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EFFECT OF BIO FERTILIZERS AND CHEMICALS ON VEGETATIVE GROWTH AND YIELD OF GERBERA

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ABSTRACT
An investigation was carried out to study the effect of bio fertilizers (*Azotobacter* @ 1l/ha and VAM @ 2g/plant) as soil application, chemicals (25 and 50 ppm each of spermine and salicylic acid) and organic growth substances (0.5 and 1% banana pseudo stem sap and 4% vermiwash) as foliar spray on gerbera under NV polyhouse condition. Gerbera plants inoculated with bio fertilizers showed improved growth and yield attributes over uninoculated plants. Among the foliar spray treatments, 25 ppm spermine and 4% vermiwash significantly increased plant height, plant spread, number of leaves, chlorophyll content in the leaf, MSI in the petal tissue, lignin content in the stalk, yield and vase life of gerbera. Treatment combination of bio fertilizer inoculation (*Azo* and VAM) along with 25 ppm spermine foliar spray recorded significantly maximum plant height (42.87 cm), plant spread (61.34 cm), number of leaves (31.17), MSI of the petal tissue (84.55, 79.77 and 75.50 %), maximum yield per plant (57.17) and vase life of the flower (9.29 days) which was followed by the treatment combination of bio fertilizers along with foliar spray of 4% vermiwash. Higher chlorophyll content in leaf tissue (2.03 mg/g) and lignin content in the flower stalk (6.84 %) were found with the treatment combination of bio fertilizers along with 4% vermiwash foliar spray which was at par with bio fertilizers along with 25 ppm spermine. Thus, the treatment combinations of bio fertilizers along with foliar spray of 25 ppm spermine or 4% vermiwash significantly improved the growth, yield and vase life of gerbera.

INTRODUCTION

Gerbera (*Gerbera jamesonii* Hook.) is one among the popular cut flowers, out valuing all utilities through its magnificent beauty, bewitching colours, exquisite shapes and sizes and easy availability throughout the year. Gerbera ranks 5th in both domestic and global cut flower trade (Zheng *et al*., 2016). Besides, nutritional management, use of soil amendments than 200 words.in the form of bio fertilizers and foliar spray of growth stimulating chemicals and organic substances can enhance the growth of the plants and flower yield. Bio fertilizers *viz*., *Azotobacter* and Vesicular Arbuscular Mycorrhizae (VAM) are the beneficial microbes that modify the rhizosphere and effect the mobilization and acquisition of soil nutrients and microbial dynamics and influence crop productivity and sustainability (Zhang *et al*., 2004). Polyamines like spermine, spermidine and putrescine are new class of plant growth regulator and have been implicated in wide range of biological processes, including cell division, protein synthesis, DNA replication, differentiation and rhizogenesis (Van denBroek *et al*., 1994). Vermiwash (VW), mixture of excretory products and mucus secretion of earthworms consists of micronutrients from the soil organic molecules, as well as growth enhancing molecules (Arancon *et al*., 2007). However, to the best of our knowledge, no reports are available on the effects of the combined use of bio fertilizers as soil inoculants and chemicals and organic growth substances as a foliar spray. Hence, this experiment was conducted to study the individual and interaction effect of bio fertilizers, chemicals and organic growth substances on growth and yield of gerbera.

MATERIALS AND METHODS

Experiment was conducted under naturally ventilated polyhouse located at greenhouse complex, Dept. of Floriculture and Landscape Architecture, ACHF, NAU, Navsari. Experiment was laid out in completely randomised design with factorial concept. Factor one consisted of two levels one being without bio fertilizers (B_0) and another with fertilizers (B_1) (*Azo* @ 1 l/ha + VAM @ 2g/plant) and factor two consists of 7 levels of foliar sprays, 25 ppm spermine (C_1), 50 ppm spermine (C_2), 25 ppm salicylic acid (C_3), 50 ppm salicylic acid (C_4), 0.5 % banana pseudo stem sap (C_5), 1.0 % banana pseudo stem sap (C_6) and 4% vermiwash (C_7). Thus, there were 14 treatment combinations and were repeated three times. Bio fertilizers *viz*., *Azotobacter* was given in the form of drenching and VAM was applied in the pits at the time of planting. Foliar spray of respective treatments were given one month after transplanting and repeated at six months interval. All the vegetative growth parameters *viz*., plant height (cm), plant spread (cm), number of leaves and yield per plant were recorded. Chlorophyll content in the leaf tissue (mg/g) was estimated by DMSO (Dimethylsulphoxide) method (Wellburn, 1994), while, lignin content in the flower stalk was estimated by the procedure given by Lopez *et al*. (2012). Membrane stability index (MSI %) was estimated depending on the electrolytic leakage of the petal tissue as described by Singh *et al*. (2008). Vase life was expressed in terms of days from the date of harvest to the day showed the sign of wilting. The experimental data pertaining to all the characters studied were subjected to statistical analysis of variance technique as

described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Data presented in Table. 1 and 2 depicted that, in general plants inoculated with bio fertilizers (B_1) recorded significantly maximum plant height, plant spread, number of leaves, chlorophyll content in the leaf tissue, membrane stability index of petal tissue, lignin in the flower stalk, yield per plant and vase life as compared to uninoculated plants (B_0). Further, the plants sprayed with 25 ppm spermine (C_1) recorded maximum plant height, plant spread, number of leaves, MSI of petal tissue, yield of flowers per plant and enhanced vase life which was followed by or at par with 4% vermiwash (C_7), whereas, maximum chlorophyll content in the leaf and lignin content in the stalk was recorded with the treatment of 4% vermiwash (C_7) which was at par with 25 ppm spermine (C_1).

Among all the treatment combinations, plants inoculated with bio fertilizers and sprayed with 25 ppm spermine (B_1C_1) recorded significantly maximum plant height (42.87 cm), plant spread (61.34 cm) and number of leaves (31.17) which was followed by the treatment combination bio fertilizers + 4% vermiwash (B_1C_7). Higher chlorophyll content in leaf tissue (2.03 mg/g) and lignin content in the flower stalk (6.84 %) were found in the treatment combination of bio fertilizers + 4% vermiwash (B_1C_7) which was at par with bio fertilizers and foliar treatment of 25 ppm spermine (B_1C_1). Azotobactin, a specific siderophore, that is present in the *Azotobacter* has a short peptide chain, containing a significant percentage of nitrogen and can constitutes a source of nitrogen (Kraepiel *et al*., 2009). The ability of *Azotobacter* to produce indole acetic acid, other auxins, gibberellins and cytokinins, enhanced the root growth and ther-eby help the plants to absorb nutrients and promote better vegetative growth and yield in different crops (Chen, 2006 and Lenart, 2012). Further, VAM *i*.e., Vesicular Arbescular Mycorrhizal fungi which are important to their hosts as they enhance the ability of plants to absorb phosphorus from soil, which is relatively unavailable to the plants (Mcgonigle and Miller, 1996; Miller, 2000). It also secretes organic acids and growth promoting substances like IAA and gibberellins which help in better plant growth (Reddy, 2008). Thus, bio fertilizers *viz*., *Azotobacter* and VAM contributed to enhanced supply of major plant nutrients and thereby led to higher vegetative growth and chlorophyll content in the leaf as also studied earlier in chrysanthemum (Neelima *et al*., 2015). Further, spermine being a polyamine enhances the uptake and accumulation of N element that is involved in different biological processes leading to the formation of protective compounds (Rangan *et al*., 2014). A direct relationship of polyamines has been established with P (Hewitt, 1963) and K (Hanafy –Ahmad *et al*., 2002). The increment in mineral uptake (N, P and K) by application of polyamines is known earlier in sweet pepper (Shawky 2003) and rose (Farahi *et al*., 2012). The stimulated effect of polyamine treatment on plant growth productivity may be due to their effect on many metabolic and physiological processes *viz*., enhanced plant growth as explored earlier (Kaur *et al*., 1982 and Sood and Nagar, 2003). Spermine has been known to alleviate the oxidative stress through regulating antioxidant system in chloroplasts, which is associated with improvement of photochemical efficiency of the leaves (Sheng *et al*., 2013) and thus maintained more chlorophyll content in the leaves. Further, vermiwash being a cocktail of enzymes and enriched with growth regulators such as cytokinins, amino acid, vitamins (Zambare *et al*., 2008) also improved the leaf chlorophyll content of gerbera plants.

Gerbera plants inoculated with bio fertilizers (*Azotobacter* and VAM) and sprayed with 25 ppm spermine (B_1C_1) showed maximum membrane stability index of the petal tissue (84.55, 79.77 and 75.50 %) and was followed by the treatment combination of bio fertilizers along foliar application of 4% vermiwash (B_1C_7), further, higher lignin content in the flower stalk (6.84 %) was found in treatment combination of bio fertilizers along foliar application of 4% vermiwash (B_1C_7) which was at par with bio fertilizers + 25 ppm spermine (B_1C_1). Inoculation of mycorrhiza has been earlier known to increase the TSS and protein content in the leaf tissue and stabilize their membrane integrity (Scagel, 2010). Further, mycorrhizal inoculation has also been reported earlier to increase lignin content in the flower stalk (Mostafa *et al*., 2003; Ziedan *et al*., 2010). In addition to this, spermine maintained the membrane stability of the petal tissue as it has the ability to bind with membrane phospholipids and other anion component of the membranes (Katarzyna *et al*., 2012). Higher membrane stability with the spray of spermine has been earlier reported in heliconia (Mangave *et al*., 2012) and in rose (Sumathi *et al*., 2015).

Maximum yield per plant (57.17) and vase life of the flower

Table 1: Effect of bio fertilizers, chemicals and organic growth substances on vegetative growth and yield of gerbera

	Plant height (cm)			Plant spread (cm)			No. of leaves/plant			Chlorophyll (mg/g)		
	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean
C_1	39.82	42.87	41.34	55.27	61.34	58.3	24.47	31.17	27.82	1.62	2.02	1.82
C_2	39.47	39.7	39.58	54.63	55.74	55.18	23	27.3	25.15	1.56	1.96	1.76
C_3	37.88	39.8	38.84	54.91	55.38	55.14	22.7	26.08	24.39	1.57	1.7	1.63
C_4	39.12	39.93	39.53	53.25	55.48	54.36	22.28	25.6	23.94	1.53	1.69	1.61
C_5	37.47	40.67	39.07	52.2	54.79	53.5	24.93	24.65	24.79	1.45	1.76	1.61
C_6	38.87	40.98	39.93	54.04	56.62	55.33	22.98	25.73	24.36	1.5	1.91	1.71
C_7	38.27	41.67	39.97	54.01	57.92	55.97	23.35	27.82	25.58	1.72	2.03	1.87
B Mean	38.7	40.8	-	53.9	56.68	-	23.39	26.91	-	1.56	1.87	-
	S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%	
B	0.15	0.44		0.14	0.43		0.13	0.37		0.003	0.01	
C	0.28	0.82		0.27	0.85		0.24	0.71		0.007	0.02	
BC	0.4	1.17		0.39	1.14		0.34	0.99		0.01	0.03	

Table 2 : Effect of bio fertilizers, chemicals and organic growth substances on membrane stability index, lignin, yield and vase life of gerbera

	Membrane stability index (%) 2nd day			4th day			6th day			Lignin (%)			Yield/plant			Vase life (days)		
	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean	B_0	B_1	C Mean
C_1	81.5	84.55	82.78	76.73	79.77	78.25	70.67	75.5	73.08	6.04	6.61	6.32	47.5	57.17	52.33	7.69	9.29	8.49
C_2	80.33	83.51	81.92	75.87	77.81	76.84	69.07	71.17	70.12	5.89	6.39	6.14	46.5	54.83	50.67	6.99	8.56	7.77
C_3	79.56	83.11	81.33	76.07	77.85	76.96	69	70.85	69.93	5.5	6.23	5.87	45.17	52.67	48.92	7	8.1	7.55
C_4	79.84	83.18	81.51	75.02	77.26	76.14	68.49	71.22	69.86	5.43	6.21	5.82	45.67	53.5	49.58	7.05	8.17	7.61
C_5	80.38	83.63	82	75.4	77.63	76.52	69.43	71.43	70.43	5.65	6.3	5.97	45.5	53.33	49.42	6.55	7.66	7.11
C_6	80.07	83.63	81.85	76.34	78.43	77.39	68.79	72.38	70.59	5.62	6.3	5.96	46.5	54	50.25	6.78	7.93	7.35
C_7	81.01	83.92	82.47	76.8	79.22	78.01	71.54	72.57	72.05	5.82	6.84	6.33	46.83	56.17	51.5	7.36	8.78	8.07
B Mean	80.39	83.58	-	76.03	78.28	-	69.57	72.16	-	5.71	6.41	-	46.24	54.52	-	7.06	8.35	-
	S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%		S.Em±	C. D. 5%	
B	0.05	0.15		0.08	0.23		0.15	0.44		0.012	0.034		0.24	0.7		0.02	0.06	
C	0.1	0.29		0.15	0.43		0.28	0.82		0.022	0.064		0.45	1.31		0.04	0.12	
BC	0.14	0.41		0.21	0.63		0.4	1.17		0.031	0.091		0.64	1.86		0.06	0.17	

(9.29 days) was recorded with the treatment combination of bio fertilizers and 25 ppm spermine (B_1C_1) which was followed by the treatment combination bio fertilizers and 4% vermiwash (B_1C_7). Beneficial effects of bio fertilizers *viz*., *Azo* and VAM and foliar spray of spermine and vermiwash improved the vegetative growth of the plant which ultimately led to higher yield. Consistent results were reported with *Azotobacter* in rose (Singh *et al*., 2006), with VAM in chrysanthemum (Karishma *et al*., 2013) and in safflower (Shariati *et al*., 2015) and with spermine in rose (Sumathi, 2013). Further, improved membrane stability index in the petal tissue and lignin content in the flower stalk delayed the petal senescence and improved the vase life of gerbera, these results are in accordance with Youssef *et al*. (2004) in mathiola, and Sumathi (2013) in rose.

REFERENCES

Arancon, N. Q., Edwards, C. A., Dick, R. and Dick, L. 2007. Vermicompost tea production and plant growth impacts. *Biocycle*. **48(5):** 51-52.

Chen, J. 2006. The combined use of chemical and organic fertilizers and/or bio fertilizer for crop growth and soil fertility. *International workshop on Sustained Management of the Soil-Rhizosphere System for Efficient Crop Production and Fertilizer Use*, Thailand, pp. 1-10.

Farahi, H. F., Khalingi, A., Kholdbarin, B., Akbar-boojar, M. M., Eshghi, S., Kavoosi, B. and Aboutalebi, A. 2012. Influence of exogenous spermidine on quality properties and vase life of rose (*Rosa hybrida* cv. Dolcvita). *Annals of Bio. Res.* **3(10):** 4758-4763.

Hanafy Ahmed, A. H., Gad, M. A., Hassan, M. A. and Amin. 2002. Improving growth and chemical composition of *Myrtus communis* grown under soil salinity conditions by polyamines foliar application. Proc. Minia 1st conf. for *Agric and Environ. Sci*., Minia, Egypt, March, PP.25-28.

Hewitt, E. J. 1963. The essential nutrients elements: Requirements and interactions in plants. In: Steward, F.C. (eds). *Plant Physiol*. Atreatise, Academic, NY, pp. 137-360.

Karishma, Ashok Aggarwal and Anju Tanwar. 2013. Growth and flower enhancement of *Chrysanthemum indicum* inoculated with arbescular mycorrhizae and other bio inoculants. *Indian Phytopatho*. **66(1):** 57-60.

Katarzyna Rubinowska., Elibieta Pogroszewska and Waadysaaw Michaaek. 2012. The effect of polyamines on physiological parameters of post-harvest quality of cut stems of rose 'Red Berlin'. *Acta Sci. Pol*. **11(6):** 81-93.

Kraepiel, A. M. L., Chiffoleau, J. F., Martin, J. M. and Morel, F. M. M. 2009. Geochemistry of trace metals in the Gironde estuary. *Geochim Cosmochim Acta*. **61:**1421-1436.

Lenart, A. 2012. Occurrence, characteristics and genetic diversity of *Azotobacter chroococcum* in various soils of southern Poland. *Pol. J. Environ. Stud*. **21(2):** 415-424.

Lopez, M., Huerta, P. O., Martinez Farre, F. and Soliva M. 2010. Approaching compost stability from Klason lignin modified method: Chemical Stability Degree for OM and N quality assessment. http://upcommons.upc.edu/e prints/bitstream/2117/11181/1/SD%20pre-print.pdf.

Mangave, B. D., Singh, A. and Mahatma, M. K. 2012. Effects of different plant growth regulators and chemicals spray on post harvest physiology and vase life of heliconia inflorescence cv. Golden Torch. *Plant Growth Regula*. **69(3):** 259-264.

Miller, M. H. 2000. Arbuscular mycorrhizae and the phosphorus nutrition of maize: A review of Guelph studies. *Canadian J. Plant Patho. Sci*. **80:** 47-52.

Neelima, P., Barad, A. V., Manisha Shinde and Nilima Bhosale. 2015. Response of bio fertilisers and organic manures on growth, flowering, yield and quality of chrysanthemum. *Green Farming Int. J.* **6(3):** 565-568.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. ICAR Pub., New Delhi.

Rangan, P., Subramani, R., Rajesh Kumar, Singh, A. K. and Singh, R. 2014. Recent advances in polyamine metabolism and abiotic stress tolerance. *Int. Bio. Med. Res*. **9:** 1-9.

Reddy, P. P. 2008. Organic Farming for Sustainable Horticulture. Scientific Publishers, Jodhpur, India. pp.20, 36, 66, 67.

Scagel, C. F. 2010. Inoculation with arbuscular mycorrhizal fungi alters nutritional allocation and flowering of *Freesia* × *hybrida*. *J. Environ. Hort*. **21(4):**196-205.

Shariati, J., Weisany, W. and Torabian, S. 2015. Effect of *Azotobacter* Arbuscular mycorrhizal on growth of safflower (*Carthamun tinctorius* L.) at different irrigation regimes. *Electronic J. Polish Agri. Uni*., **18(4):** 1-4.

Shawky, B. T. 2003. Physiological studies on the effect of salinity, ascorbic acid and putrescine on sweet pepper plant. Ph.D. Thesis, Fac. Agric., Cairo Univ., Ezypt.

Sheng Shu, Ling Yun Yuan., Shi Ring Guo., Jin Sun and Ying Hui Yuan. (2013). Effects of exogenous spermine on chlorophyll fluorescence, antioxidant system and ultrastructure of chloroplasts in *Cucumis sativus* L. under salt stress. *Plant Physiol. and Bio chem*. **63:** 209-216.

Singh, A. K., Deepti Singh and Shiva Jauhari 2006. Response of manures and bio fertilizers on growth and flowering in rose. *J. Ornm. Hort*. **9(4):** 278-281.

Singh, A., Kumar, J. and Kumar, P. 2008. Effects of plant growth regulators and sucrose on postharvest physiology, membrane stability and vase life of cut spikes of gladiolus. *Plant Growth Regula*. **55:** 221-229.

Sood, S. H. and Nagar, P. K. 2003. The effect of polyamines on leaf senescence in two diverse rose species. *Plant Growth Regula*. **39:** 155-160.

Sumathi, T. 2013. Effect of different chemicals and natural preservatives as a pre and postharvest spray on greenhouse rose cv. Samurai. M. Sc thesis submitted to Navsari Agricultural University, Gujarat.

Sumathi, T., Alka Singh and Ahlawat, T. R. 2015. Effect of polyamines on postharvest quality and vase life of rose var. Samurai. *The Bioscan*, **10(2):** 675-678.

Van den Broeck, D., Van Den, S. D., Van Montague, M. and Caplan, A. 1994. A group of chromosomal proteins in specifically released by spermine and loses DNA-binding activity upon phosphorylation. *Plant Physio*. **106:** 559-566.

Wellburn, A. R. 1994. The special determinations of chlorophyll *a* and *b* as well as total carotenoides using various solvents with spectrophotometers of different resolution. *J. Plant Physiol*. **144:** 307- 313.

Youssef, A. A., Mona, H. M. and Iman, M. T. 2004. Physiological and biolochemical aspects of *Matthiola incana* L. plants under the effect of putrsescine and kinetine treatments. *Egypt. J. App. Sci*., **19(9B):**15-19.

Zambare, V. P., Padul, M. V., Yadav, A. A. and Shete, T. B. 2008. Vermiwash: Biochemical and microbiological approach as ecofriendly soil conditioner. *J. Agri. and Bio. Sci*. **3:** 1-5.

Ziedan, E. H., Elewa I. S., Mostafa M. H. and Sahab A. F. 2010. Application of mycorrhizae for controlling root diseases of sesame. First International Congress MCOMED. Moracoo, 11–13 October 2010, p. 97.

Zhang, F. S., Shen, J. B., Li, L. and Liu, X. 2004. An overview of rhizosphere processes related with plant nutrition in major cropping systems in China. *Plant Soil*. **260:** 89-99.

Zheng Chen Yanhui., Na Lu., Min Wu., Chaoqun Wu and Shaoyun He. 2016. Genetic diversity and relationships of 48 cultivars of *Gerbera jamesonii* Adlam in China revealed by microsatellite markers.

Bangladesh J. Bot. **45(3):** 641-648.