.29 | 0.26 | 2.24 | 1.69 | 1.75 |
| $T_7$ | 3.2 | 1.84 | 2.42 | 0.26 | 0.26 | 0.24 | 1.88 | 2.40 | 1.88 |
| $T_{12}$ | 2.7 | 2.42 | 2.35 | 0.40 | 0.32 | 0.26 | 2.18 | 2.03 | 1.44 |
| $T_{13}$ | 3.0 | 2.04 | 2.60 | 0.34 | 0.29 | 0.22 | 3.03 | 2.18 | 1.81 |
| Mean | 2.65 | 1.97 | 2.71 | 0.28 | 0.27 | 0.25 | 2.61 | 2.04 | 1.64 |
| CD(0.05) | NS | NS | NS | 0.12* | 0.05* | 0.05* | NS | NS | NS |

* Significant at 5 per cent level
NS - Not significant

content at flowering phase and enzyme activity at that stage in $T_8$ which permitted external application of IAA at the rate of 150 ppm together with 20 t FYM $ha^{-1}$, a comparatively lower N content and enzyme activity was observed. This shows a direct relation between N content and IAA oxidase activity at vegetative and flowering stages in treatments receiving FYM. In general in treatments receiving application of FYM with or without IAA application, no specific relation could be observed between N content and IAA oxidase activity at the fruiting phase.

In the case of treatments receiving fertiliser application, no relation between N content and enzyme activity could be established in the vegetative phase. However, at flowering phase, $T_5$ (double dose of fertiliser application) and $T_{10}$ (normal fertiliser dose + 150 ppm IAA) recorded comparatively lower N content and enzyme activity. Treatments which received double dose of fertilizers together with 150 ppm IAA ($T_{11}$) and normal application of inorganic fertilisers ($T_4$) recorded the lowest N content and enzyme activity at the fruiting stage.

In treatments receiving combined application of FYM and fertiliser, hardly any relation between N content and enzyme activity could be observed at different stages of the study.

In general, N content of the plants and IAA oxidase activity were not influenced significantly due to treatments. According to Bulatova and Pomaz (1984) the activity of enzyme system of IAA synthesis decreased with lower content of N, P and K leading to deficiency. The absence of direct relation of N content with enzyme activity might be due to the availability of sufficient quantity of N at the different stages of growth.

## 7.2 Phosphorus

### 7.2.1 Influence of FYM

The P content of plants at all the three stages of study in FYM treated plots were not significantly superior over the corresponding P content in absolute control. Neither the recommended dose nor its doubling could enhance the P content in the three stages of the study. Also no regular trend was observed in P content due to application of IAA along with FYM. Failure to get significant difference between treatments and absolute control might be due to the high P status of the experimental soil as evident from Table 2.

Application of 40 t FYM $ha^{-1}$ ($T_3$) recorded comparatively higher P content in tissue and the highest IAA oxidase activity at the vegetative phase. Comparatively lower P content and IAA oxidase activity at vegetative stage was recorded in $T_9$ (FYM 40 t $ha^{-1}$ + IAA 150 ppm). At flowering stage treatments receiving application of FYM alone ($T_2$ and $T_3$) recorded higher P content and enzyme activity in tissues. At fruiting phase $T_3$ (FYM 40 t $ha^{-1}$) recorded low P content of tissues and enzyme activity. From this it is clear that there exists a direct relationship between the enzyme activity and the P content of tissues in the case of FYM treated plots.

### 7.2.2 Influence of fertiliser

As in the case of FYM, application of inorganic fertilisers also could not enhance the plant P content significantly over absolute control. External application of IAA along with application of inorganic fertilisers also resulted in no specific trend in P content of plants. Here also the absence of significant difference between treatments and absolute control might be due to the high P status of the experimental soil. Further the acidity of the experimental soil might have rendered the water soluble P source of the fertiliser into an unavailable form and thus leaving lower P content in plant.

In the case of treatments receiving inorganic fertiliser, the lowest enzyme activity and plant P content was recorded by $T_{10}$ (normal fertiliser dose + IAA 150 ppm) at vegetative phase. For the same treatment at flowering phase, a similar decreasing trend in enzyme activity and P content was observed. Proportionally higher enzyme activity and P content was observed in the same treatment at fruiting phase clearly indicating a direct relationship between plant P content and enzyme activity.

### 7.2.3 Influence of combination of FYM and fertiliser

The effect of combined application of FYM and inorganic fertilisers was similar to that obtained in the case of application of FYM or inorganic fertilisers separately. However, external application of IAA along with combination of FYM and fertiliser resulted in an increase in plant P content ($T_{12}$ and $T_{13}$) at initial stages of growth. This is in accordance with that reported by Michalik (1986) that IAA stimulated P absorption in maize. Same was reported in *Leucaena leucocephala* also (Hussain *et al.*, 1988).

The direct relationship of enzyme activity and plant P content of egg plant was also evident on the combined application of FYM and inorganic fertiliser at the vegetative stage. The observation is in conformity with that noted by Bulatova and Pomaz (1984) also.

## 7.3 Potassium

In all treatments K content in tissues was found to decrease with advancing growth stages possibly due to dilution effect as a result of increase in the biomass at later stages of growth.

K content of the plant at different stages of growth were not significantly influenced by any of the treatments.

Among those treatments which received application of FYM with and without IAA 150 ppm, $T_3$ (FYM 40 t $ha^{-1}$) recorded the highest value for both K content and IAA oxidase activity at the vegetative stage of the crop. At the flowering stage also the same treatment has recorded the highest enzyme activity and comparatively higher K content. In the fruiting phase of plants which received 20 t FYM $ha^{-1}$ ($T_2$) recorded the lowest K content and IAA oxidase activity though they remained nonsignificant. However the highest K content and enzyme activity at fruiting stage was recorded by $T_9$ (40 t FYM $ha^{-1}$ + IAA 150 ppm). The trend in the enzyme activity and the K content observed here is contradictory to the observations of Bulatova and Pomaz (1984).

In treatments which received application of fertiliser along with and without 150 ppm IAA, no direct relation between K content and enzyme activity could be noticed at vegetative phase. However at flowering and fruiting stages, those treatments which provided the lowest K content in plant tissues ($T_4$ and $T_{10}$ respectively) have recorded the highest enzyme activity. The observed relation of low enzyme activity and high K content in fertiliser treated plots has been substantiated by the findings of Bulatova and Pomaz (1984).

However, in the case of combination of FYM and fertiliser, no direct relation was observed between K content and IAA oxidase activity as in the case of FYM and fertiliser applied independantly.

## 8 Status of Fe and Mn in the plant and IAA oxidase activity

Influence of FYM, fertiliser and their combination on Fe and Mn content of the plant is presented in Table 8.

### 8.1 Iron

The iron content of the plant in the first two stages were higher than that observed at the third stage for all the treatments except $T_3$. The reduction in Fe content from the flowering stage to the fruiting stage might be due to the dilution effect resulting from the increase in biomass at that stage.

Treatments receiving FYM could not show any significant impact in enhancing the Fe content of plants. However, a marginal increase in Fe content was observed at all stages of growth except for the treatments $T_8$ and $T_9$ at the fruiting stage. This might be due to the direct effect of Fe present in added FYM.

Inorganic fertilisers also could not enhance the Fe content of the plant significantly although a marginal increase in the Fe content over control was observed for most of the treatments. However, treatments receiving inorganic fertilisers showed a tendency to record higher Fe content than applications of FYM. This must be a direct influence of Fe impurities in these fertilisers or might have been due to an enhanced uptake of Fe from soils possibly due to the influence of acidic nature of fertilisers.

Combination of FYM and inorganic fertilisers helped to maintain relatively higher levels of Fe in tissues especially in the vegetative and flowering stages compared to the exclusive applications of FYM and fertiliser.

Table 8. Influence of treatments on the status of Fe and Mn in the plant

| Treatment | Fe (ppm) | | | Mn (ppm) | | |
|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ |
| $T_1$ | 361.2 | 303.8 | 251.6 | 118.8 | 102.9 | 77.1 |
| FYM | | | | | | |
| $T_2$ | 366.5 | 416.7 | 363.1 | 131.7 | 101.2 | 114.3 |
| $T_3$ | 364.0 | 327.2 | 438.8 | 132.6 | 153.8 | 108.5 |
| $T_8$ | 404.9 | 410.3 | 198.0 | 128.1 | 122.9 | 78.3 |
| $T_9$ | 402.3 | 457.7 | 201.3 | 115.5 | 107.5 | 102.1 |
| Fertiliser | | | | | | |
| $T_4$ | 365.0 | 354.3 | 247.9 | 127.9 | 148.5 | 113.8 |
| $T_5$ | 438.5 | 221.4 | 151.6 | 102.5 | 136.6 | 202.1 |
| $T_{10}$ | 410.8 | 558.5 | 319.8 | 135.8 | 122.9 | 190.0 |
| $T_{11}$ | 404.5 | 562.7 | 251.5 | 105.6 | 121.5 | 155.3 |
| FYM + Fertiliser | | | | | | |
| $T_6$ | 421.7 | 768.5 | 253.6 | 116.7 | 73.8 | 82.9 |
| $T_7$ | 569.0 | 486.0 | 314.6 | 145.6 | 152.9 | 85.8 |
| $T_{12}$ | 446.3 | 402.1 | 178.9 | 167.7 | 192.1 | 103.8 |
| $T_{13}$ | 549.3 | 418.5 | 188.7 | 241.3 | 112.9 | 86.8 |
| Mean | 423.4 | 437.5 | 258.4 | 136.1 | 126.9 | 115.5 |
| CD(0.05) | 180.0* | 182.4* | NS | NS | 33.90* | 19.90** |

* Significant at 5 per cent level

** Significant at 1 per cent level

NS - Not significant

Comparison of Fe content and IAA oxidase activity at all stages and treatments indicated that Fe content of the plant had no influence on enzyme activity.

## 8.2 Manganese

In general the Mn content of the plant was found to decrease with advancment of growth which might probably be due to dilution effect. The relative content of Mn in tissues at all stages of growth remained considerably lower than that of Fe.

Application of FYM resulted in an increase in Mn content of the plant at most of the stages of growth. However the increase in Mn content of the plant was nonsignificant at vegetative and flowering stages except in the case of $T_3$ (FYM 40 t $ha^{-1}$) at flowering stage. But all the treatments receiving application of FYM alone were significantly superior to control with respect to Mn content of the plant at fruiting stage. This might be due to the direct effect of Mn supplied through FYM.

Application of inorganic fertilisers could not enhance the plant Mn content at vegetative phase. However at later stages of growth especially at fruiting stage the increase was significant. As in the case of Fe, this must be a direct influence of Mn inpurities in these fertilisers or might have been due to an enhanced uptake of Mn from soil possibly due to the influence of acidic nature of fertilisers.

However the combined application of FYM and fertiliser resulted in a significantly lower Mn content of the plant at fruiting phase compared to that in the treatment with application of FYM or fertiliser along, except in the case of $T_{12}$ where normal dose of FYM and fertiliser was combined with external application of

IAA 150 ppm. This could be so probably because of a chelation of Mn that might have taken place in presence of organic acids.

Comparison of Mn content and IAA oxidase activity at all stages and treatments indicated that Mn content of the plant had no influence on enzyme activity in this experimental condition. This might be because of the fact that Mn as a cofactor of IAA oxidase is sufficiently available even in the control condition. Relation between Mn deficiency and IAA oxidase activity are yet to study by providing Mn deficient soil condition.

## 9 Influence of FYM, fertiliser and their combination on IAA oxidase activity and nutrient uptake

The total nutrient uptake from plots which received different kinds of nutrients are given in Table 9.

### 9.1 Nitrogen

#### 9.1.1 Influence of FYM

Application of FYM alone could significantly influence the uptake of N in plants when compared to absolute control. Doubling the dose of FYM resulted in a significant increase in N uptake compared to the normal dose of FYM alone. The increase in N uptake as a result of doubling the dose of FYM might be attributed to the increased supply of N through FYM which resulted in a higher plant N content. Further the drymatter yield was higher in the treatment receiving double dose of FYM ($T_3$). A decrease in N uptake was noticed in treatments receiving supplementary addition of IAA 150 ppm in addition to FYM when compared to those treatments receiving application of FYM alone at 40 t $ha^{-1}$. This decrease in N uptake following external application of IAA is contradictory to the earlier

Table 9. Effect of treatments on nutrient uptake

| Treatment | Total nutrient uptake g plot$^{-1}$ | | |
|---|---|---|---|
| | N | P | K |
| $T_1$ | 15.824 | 1.526 | 9.503 |
| FYM | | | |
| $T_2$ | 22.855 | 2.393 | 12.926 |
| $T_3$ | 32.442 | 2.893 | 18.604 |
| $T_8$ | 24.333 | 2.869 | 18.691 |
| $T_9$ | 25.817 | 2.328 | 16.336 |
| Fertiliser | | | |
| $T_4$ | 20.287 | 2.127 | 13.354 |
| $T_5$ | 27.030 | 1.996 | 15.151 |
| $T_{10}$ | 35.146 | 3.246 | 16.983 |
| $T_{11}$ | 21.257 | 1.970 | 13.998 |
| FYM + Fertiliser | | | |
| $T_6$ | 28.847 | 2.528 | 17.168 |
| $T_7$ | 26.500 | 2.644 | 20.324 |
| $T_{12}$ | 26.099 | 2.799 | 15.932 |
| $T_{13}$ | 40.303 | 3.314 | 28.148 |
| Mean | 26.699 | 2.510 | 18.855 |
| CD(0.05) | 5.556* | 0.631* | 5.455* |

* Significant at 5 per cent level
NS - Not significant

observations in *Leucaena leucocephala* (Hussain *et al.*, 1988) and in groundnut (Sagare and Naphade, 1987).

Comparison of enzyme activity and total N uptake in treatments receiving FYM without fertiliser indicated that total N uptake was independant of IAA oxidase activity at all stages of the study.

### 9.1.2 Influence of fertiliser

Application of inorganic fertilisers both at normal dose and at double dose either alone or in combination with IAA at the rate of 150 ppm also maintained significantly higher values for N uptake when compared to control. When IAA at the rate of 150 ppm was applied along with normal dose of inorganic fertilisers ($T_{10}$), significant increase in N uptake was noticed compared to the application of inorganic fertilisers at normal dose. However just the reverse trend was observed when IAA at the rate of 150 ppm was applied along with double dose of inorganic fertilisers.

When application of FYM at different doses are compared with that of inorganic fertilisers, hardly any significant difference in N uptake could be noted except in the case of $T_{10}$ (recommended dose of fertilisers + 150 ppm IAA).

Among the treatments receiving inorganic fertilisers without FYM, those treatments which recorded lower IAA oxidase activity at vegetative phase ($T_5$ - double dose of inorganic fertilisers and $T_{10}$ - normal dose of inorganic fertilisers + IAA 150 ppm) recorded the highest N uptake. At the same time $T_4$ (normal dose of inorganic fertilisers) and $T_{11}$ (double dose of inorganic fertilisers + IAA 150 ppm) recorded comparatively higher IAA oxidase activity at vegetative phase and lower N uptake. This indicates a clear cut negative relation between IAA oxidase activity at

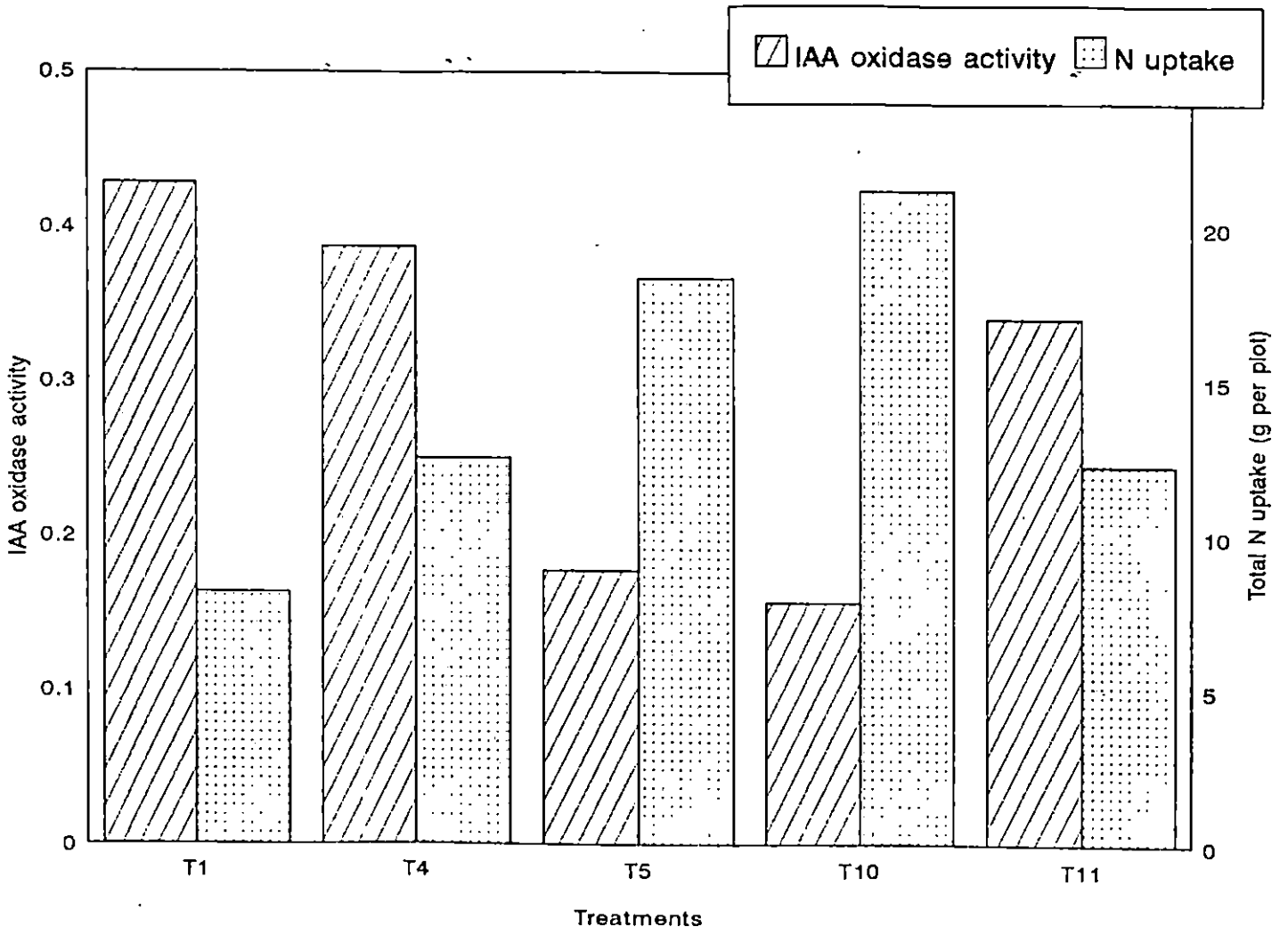


Fig.7. Influence of fertiliser on Total N uptake and IAA oxidase activity at vegetative phase

vegetative phase and total N uptake (Fig.7). Similar trend was noticed at flowering stage also. But the trend reversed when compared with the enzyme activity at the fruiting stages.

### 9.1.3 Influence of combination of FYM and fertilisers

Combination of organic and inorganic fertilisers alone as well as with supplementary addition of IAA at the rate of 150 ppm permitted significant uptake of N when compared to absolute control. The negative effect of IAA oxidase activity at vegetative phase on total N uptake as in the case of treatments receiving inorganic fertiliser without FYM could not be observed in the case of treatments receiving combined application of FYM and fertiliser.

## 9.2 Phosphorus

### 9.2.1 Influence of FYM

Application of 20 t FYM $ha^{-1}$ ($T_2$) increased the total P uptake of brinjal compared to control. Doubling the dose of FYM ($T_3$) resulted in further increase in P uptake. The increase in P uptake observed in treatments receiving FYM might be attributed to the higher drymatter yield obtained in those treatments. When IAA at the rate of 150 ppm was applied in plots receiving 20 t FYM $ha^{-1}$ slight increase in P uptake could be noticed. However, application of same dose of IAA along with 40 t FYM $ha^{-1}$ resulted in significant reduction in the total P uptake.

Comparison between IAA oxidase activity at different growth stages and total P uptake in treatments receiving FYM without fertiliser showed that no specific relation exists between total P uptake and IAA oxidase activity at any of the stages of the study.

### 9.2.2 Influence of fertiliser

As in the case of treatments receiving application of FYM alone application of inorganic fertilisers also enhanced the P uptake compared to absolute control. External application of IAA at the rate of 150 ppm along with the normal recommended dose of inorganic fertilisers resulted in significant increase in P uptake compared to $T_2$. However, external application of IAA at the rate of 150 ppm along with the double dose of inorganic fertilisers exhibited the reverse trend.

Among those treatments which received application of inorganic fertilisers alone, $T_{10}$ (normal dose of NPK + IAA 150 ppm) recorded the lowest IAA oxidase activity at vegetative stage and the highest P uptake. Treatment which received the normal dose of inorganic fertilisers ($T_4$) recorded the highest IAA oxidase activity and proportionately lower P uptake. These results indicate a negative relation between IAA oxidase activity at vegetative phase and total P uptake (Fig.8). Similar trend was observed between IAA oxidase activity at flowering phase and total P uptake.

### 9.2.3 Influence of combination of FYM and fertiliser

Combination of organic and inorganic fertilisers either alone or with supplementary addition of IAA at the rate of 150 ppm permitted significant uptake of P when compared to that in control. No specific trend with regard to the IAA oxidase activity and P uptake by the plant was noticed.

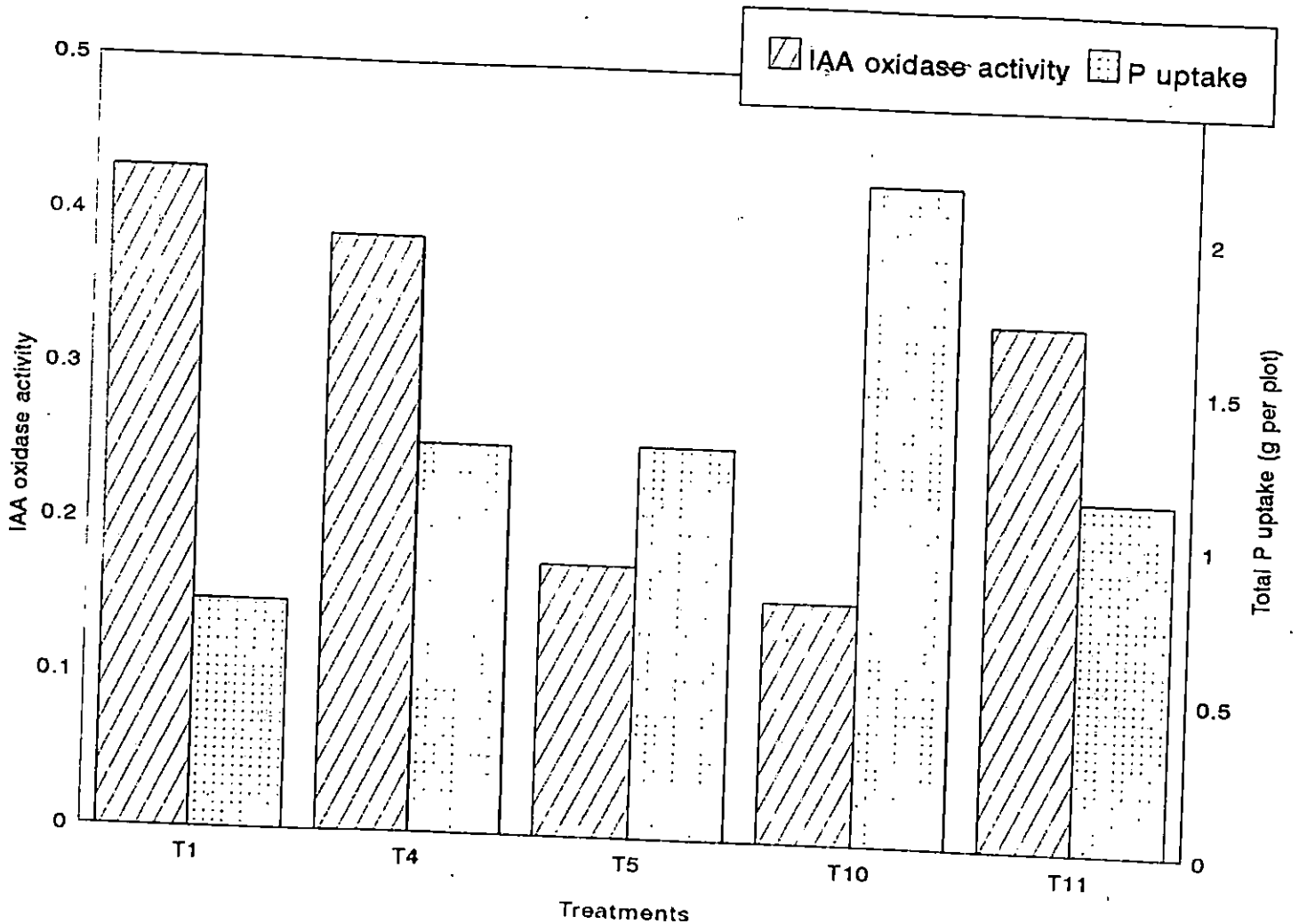


Fig.8. Influence of fertiliser on Total P uptake and IAA oxidase activity at vegetative phase

## 9.3 Potassium

### 9.3.1 Influence of FYM

Application of FYM could nonsignificantly increase the K uptake of brinjal compared to absolute control. Doubling the dose of FYM resulted in a slight increase in the K uptake compared to that recorded in the treatment which received 20 t FYM $ha^{-1}$. External application of IAA at the rate of 150 ppm along with 20 t FYM $ha^{-1}$ could significantly enhance the K uptake. However, the application of same dose of IAA along wtih 40 t FYM $ha^{-1}$ resulted in slight decrease in K uptake compared to that in $T_3$ (FYM 40 t $ha^{-1}$).

### 9.3.2 Influence of fertiliser

Application of inorganic fertilisers both at normal dose and at double dose either alone or in combination with IAA at the rate of 150 ppm also maintained significantly higher values of K uptake when compared to control. External application of IAA at the rate of 150 ppm along with inorganic fertilisers could not significantly influence the K uptake compared to the exclusive application of inorganic fertilisers.

### 9.3.3 Influence of combination of FYM and fertiliser

Combination of organic and inorganic fertilisers either alone or with the supplementary addition of IAA at the rate of 150 ppm permitted significant uptake of K compared to that in absolute control.

Comparison of K uptake and IAA oxidase activity at different stages of growth in treatments receiving application of FYM without fertiliser revealed that, no direct relation exists between K uptake and IAA oxidase activity at different stages of study in those treatments. Similar trend was observed in treatments receiving exclusive application of inorganic fertilisers without FYM as well as in treatments receiving combined application of organic and inorganic fertilisers.

# Summary

# SUMMARY

To find out the effect of application of organic manures and chemical fertilisers on IAA oxidase activity and its influence on growth and yield of brinjal, an experiment was conducted in the Vegetative Research Farm, Department of Olericulture, College of Horticulture during the rabi season of 1996. The experiment was laid out in RBD and the treatments include combinations of different levels of organic manure and fertilisers with and without foliar application of 150 ppm IAA and an absolute control. The results obtained are summarised and presented below:

1. IAA oxidase activity was found to increase with the age of the plant upto flowering stage and there after it was found to decrease.
2. Application of FYM and fertiliser separately or in combination showed a trend to decrease the IAA oxidase activity.
3. Application of IAA along with FYM decreased the IAA oxidase activity at vegetative and flowering stages and increased the enzyme activity at fruiting stage. Similar trend was observed when IAA was applied along with lower dose of fertiliser, but reverse trend was observed in the case of IAA application along with higher dose of fertiliser. At vegetative and flowering stages, application of IAA along with combination of FYM and fertiliser showed erratic behaviour of enzyme activity in plants.
4. Height of plants was not found to vary significantly between treatments. IAA oxidase activity could not influence the plant height at any of the stages of the study.
5. Application of FYM, fertiliser as well as their combination with and without IAA application resulted in no significant increase in the number of branches per plant.

6. No significant difference was observed in the number of flowers per plant, number of fruits per plant and average fruit weight as a result of application of FYM, fertiliser and their combination with and without IAA application.
7. Application of FYM, fertiliser and their combination was found to increase drymatter production compared to absolute control.
8. IAA oxidase activity had a negative effect on drymatter production at vegetative and flowering stages in treatments which received exclusive application of FYM (Treatments which received exclusive application of fertiliser as well as combination of FYM and fertiliser, exhibited no such trend.
9. Fruit yield was increased by the application of FYM, fertiliser and their combination.
10. Exogenous application of IAA was found to increase the fruit yield of brinjal.
11. Plant N content was found to decrease from vegetative to flowering phase and thereafter it was found to increase.
12. Application of FYM and fertiliser separately as well as in combination did not result in significant changes in plant N content.
13. Application of IAA could not influence the N content of the plant significantly.
14. Exclusive application of FYM or fertiliser could not significantly enhance plant P content over absolute control.
15. Application of IAA along with FYM or fertiliser did not exhibit any specific trend in plant P content. But when IAA was applied along with combination of FYM and fertiliser, plant P content was found to increase at initial stages of growth.
16. K content of the plant was found to decrease with advancing growth stages. However K content of the plant was not found to vary significantly between treatments.

17. Application of FYM and fertiliser separately or in combination was found to increase the Fe content of the plant marginally at all the three stages of the study.
18. Fe content of the plant was not found to influence the IAA oxidase activity at any of the stages of the study.
19. Mn content of the plant was found to decrease with advancement of growth.
20. The relative content of Mn in tissues at all stages of growth remained considerably lower than that of Fe.
21. Application of FYM, fertiliser as well as their combination increased the Mn content of the plant compared to that in absolute control.
22. Mn content of the plant had no influence on enzyme activity in this experimental condition.
23. Application of FYM or fertiliser alone as well as their combination with external application of IAA could significantly influence the uptake of N, P and K in plants when compared to absolute control.

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# INDOLE ACETIC ACID OXIDASE ACTIVITY IN BRINJAL AS INFLUENCED BY FERTILISER TREATMENTS

By

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## ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree of

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# ABSTRACT

The present investigation was carried out in the College of Horticulture, Vellanikkara, during 1995-1997.

The study was aimed to find out the effect of organic manuring and chemical fertilisers on the levels of IAA and its influence on growth and yield of brinjal by monitoring the activity of indole acetic acid oxidase in plant leaves at different stages of plant growth.

The experiment was laid out in randomised block design with 13 treatments and three replications. The treatments include combinations of different levels of organic manure and fertiliser, that is, zero, normal recommended dose and double recommended dose with an without foliar application of 150 ppm IAA and absolute control.

IAA oxidase activity was found to increase with the age of the plant upto the flowering stage and thereafter it was found to decrease. Application of treatment was found to influence the IAA oxidase activity only at the fruiting stage of the plant. Height, number of branches, flowers and fruits per plant and average fruit weight were not significantly influenced by the treatments. However fruit yield in brinjal was increased by the application of FYM, fertiliser and Iaa. Fruit yield was increased when IAA was applied along with FYM or fertiliser alone or in combination.

Plant N content was found to decrease from vegetative to flowering phase and thereafter it was found to increase. But the application of different treatments could not enhance the plant N content significantly.

But the P contents was influenced significantly due to treatments K content was not influenced due to treatments. Potassium content of the plant was found to decrease with advancing growth stages. However, K content of the plant was not found to vary significantly.

Treatments in general, enhanced the Fe and Mn content of the plant and the relative content of Mn in tissues at all stages of growth remained considerably lower than that of Fe. Fe and Mn contents of the plant had no influence on IAA oxidase activity in this experimental condition.

Application of FYM, fertiliser and their combination with and without supplementary addition of IAA permitted significant difference in the uptake of N, P and K compared to that in control.

Maximum uptake of N and P was recorded by the treatment which received IAA application along with the double dose of fertiliser and FYM.