II. REVIEW OF LITERATURE

The indiscriminate and continuous use of heavy doses of chemical fertilizers has led to an imbalance of nutrients in soil which has adverse effect on the soil health, affecting the yield and quality of the produce. Therefore, there is a need for the modification / manipulation of the traditional types / methods of nutrient management, to reduce environmental pollution. The use of biofertilizers like *Azospirillum* and Phosphate solubilizing bacteria (PSB) along with chemical fertilizers reduce the cost of production and supplement the secondary nutrients and micronutrients to the crops (Barker, 1975). The use these biofertilizers alone or in combination with NPK in china aster are limited. Hence, the research findings pertaining to these aspects on available literatures in china aster chrysanthemum, marigold, zinnia, gaillardia, calendula and other related flower crops have been reviewed and presented here under, in the following headings.

2.1 Effect of NPK on growth and yield

Among NPK required for the normal plant growth and development, nitrogen has greater influence right from cell division to development of vegetative and reproductive organs. It is a constituent of nucleic acid, protein, protoplasm and chlorophyll. It is one of the most mobile of all the mineral nutrients observed by the plant. Studies indicate the greater influence of nitrogen on growth, flower production and quality blooms in many ornamental flowering plants. Favourable effects of nitrogen on growth and flower production were emphasized by (Arora and Saini, 1976).

In determining the yields of flower crops, phosphorous is one of the major and crucial limiting factors. Deficiency of phosphorous may adversely affect the plant in maintaining the full supply of N and K and excess application of P may result in various nutritional problems including calcium and zinc deficiency.

2.1.1 China aster

The application of N at 180 kg and P at 120 kg/ha resulted in more plant height, leaf area and dry matter production (Maheshwar, 1977). Increased plant height, leaf area index and total dry matter production with the application of 120 kg N and 60 kg P$_2$O$_5$ per hectare was also recorded by Ramachandra (1982). Narayana Gowda (1985) noticed increase in plant height, plant spread, number of branches number of leaves, leaf area and dry weight at 180 kg nitrogen and 100 kg phosphorous application per hectare.

Mantur (1988) observed increased plant height, number of branches, leaf area and total dry matter production with increasing levels of N and P but effect of K showed reverse result in china aster. Sonawane *et al.* (2009) revealed that, application of N at 200 kg per hectare through urea, P at 75 kg per hectare through single super phosphate and FYM at 10 tonnes per hectare with basal 50 kg K$_2$O per hectare through muriate of potash was found beneficial to increase the growth parameters, flower yield and N, P and K uptake by china aster.

2.1.2 Other crops

A significant increase in plant height, number of branches and plant spread was noticed with higher doses of nitrogen, phosphorous and potassium (Sigedar *et al.*, 1991) in calendula.

Jayanthi and Gowda (1988) recorded the higher plant height with fertilizer dose of 40 g N + 40 g P$_2$O$_5$ per m$^2$ and more plant spread, number of branches per plant total dry matter production and flower yield with fertilizer dose of 30 g N and 40 g P$_2$O$_5$ per m$^2$ in chrysanthemum.
Singh and Tiwari (1993) observed significantly increase of plant height and spread in chrysanthemum with the application of 45 g nitrogen along with 45 g phosphorous per m². John and Paul (1999) recorded improvement in the number of flowers per plant, flower size and flower weight significantly with the application of nitrogen and phosphorus chrysanthemum.

Sayedkhallil (1982) observed that application of 100 kg N per hectare had significantly increased the number of flowers per plant, weight of flowers per plant, yield per plant and yield per hectare in gailardia. Mokashi (1988) reported the increase in the plant height, number of branches and number of leaves with increased levels of N and P in gailardia. An increase in flowering period and total flower yield per plant due to increased dose of NPK was reported by Singatakar et al. (1995) in gailardia.

Saranabasappa (1990) observed maximum flower yield in helichrysum with the application of N and P₂O₅ at 150 kg and 100 kg/ha, respectively. Venugopal (1991) noticed the increased plant height, number of branches, leaf area and dry matter production with increase in the nitrogen levels up to 200 kg per hectare in helichrysum. Significant increase in flower yield (7.35 tonnes per ha) with increased nitrogen level (200 kg/ha) was reported by Venugopal and Patil (2000) in helichrysum.

Application of 225 kg N + 120 kg P₂O₅ per hectare increased the plant height and number of leaves per plant in marigold (Nalawadi, 1982). Ravindran and Reddy (1986) observed higher flower yield with higher N rates of 90 kg per hectare in marigold. Anuradha et al. (1988) noticed that number of flowers per plant, flower size and weight of flowers per plant increased with increasing levels of nitrogen and phosphorous in marigold. Arulmozhiyan and Pappaiah (1989) obtained higher flower yield with the application of nitrogen at 120 kg and phosphorous at 90 kg/ha in marigold.

Agarwal et al. (2002) reported that, application of nitrogen at 200 kg per hectare and potassium 200 kg per hectare was significantly increased the plant height, number of branches per plant, number of flowers per plant, diameter of the flowers, flower yield and seed yield in marigold.

Mohanty et al. (2002) reported that application of nitrogen at 10 g/m² and phosphorous at 20 g/m² in marigold resulted increase growth, number of flower per plant and flower yield per plant. Kumar and Natarajan (2006) studied the seed quality of marigold cv. African giant seeds where collected from different positions on the mother plant, and under different nutrient management conditions (control and N:P:K at 75:75:0, 100:100:25 and 125:125:50 kg/ha). 100-seed weight, seed germination, seedling length, dry matter production and vigour was high when seeds collected from the middle position of the mother plant and N: P: K at 125:125:50 kg per hectare.

According to Elengovan (1975) judicious and balanced fertilizers are known to result in overall improvement in flower quality and total yields in petunia.

Yadav et al. (1985) showed that application of 200 kg P₂O₅ per hectare gave maximum vegetative growth in tuberose. The plants supplied with high phosphorous produced significantly greater number of flowers and weight of flowers than control. Amarjeet et al. (1996) observed increased spike and rachis length was observed with increased dose of nitrogen and phosphorous in tuberose.

2.2 Effect of NPK and biofertilizers on growth and yield

2.2.1 China aster
Prabhatkumar et al. (2003) reported that the increase in vegetative growth by biofertilizers was because of stimulation in nutrient uptake and biosynthesis of plant growth regulators, thereby stimulating the growth and development process of the plant.

Nandre et al. (2005) studied soil and seedling application of *Azotobacter* alone and in combination with 100, 75, and 50 per cent of the recommended nitrogen rate. Maximum values for the plant growth parameters (plant height, stem girth, branch number per plant, leaf number per plant, leaf area per plant and flower yield) was obtained under soil application of *Azotobacter* + 75 per cent of the recommended nitrogen rate.

Mogal et al. (2006) revealed that growth was best in plants receiving FYM at 20 t per ha, *Azotobacter* and phosphate solubilizing bacteria (PSB) at 3 kg per ha each and 100% N through urea followed by the plant receiving vermicompost 5 t per ha, *Azotobacter*, PSB and 100% N through urea and FYM 20 t per ha along with recommended doses of fertilizer (150:50:50 kg NPK per ha).

Chaitra and Patil (2007) observed significant increase in plant height, number of leaves, number of branches, total dry matter production and also flower yield in *China aster cv. Kamini* with the application of PSB with 50 per cent RDF. *China aster* treated with three levels of vermicompost (5, 7.5 and 10 tonnes per ha) and VAM (3, 4 and 5 g/plant) along with control to know the effect of vermicompost and VAM inoculation on vegetative growth and flower characteristics shown that the application of vermicompost at 10 tonnes per ha resulted in significantly tallest plants (43.70 cm) and maximum number of leaves (165.47) and branches (8.43) per plant (Vijay and Abnit, 2007).

Nowak (2009) observed slightly increased phosphorus content in leaves of mycorrhiza treated *China aster* plants and also significantly increased shoot biomass, plant height and shoot number. Whereas, lower Phosphorus content was detected in untreated plants with less shoot biomass, plant height, shoot number and delayed flowering.

### 2.2.2 Other crops

Jawaharlal and Padmadevi (2003) reported that the application of *Azospirillum* along with inorganic nutrients and growth regulators had significant effect on growth and flowering of *Anthurium*. Padmadevi et al. (2004) reported that the application of *Azospirillum*, phosphate solubilizing bacteria and VAM along with inorganic nutrients and growth regulators brought about significantly higher effects on growth and flowering in *Anthurium*.

Hosseinzadah et al. (2011) revealed the effect of biofertilizers on growth, nutrients uptake and physiological characteristics in calendula. Inoculation with strains of *Azotobacter, Pseudomonas, Azospirillum*, Vesicular Arbuscular Mycorhizae (VAM) and the combined composition of them showed extremely increased growth parameters such as the growth, dry weights of shoot and root, photosynthetic pigments, the concentration of nitrogen, phosphorus and potassium in leaves and roots.

Gupta et al. (2004) reported that the application of biofertilizers like VAM, *Azospirillum*, PSB have registered maximum plant height, minimum number of days to first flowering, maximum bud and flower size, maximum vase life and maximum cost benefit ratio in *Carnation*.

Hemavathi (1997) recorded higher number of flowers and flower yield per plant by applying PSB + 75 per cent recommended NPK in chrysanthemum. Application of 75 per cent recommended dose of fertilizer and vermicompost coupled with dual inoculation of *Azotobacter* and VAM produced significantly highest growth, flower and yield parameter over 100 per cent recommended dose of fertilizer in chrysanthemum. (Geeta et al., 2010). Panchal et al. (2010)
revealed that application of 175 Kg N / ha + *Azospirillum* + *Azotobacter* produced significantly maximum plant height (96.23 cm), number of branches per plant (50.59), plant spread (79.08 cm in North-South direction and 78.79 cm in East-West direction) in annual white chrysanthemum.

Verma *et al.* (2011) studied the growth, yield and quality of chrysanthemum cv. Raja. The treatment receiving *Azospirillum*, Phosphate solubilizing bacteria (PSB), vermicompost and 50 per cent recommended NPK recorded the highest plant height, number of branches, plant spread, dry matter accumulation and yield attributes such as number of flowers per plant and flower yield. A pot experiment was conducted to investigate the potential effect of arbuscular mycorrhizal fungi (*Glomus mosseae* and *Acaulospora laevis*) and phosphate solubilizing bacteria (*Pseudomonas fluorescens*) with different levels of super phosphate on *Chrysanthemum indicum* L (Prasad *et al.*, 2012). Results revealed that the inoculation of plants with biofertilizers and recommended dose of super phosphate significantly improved the growth parameters.

Application of *Azospirillum* improved flower yield, flower diameter and weight of flower in crossandra (Ravichandran, 1991). Application of phosphobacteria along with inorganic fertilizers resulted in increase in flowers per spike and yield in crossandra (Ravichandran and Pappiah, 1995). Narasimha and Haripriya (2001) in crossandra cv. Dindigul Local revealed that application of 100 per cent *Azospirillum* + Phosphobacteria each at 2 kg ha per hactare gave higher flower yield of 41.72 g per plant with maximum returns per rupee invested (1:3.50).

Binisha *et al.* (2002) revealed that, the treatment combination of NPK along with *Azospirillum* was more effective in improving vegetative and floral characters in dendrobium.

The yield parameters viz., number of flowers per plant, diameter of flower, ten flower weight, stalk length and flower yield per plant were increased by inoculation with *Azospirillum* strains DAD-2 and DAD-11 (Gadagi, 1999) in gaillardia. The performance of *Azospirillum* isolates on growth and nitrogen uptake in *Gaillardia pulchella* with two N levels (Gadagi *et al.*, 2004) revealed that the application of 150 kg N/ha had enhanced the plant growth significantly over 112 kg N/ha. *Azospirillum* strain OAD-2 inoculation significantly increased plant height, number of leaves per plant and total dry mass accumulation than other treatments in gaillardia. Deshmukh *et al.* (2008) revealed that, significantly maximum vegetative growth viz., plant height, plant spread, diameter of main stem, 50 per cent flowering, diameter of flower, length of flower stalks, number of flowers and yield of flowers per plant and per ha was increased in treatment 75% NPK + seedling inoculation with *Azotobacter* (500 g)+ PSB (500 g) per liter of water in gaillardia.

Muzain *et al.* (2004) in gladiolus cv. Snow Princes revealed that the treatment having the application of VAM + *Azospirillum* + PSB + *Azotobacter* was found better for the traits like early spike initiation, number of florets per spike, length and longevity of the spikes. Similar results were found with cv. American Beauty in the same crop (Mansee and Ranjan, 2004). The report by Srivastava and Govil (2005) revealed that the biofertilizers *Azotobacter*, phosphate solubilizing bacteria (PSB), VA-mycorrhiza (VAM) and farmyard manure application improved different vegetative and floral characters of gladiolus as compared to control. It was found that the treatment of corms with the biofertilizers increased the total rhizospheric bacteria population.

Dubey and Misra (2006) reported that the dual inoculation of gladiolus corm with *Azotobacter* + PSB was found best among all the biofertilizer treatment for early corm sprouting (15.75 days), increased number of leaves per plant (8.39), leaf area (316.13 cm2), plant height (21.99 cm), induced heading (91.90 days) and dry weight (24.13 g) over control.

In another study on Jathimalli cv. CO-2, Vasanthi (1994) observed the increase in corolla length, tube length, bud width, petal breadth and flower diameter with advanced flowering in plant inoculated with *Azospirillum*. Combined application of 75 per cent recommended nitrogen +
Azospirillum and 75 per cent recommended phosphorus + phosphobacteria gave highest flower yield (Bhavanisanker and Vanagamudi, 1999).

Balasubramanian (1989) reported increased growth in marigold inoculated with Azospirillum, this might be due to added nitrogen to crop through associative symbiosis and increased production of growth hormones like IAA, GA and cytokinins. Velmurgan (1998) reported that increased doses of N and P with combined application of Azospirillum and GA$_3$ at 200 ppm recorded higher flower yield in African marigold.

Chandrikapure et al. (1999) found that local variety of African marigold had produced significantly greater height in treatment with 100 per cent N + Azotobacter + phosphate solubilizing bacteria and higher flower yield per ha in treatment with Azotobacter + PSB + 75 per cent N. Rajdurai et al. (2000) indicated that application of NPK at 45:45:37.5 kg along with combined inoculation of Azospirillum and VAM exhibited increased growth in respect of plant height (144.50 cm), number of leaves (156.20) and laterals per plant (28.30) in marigold.

Benjamin and Singh (2003) opined that application of biofertilizers in different combinations was found better than single application in marigold. Shubha (2006) reported that the highest plant height, number of leaves, number of branches, flower bud initiation, flowering duration, flower yield per plant and xanthophyll yield were obtained with the application of Azospirillum + vermicompost + 75 per cent recommended dose of nitrogen and phosphorus in African marigold.

Experiment conducted to know the effect of biofertilizers on growth and yield in marigold with the doses of biofertilizers at 1.00 kg per ha and 1.50 kg per ha, Phosphobacteria at 1.00 kg per ha and 1.50 kg per ha and control revealed that the maximum plant height (6.77 cm) was recorded with Azotobacter applied at 1.50 kg/ha in marigold (Syamal et al., 2006).

Pushkar et al. (2008) studied the effect of chemical and biofertilizers on growth and yield in African marigold cv. Pusa Narangi Gainda. Application of chemical fertilizer (200 kg N, 80 kg P, 80 kg K and bio-fertilizer (VAM 10kg/ha) recorded the maximum value of growth characters.

The effect of biofertilizer (Barvar-2) and phosphorus on quantity and quality characteristics of marigold (Tagetes erecta L.), methods of biofertilizer (Barvar-2) application and different levels of chemical phosphorus (100, 200,300 and 400 mg / lit) studied showed non-significant result for interaction effect of biofertilizer and phosphorus for characters studied except for total shoot phosphorus and the number of leaf per plant. The best treatments, 200 mg per liter phosphorus without bio-fertilizer inoculation and 200 mg per liter phosphorus with seed inoculation, respectively in marigold (Davood et al., 2012).

Preethi (1990) opined that the early flowering by the inoculation of Azospirillum might be due to induced cytokinin synthesis and rapid assimilation of photosynthates resulting in early transformation of the axillary bud from vegetative to reproductive phase in rose.

Singh et al. (2003) reported that application of PSB along with the chemical fertilizer increased significantly the flower yield in rose. Chaudhari et al. (2009) that the application of 50 g N per plant + Azotobacter and Azospirillum each at 1 ml per plant in rose produced significantly maximum yield of flowers as compared to control and the application of 25 g N per plant + Azotobacter and Azospirillum each at 1 ml per plant produced maximum leaf area and initiation of first flower than control and remained at par with treatment 50 g N per plant + Azotobacter and Azospirillum each at 1 ml per plant. While, 0 g N per plant + Azospirillum 1 ml per plant produced maximum shelf life of flower.
Gayathri et al. (2004) reported that increased plant height, number of leaves, higher number of branches and higher flower yield per plant were obtained with the application of 75 per cent NP + 100 per cent K + vermicompost + Azotobacter + PSB in (Limonum caspia).

Seydeh et al. (2012) conducted to investigate the effects of biofertilizers and chemical fertilizers on growth indices of Spathiphyllum illusion. The results showed that "triple super phosphate + Barvar 2" treatment resulted in increasing leaves number, dry and fresh weight of leaves and the size of spadix. "Barvar-2 + Nitrokara" has the best effect on leaf size, height of flower stalk and chlorophyll content. The maximum amount of absorbing nitrogen was obtained under urea application.

Wange et al. (1995) revealed the increase in number of bulblets (14.3 per plant), flower stalks (23348 dozen per ha) with higher monetary returns (1.00:3.73) in tuberose cv. Single with Azospirillum inoculation. In tuberose cv. Mexican Single, combined application of NPK with Azospirillum and phosphobacteria resulted in higher spike length number of flowers per spike and flower yield compared to control (Swaminathan et al., 1999).

2.3 Effect of NPK and biofertilizers on flower quality

2.3.1 China aster

Mogal et al. (2006) reported the best growth in china aster plants received with FYM at 20 tonnes per hectare, Azotobacter and phosphate solubilizing bacteria (PSB) at 3 kg per hectare with 100 per cent nitrogen through urea. The flower quality and vase life were most superior in the plants received with vermicompost, Azotobacter, PSB and 100 per cent nitrogen.

Chaitra and Patil (2007) observed significant increase of Stalk length and flower diameter in china aster cv. Kamini with the application of PSB with 50 per cent RDF.

2.3.2 Other crops

In chrysanthemum, Jayanthi and Gowda (1988) observed the maximum flower diameter with fertilizer dose of 40 g N + 40 g P₂O₅ per m² and stalk length and number of petals with fertilizer dose of 30 g N and 40 g P₂O₅ per m². Hemavathi (1997) observed that chrysanthemum plants inoculated with VAM + 50 per cent recommended NPK increased the vase life of flowers compared to plants receiving recommended NPK.

Verma et al. (2011) revealed that the treatment receiving Azospirillum, phosphate solubilizing bacteria (PSB), vermicompost and 50 per cent recommended NPK recorded the maximum flower diameter, stalk length and flower size in chrysanthemum cv. Raja.

Gerbera plants colonized by Glomus mossae produced flowers, which lasted three days longer than flowers of non-mycorrhizal plants in the vase (Wen, 1991).

Anuradha et al. (1990) found significant increase in the flower size and stalk length by increasing the dose of N and P in marigold.

Swaminathan et al. (1999) noticed in higher spike length compared to control in the combined application of NPK with Azospirillum and Phosphobacteria in tuberose cv. Mexican Single.

2.4 Effect of NPK on post harvest life
The termination of post harvest life of cut flowers was characterized by wilting even when the flowers were constantly held in water. The flowers, which were kept in water gained weight initially but subsequently reduced weight at the end (Rogers, 1973).

Biofertilizers can influence the longevity of flowers. This may be due to the increased phosphorous uptake by the plants and better development of water conducting tissues especially in Mycorrhizal plants than with nonmycorrhizal plants (Chang, 1990).

2.4.1 China aster

China aster plants supplied with vermicompost (10 tonnes per hectare) produced flowers with the longest vase life (11.6 days) as noticed by Nethra (1996).

2.4.2 Other crops

Gupta et al. (2004) reported that the application of biofertilizers like VAM, *Azospirillum*, PSB have registered maximum vase life and maximum cost benefit ratio in carnation.

Hemavathi (1997) observed that chrysanthemum plants inoculated with VAM + 50 per cent recommended NPK reduced flowers with longest vase life compared to plants receiving recommended NPK in chrysanthemum.

Deshmukh et al. (2008) revealed that, significantly maximum yield of flowers per plant per hectare and was increased vase life in treatment 75% NPK + seedling inoculation with *Azotobacter* + PSB (500 g each 5 liter-1 of water) in gaillardia.

Gerbera plants colonized by *Glomus mossae* produced flowers, which lasted three day longer than flowers of non-mycorrhizal plants in the vase (Wen, 1991). In gerbera, maximum vase life (12 days) was observed in flowers harvested from plants treated with *Azospirillum*, VAM and 50 per cent recommended nitrogen, phosphorous and recommended potassium (Seetha, 1999).

Tiwari et al. (2010) revealed that, application of vase solutions viz., 200 ppm citric acid, 200 ppm AgNO₃, 5 per cent sucrose and 0.02 per cent Tween-20 was observed to be the best followed by 200 ppm citric acid, 200 ppm CoNO₃, 5 per cent sucrose and 0.02 per cent Tween-20, for the longest vase-life and maximum weight gain at third day and total solution uptake in gladiolus.

The prolonged longevity and promoted bud opening in hybrid limonium due to vase solution having physan (200 ml/l) and sucrose (20 g/l) has been reported by Doi and Reid (1995). In limonium cv. Blue Diamond, Kumari(2001) observed increased water uptake when flower spikes were kept in distilled water. The application of 75 per cent N and P + 100 per cent K + vermicompost + *Azotobacter* + PSB resulted in increases vase life (Gayathri et al., 2004).

Reduction in vase life of marigold flowers with increase in N rates was reported by Anuradha et al. (1990). In marigold, maximum flower longevity was recorded in treatment with vermicompost (15 tonnes per hectare) and 100 per cent recommended NPK treatment over the control (Mashaldi, 2000).

2.5 Effect of NPK on nutrient uptake

Uptake of nutrient is governed by several factors viz., soil, climatic and plant factors.
2.5.1 China aster

Ramachandra (1982) in china aster reported higher uptake of N and P$_2$O$_5$ under optimum levels of 120 kg N and 60 kg P$_2$O$_5$ per hectare.

2.5.2 Other crops

Muthamizhselvi et al. (2006) reported that the combined application of 50% recommended dose of fertilizers at 62.5:60:12.5 kg NPK/ha + vermicompost at 500 g per m$^2$ + 3 per cent panchagavya at 15 days intervals from 30 days after transplanting till peak flowering as foliar spray significantly influenced the leaf nutrient content and uptake in chrysanthemum.

Nalwadi (1982) noticed increased uptake of nutrients by different parts of marigold with increased levels of N and P. Sharanabasappa et al. (1990) revealed that total nitrogen and phosphorus uptake increased with increase in nitrogen as well as phosphorus levels from 0 to 130 kg ha$^{-1}$ in marigold.

Maximum nitrogen uptake (78.62 kg ha$^{-1}$) and phosphorus uptake (37.97 kg ha$^{-1}$) was recorded by the treatment combination of 150 kg N + 100 kg P$_2$O$_5$ in everlasting flower (*Helichrysum bracteactum*) cv. Tall Double.

Khimani (1991) in gaillardia reported that total N uptake in leaves, stem and flower were decreased with increase in nitrogen levels and were highest at 150 kg N ha$^{-1}$.

2.6 Economics

2.6.1 China aster

Vermicompost at the rate of 5 tonnes + N, P and K at the rate of 90:60:50 kg per ha recorded the highest benefit cost ratio of 3.10:1 (Nethra, 1996) in chinaaster. Phosphocompost PC-4, which was prepared with 5.0 per cent P$_2$O$_5$ asmechanical reinforced phosphocompost + 10 per cent pyrites showed highest cost-benefitratio of 1.00:2.64 which suggested that, utilization of phosphocompost is profitable and canbe recommended in the cultivation of china aster (Srinivas, 1994).

2.6.2 Other crops

Shashidhara and Gopinath (2005) reported that significantly highest benefit cost ratio (1:1.82) was found with application of 135:90:60 kg NPK per ha + Azotobacter (200 g per ha) + VAM (15.6 g per plant) in calendula.

Hemavathi (1997) observed increased cost benefit ratio when plants were inoculated with *Azospirillum* + 75 per cent recommended NPK (1:2.7) compared to NPK alone (1.0:1.9) in chrysantheum (*Chrysanthemum molifolium* Ramat.) cv. Local Yellow.

The high BC ratio obtained was significantly maximum with the treatments receiving 80% NPK + *Azospirillum* + *Azotobacter* + PSB 5 kg each ha$^{-1}$ in annual chrysantheum (Meshram et al., 2008). The economics analysis clearly indicated that, net returns per hectare and benefit cost ratio was highest in the plants treated with *Azospirillum*, PSB, vermicompost and 50 per cent
recommended NPK (3, 28, 504 and 6.04 respectively) and these findings can be used in making chrysanthemum production more profitable (Verma et al., 2011).

In crossandra cv. Dindigul Local, the application of 100 per cent NPK (75:50:125 kg/ha) + Azospirillum + phosphobacteria each at 2 kg/ha gave the highest flower yield (41.72 g/plant) with the maximum returns per rupee invested (1.0:3.5) as reported by Narismha and Haripriya (2001).

Godse et al. (2006) found that the treatment of vermicompost 8 t ha$^{-1}$ + Azotobacter and PSB at 25 kg ha$^{-1}$ each + 80 % RDF exhibited the highest B: C ratio (1.00:3.70) when compared with RDF (2.81) in gladiolus.

In tuberose cv. single, Wange et al. (1995) reported that inoculation with Azotobacter or Azospirillum alone gave a cost benefit ratio (1.0:3.5) equivalent to the application of nitrogen at 150 kg/ha.