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Influence of Different Combinations of Media and Bio Fertilizers on Flowering and Quality of Gerbera cv. Natasha under Protected Conditions

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A B S T R A C T

The present investigation entitled "Studies on the effect of different combinations of media and bio fertilizers on growth, flowering and cut flower yield of gerbera (*gerbera jamsonii* L.) cv. Natasha under protected conditions". The whole experiment was arranged over 10 treatments consisting of five levels of media combinations, M_1 - Red soil + Coco peat (1:1), M_2 - Red soil + Vermicompost (1: 1), M_3 - Red soil + Coco peat + Vermicompost (1:1:1), M_4 - Red soil + Coco peat + Vermicompost (2:1:1) and M_5 - Control (Red soil only) with two levels of bio fertilizers B_1 - PSB (Phosphate Solubilizing Bacteria) and B_2 - VAM (Vesicular Arbuscular Mycorrhiza). Interaction between different media combinations and bio fertilizers had significant influence on flower parameters and quality parameters. M_3 combination of media (Red soil + Coco peat + Vermicompost (1:1:1)) and B_2 bio fertilizer, Vesicular Arbuscular mycorrhiza (VAM) registered significantly less number of days taken to first flower bud appearance (37.42 days) and first flower opening (51.52 days), more number of flowers per plant (6.70) and maximum diameter of the flower (11.82 cm), flower stalk (0.74 mm) and disc flower (5.58 cm), longer flower stalk (59.77 cm), more number of ray florets per flower (64.94), maximum fresh weight and dry weight of the flower (31.77 and 10.82 g respectively) and maximum longevity of the flower on plant (18.63 days).

Introduction

Gerbera is one of the herbaceous dwarf perennial plant, grows in clump with solitary flower heads on long slender stalks. It belongs to the family asteraceae and is native to South Africa. It is popularly known as barberton, Transvaal and African (daisy). Gerbera is a popular cut flower grown throughout the world and its flowers are available in a wide range of colors including yellow, red, orange, cream, white, pink, brick red, scarlet, salmon peach, maroon and various other intermediate shades. Gerbera is an elegant flower of immense value as they are very attractive in garden with their star like flowers and borns

terminally on slender long stems. It is very much suitable for making bouquets and flower arrangements since a leafless feature. Moreover it forms a effective colourful borders or beds. Gerbera is an ideal flower widely used as a cut flower besides for beds, pots, borders and rock gardens.

Gerbera is grown commercially in the Telangana state under naturally ventilated polyhouses. The total area under polyhouse cultivation in Telangana is about 1500 acres and more than 90 per cent of area is under Gerbera cultivation.

Different factors affect the growth and development of gerbera plants. Among them, potting media is one of the most important factors which plays a key role in better plant growth. A potting media must serves four functions viz., providing of moisture, supply of nutrients, permits gas exchange to the roots and support to the plants. Soil alone as a growing media does not fulfill all requirements for better growth and development of any crop. Gerbera grows well in substrates such as coco peat, sawdust, vermicompost, FYM, rice husk *etc*. Soil is not considered as a good option as growing media.

The use of coco peat as a potting medium is a common practice for more than a decade. Cocopeat was gaining acceptance as a growing medium, because of its excellent aeration, durability, lightness and good water holding characteristics. The presence of organic compounds in coco peat can stimulate root growth and offer some natural resistance to plant diseases.

Vermicompost is an excellent soil conditioning agent and its incorporation to soil improves texture, structure, permeability, water holding capacity and proliferation of micro-organisms which enhanced better plant growth, root growth. Vermicompost contains 1.9, 2.0 and 0.8 per cent of N, P, K respectively. It also acts as chelating agent and regulates the availability of metabolic micronutrients like iron and zinc to the plants and increases the plant growth and yield by providing nutrients in the available form.

Vesicular Arbuscular Mycorrhiza (VAM) is a fungi, can form a symbiosis with host plant. It stimulates growth and development of plants, increases absorption of plant immobile elements, reduces disease incidence. Keeping these points in view the present work was designed to study the effect of different combinations of media and bio fertilizers on growth, flowering and cut flower yield of gerbera (*Gerbera jamesonii L.*) under protected conditions.

Materials and Methods

A Gerbera (*Gerbera jamsonii* L.) cv. Natasha was taken for the investigation during the Rabi season of the year 2017. The experiment was carried out under naturally ventilated polyhouse at post graduate research block, College of Horticulture - Mojerla, SKLTS Horticultural University, Hyderabad (Telangana) and the site is situated at 78° 29' East longitude and 17° 19' North latitude with an altitude of 542.3 m above mean sea level. The location is characterized by semi-arid climate.

The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications. The whole experiment was arranged over 10 treatments consisting of five levels of different combinations of media M_1 - Red soil + Coco peat (1:1), M_2 - Red soil + Vermicompost (1: 1) M_3 - Red soil + Coco peat + Vermicompost (1:1:1), M_4 - Red soil + Coco peat + Vermicompost (2:1:1) M_5 - Control (Red soil only) with two levels of bio fertilizers B_1 - PSB (Phosphate Solubilizing

Bacteria) and B_2 - VAM (Vesicular Arbuscular Mycorrhiza). Experiment was carried out in earthen pots having dimensions of 20 cm height and 30 cm diameter. Tissue cultured plants of gerbera cv. Natasha were used as planting material and planted one plant per each pot. The data on various parameters viz., Number of days taken to first flower bud appearance (days), Number of days taken to first flower opening, Number of flowers per plant, Flower diameter (cm), Flower stalk diameter (cm), Flower stalk length (cm), Number of ray florets per flower, Disc flower diameter (cm), Fresh weight of the flower (g), Dry weight of the flower (g) and Longevity of the flowers on plant (Days) Parameters were recorded on five tagged plants and the mean values were subjected to statistical analysis as per Panse and Sukhatme (1985).

Results and Discussion

Flower parameters

Number of days taken to first flower bud appearance (days)

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded significantly less number of days taken to first flower bud appearance (37.42 days), while it was significantly more in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (66.44 days), due to good vegetative growth converted in to early reproductive phase. Similar results were reported by Chauhan *et.al* (2014) in gerbera and they found that media enriched with higher organic matter, led to early first flower bud appearance. Moreover Barreto Maria shaila (2000) in gerbera reported that sufficient number of leaves per plant produced the healthy buds and flowers at early stage. The B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded the least number of days taken to first flower bud appearance was due to up take of good amount of phosphorous, resulted in early flower bud appearance.

Number of days taken to first flower opening

Significantly minimum number of days taken to first flower opening was recorded in M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) (51.52 days). Significantly maximum number of days taken to first flower appearance was recorded in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (89.43 days), due to the same treatment recorded early appearance of first flower bud appearance rather than others.

Number of flowers per plant

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded significantly the highest value (6.70), while it was significantly lowest in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (3.76) which might be due to vigorous vegetative growth, resulted in increased carbohydrate reserve material along with the proper uptake of all available nutrients led to more number of flowers per plant Chauhan *et al.*, (2014) in gerbera.

Flower diameter (cm)

Significantly the highest flower diameter (11.82 cm) was recorded in M_3 combination of media - Red soil + Coco peat +

Vermicompost (1:1:1) with B_2 bio fertilizer VAM (Vesicular Arbuscular Mycorrhiza), while it was significantly lowest in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer PSB (Phosphate Solubilizing Bacteria) (6.72 cm).

Due to luxuriant vegetative growth resulted in more green biomass of plant led to more availability of primary and secondary metabolites, favoured higher source to sink ratio represented the more diameter of flower Chauhan *et al.,* (2014) in gerbera.

Flower stalk diameter (cm)

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer VAM (Vesicular Arbuscular Mycorrhiza) recorded significantly maximum flower stalk diameter (0.74 cm), while it was significantly minimum in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer PSB (Phosphate solubilizing bacteria) (0.49 cm) which was due to the same treatment registered maximum flower diameter rather than other treatments Chauhan *et al.,* (2014) and Praveen Kumar (2007) in gerbera.

Flower stalk length (cm)

Highest flower stalk length was recorded significantly in M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) (59.77 cm), while it was significantly lowest in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer.

PSB- Phosphate Solubilizing Bacteria (48.49 cm) due to the same treatment recorded maximum flower and flower stalk diameter rather than other treatments Chauhan *et al.,* (2014) and Praveen Kumar (2007) in gerbera.

Number of ray florets per flower

More number of ray florets per flower was recorded in M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1)) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) (64.94), while it was significantly lowest in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer PSB (Phosphate Solubilizing Bacteria) (41.51) which was due to the same treatment recorded maximum flower diameter, flower stalk diameter and flower stalk length as compared to rest of the treatments Chauhan *et al.,* (2014) and Praveen Kumar (2007) in gerbera.

Disc flower diameter (cm)

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded significantly maximum disc flower diameter (5.58 cm), while it was significantly minimum in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (2.18 cm) due to the same treatment recorded maximum flower diameter, flower stalk diameter and flower stalk length as compared to rest of the treatments Chauhan *et al.,* (2014), Barreto Maria shaila (2000) and Praveen Kumar (2007) in gerbera.

Fresh weight of the flower (g)

Maximum fresh weight of the flower was recorded significantly in M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) (31.77 g), while it was significantly minimum in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (20.49 g) due to the same treatment recorded better flower

parameters such as maximum flower diameter, flower stalk diameter, flower stalk length, number of ray florets per flower and disc flower diameter rather than other treatments Chauhan *et al.*, (2014) in gerbera (Table 1 and 2).

Table.1a Effect of different combinations of media and bio fertilizers on flowering of gerbera cv. Natasha under protected conditions

Media (M) / Treatments	Number of flowers per plant			Flower diameter (cm)		
	B_1	B_2	Mean	B_1	B_2	Mean
M_1	4.54	4.85	4.70 [d]	8.01	8.41	8.21 [d]
M_2	5.27	5.64	5.46 [c]	8.98	9.01	8.99 [c]
M_3	6.47	6.70	6.59 [a]	11.02	11.82	11.42 [a]
M_4	5.92	6.19	6.06 [b]	9.40	10.24	9.82 [b]
M_5	3.76	4.22	3.99 [e]	6.72	7.42	7.07 [e]
Mean	5.19 [b]	5.52 [a]		8.82 [b]	9.38 [a]	
	SEm ±	CD @ 5%		SEm ±	CD @ 5%	
Media (M)	0.03	0.07		0.10	0.29	
Bio fertilizer (B)	0.02	0.05		0.06	0.18	
M x B	0.04	0.11		0.14	0.41	

M_1 - Red soil + Coco peat (1:1)
M_2 - Red soil + Vermicompost (1: 1)
M_3 - Red soil + Coco peat + Vermicompost (1:1:1)
M_4 - Red soil + Coco peat + Vermicompost (2:1:1)
M_5 - Control (Red soil only)

B_1 - PSB (Phosphate Solubilizing Bacteria)
B_2 - VAM (Vesicular Arbuscular Mycorrhiza)

Table.1b Effect of different combinations of media and bio fertilizers on flowering of gerbera cv. Natasha under protected conditions

Media (M) / Treatments	Number of days taken to first flower bud appearance (days)			Number of days taken to first flower opening (days)		
	B_1	B_2	Mean	B_1	B_2	Mean
M_1	59.84	56.82	58.33 [d]	80.83	76.81	78.82 [d]
M_2	53.81	50.80	52.31 [c]	72.80	68.79	70.80 [c]
M_3	41.72	37.42	39.56 [a]	56.71	51.52	54.11 [a]
M_4	47.73	44.73	46.23 [b]	64.72	60.72	62.72 [b]
M_5	66.44	62.89	64.66 [e]	89.43	84.88	87.15 [e]
Mean	53.91 [b]	50.53 [a]		72.90 [b]	68.54 [a]	
	SEm ±	CD @ 5%		SEm ±	CD @ 5%	
Media (M)	0.16	0.47		0.15	0.44	
Bio fertilizer (B)	0.10	0.30		0.09	0.28	
M x B	0.22	0.66		0.21	0.62	

M_1 - Red soil + Coco peat (1:1)
M_2 - Red soil + Vermicompost (1: 1)
M_3 - Red soil + Coco peat + Vermicompost (1:1:1)
M_4 - Red soil + Coco peat + Vermicompost (2:1:1)
M_5 - Control (Red soil only)

B_1 - PSB (Phosphate Solubilizing Bacteria)
B_2 - VAM (Vesicular Arbuscular Mycorrhiza)

Table.1c Effect of different combinations of media and bio fertilizers on flowering of gerbera cv. Natasha under protected conditions

Media(M) / Treatments	Flower stalk diameter (cm)			Length of the flower stalk (cm)		
	B1	B2	Mean	B_1	B_2	Mean
M1	0.55	0.56	0.56 [d]	51.82	52.87	52.35 [d]
M2	0.61	0.62	0.61 [c]	54.00	54.56	54.28 [c]
M3	0.70	0.74	0.72 [a]	57.07	59.77	58.42 [a]
M4	0.66	0.67	0.67 [b]	56.14	56.66	56.40 [b]
M5	0.49	0.51	0.50 [e]	48.49	50.65	49.57 [e]
Mean	0.60 [b]	0.62 [a]		53.50 [b]	54.90 [a]	
	SEm ±	CD @ 5%		SEm ±	CD @ 5%	
Media (M)	0.003	0.010		0.26	0.78	
Bio fertilizer (B)	0.002	0.007		0.17	0.50	
M x B	0.005	0.015		0.37	1.10	

M_1 - Red soil + Coco peat (1:1) B_1 - PSB (Phosphate Solubilizing Bacteria)
M_2 - Red soil + Vermicompost (1: 1) B_2 - VAM (Vesicular Arbuscular Mycorrhiza)
M_3 - Red soil + Coco peat + Vermicompost (1:1:1)
M_4 - Red soil + Coco peat + Vermicompost (2:1:1)
M_5 - Control (Red soil only)

Table.1d Effect of different combinations of media and bio fertilizers on flowering of gerbera cv. Natasha under protected conditions

Media(M) / Treatments	Fresh weight of the flower (g)			Dry weight of the flower (g)			Longevity of the flower on plant (days)		
	B1	B2	Mean	B_1	B_2	Mean	B_1	B_2	Mean
M1	23.82	24.87	24.35 [d]	7.01	7.41	7.21 [d]	15.31	15.66	15.49 [d]
M2	26.10	26.56	26.33 [c]	8.01	8.31	8.16 [c]	16.34	16.59	16.47 [c]
M3	29.07	31.77	30.42 [a]	10.18	10.82	10.50 [a]	18.41	18.63	18.52 [a]
M4	28.14	28.66	28.40 [b]	9.12	9.24	9.18 [b]	17.41	17.68	17.55 [b]
M5	20.49	22.65	21.57 [e]	6.08	6.42	6.25 [e]	13.45	14.57	14.01 [e]
Mean	25.52 [b]	26.90 [a]		8.08 [b]	8.44 [a]		16.18 [b]	16.63 [a]	
	SEm ±	CD @ 5%		SEm ±	CD @ 5%		SEm ±	CD @ 5%	
Media (M)	0.26	0.79		0.05	0.16		0.11	0.32	
Bio fertilizer (B)	0.17	0.50		0.03	0.10		0.07	0.20	
M x B	0.37	1.11		0.08	0.23		0.15	0.45	

M_1 - Red soil + Coco peat (1:1) B_1 - PSB (Phosphate Solubilizing Bacteria)
M_2 - Red soil + Vermicompost (1: 1) B_2 - VAM (Vesicular Arbuscular Mycorrhiza)
M_3 - Red soil + Coco peat + Vermicompost (1:1:1)
M_4 - Red soil + oco peat + Vermicompost (2:1:1)
M_5 - Control (Red soil only)

Table.2 Effect of different combinations of media and bio fertilizers on flowering of gerbera cv. Natasha under protected conditions

Media (M) / Treatments	Number of ray florets per flower			Disc flower diameter (cm)		
	B_1	B_2	Mean	B_1	B_2	Mean
M_1	46.04	48.10	47.07 [d]	3.18	3.52	3.35 [d]
M_2	50.78	54.07	52.42 [c]	3.83	4.09	3.96 [c]
M_3	60.19	64.94	62.56 [a]	5.34	5.58	5.46 [a]
M_4	56.14	58.20	57.17 [b]	4.41	4.57	4.49 [b]
M_5	41.51	44.04	42.78 [e]	2.18	2.81	2.49 [e]
Mean	50.93 [b]	53.87 [a]		3.79 [b]	4.11 [a]	
	SEm ±	CD @ 5%		SEm ±	CD @ 5%	
Media (M)	0.29	0.86		0.05	0.16	
Bio fertilizer (B)	0.18	0.55		0.03	0.10	
M x B	0.41	1.22		0.07	0.225	

M_1 - Red soil + Coco peat (1:1) B_1 - PSB (Phosphate Solubilizing Bacteria)
M_2 - Red soil + Vermicompost (1: 1) B_2 - VAM (Vesicular Arbuscular Mycorrhiza)
M_3 - Red soil + Coco peat + Vermicompost (1:1:1)
M_4 - Red soil + Coco peat + Vermicompost (2:1:1)
M_5 - Control (Red soil only)

Dry weight of the flower (g)

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded significantly maximum dry weight of the flower (10.82 g), while it was significantly minimum in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer (PSB) (Phosphate Solubilizing Bacteria) (6.08 g) which was due to the same treatment registered maximum fresh weight of the flower as compared to other treatments Chauhan *et al.,* (2014) in gerbera.

Quality parameters

Longevity of the flowers on plant (Days)

The M_3 combination of media - Red soil + Coco peat + Vermicompost (1:1:1) with B_2 bio fertilizer (VAM) (Vesicular Arbuscular Mycorrhiza) recorded significantly maximum value (18.63 days), while it was significantly minimum in M_5 combination of media - control (Red soil only) with B_1 bio fertilizer PSB (Phosphate Solubilizing Bacteria) (13.45 days) which might be due to the same treatment recorded maximum dry matter production and flower diameter rather than other treatments Chauhan *et al.,* (2014) in gerbera.

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