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EFFECT OF GROWING MEDIA PROPERTIES AND ITS CORRELATION STUDY IN GERBERA PRODUCTION

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ABSTRACT
Effect of growing media properties and its correlation study in gerbera production was carried out under protected condition with different growing media combinations *viz.* soil, sand, FYM, vermi compost, coco peat and rice husk. Significant relationships were observed between different growing media parameters with flower quality and yield parameters of gerbera. To evaluate the apparent strength of the relationship and to explain the variations on dependent variable (crop yield) multiple regression models were developed. In conclusion, it was found that the most important variables explaining the variations in the yield of gerbera were Water Holding Capacity (%) (initial), pH (initial), Available N (%) (initial), Available P (%) (initial), pH (end), Available N (%) (end) and Available P (%) (end).

INTRODUCTION

Gerbera (*Gerbera jamesonii* Bolus ex. Hook. f.) belongs to the family *Asteraceae* produces very attractive flower. It is a dwarf perennial plant, used in many ways such as cut flower, pot plant and makes a good show in exhibitions on floral arrangements. Soil and various soilless media are used as plant-growth media in horticulture. The most important physical properties of a medium for suitability are good aeration and drainage, optimum water retention, high water conductivity and low bulk density (Cabrera, 2003). Better performance can only be achieved using mixtures of potting media. The properties of different materials used as growing substrates exhibit direct and indirect effects on plant physiology and production (Verdonck *et al.*, 1981). Knowledge of interrelationship of substrate properties can help the farmers to balanced use of chemical fertilizers to maintain crop production (Hari Dahal and Routray, 2011).There is meager scientific work is available on quantitative effect of different growing media properties on yield of gerbera. Keeping these points in view, a experiment was conducted with the objective to study the combined quantitative impact of different growing media parameters on flower yield, a multilinear regression model was tested and fitted with the growing media parameters mentioned as independent variable and multiple regression coefficient (R^2) for each case and to assist growers in selecting container media based on media parameters and plant growth.

MATERIALS AND METHODS

The present investigation was carried out under a net house, covered with 75 % shade net, at College Nursery, N. M. College of Agriculture, Navsari Agricultural University, Navsari, using tissue cultured plants of gerbera variety Zingaro. The different growing media combinations *viz*., soil, sand, FYM, vermi compost, coco peat and rice husk, were tried to analyze the effect of growing media properties in gerbera production for two years. The treatment details are as bellow:

Uniform pots of 3 l volume were selected and 2.5 l growing media was filled in each pot. Recommended fertilizer doses of water soluble fertilizers were applied uniformly to all the treatments. The experiment was conducted using Completely Randomized Design (CRD), with ten treatments and 30 plants per treatment for two years. Five plants per treatment from each replication were randomly selected for the purpose of recording growth parameters and recorded at fifteen days interval from date of planting. Composite samples of different growing media used were collected from each treatment. The samples were air-dried, ground with wooden pastel and mortal, mixed thoroughly, sieved through 2 mm sieve were used for the determination of different growing media parameters.

Growing media respiration: Growing media respiration ($\mu molm^{-2}s^{-1}$) was measured at the end of experiment with portable LC pro+ without disturbing the media. The experimental data pertaining to all the characters studied were subjected to suitable statistical analysis. Correlation was calculated by means of statistical program MICROSTA copy right © 1984 by Ecosoft Inc.

RESULTS AND DISCUSSION

The different growing media parameters such as water holding capacity, pH, E. C., Organic carbon content (%), available N, P, K (%) content, and growing media respiration has significant effect on growth, quality and yield of gerbera. (Table 1).

pH

In pooled data pH of growing media highest pH value were recorded in T_1 and T_2 while lower i.e. 6.8 in T_5. Optimum pH of a container medium differs with plant species, but generally a range between 5.0 and 6.5 is desirable (Robbins and Evans, 2007). Among the different growing media treatments pH value was varied from among 5.4 to 6.8. Direct effects relate to pH, for example, a property of the soil which is not consumed by plants but has a physiological effect on growth, while resource effects relate to nutrients and moisture availability (Tanya, 2007).

E. C.

Pooled means of E. C. were ranged among 0.62 to 1.75 dsm^{-1}. As in the two years mean T_4 and T_1 given similar results i.e. maximum E. C. with T4 (1.75 dsm^{-1}) and minimum with T_1 (0.62 dsm^{-1}). Electrical conductivity is a good estimate for the total soluble salts in a media. The electrical conductivity of different growing media treatments was ranged from 0.62 to 1.75 dsm^{-1}. The highest EC was recorded in treatment T_4 [Coco peat: Rice husk: Vermi compost (2:1:1) v/v].

Organic Carbon

Treatment T_5 recorded highest organic carbon during both years i.e. 13.46 and 13.52 % while treatment T_2 recorded lower values i.e. 2.84 and 2.72 %.Pooled mean of organic carbon (%) was varied from 2.78 to 13.49 %. The results were in line with both year treatment T_5 recorded highest value i.e. 13.49 and treatment T_2 recorded lowest value i.e. 2.78 %. Organic carbon (%) content was noted maximum in treatment T_5 [Coco peat: Rice husk: FYM (1:2:1) v/v] in which initial status was also higher. Organic Carbon was high due to decomposition of media mixture.

Table 1: Treatment details

S. no.	Symbol used	Growing media combination
1.	T_1	Soil: Sand: Coco peat: FYM (1:1:1:1) v/v
2.	T_2	Soil: Sand: Coco peat: Vermi compost (1:1:1:1) v/v
3.	T_3	Coco peat: Rice husk: FYM (2:1:1) v/v
4.	T_4	Coco peat: Rice husk: Vermi compost (2:1:1) v/v
5.	T_5	Coco peat: Rice husk: FYM (1:2:1) v/v
6.	T_6	Coco peat: Rice husk: Vermi compost (1:2:1) v/v
7.	T_7	Coco peat: FYM (1:1) v/v
8.	T_8	Coco peat: Vermi compost (1:1) v/v
9.	T_9	Rice husk: FYM (1:1) v/v
10.	T_{10}	Rice husk: Vermi compost (1:1) v/v

Available N (%) content

Pooled mean for two years was ranged between 0.035 to 0.073 %. In pooled T_8 and T_1 showed the similar results of maximum (0.035 %) and minimum (0.073 %) available N (%) content. Available nitrogen (%) was found maximum in treatment T_8 [Coco peat: Vermi compost (1:1) v/v] however it was at par with T_6 [Coco peat: Rice husk: Vermi compost (1:2:1) v/v].The substrate nitrogen content was obviously increased by the addition of Vermi Compost.

Available P_2O_5 (%) content

Phosphorus content (%) was found higher i.e. 0.035 and 0.034 % in treatment T_5 during both years while treatment T_1 recorded lower values i.e. 0.009 and 0.009 % during both years. Pooled mean of phosphorus content was varied from 0.009 to 0.035 %. Highest potassium content (%) was recorded in treatment T_5 i.e. 0.034 % and lowest with T_1 i.e. 0.009 %.

Available K_2O content

Treatment T_4 recorded highest potassium content during both years i.e. 0.171 and 0.172 %; however it was at par with T_5 during both years. Lowest value for potassium content was recorded in treatment T_1 i.e. 0.052 and 0.051 %.Pooled mean of potassium content (%) was varied from 0.051 to 0.171 %. The results were in line with both year treatment T_4 recorded highest value i.e. 0.171 % and treatment T_1 recorded lowest value i.e. 0.051 %. The interaction of year × treatment was found non significant. Available phosphorus (%) and potash was recorded maximum in treatment T_5 [Coco peat: Rice husk: FYM (1:2:1) v/v] in which initial status of nutrient was also higher.

Growing media respiration (vpm)

Higher growing media respiration was recorded in treatment T_3 (908.00 and 910.00 vpm for Y_1 and Y_2) during both the years while lower value for this is recorded in treatment T_2 (203.67 and 197.00 vpm for Y_1 and Y_2). Pooled mean values for media respiration were ranged from 200.33 to 909.00

Table 2: Following methods were followed for growing media analysis

S. no.	Parameter	Method	Reference
1.	Water holding capacity (%)	International pipette method	Piper (1950)
2.	pH	1:2.5 Soil:Water suspension Potentiometric method	Jackson (1973)
3.	E.C. (dsm-1)	1:2.5 Soil:Water suspension Conductometric method	
4.	Organic carbon (%)	Walkley and Black's rapid titration method	
5.	Total N (%)	Modified kjeldahl's method	
6.	Total P (%)	Perchloric acid (HClO4) digestion method	Olsen and Sommers (1982)
7.	Total K (%)	Flame photometrically	Pratt (1965)
8.	Available N (%)	Alkaline permanganate oxidation method	Subbiah and Asija (1956)
9.	Available P (%)	Spectrophotometric (Extraction with 0.5 M NaHCO3 pH 8.5, blue colour) method	Olsen *et al.* (1954)
10.	Available K (%)	Flame photometric method	Jackson (1973)

Table 3: Correlation and regression analysis of number of flowers per plant with different growing media parameters

X_n(parameters governing yield)		Correlation coefficient 'r'	Regression coefficient
Before gerbera production (initial)			
X_1	Water Holding Capacity (%)	0.5443**	-0.0003
X_2	pH	-0.4771**	0.0856
X_3	E. C. (dsm^{-1})	-0.2433	-
X_4	Organic Carbon (%)	0.1328	-
X_5	Available N (%)	0.6900**	22.1242
X_6	Available P (%)	0.4743**	-41.0295
X_7	Available K (%)	0.2145	-
After gerbera production (end)			
X_8	pH	-0.4693**	-0.0829
X_9	E. C. (dsm^{-1})	-0.9634	-
X_{10}	Organic Carbon (%)	0.1568	-
X_{11}	Available N (%)	0.5078**	-9.7725
X_{12}	Available P (%)	0.5290**	32.6594
X_{13}	Available K (%)	0.0616	-
X_{14}	Growing media respiration (vpm)	0.0549	-
	R^2	0.5905	
	Variation explained (%)	59.05	
	R value	0.7685	
	Constant (A value)	9.6132	

Table 4: Correlation of growing media parameters with flower quality and yield parameters

Negative correlation	Significant parameter	Positive correlation
pH (initial)**, pH (end)**	1. Flower stalk length (cm)	Water holding capacity (initial)**, E.C. (initial)**, organic carbon (%) (initial)**, available N*, P**, K** (%) (initial), E.C. (end)**, organic carbon (%) (end)**, available N**, P**, K** (%) (end), growing media respiration (ppm)**
pH (initial)**, pH (end)**, growing media respiration (ppm)	2. Girth of flower stalk (cm)	Water holding capacity (initial)*, E.C. (initial)**, organic carbon (%) (initial)*, available N**, P**, K** (%) (initial), E.C. (end)**, organic carbon (%) (end)**, available N**, P**, K** (%) (end)
pH (initial)**, pH (end)**	3. Flower diameter (cm	Water holding capacity (initial)**, E.C. (initial)**, organic carbon (%) (initial)**, available N**, P**, K** (%) (initial), E.C. (end)**, organic carbon (%) (end)**, available N**, P**, K** (%) (end), growing media respiration (ppm)**
pH (initial)**, pH (end)	4. Weight of cut stem (g)	Water holding capacity (initial)**, E.C. (initial)**, organic carbon (%) (initial)**, available N**, P**, K** (%) (initial), E.C. (end)**, organic carbon (%) (end)**, available N, P**, K** (%) (end), growing media respiration (ppm)
pH (initial)**, pH (end), Available N (%) (end)	5. Number of petals per flower	Water holding capacity (initial), E.C. (initial), organic carbon (%) (initial), available N, P**, K (%) (initial), E.C. (end), organic carbon (%) (end), available P**, K (%) (end), growing media respiration (ppm)
pH (initial)**, pH (end)**	6. Vase life (days)	Water holding capacity (initial), E. C. (initial), organic carbon (%) (initial), available N*, P**, K** (%) (initial), E.C. (end)**, organic carbon (%) (end), available N, P**, K* (%) (end), growing media respiration (ppm)
pH (initial)**, E.C. (initial), pH (end)**	7. Number of flowers per plant	Water holding capacity (initial)**, organic carbon (%) (initial), available N**, P**, K (%) (initial), E.C. (end), organic carbon (%) (end), available N**, P**, K (%) (end), growing media respiration (ppm)**

* - Significant at 5 % level, ** - Significant at 1 % level

vpm. The trend of the treatment result was in same line as that of the first and second year. The higher value (909.00 vpm) was recorded with treatment T_3 and lower (200.33 vpm) with T_2.

Correlation with initial (after 6 weeks) growing media parameters

Correlation of flower stalk length, girth of flower stalk, flower diameter and weight of cut stem with water holding capacity (%), E.C. (dsm^{-1}), Organic carbon (%) content, available N, P, K (%) content was highly significant and positive while it was negative pH of the media. Number of petals per flower manifested highly significant and negative correlation with pH of media while it was found positive with available P (%) content of media. Vase life of flowers exhibited significant and positive correlation with E.C. (dsm^{-1}), Organic carbon (%) content, available N, P, K (%) content while negative correlation with pH of growing media. The correlation of number of flowers per plant with water holding capacity (%), available N and P (%) content was found highly significant and positive but it

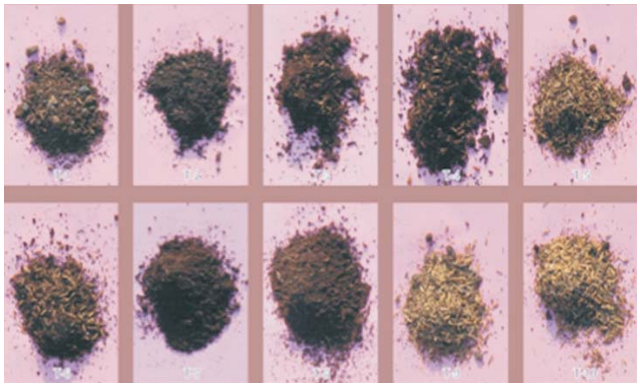

Figure 1: General view of growing media treatments

Figure 2: Measurement of media respiration rate with LC pro+ instrument (inset: soil chamber)

was found significantly negative with pH of growing media.

Correlation with growing media parameters after gerbera production (at the end of experiment)

Association of stalk length with E.C. (dsm^{-1}), Organic carbon (%) content, available N, P, K (%) content and media respiration was found significantly positive while it was negative with pH of growing media. Girth of flower stalk was significantly and positively correlated with E.C. (dsm^{-1}), Organic carbon (%) content, available N, P, K (%) content of growing media and it was negatively but significantly correlated with pH of growing media. Flower diameter exhibited significantly positive association with E.C. (dsm^{-1}), Organic carbon (%) content, available N, P, K (%) content and media respiration while it was negative with pH of media. Weight of cut stem manifested significant and positive correlation with E.C. (dsm^{-1}), Organic carbon (%) content, available P and K (%) content. Number of petals per flower was significantly and positively correlated with available P (%) content of growing media. Vase life of flowers possessed significant positive correlation with E.C. (dsm^{-1}), available P and K (%) content of media and it was negative with pH of growing media. The correlation of number of flowers per plant with available N and P (%) content of growing media was found highly significant and positive however it was negative with pH of growing media. As indicated by Januszet *al*.(2011)in *Trifoliumrepens* and *Medicago sativa* that increase in dry matter production were caused by decreasing pH of the growing medium.

Significant relationships were observed between growing media parameters with flower quality and yield parameters.Chemical properties of substrates were strongly correlated with growth, suggesting these indices can be used to characterize substrate suitability for production (Franciset *al.*, 2006).

Multiple correlation and regression analysis

The multiple correlation coefficient was found significant in some growing media parameters and the regression equation was developed for yield i.e. number of flowers per plant was as under,

$\hat{Y} = 9.6132 - 0.003*(X_1) + 0.0850*(X_2) - 22.1243*(X_5) - 41.0295*(X_6) - 0.0829*(X_8) - 9.7725*(X_{11}) + 32.6594*(X_{12})$Where, $\hat{Y}$ = Number of flowers per plantX_1 = Water Holding Capacity (%) (initial)X_2 = pH (initial)X_5 = Available N (%) (initial)X_6 = Available P (%) (initial)X_8 = pH (end)X_{11} = Available N (%) (end)X_{12} = Available P (%) (end)

The regression value of R^2 was 0.5905, which explained 59.05 % variation in number of flowers per plant due to growing media parameters.Regression equation showed the relationship of number of flowers per plant with Water Holding Capacity (%) (initial), pH (initial), Available N (%) (initial), Available P (%) (initial), pH (end), Available N (%) (end) and Available P (%) (end).Delbert *et al*., (1984) state that higher yields of crops usually occurred in media characterized by high initial nutrient and trace element levels, lower retention of N, and higher pH, EC.

Effect of growing media on media properties after gerbera production

Correlation study: The effect of different growing media parameters such as water holding capacity, pH, E. C., Organic carbon content (%), available N, P, K (%) content, and growing media respiration on some important flower quality parameters (*viz*., stalk length, stalk girth, flower diameter, weight of cut stem, petals per flower, flower grade, vase life) and flower yield correlation analysis was worked out for pooled of two years.Contents of macro and micronutrients related with different values of the yield of snap bean pods is reported by Shaban (2005).

Additional studies with physic-chemical indices of substrates may further improve our under- standing of how substrate composition, chemistry, can interact to promote growth and production.

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