The Pharma Innovation Journal 2022; 11(3): 1406-1410

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 1406-1410

www.thepharmajournal.com
Received: 09-12-2021
Accepted: 20-01-2022

Nilasree Borah
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Dr. Pradip Mahanta
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Dr. Madhumita Choudhury Talukdar
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Dr. Nilay Borah
Department of Soil Science, Assam Agricultural University, Jorhat, Assam, India

Dr. Madhumita Barooah
Department of Biotechnology, Assam Agricultural University, Jorhat, Assam, India

Corresponding Author:
Nilasree Borah
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Influence of biofertilizers in combination with organic and inorganic nutrients on growth characteristics of a Gerbera (*Gerbera jamesonii* Bolus) plant

Nilasree Borah, Dr. Pradip Mahanta, Dr. Madhumita Choudhury Talukdar, Dr. Nilay Borah and Dr. Madhumita Barooah

Abstract
An experiment was carried out to study the Influence of biofertilizers on growth characteristics and yield of Gerbera (Gerbera jamesonii Bolus)" plant under open field condition of Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2015-2016 and 2016-2017. The experiment was laid out with 9 treatments in Randomized Block Design and replicated 3 times. Pooled data analysis over two years revealed that the highest plant height (13.14, 25.32, 55.78 and 59.24cm at 45, 75, 105 and 135 DAP), highest number of leaves (9.35, 19.46, 29.38 and 33.72 at 45, 75, 105 and 135 DAP), highest leaf area (3366.25cm^2), highest plant spread (43.45cm), highest leaf area index (1.79) and highest number of suckers per plant (13.33) were observed respectively for T_7(½ NPK + ½ Vermicompost + Consortium). The study led to the conclusion that experiment Biofertilizer has been identified as an alternative to chemical fertilizer in order to increase soil fertility and crop production in sustainable farming.

Keywords: Biofertilizer, vermicompost, consortium, sustainable farming, soil fertility

1. Introduction
Gerbera (*Gerbera jamesonii* Bolus) belonging to family Asteraceae is an important cut flower, native to tropical Asia and Africa. It is a dwarf perennial stemless plant. The genus Gerbera consists of forty species of semi hardy and perennial flowering plants (Bailey, 1963) [3], the only species under cultivation is *G. jamesonii* with chromosome number n=25. *Gerbera jamesonii* Bolus commonly known as Transvaal Daisy or Barberton Daisy is a tender perennial having brilliantly coloured disc-shaped flowers and leafless stems. It is native to Transvaal, South Africa and Asia. According to the global trends in floriculture, gerbera occupies the fourth place among the top ten cut flowers in the world after rose, carnation and chrysanthemum (Choudhary and Prasad, 2000) [9].

Today, Agrochemicals are being used excessively in crop production due to high trend in industrialization and population explosion in the world. Their continuous application has introduced major challenges for farmers in the form of soil infertility, nutrient imbalance, accumulation of toxic chemicals in the soil and food products which have an adverse effect on the soil productivity, ecosystem destruction, environmental degradation and also affecting the yield and quality of the product (Eman *et al*, 2008) [10].

In that condition, sustainable agricultural practices have become a very difficult job for commercial growers now a days. To cope with all these problems a cheaper, better and safer way is necessary in order to improve the soil fertility status, maximize the agricultural productivity with minimum Eco hazards. All these criteria can be achieved through application of bio-fertilizers which is known as "microbial inoculants", these are the products containing the living cells (mainly bacteria & fungi) that naturally activate the microorganisms found in the soil, restoring the soil fertility and improve Physico-chemical and biological properties of soil. Besides their role in atmospheric nitrogen fixation and phosphate Solubilisation, they also help in stimulating the plant growth hormones providing better nutrient uptake and increasing tolerant towards drought and moisture stress (Anandaraj and Delapierre, 2010).

2. Materials and Methods
The experiment was carried out at the Experimental Farm of the Department of Horticulture,

Assam Agricultural University, Jorhat for two years during 2015-17 in a Randomized Block Design (RBD) which was replicated thrice. The Treatments were T_0 (Control), T_1 {*Bacillus subtilis* (4% solution)}, T_2 {*Microbacterium laevaniformans* (4% solution)}, T_3 NPK (@15:10:20 g m^{-2}), T_4 Vermicompost (5 kg per plot), T_5 (½ NPK + ½ Vermicompost + *Bacillus subtilis*), T_6 (½ NPK + ½ Vermicompost + *Microbacterium laevaniformans)*, T_7 (½ NPK + ½ Vermicompost + Consortium) and T_8 (Consortium). Cultivar Indukumari having uniform vigour and age were selected and planted on 15th of October in both the years of the study at a spacing of 30 cm x 30 cm. The beds of 2.25 sq. m were raised to 25 cm from the ground level to avoid water stagnation. The crops were raised by following nine treatments in both the years. Data on growth characteristics and yield were recorded after 45 days onwards up to 135 days after planting when the plants were fully grown. All results were statistically analyzed using method advocated by Panse and Sukhatme (1985). When ANOVA showed significant differences, mean separation was carried out using critical difference (C.D) test at 5% level of significance to draw the valid conclusion.

3. Result and Discussion

Growth, development and ultimate yield of any crop are regulated through a series of biological events involving biochemical, physiological and morphological changes which takes place during its development in accordance with the supply of light, water, temperature and nutrients (Donald, 1962).

Influence of biofertilizers and in combination with organic and inorganic nutrient sources significantly increased plant height, number of leaves, leaf area, plant spread, leaf area index at vegetative stage and number of suckers (Table 1 to 5). The highest values of these parameters were recorded in T_7 (½ NPK + ½ Vermicompost + Consortium), in most of the characters treatments were at par with T_5 (½ NPK + ½ Vermicompost + *Bacillus subtilis*) and T_6 (½ NPK + ½ Vermicompost + *Microbacterium laevaniformans*). This clearly indicates that there was a positive response of bio fertilizers on growth characters of gerbera. Similar findings have been reported by Saikia (2014) in gerbera and Chetia (2016) in tuberose.

Certain growth promoting substances secreted by biofertilizers which in turn might have led to better root development, better transportation of water, uptake and deposition of nutrients. These findings are in conformity with Kanwar *et al*. (2002) in cauliflower. Continuous use of the biofertilizers also results in gradual build up of their population in the soil which on many occasions lead to the stabilization of their effect even on the absence of fresh inoculation (Goyal, 1991). Enhancement in growth characters of gerbera due to addition of organic nutrient sources are in conformity with the findings of Prabhatkumar *et al*. (2003) in china aster and Gupta *et al.* (2004) in carnation.

The plant height records are furnished in Table 1. The highest plant height of 59.24cm was recorded for the treatment T_7 (½ NPK + ½ Vermicompost + Consortium). Increase in height might be due to the higher availability of nitrogen, which will convert into amino acids, which in turn leads to increased rate of meristamatic activity resulting in better plant height. This is in confirmation with earlier reports of Arora and Jhon (1978), Mukhopadhyay (1981) and Biswas *et al.* (1982) in carnation, Johnson *et al.* (1982) in chrysanthemum, Bagyaraj and Powel (1985) [2] in marigold. Continuous use of the biofertilizers also results in gradual build up of their population in the soil which on many occasions lead to the stabilization of their effect even on the absence of fresh inoculation (Goyal, 1991). Similar results of higher plant height due to combined application of *Azospirillum*, PSB and inorganic fertilizers have been reported earlier in crossandra (Narashimaraju and Haripriya, 2001) and in gundumalli (Manonmani, 1992).

Number of leaves per plant decides the efficiency of photosynthetic activity, which helps in improved plant growth and yield. In the present study, number of leaves (Table 2) produced per plant increased throughout the cropping period. The leaves serve as the active site for food synthesis in plant. The highest number of leaves (33.72) was recorded in T_7 (½ NPK + ½ Vermicompost + Consortium). This indicates that there would have been better supply of both macro and micro nutrients, which could have contributed to increased leaf number. Increased number of leaves might be attributed to efficiency of biofertilizers in terms of nitrogen fixation, phosphorus solubilisation and its mobilisation and production of growth promoting substances. The research results of the study are in conformity with the findings of Kale *et al.* (1987) [14] in salvia, Nethra (1996) in china aster and Prasanna (2007) [16] in gerbera who observed more number of leaves due to biofertiliser application. Their application to the soil and root dip treatment as they contain nitrogen in available form, which might have increased the number of leaves (Somasundaram *et al.*, 2004) [21]. The increase in plant height and number of leaves with application of organic inputs are in conformity with the findings of Gayathri *et al.* (2004) [11] in statice.

Plant spread (Table 3) was significantly influenced by the use of different sources of organic manures, biofertilizers. Maximum plant spread (43.45cm) was recorded in the treatment T_7 (½ NPK + ½ Vermicompost + Consortium). Increased plant spread might be attributed to the effective functioning of bio fertilizers which produce bioactive substances with probiotic effects. They might have produced bioactive substances having similar effect as that of growth hormones leading to better vegetative growth (Somasundaram *et al.*, 2004) [21]. This might be attributed to the sufficient quantity of nutrient flow into the plants treated with bio fertilizers and bio stimulants as reported earlier by Renukaradya (2005) in carnation.

The leaf area of the plant plays an important role in the photosynthetic activity as it harnesses more of radiant energy from the sunlight. Leaf area (Table 3) also increased throughout the cropping period. Highest leaf area (3366.25cm^2) was recorded in T_7 (½ NPK + ½ Vermicompost + Consortium). It might be due to the easy availability and uptake of the element nitrogen by the plant. Nitrogen being a constituent of chlorophyll might have increased the leaf area (Mengel and Kirkby, 1969) and (Sindhu and Gupta, 1993) [19] thereby more synthesis of carbohydrates, which are utilized in building up of new cells. Further, the highest leaf area influence the activity of phytohormones (Marchner, 1986) as it has direct effect on biosynthesis of cytokinin that have positive correlation with leaf area (Rechards, 1981). The mechanisms by which PSB augment plant growth is through phosphate dissolution and in the biosynthesis of auxin (Sattar and Gaur, 1987) and IAA (Barea *et al.*, 1976), besides providing protection against the non-parasitic root pathogens

and transforming unavailable mineral and organic compounds into available forms in plants which might be lead to increase in plant growth.

Similarly the highest leaf area index (Table 4) of 1.79 was recorded in treatment T_7 (½ NPK + ½ Vermicompost + Consortium).

The number of suckers (Table 4 and Fig. 5) produced per plant at the end of two years was maximum *i.e.* 13.33 recorded in treatment T_7, when treated with (½ NPK + ½ Vermicompost + Consortium). It might be due to the presence of phytohormones in the bio fertilizers results in production of large sized and increased number of leaves and after the diversion of the photosynthates to the sink, the rest would have been used in the production of suckers. Cytokinins are known for their potential to arrest apical dominance and thereby induce more suckers or lateral branches. Similar observation was made by Puttaswamy (2004) [17] in gerbera.

Table 1: Plant height (cm) at different growth stages

Treatment	45 Days after planting			75 Days after planting			105 Days after planting			135 Days after planting		
	2015-2016	2016-2017	Pooled	2015-2016	2015-2016	Pooled	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled
T_0: Control	7.70	8.03	7.87	16.87	18.43	17.65	42.98	43.50	43.24	45.33	47.62	46.48
T_1: *Bacillus subtilis* (4% solution)	9.27	9.93	9.60	18.93	21.33	20.13	45.77	47.08	46.43	49.96	52.51	51.24
T_2: *Microbacterium laevaniformans* (4% solution)	9.53	10.07	9.80	19.23	20.90	20.07	46.18	47.99	47.08	50.44	53.18	51.81
T_3: NPK (@15:10:20 g m^{-2})	10.21	11.26	10.74	21.48	22.90	22.19	48.76	50.33	49.55	52.46	55.44	53.95
T_4: Vermicompost (5 kg per plot)	11.07	12.02	11.54	22.96	23.35	23.15	50.39	52.36	51.38	55.31	57.48	56.40
T_5: ½ NPK + ½ Vermicompost + *B. subtilis*	11.59	12.66	12.12	23.15	24.96	24.06	52.90	54.33	53.62	56.39	57.50	56.94
T_6: ½ NPK + ½ Vermicompost + *M. laevaniformans*	12.26	13.00	12.63	23.39	25.09	24.24	53.40	55.10	54.25	57.02	58.28	57.65
T_7: ½ NPK + ½ Vermicompost + Consortium	12.79	13.50	13.14	24.13	26.50	25.32	55.41	56.15	55.78	58.63	59.84	59.24
T_8: Consortium	9.70	10.79	10.24	20.13	21.78	20.96	47.59	48.72	48.15	51.33	54.40	52.86
S.Ed (±)	0.73	0.43	0.45	0.38	0.84	0.49	1.07	1.09	0.61	1.30	1.98	1.02
CD (5%)	1.56	0.92	0.95	0.81	1.78	1.04	2.27	2.30	1.30	2.76	4.20	2.16

Table 2: Number of leaves at different growth stages

Treatment	45 Days after planting			75 Days after planting			105 Days after planting			135 Days after planting		
	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled
T_0: Control	4.67	5.40	5.03	9.67	11.67	10.67	17.99	19.33	18.66	21.07	24.17	22.62
T_1: *Bacillus subtilis* (4% solution)	5.67	6.20	5.93	11.67	13.80	12.73	21.33	23.00	22.17	23.83	26.79	25.31
T_2: *Microbacterium laevaniformans* (4% solution)	6.00	6.60	6.30	12.93	14.27	13.60	20.76	22.83	21.80	24.33	27.17	25.75
T_3: NPK (@15:10:20 g m^{-2})	7.07	7.80	7.43	15.53	15.73	15.63	23.37	25.07	24.22	26.37	29.60	27.98
T_4: Vermicompost (5 kg per plot)	7.30	8.07	7.68	16.53	17.07	16.80	25.07	27.73	26.40	28.30	31.90	30.10
T_5: ½ NPK + ½ Vermicompost + *B. subtilis*	7.80	8.73	8.27	17.00	18.93	17.97	27.21	28.88	28.04	30.67	31.33	31.00
T_6: ½ NPK + ½ Vermicompost + *M. laevaniformans*	8.00	8.07	8.03	17.40	19.33	18.37	26.60	28.10	27.35	31.43	33.57	32.50
T_7: ½ NPK + ½ Vermicompost + Consortium	8.97	9.73	9.35	18.13	20.79	19.46	28.93	29.82	29.38	33.00	34.43	33.72
T_8: Consortiaum	6.93	7.00	6.97	13.20	14.87	14.03	22.67	23.83	23.25	25.65	27.77	26.71
S.Ed (±)	0.62	1.00	0.70	1.21	1.41	0.94	2.08	1.99	1.42	2.22	1.86	1.26
CD (5%)	1.32	2.13	1.49	2.57	2.99	2.00	4.41	4.03	3.01	4.71	3.95	2.67

Table 3: Leaf area per plant and plant spread

Treatment	Leaf area (cm^2)			Plant spread(cm)		
	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled
T_0: Control	1149.47	1660.94	1405.20	34.95	36.00	35.48
T_1: *Bacillus subtilis* (4% solution)	1711.34	2238.08	1974.71	38.56	40.69	39.62
T_2: *Microbacterium laevaniformans* (4% solution)	1730.85	2129.85	1930.35	39.28	41.13	40.21
T_3: NPK (@15:10:20 g $m^{-})^2$	2024.38	2649.65	2337.02	40.73	43.61	42.17
T_4: Vermicompost (5 kg per plot)	2334.39	2926.56	2630.48	40.02	41.84	40.93
T_5: ½ NPK + ½ Vermicompost + *B. subtilis*	2622.76	3109.58	2866.17	41.82	43.07	42.45
T_6: ½ NPK + ½ Vermicompost + *M. laevaniformans*	2739.27	3255.50	2997.39	39.96	42.49	41.23
T_7: ½ NPK + ½ Vermicompost + Consortium	3191.45	3541.04	3366.25	43.08	43.82	43.45
T_8: Consortium	1938.00	2443.50	2190.75	39.94	41.73	40.83
S.Ed (±)	163.89	152.09	102.20	0.65	0.26	0.35
CD (5%)	347.44	322.41	216.66	1.38	0.54	0.75

Table 4: Leaf area index and number of suckers per plant

Treatment	Leaf area index			Number of suckers per plant		
	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled
T_0: Control	0.95	1.28	1.12	7.67	8.60	8.13
T_1: *Bacillus subtilis* (4% solution)	1.15	1.35	1.25	10.20	10.60	10.40
T_2: *Microbacterium laevaniformans* (4% solution)	1.13	1.26	1.19	10.33	10.53	10.43
T_3: NPK (@15:10:20 g m^{-2})	1.23	1.39	1.31	11.09	11.13	11.11
T_4: Vermicompost (5 kg per plot)	1.47	1.67	1.57	11.87	11.67	11.77
T_5: ½ NPK + ½ Vermicompost + *B. subtilis*	1.50	1.68	1.59	12.13	12.93	12.53
T_6: ½ NPK + ½ Vermicompost + *M. laevaniformans*	1.73	1.80	1.77	12.80	13.07	12.93
T_7: ½ NPK + ½ Vermicompost + Consortium	1.73	1.84	1.79	13.20	13.47	13.33
T_8: Consortium	1.22	1.40	1.31	10.97	10.93	10.95
S.Ed (±)	0.13	0.09	0.07	0.81	0.68	0.57
CD (5%)	0.27	0.20	0.16	1.72	1.44	1.20

Table 5: Days to bud visibility from planting and days to bud opening from bud visibility

Treatment	Days to bud visibility from planting			Days to bud opening from bud visibility		
	2015-2016	2016-2017	Pooled	2015-2016	2016-2017	Pooled
T_0: Control	78.80	74.50	76.65	15.62	15.08	15.35
T_1: *Bacillus subtilis* (4% solution)	71.67	70.87	71.27	12.92	12.03	12.48
T_2: *Microbacterium laevaniformans* (4% solution)	70.30	69.60	69.95	12.32	11.92	12.12
T_3: NPK (@15:10:20 g m^{-2})	68.23	65.74	66.99	11.12	10.67	10.89
T_4: Vermicompost (5 kg per plot)	66.10	62.80	64.45	10.22	9.67	9.94
T_5: ½ NPK + ½ Vermicompost + *B. subtilis*	65.15	62.33	63.74	9.63	9.20	9.42
T_6: ½ NPK + ½ Vermicompost + *M. laevaniformans*	64.43	61.73	63.08	9.50	8.83	9.17
T_7: ½ NPK + ½ Vermicompost + Consortium	62.13	60.05	61.09	8.97	8.33	8.65
T_8: Consortium	69.37	68.57	68.97	11.80	11.03	11.42
S.Ed (±)	3.51	3.12	2.44	1.28	1.38	0.92
CD (5%)	7.43	6.61	5.17	2.71	2.93	1.95

4. Conclusion

From the foregoing discussion, it can be concluded that the treatment T_7 (½ NPK + ½ Vermicompost + Consortium) were found to be the most efficient treatment in terms of both yield and quality as well as for sustaining soil health. In recent times government has identified whole N.E. region as organic zone where most of the cultivated areas have been identified as naturally organic. Hence, this treatment may be placed under multi-location trials in farmer's field to judge the efficacy for commercial cultivation of gerbera by reducing the quantity of chemical fertilizers in different agro climatic zones to improve the soil structure and texture, reduces soil pollution, reduced extensive fertilizer application which is beneficial for the present problems of high cost of fertilizers and environmental pollution.

5. References

1. Asghar HN, Zahir ZA, Arshad M, Khalig A. Plant growth regulating substances in the rhizosphere: microbial production and functions. Adv Agron. 2002;62:146-151.
2. Bagyaraj DJ, Powell CL. Effect of VAM inoculation and fertiliser application on growth of marigold. New Zealand Agric. Res. 1985;28(1):169-173.
3. Bailey LH. Gerebera. The Standard Encyclopedia of Horticulture. The McMillan Press. New York. In: Commercial Foriculture Bose T. K. and Yadav, L. P. (eds.) Naya Prakash, Calcutta, India, 1963, 601p.
4. Bhalla R, Dharma S, Dhiman SR, Jain R. Effect of Biofertilizers and Biostimulants on Growth and Flowering in Standard Carnation *(Dianthus Caryophyllus* Linn.*)*. J. Ornam. Hort. 2006;9(4):282-284.
5. Bonita DE, Duke ER, Elliot MC. Root colonisation by *Glomus intraradises* (VAM fungi) on horticultural species. Proc. Flo. State Hort. Sc. 1994;107:217-220.
6. Bullock LR, Brosius M, Evanylo GK, Ristaino JB. Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. Appl. Soil Ecol. 2002;19:147-160.
7. Chandrikapure KR, Sadawrte KT, Padhbhai DM, Shelke BD. Effect of bioinoculants and graded doses of nitrogen on growth and flower yield of Marigold (*Tagetes erecta* L.). Orissa J. Hort. 1999;27(2):31-34.
8. Chanu IL. Long term influence of inorganic and organic fertilization on K dynamics in rice-rice cropping system in an Alfisol. M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat, 2015.
9. Coudhary ML, Prasad KV. Protected cultivation of ornamentals-an insight. Ind. Hort. 2000;43:49-53.
10. Eman AA, Monem AE, Saleh MMS, Mostafa EAM. Minimizing the quantity of mineral nitrogen fertilization grapevine by using humic acid organic and biofertilizers. Res. J Agric. Sci. 2008;4:46-50.
11. Gayathri HN, Jayaprasad KV, Narayanaswamy P. Response of biofertilizers and their combined application with different levels of inorganic fertilizers in Statice (*Limonium caspia*). J. Ornam. Hort. 2004;7(1):70-74.
12. Gogoi B, Barua NG, Barua TC. Effect of integrated supply of nutrient on soil microbial biomass carbon in an inceptisol of Assam. J Ind. Soc. Soil Sci. 2015;58(2):241-244.
13. Gupta RK, Arora BR, Sharma KN, Ahluwalia SK. Influence of biogas slurry and farm yard manure application on the changes in soil fertility under rice-wheat sequence. J Ind. Soc. Soil Sci. 2000;48:500-505.
14. Kale RD, Bano K, Sreenivasa MN, Bagyaraj DJ. Influences of worm cast on the growth and Mycorrhizae of two ornamental plants. South Indian Hort.

1987;35(6):433-437.
15. Merelo S, Porros JD, Herencia JF, Madegon E. Chemical and biochemical properties in a silty loam soil under conventional and organic management. Soil Till. Res. 2006;90:162-170.
16. Prasanna VP. Influence of microbial inoculants on growth and flower yield of gerbera under greenhouse conditions. M.Sc. Thesis. University of Agricultural Sciences, Bangalore, 2007, 73-75p.
17. Puttaswamy NM. INM in potted gerbera (*Gerbera jamesonii* H. Bolus) grown under shade house conditions. M.Sc. Thesis, University of Agricultural Sciences, Bangalore, 2004, 60-64p.
18. Seetha MC. Effect of vermicompost and biofertilisers on growth and yield of gerbera cv. Local. M.Sc. Thesis, University of Agricultural Sciences, Bangalore, 1999.
19. Sindhu SS, Gupta AK. Effect of different levels of N, P and K on flower production in hybrid tea rose cv. Super star. Haryana. Agric. Univ. J Res. 1993;23:47-50.
20. Singh B, Srivastava R, Chandra R. Response of Panchagavya and Manchurian Mushroom Tea on floral characters in tube rose (*Polianthes tuberose* Linn.) cultivar Pearl Double. J Ornam. Hort. 2007;10(4):250-254
21. Somasundaram E, Sankaran N, Chandragiri D, Thiyagarajan TM. Bio-gas slurry and Panchagavya promising organics to reconstruct our Agro eco system. Agro bios News Letter. 2004;2(10):13-14.
22. Srikanth K, Srinivasamurthy CA, Siddaramappa R, Ramaurishnaparama VR. Direct and residual effect of enriched composts, FYM, vermicompost and fertilizers on properties of an Alfisol. J Indian Soc. Soil Sci. 2000;48:496-499.
23. Stevenson TL. Dehydrogenase activity in some soils under pasture. J. Soil Biol. Biochem. 1959; 3:97-110.
24. Tao G, Jian S, Cai M, Xie G. Phosphate solubilising and mineralising abilities of bacterial isolated from soil. Pedosphere. 2008;18(4):515-523.
25. Thane SR, Shembekar RZ, Bhongle SA, Badge SA. Effect of integrated nutrient management on flower quality, yield and vase life of gerbera (*Gerbera jamesonii* H. Bolus) grown under shade net conditions. Plant Archives. 2007;7(2):679-680.
26. Verma SK, Angadi SG, Patil VS, Mokashi AN, Mathad JC, Mummigatti UV. Growth, yield and quality of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Raja as influenced by integrated nutrient management. Karnataka J Agric. Sci. 2011;24(5):681-683.
27. Vessey JK. Plant growth promoting rhizobacteria as biofertilizers. Plant Soil. 2003; 255:571-586.
28. Yumnam S. Effect of floral preservatives on the post harvest life of gerbera (*Gerbera jamesonii* Hook.) cv. Galileo. M.Sc.(Hort) Thesis, University of Agricultural Sciences, Bangalore, 2008.
29. Zink TA, Allen MF. The Effects of Organic Amendments on the Restoration of a disturbed coastal Sage Scrub Habitat. Restoration Ecology. 1998;6(1):52-58.