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Effect of Integrated Nutrient Management on China aster (*Callistephus chinensis* L. Nees.) – A Review

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A B S T R A C T

The present paper is basically a review paper which focuses the work done by different researchers on integrated nutrient management studies on growth and flower yield of china aster. Different treatments were undertaken by different researchers. The result of different combination of chemical fertilizer and biofertilizer in studies were compared on the basis of growth, flower yield and flower quality of China aster. Their focus was on different combinations of chemical fertilizer and biofertilizer. Reducing dose of chemical fertilizer and increasing dose of biofertilizer as vermicompost, *Azotobactor*, phosphate solublizing bacteria etc. It was clear that biofertilizer beside its ability to improve the nutrient supply increases efficiency of added chemical fertilizer. From the reviews it is clear that the effect of integrated nutrient management is confirming the increased vegetative growth, floral attributes and yield. INM practices in one side increases the nutrient use efficiency and another side improves the soil wellness and sustainability.

Introduction

China aster (*Callistephus chinensis* (L.) Nees) belongs to family 'Asteraceae' and is native to China. The genus Callistephus derived from two Greek words *Kallistos* meaning 'most beautiful' and *Stephus* 'a crown' referring to the flower head. It is an important loose flower throughout the world. It is next to chrysanthemum and marigold among annual flowers and grown under different condition such as open field and cloth houses. It is used as bedding plant, potted plant and for other floral decorations such as making garlands, bouquets etc. The wide ranges of colour (blue, purple, pink and white) are available in aster. It is a hardy, free blooming and annual flower. Aster is short duration crop acclimatized to varying agro- climatic condition. Chemical fertilizers not only increase the cost of production but also cause environmental pollution. So the combination of biofertilizers will not only help to improves soil health but also the quality and yield of flower.

There were several works done on the study of effect of different combination of chemical fertilizer and biofertilizers. Let's discuss the work carried out by different researchers globally.

Kumar *et al.,* (2003) carried out their experiment at Division of Floriculture and Landscaping, IARI, New Delhi. The treatment comprised of N and P at 25, 50, 75 and 100% of the recommended dose in combination with full K and/or VAM and/or phosphobacterin. Application of 3/4th of the recommended dose of N and P in combination with full K + VAM + phosphobacterin proved to be the most effective in increasing the plant height, number of leaves, leaf area, number of branches, flower weight, flower diameter, number of flowers and flower yield.

Srivastava and Govil, (2007) conducted their experiment at the Floriculture Section, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar The plant height was maximum (26.97 cm), maximum number of leaves per plant (5.97), the days taken to opening of the lowermost floret was earliest (9.78 days), maximum number of florets per spike (17.25), maximum spike length (96.4 cm), maximum yield of spikes/m2 (18.5), on the 5th day, maximum number of opened florets (4.6), maximum number of opened florets (15.87), the minimum number of unopened florets (1.32), maximum population of *Azotobacter* in rhizosphere in c.f.u./g soil (87.2), maximum total rhizospheric bacterial population (c.f.u./g soil) (148.2) were found in the treatment received *Azotobacter* at 100 g/L. The earliest vegetative bud emergence (6.80 day) was found in treatment VAM at 100 g/L.

Earliest spike emergence (80.95 days), maximum diameter of the lowermost floret (19.17 cm), the maximum vase life recorded till all opened florets withered completely (16.12 days), delayed wilting of the lowermost floret (7.87 days), maximum c.f.u. /g soil for PSB (98.0) were observed in PSB at 100 g/L. This indicates that the improvement in the various characters of gladiolus is due to the activity of rhizospheric bacteria, which is enhanced by biofertilizer inoculation.

Chaitra and Patil, (2007) conducted their experiment at Department of Horticulture, College of Agriculture, Dharwad. They found that application of *Azospirillum*, PSB, vermicompost and 50 per cent recommended NPK (N- 180kg/ha, P_2O_5 -120kg/ha and K_2O-60kg/ha) resulted in maximum plant height (60.88 cm), number of leaves (103.81), number of branches (25.08), early flowering (74.93 days) and dry matter production (38.05g). The flower yield was also significantly influenced by all the treatments when compared to FYM + 50 % recommended NPK. Maximum number of flower per plant (46.60) and flower yield (11.71 t/ha) were recorded in treatment receiving *Azospirillum*, PSB, vermicompost and 50 per cent recommended dose of chemical fertilizer (NPK).

Kirar *et al.,* (2009) conducted their experiment at Department of Horticulture, College of Agriculture, R.V.S.K.V.V., Gwalior (M.P.) they concluded that the growth parameters, viz., Height of the plant (cm), diameter of main stem (cm), number of leaves per plant (cm), length of the longest leaf (cm) and width of the longest leaf (cm) were significantly influenced by fertilizer levels. Significantly superior aforesaid characters were observed with application of 75% NPK + vermin-compost + *Azotobactor* + PSB over application of 50 % NPK + vermin-compost + *Azotobactor* + PSB, while date of full blooming per harvesting of floral heads was significantly superior aforesaid characters were observed with application of 50% NPK + vermin-compost + *Azotobactor* + PSB. Better growth parameters and development and maximum net monetary return (Rs 2, 10 581.9/ha) from China aster can be secured by (75% NPK + Vermicompost + *Azotobactor* + PSB) and produced maximum flower yield (167.96 q/ha) can be secured by (50% NPK +

Vermicompost + Azotobactor + PSB) under the agro – climatic conditions of Gwalior region.

Masaye and Rangwala, (2009) conducted their experiment at Met, Thane, Maharashtra. They concluded that nitrogen @ 200 kg/ha gave significantly maximum plant height (53.3 cm), number of branches/plant (28.8) and flower yield (115.02 q/ha). Phosphorus @ 100 kg/ha showed significantly maximum plant height (50.27 cm), number of branches/plant (26.66) and flower yield (93.90 q/ha). Similarly, application of potassium @ 25 kg/ha showed significantly maximum plant height (50 cm), number of branches/plant (26.84) but maximum flower yield (91.87 q/ha) was recorded with 50 kg/ha of potassium. Therefore, application of 200 kg N+100 kg P_2O_5+50 kg K_2O and FYM @ 5 t/ha as a basal dose was suggested for increasing the flower yield of China aster var. Poornima.

Masaye and Rangwala, (2009) conducted their experiment at Met, Thane, Maharashtra, They found that Nitrogen @ 200 kg/ha gave significantly maximum longevity of flowers (13.03 days) and vase life (9.13 days). Application of phosphorus @ 100 kg/ha showed significantly maximum vase life (8.18 days). Similarly, application of potassium @ 50 kg/ha showed maximum vase life (8.12 days). Therefore, application of 200 kg N+100 kg P_2O_5+50 kg K_2O and FYM @ 5 t/ha as a basal dose suggested for increasing flower quality of China aster.

Patil and Agasimani (2013) conducted their investigation at Department of Horticulture, College of Agriculture, Dharwad. They recorded significantly highest plant height (60.88 cm), maximum number of leaves per plant (103.81), higher leaf area (23.16 dm^2), number of primary branches per plant (22.23) recorded significantly higher, maximum number of secondary branches (25.08), maximum dry weight of leaf and stem per plant (23.68 g), maximum root dry weight per plant (2.10 g), higher dry weight of flower per plant (12.15 g), higher total dry weight per plant (38.05 g), maximum number of flowers per plant (45.83), maximum flower yield per plant (128.46 g) and maximum flower yield (11.71 t/ha) were recorded in treatment receiving *Azospirillum* + PSB + vermicompost + 50 per cent RDF.

Almeida, *et al.*, (2013) carried out their experiment at the "Risoleta Neves" Experimental Farm, Agriculture Research Enterprise of Minas Gerais, located in São João del Rei, Minas Gerais (Brazil). They concluded that it was possible to grow rose bushes and ensure high-quality production using the Integrated Production System. It was observed that it is possible to grow 'Carolla' roses in Integrated Production System with reduced use of chemical fertilizer, but green manuring with *Calopogonio mucunoides* intercropped with the rose bush is not beneficial.

Munikrishnappa and Chandrasekhar, (2014) concluded from the reviews that positive effect of integrated nutrient management on the performance is well established. The recent approaches of saving fertilizers by the use of fertigation will enhance the nutrient and water use efficiency. From the reviews it could be concluded that the growth, flowering and quality of China aster is significantly influenced by application of major nutrients along with organic manures. The positive effect of integrated nutrient management on the performance of China aster is well established.

Patanwar, *et al.*, (2014) conducted their experiment at Department of Horticulture, Indira Gandhi Agriculture University, Raipur, C.G. The treatments comprising application

of nutrients through INM showed significant difference on the vegetative growth parameters viz., plant spread and number of branches per plant. Maximum plant height (57.02 cm), plant spread (41.91 cm) and number of branches per plant (23.07) were recorded on application of *Azospirillum* + PSB + 50% RD'N' through VC + 50% RDF followed by *Azospirillum* + PSB + 50% RD'N' through FYM + 50% RDF which had at par effect. Maximum number of flower per plot (992.8), yield of flower per plot (3.19 kg per plot) and yield (17.70 t/ha) of Chrysanthemum recorded under *Azospirillum* + PSB + 50% RD'N' through VC + 50% RDF.

Dalawai and Naik, (2014) carried out their experiment in the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere. The result of the experiment was clearly confirmed that, combined application of organic manure, biofertilizers along with 75% recommended dose of NPK resulted higher flower yield (428.34/m^2). It was concluded that, the use of *Azospirillum* (60 g/m^2), PSB (60 g/m^2), vermicompost (500g/m^2), FYM (2kg/m^2) along with 75 % recommended dose of fertilizer influenced in realizing better plant growth, higher quality flower yield and other parameter of Carnation in the economic production with maintaining soil health.

Hoda and Mona, (2014) were conducted their experiment at the Experimental Nursery of the Floriculture, Ornamental Plants Department, Faculty of Agriculture, Alexandria, Egypt. The tallest plant, highest number of branches per plants, maximum expansion of produced leaves, heaviest shoot dry weight, highest significant increase in root dry weight, shortest flowering date, highest number of flower per branch and longest flowering period resulted from the treatment of full dose of NPK + two types of biofertilizer (NFB + PDB). Under biochemical constituents highest increase in total chlorophyll content, highest value of total carbohydrate content, increase in nitrogen content (%) in leaves and highest percentage of phosphorus content (%) in dry leaves resulted in treatment receiving 100% chemical fertilizer + two types of biofertilizer (Nitrogen Fixing bacteria (NFB) + Phosphorus Dissolving Bacteria (PDB).

Singh *et al.*, (2015) carried out their experiment at Department of Horticulture, SVPUA&T, Meerut, U.P., India. They found that Among all the treatments the treatment receiving 75% recommended dose of NPK (75 kg N, 75 kg P2O5 and 75 kgK2O per hectare + vermicompost 80 q per hectare + *Azatobactor* 3.3 kg per hectare gave the maximum height of plant (94.84cm), plant spread (49.41 cm), leaf area (49.46cm) number of branches (15.92), total dry matter (39.03 g/plant), flower diameter (6.7 cm), weight of flower plant (45.97 g), number of flower (58.32), per cent weight (3.99g) and yield of flower per plant (368.29g), yield of flower (26.48 tone per hectare) The treatment was also found significantly most affected in inducing earliest flowering and duration of flowering

Pithiya *et al.*, (2016) carried out their experiment at Fruit Research Station, Jambuvadi Farm, Department of Horticulture, Junagarh Agricultural University, Junagarh. Indicated that the significant variation was observed in vegetative parameters list out plant height (59.67 cm), plant spread (396 cm^2), number of primary branches (24.67 cm), fresh and dry weight of plant (214.73 and 38.00 gm respectively) were recorded with an application of 50% RDF (180: 120:60 kg NPK/ha) + Vermicompost @1.5 t/ha + *Azotobactor* 3 l/ha + PSB @ 2 l/ha. In case of flowering and yield parameters, the variations were found significant.

Lower days of opening of first flower (55.14), days to 50% flowering (60.56), flowering span (54.85 days), highest number of flowers per plant (55.67) as well as maximum yield of flower per hectare (20.61 t/ha) was noted in treatment 50% RDF + Vermicompost @ 1.5 t/ha + *Azotobactor* 3 l/ha + PSB @ 2 l/ha.

The quality parameters like diameter of flower (76.60 mm), longest flower stalk (29.95 cm), maximum vase life (11.50 days) and highest shelf life of flower (55.86 hrs) were recorded significantly in treatment 50% RDF + Vermicompost @ 1.5 t/ha + *Azotobactor* 3 l/ha + PSB @ 2 l/ha. From the foregoing discussion, it can be inferred that the use of 50% RDF + Vermicompost @ 1.5 t/ha + *Azotobactor* 3 l/ha + PSB @ 2 l/ha, helped in realizing better plant growth, better flower quality and higher flower yield of China aster under field condition.

Singh, (2016) carried out his experiment at the Research Farm of the Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, (HP). Results revealed that maximum plant height (56.67 cm), number of leaves per plant (103.93), flowering branches per plant (8.23), plant spread (32.32 cm), number of flowers per plant (28.58), number of flowers per plot (428.67), duration of flowering (27.20 days), flower yield per plant (73.21 g), flower yield per plot (1098.20 g), shelf life of flowers (6.43 days) at ambient conditions were recorded in plants receiving 75% NPK (22.5:11.25:7.5 g NPK/m2) + *Azotobacter* + PSB. Plants supplied with 100% NPK (30:15:10 g NPK/m2) + *Azotobacter* + PSB were noticed with maximum leaf area (15.76 cm2), whereas, largest flower diameter (5.41 cm) and fresh weight of individual flower head (2.70 g) were found in plants receiving 50% NPK (15:7.5:5 g NPK/m2) + *Azotobacter* + PSB.

Maheta *et al.*, **(**2016) conducted their investigation at Horticulture Research Station, Jambavadi Farm, Junagadh Agricultural University, Junagadh (Gujarat) From the results of the experimental data, it was concluded that for cultivation of China aster in medium black soil the fertilizer application at the rate of 300 kg N ha^{-1} in two splits (first half as basal application and remaining half at 30 days after transplanting) and 200 kg P2O5 ha-1 as basal dose has been found the best for optimum growth, flowering and yield parameters in China aster.

Khanna *et al.*, (2016) conducted their experiment at Floriculture and Landscape Architecture block, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry. The data showed that tallest plant (43.09 cm), maximum plant spread (20.06 cm), highest number of primary branches per plant (12.60), highest number of leaves (43.49) and maximum leaf area (54.63 cm^2), minimum number of days taken to bud initiation and flowering (65.51 and 81.63), maximum duration of flowering (19.59 days), highest stalk length, flower diameter and average weight of flower (i.e. 33.46 cm, 6.36 cm and 2.61g respectively), the maximum number of flower per plant and per bed (35.02 and 315.18), maximum vase life (9.66 days) was observed from the plant receiving treatment containing FYM + Forest litter + PSB. From these studies, it could be inferred that combination of FYM (1.5 kg/m^2) + forest litter (1.5 kg/m2) + PSB (50 ml/15L) were to be the best treatment combination for good growth and flowering attributes in China aster.

Tembhare *et al.*, (2016) carried out their investigation at the farm of Horticulture section, College of Agriculture, Nagpur. The results revealed that nitrogen and phosphorus levels significantly influenced the flowering, yield and quality parameters in China aster.

Flowering parameters were delayed viz., days to first flower bud initiation, days to opening of first flower, days to 50 per cent flowering, days to first harvesting with the treatment 200 kg nitrogen and 75 kg phosphorus per hectare. Whereas, seed yield and quality parameters viz., weight of flower, diameter of fully open flower, number of seed per gram, test weight of seed and germination per cent of seed were recorded significantly maximum with nitrogen 200 kg and phosphorus 75 kg per hectare.

Mukhtar *et al.*, (2016) carried out their trial at Ornamental nursery, Department Horticulture, The University of Agriculture, Peshawar. On the account of results acquired, it was concluded that phosphorus at the rate of 200 kg ha-1 is more effective in enhancing growth and early flowering in zinnia. Correspondingly the response of red cultivar followed yellow cultivar was best as compared to other cultivars in most of growth and yield parameters. Hence 200 kg of phosphorus ha-1 and red and yellow cultivars respectively are recommended under agro-Climatic condition of Peshawar for better results regarding growth and flower production.

Verma *et al.*, (2017) carried out their research at Department of Horticulture, R.B.S. College, Bichpuri, Agra (Uttar Pradesh). They recorded the maximum plant height (64.48 cm), maximum diameter of main stem (3.17 cm), maximum number of leaves (126.62), maximum plant spread along and across the row (38.70 cm), maximum number of laterals (31.89), maximum length of longest leaf (10.96 cm), maximum width of the longest leaf (7.60 cm), maximum green weight of plant canopy (403.51 g), maximum dry weight of plant canopy (73.33 g), maximum date of visibility of flower bud (132.51), maximum date of colour break (140.55), maximum date of full blooming (160.66), maximum date of harvesting of floral heads (162.73), maximum fresh weight of floral head (5.10g), maximum length of floral head (3.27 cm), maximum width of floral head (6.40 cm), maximum length of floral stalk (22.05 cm), maximum diameter of floral stalk (0.29 cm) were found in the treatment received spray of micronutrient ferrous sulphate 0.2%. From the result summarized above, it may safety be concluded that foliar spray of Zinc, Iron and Copper each at 0.2% concentration through $ZnSO_4$, $FeSO_4$ and $CuSO_4$ respectively when done separately and in combination was found more effective on growth, flowering and flower yield of China aster.

Pandey *et al.*, (2017) carried out their experiment at Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, AAI-DU Allahabad, U.P. On the basis of experimental findings concluded that the treatment Vermicompost @ 2.5t/ha + Azotobactor @ 2.0 kg/ha + Phosphorous Solubilizing Bacteria @ 2.0 kg/ha were found superior in respect of plant growth, flower yield (33.65 t/ha), tuber yield (13.80 t/ha) and cost of cultivation (3, 28,101 Rs/ha) along with highest benefit cost ratio (3.58).

Singh *et al.*, (2017) conducted their experiment at Research Farm of the Department of Floriculture and Landscape Architecture, Nauni, Solan, Himachal Pradesh. They found maximum plant height (56.67 cm), number of leaves per plant (103.93), number of flowering branches per plant (8.23) and plant spread (32.32 cm) minimum number of days taken for first flower bud formation (65.90) and first flower opening (77.87), The number of flowers per plant (28.58), number of flowers per plot (428.67), duration of flowering (27.20 days), flower yield per plant (73.21 g), flower yield per plot (1098.20 g) and shelf-life of flowers

in ambient conditions (6.43 days) were maximum in plants applied with 75% NPK + *Azotobacter* + PSB, maximum flower diameter (5.41 cm) and fresh weight of individual flower head (2.70 g) were seen in treatment receiving 50% NPK + *Azotobacter* + PSB. It can be concluded that an application of 75% NPK (22.5:11.25:7.5 g NPK/m2) along with inoculation of *Azotobacter* and phosphate solubilizing bacteria (PSB) were found to be maximum regarding flower production of China aster.

Bhagat, (2017) conducted his experiment at the Horticultural unit in the campus of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) He concluded from the study that the role of different treatment combinations was significant on growth, flower yield and quality as well as vase life of flowers. Among different treatments, 100%NPK + Azotobacter (T1) was found to be best followed by 100%NPK + PSB (T4).

Verma *et al.*, (2018) conducted their experiment at Department of Horticulture, R.B.S. College, Bichpuri, Agra (Uttar Pradesh). From the result they concluded that maximum production of quality floral heads can obtain when Zinc, Iron and Copper each at 0.2% concentration through $ZnSO_4$, $FeSO_4$ and $CuSO_4$ respectively applied at 30 and 45 days after planting.

Kumar and Chaudhary (2018) on their study comparative literature research revealed that INM increases crop growth and yield of floricultural crops as compared with conventional methods. INM practices increases nutrients use efficiency and improving soil health and sustainability. Strong and convincing evidence indicates that INM practice could be an innovative and environment friendly practice for sustainable growth and yield of floricultural crops. In summery the growth, flowering and yield attributing characters of floricultural crops was significantly increased with the combined use of inorganic, organic and biofertilizers than the control and recommended doses of inorganic fertilizers.

Pratap, (2018) carried out his investigation at Department of Horticulture VNMKV Parbhani. He concluded that treatment received 100% RDF + *Azotobactor* + PSB gave superior result with respect to plant height, number of branches, Number of leaves, plant spread, number of flowers per plant, weight of single flower, yield per plant, yield per plot, yield per hector and vase life.

Krushnaiah *et al.*, (2019) carried out their experiment at Floricultural Research Station, ARI (Agricultural Research Institute) Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad. They got the highest plant height (64.25 cm), maximum plant spread E-W (34.30 cm), N-S (33.4 cm), maximum number of leaves per plant (198.06), maximum number of suckers per plant (15.46), higher number of flowers per plant (300.33), maximum number of flowers per spike (181.00) had been recorded in the treatment received RDF 50% + RDF 50% through VC + *Azotobactor* + PSB). Number of days (82.86 days) taken to flower bud initiation and 50 per cent flowering (94.90 days), number of spikelet's per spike (35.20), number of flower spikes per plant (4.20), number of flower spikes per plot (105.00), number of flower spikes per ha. (4.66 lakhs) was maximum in the treatment received RDF 50% + RDF 50% through VC + Azo + PSB. On the basis of results obtained in the present investigation, it can be concluded that the application inorganic fertilizers, organic manures along with inoculation of *Azospirillum* and PSB results in higher flower yield in aster. Therefore application of RDF 50 % through inorganic +

50 % through VC + Azo + PSB recorded better plant growth, flowering and higher yield.

Bohra *et al.,* (2019) conducted their experiment at Floriculture and Landscape Block, COH, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Uttarakhand. Data showed that tallest plant (76.73 cm) was observed in treatment received FYM @ 28.8 t/ha (80%) + PSB @ 50ml/15L + *Azotobacter* @ 30ml/15L, maximum number of primary branches (13.63), plant spread (21.63 cm) and number of leaves per plant (162.20) were observed in T16 the maximum leaf area (53.73 cm2) was observed in Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30ml/15L. Minimum number of days taken to bud initiation and flowering (58.43 and 74.43, respectively) were recorded in FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @50 ml/15L + *Azotobacter* @ 30ml/15L. The duration of flowering (20.80 days), maximum number of flowers per plant and per m2 (39.10 and 360.30, respectively) were recorded in FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @50 ml/15L + *Azotobacter* @ 30ml/15L. Quality traits viz., stalk length; flower diameter and average weight of flower were significantly improved by the use of organic manures and biofertilizers.

On perusal of data showed that maximum stalk length (34.43 cm) was observed in Control, The maximum diameter (7.73 cm) and average weight of flower (3.38 g) were observed in Vermicompost @ 9.6 t/ha (80%) + PSB @ 50 ml/15L + *Azotobacter* @ 30ml/15L. The maximum vase life (9.73 days) was recorded in FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ (50 ml/15L) + *Azotobacter* @ (30 ml/15L). From these studies, it could be inferred that combination of FYM @18 t/ha (50%) + Vermicompost @ 06 t/ha (50%) + PSB @ 50 ml/15L + *Azotobacter* @ 30 ml/15L was found to be effective in improving the growth and flowering attributes in China aster.

Bose *et al.,* (2019) carried out their experiment at Research field, Department of Horticulture, Allahabad School of Agriculture, SHIATS, Allahabad The best treatment of China- aster was prepared by using application of 5% N P K kg/ha + FYM @ 2t/ha +Vermicompost @ 0.6t/ha + *Azospirillum* @ 2.5kg/ha + PSB @ 2.5kg/ha. It resulted in maximum flower diameter (5.03 cm), flower weight (9.02 g), Number of flowers per plant (48.82), flower yield per plant (440.35 g), flower yield per plot (2642.1 g), flower yield per hectare (12.58 t / ha) and maximum days to first bud initiation (68.93), days to 50% bud initiation (76.13), days to first flowering (82.73), days to 50% flowering (87.83) found in treatment received 75% N P K kg/ha + *Azospirillum* @ 2.5kg/ ha. The study gives tremendous scope for the yield improvement in China aster with the Integrated Nutrient Management practices. The treatment 75% N P K kg/ha + FYM @ 2t/ha +Vermicompost @ 0.6t/ha + *Azospirillum* @ 2.5kg/ha + PSB @ 2.5kg/ ha was found to be better in the investigation on integrated management studies in China aster

Awale *et al.,* (2019) conducted their experimental as Pot culture in the glasshouse of All India Coordinated Cotton Improvement Project (AICCIP), Department of Plant Pathology and Agril. Microbiology, College of Agriculture, Pune. It was concluded that the application nitrogen fixing liquid biofertilizers (*Azotobacter*) as a S.T.+S.R.D.T.+S.A.+F.A. with 100% or 75% R.D.N. was found significantly superior than its carrier based counter parts and improved the soil biochemical properties as well as fulfilled the nutrient requirement of marigold crop to a considerable extent.

In conclusion the after different studies by varied researchers it can be concluded that the vegetative growth, floral attributes and yield parameters of china aster is significantly influenced by the application of combination of chemical fertilizers with different biofertilizers or micronutrients. Inoculation of *Azospirillum* and PSB enhanced the cell division and enlargement and also produced growth hormones, which is possible reason for increase growth. These results were in line with the findings of Ravichandran in crossandra and Mononmani in Jasmine. Vermicompost enhanced the micro flora and enzymatic activity which might have augmented the plant growth. Similar findings have been reported by Nethra *et al.,* in China aster and Kusuma in golden rod. The increase floral attributes might be due to possible role of *Azospirillum* through atmospheric nitrogen fixation, better root proliferation, uptake of nutrients and water. More photosynthesis enhanced food accumulation which might have resulted in better growth and subsequently higher number of flower per plant and hence, more number of flower yield per hectare. Besides this, increase in flower yield may be attributed to increased availability of phosphorus and its greater uptake by PSB (Kundu and Gaur, 1980). Further vermicompost, as the source of macro and micro nutrients like Fe and Zn, enzymes, growth hormones and beneficial effects of micro flora might have played a secondary role in increasing the flower spike yield. These results are in line with the findings Akter *et al.,* (2017) in gladiolus, Sunita Kumari and VM Prasad (2017) in petunia, Swati *et al.,* (2017) in golden rod and Ghisewad *et al.,* (2016) in gladiolus. The production of increased number of flowers per plant and flower yield per acre might be due to the indirect effect of more number of branches as estimated and developed by the influence of inorganic fertilizers along with organic manures and biofertilizers. This was in conformity to the findings of Chandrikapure *et al.,* in marigold and Bhavanishankar and Vanagamudi in crossandra.

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