*Indian Journal of Agricultural Sciences* **87** (5): 677–80, May 2017/Article
https://doi.org/10.56093/ijas.v87i5.70198

# Assessment of substrates for lilium (*Lilium longiflorum* ) forcing in container system

N S BHANDARI[1], R SRIVASTAVA[2], S P KANTIYA[3], S K GURU[4] and V GOSHWAMI[5]

*G B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand 263 145*

Received: 4 February 2016; Accepted: 28 November 2016

ABSTRACT

Right choice of the suitable substrate contributes a lot for successful flower production in container system. In order to select ideal substrates for lilium (*Lilium longiflorum* L.) forcing in container system, an experiment was conducted at Model Floriculture Centre, GBPUAT, Pantnagar during 2014-15. The bulbs were planted at spacing 15×10 $cm^2$ in plastic container under polyhouse in December. The results have been explained on the basis of mean data at 5% confidence level, that indicated among the different growing media, cocopeat enriched media ($M_2$) assessed with maximum plant height (99.80 cm), number of flower buds (5.37), flower diameter (15.23 cm), bulb diameter (52.03 cm), basal roots length (25.36 cm) and stem roots length (14.43 cm) as compare to control ($M_1$). However among the varieties, maximum plant height (98.41 cm) and number of flower buds (5.99/plant) were measured with $V_2$ and minimum with $V_1$.

**Key words:** Containers, Flower forcing, Lilium, Substrates

Lilium (*Lilium longiflorum* L.) is an unique cut flower crop ranking 4th among the top 10 cut flowers in the global florist trade which may be attributed to its excellent keeping quality, wide range of colors and ability to withstand long distance transportation, belongs to family Liliaceae (Bahr and Compton 2004). From an economical point of view, lily is the most important bulbous plants grown in India as cut flower and pot plant. Every year million of programmed lilium bulbs imported from the Netherlands to carry out all year-round intensive production in controlled condition. These intensive forcing systems require an ideal soilless substrate for success of crop because it has been observed that field soil are generally unsatisfactory for the production of 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 pot and on other side soil is carrier of the most severe diseases that compromise crop productivity and profitability (Kukal *et al*. 2012).

Growing medium has three main functions: 1) supply roots with nutrients, air, and water, 2) allow for maximum root growth, and 3) physically support the plant (Schmilewski 2008). Among the physical characteristics total porosity, oxygen diffusion ability and water holding capacity are probably the most important factors, while chemical characteristics such as pH, EC, and nutritional status of the media mixture play a crucial role in the plant development (Dewayne *et al.* 2003). Features such as granulation, pore space, water capacity, weed risk etc. are critical to the success of high performance growing media in container system. Thus, selection of an ideal substrate is one of the most important factors for success of substrate culture system because it supports overall building up of plant body.

In recent years, soilless culture recognized as advance system for ornamental crop production and lilium forcing (Oki and Lieth 2004). Many flower growers across the world focused their attention on soilless culture, which is a sound, alternative solution to chemical sterilization (Tribulato *et al*. 2001 and Sonneveld *et al*. 1999). Increasing interest of flower growers for soilless culture in India is due to the loss of fertility of the agricultural soil after several years of single crop system in areas suitable for traditional floriculture and the need to improve crop efficiency in terms of both yield and quality. Studies on soilless culture in India have advanced during the last decade. However, information regarding the suitability of organic and inorganic substrates and their mixes as potting media for hi-tech container crop production is scanty. Bach and Pavia are white and yellow colour standard exotic cultivars of LA lilium and commercially cultivated in the Tarai region of Uttarakhand

[1]Ph D Scholar (e mail: Narendra.Bhandari@icar.gov.in), Division of Ornamental Crops, IARI-IIHR, Bangalore, Karnataka 560 089. [2]Professor and Head (e mail: ranjansrivastava25@ gmail.com), [3]Ph D Scholar (e mail: kantiyasp@gmail.com), [5]M Sc student (e mail: vershagoshwami9@gmail.com), Division of Horticulture, [4]Professor (e mail: skguru@gbpuat-cbsh.ac.in), Division of Plant Physiology, GBPUA&T, Pantnagar, Udham Singh Nagar, Uttarakhand 263 145.

during autumn and spring season. Hence, it necessitated for the standardization of the substrates for lilium forcing so, that growers can obtain good yields and fetches better prices. Keeping in view the need and importance of this crop, the present investigation was undertaken to identify and standardize potting media alone or in mixture to generate a logical understanding about the interaction of seraphic factors for growth and development of lilium in container system under protected condition.

## MATERIALS AND METHODS

An experiment was carried out during 2014-15 at Model Floriculture Centre, GBPUAT, Pantnagar. The experiment was laid out in two factor factorial randomized block design. First factor included two LA lilium cultivars Bach ($V_1$) and Pavia ($V_2$) respectively, while second factor consist of four growing medium which included, $M_1$: Garden soil (control), $M_2$: Cocopeat, $M_3$: Cocopeat + Sand (1:1) and $M_4$: Soil + Cocopeat (1:1). However, programmed bulbs (vernalized) were imported from VWS EXPORT IMPORT FLOWERBULBS B V Holland. In one container (60×40×15 $cm^3$ size) containing 20 liters of substrates, 10 bulbs of each variety 'Bach'/'Pavia' (14-16" grades) were planted at spacing 15×10 $cm^2$ (row to row and bulb to bulb) in December and randomized inside greenhouse with three replications. However, four pots were kept in one replication for one variety. The crop was raised following the standard cultural practices. 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 (Table 2). 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 2). Various parameters on vegetative growth, flower and bulb production were recorded. The pooled data were analyzed using the analysis of variance (ANOVA) technique; outline by Gomez and Gomez (1994) and treatments were compared by using tabulated 'F' value at 5% level of significance.

## RESULTS AND DISCUSSION

Different potting media has profound influence on growth, flower quality and bulb production parameters. Data related to vegetative growth, flowering and bulb production of lily cv. Bach and Pavia are given in Table 1. Findings of the investigation demonstrated that maximum plant height (99.80 cm) was recorded with $M_2$ treated plants that was significantly at par with $M_3$ and followed by $M_4$. However, minimum plant height (84.55 cm) recorded with $M_1$. Among the varieties, maximum mean plant height 98.41 cm recorded with $V_1$, however minimum (86.94 cm) with $V_2$ at 5% confidence level. The maximum stem thickness (9.20 mm) of lilium plants were also recorded with $T_2$. Tribolato and Noto (2001) also reported that using a mixture of peat and basalt increases flower stem thickness of lilium. Increased stem length in $M_2$ treated plants because of its congenial physical and chemical properties like low bulk density, 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. These results got the support from the earlier findings of Singh *et al*. (2016). Grassotti *et al*. (2003) also reported the highest stem length of lilium in cocopeat as compared to control treatments.

In the present investigation results showed that plants treated with $M_2$ recorded with maximum number

Table 1 The effect of cultivar and substrate on quality characteristics of lilium plants

| Treatment | Plant height (cm) | Stem Thickness (mm) | Days to appearance of flower bud | Number of flower buds | Bud length (cm) | Flower diameter (cm) | Bulb diameter (mm) | Stem root length (cm) | Basal root length (cm) |
|---|---|---|---|---|---|---|---|---|---|
| *Cultivar* | | | | | | | | | |
| V1 | 89.64 | 8.85 | 30.57 | 2.93 | 10.71 | 15.13 | 47.18 | 9.08 | 16.11 |
| V2 | 98.41 | 8.26 | 33.77 | 5.99 | 9.97 | 13.23 | 46.34 | 10.09 | 18.64 |
| *Substrate* | | | | | | | | | |
| M1 | 84.55 | 8.21 | 33.70 | 3.90 | 9.90 | 13.44 | 42.46 | 6.22 | 8.62 |
| M2 | 99.80 | 9.20 | 31.10 | 5.37 | 10.96 | 15.23 | 52.03 | 14.43 | 25.36 |
| M3 | 95.58 | 8.49 | 31.90 | 4.63 | 10.38 | 14.11 | 47.44 | 9.00 | 19.57 |
| M4 | 96.18 | 8.36 | 31.97 | 3.93 | 10.13 | 13.95 | 45.10 | 8.70 | 15.95 |
| *Significance level* | | | | | | | | | |
| Cultivar (C) | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Substrate (S) | 1.43* | 0.04* | 0.46* | 0.30* | 0.06* | 0.32* | 0.71* | 0.39* | 0.48* |
| C×S | 2.03* | NS | NS | 0.42* | 0.08* | 3.26* | 1.00* | NS | 0.67* |

* Significant at P≤ 0.05; NS: non-significant respectively.

Table 2 Physico-chemical properties and available nutrients in growing media

| Treatment | Chemical properties of growing substrates properties | | | | | | |
|---|---|---|---|---|---|---|---|
| | pH | EC (dS/m) | Db (g/cm$^3$) | Porosity (%) | N (kg/ha) | P (kg/ha) | K (kg/ha) |
| M1: Soil (100%) | 6.8 | 1.68 | 1.07 | 24.60 | 186.60 | 37.63 | 193.40 |
| M2: Cocopeat (100%) | 5.9 | 1.98 | 0.53 | 57.40 | 1.96 (mg/L) | 1.32 (mg/L) | 477.7 (mg/L) |
| M3: Cocopeat + Sand (1:1) | 6.2 | 1.12 | 0.77 | 49.35 | 207.6 | 11.8 | 190.0 |
| M4: Cocopeat + Soil (1:1) | 6.5 | 0.96 | 0.92 | 37.23 | 281.21 | 28.31 | 222.34 |

of flower buds per plant (5.37) that was significantly at per with $M_3$, $M_4$ and minimum $M_1$. Among the varieties, maximum number of flower buds recorded with $V_1$ (2.93) as compared to $V_2$ (2.93). Variety $V_2$ probably fully expressed its genetic potential in $M_2$ as it got the congenial growing condition. From the Table 1 it is evident that flower bud count was gradually increased with improving the physical and chemical properties of potting media. These results are also in consonance with earlier findings of Asil (2008) who reported that flower bud count of hybrid cultivars are influenced by altering the physical properties of growing media. However, the container filled with cocopeat ($M_2$) affected both number of buds (5.37) and days to commence flower buds (31.10) in both cultivars at 5% confidence level. Interaction effects of growing medium and cultivars on flower bud count were significant. These results are in accordance with the findings of Prisa *et al*. (2011). Among the media, maximum flower bud length was recorded (10.96 cm) in the $M_2$ treatment as compared to the control ($M_1$). Highest longevity of flower buds (10.71 cm) measured with the cultivar Bach as compared to Pavia (9.97 cm) at 5% confidence level. Results in Table 1 showed that $M_2$ again performed better and gave maximum flower diameter (15.23 cm) followed by $M_3$ and $M_4$. Among variety, $V_1$ recorded with maximum flower diameter (15.13 cm) while minimum with $V_2$ (13.23 cm). Interactions effect was significant at 5% confidence level. Congenial growing condition in $M_2$ leads better plant growth resulting maximum production and utilization of photo-synthates that might further enhanced the flower diameter. The results are in agreement with the findings of Seyedi *et al*. (2012) who reported that perlite and cocopeat as the growing media for lilium cultivation, increased all growth indices particularly flower buds number and flower diameter.

The result of present experiment inferred that like flowering attributes, bulb size (diameter) also significantly influenced by physical and chemical properties of different potting media. The maximum flower bulb diameter (52.03 mm) recorded in $M_2$ that was significantly at par with $M_3$, $M_4$ and $M_1$. However, minimum bulb diameter (42.46 mm) measured with $M_1$, this may be because of unfavorable growing condition like media compactness, latent infection and high pathogen load with $M_1$ which leads rotting and depletion of mother bulbs. Interacting effects of cultivars and potting media on bulb size was significant. These results are also got support from earlier findings of Tehranifar *et al*. (2011). The effect of growing media on stem/feeder root of lilium was significant (Table 1). Among the treatments, $M_2$ treated plants recorded with maximum stem root length (14.43 cm) that was significantly at par with rest of the treatments. However, the minimum root length (6.22 cm) was recorded in $M_1$. Among variety minimum root length (9.08 cm) was recorded in $V_1$ while the maximum stem root length (10.09 cm) was measured in $V_2$ however the difference was non-significant. Root distribution in container influenced by texture and porosity of the substrates, which is positively correlated with water and nutrients uptake (Ingram *et al*. 2003). The findings are also in accordance with the earlier findings of Jorgensen *et al*. (2014) that reported, plants grown in the coir medium showed stronger root growth compared to the rockwool media. Table 1 reveals that among the varieties longest basal root length (18.64 cm) was measured in $V_2$ however $V_1$ was recorded with minimum root length (16.11 cm). Among the potting media $M_2$ raised plants showed maximum basal root length (25.36 cm) that was significantly at par with rest of the treatments. These results got support from earlier findings of Tehranifar and Selahvarzi (2005). However, the minimum root length (8.62 cm) was reported in $M_1$. Nikrazm *et al*. (2011) reported that the combined medium of perlite and cocopeat promote growth indices by facilitating congenial growing condition that favors long basal and feeder roots of lilium.

It was found that there were significant differences in plant growth parameters including mean plant height, number of flower buds, flower diameter, bulb development, basal and feeder root growth of lilium with respect to growing media containing horticulture-grade cocopeat, sand and soil. The incorporation of horticulture-grade coco coir into sand and soil brought about a significant increase in all plant growth parameters. It was found that the medium containing fine-grade coco coir (100%) had the excellent performance for lilium plant growth because physical and chemical characteristics of the growing media directly affect the development of the root system, and indirectly affect the morphogenesis of the aboveground. There is a physical contact between the root system and the growing medium, the medium of superior quality can afford a favorable root rhizosphere and steady supplying of the water and nutrients. Based on the above results, Lilium can be successfully force in cocopeat (100%) and in a mixture of cocopeat + sand (1:1 v/v) which is durable in nature, good physical properties, cost effective and more over easily available. With regard to future growth of a soil-less culture with cocopeat substrate, it is important to make an operational additional research projects for flowers grown in fine grades of coco coir, with

the objective of building further confidence in the advantages of this type of flower forcing in container system.

REFERANCES

Asil M H. 2008. Effects of growing medium on some postharvest characteristics of cut flowers in six cultivars of Asiatic hybrid lilies (Lilium longiflorum). Journal of Food, Agriculture and Environment **6**(2): 442–6.

Dewayne L I, Richard W H and Thomas H Y. 2003. Growth Media for Container Grown Ornamental Plants. The Environmental Horticulture Department, Florida Cooperative Extension Service, UF, Bull. 241.

Gomez K A and Gomez A A, 1984. Statistical Procedure for Agriculture Research, 2nd edition. John Willey and Sons, Singapore.

Grassotti A, Nesi B, Maletta M and Magnani G. 2003. Effect of growing media and planting time on lily hybrids in soilless culture. *Acta Horticulturae* 609:395–9.

Ingram D L, Henley R W and Yeager T H. 2003. Growth media for container grown ornamental plants. (http://edis.ifas.ufl.edu/pdffiles/CN/CN0040 0.pdf).

Jorgensen L, Dresboll D B and Kristensen K T. 2014. Root growth of perennials in vertical growing media for use in green walls. *Scientia Horticulturae* **166**: 31–4.

Kukal S S, Debasish S, Arnab B and Dubey R K. 2012. Water retention characteristics of soil bio-amendments used as growing media in pot culture. *Journal of Appllied Horticulture* **14**: 92–7.

Nikrazm R and Alizadesh S. 2011. The impact of different growth media in growth of two cultivar of lilium at the soilless system. *Journal of Greenhouse Cultivation* **2**(6): 12–7.

Oki L R and Leith J H. 2004. Effect of changes in substrate salinity on the elongation of Rosa hybrida L.'Kardinal' stems. *Scientia Horticulturae* **101**: 103–9.

Prisa D, Burchi G M, Antonetti and Teani A. 2011. Use of organic or inorganic substrates for reducing the use of peat and improving the quality of bulbs and inflorescences in Asiatic lily. *Acta Horticulturae* **900**: 143–8.

Seyedi N, Mohammadi A and Allahyari M S. 2012. The impact of perlite and cocopeat as the growth media on Asiatic lilium. Asian *Journal of Experimental Biological Sciences* **3**(3): 502–5.

Singh M K, Kumar S, Ram R and Prasad R. 2016. Effect of size of bulb, growing conditions and depth of planting on flower and bulb production of Asiatic hybrid lily (Lilium spp) cv. Brunello. *Indian Journal of Agricultural Sciences* **86** (3): 391–3.

Schmilewski G, 2008. The role of peat in assuring the quality of growing media. Mires Peat 3/02: http://www.mires-and-peat.net/, 1–8

Sonneveld C, Baas R, Nijssen H M C and Hoog J. 1999. Salt tolerance of flower crops grown in soilless culture. *Journal of Plant Nutrition* **22**:1 033–48.

Tehranifar A, Selahvarzi Y and Alizadeh B. 2011. Effect of different growing media on growth and development of two Lilium (Oriental and Asiatic Hybrids) types in soilless conditions. *Acta Horticulturae* **900:** 139–42.

Tehranifar A and Selahvarzi Y. 2005. Effect of different growing medium on certain characteristics in Asiatic and Oriental hybrid lilies, in cultivation without soil. 4 *Iranian Horticultural Science Congress* 350 pp.

Tribulato A. and Noto G. 2001. Forcing oriental and Asiatic lilies in soilless culture. *Acta Horticulturae* 559:639–54.