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Response of Gerbera cv. Antibes to Different Organic Growing Media under Naturally Ventilated Polyhouse

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ABSTRACT

An investigation was carried at department of horticulture, Assam Agricultural University, Jorhat district, to study the effect of different growing media in improving growth, flowering, physiological, soil microbial and bio-chemical properties of gerbera cv. Antibes. The experiment was conducted with five different growing media i.e. partially decomposed rice husk, vermicompost, enriched compost, soil based biofertilizer and control. The experimental design was laid out in Completely Randomized Design with three replications. Among the growing media enriched compost was found to be superior with respect to plant height (66.05 cm), no. of leaves per plant (38.50), plant spread (53.50 cm), leaf area per plant (5828.37 cm^2), leaf area index (2.06), net assimilation rate (0.067 mg cm^{-2} day^{-1}), leaf area duration (64.40 LAI days), leaf relative water content (87.14%). Diameter of flower (10.43 cm), no. of flower per plant (13.50) was recorded highest in enriched compost. Enriched compost demonstrated clear increase in soil enzymes such as Phosphomonoesterase (374.22 µg p-nitrophenol g^{-1} soil h^{-1}), Fluorescein di-acetate (10.03 µg fluorescein g^{-1} soil h^{-1}), Dehydrogenase (281.82 µg TPF g^{-1} soil 24 hr^{-1}) activity in this experiment. Available N, P_2O_5, K_2O in soil were also increased in application of organic growing media. Application of enriched compost resulted in highest available P_2O_5 content (33.72 kg ha^{-1}) in soil. The study was done to motivate the growers of Assam to take up application of organic amendments in flower cultivation and to know the impact of it on growth and development of gerbera. The present study revealed that the use of organic amendment is useful to gerbera as it gives significantly higher values than the control plots.

Key words: *Antibes, Enzymes, Gerbera, Growing media, Polyhouse*

INTRODUCTION

Gerbera (*Gerbera jamesonii* Bolus) is one of the beautiful cut flower being grown commercially under protected condition. It is considered a promising and valuable cut flower crop next to rose, ranks fifth among top ten cut flowers of world market. Gerbera is dwarf perennial plant. It is used as cut flower, garden plant and it makes a good showing in exhibitions and floral arrangements because of its numerous colors and shapes.

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Today, Agrochemicals are being used excessively in crop production due to high trend in industrialization and population explosion in the world. Use of imbalanced chemical fertilizers without proper organic amendments might have reduced the fertility status of soil. 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 organic growing media. Selection of organic inputs characterized by a reliance on local agricultural bioresources is now in great demand because they are more cost-effective[2]. Suitable growing media are essential for quality flower production as these affect development and maintenance of plant rooting[1]. There is meagre scientific work available on quantitative effect of different growing media on growth and yield of gerbera. Although, Thangam *et al.* (2009) evaluated the performance of gerbera varieties (Dalma, Dana Ellen, Rosalin and Savannah) in different growing media comprising soil with sand, FYM, vermicompost, rice husk and coco peat (3:1) in naturally ventilated polyhouse and found that among the five growing media evaluated, growth and flower quality were better in soil with vermicompost followed by soil with FYM. Dalma was the prolific bearer with 70.24 flowers per plant per year followed by Savannah and Rosalin. Longchar *et al*[6] studied the response of planting time and organic manure (FYM, pig manure and vermicompost) on Alfisol in flower yield and vase life of gerbera. Where vermicompost used as organic sources showed sustained improvements in growth parameters (number of leaves), floral characteristics and flower yield parameters in addition to flower vase.North East region of India is going to be an organic hub very soon and there is plenty of work done in organic fruit and vegetable cultivation but very less work was done in flowers. As floriculture is not yet organically practiced that's why we are taking initiative on organic flower cultivation in North East India. The present study was, therefore, intended to evaluate the influence of organic amendments on growth, flowering, physiological attributes of gerbera and on soil microbial and bio-chemical properties and to motivate the growers of Assam to take up application of organic amendments in flower cultivation.

MATERIAL AND METHODS

The present experiment was carried out during 2012-2013 and 2013-2014 in completely randomized design with three replication under naturally ventilated greenhouse at the Experimental farm of Assam Agricultural University, Jorhat, Assam. The experimental site was located at 26°47'N latitude, 94°12'E longitude and 86.8m above mean sea level. The topography of the land was uniform. In general the maximum temperature being around 34.36°C during summer and minimum around 7°C during winter. Gerbera cv. Antibes was planted using five growing media including control *viz*., partially decomposed rice husk, vermicompost (2.5-3.0% N, 1.0-1.5% P_2O_5 and 1.5-2.0% K_2O), enriched compost (1.83-1.90% N, 1.1-1.25% P_2O_5 and 0.72-0.92% K_2O), soil based biofertilizer (Azospirillum and Phosphate Solubilizing Bacteria). Enriched compost is a premium mixture of organic materials of plant origin. It is fortified with rock phosphate and biofertilizer. Rock phosphate contained 8.5% P were spread evenly @1% (as P) and mixed with the compost (made from rice straw) prior to inoculation with biofertilizer agents. N-fixing Azospirillum were multiplied in N-free bromomethyl blue (NFb) and PSB was grown in Pikovskaya broth and inoculated into the compost @ 1% (v/w) (10^9 cfu ml^{-1}). There were fifteen plots each having seventeen numbers of plants with the spacing of 30cm×30cm. Individual plot size was $1.56m^2$. Rice husk, vermicompost and enriched compost was applied on plots and mixed in the soil. Biofertilizers (Azospirillum and PSB) were mixed with cowdung and kept overnight and applied next day in ring method. The pH of the experimental site was 5.2 in 2012-2013 and 4.9 in 2013-2014. Tissue culture plants

which were collected from *Rise n' Shine Biotech* Pvt. Ltd., Pune having 4-6 leaves were planted on beds. Organic carbon, available N, P_2O_5 and K_2O were analysed as per the methods described by Jackson[5]. Prior to estimation of soil enzymatic activities and microbial biomass carbon the field moist samples were preserved in refrigeration at 4°C. Microbial biomass carbon was determined by chloroform fumigation- extraction technique following the method of Vance *et al*.[10], Dehydrogenase (DH) activity was determined by the reduction of triphenyl tetrazolium chloride (TTC) to triphenyl formazan (TPF) as described by Casida *et al*.[4] with modifications, the method of Tabatabi and Bremner (1969) is followed to estimate the Phosphomonoesterase (PMEase) activity. Observations were recorded periodically for two years and statistically analyzed using completely randomized design to draw conclusion.

RESULTS AND DISCUSSION

The different media used in the present experiment had significant effect on the growth, flower and physiological characters of gerbera cv. Antibes (Table 1, Table 2 and Table 3). Enriched compost was found to be superior with respect to plant height (66.05 cm), no. of leaves per plant (38.50), plant spread (53.50 cm), leaf area per plant (5828.37 cm^2), leaf area index (2.06), net assimilation rate (0.067 mg cm^{-2} day^{-1}), leaf area duration (64.40 LAI days), leaf relative water content (87.14%). Significant increase in growth and physiological characters of gerbera varieties under organic treatments was due to increased absorption of nutrients which resulted in increase in the synthesis of carbohydrates, hormones activity produced by Azospirillum and PSB which are present in enriched compost. PSB might have increased phosphate availability in the soils which in turn helped better proliferation of root growth and uptake of other nutrients to a great extent. This is in line with the findings of Raha (2015) where he showed the use of vermicompost as organic amendment can enhance the growth and flowering of chrysanthemum plants. The enriched compost resulted in earliness in flower bud visibility (19.44days). The induction of earliness was due to better nutritional status of the soil which ultimately increases the nutritional status of the plants. Diameter of flower (10.43 cm), no. of flower per plant (13.50) were recorded highest in enriched compost while the lowest was recorded in control. Naik *et al.* (2006) reported that in gerbera, greater leaf area, more number of leaves per plant and plant spread in turn resulted in production and accumulation of maximum photosynthates resulting more number of flowers. Significant variation in available phosphate content was recorded due to application of different growing media over control (Table 4). Application of enriched compost resulted in highest P_2O_5 content (33.72 kg ha^{-1}) in soil which was significantly higher over all other growing media. Application of enriched compost yielded significantly higher phosphomonoesterase activity (374.22 µg *p*-nitrophenol g^{-1} soil h^{-1}). This increase in activity may be due to release of more organically bound P, as synthesis of enzyme is stimulated by the presence of organic substrate[3]. Fluorescein di-acetate hydrolysis is showing highest value in enriched compost (10.03 µg fluorescein g^{-1} soil h^{-1}). This significant increase of Fluorescein di-acetate hydrolysis in enriched compost could be attributed to increased microbial biomass resulting from continuous organic matter enrichment in soil, since addition of good quality compost has a direct bearing on microbial biomass and soil enzyme activities. Sources of potential beneficial microbes in the enriched compost may possibly provide microbial diversity and activity of microorganism accompanied by better DH activity. Similar findings were also reported by Nath *et al*. The dehydrogenase activity in the present study increased significantly in soils applied with enriched compost (270.70 µg TPF g^{-1} soil 24 hr^{-1}). Dehydrogenase activities increase with increasing microbial population following amendments of soils with nutrients. The experimental results lead us to the conclusion that enriched compost considerably

improved the growth of gerbera cv. Antibes. It is therefore recommended that enriched compost should be used as planting medium for gerbera.

Table 1: Effect of growing media on growth characteristics of gerbera under naturally ventilated greenhouse

Treatments	Plant height (cm)	No. of leaves per plant	Plant spread (cm)	No. of suckers per plant	Leaf area (cm^2) per plant	LAI
Partially decomposed rice husk	54.53	34.22	49.82	5.72	4756.19	1.62
Vermicompost	61.85	35.72	52.30	6.11	5425.80	1.76
Enriched compost	66.05	38.50	53.50	6.94	5828.37	2.06
Soil based biofertilizer	57.20	33.34	49.54	6.39	4558.26	1.74
Control	53.30	31.06	48.14	5.22	3692.80	1.48
$CD_{0.05}$	1.92	0.95	1.14	NS^*	314.06	0.03

NS^* = Not Significant

Table 2: Effect of growing media on flower characteristics of gerbera under naturally ventilated greenhouse

Treatments	Days to flower bud visibility	Days to bud opening	Days to full bloom	Length of flower stalk (cm)	Diameter of flower (cm)	No. of flowers per plant	Duration of flowering (days)	Length of flower stalk (cm)	Vase life of flower (days)
Partially decomposed rice husk	85.89	22.17	19.28	48.00	9.07	6.67	109.16	15.17	8.56
Vermicompost	81.50	18.83	18.11	55.88	9.55	11.50	115.94	17.22	10.44
Enriched compost	79.44	19.44	18.17	56.72	10.43	13.50	118.67	18.55	11.24
Soil based biofertilizer	85.50	21.89	20.00	48.75	8.883	9.17	111.83	15.33	8.72
Control	89.33	23.94	20.89	46.85	8.65	6.33	103.83	14.44	7.89
$CD_{0.05}$	1.89	1.69	1.82	3.33	0.22	0.91	3.09	1.84	0.99

Table 3: Effect of growing media on physiological characteristics of gerbera under naturally ventilated greenhouse

Treatments	Total Chlorophyll Content (mg g^{-1}FW)	Net Assimilation Rate (mg cm^{-2} day^{-1})	Leaf Area Duration (LAI days)	Leaf Relative Water Content (%)
Partially decomposed rice husk	0.177	0.056	52.05	79.81
Vermicompost	0.242	0.060	61.02	82.46
Enriched compost	0.258	0.067	64.40	87.14
Soil based biofertilizer	0.207	0.058	55.78	78.06
Control	0.177	0.053	46.67	71.68
$CD_{0.05}$	0.021	0.005	2.83	1.93

Table 4: Effect of growing media on soil bio-chemical parameters

Treatments	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	OC (%)
Partially decomposed rice husk	246.18	24.27	131.58	0.66
Vermicompost	241.58	29.22	141.93	0.67
Enriched compost	248.05	33.72	140.70	0.69
Soil based biofertilizer	216.65	24.28	134.15	0.65
Control	231.72	21.02	129.15	0.63
$CD_{0.05}$	NS^*	3.29	4.74	NS^*
NS^* = Not Significant				

Table 5: Effect of growing media on soil enzymes activities and microbial biomass carbon

Treatments	MBC (µg g^{-1} soil)	PMEase (µg *p*-nitrophenol g^{-1} soil h^{-1})	FDA (µg fluorescein g^{-1} soil h^{-1})	DH (µg TPF g^{-1} soil 24 hr^{-1})
Partially decomposed rice husk	171.07	317.15	7.61	169.15
Vermicompost	227.00	353.35	8.84	248.65
Enriched compost	236.05	374.22	10.03	281.82
Soil based biofertilizer	196.05	337.18	8.34	175.15
Control	100.57	269.35	7.25	125.48
$CD_{0.05}$	28.41	10.84	0.56	23.77

Table 6: Economic aspects and profits associated with best treatment

Treatments	Plant population	Return from sucker @Rs.10/sucker (considering 5% loss in no. of suckers)	Return from flower @Rs.7/flower (considering 5% loss in no. of flowers)	Gross return (in Rupees)	Total expenditure (in Rupees)	Net return (in Rupees)	Benefit:Cost
Partially decomposed rice husk	5556	331471	352055.9	683526.9	172560	510966.9	2.96
Vermicompost	5556	366307.1	527820	894127.1	186618	707509.1	3.79
Enriched compost	5556	386892.1	615965.9	1002858	180458	822400	4.56
Soil based biofertilizer	5556	316164.2	431228.9	747393.1	172596	574797.1	3.33
Control	5556	263382.2	316692	580074.2	113548	466526.2	4.10

CONCLUSION

Enriched compost was found to be the best growing media for gerbera cv. Antibes under naturally ventilated greenhouse. This growing media significantly increased vegetative growth and flowering in Antibes.

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