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Effect of light condition and height of flower harvesting on bulb and bulblet production in Asiatic hybrid lily

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Abstract

Availability of planting material is a limiting factor in the cultivation of Asiatic hybrid lily and small farmers are facing the constrains by frequently importing the Lilium bulbs for planting. An experiment was carried out to study the effect of light condition and height of flower harvesting on bulb and bulblet production in Asiatic hybrid lily at CSIR-Institute of Himalayan Bioresource Technology, Palampur, Kangra, Himachal Pradesh. The treatments consisted of four shade conditions *i.e.,* 30 % green shade net (G1), 50 % green shade net (G2), 75 % green shade net (G3) and open field condition (control) (G4) in main plot, four height of flower harvesting *i.e.,* 15 cm above ground (H1), 30 cm above ground (H2), 45 cm above ground (H3) and no flower harvesting (H4) in sub plot and three cultivar *i.e.*, Gran Paradiso (V1), Novecento (V2) and Adelina (V3) in sub-sub plot. Experiemnt was laid out in split-split plot design with three replications. Comparison was made for the treatment effect on characters related to number of bulb and bulblet production, circumference (cm) and weight characters. Results revealed that green shade net significantly improved the bulb and bulblet production and higher number of bulb and bulblet per plant were produced under 50 % green shade net whereas least number of bulb were found in open field condition. More number of bulb and bulblet production were observed where no flowers were harvested. Among varieties, Gran Paradiso produced more number of bulb and bulblet per plant while minimum number of bulb per plant was observed by Novecento. Higher bulb circumference (cm) of bulb and bulblet was found with 50 % green shade net condition. The maximum bulb circumference was found in no flower harvesting treatment and minimum in 15 cm above ground of harvesting. The cultivar Gran Paradiso noted maximum bulb and bulblet circumference (cm). Results indicated that 50 % green shade net gave maximum weight of bulb and bulblet per plant. No flower harvesting treatment produced maximum weight of bulb and bulblet per plant. Among cultivars, Gran Paradiso produced highest weight of bulb per plant while cultivar Novecento produced minimum bulb weight per plant.

Key words: Light condition, bulb, bulblet, Asiatic hybrid lily, shade, Gran Paradiso, Novecento, Adelina

Introduction

Floriculture has been accepted an important agri-business in many parts of the country providing employment opportunities and entrepreneurship. A large number of farmers in rural areas are already engaged in growing flowers. Opportunity to increase their income by using newer techniques has increased due to crop diversification and a good number of technologies are available for this purpose. During the last decade, there has been a thrust on export of cut flowers, especially roses and export surplus has found its way to the local market influencing people in cities to purchase and use flowers in their daily lives. Floriculture in India has a long tradition and serving the purpose for meeting socio-cultural requirements of ethnic populations since time immemorial. However, with rapid commercialization of agriculture and graduation of farming from subsistence level to commercial level, exposure to newer markets and opportunities have resulted in market segmentation and evolution of niche markets. To avail the multitude of opportunities provided by the modern trends, the increasing demand of cut flowers would require reorientation of production technologies suited to the farmers for better livelihood. High value added advantages in floriculture are increasing because flowers, especially for the export market, are high value commodities with increased demand. The floriculture industry is constantly looking for new products *i.e.*, new species or cultivars with interesting traits with commercial scope. Different flowering time, plant size, flower colour, bulblet/bulbil production and pollenless flowers are important in consumer demand expectation.

Lily, a monocotyledonous species of genus *Lilium* belongs to the family Liliaceae, is native to northern hemisphere, in Asia, Europe and North America. Lilies occupy prominent position among the top five flowers of the world. In lilies, the Asiatic, Oriental and LA hybrids are commercially important types owing to their very attractive flowers with excellent vase-life and largely traded in the international market (www.floraholland.com). It is widely used in the floral industry as cut flower and potted plants. The area under commercial cultivation of Asiatic hybrid is increasing day by day in India. Unfortunately till date, the growers engaged in plant material production business do not have the requisite technologies for production of commercial size healthy bulbs. Hence, the flower growers have no option but to import the plant material of lilies from abroad draining out an appreciable amount of foreign exchange.

Lilium respond easily to different methods of propagation. It can be multiplied through seeds, bulb scales, bulb division, stem bulblet and tissue culture. Stem bulblet and bulb divisions are very common propagation methods. Usually one large daughter bulb produces 1 or 3 bulblet every year. Prior to flowering, new daughter bulb(s) develop within the mother bulb. It usually initiates, in autumn and winter, from a growing point in the axil of a scale at the base of the stem axis. During next spring, the daughter bulb initiates new scales and leaf primordia at the growing point. Newly formed bulblet increase in size during spring and continue throughout summer. The bulblet is usually planted in the field and within a period of 2 to 3 years they become ready for commercial planting with a circumference of 15-20 cm (Dole and Wilkins, 1999). After flowering of the mother bulb, no more bulblets are produced by the daughter bulbs (Hartmann *et al.* 1993). Many other factors like nutrition also influence bulb characteristics in lily (Muneeb, 2015; Neerja *et al.*, 2005).

Asiatic lilies are mostly propagated by bulb and bulblets. In general, availability of these propagules is a limiting factor in its cultivation. Therefore, the present investigation aimed to study effect of environmental conditions, harvesting methods and varieties on the bulb and bulblet production.

Materials and methods

The present investigation on the effect of light condition and height of flower harvesting on bulb and bulblet production of Asiatic hybrid lily was carried out in Experimental Field of Floriculture and Crop Improvement, CSIR-Institute of Himalayan Bioresource Technology, Palampur, Kangra, Himachal Pradesh.

The treatments consisted of four light conditions *i.e.,* 30 % Green shade net (G1), 50 % Green shade net (G2), 75 % Green shade net (G3) and open field condition (control) (G4) in main plot, four height of flower harvesting *i.e.* 15 cm above ground (H1), 30 cm above ground (H2), 45 cm above ground (H3) and no flower harvesting (H4) arranged in sub plot and three cultivar *viz.,* Gran Paradiso (V1), Novecento (V2) and Adelina (V3) as sub-sub plot treatments. Experiement was laid out in split-split plot design with three replications. Number of bulbs/ bulblets produced per plant was counted at the time of harvesting. The circumference of the bulbs/bulblets was recorded with the help of a vernier calliper. The weight of individual bulb was recorded in g after cleaning / washing, treatment with fungicide and drying in shade for 24 hours.

The experimental data were analysed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of treatment means and compared at P=0.05 (Gomez and Gomez,1984). Comparison of treatments effect on the crop characters related to number of bulb and bulblet production, circumference (cm) and weight characters were performed using LSD (P=0.05).

Results and discussion

Various green shade net conditions had significant effect on bulb production (Table 1). Plant grown under 50 % green shade net produced highest number of bulb per plant followed by 30 % green shade condition. The no flower harvesting treatment gave higher number of bulb per plant in present investigation. Cultivar Gran Paradiso produced more number of bulb per plant followed by Adelina and minimum number of bulb per plant was observed by Novecento. It is clear that lily cultivar grown under 50 % green shade net condition with no flower harvesting produced more number of bulb. This may be due to availability of better light conditions which resulted in higher production of bulb. These genotypes produced least number of bulb with 75 % shade net condition with 15 cm above ground flower harvesting in present investigations. Similar result was earlier reported by Ahlawat *et al.* (2012). Significant difference was observed in bulb circumference (cm) due to green shade net condition, height of flower harvesting and varieties of lily. Shading condition gave higher bulb circumference with the use of 50 % green shade net condition. However, bulb circumference was higher in no flower harvesting treatment in the cultivar Gran Paradiso, while minimum bulb circumference was observed by Novecento. The different green shade condition and flower harvest treatment had significant effect on weight of bulb per plant. The better light condition and proper height of flower harvesting resulted maximum bulb weight by genotypes of lily under 50 % green shade net condition with no flower harvesting. Similarly, higher bulb weight was recorded by Gran Paradiso followed by Adelina and Novecento under 50 % green shade net conditions with no flower harvesting. However, minimum bulblet weight was observed with 75 % shade net condition with 15 cm above ground flower harvesting in present investigations. Mandal *et al.* (2009) and Zhang *et al.* (2011) concluded that there were maximum dry matter production in the bulb, stem and whole plant of Lilium cultivated in the shade.

Results revealed that bulblet production was maximum with 50 % green shade followed by 30 % green shade condition while minimum number of bulblet was observed under open field conditions (Table 2). Table indicated that no flower harvested plants produced maximum number of bulblet whereas, flower cut from 15 cm above ground gave minimum bulblet per plant. Among the cultivars, Gran Paradiso gave maximum number of bulblet per plant followed by Adelina while least number of bulblet per plant was observed by Novecento.

The crop grown under 50 % green shade net had highest bulblet circumference which was significantly higher than other green shade condition and minimum bulblet circumference was observed under open field conditions. The higher bulblet circumference was recorded with no flower harvest treatment. Further it is clear that Gran Paradiso cultivar produced maximum bulblet circumference and minimum bulblet circumference was observed in Novecento. Kim *et al.* (2007) reported that for bulb and bulblet production, reduced flowering is desired since flowers are generally removed during the outdoor bulb production period.

The 50 % green shade net gave maximum weight of bulblet per plant which was significantly higher than 30 % green shade net and 75 % green shade net conditions. Plants with no flower harvesting produced maximum weight of bulblet, while flower harvested from 15 cm above ground resulted minimum bulblet weight per plant. Among cultivars, Gran Paradiso gave highest weight of bulblet per plant while cultivar Novecento resulted minimum bulblet weight per plant.

Table 1. Effect of light conditions, height of flower harvesting and varieties of Asiatic hybrid lily on number of bulbs produced per plant (average of two years)

Shade	Height of flower harvest	Bulb production				Bulb circumference (cm)				Bulb weight (g)			
		V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
G_1	H_1	1.210	1.140	1.210	1.187	14.33	12.90	13.74	13.66	51.35	47.22	49.67	49.41
	H_2	1.275	1.170	1.220	1.222	15.98	16.76	14.31	15.68	54.57	49.02	51.63	51.74
	H_3	1.305	1.225	1.255	1.262	17.19	15.83	17.10	16.71	59.72	51.94	55.31	55.66
	H_4	1.350	1.265	1.310	1.308	19.08	17.79	18.69	18.52	63.89	57.97	61.32	61.06
	Mean	1.285	1.200	1.249	1.245	16.64	15.82	15.96	16.14	57.38	51.54	54.48	54.47
G_2	H_1	1.260	1.205	1.240	1.235	16.04	14.51	15.17	15.24	57.29	51.33	54.75	54.46
	H_2	1.320	1.245	1.315	1.293	19.07	16.86	18.20	18.04	64.54	56.50	60.32	60.45
	H_3	1.390	1.320	1.345	1.352	22.14	20.54	21.54	21.41	72.13	65.63	69.04	68.93
	H_4	1.470	1.370	1.415	1.418	24.17	21.56	22.61	22.78	78.09	69.28	72.52	73.30
	Mean	1.360	1.285	1.329	1.325	20.35	18.36	19.38	19.36	68.01	60.68	64.16	64.28
G_3	H_1	1.125	1.000	1.045	1.057	12.65	11.06	11.54	11.75	43.48	40.32	41.51	41.77
	H_2	1.245	1.075	1.180	1.167	13.26	11.76	12.23	12.42	46.74	41.33	43.70	43.92
	H_3	1.315	1.125	1.255	1.232	14.27	12.35	12.98	13.20	49.84	43.80	46.61	46.75
	H_4	1.355	1.210	1.295	1.287	14.55	13.23	13.76	13.85	51.64	44.04	48.28	47.98
	Mean	1.260	1.103	1.194	1.185	13.68	12.10	12.62	12.80	47.92	42.37	45.02	45.10
G_4	H_1	1.165	1.095	1.140	1.133	12.60	11.70	12.45	12.25	46.17	41.31	44.17	43.88
	H_2	1.250	1.185	1.215	1.217	13.26	13.07	12.90	13.08	50.32	43.94	47.79	47.35
	H_3	1.290	1.195	1.240	1.242	14.42	12.89	13.92	13.74	53.13	45.82	49.06	49.34
	H_4	1.315	1.220	1.275	1.270	15.99	14.54	15.39	15.31	55.82	49.17	53.11	52.70
	Mean	1.255	1.174	1.218	1.215	14.07	13.05	13.67	13.59	51.36	45.06	48.53	48.32
Main effects	Varieties	1.290	1.190	1.247		16.20	21.39	15.42		56.17	49.91	53.05	
	Flower harvesting	1.153	1.225	1.272	1.321	13.23	23.55	16.26	17.61	47.38	50.86	55.17	58.76
	Factors	SE(m)	LSD			SE(m)	LSD			SE(m)	LSD		
	G	0.01	0.03			0.15	0.52			0.33	1.13		
	H	0.01	0.02			0.15	0.44			0.38	1.11		
	G X H	0.01	0.04			0.30	0.89			0.76	2.21		
	V	0.01	0.02			0.14	0.40			0.31	0.88		
	V X G	0.01	NS			0.28	0.80			0.62	NS		
	V X H	0.01	NS			0.28	0.80			0.62	NS		
	V X G X H	0.03	NS			0.56	1.60			1.25	NS		

LSD value at P=0.05

Table 2. Effect of light conditions, height of flower harvesting and varieties of Asiatic hybrid lily on number of bulblets produced per plant (average of two years)

Shade	Flower harvesting	Bulblet production				Bulblet circumference (cm)				Bulblet weight (g)			
		V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
G_1	H_1	4.62	4.03	4.40	4.35	3.50	3.12	3.29	3.30	5.86	5.20	5.57	5.54
	H_2	5.03	4.90	4.58	4.83	3.71	3.23	3.38	3.44	7.09	6.59	6.75	6.81
	H_3	5.54	4.90	5.40	5.28	3.80	3.42	3.66	3.63	8.23	7.57	7.88	7.89
	H_4	6.15	5.53	5.92	5.86	3.87	3.68	3.75	3.77	9.80	9.06	9.55	9.47
	Mean	5.33	4.84	5.07	5.08	3.72	3.36	3.52	3.53	7.74	7.10	7.44	7.43
G_2	H_1	5.13	4.52	4.43	4.69	3.77	3.21	3.50	3.49	7.93	7.15	7.64	7.57
	H_2	6.03	5.25	5.52	5.60	3.95	3.57	3.69	3.74	9.50	8.69	9.13	9.10
	H_3	7.08	6.20	6.72	6.67	4.16	3.84	3.98	3.99	11.92	11.01	11.56	11.49
	H_4	7.73	6.87	7.35	7.32	4.28	3.99	4.17	4.15	14.08	12.95	13.47	13.50
	Mean	6.49	5.71	6.00	6.07	4.04	3.65	3.83	3.84	10.85	9.95	10.45	10.42
G_3	H_1	3.78	3.28	3.50	3.52	2.73	2.48	2.57	2.59	4.00	3.51	3.75	3.75
	H_2	4.14	3.48	3.61	3.74	2.84	2.70	2.70	2.75	4.30	3.83	4.06	4.06
	H_3	4.41	3.70	3.93	4.01	2.96	2.73	2.88	2.86	4.86	4.31	4.52	4.56
	H_4	4.48	4.10	4.24	4.27	3.18	2.79	3.05	3.01	5.34	4.92	5.13	5.13
	Mean	4.20	3.64	3.82	3.88	2.93	2.67	2.80	2.80	4.62	4.14	4.36	4.38
G_4	H_1	3.96	3.55	3.74	3.75	2.82	2.52	2.66	2.67	4.72	4.33	4.50	4.52
	H_2	4.28	3.84	4.09	4.07	2.90	2.54	2.79	2.74	5.15	4.62	4.86	4.88
	H_3	4.65	4.09	4.40	4.38	3.03	2.81	2.91	2.92	5.96	5.22	5.65	5.61
	H_4	5.00	4.48	4.69	4.72	3.38	2.93	3.20	3.17	6.43	5.93	6.14	6.17
	Mean	4.47	3.99	4.23	4.23	3.03	2.70	2.89	2.87	5.56	5.02	5.29	5.29
Main effects	Mean varieties	5.12	4.54	4.78		3.42	3.09	3.27		7.20	6.55	6.88	
	Flower harvesting	4.08	4.56	5.08	5.54	3.00	3.15	3.36	3.51	5.35	6.21	7.39	8.56
	Factors	SE(m)	C.D.			SE(m)	C.D.			SE(m)	C.D.		
	G	0.04	0.13			0.02	0.07			0.04	0.13		
	H	0.03	0.07			0.02	0.07			0.03	0.09		
	GXH	0.05	0.15			0.04	NS			0.06	0.18		
	V	0.03	0.08			0.01	0.04			0.04	0.11		
	V X G	0.06	NS			0.03	NS			0.08	NS		
	V X H	0.06	NS			0.03	NS			0.08	NS		
	V X G X H	0.12	NS			0.02	NS			0.16	NS		

In the present investigation, shade conditions, height of flower harvesting and variety influenced number of bulb produced per plant and their weight. Higher number of bulb and bulblet per plant were produced under 50 % green shade net and more number of bulb and bulblet production were observed where no flowers were harvested. Among varieties, Gran Paradiso produced more number of bulb and bulblet per plant. These factors may be considered for commercial production of bulbs.

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