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Short communication

Effect of substrates on lilium (*Lilium longiflorum* L.) programming in container system

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ABSTRACT

Substrate plays an important role for the success of ornamental crop production in container system. An experiment was carried out to examine the effect of substrates on lilium (*Lilium longiflorum* L.) programming in container system at Model Floriculture Centre, GBPUA&T, Pantnagar, Uttarakhand during 2014-15. The experiment was laid out in completely randomized design. The effect of the substrates on flowering and bulbous attributes was investigated. Cocopeat (T2) substrate demonstrated significant effects on flowering attributes like plant height (108.66 cm), stem diameter (8.77 mm), No. of flower buds (7.26), flower bud length (10.46 cm), flower bud diameter (31.52 mm), flower diameter (14.29 cm) and vase-life (10.73 days). However, number of days to bud appearance (35.40) and number of days to first flower opening (66.53) were maximum with soil substrate (T_1). Among bulbous characteristics bulb diameter (52.07 mm), bulb weight (56.24 g), number of bulblets (3.46), stem roots (15.26 cm) and basal roots length (25.12 cm) were found maximum with cocopeat substrate. Among the potting media, 100% cocopeat (T_2) showed overall positive influence on growth, flowering and bulbous attributes as compared to control (T_1), hence, recommended for lilium cultivation in container system.

Key words: Lilium programming, substrate, container, flowering characteristics, bulbous attributes.

Lilium (*Lilium longiflorum* L.) is a diverse and highly cherished genus of bulbous flower belonging to family Liliaceae. With having different shape, size, colour and fragrant flowers lilium holds 4th position among top 10 cut flowers in world floriculture trade (Bahr and Compton, 2). The programmed bulbs of lilium cultivated almost throughout the year in container system under protected condition. In recent years, substrate culture recognized as advance system for ornamental crop production and lilium forcing. It has been observed that field soil are generally unsatisfactory for the production of bulbous plants in containers, primarily because they do not provide the required aeration and water retention status that are essential to maintain equilibrium between moisture content and gaseous exchange in a limited volume of container (Kuklal *et al*., 6). Thus, selection of an ideal substrate is one of the important key for success of soilless culture system. Studies have revealed that increasing the proportion of potting media like cocopeat improve all growth indices particularly plant height, stem diameter, flower diameter, and number of buds (Seyedi *et al*., 11). However, in India information regarding this aspect is scanty. Therefore, the present investigation was carried out for assessment of substrates for programmed lilium production in container system.

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Present investigation was conducted at the Model Floriculture Center, GBPUA&T Pantnagar located in *Tarai* regions of Uttarakhand in foothills of Himalaya. The experiment was laid out in Completely Randomized Design ensuring uniformity to all the treatments. Four treatments were T_1 = Garden soil, T_2 = Cocopeat, T_3 = Cocopeat + sand (1:1) and T_4 = Soil + cocopeat (1:1). However, programmed bulbs (vernalized) of lilium cv. Bach were imported from VWS Export Import Flowerbulbs B.V. Holland. Ten bulbs of 'Bach' 14-16 cm grades were planted in plastic containers (60 x 40 x15 cm^3) containing 20 liters (by volume) of substrates and randomized inside naturally ventilated greenhouse during autumn-spring season. The data were recorded on five plants in each replication. Observations were recorded on mean flower plant height (cm), stem diameter (mm), No. of flower buds, No. of days to bud appearance, flower bud length (cm), flower diameter (cm), No. of days to first flower opening, vase-life (days), bulb diameter (cm) and weight (gm), No. of bulblets, stem and basal roots length (cm). The physico-chemical properties of growing media components were determined before planting. The electrical conductivity (EC) and pH of substrate were determined by using EC Systronics conductivity meter and digital pH meter, respectively. Nitrogen was determined by alkaline potassium permanganate method. Phosphorus was determined by Olsen's method. Potassium was determined with the help of

flame photometer. Bulk density (Db) was determined by weighing bottle method and expressed in g/cm^3. Porosity was also calculated on percentage basis (Table 3).

Stem length of lilium is an important characteristic because stem with more than 90 cm length preferred in both domestic and international flower trade and considered as 'A' grade flowers. From this study, it was found that floral height significantly affected by substrate treatments (Table 1). Maximum plant height (108.66 cm) was recorded with T_2 that was at par with T_3 and followed by T_4, however, it was minimum (97.13 cm) in T_1. Increased stem length in T_2 substrate may be attributed to good physical properties like high porosity, high water holding capacity, slow water and nutrient releasing ability resulting better vascular tissues development which helps in maximum water and nutrient absorption. The optimum pH and electrical conductivity might further have helped in better uptake of nutrients. Lesser plant height (97.13 cm) recorded in T_1 was significantly at par with T_3 and T_4. This might be due to high EC, bulk density or low porosity of soil enriched media (Table 3). Likewise stem length, stem thickness (8.77 mm) was also significantly higher in T_2 and on par with T_3, T_4 and T_1. However, minimum stem girth (7.90 mm) was recorded with T_1 treatment (Table 1). Increased stem thickness in T_2 substrate might be due to congenial growing environment that favours plant growth. These results are also in agreement with the earlier findings of Kaur *et al*. (5) who reported that using a mixture of paddy straw compost + burnt rice husk as potting media significantly improved growth and flowering of *Kalanchoe blossfeldiana*.

Early flowering is an ideal flowering attributes among all ornamental crops because it favours off-season production resulting farmers fetches better market prices. Findings of this investigation clearly indicated that plants grown with T_2 substrate took minimum number of days (32.66) to flower bud appearance, whereas the maximum days (35.40) was recorded with T_1 treated plants that was at par with T_2, T_3 and T_4. Among the potting mixture, plants raised on cocopeat (T_2) was significantly earlier in flowering than rest of the treatments (Table 1). Similar results were reported by Tehranifar *et al*. (12) in Lilium (Asiatic and Oriental hybrids, cultivars 'Gironde' and 'Cassandra', respectively). The data in Table 1 shows that potting media have a significant influence on number of flower buds in lilium hybrid 'Bach'. Highest numbers of flower buds (7.26) were recorded with T_2 that was at par with T_3 and followed by T_4. However, minimum numbers of flower buds (5.40) were recorded in T_1 (Table 1). The lilium hybrid 'Bach' probably fully expressed its genetic potential in T_2 as it got the congenial growing condition. This might be due to higher EC that favours maximum absorption and utilization of water and nutrients. Findings of Nair and Bharathi (8) are in accordance with our finding that cocopeat + sand + FYM + vermicompost (2:1:0.5:0.5 v/v) was found to be one of the best potting media combinations resulting in the production of highest number of chrysanthemum flowers per plant (192.02) as compared to 164.93 in soil + sand + FYM + vermicompost (2:1:0.5:0.5 v/v). Sangwan *et al*. (10) also recorded less number of flowers in marigold when grown in soil. The flower bud opening was quickest (59.33 days) in T_2 treated plants that was significantly at par with rest of the treatments. These results got the support from the earlier findings of Seyedi *et al.* (11).

Exhibition quality of a flower is determined by its shape and size. Bigger the bloom means having better display quality and attractiveness. This study shown that maximum flower bud length (10.46 cm), flower bud diameter (31.52 mm) and diameter of fully open flower (14.29 cm) were recorded with T_2 that were significantly at par with rest of the treatments (Table 1). However, minimum flower bud length (9.46 cm), flower bud diameter (29.49 mm) and diameter of fully open flower (12.48 cm) were recorded with T_1. The increase in all these flowering attributes might be due to better plant growth resulting maximum production and utilization of photo-synthates for enhancing the qualitative attributes of lilium flower. These results are in accordance with earlier findings of Thakur *et al*. (13). Vase-life determines the commercial value of cut flowers and higher value is always preferred in trade. Maximum vase-life (10.73 days) was recorded in T_2 that was at par with T_3 and T_4. However, plants treated with T_1 recorded with minimum vase-life (6.53 days). Increase in vase-life in T_2 might be due to healthy plant growth that leads production and accumulation of more food reserves that were utilized during the vase period. These results are in accordance with findings of Prisa *et al*. (9).

Like flowering attributes, bulbous characteristics like bulb size and weight were also significantly influenced by physical and chemical properties of different potting media. The findings of this experiments reveals that maximum flower bulb diameter (52.07 mm) and weight (56.24 g) were recorded in T_2 that was significantly higher than T_3, T_4 and T_1. However, minimum bulb diameter (43.40 mm) and weight (44.25 g) measured with T_1 (Table 2). This might be because of unfavourable growing condition like media compactness and high pathogen load with T_1 which leads rotting of mother bulbs and its depletion. These results got supports

Table 1. Effect of substrates on growth and flowering attributes of lilium cv. Bach.

Treatment	Plant height (cm)	Stem dia (mm)	Bud appearance (days)	Flower buds per plant	First flower opening (days)	Bud length (cm)	Bud dia. (mm)	Flower dia. (cm)	Vase-life (days)
Soil (100%)	97.13	7.90	35.40	5.40	66.53	9.46	29.49	12.48	6.53
Cocopeat (100%)	108.66	8.77	32.66	7.26	60.33	10.46	31.52	14.29	10.73
Cocopeat + sand (1:1)	101.33	8.39	33.46	6.00	63.33	10.18	30.99	13.16	7.53
Cocopeat + soil (1:1)	103.46	8.08	33.53	5.26	63.93	9.77	29.47	13.00	6.93
CD at 5%	7.09	0.36	0.54	0.59	2.08	0.09	0.55	0.20	1.19

Table 2. Effect of substrates on bulbous attributes of lilium cv. Bach.

Treatment	Bulb dia. (mm)	Bulb wt. (g)	No. of bulblets per plant	Length of stem/ feeder roots (cm)	Length of basal roots (cm)
Soil (100%)	43.40	44.25	2.80	6.56	10.02
Cocopeat (100%)	52.07	56.24	3.46	15.26	25.12
Cocopeat + sand (1:1)	45.54	48.27	2.93	9.33	22.13
Cocopeat + soil (1:1)	44.30	45.79	2.60	9.20	16.62
CD at 5%	3.10	0.95	0.49	0.87	1.54

Table 3. Physico-chemical properties and available nutrients in substrates at the time of planting.

Treatment	pH	EC (dSm^{-1})	D_b (g/cm^3)	Porosity (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Soil (100%)	6.8	1.68	1.07	24.60	186.60	37.63	193.40
Cocopeat (100%)	5.9	1.98	0.53	57.40	1.96 (mg/l)	1.32 (mg/l)	477.7 (mg/l)
Cocopeat + sand (1:1)	6.2	1.12	0.77	49.35	207.6	11.8	190.0
Cocopeat + soil (1:1)	6.5	0.96	0.92	37.23	281.21	28.31	222.34

from earlier findings of Bahadoran *et al*. (1) in tuberose. Maximum numbers of bulblets (3.46) per plant were recorded with T_2 treatment which was significantly at par with the rest of the treatments and was recorded minimum (2.80) with T_1 treated plants. Similar finding have been documented in gladiolus cv. White Prosperity by Kumar and Pathak (7). Minimum Stem root length (6.56 cm) and basal root length (10.02 cm) were recorded with T_1 treatment. This might be due to the high bulk density and low porosity resulting low oxygen supply to root zone of T_1 treated plants that leads poor root growth and improper release and uptake of nutrients in these media. However, maximum stem root length (15.26 cm) and basal root length (25.12 cm) were measured with T_2 treated plants (Table 2). T_2 gave significant higher results, which might be due to their ability to supply sufficient amount of water and nutrients like nitrogen, phosphorus and potassium to the plants because of high EC and low pH as compare to other potting substrates. The findings are in accordance with the earlier findings of Jorgensen *et al*. (3) also reported that, plants grown in the coir medium showed stronger root growth compared to the rockwool media. Maximum root number of *Spathiphyllum* was recorded in the potting medium containing perlite: sand mixture (3:1) and only perlite as compare to control by Kakoei and Salehi (4)

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