ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. VII: 00-00: 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.in

EFFECT OF ORGANIC, INORGANIC AND BIO-FERTILIZERS ON PRODUCTION OF LOOSE FLOWER-A REVIEW

Mridubhashini Patanwar *et al.*,

KEYWORDS

Bio-fertilizers
Flowering
Growth
Inorganic fertilizer
Loose flower
Organic fertilizer

Proceedings of National Conference on
Harmony with Nature in Context of
Bioresources and Environmental Health
(HORMONY - 2015)
November 23 - 25, 2015, Aurangabad,
organized by
Department of Zoology,
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad (Maharashtra) 431 004
in association with
NATIONAL ENVIRONMENTALISTS ASSOCIATION, INDIA
www.neaindia.org

The Ecoscan
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

MRIDUBHASHINI PATANWAR*[1], PRITEE AWASTHY[2] AND BHAVESH PATEL[1]
[1]Department of Horticulture, Indira Gandhi Agriculture University, Raipur - 492 012, Chhattisgarh, INDIA
[2]Department of Agronomy, Indira Gandhi Agriculture University, Raipur - 492 012, Chhattisgarh, INDIA
e-mail: to.mridu09@gmail.com

ABSTRACT

Loose flowers are most popular and preferred by most of the farmer inIndia and Chhattisgarh. In India it occupied about 255 ('000 ha) with average production 2297 ('000 MT).Indian floriculture industry is very dynamic in its varieties and trade volumes demonstrating 6-9% of Annual growth.The effects of integrated use of organics with bio-fertilizersand inorganic fertilizers and impacts of long-term use of INM on enhancing crop productivity were studied on flowers. INM enhances the yield potential of crops over and above achievable yield with recommended fertilizers and results in better synchrony of crop N needs due to slower mineralization of organics, reduced N losses via denitrification, increase nitrogen fixation, phosphorous availability, lowering nitrate leaching, enhanced nutrient use efficiency, improvements in soil health and productivity and hence could sustain high crop yields in various cropping systems ensuring long-term sustainability of the system.In addition, this review there is greater opportunity to researcher to develop a perfect combination of organic, inorganic and biofertilizer for better production of loose flower.

*Corresponding author

INTRODUCTION

In a world that is increasingly becoming urbanized, ornamental plants provide an important link with the natural world. Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, Maharashtra, Uttarakhand, Uttar Pradesh, Delhi, Haryana, Kerala, Himachal Pradesh and North Eastern states are the major flower growing states in India. Andhra Pradesh is having largest area *i.e.* 34.85 ('000'ha) of flowers.Tamil Nadu is the largest loose flower producing state *i.e.* 312.97 ('000'Mt), while West Bengal is the leading cut flower producing statei.e. 25429.1 (lakh Nos) in India (Anonymous, 2013). While ornamental plantsare produced mainly for their aesthetic value, the propagation and improvement of qualityattributes such as leaf types, flower colour and fragrance, longevity and form and the creation ofnovel variation are the important economic goals for the expanding ornamental industry(Verma*et al.*, 2011).Loose flower uses for making garlands, veni and bracelets as well as for worshipping (Bohra and Kumar, 2014).Organic farming may be a desirable proposition for improving the quality of horticultural produce and soil health; it is difficult to meet the nutrient requirement of the crops, exclusively through organic farming. The use of organic manures and bio-fertilizers along with the balance use of chemical fertilizers is known to improve physico-chemical and biological properties of soil, besides improving the efficiency of applied chemical fertilizers (Patanwar*et al.,* 2014). In addition, they are ecofriendly, easily available and cost-effective. In many areas of the country, the overall health and productivity of the soil have declined due to use of high yielding varieties and enhanced application of chemical fertilizers. High yielding varieties of crops can perform to their potential, only if they are grown in productive soils. Nutrient status of the plants can be pointer to the response of plant to the fertilization and internal content of the nutrient determine the fertilizer requirements (Polara *et al.,* 2014).The quality of flowers is greatly influenced by the quantity and source of nutrients. At present, these nutrients are primarily supplied through chemical fertilizers. Therefore, recently the use of organic manures viz., farm yard manure, vermicompost and biofertilizers like Azospirillum and Phosphate Solubilizer Bacteria and Phosphate Solubilizermicroorganism is gaining momentum. Therefore, under these circumstances, our objective is to evolve judicious combination of organic manures, biofertilizers and chemical fertilizers, it may be feasible and viable option for sustainable production on a commercial and profitable scale and is the need of hour.

Organic manure

The practical way to improve the quality of soil which a low organic matter content is of the addition of organic materials to the soil either fresh or composted (Garcia *et al.,*2000 and Pascual *et al.,*1999). These materials are rich in labile carbon function which acts as a source of energy for microorganisms also increasing soil microbial populations and their activities (Papavizas*et al.,* 1982). Organic materials also increase soil water holding capacity and aggregation and improve the nutrient status (Ros *et al.,* 2001). In addition organicmatteris a necessary food for the soil organisms. The combination of organic matter like farm yard manure and mineral fertilizers provides the ideal environmental conditions.The use of manures as on organic source occupy an important place as they provide a scope for reduction on use of costly chemical fertilizers which can pollute soil in long term use (Sharma, 2005). The effect of fym on number of flowers can also be attributed to the fact that there will be higher translocation of carbohydrates from other parts to reproductive parts during development. The source to sink translocation can be more effective only when the rate of photosynthesis is high (Johnson, 1984). Srinivas and Gowda, (1999) reported in China aster that the application of FYM at the rate of 15 t/ha along with recommended NPK increased in number of flowers/ plant and flower yield. In chrysanthemum that application of FYM resulted in better growth and yield like taller plant and more number of leaves, number of flowers plant^{-1}, large size flower and yield plant^{-1}. Similar results were found by Haripriya and Sriramachandrasekharan, (2002)in chrysanthemum and Prakash *et al.,*(2002) in marigold.

Vermicomposts are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms (Edwards *et al.,*1998).Vermicompost besides being a rich source of micronu-trients, also act as chelating agent and regulates the avail-ability of metabolic micronutrients like iron and zinc to the plants and increases the plant growth and yield by pro-viding nutrients in the available form. Use of vermicompost in agriculture was first reported by (Hopp and Slater, 1979). Further, they quantified the response of crop to earthworms in terms of yield. Vermicompost serves as organic manure, since it is a source of nutrients viz., nitrogen, phosphorus, potassium, humic acids and micronutrients (Biradar and Shaila, 2006).Maximum plant height, number of leaves, number of flowers plant^{-1} and flower yield hectare^{-1} due to the application of ver-micompost 10 tonnes per hectare and recommended dose of NPK in China aster (Nethra, 1996,Chaitra and Patil, 2007,Sonawane*et al.,* 2009, Gharat*et al.,*2008and Balaji*et al.*, 2006). In gladiolous yield and quality is increased by the application of vermicompost (Gangadharan and Gopi-nath, 2000). In chrysanthemum plant grown in 50% vermicompost had a greater growth index at harvest, number of flowers plant^{-1} as well as early flower development the result are in line withAngadi, (2010), Hidalgo and Harkers, (2002) in chrysanthemum and Bashan, (2004). In marigold application of vermicompost (60%) resulted in the highest weight, size and dry weight of shoot, but the maximum bush height was obtained by 20% vermicompost.The heighest number of lateral branches was recorded in 40% vermicompost treatment. Similar results were found by Atiyeh *et al.* (2000), Chauhan *et al.* (2005) in calendula, Patel *et al.* (2011), Shadanpour *et al.* (2011) andAjitkumar, (2002) in marigold.

Bio-fertilizers

Bio-fertilizers are biological preparations of live or latent cell of selected strain of nitrogen fixing or phosphorous solubilizing beneficial soil microorganisms(Bhaskaran *et al.,* 2002). These may help in mineralization of nitrogen and transformation of several elements like sulphur and iron into available forms. These biofertilizers benefit flower production by making the nutrients available to plants. Common biofertilizers used in horticultural crops are Azospirillum, Azotobacterand PSB. Azospirillumis a non-symbiotic, N fixing bacterium, which fixes the atmospheric nitrogen when inoculated to plants and helps in saving the application of N fertilizers to an extent of 20-25 percent (Subbarao, 1993). Wild strain of Azospirillumfixes atmospheric nitrogen efficiently either as a free living bac-terium or in combination with plants and thus participates in the nitrogen cycle (Tarrand *et al.,* 1978). It is associated with root tissues and lives in harmony with root tissues, fixing substantial amount of nitrogen.Increased growth in marigold by inoculation ofAzospirillum, this might be due to added nitrogen to crop through associative sym-biosis and increased production of growth hormones like NAA, GA and cytokinins (Bashan, 2004 and Balasubramanian, 1989). (Preethi,1990) Early flowering in rose by the inoculation of Azospirillummight be due to induced cytokinin syn-thesis and rapid assimilation of photosynthates resulting in early transformation of the axillary bud from vegetative to reproductive phase (Bashan, 2004). Wange *et al.* (1995) reported that Increase in number of bulblets (14.3/plant), flower stalks (23348 dozen/ha) with higher monetary re-turns (1.00:3.73) in tuberose Cv. 'Single' by the inoculation ofAzospirillum. Increase in vegetative growth in China aster by bio-fer-tilizers was because of stimulation in nutrient uptake and biosynthesis of plant growth regulators similar result were found by Prabhatkumar*et al.,*(2003).

subsequent years several other types of Azotobacteria group have been found in the soil and rhizosphere such as Azotobactervinelandii, (Lipman,1903), Azotobacterbeijernckii, (Lipman, 1904), Azotobacternigricans, (Krassilnikov, 1949), Azotobacterpaspali, (Döbereiner, 1966, Thompson and Skerman 1980) Azotobacterarmenicus (Thompson and Skerman, 1981), Azotobactersalinestris, (Page and Shivprasad, 1991). Three possible mechanisms have been proposed: N_2 fixation, delivering combined nitrogen to the plant, the production of phytohormonelike substances that alter plant growth and morphology and bacterial nitrate reduction which increases nitrogen accumulation in inoculated plants (Triplett 1996). Biological nitrogen fixation is one way of converting elemental nitrogen into plant usable form (Gothwal*et al.,* 2007). Nitrogen-fixing bacteria (NFB) that function transform inert atmospheric N_2 to organic compounds (Bakulin*et al.,* 2007).These nitrogen-fixing bacteria are important for ecology and agriculture.Maximum leaf area, length of first order lateral shoots, number and weight of flowers/m^{2}during first and second flush were observed with inoculation of Azotobacter in rose (Singh, 2005).Azotobacterwhen applied in marigold with Azospirillumunder different level of chemical nitrogen increase in growth, yield and biochemical attributes (i.e.

Table 1: Nutrients present in vermicompost

N (%)	P2O5(%)	K2O (%)	Cu (ppm)	Mn (ppm)	Fe (ppm)	Zn (ppm)	Ca (ppm)	Mg (ppm)	S (ppm)
0.9-1.5	0.3-0.64	0.54-1.72	2.00-37.7	10.0-105.0	10.0-161.00	5.7-120.0	1.0-1.75	0.47-1.75	0.50-1.50

[Sources:Kale, (1998), Chaudhuri *et al.*, (2000),Kitturmath*et al.*,(2007), Giraddi, (2007) and (2011),Meenatchi, (2008) and Waseem *et al.*,(2013)] chlorophyll, total sugar, total free amino acid, and nitrate reductase). Phosphorus is a major growth limiting nutrient and unlike the case of nitrogen, there is no large atmospheric source that can be made biologically available (Ezawa*et al.* 2002). Root development, stalk and stem strength, flower and seed formation, crop maturity and production, crop quality and resistance to plant diseases are the attributes associated with phosphorus nutrition. Higher crop yields result from solubilization of fixed soil P and applied phosphates by PSB (Zaidi (1999). Microorganisms with phosphate solubilizing potential increase the availability of soluble phosphate and enhance the plant growth by improving biological nitrogen fixation (Kucey*et al.*, 1989; Ponmurugan and Gopi, 2006). Bacteria are more effective in phosphorus solubilization than fungi (Alam*et al.*, 2002). Among the whole microbial population in soil, PSB constitute 1 to 50 % (Chen *et al.*, 2006). Number of PSB among total PSM in north Iranian soil was around 88 % (Fallah, 2006). Among the soil bacterial communities, ectorhizospheric strains from Pseudomonas and Bacilli, and endosymbiotic rhizobia have been described as effective phosphate solubilizers (Igual*et al.*, 2001). Strains from bacterial genera Pseudomonas, Bacillus, Rhizobium and Enterobacter along with Penicillium and Aspergillus fungi are the most powerful P solubilizers (Whitelaw, 2000).Kumar *et al.*(2006) observed in Marigold cv. PusaNarangi that FYM + PSB followed by FYM + Azotobactorresulted in maximum yield per plant, flower diameter, average flower weight and fresh weight of flower per plant.In dahlia height of plant, number of leaves per plant, plant spread, earliness of flowering and yield of flower was superior in the plants receiving vermicompost (500 g) with PSB 25 g per plot (Warade*et al.*2007). In China aster application of full dose of nitrogen in addition of Azotobacterand PSB resulted in more plant weight, stem diameter, number of branches, number of leaves, while, flower yield was maximum under Azotobacterand PSB with 75% N(Kulkarni *et al.*, 1996).

Table 2: Microbial population in vermicompost

Bacteria (cfu/g)	Fungi (cfu/g)	Actinomycetes (cfu/g)
5×10^6 to 10×10^7	10×10^3 to 27×10^3	2.2×10^4 to 15×10^7

[Sources: Jones *et al.*,(2005), Giraddi, (2007) and (2011),Meenatchi*et al.*,(2009) and Waseem *et al.*,(2013)]

Inorganic fertilizer

The application of chemical fertilizer in balanced dose helpful in increase the production of flowers as nitrogen is a component of amino acid, which is essential for protein synthesis. Nitrogen bases like pyrimidines and purines and many co-enzymes need nitrogen for their synthesis. It is also a component of cytochrome and chlorophyll which are essential for photosynthesis. While Phosphorus forms a source of energy in the form of ATP and ADP, the cell division is also influenced by phosphorus. It is also a component of many enzymes, co-enzymes, nucleic acids and phospholipids and potash acts as catalyst for various enzymes and co-enzymes and starch synthesis takes place in the presence of potash. It has a vital role in photo respiration, translocation of metabolites and transpiration. In annual chrysanthemum

cv. Nivea, plant height and number of primary branches per

Table 3: INM treatments on chrysanthemum and marigold flowers

S. No.	Treatments	Chrysanthemum Treatment detail	Marigold Treatment detail
1.	T_1	100% RDF	100% RDF
2.	T_2	50% RD'N' through FYM+50%RDF	50% VC equivalent to RDÚN' + 50% RDF
3.	T_3	50% RD'N' through VC +50%RDF	Azo + 75% RD'N' + 100% RDÚP' and 'K'
4.	T_4	*Azo*+75%RD'N'+100%RD'P' and RD'K'	PSB + 75% RD'P' + 100% RD'N' and 'K'
5.	T_5	PSB +75%RD'P' +100%RD'N' and RD'K'	Cow Urine (5%) + 75% RD'N' + 100% RD'P' and 'K'
6.	T_6	*Azo*+ 50% RD'N' through FYM +50%RDF	*Azo* + 50% VC equivalent to RD'N' + 50% RDF
7.	T_7	*Azo*+50% RD'N' through VC +50%RDF	PSB + 50% VC equivalent to RD'N' + 50% RDF
8.	T_8	PSB+50% RD'N' through FYM +50%RDF	Cow Urine (5%) + 50% VC equivalent to RD 'N'+ 50% RDF
9.	T_9	PSB+ 50% RD'N' through VC +50%RDF	*Azo* + PSB + 50% RD'N' and 'P' + 100% RD'K'
10.	T_{10}	*Azo*+PSB+50%RD'N'and 'P' +100%RD'K'	*Azo* + PSB + Cow Urine (5%) + 50% RD'N' and 'P' + 100% RD'K'
11.	T_{11}	*Azo*+PSB+50% RD'N' through FYM +50%RDF	*Azo* + PSB + 50% VC equivalent to RD'N' + 50% RDF
12.	T_{12}	*Azo*+PSB+50% RD'N' through VC +50%RDF	*Azo* + PSB + Cow Urine (5%) + 50% VC equivalent to RD'N' + 50% RDF

(source-Patanwar *et. al.*, 2014, Sahu, 2014)

Table 4: Phosphorus solubilization potential of various bacterial strains at different pH values of the medium

PSB strains	Estimated quantity in a standing liquid culture P (ìg mL^{-1})	Ph	References
D 5/23 Pantoeaagglomerans	62.76	5.93	Amellal*et al.*,(1999).
CC 322 Azospirillum sp. Mac 27	83.39	6.19	Ratti*et al.*,(2001).
AzotobacterchroococcumAla 27	98.11	4.84	Narula*et al.*,(2000).
AzotobacterchroococcumMsx 9	1.10	7.50	Narula*et al.*,(2000).
AzotobacterchroococcumER 3	65.90	5.82	Narula*et al.*,(2000).

Phosphobacteria ***Azotobacter*** ***Azospirillum***

Figure 1:

plant at full bloom were at maximum by the application of nitrogen at 300 kg ha^{-1}, phosphorus at 200 kg ha^{-1} and potash 160 kg ha^{-1}. Similar results were found by Baboo and Sharma, (1997), Dixit *et al.* (2004) and Dorajeerao *et al.* (2012). In marigold cv. African giant, Effect of N:P:K on flowering attributes was highest number of flowers per plant, number of seeds per flower, seed yield per plant and plant germination percentage.The result are also corroborated withGavanhe*et al.* (2004), Acharya and Dashora, (2004), Kore *et al.* (2004), Naik *et al.* (2005), Karuppaiah and Krishna, (2005), Das *et al.* (2005) and Jawaharlal *et al.* (2013). (Gurav *et al.,* 2004) In gerbera found that application of nitrogen @ 15 g /m^2/month significantly produced more number of flowers per plant (29.88), flowers with longer stalk length (47.33 cm) and larger diameter (8.75 cm). Application of phosphorus @ 20 g /m^2/ month significantly produced more number of flowers per plant (29.55) and flowers with larger diameter (8.70 cm). In Calendula officinalis effect of nitrogen fertilizer was significant on dried and fresh weight of flower and that the highest one obtained from 90 kg of N ha^{-1} treatment reported by Mollafilabi *et al.* (2013).

REFERENCES

Acharya, M. M. and Dashora, L. K. 2004. Response of graded levels of nitrogen and phosphorus on vegetative growth and flowering in African marigold (*Tageteserecta*L.). *J. Orn. Hort.* **7(2):** 179-183.

Ajitkumar 2002. Effect of organic and inorganic fertilizers on growth, yield and post harvest life of marigold. *M. Sc. (Ag.) Thesis,* UAS, Dharwad.

Alam, S., Khalil, S., Ayub, N. and Rashid, M. 2002. In *vitro* solubilization of inorganic phosphate by phosphate solubilizing microorganism (PSM) from maize rhizosphere. *Intl. J. Agri. Bio.* **4:** 454-458.

Amellal, N., Bartoli, F., Villemin, G., Talouizte, A. and Heulin, T. 1999. Effects of inoculation of EPS-producing *Pantoeaagglomerans*on wheat rhizosphere aggregation. *Plant Soil.* **211:** 93-101.

Angadi, P. 2010. Integrated nutrient management studies on growth, yield and quality of garland chrysanthemum (*Chrysanthemum coronarium* L.). *M. Sc. (Ag.) Thesis,* UAS, Dharwad.

Anonymous. 2013. Report of national horticulture board, Indian horticulture database. p. 283.

Atiyeh, R. M., Edwads, C. A., Subler, S. and Metzer, J. D. 2000. Earthworm processed organic waste as components of horticulture potting media for growing marigold and vegetable seedlings. *Compost Sci. Utili.* **8:** 215-223.

Baboo, R. and Sharma, K. S. K. 1997. Effect of nitrogen and potassium fertilization on growth and flowering of annual chrysanthemum. *J. Orn. Hort.* **5(1-2):** 44-45.

Balaji, S. K., Reddy, B. S., Patil, B. C. and Divakara, A. 2006. Influence of vermicompost and *in situ* vermiculture on the quality attributes and saleable yield in China aster. *Scientia Hort.***10:** 217-221.

Balasubramanian, J. 1989. Studies on the combined effect of *Azospirillum*, vesicular arbuscular mycorrhizal and inorganic fertilizers on growth performance of French marigold (*Tagetesputula*L.).*M. Sc. (Agri.) Thesis,*TNAU.,Coimbatore.

Bakulin, M. K., Grudtsyna, A. S. and Pletneva, A. 2007. Biological fixation of nitrogen and growth of bacteria of the genus Azotobacter in liquid media in the presence of Perfluoro carbons. *Appl. Bioch. Microb.* **4:** 399-402.

Bashan, Y. and Holguin, G. 2004. Azospirillum-plant relationships: physiological, molecular, agricultural, and environmental advances (1997-2003). *Can. J. Microb.* **50(8):** 521-577.

Beijerinck, M. W. 1901. Uberologonitro philemikroben. Zentralbl. Bakteriol. Parasitenkd.Infektionskr. *II Abt.* pp. 561-582.

Bhaskaran, P. A. and Jayabalan, N. 2002. Usefulness of biofertilizers in economizing nitrogenous fertilizers in *Tageteserecta*L. *J. Phyto. Res.***15(2):** 155-160.

Biradar, A. P. and Shaila, H. M. 2006. Studies on suitability of vermicomposting structures. *Karnataka. J. Agri. Sci.***19:** 411-413.

Bohra, M. and Kumar, A. 2014. Studies on effect of organic manure and bioinoculants on vegetative and floral attributes of chrysanthemum cv. Little darling. *The Bioscan.* **9(3):** 1007-1010.

Chaudhuri, P. S., Bhattacharjee, G. and Dey, S. K. 2000. Chemical changes during vermicomposting (*Perionyxexcavatus*) of Kitchen waste. *Tropical Ecol.* **41:** 107-110.

Chaitra, R. and Patil, V. S. 2007. Integrated nutrient management studies in china aster (*Callistephuschinensis*Nees) cv. Kamini. *K.J. Agri. Sci.* **20(3):** 689-690.

Chauhan, A. and Kumar, V. 2007. Effect of graded levels of nitrogen and VAM on growth and flowering in calendula (*Calendula officinalis* L.)*Ind. J. Hort.* **10(1):** 61-63.

Chen, Y. P., Rekha, P. D., Arunshen, A. B., Lai, W. A. and Young, C. C. 2006. Phosphate solubilizing bacteria from subtropical soil and their tri-calcium phosphate solubilizing abilities. *App. Soil Ecol.* **34:**

33-41.

Das, J. N. and Mishra, H. N. 2005. Studies on graded doses of fertilizers and polythene mulches on growth, flowering and yield of African marigold (*TageteserectaL.*) cv. Siracole. *Ori. J. Hort.* **33(2):** 42-45.

Dixit, A., Trivedi, J. and Verma, S. 2004. Effect of nitrogen and phosphorus on growth yield and quality of chrysanthemum cv. Local white under Chhattisgarh region. *Plant Arch* **.4(1):** 171-173.

Döberainer J. 1966. *Azotobacterpaspali*sp. nov., uma bacteria fixadora de nitrogenionarhizosfera de Paspalum. *Pesquisa Agropecuaria Brasileira.* **1:** 357-365.

Dorajeerao, A. V. D., Mokashi, A. N., Patil, V. S., Venugopal, C. K., Lingaraju, S. and Koti, R. V. 2012. Effect of graded levels of nitrogen and phosphorus on growth and yield of garland chrysanthemum (*Chrysanthemum coronariumL.*).*K. J. Agri. Sci.* **25(2):** 224-228.

Edwards, C. A. and Fletcher, K. E. 1998. Interactions between earthworms and microorganisms in organic matter breakdown.*Agri. Eco. Environ.* **24:** 225-247.

Ezawa, T., Smith, S. E. and Smith, F. A. 2002. P metabolism and transport in AM fungi. *Plant Soil.* **244:** 221-230.

Fallah, A. 2006. Abundance and distribution of phosphate solubilizing bacteria and fungi in somesoil samples from north of Iran.18th World Congress of Soil Science, July 9-15, Philadelphia, Pennsylvania, USA.

Gangadharan, G. D. and Gopinath, G. 2000. Effect of organic and inorganic fertilizers on growth, flowering and quality of gladiolus Cv. white prosperity. *K. J. Agri. Sci.* **11(3):** 401-405.

Garcia, C., Hernandez, T., Roldan, A., Albaladejo, J. and Castillo, V. 2000. Organic amendment and mycorrhizal inoculation as a practice in afforestation of soils with pinushalepensis miller, effect on their microbial activity. *Soil Bio. Bioch.* **16:** 1173-1181.

Gavhane, P. B., Kore,V. N., Dixit, A. J. and Gondhali, B. V. 2004. Effect of graded doses of fertilizers and polythene mulches on growth, flower quality and yield of marigold (*TageteserectaL.*) Cv. Pusa Narangi Gainda. *Ori. J. Hort.* **32(1):** 35-37.

Gharat, S. N., Rohidas, S. B., Patil, M. B. and Nawghare, P. D. 2008. Impact of organic and inorganic fertilizers on yield and quality parameters of china aster flower var. California giant. *J. MH. Agri. Uni.* **33(1):** 103-104.

Giraddi, R. S. 2007. Vermitechnologies (in Kannada), UAS, Dharwad, India, p. 62.

Giraddi, R. S. 2011. Research priorities in vermitechnologies. Final report submitted to NABARD, Mumbai, p.106.

Gothwal, R. K., Nigam, V. K., Mohan, M. K., Sasmal, D. and Ghosh, P. 2007. Screening of nitrogen fixers from rhizospheric bacterial isolates associated with important desert plants. *App. Eco. Environ. Res* **.6(2):** 101-109.

Gurav, S. B., Katwate, S. M., Singh, B. R., Sabale, R. N., Kakade, D. S. and Dhane, A. V. 2004. Effect of nutritional levels on yield and quality of gerbera. *J. Orn. Hort.* **7(3-4):** 226-229.

Haripriya, K. and Sriramachandrasekharan, M. V. 2002. Effect of organic amendments on the growth and yield of chrysanthemum.*J. Eco.***14(1):** 39-42.

Hidalgo, P. R. and Harkers, R. L. 2002. Earthworms eating as a substrate amendment for chrysanthemum production. *Hort. Sci.* **37(7):** 1035-1039.

Hopp, H. and Slatter, C. S. 1979. The effect of earth worms on the productivity of agricultural soil. *J. Agri. Res.* **78:** 325-329.

Igual, J. M., Valverde, A., Cervantes, E. and Velázquez, E. 2001. Phosphate-solubilizing bacteria as inoculants for agriculture: use of updated molecular techniques in their study. *Agronomie.* **21:** 561-568.

Jawaharlal, M., Swapna, C. and Ganga, M. 2013. Comparative analysis of conventional and precision farming systems for African marigold (Tageteserecta L.). *Acta. Hort.* **970:** 311-318.

Johnson, C. R. 1984. Phosphorus nutrition on mycorrhizal colonization, photosynthesis, growth and nutrient composition of Citrus aurantium. *Plant Soil.* **80:** 35-42.

Jones, P. N., Biradar, A. P., Patil, M. B. 2005. Microflora associated with vermicompost obtained from different weeds. *K. J. Agri. Sci.* **18:** 186-187.

Kale, R. D. 1998. Earthworm-Cinderella of Organic Farming, Prism Books Pvt. Ltd., Bangalore. p. 87.

Karuppaiah, P. and Krishna, G. 2005. Response of spacing and nitrogen levels on growth, flowering and yield characters of French marigold (*TagetespatulaL.*). *Ind. J. Hort.* **8(2):** 96-99.

Kitturmath, M. S., Giraddi, R. S. and Basavaraj, B. 2007. Nutrient changes during earthworm, *Eudriluseugeniae* (Kinberg) mediated vermicomposting of agro industrial wastes. *K. J. Agri. Sci.* **20:** 653-654.

Kore, V. N., Gavhane, P. B., Patil, R., Gondhali, B. V. and Bendale, V. W. 2004. Effect of graded levels of fertilizers and polythene mulches on growth and yield of marigold. *J. Soils Crops.***14(2):** 258-261.

Krassilnikov, N. A. 1949. Opredeliteli Bakteriii Aktinomicetov. Izd. AN sssr. M.

Kucey, R. M. N., Janzen, H. H. and Legget, M. E. 1989. Microbial mediated increases in plant available phosphorus. *Adv. Agron.* **42:** 199-228.

Kulkarni, B. S., Nalawadi, U. G. and Giraddi, R. S. 1996. Effect of vermicompost and vermiculture on growth and yield of china aster (*CallistephuschinensisNees*) cv. Ostrich plum mixed. *S. Ind. Hort.* **44(1&2):** 33-35.

Kumar, M., Sharma, S. K., Singh, S., Dahiya, D. S., Mohammed, S. and Singh, V. P. 2006. Effect of farm yard manure and different biofertilizers on yield and nutrient content of marigold cv. Pusa Narangi. *Har. J. Hort. Sci.* **35(3-4):** 256-257.

Lipman, J. G. 1903. Report on the New Jersey Agricultural Experiment Station. **24:** 217-285.

Lipman, J. G. 1904. Report on the New Jersey Agricultural Experiment Station. **25:** 237-289.

Madhuri, D. 2011. Discemination of vermitechnology to Women. *DST (GOI) Report,* New Delhi. p. 45.

Meenatchi, R. 2008. Molecular characterization of earthworms, nutrient assessment and use of vermitechnologies in pest management. *Ph. D. Thesis,* UAS, Dharwad, Karnataka.

Meenatchi, R., Giraddi, R.S. and Biradar, D.P. 2009. Assessment of genetic variability among strains of earthworm, *Eudriluseugeniae* (Kinberg) using PCRRAP Dtechnique. *K. J. Agri. Sci.* **22:** 942-945.

Mollafilabi, A. and Hosseini, H. 2013. Effect of different seed rates and nitrogen fertilizer on yield and yield components of calendula (*Calendula officinalis*). *Acta Hort.* **997:** 43-50.

Patanwar, M., Sharma, G., Banjare, C., Chandravanshi, D. and Sahu, E. 2014. Growth and development of chrysanthemum (dendranthema grandifloratzvelev) as influenced by integrated nutrient management. *The ecoscan.* **6:** 459-462.

Naik, B. H., Patil, A. A., Patil, V. S. and Basavaraj, N. 2005. Effect of nitrogen and phosphorus on xanthophyll yield of marigold. *K. J. Agri. Sci.***1(3):** 81-88.

Narula, N., Kumar, V. R. K., Behl, Deubel, A., Gransee, A. and Merbach, W. 2000. Effect of Psolubilizing*Azotobacterchroococcum*on N, P, K uptake in P-responsive wheat genotypes grown under greenhouse conditions. *J. Plant Nutri. Soil Sci.* **163:** 393-398.

Nethra, N. N. 1996. Effect of organic and inorganic fertilizers on growth, yield and postharvest life of china aster (*Callistephus chinensis* Nees.). *M. Sc. (Hort.) Thesis,* UAS, Bangalore.

Page, W.J. andShivprasad, S. 1991. *Azotobactersalinestris*sp. nov., a sodium-dependent, microaerophili, and aeroadaptive nitrogen-fixing bacterium. *Int. J. Sys. Bacteriol.* **41:** 369-376.

Papavizas, G. C. and Lumsden, R. D. 1982. Improved medium for isolation of *Trichoderma spp.*From soil. *Plant Dis.* **66:** 1019-1020.

Pascual, J. A., Garcia, C and Hernandez, T. 1999. Comparison of fresh and composted organic waste in their efficacy for the improvement of arid soil quality. *Biores. Tech.* **68:** 255-264.

Patel, P. R., Patel, N. K., Valia, R. Z. and Chaudhari, S. R. 2011. Effect of nitrogen and vermicompost on floral and yield parameters of african marigold. *Asi. J. Hort.* **6(2):** 478-480.

Polara, N. D., Gajipara, N. N. and Barad, A. V. 2014. Effect of nitrogen and phosphorous on nutrient content and uptake in different varieties of African marigold (Tageteserecta L.). *The Bioscan.* **9(1):** 115-119.

Ponmurugan, P. and Gopi, C. 2006. Distribution pattern and screening of phosphate solubilising bacteria isolated from different food and forage crops. *J. Agron.* **5:** 600-604.

Prabhatkumar, S., Raghava, P. S. and Mishra, R. L. 2003. Effect of biofertilizers on growth and yield of China Aster. *J. Orn. Hort.* **6(2):** 85-88.

Prakash, A., Sharma, S. K., Sindhu, S. S. and Prakash, A. 2002. Effect of phosphorous and FYM on NPK content of marigold in chloride dominated soil. *Har. J.Hort. Sci.* **31(1&2):** 47-49.

Preethi, T. L. 1990. Studies on the effect of nitrogen, *Azospirillum*and ascorbic acid on growth and flowering of Edward rose (*Rosa bourboniana* Desp.). *M. Sc. (Agri.)Thesis,* TNAU, Coimbatore.

Ratti, N., Kumar, S., Verma, H. N. and Gautam, S. P. 2001. Improvement in bioavailability of tricalcium phosphate to Cymbopogonmartiniivar.motiaby rhizobacteria, AMF and Azospirilluminoculation. *Microb. Res.***156:**145-149.

Ros, M., Garcia, C. and Hernandez, T. 2001. The use of organic waste in the control of erosion in a semiarid mediterrannean soil.*Soil Use Manag.***17:** 292-293.

Sahu, N. P. 2014. Effect of bio-organic and inorganic nutrient sources on the growth and flower yield of marigold. *M. Sc. (Agri.)Thesis,*IGKV, Raipur.

Shadanpour, F., Torkashvand, A. M. and Majd, K. H. 2011. Marigold the possibilty using vermicompost as the growth medium. *J. Orn. Hort. Plants.* **1(3):** 153-160.

Sharma, A. K. 2005. The living soil Bio-fertilizers for Sustainable Agriculture, Agrobios (India), Jodhpur, pp. 1-19.

Singh, A. K. 2005. Response of rose plant growth and flowering to nitrogen, *Azotobacter*and farm yard manure. *J.Orn. Hort.***8(4):** 296-298.

Srinivasa, K. N. and Narayana Gowda, J. V. 1999. Effect of different organic manures on growth and flower yield of china aster (*Callistephuschinensis*(L.) Nees.).*Crop Res.***18:** 104-107.

Sonawane, S. P., Dabke, D. J., Dabke, S. B. and Dhane, S. S. 2009. Effect of nitrogen, and FYM on yield and nutrient uptake by china aster (*Callistephuschinensis*(L.) Ness).*J. Mh. Agri. Uni.***34(1):** 90-91.

Subbarao, N. S., Venkataraman. G. S. and Kannaiyan, S. 1993. Biological nitrogen fixation.*Allied publication*, 104 A Mayapuri, New Delhi.

Tarrand, J. J., Krieg, N. R. andDoberreiner, J. 1978.A taxonomics study of the *Spirillum lipoferum*group, with descripction of new genus.*Azospirillum*gen. Nov and species.*Azospirillumlipoferum*(Bejerink) Comb.Nov and *Azospirillumbrasili-nese*.Sp. Nov.*Can. J.Micro.***27:**967-980.

Thompson, J.P. andSkerman V.B.D. 1980.*Azotobacteraceae*: the taxonomy and ecology of the aerobic nitrogen fixing bacteria. Academic Press, London.

Thompson, J.P. andSkerman V.B.D. 1981. Validation list No6. *Int. J. Syst. Bacteriol.,***31:** 215-218.

Tripllet, E.W. 1996. Diazotrophic endophytes: progress and prospects for nitrogen fixation in monocots. *Plant Soil***186:** 29-38.

Verma, S. K., Angadi, S. G., Patil, V. S., Mokashi, A. N., Mathad , J. C. And Mummigatti, U.V. 2011. Growth, yield and quality of chrysanthemum (*Chrysanthemum morifolium*Ramat.) cv. Raja as influenced by integrated nutrient management. *K. J. Agri. Sci.***24(5):** 681-683.

Wange, S.S., Patil, P.L. and Patil, J.J. 1995. Effect of biofertilizers alone and with nitrogen levels on tuberose cv. Single petated. *J. Soils and Crops***5(2):** 97-99.

Warade, A. P., Golliwar, V. J., Chopde, N., Lanje, P. W. and Thakre, S. A. 2007. Effect of organic manures and biofertilizers on growth, flowering and yield of dahlia.*J Soils Crops***17(2):** 354-357.

Waseem, M. A.,Giraddi, R. S. and Math, K. K. 2013. Assessment of nutrients and micro flora in vermicompost enriched with various organics. *J. Exp Zoo I***16:** 697-703.

Whitelaw, M. A. 2000. Growth promotion of plants inoculated with phosphate solubilizing ;fungi.*Adv.Agron.* **69:**99-151.

Zaidi, A. 1999. Synergistic interactions of nitrogen fixing microorganisms with phosphate mobilizing microorganisms.Ph.D. Thesis, Aligarh Muslim University, Aligarh, India.