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Response of biostimulants and biofertilizers on corm, cormels and spike yield of gladiolus (*Gladiolus grandiflorus* L.) cv. American beauty under greenhouse conditions

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Abstract
The present experiment entitled "Response of biostimulants and biofertilizers on corm, cormels and spike yield of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty under greenhouse conditions" was carried out at High Tech Horticulture Park, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during 2015-2017. The experiment was laid out in Factorial Completely Randomized Block Design (FCRD) consisting two factors with three repitations. Four treatments of biostimulants and three treatments of biofertilizers were considered as treatment combinations. The results indicated that application of humic acid 0.2% with *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant at first spray at 30 DAP, second spray at 45 DAP and third spray at 60 DAP of biostimulants and soil application of biofertilizers at the time of planting and two month after planting gives higher corm, cormels and spike yield parameters in gladiolus.

Keywords: Gladiolus, corms, cormels, biostimulants, biofertilizers

Introduction
Gladiolus (from Latin, the diminutive of gladius, a sword) is a genus of perennial bulbous flowering plants in the iris family (Iridaceae). Sometimes called the sword lily, the most widely used English common name for these plants is simply gladiolus (plural gladioli, gladioluses or sometimes gladiolas). Gladiolus could be grown in any type of soil provided it is well drained. For good performance, it prefers a sandy loam soil, rich in organic matter. A soil pH between 6 and 7 is ideal; however, a soil with pH ranging from 5 to 7 can also be used for gladiolus cultivation. In soil by adding organic manures and microbial agents make easy uptake of nutrients when crop required comparing to chemical fertilizers (Vanilarasu and Balakrishnamurthy, 2014) [24]. Mineral nutrition does play an important role in influencing the quality of crops and it is fact that the soil health deteriorates due to continuous use of chemical fertilizers. The use of biostimulants and biofertilizers improves physico-chemical and biological properties of soil, besides improving the efficiency of applied nutrients. In case of biostimulants, Salukhe (2010) [18] analysed the samples of banana pseudostem for its elemental composition and found that banana pseudostem contained macro elements in the range of 1.00 to 1.12% N, 0.50 to 0.71% P, 2.39 to 2.62% K and micro nutrients in the range of 259 to 323.2 mg/kg Fe, 47.3 to 241.3 mg/kg Mn, 10.1 to 107.4 mg/kg Zn and 13.4 to 83.6 mg/kg Cu. Seaweed extracts act as biostimulants mainly due to the presence of plant hormones. Main phytohormones identified in seaweed extracts are: auxins, cytokinins, gibberelins, abscisic acid and ethylene. Panchagavya consists of nine products viz. cow dung, cow urine, cow milk, curd, jaggery, ghee, banana, tender coconut and water. When suitably mixed and used, these have miraculous effects. Physico-chemical properties of panchagavya revealed that they possess almost all the major nutrients, micro nutrients and growth harmones (IAA & GA) required for crop growth. It contain properties like naturally occurring, beneficial, effective microorganisms, predominately lactic acid bacteria, yeast, actinomycetes and photosynthetic bacteria. Humic acid that promote plant health and growth. The importance of humic acid lies in their ability to promote hormonal activity in plants. Plant hormones are chemical communicators, or agents, which help regulate a plant's development and its response to its surrounding environment. Humic acids also promote antioxidant production in plants which, in turn, reduces "free radicals".

Free radical molecules result from stress such as drought, heat, ultraviolet light and herbicide use. Free radicals are damaging because they are strong oxidizing agents which damage lipids, proteins and DNA within plants cells. Antioxidants are metabolites and enzymes which seek out free radical molecules and protect plants from damage. They include lipid soluble substances like vitamin "E" and beta-carotene and water soluble materials such as vitamin C and various enzymes. In case of biofertilizers, which have a ability to enrich the soil with beneficial microorganisms as well as to mobilize the nutritionally important elements from non-usable to usable forms through biological processes resulting in enhanced production of flowers, fruits and vegetables offer an alternative (Purkayastha *et al*., 1998) [15]. The use of biofertilizers in combination with chemical fertilizers and organic manures offers a great opportunity to increase the production as well as quality of gladiolus. Among the nitrogen fixing bacteria, *Azotobacter*, not only provides nitrogen, but also synthesizes growth promoting hormones such as IAA and GA. *Azospirillum* also helps in plant growth and increases the yield of crops by improving root development, mineral uptake etc. The positive role of these biofertilizers has been recorded in many vegetables and spice crops by different scientists. To maintain long term soil health and productivity there is a need for integrated nutrient management through manures and biofertilizers apart from costly chemical fertilizers for better yield of the crop (Mondel *et al*., 2003) [13] considering the above facts, the present study was planned and undertaken with the objective to assess the effect of biostimulants and biofertilizers on corm, cormels and spike yield of gladiolus.

Materials and Methods

The field experiment entitled "Response of biostimulants and biofertilizers on corm, cormels and spike yield of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty under greenhouse conditions" was carried out at High Tech Horticulture Park, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during 2015-2017. The trial was laid out in Factorial Completely Randomized Block Design (FCRD) with 12 treatments and three replication. The different treatments were T_1: Banana pseudo stem sap 1% + *Azotobacter* @ 1.5 ml/plant + PSB @ 1.5 ml/plant + KSB @ 1.5 ml/plant, T_2: Banana pseudo stem sap 1% + *Azotobacter* @ 2 ml/plant + PSB @ 2 ml/plant + KSB @ 2 ml/plant, T_3: Banana pseudo stem sap 1% + *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant, T_4: Seaweed extract 1% + *Azotobacter* @ 1.5 ml/plant + PSB @ 1.5 ml/plant + KSB @ 1.5 ml/plant, T_5: Seaweed extract 1% + *Azotobacter* @ 2 ml/plant + PSB @ 2 ml/plant + KSB @ 2 ml/plant, T_6: Seaweed extract 1% + *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant, T_7: Panchgavya 3% + *Azotobacter* @ 1.5 ml/plant + PSB @ 1.5 ml/plant + KSB @ 1.5 ml/plant, T_8: Panchgavya 3% + *Azotobacter* @ 2 ml/plant + PSB @ 2 ml/plant + KSB @ 2 ml/plant, T_9: Panchgavya 3% + *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant, T_{10}: Humic acid 0.2% + *Azotobacter* @ 1.5 ml/plant + PSB @ 1.5 ml/plant + KSB @ 1.5 ml/plant, T_{11}: Humic acid 0.2% + *Azotobacter* @ 2 ml/plant + PSB @ 2 ml/plant + KSB @ 2 ml/plant, T_{12}: Humic acid 0.2% + *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant.

Time of application of biostimulants (spray)	**Time of application of biofertilizers (Drenching)**
1. 1st spray at 30 DAP	1. 1st - At the time of planting
2. 2nd spray at 45 DAP	2. 2nd - 2 month after planting
3. 3rd spray at 60 DAP	

Result and Discussion

Table 1: Effect of biostimulants and biofertilizers on corm and cormels parameters in gladiolus (Pooled)

Treatments	**Number of corms per plant**	**Number of cormels per plant**	**Diameter of corm (cm)**	**Weight of corm (g)**
Biostimulants (B)				
B_1 - Banana pseudostem sap 1%	1.72	23.87	4.54	41.86
B_2 - Seaweed extract 1%	1.42	21.73	4.27	39.73
B_3 - Panchgavya 3%	1.87	29.63	4.97	47.59
B_4 - Humic acid 0.2%	2.01	31.85	5.10	49.52
S.Em. ±	0.02	0.30	0.04	0.30
C.D. at 5%	0.05	0.85	0.10	0.85
Biofertilizers (F)				
F_1 - *Azoto*. + PSB + KSB each @ 1.5 ml/plant	1.51	23.77	4.47	41.77
F_2 - *Azoto*. + PSB + KSB each @ 2.0 ml/plant	1.70	26.92	4.79	44.66
F_3 - *Azoto*. + PSB + KSB each @ 2.5 ml/plant	2.05	29.63	4.90	47.60
S.Em. ±	0.01	0.26	0.03	0.26
C.D. at 5%	0.04	0.74	0.09	0.74
Interaction (B X F)				
S.Em. ±	0.03	0.52	0.06	0.52
C.D. at 5%	0.08	1.47	0.18	1.47
CV%	3.90	4.74	3.31	2.84

Effect of Biostimulants

Significantly maximum number of corms per plant (2.01), number of cormels per plant (31.85), diameter of corm (5.10 cm) and weight of corm (49.52 g) were registered with an application of humic acid 0.2% (B_4) in pooled. The result may be due to effect of humic acid which improves soil physical and biochemical properties. Corm and cormels development requires the good physical condition of soil because it develops underground. This might be due to the translocation of humic compound to different parts of the plant, thus, enhancing the growth of the plant as well as corm parameter. Increasing corm and cormel parameters due to allowing for enhanced water penetration and better root zone growth and development by break up compacted soil and also be attributed to the mobilization of reserve food material to the sink through increased activity by hydrolyzing and oxidizing enzymes. Similar results were also obtained by Sankari *et al*. (2015) [19] in gladiolus and Vasudevan *et al*. (1997) [25] in sunflower.

Effect of Biofertilizers

Significantly maximum number of corms per plant (2.05), number of cormels per plant (29.63), diameter of corm (4.90 cm) and weight of corm (47.60 g) were registered in *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant (F_3) in pooled. Increase in number of corms and cormels per plant and their related characters by the applications of bio-fertilizers may be due to the improvement in soil properties with help of micro nutrients added in soil through biofertilizers. The increased weight of corm per plant could be mainly due to availability of adequate quantity of nutrients for better filling up of corms, which resulted in the increased corm weight. The results of present study are in close conformity with findings of Gangadharan and Gopinath (2000) [7], Godse *et al.* (2006) [8], Dongardive *et al*. (2007) [5], Srivastava and Govil (2007) [23] and Kaushik *et al.* (2016) [10] in gladiolus; Satyavir (2007) [20] in tuberose and Khan *et al*. (2009) [11] in tulip.

Table 1.1: Interaction effect of biostimulants and biofertilizers on corm and cormels parameters in gladiolus (Pooled)

Treatment combinations	Number of corms per plant	Number of cormels per plant	Diameter of corm (cm)	Weight of corm (g)
B_1F_1	1.53	22.46	4.49	40.46
B_1F_2	1.64	23.40	4.68	41.36
B_1F_3	1.99	25.76	4.47	43.76
B_2F_1	1.13	20.14	4.00	38.14
B_2F_2	1.26	21.25	4.32	39.25
B_2F_3	1.87	23.81	4.50	41.81
B_3F_1	1.60	25.11	4.60	43.11
B_3F_2	1.88	30.16	5.04	48.16
B_3F_3	2.13	33.61	5.26	51.51
B_4F_1	1.77	27.35	4.79	45.35
B_4F_2	2.03	32.88	5.12	49.88
B_4F_3	2.21	35.33	5.39	53.33
S.Em. ±	0.03	0.52	0.06	0.52
C.D. at 5%	0.08	1.47	0.18	1.47
CV%	3.90	4.74	3.31	2.84

Maximum number of corms per plant (2.21), number of cormels per plant (35.33), diameter of corm (5.39 cm) and weight of corm (53.33 g) were registered with an application of humic acid 0.2% with *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant (B_4F_3). The result might be due to positive interaction effect of humic acid with various biofertilizers was resulted to improve the soil properties which created a condition for better performance in corm and cormels production. Increase in number of corms and cormels per plant and their related characters by the applications of biofertilizers and biostimulants may be due to the availability of micro and macro nutrients to the plants and increase in hormonal activities within the plant. The increased weight of corm per plant could be mainly due to availability of adequate quantity of nutrients for better filling up of corms, which resulted in the increased corm weight. The results of present study are in close conformity with findings of Bhalla *et al.* (2006) [1] and Pandey *et al.* (2013) [14] in gladiolus.

Table 2: Effect of biostimulants and biofertilizers on spike yield parameters in gladiolus (Pooled)

Treatments	Number of florets per spike	Number of spikes per plant	Number of spikes per plot	Number of spikes per hectare (Lakh)
Biostimulants (B)				
B_1 - Banana pseudostem sap 1%	14.24	2.15	25.78	2.39
B_2 - Seaweed extract 1%	13.59	1.87	22.49	2.08
B_3 - Panchgavya 3%	15.14	2.37	28.38	2.63
B_4 - Humic acid 0.2%	15.82	2.59	31.12	2.88
S.Em. ±	0.08	0.02	0.25	0.03
C.D. at 5%	0.22	0.05	0.72	0.07
Biofertilizers (F)				
F_1 - *Azoto*. + PSB + KSB each @ 1.5 ml/plant	13.85	1.91	22.96	2.13
F_2 - *Azoto*. + PSB + KSB each @ 2.0 ml/plant	14.63	2.27	27.29	2.53
F_3 - *Azoto*. + PSB + KSB each @ 2.5 ml/plant	15.62	2.55	30.58	2.83
S.Em. ±	0.07	0.02	0.22	0.02
C.D. at 5%	0.19	0.05	0.63	0.06
Interaction (B X F)				
S.Em. ±	0.13	0.03	0.44	0.04
C.D. at 5%	0.37	0.09	1.25	0.12
CV%	2.19	3.54	4.00	4.28

Effect of Biostimulants

Maximum number of florets per spike (15.82), number of spikes per plant (2.59), number of spikes per plot (31.12) and number of spikes per hectare (2.88) were recorded with an application of humic acid 0.2% (B_4) in pooled. It is true that the application of humic reduces the requirement of other fertilizers. It also increases crop yield, soil aeration, and drainage can also be improved by humic, the establishment of desirable environment for the development of microorganisms. Humic acid is one of the best natural chelating products Mother Nature offers. It not only raises cation exchange capacity (CEC) or nutrient-holding capacity of soil, it also holds calcium and other micronutrients in forms that are easy for plants to uptake. Humic acid contains numerous negatively charged anions that attract or hold onto positively charged cations in the soil. The cations growers are concerned with include a host of micro elements good for growing plants, with calcium, ammonium, magnesium, and iron among the most important. This chelation of cations is probably the most important role of humic acid with respect to boosting plant production and flower and vegetable yields. In short it improves the soil physical, biochemical properties which resulted to improve growth and flowering which resulted to improve in flower yield. Similar results were also obtained by Sankari *et al*. (2015) [19] in gladiolus; Khenizy *et al*. (2013) [12] in gerbera; Yasser *et al*. (2011) [27] in hibiscus; Farjami and Nabavi (2014) [6] in marigold; Vijayalakshmi and Mathan (1997) [26] in sunflower.

Effect of Biofertilizers

Significantly maximum number of florets per spike (15.62), number of spikes per plant (2.55), number of spikes per plot (30.58) and number of spikes per hectare (2.83) were recorded with an application of *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant (F_3) in pooled. The result might be due to positive effect of biofertilizer on soil which resulted to better yield. Bio inoculants improve the nutrient availability of the plant by addition of atmospheric nitrogen to the soil and promote vegetative growth and yield of the plant. The conversion of photosynthates into proteins results in more flower primordia and development of flower bud attributing to higher flower yield. The increase in number of spikes might be due to possible role of *Azotobacter* through atmospheric nitrogen fixation, better root proliferation, uptake of nutrients and water and also attribute of PSB to the increase availability of phosphorus and KSB to the increase availability of potash. The results of present study are in close conformity with findings of Dongardive *et al.* (2007) [5], Srivastava and Govil (2007) [23] and Kaushik *et al.* (2016) [10] in gladiolus and Renukaradya *et al*. (2011) [17] in carnation; Singh *et al*. (2008) [22] in calendula; Bhavanisankar and Vanangamudi (1999) [3] in crossandra; Bhaskaran *et al*. (2002) and Radhika *et al*. (2010) [16] in marigold.

Table 2.1: Interaction effect of biostimulants and biofertilizers on spike yield parameters in gladiolus (Pooled)

Treatment combinations	Number of florets per spike	Number of spikes per plant	Number of spikes per plot	Number of spikes per hectare (Lakh)
B_1F_1	13.24	1.95	23.34	2.16
B_1F_2	14.56	2.09	25.04	2.32
B_1F_3	14.93	2.42	28.98	2.68
B_2F_1	12.89	1.73	20.32	1.95
B_2F_2	13.67	1.95	23.34	2.16
B_2F_3	14.21	2.15	25.82	2.39
B_3F_1	14.26	1.94	23.24	2.15
B_3F_2	14.73	2.45	29.42	2.72
B_3F_3	16.43	2.71	32.50	3.01
B_4F_1	15.02	2.25	26.94	2.49
B_4F_2	15.55	2.62	31.38	2.91
B_4F_3	16.90	2.92	35.04	3.18
S.Em. ±	0.13	0.03	0.44	0.04
C.D. at 5%	0.37	0.09	1.25	0.12
CV%	2.19	3.54	4.00	4.28

Significantly maximum number of florets per spike (16.90), number of spikes per plant (2.92), number of spikes per plot (35.04) and number of spikes per hectare (3.18) was registered in combined application of humic acid 0.2% with *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant (B_4F_3) in pooled. It is true that humic acid with biofertilizers increase the efficiency of biofertilizers resulted to more availability of various nutrients resulted to higher yield. The application of humic with biofertilizers reduces the requirement of other fertilizers. It also increases crop yield, soil aeration, and drainage. The increase in number of spikes might be due to possible role of *Azotobacter* through atmospheric nitrogen fixation, better root proliferation, uptake of nutrients and water and also attribute of PSB to the increase availability of phosphorus and KSB to the increase availability of potash easily make available due to humic acid. The results of present study are in close conformity with findings of Bhalla *et al.* (2006) [1] and Pandey *et al.* (2013) [14] in gladiolus; Jadhav *et al*. (2014) [9] in marigold; Bihari *et al*. (2009) [4] in rose.

Summary and Conclusion

From the foregoing discussion it can be concluded that for getting higher corm, cormels and spike yield in gladiolus cv. American Beauty should be sprayed with combined application of humic acid 0.2% with *Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant at first spray at 30 DAP, second spray at 45 DAP and third spray at 60 DAP of biostimulants (humic acid 0.2%) and soil application of biofertilizers (*Azotobacter* @ 2.5 ml/plant + PSB @ 2.5 ml/plant + KSB @ 2.5 ml/plant) at the time of planting and two month after planting.

References

1. Bhalla Rahesh, Dhiman PK, Jain SR. Effect of biofertilizers and biostimulants on growth and flowering in gladiolus. J Ornamental. Hort. 2006; 9(4):248-252.
2. Bhaskaran P, Ambrose G, Jayabalan N. Usefulness of biofertilizers in economizing nitrogenous fertilizers in Tagetes erecta L., J Phytol. Res. 2007; 15(2):155-160.
3. Bhavanisankar K, Vanangamudi K. Intigrated nutrient management in gundumalli (*Jasminum sambac* L.). South Indian Hort. 1999; 47(1-6):111-114.
4. Bihari Man, Narayan Slirya, Singh Amit Kumar. Effect of pruning levels and bio-fertilizers on production of rose cut flowers. J. Ornamental Hort. 2009; 12(1):48-53.
5. Dongardive SB, Golliwar VJ, Bhongle SA. Effect of organic manure and biofertilizers on growth and

flowering in Gladiolus. Plant Archives. 2007; 7(2):657-658.
6. Farjami AA, Nabavi SM. Effect of humic acid and phosphorus on the quantity and quality of marigold (*Calendula officinalis* L.) yield. J crop ecophysiology. 2014; 4(28):443-452.
7. Gangadharan GD, Gopinath G. Effect of organic and inorganic fertilizers on growth, flowering and quality of gladiolus cv. white prosperity. Karnataka J Agril. Sci. 2000; 11(3):401-405.
8. Godse SB, Golliwar VJ, Neha Chopde, Bramhankar KS, Kore MS. Effect of organic manures and biofertilizers with reduced doses of inorganic fertilizers on growth, yield and quality of gladiolus. J Soils and Crops. 2006; 16(2):445-449.
9. Jadhav PB, Singh A, Mangave BD, Patil NB, Patel DJ, Dekhane SS *et al.* Effect of organic and inorganic fertilizers on growth and yield of african marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. Annals of Bio. Res. 2014; 5(9):10-14.
10. Kaushik H, Kumar J, Singh JP, Singh RK, Rajbeer, Kumar S Effect of GA_3 and biofertilizers on growth and flowering in gladiolus (*Gladiolus floribundus* L.) cv. American Beauty. Adv. Res. J Crop Improv. 2016; 7(1):52-55.
11. Khan FU, Siddique MA, Khan FA, Nazki IT. Effect of biofertilizers on growth, flower quality and bulb yield in tulip. Indian J Agril. Sci. 2009; 79(4):248-251.
12. Khenizy AM, Zaky AA, Yasser ME. Effect of humic acid on vase life of gerbera flowers after cutting. J Hort. Sci. & Orna. Plants. 2013; 5(2):127-136.
13. Mondel T, Ghanti P, Mahato B, Mondel AR, Thapa U. Effect of spacing and biofertilizer on yield and yield attributes of direct sown Chilly. Env. Eco. 2003; 21:712-15.
14. Pandey A, Singh AK, Sisodia A. Effect of vermicompost and biostimulants on growth and flowering of gladiolus. Asian J Hort. 2013; 8(1):46-49.
15. Purkayastha TJ, Singh CS, Chhonkar PK. Growth and iron nutrient of broccoli grown in a typic ustochrept as influenced by VAM fungi in presence of pyrite and farmyard manure. Biol. Fert. Soil. 1998; 27(1):45-48.
16. Radhika Mittal, Patel HC, Nayee DD, Sitapara HH. Effect of integrated nutrient management on growth and yield of African marigold (*Tagetes erecta* L.) cv. Local under middle Gujarat agro climatic conditions. Asian J Hort. 2010; 5(2):347-349.
17. Renukaradya S, Pradeepkumar CM, Santhoskumar HM, Dronachari M, Shashikumar RS. Effect of integrated system of plant management on growth, yield and flower quality of carnation (*Dianthus caryophyllus* L.) under greenhouse. Asian J Hort. 2011; 6(1):106-112.
18. Salukhe JR. Feasibility of using banana pseudostem sap as liquid fertilizer in onion under drip irrigation. Thesis submitted to Navsari Agricultural University (N.A.U.), Navsari, 2010.
19. Sankari A, Anand M, Arulmozhiyan R. Effect of biostimulants on yield and post harvest quality of gladiolus cv. White Prosperity. Asian J Hort. 2015; 10(1):86-94.
20. Satyavir SC. Effect of nitrogen, phosphorus and biofertilizer application on plant growth and bulb production in tuberose. Haryana J Hort. Sci. 2007; 36(1-2):82-85.
21. Savci S. An agricultural pollutant: chemical fertilizer, International J Environmental science and development. 2012; 3(1):77-80.
22. Singh YP, Dwivedi R, Dwivedi SV. Effect of bio-fertilizer and graded dose of nitrogen on growth and flower yield of calendula (*Calendula officinalis* L.). Plant Archives. 2008; 8(2):957-958.
23. Srivastava R, Govil M. Influence of biofertilizers on growth and flowering in gladiolus cv. American Beauty. Acta Horticulture. 2007; 7(2):183-188.
24. Vanilarasu K, Balakrishnamurthy G. Influences of organic manures and amendments in soil physiochemical properties and their impact on growth, yield and nutrient uptake of banana. The Bioscan. 2014; 9(2):525-529.
25. Vasudevan SN, Virupakshappa K, Venugopal N, Bhaskar S. Response of sunflower (*Helianthus annuus* L.) to phosphorus, sulphur, micronutrients and humic acid under irrigated condition on red sandy loam soil. Indian J Agril Sci. 1997; 67(3):110-112.
26. Vijayalakshmi K, Mathan KK. Effect of humic acid complex with borax on available boron nutrition and yield of sunflower. J Oilseeds Res. 1997; 14(1):128-130.
27. Yasser M, Shalaby EA, Shanan NT. The use of organic and inorganic cultures in improving vegetative growth, yield characters and antioxidant activity of Roselle plants (*Hibiscus sabdariffa* L.) African. J Biotec. 2011; 11:1988-1996.