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Effect of planting time and nitrogen levels on growth, flowering and bulb production of lilium cv. blackout

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Abstract
An experiment was conducted at Horticulture farm, Nagaland University, Medziphema Campus, School of Agricultural Sciences and Rural Development, Nagaland to standardize the planting time and nitrogen requirement in lilium cv. Blackout. Three dates of planting (30th October, 15th November and 30th November) were taken and four levels of nitrogen (0, 100, 200 and 300 kg/ha) were applied in this experiment, and it was laid out in Factorial RBD with three replications. The results indicated that 30th October planting date and application of nitrogen @ 300kg/ha exhibited superior growth characters except for number of leaves which was recorded maximum in 15th November planting. The days required for bud emergence, bud colour visibility and first floret opening were reduced in 30th November planting while the highest dose of nitrogen delayed the days required for the same characters. The floral attributes *viz.* length and diameter of flowering shoot, length and diameter of flower bud, width of flower, number of flower buds per shoot, as well as bulb characters *viz.* weight and diameter of bulb, weight of bulblets and number of bulblets per bulb were found to be greatest with earlier planting and higher doses of nitrogen.

Keywords: Planting time, nitrogen, growth, flowering, bulb, lilium

Introduction
The genus Lilium (Lilium spp.) is a herbaceous flowering plant normally growing from bulbs has 110 species belonged to Liliaceae family (Vinodh *et al.* 2016) [10]. Lilies are wonderful ornamental plants with varied uses, grown in border, beds, pots and are excellent cut flowers of magneficient appearance & beautiful colours. (Swetha *et al.* 2018) [8]. Lilies are very useful flowering plants which can be planted in any location as they do well in the bed or border with other perennial (Singh, 2006) [7]. Agro techniques like planting time and nutrition play an important role in the production of flowers. The growth, flowering and bulb production of lilium are greatly influenced by nutrient supply, particularly nitrogen. Among the various factors influencing the growth and yield of flowers and bulbs of lilium, timely planting is of great importance. Planting time is considered to be one of the non-monetary inputs because a crop planted at the optimum time helps to make the best utilization of all the factors. Planting at optimum time coincides with suitable environment at all growth stages of the crop and therefore leads to higher and better quality yield. The North East region, particularly Nagaland offers conducive condition for the cultivation of this economically viable crop. However, not much work has been done in the region to standardize the planting time and nitrogen requirement of Lilium. Keeping in view the acceptability of lilium cv. Blackout in domestic and global market, it was considered pertinent to conduct the present investigation.

Materials and Methods
To standardize the planting time and nitrogen requirement in lilium cv. Blackout, an experiment was carried out at Horticulture farm, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland. The location is situated at 25°45'45" N latitude and 95°53'04"E longitude at an elevation of 305.8m above MSL bearing a sub-tropical climate. The treatments included three dates of planting (P_1: 30th October, P_2: 15th November and P_3: 30th November) and four levels of nitrogen (N_0: 0 kg/ha, N_1: 100 kg/ha, N_2: 200 kg/ha and N_3: 300 kg/ha). The experiment was laid out in Factorial RBD with three replications. Standard package of practice for lilium was followed for raising the crop. At the time of planting the bulbs, a standard dose of phosphorus (50 Kg/ha) and potassium (300 Kg/ha) were applied along with various levels of nitrogen (0, 10, 20 and 30

g/m2). Nitrogen was applied in 3 split doses. First dose of nitrogen was applied at the time of planting and the second and third doses were applied at 40 and 60 days after planting respectively. The observations were recorded for growth, flowering and bulb characters from five randomly selected plants for each replication under all the treatment combinations. All the data collected was statistically analysed as per the analysis of variance method (Panse and Sukhatme, 1978).

Results and Discussion

Growth characters

There was varying influence by the different planting dates and nitrogen levels studied. The data regarding the influence of planting time and nitrogen levels on the growth characters in Lilium cv. Blackout are depicted in Table 1. The earlier planting (30th Oct.) increased the plant height, plant spread and leaf area significantly while the numbers of leaves is recorded to be highest in 15th Nov. planting. Plant height was higher in 30th October planting and a decreasing trend was recorded in later plantings. Better vegetative growth was obtained by planting early which may be due to gaining the benefit of favourable temperatures. This might be attributed to the fact that during this period, the day and night temperature was favourable for the synthesis of growth stimulating compounds, absorption of nutrients, cell division and cell elongation which might have resulted in vigorous growth and higher plant height (Meena *et al.,* 2018) [3]. Vinodh *et al.* (2016) [10] reported that planting of Asiatic hybrid lilium cultivars in summer influenced all the growth parameters and mentioned that height temperature and humidity were probably responsible for the increased plant height and more number of leaves per plant. According to Meena *et al.* (2018) [3], more leaves per plant in tuberose under earlier sown condition might be due to the fact that the crop received congenial climate and days with longer sunny hours during early stage of growth which might have resulted in higher rate of photosynthesis, which ultimately reflected for increased number of leaves. The highest dose of nitrogen (30g/m^2) applied proved its superiority over the other doses for plant height, plants spread, number of leaves and leaf area. Similarly, Verma *et al.* (2019) [9] reported that maximum plant height and plant spread were obtained in iris at higher doses of nitrogen. Nitrogen had an encouraging effect on plant height as it forms an important constituent of protein, which is essential for the formation of protoplasm thus affecting the cell division and cell enlargement and ultimately leads to better vegetative growth (Sheoran *et al.*, 2015) [6]. Parallel findings to these results have been demonstrated in Asiatic lily cv. Tressor (Swetha *et al.*, 2018) [8] and in tuberose (Khalaj and Edrisi, 2012) [1]. An increase in number of leaves with the application of higer doses of nitrogen might be due to the fact that nitrogen is an essential part of nucleic acid which plays a vital role in promoting the plant growth and number of leaves (Patel *et al.*, 2006). Increase in leaf area with higher doses of nitrogen application might be due to the fact that, increased photosynthetic ability had positive influence on growth parameters (Rathore and Singh, 2013). The interaction between planting time and various nitrogen doses did not show significant variations on the vegetative growth of the plants.

Flowering attributes

The data regarding the influence of planting time and nitrogen levels on the flowering attributes in Lilium cv. Blackout are depicted in Table 2. On 30th November planting, the days required for bud emergence, bud colour visibility and first floret opening were reduced. The length and diameter of flowering shoot were recorded maximum in early planting (30th October). These results are in accordance with the findings of Prashanta *et al.* (2016) [4] who reported that the differences in flower characters of tuberose might be due to favorable climatic conditions like temperature, high relative humidity and long day sunshine hours in early plantings in the experimental area which induced better vegetative growth followed by induction of early flowering, improved florets number per spike, floret length and spike length while unfavorable climatic conditions *viz*., low temperature delayed flowering, reduced florets number per spike, floret length and spike length. The flowering attributes *viz.* bud length, bud diameter and flower width were found to be highest with early planting. Planting on 30th October also resulted in maximum number of buds per shoot. Thokchom and Singh (2015) while working on tuberose also observed more number of spikes and better spike length in early plantings. The increase in number of spikes per plant and better spike length in early plantings could be attributed to early sprouting and better vegetative growth due to the fact that the plants experienced optimum temperature and humidity during their growth period (Vaid *et al.*, 2019). The highest dose of nitrogen (30g/m^2) delayed the days required for bud emergence, bud colour visibility and first floret opening. Similarly, Verma *et al.* (2019) [9] reported that application of increasing levels of nitrogen in iris delayed days taken for initiation of flower buds as well as days taken for first flower opening which might be due to the reason that higher doses of nitrogen may have caused excessive vegetative growth adversely affecting days taken to flower. The length and diameter of flowering shoot were greatest with higher dose of nitrogen (30 gm/m^2). Bud length, bud diameter and flower width showed a positive increase with the increasing levels of nitrogen application. The number of buds per shoot was recorded maximum with the highest level of nitrogen application. This finding is in agreement with that of Swetha *et al.* (2018) [8] who reported that a significant increase of flowering shoots per plot was induced from an increase in nitrogen. The maximum number of flowering shoots per plot with application of higher nitrogen might be due to the reason that increased flower bearing portion with respect to number of florets on the spike consequently leads to maximum flower yield (Sheoran *et al.*, 2015) [6]. Similar results were also expressed by Khalaj and Edrisi (2012) [1] in tuberose, Regar *et al.* (2016) in gladiolus and Verma *et al.* (2019) [9] in iris who reported that maximum number of florets per spike obtained with the higher doses of nitrogen application might be the fact that, applied nitrogen had significantly increased the growth parameters and synthesized more plant metabolites ultimately leading to increased flower production. The interaction of planting time and nitrogen doses showed significant variations on the days taken for bud emergence and first floret opening. The minimum number of days (15.93 days) to bud emergence and the minimum number of days (36.47 days) for opening first floret were observed in P_3N_0. Whereas the maximum number of days for bud emergence (30.40 days) was exhibited in P_1N_3 and maximum number of days for opening first floret (51.87 days) was observed in P_1N_1. The floral attributes such as length and diameter of flowering shoot and flower bud were found greatest in those planted on the earliest date with the highest dose of nitrogen. Planting on 30th October with the highest dose of nitrogen proved its superiority over other treatments in producing the greatest flower width and number of flower buds per shoot. However, the interaction between planting time and nitrogen doses failed to reach the level of significance for all the flower attributes except for flower bud diameter. The maximum flower bud diameter (1.91cm) was found in P_2N_2 and minimum (1.78cm) was noted in P_2N_o.

Bulb characters

The data regarding the influence of planting time and nitrogen levels on the bulb characters in Lilium cv. Blackout are depicted in Table 3. Significant variations were observed on the bulb and bulblet characteristic due to different planting time. The weight and diameter for bulb as well as the number and weight for bulblets per bulb were observed to be maximum in 30th October planting. The results are in accordance with the results of Vaid *et al.* (2019) and Thokchom and Singh (2015) who recorded diameter of largest bulb in early date of planting in tuberose. The highest dose of nitrogen fertilizer maintained its superiority over all the bulb characters *viz.* weight and diameter for bulb as well as the number and weight for bulblets per bulb. Sheoran *et al.*(2015) [6] reported that there was a continuous increase in the number of bulbs/plant with every increase in N doses in tuberose which might be due to the fact that nitrogen helped in increasing more amount of assimilates that are needed for improvement in number of bulbs. Vedavathi *et al.*(2014) also reported that the plants supplied with higher dose of nitrogen produced maximum number of bulblets per plant due to the reason that plants grow more vigorously and produce more metabolites which might result in more bulblets per plant. According to Swetha *et al.* (2018) [8], the plants of Asiatic lily cv. Tressor supplied with higher doses of nitrogen produced highest bulb weight which miht be due to the reason that, when optimum nitrogen was supplied to a plant, there was greater translocation of photosynthetic material from leaves to bulbs resulting in maximum bulb weight. Similar observations were noted by khalaj and Edrisi (2012) [1] in tuberose. However, the interaction between planting time and levels of nitrogen failed to evoke any significant response on the bulb and bulblet characteristic of lilium.

Table 1: Influence of planting time and levels of nitrogen on the growth characters in *Lilium* cv. Blackout.

Treatment	Plant height (cm)		Plant spread (cm)		Number of leaves per plant	Leaf area (cm^2)
	At bud emergence stage	At colour break stage of bud	At bud emergence stage	At colour break stage of bud		
Planting time (P)						
P_1 (30th Oct)	19.24	42.92	8.82	10.12	104.13	5.50
P_2 (15th Nov)	16.16	36.86	6.71	9.77	110.07	4.61
P_3 (30th Nov)	13.55	33.09	5.83	9.42	100.03	4.18
Sem±	0.25	0.68	0.14	0.07	1.98	0.12
CD at 5%	0.74	1.98	0.42	0.22	5.79	0.35
Nitrogen (N)						
N_0 (0 g/m^2)	14.63	33.88	5.94	8.49	98.38	3.99
N_1 (10 g/m^2)	16.00	36.50	6.70	9.52	101.73	4.64
N_2 (20 g/m^2)	16.77	38.64	7.19	10.04	105.89	5.04
N_3 (30 g/m^2)	17.86	41.48	7.94	11.04	112.98	5.37
Sem±	0.29	0.78	0.16	0.09	2.29	0.14
CD at 5%	0.86	2.29	0.48	0.25	6.68	0.40
Interaction (P X N)						
P_1N_0	17.18	38.56	7.46	9.04	96.47	4.60
P_1N_1	18.77	42.75	8.02	9.72	102.53	5.45
P_1N_2	20.05	43.62	8.45	10.48	108.33	5.82
P_1N_3	20.96	46.76	9.20	11.24	109.20	6.13
P_2N_0	14.79	32.48	5.53	8.46	100.07	3.88
P_2N_1	16.33	34.31	6.26	9.58	103.73	4.48
P_2N_2	16.45	38.95	7.07	9.89	108.67	5.08
P_2N_3	17.07	41.70	7.99	11.16	127.80	5.01
P_3N_0	11.92	30.58	4.82	7.96	98.60	3.51
P_3N_1	12.89	32.43	5.81	9.25	98.93	4.00
P_3N_2	13.82	33.38	6.04	9.76	100.67	4.23
P_3N_3	15.55	35.99	6.65	10.71	101.93	4.97
Sem±	0.51	1.36	0.29	*0.15*	*3.97*	*0.24*
CD at 5%	NS	NS	*NS*	NS	NS	NS

Table 2: Influence of planting time and levels of nitrogen on the flowering attributes of lilium cv. Blackout

Treatment	Days required for emergence of bud (Days)	Days required to colour visibility of buds (Days)	Days to opening of first floret (Days)	Length of flowering shoot (cm)	Diameter of flowering shoot (cm)	Flower bud length (cm)	Flower bud diameter (cm)	Flower width(cm)	Number of flower buds per shoot
Planting time(P)									
P_1 (30th Oct)	28.82	36.95	49.72	5.86	0.44	7.31	1.88	13.75	4.54
P_2 (15th Nov)	24.98	24.62	37.98	4.74	0.42	7.22	1.84	13.59	4.03
P_3 (30th Nov)	18.33	23.87	37.90	3.76	0.42	7.19	1.81	13.35	3.07
Sem±	0.16	0.45	0.35	0.11	0.00	0.04	0.01	0.05	0.09
CD at 5%	0.46	1.31	1.02	0.33	0.01	0.12	0.04	0.15	0.28
Nitrogen (N)									
N_0(0 g/m^2)	20.04	26.20	40.44	3.36	0.40	6.98	1.82	12.81	2.61

N_1(10 g/m^2)	23.69	28.53	42.42	4.36	0.42	7.22	1.83	13.53	3.40
N_2(20 g/m^2)	24.82	29.16	42.76	5.67	0.44	7.31	1.86	13.84	4.93
N_3(30 g/m^2)	27.62	30.02	41.84	5.76	0.45	7.45	1.88	14.09	4.57
Sem±	0.18	0.52	0.40	0.13	0.00	0.05	0.02	0.06	0.11
CD at 5%	0.54	1.51	1.18	0.38	0.01	0.13	0.04	0.17	0.32
Interaction (P X N)									
P_1N_0	26.67	32.67	47.53	4.41	0.42	7.06	1.87	13.05	3.07
P_1N_1	29.00	36.93	51.87	5.16	0.43	7.31	1.78	13.73	4.10
P_1N_2	29.20	38.40	51.13	6.89	0.45	7.32	1.87	13.97	5.67
P_1N_3	30.40	39.80	48.33	6.97	0.46	7.55	1.99	14.27	5.33
P_2N_0	17.53	23.67	37.33	3.19	0.38	6.90	1.78	12.99	2.73
P_2N_1	25.67	24.67	37.67	4.43	0.42	7.20	1.82	13.53	3.53
P_2N_2	28.33	24.87	38.07	5.60	0.44	7.31	1.91	13.76	5.13
P_2N_3	28.40	25.27	38.87	5.74	0.45	7.45	1.85	14.07	4.70
P_3N_0	15.93	22.27	36.47	2.48	0.40	6.96	1.79	12.37	2.03
P_3N_1	16.40	24.00	37.73	3.49	0.41	7.15	1.88	13.33	2.57
P_3N_2	16.93	24.20	39.07	4.52	0.42	7.28	1.79	13.79	4.00
P_3N_3	24.07	25.00	38.33	4.56	0.43	7.36	1.79	13.91	3.67
Sem±	*0.32*	*0.90*	*0.70*	*0.23*	*0.01*	*0.08*	*0.03*	*0.10*	*0.19*
CD at 5%	0.93	NS	2.05	NS	NS	NS	0.07	NS	NS

Table 3: Bulb characters as regulated by different planting times and levels of nitrogen in lilium cv. Blackout

Treatment	Weight of bulb (g)	Diameter of bulb (cm)	Number of bulblets per bulb	Weight of bulblets per bulb (g)
Planting time(P)				
P_1 (30th October)	34.75	4.29	2.87	3.40
P_2 (15th November)	33.42	4.09	2.33	2.15
P_3 (30th November)	31.41	3.99	1.48	1.42
Sem±	0.63	0.05	0.21	0.19
CD at 5%	1.85	0.15	0.60	0.56
Nitrogen (N)				
N_0 (0 g/m^2)	29.29	3.83	0.91	1.11
N_1 (10 g/m^2)	31.80	4.00	1.82	2.01
N_2 (20 g/m^2)	33.97	4.19	2.67	2.80
N_3 (30g/m^2)	37.73	4.48	3.51	3.37
Sem±	0.73	0.06	0.24	0.22
CD at 5%	2.14	0.17	0.69	0.65
Interaction (P X N)				
P_1N_0	30.21	3.92	1.73	2.37
P_1N_1	31.77	4.19	2.07	2.78
P_1N_2	36.67	4.37	3.33	4.00
P_1N_3	40.36	4.67	4.33	4.46
P_2N_0	29.69	3.73	0.67	0.63
P_2N_1	32.34	3.95	2.00	1.89
P_2N_2	33.67	4.14	2.87	2.65
P_2N_3	37.98	4.55	3.80	3.43
P_3N_0	27.96	3.84	0.33	0.33
P_3N_1	31.30	3.86	1.40	1.37
P_3N_2	31.56	4.05	1.80	1.74
P_3N_3	34.84	4.21	2.40	2.23
Sem±	1.27	0.10	0.41	0.38
CD at 5%	NS	NS	NS	NS

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