Research Article

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Effect of management practices and bulb sizes for quality bulb production in Lilium (*Lilium* sp.)

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ABSTRACT

An experiment was conducted at Horticulture Research Centre, BARI, Gazipur, during November 2019 - June 2021 to study the effect of management practices and bulb sizes on production of quality bulbs and bulblets of lilium (*Lilium* sp.). Two management practices, viz. removal of spikes and without removal of spikes were considered as one factor and three bulb sizes, viz. large, medium and small as another factor in a randomized complete block design. Removal of spikes produced maximum number of bulbs and bulblets/plant (1.41 and 1.81, respectively), the heaviest and largest bulb (26.02g and 4.47cm) and bulblets/plant (6.88g). Large-sized bulbs produced maximum number of bulbs and bulblets/plant (1.51 and 1.98, respectively), heaviest and largest bulb (27.80g and 4.67cm, respectively) and bulblets/plant (7.92g). The removal of spikes produced longest plant (52.58 cm), spike (64.05 cm), rachis (22.18 cm) and bud (8.69 cm) and largest bud and floret (2.80 and 16.96 cm, respectively) and maximum number of florets/stick (4.78) from bulbs obtained during first year. Considering various levels of bulb sizes, large-sized bulbs produced longest plant (53.77 cm), spike (67.22 cm), rachis (23.17 cm) and bud (8.86 cm) and largest bud and florets (2.86 and 17.14 cm, respectively) and maximum number of florets/stick (5.11) from bulbs obtained during first year. Similarly, removal of spikes and large-sized bulbs produced a good number of bulbs and bulblets during second year from bulbs obtained during first year. Large-sized bulbs combined with removal of spikes produced quality bulbs as well as flowers.

Key Words: Bulb production, Management practices, Bulb sizes, Bulblets, Spikes

Liliums (*Lilium* sp.) are normally propagated asexually by natural formation of daughter bulbs. A single bulb normally produces one or two daughter bulb and with average of 5-8 bulblets in each season. Due to a very low rate of natural multiplication of its bulb and bulblet, it results in non-availability of enough planting materials. Therefore, multiplication of bulbs through improved techniques may play an important role. Production of healthy bulb and bulblets are enhanced when all buds or flowers in spike are not allowed to grow or when spikes are harvested leaving some portions of stems in soil because opened flowers and buds draw photosynthates (food/energy) manufactured in green leaves (Almeida *et al*., 2017; Xiujuan *et al*., 2010). Shafiullah *et al*. (2018) reported that spike removal gave efficiently more number of corms, daughter corms, corm diameter and corm weight in gladiolus flower. Keeping in view, an experiment was conducted to standardize the management practices and to determine the optimum bulb size for quality bulb and bulblet production of lilium.

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MATERIALS AND METHODS

The experiment was conducted at Floriculture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh, during November 2019-June 2021 under protected condition using agro shade net. Two management practices like without removing of spikes and removal of spikes were considered as one factor, while other factor consisted of three levels of bulb size (large, 4.0-4.9cm; medium, 3.0-3.9cm and small, 2.0-2.9cm). The experiment was laid out in RCB design with 3 replications. The unit plot size was 1.2 m × 1.50 m and spacing was maintained at 20cm × 15cm. The bulbs of BARI Lilium-1 (Asiatic group and flower creamy white in colour) were planted on

15 November, 2019 as per the treatments. When lower most buds showed colour, spikes were harvested in case removal of spike treatment. Bulbs were lifted on 03 June, 2020 when leaves were brown and more or less damaged.

After cleaning and treating with Autostin (2g/L of water), the bulbs were stored at 2.1-2.4^{0}c temperature to see the performance of flowers for the next season those were planted on 12 November 2020. During flower collection, plants leaving 25-30cm stem were kept in the field for bulb development and bulbs were also lifted on 06 June, 2021. The land was well prepared by adding cocodust (50:50 soil and cocodust), 10 tonnes cowdung/ha. No chemical fertilizer up to 3 weeks of bulb planting was applied. After 3 weeks of bulb planting, NPK@30:20:20g/m^2 was applied. Urea and MoP @ 100kg/ha were topdressed before spike initiation stage and bulb lifting, respectively.

The cultural operations like weeding and watering were done as per the requirement. Mulching with straw was done when temperature got high. Netting (GI wire and nylon thread) was given to support the plants. The plants were protected from birds and other harmful animals using net made of nylon threads. 'Carbendazim' (Autostin) was sprayed @ 1g/L of water at 15 days interval starting from 20 days after planting to protect the plants from botrytis blight disease. Simultaneously, neem oil and Biomax (1 ml/L) were used to protect from aphids and beetles. The data on growth, flowering and bulb characters were recorded from ten randomly selected plants from each unit plot. The data were analyzed statistically by using R software to find out the variation among different treatments. Treatment means were compared by DMRT (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

All the parameters showed significant differences in management practices (Table 1). The treatment removal of spikes produced maximum number of bulbs and bulblets/plant (1.41 and 1.81, respectively), heaviest and largest bulb (26.02g and 4.47cm) and heaviest bulblets/plant (6.88g). That might be due to removal of spikes that helped to utilize the reserve food by rest of the plant as well as help in bulb development. Absence of spike allows the plant to divert its energies (dry matter) toward the development of corms in gladiolus, supporting the findings. The increase in number and weight of bulbs and bulblets/plant may be a result of more resource allocation to the underground sink (bulbs) which could have otherwise been used by the developing flowers.

Shafiullah *et al*. (2018) reported that, in case of spike removal, maximum number of corms/mother corm, corm weight, corm diameter, number of cormels /mother corm were observed in plants whose spikes were removed at the spike emergence stage. Qureshi *et al*. (2018) obtained higher number of corms and cormels/plant from treatment, removal of spike after 10 days of appearance than that of removal of spike at colour break stage and no spike removal treatments in gladiolus. Those plants were allowed to give flowers did not perform well.

Considering various levels of bulb sizes, large-sized bulbs produced maximum number of bulbs and bulblets/plant (1.51 and 1.98, respectively), heaviest and largest bulb (27.80g and 4.67cm) and heaviest bulblets/plant (7.92g) (Table 1). Better performances of larger bulbs might be due to availability of food materials stored in bulbs which ultimately helped the initial growth of plants as well as bulb and bulblet production. Sarkar *et al.* (2014) observed that large corms (120-125 g) increased the yield of corms and cormels as compared to the control (80-100 g) in gladiolus. Ahmed *et al.* (2009) observed that in tuberose (*Polianthes tuberosa* L. cv. Single), large bulb resulted in vigorous growth, maximum yield and a more number of bulbils as compared to small and medium-sized bulbs. Similarly, Ara (2000) showed that weight and diameter of corms were maximum (21.53g and 4.06cm, respectively) from plants grown from large-sized corms in gladiolus.

The bulb and bulblet production did not show significant variations among treatment combinations except bulblet numbers/plant (Table 2). Large-sized bulbs in combination with removal of spikes produced maximum number of bulblets/plant (2.45), whereas small-sized bulb without removing of spikes produced very poor bulblets/plant (0.89). Though other parameters did not show significant variations among the treatment combinations, large-sized bulbs combined with spike removal treatment showed better performances.

The vegetative growth and flower production influenced by management practices from bulbs obtained during first year showed significant variations (Table 3). The treatment removal of spikes produced longest plant (52.58 cm), spike (64.05 cm), rachis (22.18 cm) and bud (8.69 cm) and largest bud

Table 1. Bulb and bulblet production influenced by management practice and bulb sizes

Treatment	Bulb number/ plant	Single bulb weight (g)	Bulb diameter (cm)	Bulblet number/ plant	Bulblet weight/ plant (g)
Management practices					
Without removal of spikes (T_1)	1.22b	21.46b	3.73b	1.27b	4.40b
Removal of spikes (T_2)	1.41a	26.02a	4.47a	1.81a	6.88a
Level of significance	**	**	**	**	**
Bulb sizes					
Large (S_1)	1.51a	27.80a	4.67a	1.98a	7.92a
Medium (S_2)	1.34b	23.37b	4.17b	1.49b	5.58b
Small (S_3)	1.10c	20.05c	3.47c	1.16c	3.43c
Level of significance	**	**	**	**	**
CV (%)	9.03	6.61	5.41	13.37	20.40

Means with the same letter (s) are not significantly different at 1% level by DMRT;
**, Significant at 1% level of probability

Table 2. Bulb and bulblet production influenced by combined effect of management practice and bulb sizes

Treatment	Bulb number/ plant	Bulb weight (g)	Bulb diameter (cm)	Bulblet number/ plant	Bulblet weight/ plant (g)
T_1 S_1	1.42	25.53	4.29	1.52ab	6.50
T_1 S_2	1.25	21.0	3.79	1.42b	4.33
T_1 S_3	1.0	17.85	3.12	0.89c	2.37
T_2 S_1	1.60	30.06	5.04	2.45a	9.33
T_2 S_2	1.43	25.75	4.55	1.57ab	6.83
T_2 S_3	1.19	22.25	3.83	1.42b	4.49
Level of significance	NS	NS	NS	*	NS
CV (%)	9.03	6.61	5.41	13.37	20.40

*Significant at 5% level, NS, non-significant; T_1, without removal of spikes, T_2, removal of spikes; S_1, large, S_2, medium, S_3, small

and floret (2.80 and 16.96 cm, respectively) and also maximum number of florets/stick (4.78). This may be due to heaviest and largest bulbs obtained from treatment, removal of spikes. Those plants were allowed to give flowers showed poor performances. The removal of spikes showed better vegetative growth and flower production in gladiolus from corm obtained during first year (Khan *et al.,* 2013).

Considering various levels of bulb sizes, all the parameters of vegetative growth and flower production from bulbs obtained during first year showed significant variations (Table 3). The maximum plant height (53.77 cm) was recorded from large-sized bulbs. Medium sized bulbs gave plant height (51.11 cm) statistically similar to that of large-sized bulbs and lowest plant height (47.03 cm) was obtained from small-sized bulb. Larged-sized bulbs produced maximum plant hight which might have been due to availability of more food assimilates, resulting in plants acquiring maximum growth and better development. Akand *et al*. (2016) reported that higher reserved food resulted in better growth and ultimately maximum plant height compared to small bulbs. The large sized bulbs produced longest spike (67.22 cm) and rachis (23.17 cm).

The increased spike and rachis length from large bulb were probably due to better vegetative growth of plants. Similar results were also observed by Methela *et al*. (2019) and Hossain *et al*. (2021). The Large-sized bulbs also produced longest bud (8.86 cm), and largest buds and florets (2.86 and 17.14 cm, respectively) and also maximum number

of florets/spike (5.11). Small sized bulbs showed poor performances in vegetative, flower characters and yield. This might have been due to that large bulbs have higher food reserves than small bulb. Therefore, plants produced larger bulb have better flower quality characters and yield than other ones. Similar results were reported by Almeida *et al.* (2017), Sowjanya *et al.* (2017); Sarkar *et al*. (2014), Hossein A-Dur and Al-Atrakchii (2021), Patil and Jhadav (2010); Khan *et al*. (2016).

Though vegetative growth and flower production did not show significant variations among treatment combinations, large-sized bulbs combined with removal of spikes showed better performance in plant height (55.48 cm), spike (72.22 cm), rachis (24.59 cm) and bud length (9.10 cm), bud and floret diameter (2.96 cm and 17.50 cm, respectively) and floret numbers/stick (5.72) (Table 4).

All the parameters showed significant differences by management practices on bulb and bulblet production of Lilium in the second year from bulbs obtained in the first year (Table 5). The treatment removal of spikes produced maximum number of bulbs and bulblets/plant (1.66 and 2.46, respectively), heaviest and largest bulb (48.72 g and 5.40 cm) and also heaviest bulblets/plant (8.06 g). Those plants were allowed to give flowers did not perform well compared to bulbs obtained from removal of spikes treatment.

Table 3. Vegetative growth and flower production influenced by management practice and bulb sizes from bulbs obtained during first year

Treatment	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Bud length (cm)	Bud diameter (cm)	Floret number/ stick	Floret diameter (cm)
Management practices							
Without removal of spikes (T_1)	48.69b	56.0b	19.97b	8.32b	2.63b	3.81b	16.39b
Removal of spikes (T_2)	52.58a	64.05a	22.18a	8.69a	2.80a	4.78a	16.96a
Level of significance	**	**	**	**	**	**	**
Bulb sizes							
Large (S_1=4.0-4.9 cm)	53.77a	67.22a	23.17a	8.86a	2.86a	5.11a	17.14a
Medium (S_2=3.0-3.9 cm)	51.11a	59.28b	20.75b	8.47b	2.71b	4.26b	16.63b
Small (S_3=2.0-2.9 cm)	47.03b	53.57c	19.31b	8.18b	2.57c	3.50c	16.25c
Level of significance	**	**	**	**	**	**	**
CV (%)	4.53	3.71	6.94	2.81	2.07	9.74	1.43

Means with the same letter(s) are not significantly different at 1% level by DMRT; **, Significant at 1% level of probability

Table 4. Vegetative growth and flower production influenced by combined effect of management practice and bulb sizes from bulbs obtained during first year

Treatment	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Bud length (cm)	Bud diameter (cm)	Floret number/ stick	Floret diameter (cm)
T_1 S_1	52.05	62.22	21.75	8.62	2.76	4.50	16.78
T_1 S_2	50.0	55.18	19.67	8.29	2.63	3.92	16.30
T_1 S_3	44.02	50.59	18.50	8.05	2.49	3.0	16.08
T_2 S_1	55.48	72.22	24.59	9.10	2.96	5.72	17.50
T_2 S_2	52.22	63.37	21.83	8.65	2.79	4.61	16.95
T_2 S_3	50.03	56.56	20.11	8.31	2.65	4.0	16.42
Level of significance	NS	NS	NS	NS	NS	NS	NS
CV (%)	4.53	3.71	6.94	2.81	2.07	9.74	1.43

NS, Non-significant; T_1, without removal of spikes; T_2, removal of spikes

S_1, large, S_2, medium and S_3, small

Table 5. Bulb and bulblet production in second year influenced by management practice and bulb sizes from bulbs obtained during first year

Treatment	Bulb number/ plant	Bulb weight (g)	Bulb diameter (cm)	Bulblet number /plant	Bulblet weight/ plant (g)
Management practices					
Without removal of spikes (T_1)	1.33b	41.01b	5.01b	1.73b	5.23b
Removal of spikes (T_2)	1.66a	48.72a	5.40a	2.46a	8.06a
Level of significance	**	**	**	**	**
Bulb sizes					
Large (S_1)	1.72a	51.08a	5.52a	2.70a	9.12a
Medium (S_2)	1.51a	44.28b	5.20b	2.07b	6.57b
Small (S_3)	1.25b	39.23c	4.89c	1.53c	4.25c
Level of significance	**	**	**	**	**
CV (%)	12.09	6.33	2.45	9.38	13.18

Means with the same letter(s) are not significantly different at 1% level of significance by DMRT

**, Significant at 1% level of probability

Table 6. Bulb and bulblet production in second year influenced by combined effect of management practice and bulb sizes from bulbs obtained during first year

Treatment	Bulb number / plant	Bulb weight (g)	Bulb diameter (cm)	Bulblet number/ plant	Bulblet weight/ plant (g)
T_1 S_1	1.50	46.17	5.27	2.20b	7.40
T_1 S_2	1.42	40.95	5.02	1.90b	5.30
T_1 S_3	1.07	35.90	4.73	1.10c	3.0
T_2 S_1	1.93	56.0	5.78	3.18a	10.83
T_2 S_2	1.60	47.60	5.36	2.23b	7.83
T_2 S_3	1.43	42.55	5.05	1.95b	5.50
Level of Significance	NS	NS	NS	*	NS
CV (%)	12.09	6.33	2.45	9.38	13.18

NS, Non-significant, *, Significant at 1% level of probability;

T_1= without removal of spikes; T_2 = removal of spikes; S_1, large, S_2, medium and S_3, small

Khan *et al.* (2013) also showed removal of spikes in gladiolus produced large amount of corm and cormels. Considering various levels of bulb sizes, large-sized bulbs produced significantly maximum number of bulbs and bulblets/plant (1.72 and 2.70, respectively), heaviest and largest bulb (51.08 g and 5.52 cm) and also the heaviest bulblets/plant (9.12 g) (Table 5).

All the parameters related to bulb and bulblet production did not show significant variations among the treatment combinations except bulblet numbers/ plant (Table 6). Large-sized bulbs in combination with removal of spikes produced the maximum number of bulblets/plant (3.18) whereas small sized bulb without removing of spikes produced very poor bulblets/plant (1.10).

CONCLUSION

Large-sized lilium bulbs and removal of spikes independently and in combination performed very excellent with regard to quality lilium bulb production as well as flower production. Medium-sized and small-sized lilium bulbs combined with removal of spikes also showed better results compared to without removal of spike. Removal of spikes may be recommended for producing quality bulb as well as

flower production of lilium using large, medium and small sized bulbs.

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