EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS WITH REDUCED DOSES OF NITROGEN ON GROWTH, YIELD AND QUALITY OF CHINA ASTER

THESIS

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By

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DECLARATION OF STUDENT

I hereby, declare that the experimental work and it's interpretation of the thesis entitled **"EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS WITH REDUCED DOSES OF NITROGEN ON GROWTH, YIELD AND QUALITY OF CHINA ASTER"** or part thereof has neither been submitted for any other Degree or Diploma of any University, nor the data have been derived from any thesis or publication of any University or Scientific Organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place : Nagpur
Date : 30.9.05

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CERTIFICATE

This is to certify that the thesis entitled **"EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS WITH REDUCED DOSES OF NITROGEN ON GROWTH, YIELD AND QUALITY OF CHINA ASTER"** submitted in partial fulfillment of the requirements for the degree of **"Master of Science in Agriculture (Horticulture)"**, of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Miss. MOGAL SMITA ASHOK** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

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Miss. Mogal Smita Ashok

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ABBREVIATIONS USED

Abstr.	:	Abstract
%	:	per cent
/	:	Per
@	:	at the rate of
Anon	:	Anonymous
Azt.	:	Azotobacter
CD	:	critical difference
Cv.	:	Cultivar
cm	:	Centimeter
DAP	:	days after planting
et al.	:	*et. alii* (and other)
EC	:	Electrical conductivity
Fig.	:	Figure
FYM	:	Farm Yard Manure
g	:	gram (s)
ha	:	Hectare
i.e.	:	*id est* (that is)
kg	:	Kilogram
Lit.	:	Liter
m	:	Meter
m^2	:	Square meter
ml	:	Milliliter
MT	:	metric tonne
NS	:	Non significant
°C	:	degree Celsius
PSB	:	Phosphate solubilizing bacteria
RDF	:	Recommended dose of fertilizer
q	:	Quintals
t	:	Tonnes
$t\ ha^{-1}$	:	tonne per hectare
Temp.	:	Temperature
SE (m)	:	Standard error of mean
Sig.	:	Significant
N	:	Nitrogen
P	:	Phosphorus
K	:	Potashium
Var.	:	Variety
viz.,	:	namely

CHAPTER – I

INTRODUCTION

Flowers, the crowning glory of Gods creation are an inseparable part of human life. They are part of age old tradition and culture of Indian society symbolizing purity, peace, passion, love and beauty. Due to their aesthetic, economic and social value their demand in the globe is increasing tremendously.

Floriculture has become a potential money-spinner for the developing countries. It is multi million dollar trade abroad. Growing flowers commercially is a recent trend. Flowers have an increasing demand in local as well as international markets. Now a days, commercial flower growing is an important export oriented business fetching very high returns and also earning a lot of foreign exchange.

The total area under floriculture in India is 88,067 ha with production of 5,09,193.60 tonnes of flowers and India exports floriculture product of 26,971 thousands US dollars (Singh, 2002). The major flower growing states are Tamilnadu, Andhra Pradesh, Karnataka, Maharashtra, West Bengal, Uttar Pradesh, Haryana and Delhi. The important flowers grown and having more demand are rose, gerbera, carnation, gladiolus, chrysanthemum, marigold, aster, orchid etc. India has succeeded in exporting flowers worth Rs. 252 crores to Europe, Japan, Oman, Netherland, France and some middle east countries (Shrivastava, 2000)

The consumption of floriculture products in the world is estimated to be of worth $ 40 billion and is growing at an annual rate of 10-15% and is expected to touch $ 75 billion by 2000 A.D. Floriculture trade in the world is estimated to be worth 50,000 crores US dollars (Dadlani, 2002)

Maharashtra is one of the leading state of the country in flower production. The area under traditional flowers is estimated to be 6,600 ha with production of 28,336 tonnes of flowers (Singh, 2002). The flower growing area of Maharashtra are Pune, Nasik, Ahmednagar, Sangli, Kolhapur, Thane, Nagpur and Satara. The

major flowers grown in these areas are chrysanthemum, gladiolus, gerbera, carnation, aster, marigold and jasmine. Majority of flowers are grown in open conditions whereas gerbera, rose and carnation are grown under protected conditions. In Nagpur district, the area under floriculture during the year 2000-2001 was 837.65 ha having 2,351.64 t of flower production (Anon., 2002).

Among the flower used for domestic market, aster (*Callistephus chinensis* (L.) Nees) is to be considered as one of the important commercial flower. It (2n=18) belongs to family Asteraceae and is native to China. Its generic name Callistephus is derived from two Greek words *kallos* – beauty and *stephanus* – a crown allowing large colourful flower heads. Aster have been developed from a single form of wild species *Callistephus chinesis*.

Aster is half hardy annual. Plants are dwarf, medium or tall and erect having hispid branches bearing alternate, broadly ovate or triangularly ovate, deeply and irregularly rooted leaves. Flowers are solitary and showy. Aster is a self pollinated crop (Watts, 1980). Natural crossing takes place to the extent of 10% (Fleming, 1937). The prominent flower colours are blue, lavander, pink and white.

Aster is grown for its prettiness, elegance, diverse form and varied attractive colours. Also it has gained considerable importance in flower trade as these flowers are used as loose flowers for garlands, cut flowers for decoration and for preparing bouquet. It is also used for bedding and potting purposes. It has got very beautiful effect when grown in large masses in beds and are valuable for filling gaps in mixed herbaceous borders. Their long shelf life lends them beautifully to different floral arrangements for interior decoration.

The total area under aster cultivation in Maharashtra during 1999-2000 is 90 ha with production of 900 tonne flowers (Anon., 2000).

There are many reasons behind the low acerage and production of aster crop in Maharashtra. Among the many constraints in the way of aster production, nutrient management is of prime importance. Application of proper nutrients like nitrogen gave higher yields in aster, Bose and Das (1965) and Yadav (1983).

Therefore, sufficient attention is needed to be given to the amounts, kinds, methods and time of fertilizer application. But these things are not being practiced by the cultivators due to high prices of chemical fertilizers. Though addition of chemical fertilizers guarantees high yield to the farmers, it has some adverse effect on physical, chemical and biological properties of soil. The addition of these chemical fertilizers is slow poison to the soil which is an incoming calamity facing agriculture. Thus, any step leading to reduction of high fertilizer doses is a boon to the farmers. Organic manures improve physical properties of soil by increasing humus content in the soil and consequently water holding capacity of soil increases. It also provides food for soil microorganisms. This increases the activities of microbes which in turn helps to convert unavailable plant nutrient into available form. Biofertilizers offer an economically attractive and ecologically sound means of reducing external inputs and improving the quality and quantity of internal sources. They are less expensive, ecofriendly, sustainable and do not require non-renewable source of their production and improve crop growth and quality of crops by production of plant hormones. They increase the sustainability of soil and make it productive. The beneficial microbes in the soil which are of great significance to horticultural situations are the biological nitrogen fixers, phosphate solubilizers etc.

Azotobacter are group of free living aerobic, non symbiotic nitrogen fixing bacteria which can be a substitute part of inorganic fertilizers. Azotobacter inoculation saves addition of nitrogenous fertilizers by 10-20% i.e. it fixes nearly 20-40 kg N ha^{-1}. It produces growth promoting substances like vitamins of B group, IAA and gibberellins. Other asymbiotic nitrogen fixing bacterias are *Azotobactor chrococum, Azotobacter vinelandii, Azotobacter paspali* and *Azotobacter beijerinckii* etc.

Phosphate solubilzing micro-organisms possess the ability to convert insoluble phosphates in soil into soluble forms by secreting organic acids such as acetic acid, formic acid, propionic acid, glycolic acid, fumaric and succinic acid. These acids lower the pH and bring out dissolution of bound form of phosphate.

The importance of organic farming in commercial horticulture has been realised throughout the world. There is an increasing demand for homogeneous organic substitutes. This has led to intensive research for producing high quality flowers by using low-cost substitutes. The quantum of inorganic fertilizer can be reduced by exploring the possibilities of using organic material in production of china aster.

The work on use of organic manures and biofertilizers in china aster is inadequate, hence the experiment entitled "Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster." was carried out with following objectives.

Objectives :

1. To find out the effect of organic manures and bio-fertilizers on growth, yield and quality of china aster.
2. To compare the efficiency of reduced doses of nitrogen manures and bio-fertilizers on growth, yield and quality of china aster.

CHAPTER - II

REVIEW OF LITERATURE

The present investigation was carried out to study the effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster. For getting higher returns farmer are using chemical fertilizers abundantly. Cost of chemical fertilizers are increasing day by day and grower has to pay more cost. Hence use of organic manures and biofertilizers is being practiced to reduce the cost of fertilizers to be applied.

Organic manures are indispensable from the manurial schedule for any flower crop production. They contain essential plant nutrients and growth promoting agents like enzymes and hormones while no chemical fertilizer can supply all together.

Biofertilizers have been used in India since 1954-55. Though, biofertilizers can't replace the chemical fertilizers completely, their application with chemical fertilizers can improve soil quality. Biofertilizers application with chemical fertilizers can produce crop yield equivalent to that obtained by 50 per cent and 75 per cent dose of chemical fertilizers. Thus biofertilizer is a boon for small and marginal farmers who cannot afford costly chemical fertilizers.

There is immense potential for application of organic manures and biofertilizers. However, very limited work has been undertaken in floricultural crops and literature is seldom available, hence the present review includes the research work done on use of biofertilizers and organic manures in flowers as well as in vegetable crops.

2.1 Effect of biofertilizers on growth, yield and quality of Aster and other horticultural crops :

Martinez *et al.* (1993) observed that the soil inoculation of *Azotobacter chrococcum* improved the flower quality in terms of diameter and weight of flowers in balsam.

Wange and Patil (1994) observed that inoculation with Azotobacter significantly increased the number of flowers per stalk, bulb yield and number of flower stalks in *polianthus tuberosa* cv. single in pot experiment.

Wange *et al.* (1995) conducted an experiment on tuberose cv. single petal and revealed that, for getting increased yield of underground parts and floral stalks as well as more monetary returns, the tuberose crop should be inoculated with biofertilizers individually or in mixture.

Gupta (1997) observed that the growth parameters like height, number of branches, number of leaves, main stem diameter, leaf area per plant in marigold were significantly increased in treatment receiving Azotobacter + PSB.

Misra (1997) showed that use of Nafed super culture (NSC) containing *Azotobacter spp.* increased significantly the number of florets per spike in gladiolus.

Chandrikapure (1998) conducted an experiment on marigold and observed that, the vegetative growth of plants like height, stem diameter, number of leaves and branches were maximum under treatments receiving bioinoculants.

Deshmukh (1998) observed that all the growth parameters showed positive effect of Azotobactor and PSB application as compared to other treatments in gaillardia.

Kaloti (1998) reported that plant height, number of branches, number of leaves, stem diameter and leaf area per plant in aster were maximum under the treatment of Azotobacter and PSB inoculation.

Shitare (1999) observed that yield and yield contributing characters like number of florets per spike, number of florets per plant, weight of loose flowers per plant and floret size were maximum with Azotobacter application in tuberose.

Parthiban *et al.* (2001) observed that treating amaranth with Azotobacter resulted in maximum flower yield of 17,136 kg per ha in pink type and 17,132 kg per ha in white type flowers during kharif season.

Mostafa (2002) observed that an experiment on *Calendula officinalis* cv. Muraj and *D. ecklinis* resulted that biofertilizers increased that leaf area and plant height of *Calendula officinalis* and inflorescence diameter of *D. ecklinis*.

Shashidhara *et al.* (2002) conducted an experiment on calendula cv. Red orange and investigated that height of plant, number of branches, number of improved quality flowers were observed maximum on the plants treated with Azotobacter.

Singh *et al.* (2002) concluded that Azotobacter had the most favourable effect on plant growth and flower yield was also found highest.

Prabhat kumar (2003) observed that an application of PSB + VAM proved to be most effective in increasing plant height, number of leaves, leaf area, number of branches, flower weight, flower diameter, number of flowers and flower yield.

2.2 Effect of organic manures on growth, yield and quality of Aster and other horticultural crops :

Irrulpan *et al.* (1980) observed that an application of 10 kg FYM per plant to Edward rose resulted in optimum rate of flower production with highest yield.

Deewan (1982) revealed that an application of 20 kg well rotted cow dung after pruning resulted in better growth as well as good flowering in rose.

Nambisan *et al.* (1983) observed that during soil preparation a basal dose of FYM or cattle manure at the rate of 20-25 tonnes per ha ensured better growth and flowering in tuberose.

Natarajan and Madhavrao. (1984) observed the higher flower yield with the highest essential oil content in the flowers receiving FYM at the rate15 kg per plant in jasmine.

Cheziyan *et al.* (1986) conducted a field trial over two years of the *Chrysanthemum indicum* cv. Co. 1 and obtained the highest flower yield in both the years (16.85 t and 16.77 t per ha) when FYM applied at 5 kg per m^2.

Kale *et al.* (1987) found that the worm cast when used as manures in place of FYM significantly influenced the flowering in Aster.

Putrasamedja and Sutapradja (1989) observed that Soil + FYM + bamboo compost in various combinations and proportions showed good flower diameter (10.15-10-56 cm) in chrysanthemum.

Ishimura *et al.* (1990) observed that application of FYM to chilli significantly increased the number of fruits as well as weight of fruits having the highest yield with increased storage life of fruits by 10 days.

Singh *et al.* (1990) conducted trials in 1988-89 on chrysanthemum cv. Flirt and observed that basal dressing of FYM at 5 kg per m^2 had taken more number of days to visible bud, days to complete bud formation and days to complete flowering.

Batra *et al.* (1992) reported that soil nitrogenous activity was increased by application of FYM in french bean.

Sood *et al.* (1992) reported that the highest yield of potato (28.0 t/ha) with better tuber quality was obtained by the application of FYM while the lowest yield (23.8 t /ha) recorded under control treatment.

Kulkarni *et al.* (1996) in an experiment on growth and yield of China aster cv. Osmich plume mixed, obtained more flower yield (11 t/ ha) when FYM was applied at the rate 15 t ha^{-1} and vermicompost at 2.5 t ha^{-1}.

Lou-yi Long *et al.* (1996) investigated an application of FYM @ 50 g/ hole increased the petal length, daughter bulb, weight and propagation coefficient in tulip.

Rajamani and Sundaram (1997) reported that application of FYM had increased plant height, number of flowers, stem length and total number of flowers per plant in rose cv. Happiness.

Yadav and Singh (1997) observed that, an application of FYM at the highest rate significantly improved the growth parameters and yield of marigold but effect was more prominent at low rate of FYM.

Beno (1989) reported that the plant height increased when vermicompost was used in china aster.

Jagannath (1998) reported that in organic cultivation of flower crops, vermicompost used in mixture with garden soil or sand in pots had good results in salvia and aster.

Nethra *et al.* (1999) reported that plant height, number of branches, number of leaves and vase life of china aster were best in the treatment receiving vermicompost.

Anonymous (2000) reported an increase in growth with the application of FYM @ 30 t / ha^{-1} in safed musali.

Dutta (2000) observed that chrysanthemum plants grown in compost based medium were early in days required for buttoning, days required for first flower opening and days for 50% flowering.

Anonymous (2001) revealed that application of 20 t FYM ha^{-1} produced significantly the highest length and diameter of roots of safed musali.

Parthiban *et al.* (2001) revealed that application of 20 t FYM per ha in *Gompherena globosa*, resulted in maximum number of flowers 292.56 in pink type, and 308.35 in white type during summer.

Atiyeh *et al.* (2002) revealed that the greatest vegetative growth resulted from substitution of metromix 360 with 30 and 40% pig manure and vermicompost in marigold.

Barreto *et al.* (2002) observed that the flower quality with respect to head and disc diameter, number of ray florets, stalk length, stalk diameter, vase life and flower yield were superior from the plants in pot receiving vermicompost in gerbera cv. Sangria.

Haripriya *et al.* (2002) observed that application of FYM as organic amendment showed better growth and yield as compared to leaf mould and press mud in marigold.

Haripriya and Shekaran (2002) revealed that the application of FYM showed the better growth in terms of height of plants and number of laterals as well as number of leaves in marigold.

Hlidalgo and Harken (2002) observed that chrysanthemum plants grown in mixture of 50% vermicompost obtained greater number of flowers per plant than plants grown in other substrate.

Singh *et al.* (2002) observed that application of FYM as organic source of nutrient at the rate of 4 kg/m^2 had most progressive effect on the plant height and flowers yield in rose.

Paturde *et al.* (2002) found that yield was significantly increased with the application of organic manures like vermicompost @ 5 t ha^{-1} in safed musali.

Ram *et al.* (2003) found that 10 t FYM ha^{-1} gave highest plant height (107 cm) and more number of leaves per plant (2656) in rose.

2.3 Effect of nitrogen alone :

Bose and Das (1966) conducted fertilizer experiment with nitrogen, phosphorus and potassium on aster and suggested that, nitrogen deficiency affected the vegetative growth in respect of number of branches, number of leaves and dry matter weight and caused stunted growth.

Maheshwar (1977) reported that increased levels of nitrogen upto 180 kg/ha when applied to aster var. Vicks branching purple, had favourable and significant effect on all the vegetative growth parameters studied i.e. plant height, number of branches and number of leaves.

Cerneva and Pandev (1984) studied the effect of predominance of micronutrient ions in nutrient solution on growth of aster and found that, predominance of nitrogen produced more vegetative growth.

Ramchandra (1985) conducted an experiment on china aster cv. Ostrich plume and observed that, plant height, branches, number of leaves and leaf area were maximum in the treatment receiving 120 kg N/ ha.

Vijaykumar *et al.* (1988) observed that higher leaf area and leaf area index in the treatments supplied with 240 kg N/ ha in china aster cv. Ostrich plume mixed.

Mantur (1989) observed that in aster cv. Ostrich plume mixed, all the growth components were influenced by nitrogen application.

Sigedar *et al.* (1991) reported that application of 100 kg N/ha to *Calendula officinalis* had shown better effect on number of leaves, height and spread of plant and number of branches per plant.

Kozik (1992) recorded marked increase in number and length of lateral shoots due to nitrogen (0.08 - 0.64 gm/ dm^2) in aster cv. Alabaster.

Kozik (1993) studied the critical content and limiting levels of nitrogen for cv. Alabaster in pot trial and observed that, nitrogen is essential for growth of aster.

Dhua (1999) reported that nitrogen deficiency produced stunted growth in aster.

Mili (2000) conducted an experiment on calendula and observed that, height of plant, number of leaves, number of branches and leaf area per plant were maximum in application of 100 kg N / ha.

Jamkhande (2001) conducted an experiment on aster cv. Local and revealed that application of 150 kg N / ha in combination with 100 kg P_2O_5 / ha attributed superior results in respect of plant height, number of leaves per plant, number of branches per plant and spread of plant.

Jayabalakrishnan and Sekar (2002) reported that plant height at final harvest, number of branches per plant and number of leaves per plant were maximum in application of 200 kg N / ha along with 300 ppm GA spray in aster.

2.5 Effect of inorganic fertilizers on growth, yield and flower quality of Aster and other horticultural crops :

Gilly (1977) reported that deficiency of nitrogen shortened the vase life of *Chrysanthemum morifolium.*

Arulmozhiyan (1988) observed the effect of nitrogen and phosphorus on marigold cv. MDU – 1 and concluded that the application of nitrogen 120 kg ha^{-1} increased plant height, number of laterals, number of flowers, size of flower and yield of flowers per plant whereas 90 kg P_2O_5 ha^{-1} increased the growth, number of flowers and yield of flowers.

Terril *et al.* (1989) observed that the higher level of nitrogen decreased the keeping quality of cut flowers of chrysanthemum.

Abdul Khader (1990) reported that the application of 200 kg each of N, P and K ha^{-1} produced the highest yield of flowers in chrysanthemum cv.Co-1,Co-2.

Lodhi *et al.* (1991) noticed the longest vase life of chrysanthemum with the application of 60 g N and 50 g P per sq. meter.

Patil *et al.* (1992) observed that the application of 300 kg N, 200 kg P_2O_5 and 200 kg K_2O per ha gave maximum flower yield in chrysanthemum cv. Zipri.

Damke *et al.* (1997) recorded maximum vase life of cut blooms of chrysanthemum under lowest nitrogen level (10 g per sq. meter) and highest phosphorus level (40 g per sq. meter).

Bose *et al.* (1999) observed that phosphorus played an important role in initiation and development of flowers while its deficiency reduced the growth and yield of flowers. Potassium was also found essential for proper growth and flowering of chrysanthemum while marginal browning and reduction of leaf size showed its deficiency.

Shitare (1999) conducted an experiment on tuberose and observed maximum vase life of tuberose cut flowers with the application of all the three levels of nitrogen (200, 150 and 100 kg N/ ha) in combination with Azotobacter and Azospirillum as compared to those under control.

Milli (2000) reported that vase life of calendula increased with increase in nitrogen levels upto 100 kg N / ha, the maximum vase life being observed in flowers supplied with 100 kg N/ ha.

Jamkhande (2001) conducted an experiment on aster cv. Local and observed that application of 150 kg, N and 100 kg P_2O_5 / ha recorded maximum vase life of flowers.

2.6 Effect of biofertilizers with combination of inorganic fertilizers on growth, yield and quality of Aster and other crops :

Dange (1986) revealed that the treatment of seed innoculation with mixed culture of Azotobacter and Pseudomonas coupled with 30 kg N ha^{-1} significantly influenced the plant height, number of leaves, number of internodes, root development, length of green pod, yield per plot of okra.

Baig and Madalgiri (1989) studied the effect of Azotobacter inoculation by root dipping at the time of transplanting and soil application combined with 50 kg N / ha in tomato and obtained enhanced yield level as much as that of 75 kg N / ha alone resulting in saving nearly 30% of nitrogen.

Kulkarni (1990) observed that application of 75 kg N ha^{-1} along with Azotobacter and Azospirillum helped in increasing the flower yield of aster.

Gupta (1997) conducted an experiment on marigold and observed that higher yield was obtained from treatment where soil as well as seedlings were treated with Azotobacter + PSB culture in combination with 75% nitrogen.

Chandrikapure (1998) reported that, the response of flower parameters and yield of flowers / ha were highest under the treatment Azotobacter + PSB + 75 N % in marigold.

Kaloti (1998) obtained the highest yield of aster from the plants supplied with Azotobacter + PSB and 75% N.

Deshmukh (1998) reported that maximum yield of seed and flowers /ha were obtained from treatments including Azotobactor + PSB in combination with 75% N in gaillardia.

Shitare (1999) conducted an experiment on tuberose and revealed that yield and yield contributing characters like number of florets / spike, number of

florets / plant, weight of loose flowers / plant and floret size were maximum with the application of 150 kg N/ ha along with Azotobactor + Azospirillum.

Gajbhiye *et al.* (2003) conducted an experiment on effect of biofertilizers in tomato and revealed that phosphobacteria along with inorganic fertilizers increased the growth and yield of tomato.

2.7 Effect of biofertilizers with combination of organic manures on growth, yield and quality of flowers in Aster and other horticultural crops :

Sharma and Bhalla (1995) noted that integration of biofertilizers Azospirillum + PSB with compost 10 t ha^{-1} produced more green fruit yield (48.18 q ha^{-1}) as compared to biofertilizers alone (36.83 q ha^{-1}) in okra crop.

Nirmala *et al.* (2000) revealed that combined application of Azospirillum + PSB and FYM was found to have earliness, closer sex ratio, increased fruit size, number of fruits and yield of tender fruits in cucumber.

2.8 Effect of combination of organic, inorganic and biofertilizers an growth, yield and quality of Aster and other horticultural crops :

Prabhu *et al.* (2002 a) reported that the application of FYM and biofertilizers along with reduced dose of inorganic fertilizers was found to increase the yield and yield attributes in okra cv. Parbhani Kranti. Increase in yield by 9.39% was noticed in Azospirillum + PSB treated plots on an average over control. The results indicated that maximum yield was obtained from the plots receiving full RDF and 2/3 RDF. It also increased vegetative growth and chlorophyll content.

Prabhu *et al.* (2002 b) studied the effect of Integrated nutrient management on growth and yield of coriander and the results revealed that the application of FYM + Azospirillum + PSB + 25% RDF was found best for increase in fresh and dry weight of plant, height of plant, shoot to root ratio and yield per plot.

CHAPTER – III

MATERIAL AND METHODS

The experiment was carried out to study the "Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster", during rabi season, 2004 at College Garden of Horticulture section, College of Agriculture , Nagpur.

3.1 Basic Resource Information :

3.1.1 Experimental Site :

An experiment was conduced at College Garden of Horticulture section, College of Agriculture, Nagpur. The field was fairly leveled and having gentle slope.

3.1.2 Climate :

Nagpur is situated at 21°10' North latitude and 79°19' East latitude at the elevation of 321.26 m above mean sea level and lies under subtropical zone. Nagpur is characterised by hot and dry summer and fairly cold winter. This area shows wide diurnal fluctuations in temperature. The maximum and minimum temperatures ranged from 25°C to 41.5°C and 9.8°C to 23.4°C respectively. The relative humidity varied from 14 to 75 per cent during the crop growth period. The meteorological data recorded during the period from September 2004 to March 2005 at observatory of Agricultural College Farm, Nagpur is presented in Appendix A.

3.1.3 Soil :

The land used under the experimental layout was fairly uniform with gentle slope. The soil was medium black with uniform in texture, colour and having good drainage. The experimental plot was developed into fine tilth by ploughing and harrowing.The soil of the experimental plot was analysed for knowing its

nutritional status prior to conduct the experiment and the details so obtained from soil testing laboratory are given as below.

Table 1 : Chemical composition of soil :

Sr. No.	Particulars	Content	Analytical method used
1.	pH	7.1	Blackman's electrode pH method (Jackson, 1967).
2.	Electric Conductivity	0.35 dSm^{-1}	Electric conductivity meter
3.	Organic Carbon	0.56%	Walkey and Blacks rapid titration method (Piper, 1966).
4.	Available Nitrogen	430.7 kg ha^{-1}	Modified kjeldahl method (Piper, 1966).
5.	Available Phosphorus	15.35 kg ha^{-1}	Olsen's method (Jackson, 1967).
6.	Available Potash	162.3 Kg ha^{-1}	Flame photometer (Jackson, 1967).

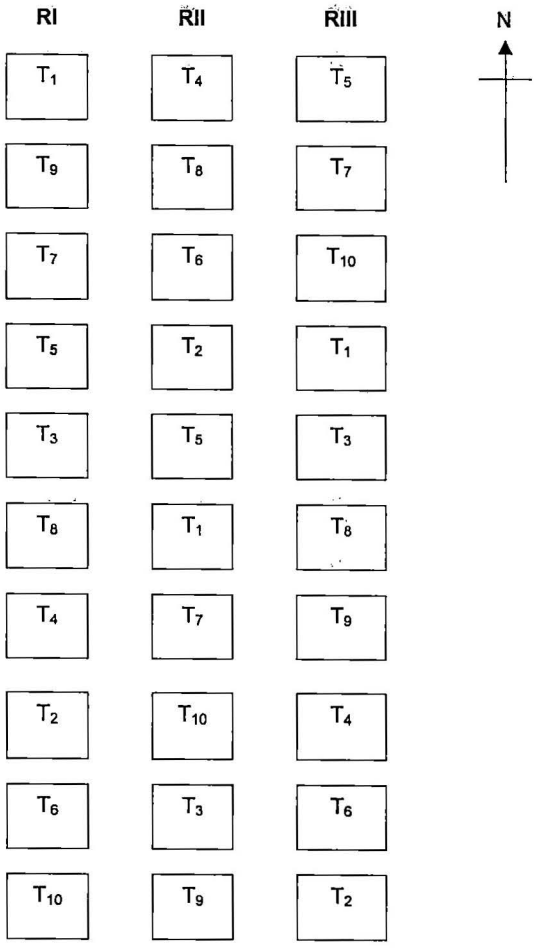
3.2 Experimental Details :

3.2.1 Design of experiment :

The experiment was laid out in Randomized Block Design with 10 treatments and 3 replications. The details of the experiment are as under.

1. Name of the crop : Aster
2. Botanical name : *Callistephus chinensis*
3. Variety : Local
4. Year of experiment : 2004-2005
5. Experiment Design : Randomized Block Design
6. Layout : Flat bed
7. Treatments : 10
8. Replications : 3
9. Plot size : Gross plot : 3m x 1.5 m
   Net plot : 2.4 m x 0.9 m

Fig. 1 : Plan of Layout



10. Gross field size	:	35.5 m x 8.5 m
11. Spacing	:	30 cm x 30 cm.
12. Date of sowing seed	:	28/08/2004
13. Date of transplanting	:	06/10/2004
14. Season	:	Rabi 2004
15. Number of plants per plot	:	60
16. Number of plots	:	30
17. Recommended fertilizer dose	:	150 : 50: 50 NPK kg ha^{-1}
18. Fertilizers applied at the time of transplanting	:	Half dose of N and full P and K
19. Top dressing	:	Half N

3.2.2 Treatment Details :

Abbreviation	Treatments
T_1	Recommended Fertilizer dose (150:50:50 Kg NPK ha^{-1} + 20 t ha^{-1} FYM)
T_2	FYM 20 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1}
T_3	FYM 20 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 100% N
T_4	FYM 20 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 75% N
T_5	FYM 20 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 50% N
T_6	Vermicompost 5 t ha^{-1}+ Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1}
T_7	Vermicompost 5 t ha^{-1}+ Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 100% N
T_8	Vermicompost 5 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 75% N
T_9	Vermicompost 5 t ha^{-1} + Azotobacter 3 kg ha^{-1} + PSB 3 Kg ha^{-1} + 50% N
T_{10}	Control

3.2.3 Preparatory tillage :

The plot was ploughed, harrowed and clods were crushed until the soil was in well pulverized condition and fairly leveled. The experimental field was laid out as per plan of layout. Well decomposed FYM and verimcompost were incorporated in soil at the rate of 20 metric tonnes and 5 metric tonnes per hectare respectively to the concern treatments plot and mixed in the soil.

3.2.4 Raising of seedlings :

Aster seeds of the cv. Local was made available from Maharaj Baug. Horticulture section, College of Agriculture, Nagpur. The seeds were sown on 28.8.04 on well prepared raised beds.

3.2.5 Soil application of bioinoculants :

For the treatments of soil application of Azotobacter and PSB, the culture of bioinoculants was spread in the concerned treatment plot @ 3 kg/ha by mixing in moist soil and was covered with soil before transplanting.

3.2.6 Transplanting of seedlings :

Transplanting was carried out on 6.10.04 in the plot already laid out as per plan. Uniform and healthy seedlings were selected for transplanting.

3.3 Details of cultural operations :

	Operation	Details
I.	Preparatory tillage	
	a. Ploughing	One
	b. Harrowing	Two
II.	Manuring	Recommended Dose 150 Kg N; 50 Kg P_2O_5 50 kg K_2O ha^{-1} FYM and verimcompost at the rate of 20 t ha^{-1} and 5t ha^{-1} respectively before application of inorganic fertilizers.

		Treatment levels of N : Full dose (100%) i.e. 150 kg N ha^{-1}, 75% N i.e. 112.50 kg N ha^{-1}, 50% N i.e. 75 kg N ha^{-1} At the time of transplanting half dose of nitrogen was given from each level as per the treatments along with full dose of P_2O_5 and K_2O and remaining half dose of nitrogen was applied at 30 days after transplanting.
III	Irrigation	At an interval of 8-10 days.
IV	Weeding	Four
V	Spraying	Two sprayings of 0.02% monocrotophos 35 EC.
VI	Harvesting of flowers	At an interval of 6-8 day.

3.4 Details of various observations :

3.4.1 Growth observations :

1. Height of plant (cm) :

Plant height was measured from 15th day after transplanting upto 90th day of growth period at 15 days interval by using meter scale.

2. Girth of stem (cm) :

The stem of plant was measured at 3 cm above ground level at every 15 days interval by using vernier caliper.

3. Number of branches per plant :

All the branches arising from main stem were recorded at a periodical interval of 15 days starting from 45 days after transplanting.

4. Number of leaves per plant :

The number of leaves per plant were recorded from 15 days of transplanting onwards at 15 days interval during the growth period.

5. Spread of plant (cm) :

The spread of the observational plant in all was measured in both the directions East-West and North-South at all growth stages with the help of meter scale and the average values were calculated and recorded in centimeter.

6. Fresh weight of shoots and roots per plant (g) :

The fresh weight of the shoots and roots of each plant were recorded separately in grams.

7. Dry weight of shoots and roots per plant (g) :

After recording the fresh weight of shoots and roots these plant parts were kept in the hot air oven for drying till the attainment of constant weight and then dry weight of shoots and roots was noted separately in grams.

3.4.2 Flowering attributes :

1. Days required for 1st flower initiation :

The first flower bud appearance of each plant was noted soon after the minute flower bud was visible to the open eyes after planting. To record the first flower bud appearance, plants were observed critically and after its emergence the flower buds were tagged. Days taken for first flower bud appearance were calculated from transplanting date to flower bud appearance date.

2. Days required for 50% flowering :

Dates and number of flowers harvested on these dates were recorded and from this data, number of days required for 50% flowering was worked out.

3. Number of flowers per plant :

Flowers harvested from observational plants were counted and the average number of flowers per plant was worked out.

4. Diameter of flower (cm) :

The diameter of five fully opened flowers from the various treatments was recorded randomly and average was calculated.

5. Weight of flower per plant (g) :

Fresh flowers picked from the observational plants at each harvest was weighed in grams and aggregate weight of flowers obtained from different pickings were calculated and values were averaged.

6. Weight of 10 flowers (g) :

Weight of ten flowers harvested from net plot treatmentwise was recorded in grams.

7. Yield of flowers per hectare (t) :

Treatmentwise total yield obtained from net plot was multiplied with hectare factor and thus the yield of flowers in tonnes per hectare was calculated.

8. Vase life in days :

Just opened cut flowers of uniform stem length (20 cm) were harvested at morning hours from each treatment plot and kept in measuring cylinders containing distilled water for recording vase life. The end of vase life was confirmed when flowers start fading or dropping down and accordingly vase life in days was recorded.

3.5 Statistical analysis :

The data was subjected to statistical analysis as per Gomez and Gomez (1984). The appropriate standard error of mean S.E. (m) and the critical difference (CD) were calculated at 5% level of probability. The data have been depicted by suitable graphs and figures at appropriate places.

3.6 Economics of flower production :

The economics of flower production was calculated by obtaining the prevailing market rates of Aster flowers produced. Accordingly values of flowers produced treatmentwise were estimated and converted into hectare basis. Simultaneously the treatmentwise cost of cultivation was calculated on hectare basis. Net return per hectare under such treatment was calculated by deducting the cost incurred from the gross income of a treatment. B : C ratio was calculated at Net return : Cost incurred i.e.

$$\text{Cost benefit ratio} = \frac{\text{Net monetary returns}}{\text{Total cost of cultivation}}$$

CHAPTER - IV
EXPERIMENTAL FINDINGS

The present investigation was carried out to study the "Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster" at College Garden of Horticulture section, College of Agriculture, Nagpur during rabi season of 2004. The data collected on various aspects during the investigation are presented in this chapter under appropriate headings.

4.1 Effect of organic manures and biofertilizers with reduced doses of nitrogen on vegetative growth of china aster :

4.1.1 Height of plant (cm) :

Height of plant was recorded at 15, 30, 45, 60, 75, 90 days after transplanting and data presented in table 2 and illustrated in fig. 2.

The data in respect of height of plant showed significant difference at all stages of observations. At 15 days after transplanting significantly maximum height of plant (8.51 cm) was recorded in the treatment T_7 and was found at par with treatment T_1 (8.46 cm) and T_3 (8.40 cm) closely followed by treatment T_4. The treatments T_4 (7.98 cm), T_8 (7.78 cm) and T_5 (7.57 cm) were at par with each other. However, minimum height of plant was noted in control (5.38 cm) treatment.

At 30 days after transplanting maximum height (22.97 cm) of plant was recorded in the treatment T_3, which was significantly superior over all other treatments. Treatments T_7 (20.97 cm) and T_1 (20.20 cm) were at par with each other. The minimum height (11.37 cm) was recorded in treatment T_{10} (control).

Table 2 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on height of plant (cm).

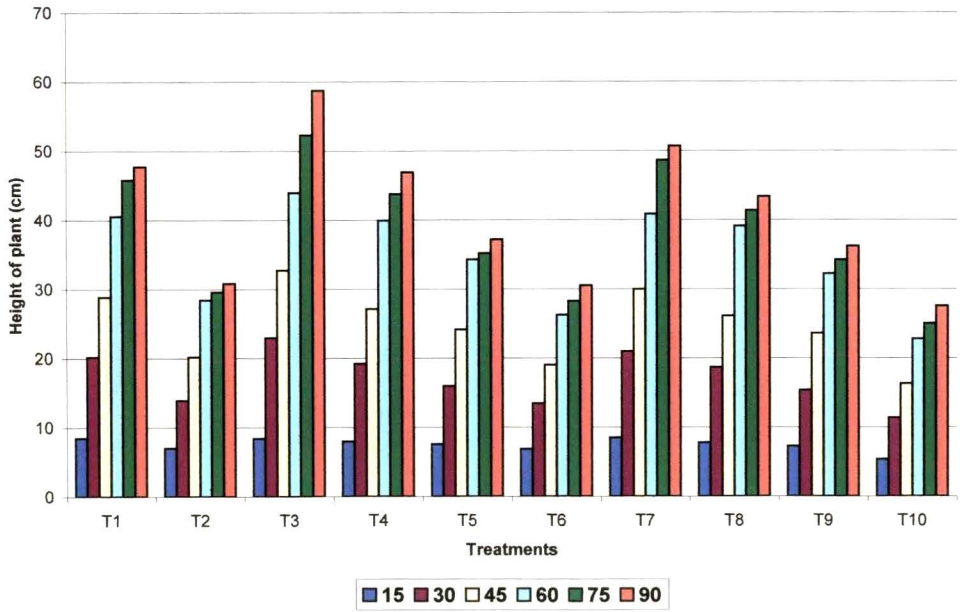
Treatments		Height of the plant (cm)					
		Days after transplanting					
		15	30	45	60	75	90
T_1	FYM + RDF 100%	8.46	20.20	28.88	40.53	45.81	47.73
T_2	FYM + Azt + PSB	7.03	13.88	20.18	28.45	29.58	30.85
T_3	FYM + Azt + PSB + 100% N	8.40	22.97	32.72	43.92	52.26	58.72
T_4	FYM + Azt + PSB + 75% N	7.98	19.21	27.15	39.92	43.73	46.90
T_5	FYM + Azt + PSB + 50% N	7.57	15.98	24.15	34.28	35.20	37.18
T_6	Vermicompost + Azt + PSB	6.87	13.46	19.02	26.25	28.26	30.54
T_7	Vermicompost + Azt + PSB + 100% N	8.51	20.97	29.99	40.86	48.65	50.70
T_8	Vermicompost + Azt + PSB + 75% N	7.78	18.68	26.09	39.14	41.37	43.36
T_9	Vermicompost + Azt + PSB + 50% N	7.27	15.37	23.57	32.19	34.19	36.20
T_{10}	Control	5.38	11.37	16.27	22.78	25.01	27.55
	'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.17	0.27	0.21	0.26	0.45	0.40
	C.D. at 5%	0.51	0.81	0.65	0.78	1.35	1.21

At 45 days after transplanting maximum height (32.72 cm) was recorded in T_3. Which was followed by treatment T_7 (29.99 cm). The minimum height (16.27 cm) was recorded in control treatment.

The maximum height (43.92 cm) was recorded in the treatment. T_3 at 60 days after transplanting which was found significantly superior over all other treatments. Treatment T_7 (40.86 cm) and T_1 (40.53 cm) were at par with each other. However, the minimum height (22.78 cm) was noted in treatment T_{10} (control).

At 75 days after transplanting maximum height (52.26 cm) was recorded in T_3 which was significantly superior over all other treatments. Treatment T_7

Fig. 2 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on height of plant (cm).



(48.65 cm) was found next in order. However, the minimum height (25.01 cm) was noted in treatment T_{10} (control).

At 90 days after transplanting the maximum height (58.72 cm) of plant was noted in treatment T_3 which was significantly superior over all other treatments followed by treatment T_7 (50.20 cm). Whereas treatment T_1 (47.73 cm) and T_4 (46.90 cm) were found at par with each other. The minimum height (27.55 cm) was recorded in treatment T_{10} (control).

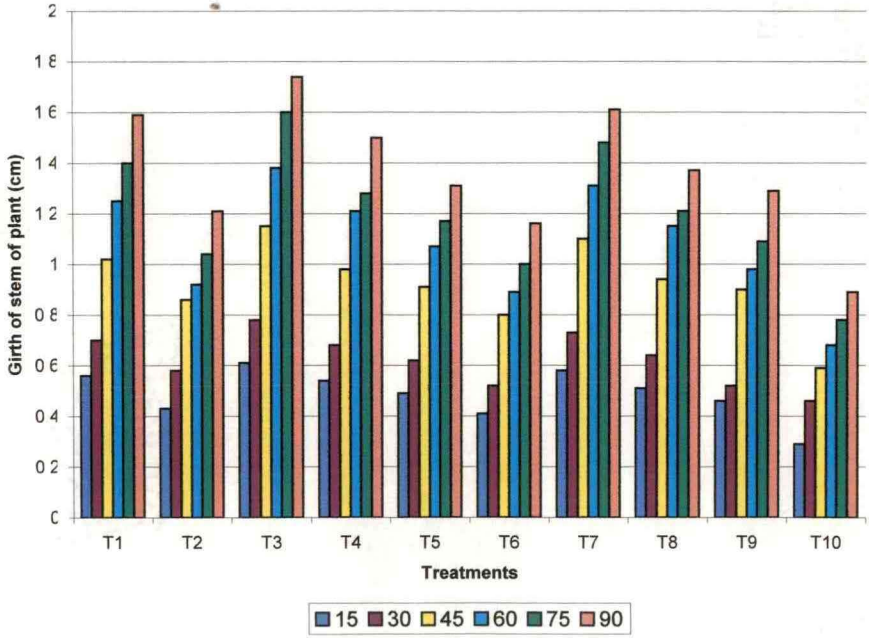
4.1.2 Girth of Stem (cm) :

The data in respect of radial growth measure at 15th day interval after transplanting is presented in table 3 and graphically illustrated in fig. 3.

Table 3 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on girth of stem of Aster at different growth stages (cm).

Treatments		Girth of stem of plant (cm)					
		Days after transplanting					
		15	30	45	60	75	90
T_1	FYM + RDF 100%	0.56	0.70	1.02	1.25	1.40	1.59
T_2	FYM + Azt + PSB	0.43	0.58	0.86	0.92	1.04	1.21
T_3	FYM + Azt + PSB + 100% N	0.61	0.78	1.15	1.38	1.60	1.74
T_4	FYM + Azt + PSB + 75% N	0.54	0.68	0.98	1.21	1.28	1.50
T_5	FYM + Azt + PSB + 50% N	0.49	0.62	0.91	1.07	1.17	1.31
T_6	Vermicompost + Azt + PSB	0.41	0.52	0.80	0.89	1.00	1.16
T_7	Vermicompost + Azt + PSB + 100% N	0.58	0.73	1.10	1.31	1.48	1.61
T_8	Vermicompost + Azt + PSB + 75% N	0.51	0.64	0.94	1.15	1.21	1.37
T_9	Vermicompost + Azt + PSB + 50% N	0.46	0.52	0.90	0.98	1.09	1.29
T_{10}	Control	0.29	0.46	0.59	0.68	0.78	0.89
	'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.021	0.035	0.037	0.047	0.476	0.373
	C.D. at 5%	0.065	0.107	0.113	0.139	0.140	0.109

Fig. 3 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on girth of stem of plant (cm).



Different treatments of organic manures and biofertilizers with reduced doses of nitrogen had significantly promoted the girth of stem of plant at 15th, 30th, 45th, 60th and 90th day of crop growth. It is revealed from the data presented in table 3 that at 15 days after transplanting showed the maximum girth of stem in the treatment T_3 (0.61 cm) which was found significantly superior over all other treatments except treatment T_7 (0.58 cm), T_1 (0.56) and T_4 (0.54). The minimum girth of stem was recorded in treatment T_{10} (0.29 cm).

At 30 days after transplanting, maximum girth of stem was recorded in treatment T_3 (0.78 cm). Treatments T_7 (0.73 cm), T_1 (0.70 cm) and T_4 (0.68 cm) were found at par with T_3. However, the minimum girth of stem (0.46 cm) was recorded in T_{10}.

At 45 days after transplanting the maximum girth of stem was recorded in treatment T_3 (1.15 cm) which was significantly superior over all other treatments except T_7. Treatments T_7 (1.10 cm), T_1 (1.02 cm) and T_4 (0.98 cm) were found at par with each other. The minimum girth of stem (0.59 cm) was recorded in control.

At 60 days after transplanting the maximum girth of stem was measured in the treatment T_3 (1.38 cm) followed by treatments T_7 (1.31 cm), T_1 (1.25 cm) and were found at par with each other. Whereas treatments T_4, T_8 and T_5 were at par with each other. The minimum girth of stem (0.68 cm) was recorded in treatment T_{10} (control).

A similar trend was noticed in radial growth of Aster stem at 75th and 90th day of crop growth after transplanting of Aster seedlings.

4.1.3 Number of branches per plant :

The data in respect of number of branches per plant influenced by various treatments at 45, 60, 75 and 90 days after transplanting are presented in table 4 and illustrated in fig. 4.

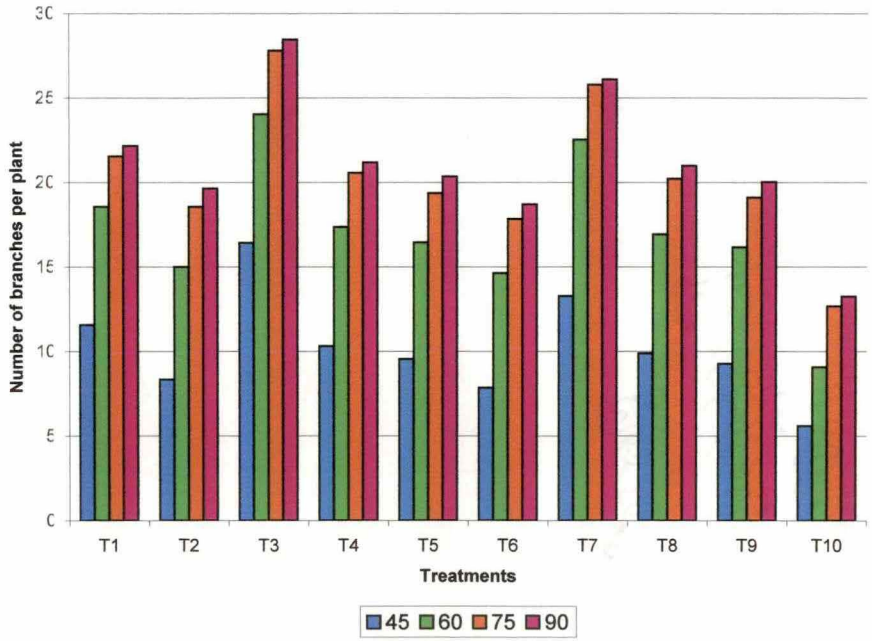
Table 4 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of branches per plant.

Treatment		Number of branches			
		Days after transplanting			
		45	60	75	90
T_1	FYM + RDF 100%	11.58	18.57	21.55	22.17
T_2	FYM + Azt + PSB	8.34	15.00	18.57	19.65
T_3	FYM + Azt + PSB + 100% N	16.42	24.03	27.80	28.45
T_4	FYM + Azt + PSB + 75% N	10.32	17.35	20.57	21.18
T_5	FYM + Azt + PSB + 50% N	9.55	16.45	19.37	20.35
T_6	Vermicompost + Azt + PSB	7.85	14.64	17.84	18.70
T_7	Vermicompost + Azt + PSB + 100% N	13.27	22.53	25.78	26.10
T_8	Vermicompost + Azt + PSB + 75% N	9.89	16.93	20.21	20.98
T_9	Vermicompost + Azt + PSB + 50% N	9.27	16.16	19.11	20.02
T_{10}	Control	5.59	9.07	12.67	13.25
	'F' Test	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.234	0.469	0.240	0.295
	C.D. at 5%	0.703	1.407	0.714	0.888

It is revealed from data that at 45th day after transplanting the treatment T_3 recorded maximum number of branches per plant (16.42) which was significantly superior over rest of the treatments closely followed by treatment T_7 (13.27), T_1 (11.58) and T_4 (10.32) were at par with each other. The minimum number branches per plant were noticed in T_{10} (5.59).

The maximum number of branches per plant were recorded in the treatment T_3 (24.03) at 60 days after transplanting which was significantly superior over all other treatments and found closely followed by treatment T_7 (22.53). Treatments T_1 (18.50) and T_4 (17.35) were at par with each other. The minimum number of branches were noticed in T_{10} (9.07). A similar trend was observed at 75th to 90th day of crop growth.

Fig. 4 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of branches per plant



In general application of FYM, Azotobacter, PSB and 100% nitrogen (T_3) produced the highest number of branches as compared to other treatments closely followed by T_7, T_1 and T_4.

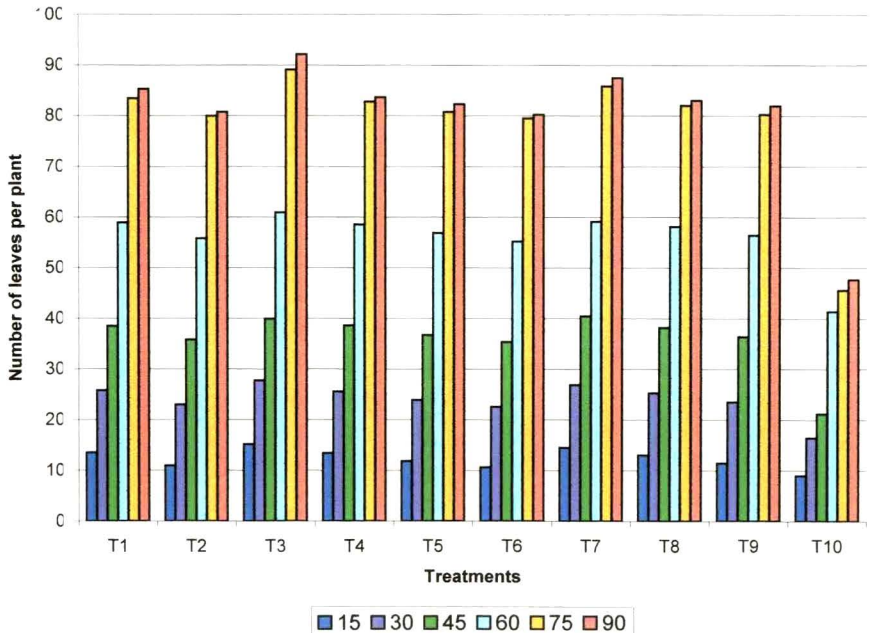
4.1.4 Number of leaves per plant :

Data presented in table 5 indicates the observations recorded for number of leaves per plant at 15, 30, 45, 60, 75, 90 days after transplanting and illustrated in fig. 5.

Table 5 : Effect of organic manures and bioferilizers with reduced doses of nitrogen on number of leaves per plant.

Treatment		Number of leaves per plant					
		Days after transplanting					
		15	30	45	60	75	90
T_1	FYM + RDF 100%	13.50	25.78	38.51	58.89	83.45	85.29
T_2	FYM + Azt + PSB	10.97	22.98	35.82	55.78	79.99	80.78
T_3	FYM + Azt + PSB + 100% N	15.17	27.75	39.91	60.90	89.11	92.15
T_4	FYM + Azt + PSB + 75% N	13.39	25.54	38.63	58.51	82.78	83.67
T_5	FYM + Azt + PSB + 50% N	11.85	23.88	36.74	56.83	80.76	82.32
T_6	Vermicompost + Azt + PSB	10.61	22.53	35.37	55.21	79.53	80.22
T_7	Vermicompost + Azt + PSB + 100% N	14.50	26.85	40.45	59.11	85.85	87.50
T_8	Vermicompost + Azt + PSB + 75% N	13.00	25.26	38.21	58.10	82.04	83.02
T_9	Vermicompost + Azt + PSB + 50% N	11.47	23.50	36.39	56.41	80.27	81.93
T_{10}	Control	9.00	16.45	21.15	41.40	45.60	47.70
	'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.30	0.31	0.41	0.80	0.59	0.69
	C.D. at 5%	0.89	0.90	1.25	2.38	1.76	2.06

Fig. 5 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of leaves per plant.



At 15 days after transplanting, significantly highest number of leaves per plant were recorded in the treatment T_3 (15.17) which was found at par with T_7 (14.50). Treatments T_1 (13.50), T_4 (13.39) and T_8 (13.00) were found at par with each other. Lowest number of leaves (9.00) were recorded in T_{10} (control).

The maximum number of leaves at 30 days after transplanting were recorded in the treatment T_3 (27.75) which was found significantly superior over other treatments except T_7 (26.85). Treatments T_1 (25.78), T_4 (25.54) and T_8 (25.26) were found at par with each other. The minimum number of leaves (16.45) per plant were recorded in T_{10}.

A similar trend was observed at 45th, 60th, 75th and 90th day crop growth.

4.1.5 Spread of plant (cm) :

The data in respect of spread of plant was measured at 15, 30, 45, 60, 75 and 90 days after transplanting and data is presented in table 6 and illustrated in fig. 6.

Data obtained from observations recorded at 15 days after transplanting showed maximum spread of plant in treatment T_3 (18.57 cm) which was significantly superior over other treatments except T_7 (18.08 cm), T_1 (17.82 cm), T_4 (17.38 cm) and T_8 (17.02 cm). The minimum spread of plant was recorded in treatment T_{10} (12.00 cm).

At 30 days after transplanting, maximum spread of plant was recorded in treatment T_3 (23.09 cm) closely followed by treatments T_7 (22.18 cm) and T_1 (21.76 cm) found at par with each other. Treatments T_7, T_1, T_4, T_8, T_5 were found at par with each other. Lowest spread of plant was recorded in control (16.78 cm).

At 45 days after transplanting, the maximum spread of plant was recorded in T_3 (28.17 cm) which was found significantly superior over other treatment except T_7 (27.36 cm) and T_1 (26.91 cm). Treatments T_1 (26.91 cm), T_4 (26.21 cm) and T_8 (26.02 cm) were at par with each other. The minimum spread of plant (17.79) was recorded in T_{10} (control).

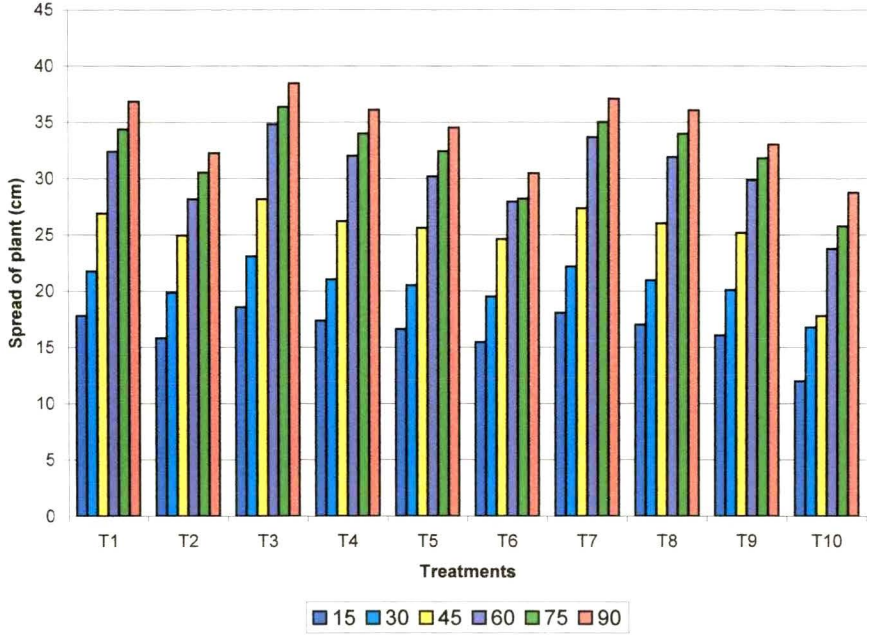
Table 6 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on spread of plant (cm).

Treatment		Spread of plant (cm)					
		Days after transplanting					
		15	30	45	60	75	90
T_1	FYM + RDF 100%	17.82	21.76	26.91	32.40	34.39	36.84
T_2	FYM + Azt + PSB	15.81	19.86	24.93	28.17	30.53	32.26
T_3	FYM + Azt + PSB + 100% N	18.57	23.09	28.17	34.81	36.34	38.47
T_4	FYM + Azt + PSB + 75% N	17.38	21.05	26.21	32.02	34.01	36.11
T_5	FYM + Azt + PSB + 50% N	16.63	20.52	25.60	30.18	32.43	34.54
T_6	Vermicompost + Azt + PSB	15.45	19.51	24.61	27.94	28.20	30.47
T_7	Vermicompost + Azt + PSB + 100% N	18.08	22.18	27.36	33.69	35.02	37.09
T_8	Vermicompost + Azt + PSB + 75% N	17.02	20.96	26.02	31.91	33.99	36.07
T_9	Vermicompost + Azt + PSB + 50% N	16.08	20.11	25.18	29.86	31.81	33.02
T_{10}	Control	12.00	16.78	17.79	23.74	25.75	28.76
	'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.59	0.65	0.45	0.41	0.99	0.17
	C.D. at 5%	1.76	1.96	1.33	1.22	2.98	0.50

Significantly maximum spread of plant was recorded in the treatment T_3 (34.81 cm) followed by T_7 (33.69 cm) at 60 days after transplanting. However, these treatments were at par with each other. The minimum spread of plant was recorded in control (23.74 cm).

At 75 days after transplanting, the maximum spread of plant was recorded in T_3 (36.34 cm) which was significantly superior over other treatment except T_7 (35.02 cm), T_1 (34.39 cm), T_4 (34.01 cm) and T_8 (33.99 cm). Treatments T_5, T_2 and T_9 were at par with each other. The minimum spread of plant was recorded in control (25.75 cm).

Fig. 6 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on spread of plant (cm).



At 90 days after transplanting spread of plant was recorded maximum in treatment T_3 (38.47 cm) which was significantly superior over all other treatments. It was closely followed by treatment T_7 (37.09 cm). Treatments T_1, T_4 and T_8 were found at par with each other. The minimum spread of plant (28.76 cm) was measured in T_{10}.

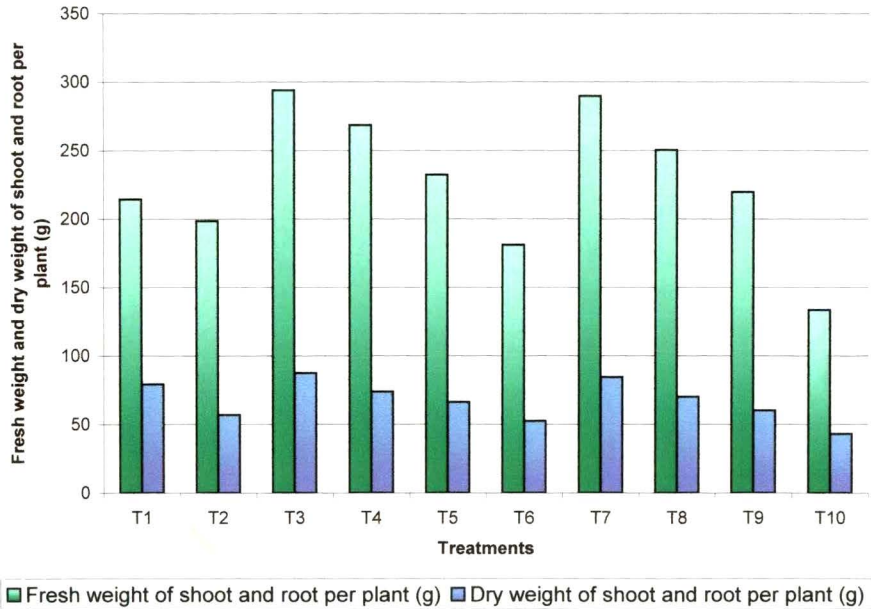
4.1.6 Fresh weight and dry weight of shoot and root per plant (g) :

The data regarding fresh weight and dry weight of shoot and root per plant as influenced by different treatments was noted and presented in table 7 and graphically illustrated in fig. 7.

Table 7 : Effect of organic manures and bioferilizers with reduced doses of nitrogen on fresh weight and dry weight of shoot and root / plant.

Treatments		Fresh weight of shoot and root per plant (g)	Dry weight of shoot and root per plant (g)
T_1	FYM + RDF 100%	214.35	79.32
T_2	FYM + Azt + PSB	198.45	56.97
T_3	FYM + Azt + PSB + 100% N	294.07	87.45
T_4	FYM + Azt + PSB + 75% N	268.50	73.81
T_5	FYM + Azt + PSB + 50% N	232.42	66.17
T_6	Vermicompost + Azt + PSB	181.07	52.42
T_7	Vermicompost + Azt + PSB + 100% N	289.85	84.36
T_8	Vermicompost + Azt + PSB + 75% N	250.35	70.15
T_9	Vermicompost + Azt + PSB + 50% N	219.64	60.17
T_{10}	Control	133.51	43.15
	'F' Test	Sig.	Sig.
	S.E. (m) ±	2.22	1.12
	C.D. at 5%	6.59	3.33

Fig. 7 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on fresh weight and dry weight of shoot and root per plant.



The data revealed the significant differences among the treatments in respect of fresh weight and dry weight of shoot and root per plant. The maximum fresh weight (294.67 g) was found in treatment T_3. Which was significantly superior over all other treatments except treatment T_7 and closely followed by treatment T_1. However, the minimum fresh weight and dry weight of shoot and root per plant (133.51 g) and (43.15 g) respectively was noted in control treatment (T_{10}).

In general it was noticed that application of FYM, Aztobacter, PSB and 100% nitrogen and vermicompost, Azotobacter, PSB and 100% nitrogen significantly increased fresh and dry weight of plant closely followed by application of FYM and recommended dose of fertilizer.

4.2 Effect of organic manures and biofertilizers with reduced doses of nitrogen on yield and quality of china aster.

4.2.1 Days required for first flower initiation :

The data regarding the number of days required for first flower initiation from transplanting as influenced by different treatments of organic manures and biofertilizers with reduced doses of nitrogen were recorded and presented in table 8 and graphically illustrated in fig. 8.

The data revealed the significant differences among the treatments in respect of number of days required for first flower initiation. The early initiation of flowers was observed in control (47.70) followed by T_2 (51.75). The treatment T_6 (54.25), T_9 (55.85) and T_5 (56.65) were found at par with each other. However maximum days (60.85) were recorded in treatment T_3.

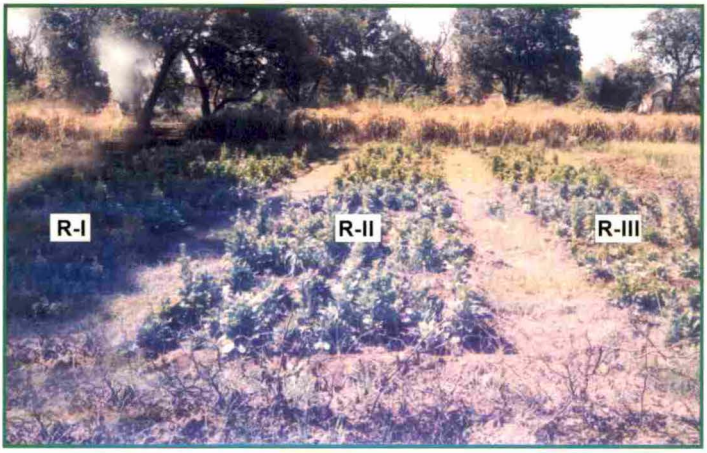


Plate No. 1 : Experimental plot in pre-bloom stage

Plate No. 2 : Flowering in treatment T_7
(Vermicompost + Azotobacter + PSB + 100% N)

Table 8 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on days required for first flower initiation.

Treatments		Days required for first flower initiation
T_1	FYM + RDF 100%	60.35
T_2	FYM + Azt + PSB	51.75
T_3	FYM + Azt + PSB + 100% N	60.85
T_4	FYM + Azt + PSB + 75% N	58.94
T_5	FYM + Azt + PSB + 50% N	56.65
T_6	Vermicompost + Azt + PSB	54.25
T_7	Vermicompost + Azt + PSB + 100% N	59.92
T_8	Vermicompost + Azt + PSB + 75% N	58.65
T_9	Vermicompost + Azt + PSB + 50% N	55.85
T_{10}	Control	47.70
	'F' Test	Sig.
	S.E. (m) ±	1.06
	C.D. at 5%	3.164

4.2.2 Days required for 50% flowering :

The data in respect of days required for 50% flowering as influenced by the different treatments were recorded and presented in table 9 and graphically illustrated in fig. 9.

The data revealed that, the number of days required for 50% flowering in different treatments were statistically significant. The minimum days required for 50% flowering were recorded in the treatment T_7 (70.50 days) followed by T_3 (70.85 days). However treatments T_3 (70.85 days), T_1 (71.00 days) and T_8 (71.65 days) were at par with each other.

Fig. 8 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on days required for first flower initiation.

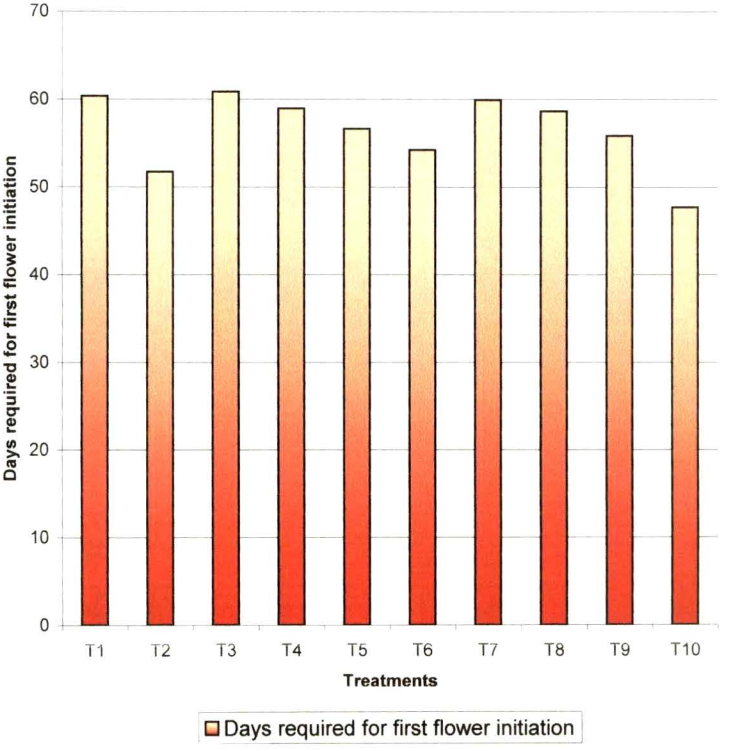


Table 9 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on days required for 50% flowering.

Treatments		Days required for 50% flowering
T_1	FYM + RDF 100%	71.00
T_2	FYM + Azt + PSB	78.15
T_3	FYM + Azt + PSB + 100% N	70.85
T_4	FYM + Azt + PSB + 75% N	71.95
T_5	FYM + Azt + PSB + 50% N	76.85
T_6	Vermicompost + Azt + PSB	77.85
T_7	Vermicompost + Azt + PSB + 100% N	70.50
T_8	Vermicompost + Azt + PSB + 75% N	71.65
T_9	Vermicompost + Azt + PSB + 50% N	75.40
T_{10}	Control	84.12
	'F' Test	Sig.
	S.E. (m) ±	0.336
	C.D. at 5%	0.997

The maximum days required for 50% flowering were recorded in control (84.12 days) treatment which was significantly inferior over rest of the treatments.

4.2.3 Number of flowers per plant, per plot and per hectare :

The data regarding yield of flowers in respect of number of flowers per plant, per plot and per hectare as influenced by various treatments of organic manures and biofertilizers with reduced doses of nitrogen were recorded and presented in table 10 and graphically illustrated in fig. 10.

Fig. 9 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on days required for 50% flowering.

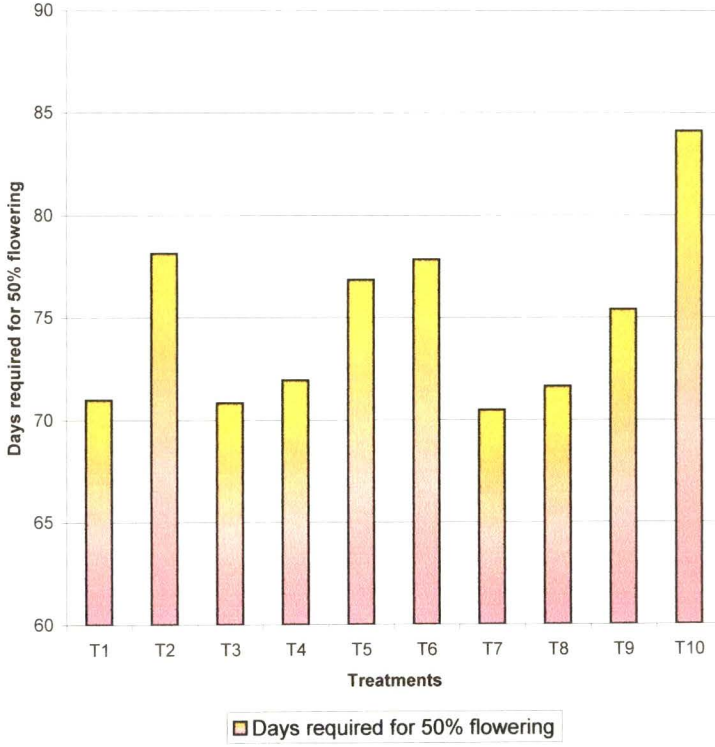


Table 10 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of flowers per plant, per plot and per hectare.

Treatments		No. of flowers per plant	No. of flowers per plot	No. of flowers per ha. (lakh)
T_1	FYM + RDF 100%	36.50	915.00	38.61
T_2	FYM + Azt + PSB	25.70	642.50	27.11
T_3	FYM + Azt + PSB + 100% N	37.95	948.75	40.03
T_4	FYM + Azt + PSB + 75% N	35.85	896.25	37.82
T_5	FYM + Azt + PSB + 50% N	27.20	680.00	28.69
T_6	Vermicompost + Azt + PSB	26.45	661.25	27.90
T_7	Vermicompost + Azt + PSB + 100% N	39.80	995.00	41.98
T_8	Vermicompost + Azt + PSB + 75% N	36.72	918.00	38.73
T_9	Vermicompost + Azt + PSB + 50% N	28.10	702.50	29.64
T_{10}	Control	19.20	480.00	20.25
	'F' Test	Sig.	Sig.	Sig.
	S.E. (m) ±	0.283	16.01	0.307
	C.D. at 5%	0.842	47.56	0.913

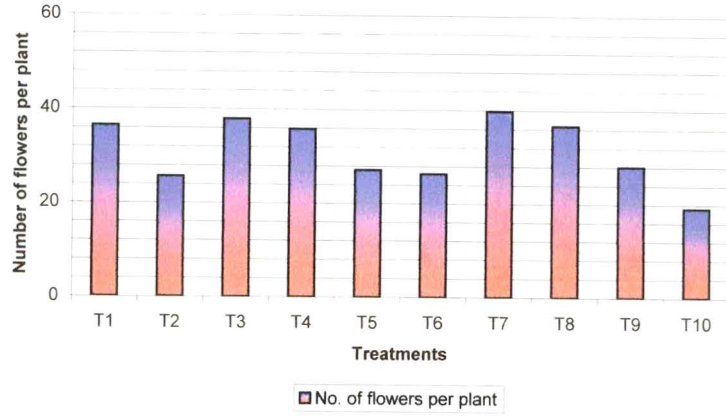
The treatment T_7 produced highest number of flowers (39.80 per plant, 995.00 per plot and 41.98 lakh per hectare) which was significantly superior over all other treatments. Treatment T_7 was closely followed by treatment T_3 (37.95 per plant, 948.75 per plot, 40.03 lakh per hectare). The lowest number of flowers were obtained from the control (19.20 per plant, 480.00 per plot, 20.25 lakh per hectare).

The yield of flower chronologically increased under the treatments T_{10}, T_2, T_6, T_5, T_9, T_4, T_1, T_8, T_3 and T_7.

4.2.4 Diameter of flower (cm) :

Diameter of flower is one of the important aspect for judging its quality. Diameter of each flower was recorded at the time of harvesting and presented in table 11 and graphically illustrated in fig. 11.

Fig. 10 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of flowers per plant.



Effect of organic manures and biofertilizers with reduced doses of nitrogen on number of flowers per ha (Lakh)

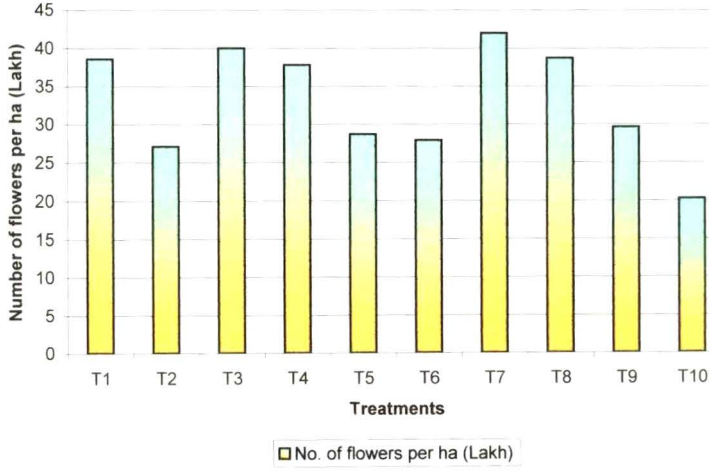


Plate No. 3 : Branching in treatment T_3
(FYM + Azotobacter + PSB + 100% N)

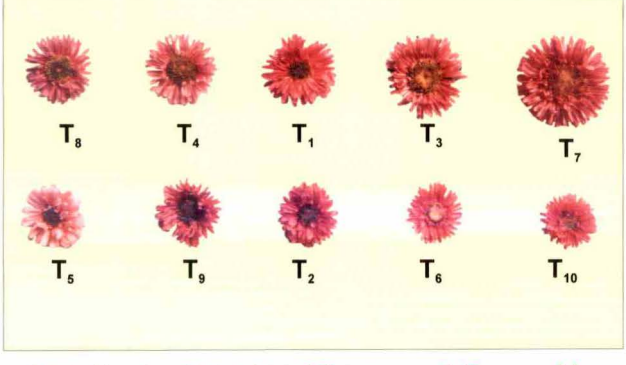


Plate No. 4 : Diameter of flowers as influenced by various treatments.

Table 11 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on diameter of flower (cm).

Treatments		Diameter of flowers (cm)
T_1	FYM + RDF 100%	7.15
T_2	FYM + Azt + PSB	5.98
T_3	FYM + Azt + PSB + 100% N	7.27
T_4	FYM + Azt + PSB + 75% N	7.10
T_5	FYM + Azt + PSB + 50% N	6.80
T_6	Vermicompost + Azt + PSB	5.81
T_7	Vermicompost + Azt + PSB + 100% N	7.45
T_8	Vermicompost + Azt + PSB + 75% N	7.02
T_9	Vermicompost + Azt + PSB + 50% N	6.75
T_{10}	Control	3.47
	'F' Test	Sig.
	S.E. (m) ±	0.165
	C.D. at 5%	0.491

The data presented in table showed significant differences among the various treatments in respect of diameter of flowers.

The maximum diameter of flower was found in treatment T_7 (7.45 cm) which was significantly superior over other treatment except T_3 (7.27 cm), T_1 (7.15 cm), T_4 (7.10 cm) and T_8 (7.02 cm). Treatments T_5 (6.80 cm) and T_9 (6.75 cm) were also found at par with each other. The minimum diameter of flower was noticed in control (3.47 cm).

4.2.5 Weight of flowers per plant (g), ten flowers (g), per plot (kg) and per hectare (tonnes) :

The data in respect of weight of flower per plant (g), ten flowers (g), per plot (kg) and per hectare (t) were recorded under different treatments and presented in table 12 and graphically illustrated in fig. 12.

Fig. 11 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on diameter of flowers (cm).

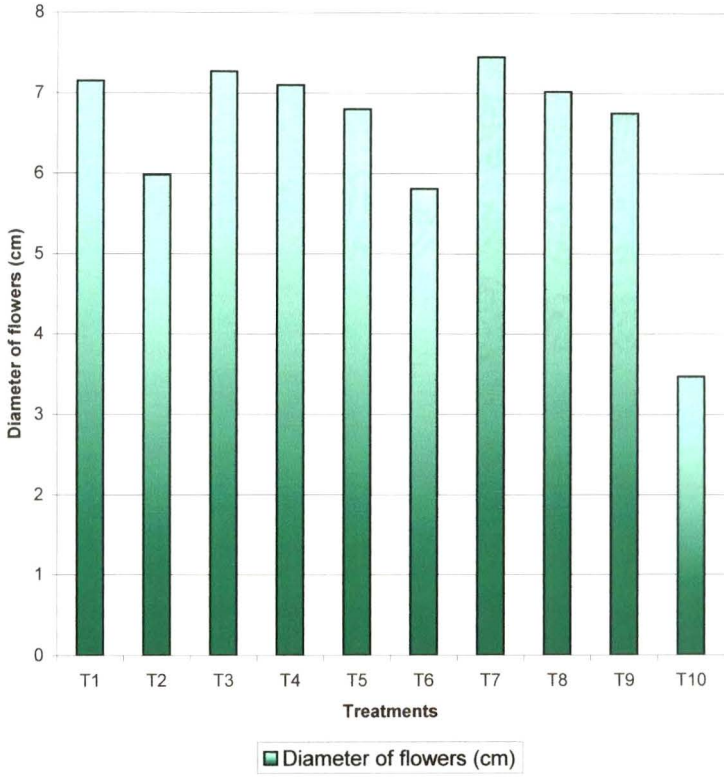


Table 12 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on weight of flower per plant (g), ten flowers (g), per plot (kg) and per hectare (t).

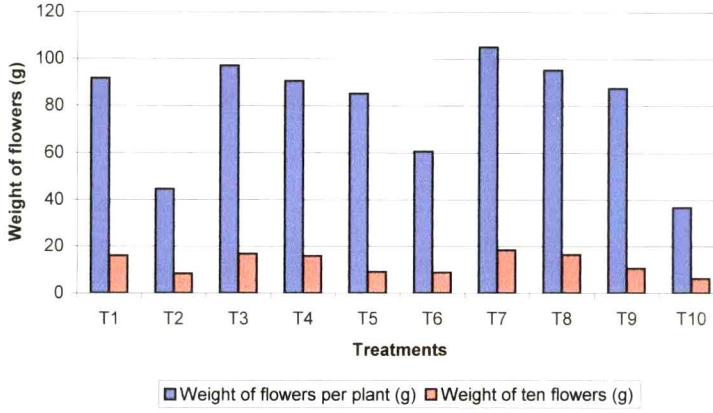
	Treatments	Weight of flowers per plant (g)	Weight of ten flowers (g)	Weight of flowers per plot (kg)	Weight of flowers per ha (t)
T_1	FYM + RDF 100%	91.75	16.06	2.29	9.67
T_2	FYM + Azt + PSB	44.64	8.37	1.11	4.70
T_3	FYM + Azt + PSB + 100% N	97.05	16.80	2.42	10.23
T_4	FYM + Azt + PSB + 75% N	90.60	15.85	2.26	9.55
T_5	FYM + Azt + PSB + 50% N	85.25	9.05	2.13	8.99
T_6	Vermicompost + Azt + PSB	60.66	8.82	1.51	6.39
T_7	Vermicompost + Azt + PSB + 100% N	105.10	18.40	2.62	11.08
T_8	Vermicompost + Azt + PSB + 75% N	95.22	16.40	2.38	10.04
T_9	Vermicompost + Azt + PSB + 50% N	87.52	10.60	2.18	9.23
T_{10}	Control	36.65	6.23	0.91	3.85
	'F' Test	Sig.	Sig.	Sig.	Sig.
	S.E. (m) ±	0.221	0.361	0.250	0.188
	C.D. at 5%	0.657	1.073	0.741	0.558

From the data, it was revealed that, there were significant differences among the treatments in respect of flower weight.

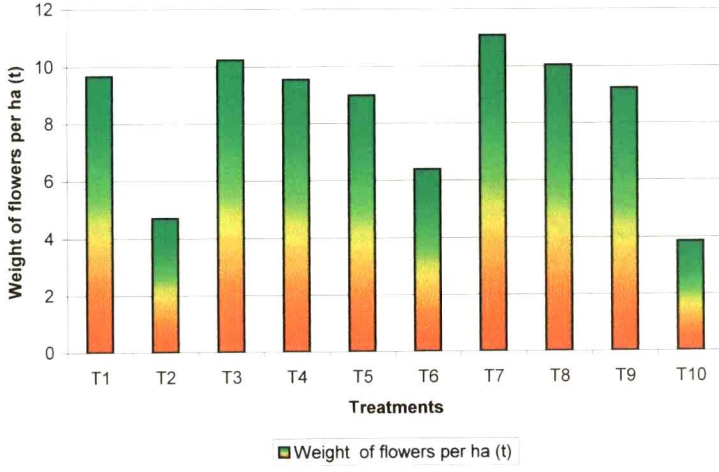
The highest weight of flowers per plant (105.10 g), weight of ten flowers (18.40 g), weight of flowers per plot (2.62 kg) and weight of flowers per hectare (11.08 t) were obtained under the treatment T_7 which was significantly superior over all other treatments. It was closely followed by treatment T_3 (97.05 g), ten flowers (16.80 g), per plot (2.42 kg) and per hectare (10.23 tonnes). However, the lowest weight of flowers per plant (36.55 g), ten flowers (6.23 g) per plot (0.91 kg) and per hectare (3.85 tonnes) were recorded under control.

The weight of flower chronologically increased under the treatments T_{10}, T_2, T_6, T_9, T_5, T_4, T_1, T_8, T_3 and T_7.

Fig. 12 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on weight of flower per plant (g), ten flowers (g),



Effect of organic manures and biofertilizers with reduced doses of nitrogen on Weight of flowers per ha (t)



4.2.6 Vase life studies :

The data in respect of vase life of cut flowers in days as influenced by the different treatments was recorded and presented in table 13 and graphically illustrated in fig. 13.

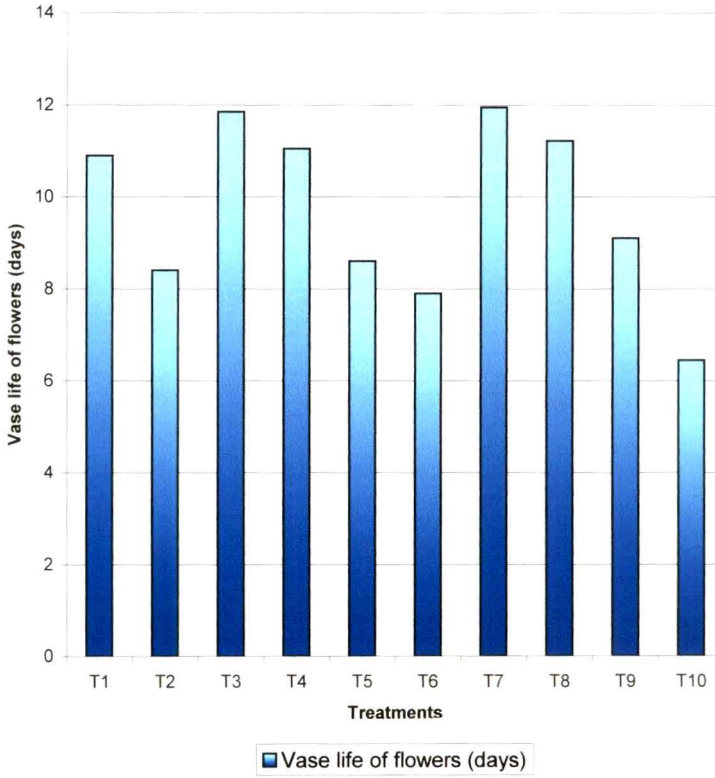
Table 13 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on vase life of flower.

Treatments		Vase life (days)
T_1	FYM + RDF 100%	10.90
T_2	FYM + Azt + PSB	8.40
T_3	FYM + Azt + PSB + 100% N	11.85
T_4	FYM + Azt + PSB + 75% N	11.05
T_5	FYM + Azt + PSB + 50% N	8.60
T_6	Vermicompost + Azt + PSB	7.90
T_7	Vermicompost + Azt + PSB + 100% N	11.95
T_8	Vermicompost + Azt + PSB + 75% N	11.22
T_9	Vermicompost + Azt + PSB + 50% N	9.10
T_{10}	Control	6.45
	'F' Test	Sig.
	S.E. (m) ±	0.15
	C.D. at 5%	0.44

The data exhibit the significant differences in respect of vase life as affected by various treatments of organic manures, biofertilizers and nitrogen doses.

The maximum vase life of cut flower was observed in the flower harvested from the treatment T_7 (11.95 days) which was found significantly superior over other treatments except T_3 (11.85 days). Treatments T_8 (11.22 days), T_4 (11.05 days), T_1 (10.90 days) were also found at par with each other. However, vase life was found minimum in the flowers harvested from control (6.45 days).

Fig. 13 : Effect of organic manures and biofertilizers with reduced doses of nitrogen on vase life of flowers (days)



CHAPTER - V
DISCUSSION

The present investigation entitled "Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster", was carried out during rabi season of 2004-2005. The result presented in previous chapter as influenced by different treatments are discussed in this chapter.

5.1 Effect of organic manures and biofertilizers with reduced doses of nitrogen on vegetative growth of china aster :

It is evident from the data presented in chapter IV, different treatments of organic manures, biofertilizers and inorganic fertilizers influenced the vegetative growth viz, height of plant, spread of plant, girth of stem, number of branches, number of leaves and fresh and dry weight of shoots and roots of aster plants.

It was observed that in each growth phases as the plant advanced in age from 30^{th} to 90^{th} days after planting, significantly highest values were recorded in all growth attributing characters.

5.1.1 Height of plant (cm) :

At every 15 days interval from 30^{th} to 90^{th} days during the crop growth maximum plant height was noticed in treatment T_3 (FYM + Azotobacter + PSB + 100% N) closely followed by treatment T_7 (Vermicompost + Azotobacter + PSB + 100% N) which were significantly superior over other treatments. However the minimum plant height was recorded in treatment T_{10} (control). At all stages of growth there was progressive increase in height of plant.

5.1.2 Girth of stem (cm) :

The periodical data in respect of girth of stem (cm) is presented in Table 3 and revealed that, the maximum girth of stem was recorded in treatment

T_3 (1.74 cm), which was closely followed by treatments T_7 (1.61 cm). The minimum (0.89 cm) girth of stem was recorded in T_{10} (control).

5.1.3 Number of branches per plant :

The data in respect of number of branches per plant was recorded at 45, 60, 75 and 90 days after transplanting and the data is presented in Table 4.

Maximum number of branches per plant (28.45) were noticed in treatment T_3 (FYM + Azotobacter + PSB + 100% N) closely followed by treatment T_7 (26.10), while the minimum number of branches was observed in T_{10} (control).

5.1.4 Number of leaves per plant :

The data in respect of number of leaves per plant were recorded at 15, 30, 60, 75 and 90 days after transplanting and the data is presented in the Table 5.

The maximum number of leaves were observed in treatment T_3 (92.15). Whereas the minimum (47.70) number of leaves were noticed in control treatment (T_{10}).

5.1.5 Spread of plant (cm) :

Maximum spread of plant was recorded in treatment T_3 (38.47 cm) (FYM + Azotobacter + FYM + 100% N), which was significantly superior over rest of the treatments. It was closely followed by T_7 (37.09). The minimum spread of plant was observed in treatment T_{10} (28.76 cm). As the crop advanced in age from 30^{th} to 90^{th} days a similar trend in respect of spread of plant was observed with successive increased from 30^{th} to 90^{th} days of crop growth.

5.1.6 Fresh and dry weight of shoots and roots of the plant :

From the data it revealed, that the treatment T_3 had the highest fresh weight (294.67 g) and dry weight (87.45 g) of plant, which was found significantly superior over other treatments. However, the lowest fresh and dry weight (133.51 g and 43.15 g) was observed in treatment T_{10} (control).

In general, it can be concluded that an application of FYM + Azotobacter + PSB + 100% N was found most effective or beneficial in accelerating the vegetative growth of china aster at all phases of crop growth.

It is well known that FYM is very good and rich source of nutrients and availability of nutrients from FYM might be enhanced due to activities of Azotobacter and PSB. Azotobacter is having an ability to produce growth promoting substance such as auxins, cytokinins, gibberillins etc. It also plays significant role in fixation of elemental nitrogen. This might be proved helpful in improving the vegetative growth of the plant.

These results were proved with the findings of various research workers :

Very few reports are available regarding the aster therefore results on other horticultural crops have been mentioned below.

Gupta (1997) observed maximum height, number of leaves, number of branches girth of stem in marigold in treatment receiving Azotobacter + PSB + 100% N.

Similar results were also obtained by Kaloti (1998) in aster Deshmukh (1998) in gaillardia, Chandrikapure (1998) in marigold.

Prabhat Kumar (2003) observed that an application of PSB + VAM proved to be most effective in increasing the plant height, number of leaves, number of branches, flower weight, flower diameter, flower yield of china aster. Nambisan *et al.* (1983) reported that application of FYM at the rate of 20-25 tonnes per ha ensured better growth and flowering in tuberose.

Batra *et al.* (1992) reported that soil nitrogenous activity was increased by application of FYM in french bean. Netra *et al.* (1999) reported that maximum vegetative growth was obtained in china aster in the treatment receiving vermicompost.

Prabhu *et al.* (2002) reported maximum shoot weight per plant in coriander, might be due to the production of some growth substance by Azotobacter and Azospirillum beside its main function of nitrogen fixation. The application of PSB might have resulted in increased uptake of nutrients by plant root.

Vegetative growth influenced by the treatment of organic manures, biofertilizers and inorganic fertilizers :

Addition of Azotobacter and PSB with in organic fertilizers resulted in more N accumulation in soil, which results into more plant height. PSB posses an ability to bring insoluble phosphate in soil into soluble form by secreting organic acid, such as formic, acetic propionic, lactic, glycolic, fumaric and succinic acid. These acids, helps to maintained the soil pH and bring the dissolution of bound forms of phosphate (Gupta, 1991).

5.2 Effect of organic manures, biofertilizers and inorganic fertilizers on flowering :

5.2.1 Days required for first flower initiation :

The minimum days required (47.70) for emergence of flower bud in treatment T_{10} (control), where organic manures, biofertilizers and nitrogen were not applied which was followed by T_2 (51.75).

The late initiation of flowers was observed under the treatment T_3 (60.85) followed by T_1 (60.35) and T_7 (59.92)

The earlier flowering may be due to less availability of nitrogen which caused stunted growth of plant resulting into earlier flower initiation.

The late flowering in the treatment with higher levels of nitrogen may be due to continuos vegetative growth of plant for a longer period utilizing the carbohydrates stored in plant organ (Ingle *et al.* 1993). Application of Azotobacter cause, fixation of atmospheric nitrogen which is supplied to plant to promote the excess vegetative growth. Ingle *et al.* (1993) reported that minimum days were required for flower bud initiation under the lowest level of nitrogen and flowering was delayed with increasing doses of nitrogen in chryanthemum.

5.2.2 Days required for 50% flowering :

The data in respect of days required for 50% flowering was recorded and presented in Table 9.

The minimum days required for 50% flowering were recorded in treatment T_7 (70.50 days) (Vermicompost + Azotobacter + PSB + 100% N) followed by T_3 (70.85 days). The maximum days required for 50% flowering was noticed in control treatment (84.12 days).

Regarding the days required for 50% flowering increase in the level of nitrogen along with Azotobacter and PSB and well balanced nutrients content of vermicompost helped to induce maximum flowering within a certain period after its initiation. And this effect may be due to beneficial action of Azotobacter and PSB, which helped to increase the availability of nitrogen and phosphorus to the plants for inducing flowering. Bose *et al.* (1965) stated that, deficiencies of N and P caused delay in formation of flower bud from 121 to 146 days after transplanting in aster.

Gupta (1997) reported the results in close conformity with the results of present study. He stated, flowering was induced due to application of 100% N with bioinoculants in African marigold. Kaloti (1998) reported similar results in aster and he stated that, the minimum days required for 50% flowering in the treatment of inoculation of Azotobacter + PSB + 100% N application.

Dutta (2000) observed that chysanthemum plants grown in compost media required less number of days for 50% flowering.

5.3 Effect of organic manures, biofertilizers and inorganic fertilizers on flower quality :

5.3.1 Diameter of flowers :

From the data, maximum flower diameter (7.45 cm) was recorded in T_7 (Vermicompost + Azotobacter + PSB + 100% N) treatment which was closely followed by treatment T_3 (7.27 cm). The minimum diameter (3.47 cm) of flower was measured in T_{10} (control).

The maximum diameter may be due to the proper nutrient proportion. Vermicompost is rich in available nutrient like P_2O_5, Ca, Mg, Fe, B, Zn and Mo which promote production of quality flowers. Azotobacter and PSB mobilize P and make it available to plants, phosphorus has an important role in respiration, cell

division, photosynthesis and sugar : starch transformation in plants which produced quality flowers.

These findings lead support to the findings of Mostafa (2002) in *D. ecklinis*, Barreto *et al.* (2002) in gerbera, Prabhat (2003) in china aster and Shitare (1999) reported maximum floret size with Azotobacter application in tuberose.

The flower diameter increased significantly due to increased levels of nutrients as reported by Ingle *et al.* (1993) by chrysanthemum.

5.3.2 Vase life of flowers :

From the data it is observed that the vase life of cut flowers was significantly more in the flowers harvested from the treatment T_7 (11.95 days) which was closely followed by T_3 (11.85 days). The lowest vase life of cut flowers was recorded in the flowers harvested from the control (6.45 days).

The longetivity of vase life mostly depends upon the carbohydrates reserves in stem, the accumulation of dry matter and respirable substrate, which promotes respiration and extend longevity.

The results obtained in present investigation and discussed above are in confirmation with findings of Bose and Das (1966) reported that deficiency of nitrogen reduces vase life of aster cv. Heart of France. Nethra *et al.* (1999) reported that vase life of china aster was best in the treatment receiving vermicompost. Barreto *et al.* (2002) observed that the flower quality with respect to head and disc diameter, number of ray florets, stalk length, stalk diameter, vase life and flower yield were superior from the plant in pot receiving vermicompost in gerbera cv. Sangria.

5.4 Effect of organic manures, bioferilizers and inorganic fertilizers on yield of flowers :

In the present study, he flower yield regarding number of flowers per plant, per plot, per hectare, weight of flowers per plant, weight of ten flowers, weight of flower per hectare were significantly affected by different treatments.

5.4.1 Number of flowers per plant, per plot and per hectare :

It was investigated from the data that the plants treated with vermicompost + Azotobacter + PSB + 100% N (T_7) produced the highest number of flowers per plant (39.80) per plot (995.0) and per hectare (41.98 lakh) and it was found significantly superior over rest of the treatments. The lowest number of flowers were obtained from the control (19.20 per plant, 480.0 per plot and 20.25 lakh per hectare).

5.4.2 Weight of flowers per plant (g) :

It was observed from the data that, the highest weight of flowers per plant was obtained in T_7 treatment (105.10 g). However, the lowest weight of flowers were obtained from the control (36.55 g).

5.4.3 Weight of ten flowers (g) :

The maximum weight of ten flowers was observed in T_7 (18.40 g) and the minimum was recorded in T_{10} (6.23 g).

5.4.4 Weight of flowers per plot (g) and per hectare (tonnes) :

Significantly maximum weight of flowers per plot and per hectare were recorded in treatment T_7 (2.62 kg per plot and 11.08 tonnes per hectare) and the lowest weight of flowers were recorded in treatment T_{10} (0.91 kg per plot and 3.85 tonnes per hectare).

The increase in flower yield may be due to application of vermicompost along with bioinoculants like Azotobacter and PSB and also due to the increased availability of essential elements at critical growth stages.

Vermicompost which is as such rich in available nutrients, further improving the status of the soil by providing the medium for the soil and for the activation and establishment of beneficial microbes, which in turn provide growth substances and other essential nutrients, Kale *et al.* (1987). As reported by Kulkarni *et al.* (1996) due to the activities of earthworms there would be mixing of top soil, formation of soil aggregates, improvement of drainage, porosity and

aeration. The establishment of plants was found to be good in vermiculture plots which ultimately resulted in increased flower yield. These findings were supported by Nethra *et al.* (1999) who recorded the increase in flower yield in china aster with vermicompost application.

Similar results were obtained by Wange and Patil (1994) in tuberose, Parthiban *et al.* (2001) in globe amaranth, Chandrikapure (1999) in marigold and Prabhat *et al.* (2003) in aster.

5.5 Influence of organic manures and biofertilizers with reduced doses of nitrogen on net return and benefit : cost ratio :

The data presented in Appendix – B. T_7 (Vermicompost + Azotobacter + PSB + 100% nitrogen of the recommended dose) found more economically feasible to the farmers over other treatments, closely followed by treatment T_8 (Vermicompost + Azotobacter + PSB + 75% nitrogen of the recommended dose). Aster plot applied with vermicompost, Azotobacter, PSB and 100% nitrogen had obtained maximum net return Rs. 1,70,801 per hectare and benefit cost ratio 3.36 followed by the plot applied with vermicompost, Azotobacter, PSB and 75% nitrogen (Rs. 1,50,864 net return with 3.02 B : C ratio).

The main reason behind the increase in net return and benefit cost ratio in T_7 and T_8 treatment is higher yield obtained by the optimum and 75% reduction of recommended dose of nitrogen along with vermicompost, Azotobacter and PSB.

CHAPTER – VI

SUMMARY

An experiment entitled "Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of china aster" was conducted during rabi season of 2004-2005 at College Garden, College of Agriculture, Nagpur. The experiment was laid out in Randomized Block Design replicated three times with ten treatments. The objectives were 1) To find out the effect of organic manures and biofertilizers on growth, yield and quality of china aster and 2) To compare the efficiency of reduced doses of nitrogen, manures and biofertilizers on growth, yield and quality of china aster.

The analysis of variance revealed highly significant differences among the different treatment in almost major characters. The result obtained in the present investigation in respect of growth, quality and yield contributing character and yield of flowers of china aster as influenced by different treatment summarised below.

1. As regard the height of plants, the treatment effect were found statistically significant throughout the growth period. At final observation (90 DAP), the maximum plant height (58.72 cm) was recorded in plants which received FYM 20 t + Azt + PSB + 100% N (T_3) and it was followed by vermicompost + 5 t + Azt + PSB + 100% N T_7 where as the minimum plant height (27.55 cm) was recorded in treatment T_{10} (control).

2. Regarding the girth of stem, number of branches, number of leaves, spread of plant and fresh and dry weight of shoots and roots of plant, treatment effect were found statistically significant. Plant receiving FYM 20 t + Azt + PSB + 100% N (T_3) (1.74 cm, 28.45, 92.15, 38.47 cm, 294.67 g and 87.45 g respectively) had promoted higher vegetative growth while the minimum values was noted in treatment T_{10} (control) (0.89 cm, 13.25, 81.93, 28.76 cm, 133.51 g and 43.15 g respectively).

3. An early flower bud emergence (47.70 day) was observed in control (T_{10}) while maximum 50% flowering was obtained in treatment T_7 (Vermicompost + 5 t + Azt + PSB + 100% N) followed by T_3 (FYM + 20 t + Azt + PSB + 100% N).

4. Diameter of fully opened flowers was increased with an application of vermicompost 5 t + Azt + PSB + 100% N (T_7) and minimum diameter was recorded in control (T_{10}).

5. The yield of flowers was maximum in treatment receiving vermicompost 5 t + Azt + PSB + 100% N (T_7). The number of flowers per plant, per plot, per hectare, weight of flowers per plant, weight of ten flowers, weight of flowers per plot and per hectare were maximum in treatment (T_7) (39.80, 995.00, 41.98, 105.10 g, 18.40 g, 2.62 kg and 11.08 t respectively). The minimum yield was obtained from control (T_{10}) treatment.

6. The maximum vase life (11.95 days) was observed in the plants supplied with vermicompost 5 t + Azt + PSB + 100% N (T_7), where as minimum (6.45 days) in control (T_{10}).

7. In respect of benefit cost ratio the treatment vermicompost 5 t + Azt + PSB + 100% N (T_7) acquired higher B : C ratio (3.36) followed by (T_8) (3.02) vermicompost 5 t + Azt + PSB + 75% N.

CONCLUSION :

From the present investigation, it can be concluded that the application of Azotobacter (3 kg ha^{-1}) phosphate solubilizing bacteria (3 kg ha^{-1}) vermicompost (5 t ha^{-1}) with 100% nitrogenous fertilizer, full dose of phosphorus and potassium (150 : 50 : 50 kg NPK ha^{-1}) in combination are advantageous rather than their use alone or without inorganic fertilizer or only inorganic fertilizer.

The treatment received vermicompost 5 t + Azotobacter + PSB + 100% N was favourable for producing higher yield and quality of flowers of china aster var. local, with higher benefit : cost ratio (3.36).

The observations are based on the results of experiment conducted for only one season and therefore these results are suggestive and not conclusive. The findings obtained in present investigation need confirmation.

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THESIS ABSTRACT

Title of the thesis	:	**"EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS WITH REDUCED DOSES OF NITROGEN ON GROWTH, YIELD AND QUALITY OF CHINA ASTER "**
Full name of student	:	**Miss. Mogal Smita Ashok**
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Degree to be awarded	:	M. Sc. (Agri.)
Year of award of degree	:	2005
Major subject	:	Horticulture
Total No. of pages in thesis	:	59
Number of words in thesis abstract	:	420
Signature of student	:	Mogal
Signature, Name and Address of forwarding authority	:	**(Dr. M. M. Damke)** Professor of Horticulture, College of Agriculture, Nagpur

ABSTRACT

Investigation entitled "Effect of organic manures and biofertilizers with reduced doses of nitrogen and growth, yield and quality of china aster" was undertaken at College Garden, College of Agriculture, Nagpur during rabi, 2004-2005.

The experiment was laid out in Randomized Block Design with ten treatments and three replications.

The ten treatments included under studies were

T_1 FYM + RDF 100%
T_2 FYM + Azotobacter + PSB
T_3 FYM + Azotobacter + PSB + 100% N
T_4 FYM + Azotobacter + PSB + 75% N
T_5 FYM + Azotobacter + PSB + 50% N
T_6 Vermicompost + Azotobacter + PSB
T_7 Vermicompost + Azotobacter + PSB + 100% N
T_8 Vermicompost + Azotobacter + PSB + 75% N
T_9 Vermicompost + Azotobacter + PSB + 50% N
T_{10} Control

The experimental findings revealed that the growth in respect of height of plant, stem girth, number of branches, number of leaves, spread of plant, fresh weight and dry weight of plant were found maximum in plants received 20 t FYM + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1} followed by 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1} treatment.

The treatment receiving 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1} showed satisfactory best results regarding days required for 50% flowering and the control treatment where organic manures, biofertilizers and nitrogen was not applied showed earliest flowering.

The yield contributing characters like number of flowers plant^{-1}, number of flowers plot^{-1}, number of flowers ha^{-1}, weight of flowers plant^{-1}, weight of ten flowers, yield of flowers plot^{-1}, yield of flowers ha^{-1} were found maximum in treatment applied with 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1} closely followed by 20 t FYM + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1}.

The quality flowers with big sized and longer vase life of cut flowers was obtained in treatment receiving 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1}.

Thus the treatment 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 100% N ha^{-1} was found beneficial for china aster to obtain maximum yield and quality flowers. However the same treatment was found economically beneficial being higher in B : C ratio (3.36) acquired as compared to other treatment followed by treatment receiving 5 t vermicompost + 3 kg Azotobacter + 3 kg PSB + 75% N (3.02).

APPENDIX - A

Weekly Meteorological Data from Sept. 2004 to March 2005 recorded at observatory of College of Agriculture, Nagpur.

Date / month / Year	Met. week	Temp. °C		Relative Humidity (%)		Total rainfall (mm)	No. of rainy days	Evaporation
		Max.	Min.	Mor.	Noon.			
27 to 2 Sept. 04	35	31.7	22.6	78	57	-	-	03.8
3 to 9	36	34.0	23.7	81	60	03.5	-	03.1
10 to 16	37	33.5	23.8	75	57	-	-	04.2
17 to 23	38	32.7	23.2	83	66	35.2	3	04.1
24 to 30	39	32.2	23.3	79	66	09.0	1	03.4
01 to 07 Oct. 04	40	34.0	23.0	76	53	08.0	2	04.5
08 to 14 Oct.	41	34.2	20.1	71	46	-	-	04.1
15 to 21 Oct.	42	31.2	15.8	66	41	-	-	04.5
22 to 28 Oct.	43	32.4	14.8	64	40	-	-	04.0
29 to 04 Nov. 04	44	31.5	14.7	62	40	-	-	03.8
05 to 11 Nov.	45	30.6	15.3	67	52	-	-	02.0
12 to 18 Nov.	46	31.0	17.9	70	50	02.4	-	02.1
19 to 25 Nov.	47	32.0	12.4	58	36	-	-	03.3
26 to 02 Dec. 04	48	30.6	11.7	64	38	-	-	03.1
03 to 09 Dec.	49	29.2	10.7	57	27	-	-	03.1
10 to 16 Dec.	50	29.2	09.9	59	28	-	-	02.5
17 to 23 Dec.	51	30.3	10.2	63	28	-	-	02.8
24 to 31 Dec.	52	27.0	12.2	56	33	-	-	02.7
01 to 07 Jan. 05	1	30.0	15.0	74	39	-	-	02.5
08 to 14	2	29.5	10.5	58	25	-	-	03.3
15 to 21	3	28.2	10.5	52	28	-	-	03.7
22 to 28	4	28.8	13.6	63	60	07.6	1	03.5
29 to 04 Feb. 05	5	26.1	11.8	80	55	101.0	4	02.7
05 to 11	6	31.7	15.0	68	34	-	-	04.1
12 to 18	7	36.8	15.5	53	21	-	-	05.5
19 to 25	8	31.8	15.8	44	30	-	-	05.4
26 to 04 March 05	9	34.6	17.4	55	24	-	-	05.1
05 to 11	10	33.8	17.9	61	33	12.6	2	5.4
12 to 18	11	36.7	17.1	62	21	-	-	6.3
19 to 25	12	38.2	0.5	36	15	-	-	7.1
26 to 01 April 05	13	38.2	19.8	22	13	-	-	8.1

APPENDIX - B

Marginal analysis of various treatments and their effect on cost and return of china aster per hectare

Treatments	Common expenditure (Rs.)	Treatment expenditure (Rs.)	Total expenditure (Rs.)	Yield per ha (t)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit : Cost ratio
T_1	30,003	20,526	50,529	9.67	1,93,400	1,42,871	2.82
T_2	30,003	15,720	45,723	4.70	94,000	48,277	1.05
T_3	30,003	20,996	50,999	10.23	2,04,600	1,53,601	3.01
T_4	30,003	20,133	50,136	9.55	1,91,000	1,40,864	2.80
T_5	30,003	19,271	49,274	8.99	1,79,800	1,30,526	2.64
T_6	30,003	15,520	45,523	6.39	1,27,800	82,277	1.80
T_7	30,003	20,796	50,799	11.08	2,21,600	1,70,801	3.36
T_8	30,003	19,933	49,936	10.04	2,00,800	1,50,864	3.02
T_9	30,003	19,071	49,074	9.23	1,84,600	1,35,526	2.76
T_{10}	30,003	—	30,003	3.85	38,5000	8,497	0.28

Azotobacter	- Rs. 50/kg	Urea	- Rs. 500/q	Sale rate			
PSB	- Rs. 60/kg	SSP	- Rs. 170/q	Quality Flowers	-	Rs. 20/kg	
FYM	- Rs. 750/t	MOP	- Rs. 460/q	General Flowers	-	Rs. 10/kg	
Vermicompost	- Rs. 3/kg						

VITA

Miss Smita Ashok Mogal was born on 14th July 1982 at Shrirampur, Dist. Ahmednagar (M.S.). She passed her S.S.C. Examination with distinction from Gautam Public School, Gautam Nagar, Kopargaon in the year 1997 and H.S.S.C. Examination with first division from Gautam Public School, Gautam Nagar, Kopargaon in the year 1999. She passed S.S.C. and H.S.S.C. Examination from Maharashtra State Board of Secondary and Higher Secondary Education, Divisional Board, Pune. She completed her B.Sc. (Agri.) degree with first division from College of Agriculture, Dhule, in the year 2003, affiliated to Mahatma Phule Krishi Vidyapeeth, Rahuri.

Thereafter, she secured admission for Master Degree Course in the Discipline of Horticulture in College of Agriculture, Nagpur under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2003.