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Short communication

Effect of calcium nitrate on propagation of LA hybrid lilies through scaling

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ABSTRACT

The experiment was laid out in a Completely Randomized Design (factorial) consisting of three cultivars and six calcium nitrate doses (0, 5, 10, 15, 20 and 25 g/m^2). Among the cutivars, maximum bulblet multiplication was found in UHFS LA Lily Collection 1 (2.59) followed by Batistero (2.48) and Frans Hals (2.32), respectively. Among the different calcium nitrate doses, 10 g/m^2 calcium nitrate dose gave best results for per cent sprouting (76.03 %), minimum days taken for sprouting (102.00 days), sprout length (9.60 cm), fresh weight of bulblet/scale (1.69 g), bulblet diameter (9.32 mm) and propagation index (125.69 %) when supplied to the scales in ten equal split doses in liquid form. However, for obtaining higher number of leaves/scale (6.38) and maximum multiplication (2.90 bulblets/scale) calcium nitrate application at the rate of 20 g/m^2 supplied to these scales proved to be most effective treatment. The interaction between cultivars and calcium nitrate doses has shown variable responses. Highest per cent sprouting was observed in Frans Hals (77.14 %) with 15 g/m^2 and 25 g/m^2 calcium nitrate and in UHFS LA Lily Collection 1 (77.14 %) with 10 g/m^2, whereas maximum sprout length (10.18 cm), number of bulblets/scale (3.01) and bulblet diameter (9.77 mm) were found in cultivar UHFS LA Lily Collection 1 with 10 g/m^2 and number of leaves/scale (7.03) in cultivar Batistero with 25 g/m^2 calcium nitrate dose.

Key words: Lilium, bulblet multiplication, cocopeat.

Lilium is one of the leading cut flower on the basis of sale in the world and very popular due to its richness and variety of colours. About 76% of the total world lily bulb production takes place in the Netherlands, with the area of 4,280 hectares and with the number of 2.2 billion lily bulbs, of which 2.1 billion (96%) are used as starting material for cut flower cultivation within the Netherlands and abroad. To generate new white flowering Easter lilies, *L. longiflorum* have been crossed with Asiatic hybrid lilies to develop the new series of LA hybrids. These new hybrids have outward facing flowers of different colours. LA hybrids have become very popular these days. They are valued for their good vase life, availability in wide range of colours, wider adaptability and ease of cultivation. In India suitable climatic conditions for lilium cultivation have been identified in different pockets of the country. In Himachal Pradesh, Lahaul, Kullu and Chail area in Solan are highly suitable for its multiplication.

Presently, lilium bulbs for flower production are imported in India from other countries. Netherlands is the chief exporter and supplier. Therefore, to reduce the cost of bulb and to meet out the increasing demand of flowers throughout the year by providing sufficient planting material, there is an urgent need to develop cheaper multiplication techniques indigenously to increase the bulblet production. Asexual propagation of *Lilium* species can be accomplished by separation of stem bulbils or bulblets, division of bulbs and scaling. Another advanced method of propagation is through tissue culture. Propagation of lilium through scaling is the most effective, cheap and rapid method for multiplication, however the commercial sized bulbs are obtained in 3-4 years. The present experiment was, therefore, planned to study the effect of calcium nitrate on propagation of LA hybrid lilies through scaling. The experiment was carried out with the objective to find out optimum dose of calcium nitrate for multiplication through scaling in LA hybrid lilies.

Study on the propagation of three LA hybrid lily cultivars viz., 'Batistero', 'Frans Hals' and 'UHFS LA Lily Collection 1'through scaling was carried out at the experimental farm of the Department of Floriculture and Landscape Architecture, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during November, 2013 to June, 2014. Uniform sized (14/16), healthy and pre-cooled bulbs of these LA hybrid lily cvs. were used for the present study. These were procured from Sheel Biotech-Ltd., Pune in November, 2013. Cocopeat was used as propagation medium. The cocopeat bricks were soaked in water and then thoroughly washed in running water so that phenols could be removed by draining out the extra water. The medium was treated with fungicidal solution Mancozeb (0.25 %) and Carbendazim (0.1 %) before use.

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The outermost two whorls in the bulb scales were selected for the experimentation. The individual scales were excised from the mother bulb with the help of a sharp sterile blade in such a way so that a small portion of basal plate remains attached to it. Rotten, broken and scales without basal plate were discarded. Average fresh weight of the scales was recorded. The detached scales were then disinfected by dipping them in fungicidal solution of Mancozeb (0.25 %) and Carbendazim (0.1 %) for one hour. These scales were kept in shade to drain out the excess solution. A quick dip was given to the basal end of the scale in NAA 500 ppm solution before planting. Planting of scales was done in plastic trays of size 36 cm x 27 cm x 7 cm provided with drainage holes. Recommended cultural practices were taken for better crop growth.

Application of Calcium nitrate (Laboratory grade; N 25 % and Ca 8.1 %) in solution form was started after 60 days of planting. Fertilizer was applied in 10 split doses at 15 days interval variable with the treatment. Application of Calcium nitrate was supplemented with phosphorus and potassium at 20 g/m^2 each which is supplied through phosphoric acid 3.84 ml/m^2 and Multi-K 4.44 g/m^2. The bulblets were harvested when the 75 % foliage turned yellow. Overall, the experiment consisting of 6 treatment combinations and three cultivars was conducted in completely randomized design (factorial). Observations on various vegetative and bulblet parameters recorded were subjected to analysis of variance.

Results revealed that per cent sprouting differed significantly among cultivars and calcium nitrate doses. Maximum sprouting (75.55%) was recorded in cultivar 'Frans Hals' was found to be at par with scale sprouting in 'UHFS LA Lily Collection 1' (75.00 %) and minimum (74.04%) sprouting was recorded in 'Batistero' (Table 1). Variation in per cent sprouting among cultivars might be due to the genotypic differences. Similar findings have also been reported by Matsuo and Arisumi (6) in *Lilium longiflorum* cultivars, Singh (12) in Asiatic cultivars, Sharma *et al.* (11) in Oriental lilies and Lyngdoh (5) in LA hybrid lilies and variation in days to corm sprouting in different gladiolus genotypes have also been reported by Safiullah and Ahmed (9) and Nair and Shiva (7).

Among calcium nitrate doses maximum scale sprouting (76.03 %) was recorded with 10 g/m^2 application (Table 1). Interaction (Table 2) effect of cultivars with calcium nitrate doses showed highest per cent sprouting (77.14%) in 'Frans Hals' with 15 g and 25 g/m^2 calcium nitrate and 'UHFS LA Lily Collection 1' (77.14 %) with 10 g/m^2 followed by 'Batistero' (75.71 %) with 5 g/m^2 calcium nitrate.

Days taken for sprouting also differed significantly due to different treatments. Earliest sprouting (105.56 days) was recorded in cultivar 'UHFS LA Lily Collection 1' which was found to be at par with time taken for sprouting in cultivar 'Frans Hals' (107.28 days). The cultivar 'Batistero' (109.17 days), however took maximum days to sprouting (Table 1). Such variation among cultivars may be attributed to their genetic

Table 1. Effect of cultivars and calcium nitrate doses on propagation of lilies through scaling.

Characters / Treatments	Per cent sprouting (%)	Days taken for sprouting	Sprout length (cm)	Number of leaves/ scale	Number of bulblets/ scale	Bulblet diameter (mm)	Fresh weight of bulblet (s)/ scale	Propagation index (%)
Cultivars (V)								
Batistero (V_1)	74.04 (8.61)*	109.17	8.90	6.13	2.48	8.14	1.55	110.67
Frans Hals (V_2)	75.55 (8.69)	107.28	8.34	5.79	2.32	8.63	1.57	117.66
UHFS LA Lily Collection 1(V_3)	75.00 (8.66)	105.56	9.01	5.93	2.59	9.34	1.46	112.39
CD at 5%	0.06	2.17	0.43	0.21	0.16	0.28	0.07	5.53
Calcium nitrate doses (T)								
0 g/m^2(T_1)	73.01 (8.54)	109.33	8.24	5.45	2.12	8.40	1.32	97.94
5 g/m^2(T_2)	74.91 (8.65)	109.22	8.39	5.78	2.25	8.47	1.48	110.07
10 g/m^2(T_3)	76.03 (8.72)	102.00	9.60	5.88	2.58	9.32	1.69	125.69
15 g/m^2(T_4)	75.24 (8.67)	105.89	9.11	6.13	2.62	8.82	1.63	121.66
20 g/m^2(T_5)	75.08 (8.67)	108.89	8.67	6.38	2.90	8.66	1.59	118.85
25 g/m^2(T_6)	74.92 (8.65)	108.67	8.47	6.10	2.29	8.55	1.45	107.23
CD at 5%	0.09	3.08	0.62	0.30	0.23	0.40	0.10	7.82

*Figures in parenthesis are square root transformed value

Table 2. Interaction effect of cultivars and calcium nitrate doses on propagation of lilies through scaling.

Characters / Treatments	Per cent sprouting (%)	Days taken for sprouting	Sprout length (cm)	Number of leaves/ scale	Number of bulblets/ scale	Bulblet diameter (mm)	Fresh weight of bulblet (s)/scale	Propagation index (%)
Interaction (V x T)								
V_1T_1	72.37 (8.51)*	111.33	8.31	5.33	2.09	7.65	1.31	93.33
V_1T_2	75.71 (8.70)	110.67	7.95	6.39	2.36	7.71	1.46	104.28
V_1T_3	74.76 (8.65)	103.67	10.10	5.39	2.61	8.81	1.66	118.57
V_1T_4	72.38 (8.51)	107.67	9.09	6.49	2.69	8.16	1.65	117.85
V_1T_5	74.28 (8.62)	111.67	9.18	6.17	2.99	8.26	1.63	113.33
V_1T_6	74.76 (8.65)	110.00	8.74	7.03	2.15	8.25	1.59	113.33
V_2T_1	72.85 (8.53)	109.33	7.57	5.83	2.09	8.55	1.34	100.49
V_2T_2	73.80 (8.59)	109.33	7.90	5.35	2.11	7.98	1.74	130.82
V_2T_3	76.19 (8.73)	101.67	8.53	6.11	2.13	9.39	1.75	131.58
V_2T_4	77.14 (8.78)	105.67	9.33	5.45	2.30	8.98	1.65	124.06
V_2T_5	76.19 (8.73)	109.00	8.17	6.54	2.78	8.25	1.54	116.04
V_2T_6	77.14 (8.78)	108.67	8.51	5.48	2.48	8.65	1.39	102.98
V_3T_1	73.80 (8.59)	107.33	8.84	5.18	2.18	8.99	1.30	99.99
V_3T_2	75.23 (8.67)	107.67	9.33	5.60	2.28	9.71	1.24	95.12
V_3T_3	77.14 (8.78)	100.67	10.18	6.14	3.01	9.77	1.65	126.92
V_3T_4	76.19 (8.73)	104.33	8.90	6.45	2.88	9.31	1.60	123.07
V_3T_5	74.76 (8.65)	106.00	8.66	6.43	2.94	9.48	1.61	123.84
V_3T_6	72.85 (8.53)	107.33	8.17	5.79	2.24	8.75	1.37	105.38
CD at 5%	0.16	NS	1.07	0.52	0.41	0.69	0.18	13.56

*Figures in parenthesis shows the square root transformed values.

make-up. Similar results on differences in scale sprouting has also been reported by Matsuo and Arisumi (6). Among calcium nitrate doses, earliest sprouting (102.00 days) was recorded with 10 g/m^2 calcium nitrate applied to scales. Early germination (up to 12 days after sowing) was promoted following treatment with $Ca(NO_3)_2$ and KNO_3 was also reported by Jong Won *et al*. (2).

The perusal of Table 1 also revealed that among the cultivars, the perused of maximum sprout length (9.01 cm) was recorded in 'UHFS LA Lily Collection 1'. Similar results with respect to length of sprout were recorded in 'Batistero' (8.90 cm) and minimum sprout length (8.34 cm) was observed in cultivar 'Frans Hals'. Data also showed that application of calcium nitrate at all the levels had a significant effect on sprout length of scales compared to that of control. Maximum sprout length (9.60 cm) was, however, obtained when calcium nitrate was applied to the scales at the rate of 10 g/m^2. It is also evident from the data that optimum level of calcium nitrate varies with cultivars (Table 2). Maximum sprout length (10.18 cm) was recorded in cultivar 'UHFS LA Lily Collection 1' followed by 'Batistero' (10.10 cm)when calcium nitrate was applied to the scales at 10 g/m^2, and in 'Frans Hals' (9.33 cm) when calcium nitrate was given at the rate 15 g/m^2 to the scales. Our results are in close confirmity with Treder (13) in oriental lily 'Star Gazer' and Karimi *et al.*(3), they have concluded that optimum dose of calcium nitrate varies with cultivars and the best growth in Asiatic cv. 'Navona' and LA cv. 'Fangio'was observed at two different calcium nitrate levels *i.e.*, 1.5 and 2 mM, respectively.

Data (Table 1) also showed that number of leaves per scale varied with cultivars. Maximum number of leaves/scale (6.13) recorded in cultivar 'Batistero' were found to be at par with 'UHFS LA Lily Collection 1' (5.93) and minimum number of leaves/ scale (5.79) were recorded in cultivar 'Frans Hals'. Variable number of leaves/plants have also been observed in field experiment on different Asiatic lily cultivars by Rani *et al.* (8) and through scaling in Oriental lily cultivars by Sharma *et al.*(11). Data showed increasing trend in number of leaves/scale with increasing calcium nitrate dose upto 20 g/m^2. The maximum number of leaves/scale (6.38) were

obtained when calcium nitrate was applied at 20 g/m^2. Choi *et al*. (1) have also stated that various lily cultivars have different optimum tissue nutrient levels which should be adjusted to ensure maximum growth and flower quality. It is also evident from Table 2 that maximum number of leaves/scale (7.03) were also observed in cultivar 'Batistero' when calcium nitrate was applied at 25 g/m^2. In cultivar 'Frans Hals' maximum number of leaves/scale (6.54) were obtained with calcium nitrate at 20 g/m^2 and in 'UHFS LA Lily Collection 1' maximum number of leaves/scale (6.45) were recorded with 15 g/m^2 application of calcium nitrate.

The cultivars under study varied significantly for the production of bulblets per scale (Table 1) with maximum bulblets (2.59) observed in cultivar 'UHFS LA Lily Collection 1'. It was, however, found to be at par with number of bulblets/scale (2.48) obtained in cultivar 'Batistero'. Results indicated that reproductive ability depended almost entirely on cultivar. Our results are in line with those of Krause (4) who studied the reproductive ability of some *Lilium longiflorun* varieties. Similar findings have also been reported by Matsuo and Arisumi (6) in *Lilium longiflorum* cultivars, Singh (12) in Asiatic cultivars, Sharma *et al.* (11) in Oriental lilies and Lyngdoh (5) in LA hybrid lilies. Among different calcium nitrate doses, maximum number of bulblets/scale (2.90) observed with 20 g/m^2 application of calcium nitrate to the scales. Interaction (Table 2) effect of cultivars with calcium nitrate doses showed maximum number of bulblets/scale (3.01) in cultivar 'UHFS LA Lily Collection 1' when supplied with 10 g/m^2 calcium nitrate and in 'Batistero' (2.99) and 'Frans Hals' (2.78) maximum number of bulblets/scale were obtained with calcium nitrate at 20 g/m^2.

Bulblet size was found to be maximum (9.34 mm in diameter) in cultivar 'UHFS LA Lily Collection 1' and minimum bulblet diameter (8.14 mm) in cultivar 'Batistero' (Table 1). The varietal differences in bulblet size during scaling of different types of lilies was also reported earlier by Singh (12), Sharma *et al.* (11) and Lyngdoh (5). Among different calcium nitrate doses, maximum bulblet size (9.32 mm) was observed when 10 g/m^2 calcium nitrate was given to the scales. Interaction (Table 2) effect of cultivars with calcium nitrate doses showed maximum bulblet diameter (9.77 mm) in cultivar 'UHFS LA Lily Collection 1'. In 'Frans Hals', maximum bulblet size (9.39 mm) and in 'Batistero', maximum bulblet diameter (8.81 mm) was recorded with 10 g/m^2 application of calcium nitrate, respectively. Seyedi *et al*. (10) observed maximum height of the plant, stem diameter, procreative height, number of buds, flower diameter and longevity of cut flowers in Asiatic hybrid lilium cv. 'Tresor' with 6 mM calcium.

The weight of bulblets also differed significantly due to different treatments. Bulblets of higher diameter had higher weight. Maximum fresh weight of bulblets/scale (1.57 g) found in cultivar 'Frans Hals' was statistically at par with that of 'Batistero' (1.55 g). The cultivar 'UHFS LA Lily Collection 1', however, produced minimum fresh weight of bulblets/scale (1.46 g) (Table 1). The varietal variability could be attributed to the genotypic differences between them which is in line with the earlier reports of Singh (12), Sharma *et al.* (11) and Lyngdoh (5). Among calcium nitrate doses maximum fresh weight of bulblets/scale (1.69 g) was obtained when calcium nitrate was applied to the scales at the rate of 10 g/m^2. Increased fresh weight of the bulblets obtained in this treatment corresponds to the maximum leaf length and respective increased bulblet diameter in this treatment. Longer leaves contributed to the more carbohydrate accumulation and their channelization into the bulblets increasing their weight thereby. Interaction (Table 2) effect of cultivars with calcium nitrate doses revealed maximum fresh weight of bulblets/scale (1.75 g) in cultivar 'Frans Hals' followed by 'Batistero' (1.66 g) and 'UHFS LA Lily Collection 1' (1.65 g) produced with log/m^2 calcium nitrate. Maximum propagation index (117.66%) was recorded in cultivar 'Frans Hals'. It was, however, found to be at par with propagation index of 'UHFS LA Lily Collection 1' (112.39%), whereas 'Batistero' recorded minimum (110.67 %) propagation index (Table 1). The genotypic variation reflected in the propagation index was also highest in cultivar Frans Hals followed by UHFS LA Lily Collection 1 and Batistero. Among different calcium nitrate doses, maximum propagation index (125.69%) was observed in 10 g/m^2 (Table 1). Interaction (Table 2) effect of cultivars with calcium nitrate doses showed maximum propagation index (131.58%) in Frans Hals, followed by Batistero (118.57 %) and UHFS LA Lily Collection 1 (126.96 %) with 10 g/m^2 application of calcium nitrate.

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