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Short communication

Response of different growing media on the growth and yield of gerbera in hydroponic open system

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Gerbera (*Gerbera jamesonii*) is one of the herbaceous plants with colorful and beautiful flowers that are used as cut, pot and garden flower. Various planting beds around the world is used for growing gerbera such as perlite, rock wool, vermiculite, sand, coconut fibre (coco peat), expanded clay, organic substrates, compost cow, zeolite, pumice, sand etc. reported by Khalaj (5) and Fakhri *et al*. (4). Soil-less cultures have been successfully used for several decades with the aim to intensify production and reduce cost of cultivation (Maloupa *et al.*, 6). Peat is the most widely used substrate for potted plant production in the nurseries and accounts for a significant portion of the materials used to grow potted plants (Marfa` *et al*., 8; Ribeiro *et al*., 15). Since the last few years, coco peat, also known as coir dust has been considered as a renewable sphagnum peat substitute for the use in horticulture (Yau and Murphy, 19; Pisame *et al.*,13). Perlite has been widely used in soil-less cultures too. Perlite, an alumino-silicate of volcanic origin, is rather inert (low buffering and cation exchange capacities of 0-1 mg l^{-1}). In general, it has a closed cellular structure, with the majority of water being retained superficially and released slowly at a relatively low tension, providing excellent drainage of the medium and aeration of rhizosphere (Maloupa *et al*., 6). The objective of this study was to determine the effect of different substrates on growth and yield of gerbera under an open soil-less production system.

This experiment was carried out as Randomized Complete Block Design (RCBD) with 14 treatments and three replications for study on the effect of different substrates on growth and yield of gerbera over a period of 6 months as (v/v) : T_0 = fine sand, T_2 = peat + fine sand (25% + 75%), T_3 = peat + fine sand (50% +50%), T_4 = perlite + peat (75% + 25%), T_5 = perlite + peat (50% + 50%), T_6 = perlite + peat (25% + 75%), T_7 = perlite + peat + expanded clay (25% + 70% + 5%), T_8 = perlite + peat + expanded clay (50 %+ 25%+ 25%), T_9 = perlite + peat + expanded clay (25%+ 50% + 25%), T_{10} = perlite + expanded clay (50% + 50% , T_{11} = coco peat, T_{12} = coco peat + perlite (75 %+ 25%), T_{13} = coco peat + perlite (50% + 50%), and T_{14} = coco peat + perlite + expanded clay (50% + 25% + 25%). The different physical properties of the media tested are given in Table 1.

Plants were fertilized with a same nutrient solution in all the treatments. Sand, perlite and expanded clay were used with 0.5-1.0, 1.0-2.0 and 3.0-5.0 mm in diameter, respectively. The greenhouse temperature and relative humidity were 18-28^{0}C and 50-70% and the intensity ranged from 23,000-25,000 (lumens/m^2). Gerbera plants were transplanted in 4 l capacity pots. They were irrigated 3-4 times daily. Electrical conductivity and pH of water (nutrient solution) was 5.5-6.5 and 1.5-2.0 dS/m, respectively. In a period of six months, different flower characteristics were measured such as flower number, flower stem height, flower disc diameter, stem diameter, stem neck diameter and vase-life. Standard procedures were followed to collect the data for growth and flowering parameters. The data collected was analyzed statistically by using Duncan's Multiple Range (DMR) test at 5% probability level and used to compare the difference among treatment means (Steel *et al.*, 16).

The selecting of media is based on many factors as existence; ease of use, cheap for producers. The different types of media can be used as peat and recently coco peat (coconut fibre), rock wool, vermiculite, perlite, expanded clay, pumice, sand etc. have been used in different proportions. In this experiment, based on various sources of external and internal reviews, common media used in gerbera cultivation were evaluated (Sindhu *et al.*, 15; Khalaj, 5; Venezia *et al*., 18; Mascecarini, 9; Pisanu *et al*., 13). The results showed that T_7 treatment, which includes a mixture of perlite + peat + expanded clay (25% + 70% + 5%) produced maximum flower numbers (10.33) against control comprising sand bed alone (3.77 flowers) (Table 2). The flower numbers of gerbera in T7 treatment could be due to the faster plant development and good root system and better physico-chemical properties of mixes. Growth medium is known to have a large effect on value of potted ornamental plants (Vendrome *et al*., 17). Cation exchange capacity (CEC) of substrate No. 7 was 80

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Table 1. Physical and chemical properties of substrates used in the experiment.

Treatment No.	pH	EC (dS/m)	CEC (cmol C/kg)	Porosity (%)	Substrate
T_1	6.91	1.04	0.75	40	Fine sand
T_2	6.87	1.02	3.5	41.1	Peat + fine Sand (25% + 75%)
T_3	6.82	0.99	7.7	42.7	Peat + fine Sand (50% + 50%)
T_4	6.54	0.84	26.5	73.7	Perlite + peat (75% + 25%)
T_5	6.15	0.65	57.2	79.4	Perlite + peat (50% + 50%)
T_6	6.65	0.41	94.9	86.3	Perlite + peat (25% + 75%)
T_7	6.17	0.34	80.3	80.7	Perlite + peat + expanded clay (25% + 70% + 5%)
T_8	7.75	0.49	22.4	62.7	Perlite + peat + expanded clay (50% + 25% + 25%)
T_9	6.51	0.39	43.5	66.2	Perlite + peat + expanded clay (25% + 50% + 25%)
T_{10}	8.29	0.18	35.3	59	Perlite + expanded clay (50% + 50%)
T_{11}	5.29	0.5	75	90	Coco peat
T_{12}	5.75	0.64	54	84.1	Coco peat + perlite (75% + 25%)
T_{13}	6.17	0.77	34.5	78.6	Coco peat + perlite (50% + 50%)
T_{14}	7.48	0.45	27.6	66.3	Coco peat + perlite + expanded clay (50% + 25% + 25%)

cmol kg^{-1}. According to different researches, organic materials and high cation exchange capacity (CEC) increase the absorption and storage of nutrient, water and also by creating of suitable conditions for plant root growth, can increase qualitative and quantitative characteristics of flowers. When peat was used alone, there was low ventilation and so was the case with sand or perlite (Khalaj, 5). Among the physical characteristics, aeration and water holding capacity are probably the most important factors while, among the chemical characteristics, nutritional status, and salinity level have a crucial role on plant development (Dewayne *et al*., 3). Earlier, Nowak and Strojny (10) reported that the total porosity, bulk density, shrinkage water capacity and air capacity of the growing substrates had significant effects on the number and weight of fresh flowers in gerbera.

Data showed that flower disc diameter was positively influenced by the different media and the largest flower diameter, 11.6 cm in T_7 treatment and the lowest flower diameter 10.9 cm in sand alone (Table 2). Fakhri *et al*. (4) obtained the largest flower on mixes of peat and perlite. They noted that media physico-chemical characteristics improving because of the organic matter existence was the main reason of differences. There was significant difference in the flower height, significantly greater mean flower height were produced in medium 7 with 54.5 cm, the optimum growing media (Table 2). Greater flower stem height and yields were produced by plants grown on medium 7 suggest that this treatment is best suited for growing gerbera. Medium 7, had the least salinity (0.39 dS/m) compared to other media, hence good rooting medium provided helped in better nutrient absorption and growth for plants.

Papadopoulos (12) has shown that mixture of perlite and peat with equal volume produced the maximum flower height with 69 cm. Aswath and Padmanabha (1) reported that in gerbera electrical conductivity medium had significant influence on stalk length, stalk thickness and flower diameter. Ozcelik *et al*. (11) studied the effects of different planting media as the alone or the combination on quality and quantity of gerbera, they observed that the most appropriate mixture for gerbera yield in a 15-month period. A strong relationship between substrate physico-chemical properties, gerbera quantity and quality characteristics were observed in this study. Data showed that significant differences in the gerbera vase-life grown on media with varying substrate (Table 2). In medium 7, has the longest vase-life of 13.6 days was recorded (Table 2). The vase-life is directly related to dry matter production as well as size of flowers. This finding is in agreement with Manins *et al*. (7), which had showed significant differences between different substrates on gerbera vase-life. De Jong (2) found that gerbera flowers with strong stem were less likely to fold in the vase due to better turgor pressure maintenance. As the vegetative growth was found to be better in cocopeat combinations, the flower set was early producing high quality cut flowers.

The present study confirms the fact that selection of the appropriate growth medium for cut flower gerbera plants was very important from yield and quality point of view. The medium must ensure the production of plants of the required quality on cost

Table 2. Effect of different substrates on the growth and yield of gerbera.

Treatment	Flower height (cm)	Stem neck dia. (cm)	Stem dia. (cm)	Flower disc dia. (cm)	Flower No. (per plant)	Vase-life (days)
T_1	48.4	0.49	0.66	10.9	3.77	10.6
T_2	51.3	0.52	0.69	11.6	3.9	11.4
T_3	50.4	0.52	0.66	11.1	5.67	10.7
T_4	45.0	0.5	0.65	11	7.9	11.6
T_5	51.6	0.51	0.64	11.1	7.43	10.8
T_6	54.0	0.5	0.67	11.5	7.76	10.3
T_7	54.5	0.58	0.79	12.4	10.33	13.6
T_8	48.4	0.5	0.68	11	7.9	11.3
T_9	48.2	0.51	0.68	11.2	9.23	11.1
T_{10}	46.0	0.51	0.69	11.2	7.9	11.3
T_{11}	51.0	0.51	0.7	11.1	5.57	10.6
T_{12}	54.3	0.5	0.69	11.3	6.67	10.7
T_{13}	54.2	0.5	0.69	11.3	6	10.3
T_{14}	53.2	0.5	0.7	10.9	7.77	10.1
CD at 5%	3.04	0.04	0.04	0.41	3.49	1.27

effective basis. In the present study, perlite + peat + expanded clay mix (25% + 70% + 5%) produced significantly the maximum number of flowers per plant and other quality characteristics among different media.

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