



Effect of growing media composition on growth, flowering and bulb production of LA hybrid (Red Alert) and Oriental (Avocado) group of *Lilium* under protected condition

NARENDRA CHAUDHARY¹, S S SINDHU², RAMESH KUMAR³, T N SAHA⁴, D V S RAJU⁵, AJAY ARORA⁶ and R R SHARMA⁷

ICAR–Indian Agricultural Research Institute, New Delhi 110 012

Received: 7 September 2017; Accepted: 28 June 2018

ABSTRACT

An experiment was carried out to study the effect of growing media on growth, flowering and bulb production of LA hybrid and Oriental group of *Lilium* under protected condition. One cultivar from each group (Cv. Red Alert from LA hybrid group and cv. Avocado from Oriental group) were selected for the experiment. Fresh and healthy bulbs of each cultivar were planted in the different media composition and placed under protected condition. Results of present study showed that all the vegetative attributes of both the cultivars, viz. number of leaves, leaf area, leaf length, leaf width, plant height and stem diameter found optimistic in media containing cocopeat and vermiculite either with perlite or soil. Flowering traits, viz. number of days from visible bud to flowering, total number of buds, bud diameter, flower bud length, days taken to ¼, ½, ¾ colour bud break and full colour bud development, total number of flowers, diameter of flowers, duration of flowering and vase life of both the cultivar were also reported superior in media containing cocopeat and vermiculite either with perlite or soil. Similarly, bulb attributing characters viz. number of bulblets, weight of bulb and bulblets, diameter of bulb and bulblets of both the cultivars were also recorded promising in media containing cocopeat and vermiculite either with perlite or soil. It could be concluded that media containing cocopeat and vermiculite either with soil or perlite observed to be the best substrate for growth, flowering and bulb production of *Lilium*.

Key words: Cocopeat, *Lilium*, Media, Perlite, Vermiculite

Lilium is one of the important commercial bulbous cut flower growing throughout the world. The genus *Lilium* belongs to the family *Liliaceae* and comprised more than 80 species in North America, Asia, and Europe with considerable variation in plant architecture, flower shapes, sizes, colours, fragrances and bulb morphologies. (Grassotti and Gimelli 2011, De Jong 1974). *Lilium* ranks fourth among top ten cut flowers of the world next to rose, chrysanthemum and tulip. LA hybrids and Oriental lilies are widely used in the floral industry as cut flowers as well as potted plants. LA hybrids created by crossing between *Lilium longiflorum* and

Asiatic hybrid. These cultivars combined the wide colour range of the Asiatics, with the delicacy of flower form and fragrance of the *longiflorum*. Oriental hybrids, derived from *Lilium auratum*, *L. speciosum*, *L. japonicum* and *L. rubellum*. Oriental lilies are known for their large flowers, pleasant scent and attractive white, pink, and cream colours. In India, *Lilium* is one of the important commercial bulbous cut flowers growing in Nilgiri hills in southern peninsula, Himachal Pradesh in the north west Himalayas and some part of hilly areas of Uttarakhand and Jammu and Kashmir.

Liliums are commercially propagated through bulbs. The cut Liliums although fetches a good price, often the cost of bulbs constitutes a major expenditure of *Lilium* production specially in those areas where bulb formation is poor (such as tropical and subtropical areas). Fresh purchase of planting material every season results in increased cost of production. Further, the growers are to be assured of the supply of disease free quality planting material without which *Lilium* production is not sustainable. So, there is urgent need to work out the media composition for better vegetative and reproductive growth of *Lilium*. In this perspective, the present investigation was undertaken to investigate the effect of growing media composition on

¹Scientist (e mail: ncfls1983@gmail.com), ICAR-Indian Institute of Spices Research, Regional Station, Appangala, Karnataka. ²Head and Principal Scientist (e mail: sssindhu2003@yahoo.co.in), Division of Floriculture and Landscaping, ⁶Principal Scientist (e mail: ajayarora@iari.res.in), Division of Plant Physiology, IARI, New Delhi. ³Dean (e mail: ramesh.19212@lpu.co.in), School of Agriculture, Lovely Professional University, Phagwara. ⁴Scientist (e mail: tnsaha@gmail.com), ⁵Principal Scientist (e mail: rajivalex@gmail.com), Directorate of Floricultural Research, Pune. ⁷Principal Scientist (rrs_fht@rediffmail.com), Division of Food Science and PHT, IARI, New Delhi 110 012.

growth, flowering and bulb production of LA hybrid and Oriental *Lilium* under protected condition.

MATERIALS AND METHODS

The present experiment was carried out for two consecutive years during *rabi* 2012-2013 and 2013-2014 at the experimental farm of Directorate of Floricultural Research, Indian Agricultural Research Institute, New Delhi. One cultivar from each group (Cv. Red Alert from LA hybrid group and cv. Avocado from Oriental group) were selected for the experiment. Fresh and healthy bulbs of selected cultivars were planted in 20 cm size plastic pots containing 4 to 5 holes at the bottom. After planting of bulbs, pots were placed in protected condition (Shade net house with shading percentage of 50%). Different media composition used for filling of pots were: T₁: Control (Soil-loamy), T₂: Cocopeat, T₃: Soil: Perlite (1: 2 v/v), T₄: Soil: Vermiculite (1: 2 v/v), T₅: Soil: Cocopeat (2: 1 v/v), T₆: Soil: Cocopeat: Vermiculite (1: 2: 1 v/v), and T₇: Cocopeat: Vermiculite: Perlite (3: 1: 1 v/v). The experiment was laid out in completely randomized design (CRD) with three replications. Each treatment contained thirty pots and each pot contained one bulb. There were 210 pots of each cultivar. The data were statistically analyzed as suggested by Gomez and Gomez (1984). A probability of $P \leq 0.05$ was considered significant.

RESULTS AND DISCUSSION

Vegetative attributes

Perusal of data (Table 1 and 2) showed that all vegetative parameters (Bud emerging stage) of Red Alert (LA hybrid) and Avocado (Oriental) cultivar were significantly affected with media composition.

Earliest shoot emergence (6.13 days) was recorded with T₄ and T₁ (Control) treatments and latest (6.67 days) recorded with T₃ treatment in cultivar Avocado. The effect of media composition found to be non-significant in cultivar Red Alert.

In cultivar Red Alert, maximum and minimum number of leaves (51.20 and 45.80), leaf area (31.53 and 6.78 cm²), leaf length (9.90 and 6.07 cm) and leaf width (3.19 and 1.12 cm) recorded with treatment T₇ and T₁, respectively. In cultivar Avocado also maximum and minimum number of leaves (71.47 and 55.80), leaf area (35.66 and 11.09 cm²), leaf length (13.70 and 9.76 cm) and leaf width (2.61 and 1.14 cm) recorded with treatment T₇ and T₁, respectively.

Plant height of Red Alert varied from 52.00 to 84.60 cm with maximum in T₆ (84.60 cm) followed by T₅ (64.87 cm) and minimum in control (52.00 cm). Cultivar Avocado recorded maximum plant height with T₅ (89.53 cm) followed by T₇ (87.67 cm) and minimum in control (75.87 cm).

Improved vegetative traits could be attributed due to

Table 1 Effect of media composition on vegetative traits of LA- hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Days to shoot emergence		Number of leaves/plant		Leaf area (cm ²)		Leaf length (cm)	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	6.60	6.13	45.80	55.80	6.78	11.09	6.07	9.76
T ₂	6.73	6.47	46.27	66.80	11.83	17.76	8.70	12.48
T ₃	6.67	6.67	47.47	66.27	15.76	14.45	6.75	9.30
T ₄	6.73	6.13	47.00	65.47	13.32	23.75	6.64	12.00
T ₅	6.80	6.53	47.20	67.47	17.70	31.27	7.47	13.47
T ₆	6.80	6.27	50.00	67.87	23.47	29.92	8.78	12.13
T ₇	6.73	6.60	51.20	71.47	31.53	35.66	9.90	13.70
CD (P=0.05)	NS	0.27	3.09	3.43	1.46	2.10	0.45	0.52

Table 2 Effect of media composition on vegetative traits of LA- hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Leaf width (cm)		Plant height (cm)		Stem diameter (mm)	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	1.12	1.14	52.00	75.87	6.29	5.66
T ₂	1.35	1.43	62.47	81.07	6.74	6.84
T ₃	2.35	1.55	61.53	68.00	7.61	6.39
T ₄	2.01	1.98	63.13	81.00	7.86	7.06
T ₅	2.37	2.32	64.87	89.53	8.37	6.62
T ₆	2.66	2.47	84.60	85.80	9.22	6.65
T ₇	3.19	2.61	64.73	87.67	7.75	7.88
CD (P=0.05)	0.16	0.14	3.87	4.53	0.24	0.25

good water holding capacity and proper drainage of media containing, cocopeat and vermiculite either with soil or perlite which provide better condition for root development and producing long root system. These findings are in close conformity with Treder (2008) in Oriental lily, Wazir *et al.* (2009) in alstroemeria and Seyed *et al.* (2012) in lily.

Flowering attributes

Data presented (Table 3, 4 and 5) showed that all flowering attributes of Red Alert (LA hybrid) and Avocado

(Oriental) cultivars were significantly influenced by different media composition.

Number of days from visible bud to flowering was observed minimum with T₇ (13.73 days) followed by T₅ (14.20 days) and maximum in control (15.53 days) in cultivar Red Alert. Avocado also recorded minimum in T₇ (15.07 days) followed by T₆ (15.53 days) and maximum in control (17.67 days).

Number of buds were recorded maximum in T₆ and T₇ (3.40) followed by T₃ (3.27) and minimum in T₁ control

Table 3 Effect of media composition on flowering traits of LA-hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Days to visible bud formation		Number of days from visible bud to flowering		Total number of buds		Bud diameter (mm)		Flower bud length (cm)	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	14.93	17.27	15.53	17.67	2.33	2.87	19.63	18.24	7.56	8.79
T ₂	15.40	17.13	15.20	16.87	2.73	2.47	24.25	18.97	9.53	8.77
T ₃	15.47	17.40	14.93	16.53	3.27	2.67	24.29	20.17	9.53	8.49
T ₄	15.40	17.20	14.33	16.20	3.13	2.27	24.73	21.36	9.50	9.23
T ₅	15.33	17.33	14.20	15.93	3.13	2.40	23.28	22.16	9.63	9.74
T ₆	15.33	17.20	14.27	15.53	3.40	3.00	29.99	22.21	10.53	9.57
T ₇	15.27	17.33	13.73	15.07	3.40	3.40	27.34	25.14	9.73	10.70
CD (P=0.05)	NS	NS	0.64	0.33	0.29	0.31	0.88	0.34	0.54	0.53

Table 4 Effect of media composition on flowering traits of LA-hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Days to 1/4 colour bud break		Days to 1/2 colour bud break		Days to 3/4 colour bud break		Days to full bud colour development	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	72.07	91.60	75.00	94.60	78.07	97.67	81.27	100.8
T ₂	71.53	90.93	74.40	94.00	77.40	96.93	80.40	99.80
T ₃	71.33	90.27	74.27	93.20	77.20	96.27	80.20	99.33
T ₄	71.00	90.07	73.93	92.87	76.87	95.73	79.87	98.80
T ₅	70.47	89.73	73.47	92.80	76.47	95.80	79.47	98.80
T ₆	70.20	89.20	73.20	92.20	76.13	95.20	79.13	98.27
T ₇	69.40	87.93	72.27	90.80	75.07	93.67	77.93	96.73
CD (P=0.05)	0.91	0.62	0.98	0.62	1.03	0.75	1.08	0.87

Table 5 Effect of media composition on flowering traits of LA-hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Total number of flowers		Diameter of flower (cm)		Duration of flowering (days)		Vase life (days)	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	2.33	2.87	13.67	14.33	8.80	10.27	9.33	11.13
T ₂	2.73	2.47	14.40	14.30	9.60	10.93	10.13	13.20
T ₃	3.27	2.67	14.37	15.43	9.27	10.87	10.40	12.93
T ₄	3.13	2.27	14.43	15.27	9.40	11.20	10.27	13.20
T ₅	3.13	2.40	15.40	15.63	9.40	11.20	10.27	13.33
T ₆	3.40	3.00	15.67	15.73	9.27	11.20	10.40	13.53
T ₇	3.40	3.40	15.90	15.90	9.80	11.80	11.60	13.93
CD (P=0.05)	0.29	0.31	0.24	0.42	0.48	0.68	0.56	0.59

(2.33) in Red Alert. In Avocado also it was recorded maximum with T₇ (3.40) followed by T₆ (3.00) and minimum in T₄ (2.27).

The maximum and minimum bud diameter (29.99 and 19.63 mm) and flower bud length (10.53 and 7.56 cm) were registered with treatment T₆ and T₁, respectively in cultivar Red Alert. Avocado registered maximum bud diameter with T₇ (25.14 mm) followed by T₆ (22.21 mm), whereas minimum with control (18.24 mm).

Flower bud length was recorded maximum in T₇ (10.70 cm) followed by T₅ (9.74 cm) and minimum in T₃ (8.49 cm) in cultivar Avocado.

Number of days taken to 1/4, 1/2, 3/4 colour bud break and full colour bud development in cultivar Red Alert registered minimum with T₇ (69.40, 72.27, 75.07 and 77.93 days respectively) followed by T₆ (70.20, 73.20, 76.13 and 79.13 days respectively), whereas maximum registered with control (72.07, 75.00, 78.07 and 81.27 days respectively). In cultivar Avocado also these parameters recorded minimum with T₇ (87.93, 90.80, 93.67 and 96.73 days respectively) followed by T₆ (89.20, 92.20, 95.20 and 98.27 days respectively), while maximum recorded in control (91.60, 94.60, 97.67 and 100.8 days respectively).

Total number of flowers were observed to be maximum in T₆ and T₇ (3.40) followed by T₃ (3.27) and minimum in control (2.33) in Red Alert. Cultivar Avocado recorded maximum number of flowers with T₇ (3.40) followed by T₆ (3.00) and minimum with T₄ (2.27).

Diameter of flower of cultivar Red Alert varied from 13.67 to 15.90 cm. The highest flower diameter was registered with T₇ (15.90 cm) followed by T₆ (15.67 cm) and smallest with control (13.67 cm). Diameter of flower of Avocado varied from 14.33 to 15.90 cm. The maximum was recorded with T₇ (15.90 cm) followed by T₆ (15.73 cm) and minimum with T₂ (14.30 cm).

Cultivar Red Alert recorded prolonged duration of flowering with T₇ (9.80 days) followed by T₂ (9.60 days) and shortest with control (8.80 days). Avocado recorded prolonged duration of flowering with T₇ (11.60 days)

followed by T₄, T₅ and T₆ (11.20 days) and shortest with control (10.27 days).

Vase life varied from 9.33 to 11.60 days. The maximum was observed with T₇ (11.60 days) followed by T₃ and T₆ (10.40 days) and lowest with control (9.33 days) in cultivar Red Alert. Avocado also recorded highest vase life with T₇ (13.93 days) which was at par with T₆ (13.53 days) and lowest with control (11.13 days).

Superior flowering traits might be due to better growing conditions and good physico-chemical properties of media containing, cocopeat and vermiculite either with soil or perlite. These finding are in agreement with the result obtained by Grassotti *et al.* (2003) in *Lilium*, Awang *et al.* (2009) in *Celosia cristata*, Kale *et al.* (2009) in gerbera, Tehranifar *et al.* (2011) in *Lilium* and Khalaj *et al.* (2011) in gerbera.

Bulb attributes

Perusal of data (Table 6) depicted that bulb traits of Red Alert (LA hybrid) and Avocado (Oriental) cultivar were significantly influenced by different media composition.

The number of bulblets were registered maximum with T₇ (3.13) followed by T₆ (2.53) and minimum with control (1.07) in Red Alert. In Avocado also it was recorded maximum with T₇ (7.93) followed by T₆ (6.07) and minimum with control (1.60).

Both, Red Alert and Avocado registered maximum weight of bulb with T₆ and recorded as 34.80 and 49.53 g respectively, similarly both the cultivars recorded minimum weight of bulb with control and recorded as 21.73 and 25.47 g respectively.

Weight of bulblets of Red Alert varied from 0.37 to 1.69 g. The maximum was recorded with T₆ (1.69g) followed by T₇ (1.20g) and minimum with control (0.37g). In Avocado it was recorded maximum with T₇ (2.76g) followed by T₆ (1.69g) and minimum with T₅ (0.35g).

In cultivar Red Alert, largest diameter of bulb registered with T₆ (39.59 mm) followed by T₇ (38.87 mm), whereas smallest with T₄ (33.87 mm). Avocado also registered largest

Table 6 Effect of media composition on bulb traits of LA-hybrid cv. Red Alert and Oriental lily cv. Avocado (Pooled data over two years)

Treatment	Number of bulbs/ plant		Number of bulblets/bulb		Weight of bulb (g)		Weight of bulblets/bulb (g)		Diameter of bulb (mm)		Diameter of bulblets (mm)	
	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado	Red Alert	Avocado
T ₁	1.00	1.00	1.07	1.60	21.73	25.47	0.37	1.20	34.29	36.66	9.98	14.37
T ₂	1.00	1.00	1.20	3.53	24.33	44.00	0.51	1.49	34.18	47.49	10.75	13.46
T ₃	1.00	1.00	1.47	2.93	23.87	23.47	0.39	1.27	35.40	42.24	11.58	13.59
T ₄	1.00	1.00	2.47	3.73	26.53	34.53	0.88	1.57	33.87	44.10	14.04	13.69
T ₅	1.00	1.00	2.67	2.33	31.60	37.53	1.09	0.35	37.00	44.01	12.71	10.39
T ₆	1.00	1.00	2.53	6.07	34.80	49.53	1.69	1.69	39.59	50.57	17.61	16.65
T ₇	1.00	1.00	3.13	7.93	32.33	53.27	1.20	2.76	38.87	47.87	15.47	19.13
CD (P=0.05)	NS	NS	0.54	0.38	0.91	1.65	0.04	0.07	0.678	1.15	0.24	0.56

diameter of bulb with T₆ (50.57 mm) followed by T₇ (47.87 mm) while smallest with control (36.66 mm).

Diameter of bulblets of Red Alert varied from 9.98 to 17.61 mm with different media composition. The maximum was recorded with T₆ (17.61 mm) followed by T₇ (15.47 mm) and minimum with control (9.98 mm). In Avocado, it was varied from 10.39 to 19.13 mm. The maximum was recorded with T₇ (19.13 mm) followed by T₆ (16.65 mm) and minimum with T₅ (10.39 mm).

Promising bulb attributes could be due to better physical, chemical and biological properties of media containing, cocopeat and vermiculite either with soil or perlite which provide congenial root environment for proper growth of bulb and bulblets. These findings are in agreement with the reports of Nazari *et al.* (2011) in hyacinth.

Based on the results, it could be concluded that media containing cocopeat and vermiculite either with soil or perlite observed to be the best media/substrate for growth, flowering and bulb production of *Lilium*.

The results of this study confirmed that vegetative attributes of both the cultivars (Red Alert and Avocado) were found to be optimistic in media containing cocopeat and vermiculite either with perlite or soil. Flowering traits, viz. number of days from visible bud to flowering, total number of buds, bud diameter, flower bud length, days taken to ¼, ½, ¾ colour bud break and full colour bud development, total number of flowers, diameter of flowers, duration of flowering and vase life of both the cultivars was also reported to be superior in media containing cocopeat and vermiculite either with perlite or soil. Bulb attributing characters, viz. number of bulblets, weight of bulb and bulblets, diameter of bulb and bulblets of both the cultivar were too recorded superior in media containing cocopeat and vermiculite either with perlite or soil.

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