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Pooja Pahare
Department of floriculture and landscaping {OUAT}
Bhubaneswar, Orissa, India

Sulekha Pahare
Department of floriculture and landscaping {OUAT}
Bhubaneswar, Orissa, India

Sanjay Kumar Jangde
Department of Horticulture, College of Agriculture {RVSKV}
Indore, Madhya Pradesh, India

Corresponding Author:
Pooja Pahare
Department of floriculture and landscaping {OUAT}
Bhubaneswar, Orissa, India

Effect of NPK on plant growth and quality of *Lilium* (L. A. hybrid Nashville) under polyhouse and open condition

Pooja Pahare, Sulekha Pahare and Sanjay Kumar Jangde

Abstract
The investigation entitled the "Effect of NPK on plant growth and quality of *Lilium* L.A. hybrid (Nashville) under polyhouse & open condition" A field trial was conducted in the Department of Floriculture and Landscaping, RKVY project at Biotechnology-cum-Tissue Culture Centre, College of Agriculture, OUAT, Bhubaneswar 2015-2016. The experiment was laid out in R.B.D with three replication and seven treatments T_1 (Control (FYM mixed to the soil @ $1m^3$ per 100 m^2 area), T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week),T_3 (Foliar application of NPK 10:10:10 @ 5g/l twice a week), T_4 (Foliar application of NPK 10:10:10 @ 5g/l once a week),T_5 (Soil drenching with NPK 10:10:10 @ 5g/l thrice a week),T_6 (Soil drenching with NPK 10:10:10 @ 5g/l twice a week), T_7 (Soil drenching with NPK 10:10:10 @ 5g/l once a week), Study shows T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) significant effect on growth and quality of *Lilium* in polyhouse and open condition. In polyhouse T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) was found most suitable in relation to Plant height (34.29cm), Number of leaves per plant (64.68),Plant spread(14.67cm), Spike length (39.73cm),Spike diameter (4.95mm), Flower length (139.30mm), Flower diameter (133.62mm), Bud length (106.21mm) Bud diameter (5.11mm), Days to bud emergence (48.33 days), Number of bud per plant (3.66), Vase life (14.67days) and In open condition Plant height (22.15cm),Number of leaves per plant (55.36), Plant spread (12.68cm),Spike length (29.98cm), Spike diameter (4.14mm),Flower length (145.57mm), Flower diameter (135.36 mm),Bud length (17.45 mm), Bud diameter (2.67mm), Days to bud emergence (38.36 days), Number of bud per plant (2.33),Vase life (10days), Polyhouse provide better growing condition to asiatic lilies with the larger, trumpet-flowering Easter lily, *Lilium longiflorum* (hybrid Nashville) than open condition under the agro-climatic conditions of Odisha.

Keywords: Lilium, NPK, varieties/hybrids, growth and polyhouse

Introduction
Lilium is one of the most important genera of cut flower and pot plant production. It has always played a special role in the garden design due to the great number of species that can be adapted to many environments of garden. Moreover, the flower colors, the scents and the cultivar choice can guarantee a continuous flowering from spring to autumn. The use of *Lilium* cultivars for urban decoration can also be of great interest (Grassotti *et al.*, 2011) [3]. Lilies occupy the fourth position after rose, tulip and spray chrysanthemum for total sales and are considered one of the leading geophytes. There exist two groups, viz. Asiatic and Oriental hybrids. Lily is the common English name for flowering plants of the *Lilium* genus and they are extensively being grown in greenhouses as cut favoured in global flower trade due to wider choice of growing periods, array of colours and everlasting quality. (Sindhu and Pathania, 2003) [8] *Lilium* (members of which are true lilies) is a genus of herbaceous flowering plants growing from bulbs, all with large prominent flowers. Lilies are a group of flowering plants which are important in culture and literature in much of the world. Most species are native to the temperate northern hemisphere, though their range extends into the northern subtropics. Many other plants have "lily" in their common name but are not related to true lilies. The flowers are large, often fragrant, and come in a range of colours including whites, yellows, oranges, pinks, reds and purples. Markings include spots and brush strokes. The plants are late spring- or summer-flowering. Cut flowers have complex nature that requires special attention in developing handling technique, concentration of sugar and other substances for pulsing and bud opening of cut flower Use of floral preservatives at all stages of flower handling and marketing known to improve the flower quality,

longevity and better consumer acceptability. Prolonging the vase-life depends on water balance and retardation of petal senescence which can be achieved by the use of sucrose, nutrients and certain chemicals (Beura and Singh, 2002) [2]. Nitrogen (N) has the quickest most pronounced effect on the plant growth that ultimately leads to good yield nitrogen is the constituent of different amino acids, proteins and chlorophyll which is essential for good growth of plant. Nitrogen deficiency can be characterized by stunted growth; flowering and fruiting are also reduced. (Bankar *et al*. 1990) [1] Phosphorus (P) is one of the essential elements for plant growth and development. The phosphorus plays on important role in maintaining quality of the flower. It is essentially required for the proper root growth the phosphorus should the applied as the basal dose. Potassium (K) is needed for healthy roots and stems, and aids plants with the respiration process. It is sometimes called potash.

Materials and Methods

The present experiment was conducted in the Department of Floriculture and Landscaping, RKVY project at Biotechnology-cum-Tissue Culture Centre, of College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar during the year 2016. Crop lilum asiatic hybrid Nashville. Disease free healthy and fungicide (bavistin 2g/l of water for 30 mintes) treated bulbs are sown in the polyhouse field. After sowing the bulbs were pressed gently and given light irrigation. Planting was done on the 2nd October, 2016. Plot with dimension 48m^2 were prepared at a spacing of 40X40cm. plant nutrient (Nitrogen, Phosphorus and Potash) each at three concentrations *viz*, (10:10:10) and control ((FYM mixed to the soil @ 1m ^{3}per 100 m^2 area) were allocated in randomized block design with three replication with six bulbs per replication. The nutrient was applied in form of foliar spray and soil drenching, once at 30 days after planting (DAS) bulbs & again after 30 days of first application. Cultural operations like hoeing was manually taken at 30 days interval till the crop in the field. Weeding was done at monthly interval. The experimental plot was kept weed free by manual weeding till the crop in the field were followed as per standard cultural practices. Data on different growth, flowering and yield parameters were recorded on two randomly taken competitive plants for all the observations, *i.e.* plant height, number of functional leaves per plant, Plant spread, Days to bud emergence, Number of bud per plant, Flower Spike length, Flower Spike diameter, Flower diameter, Bud length, Bud diameter, Flower length, First flower senescence and Vase life of flower were recorded at 30 days intervals from planting to flower buds.

Result and Discussion

Growth characters

The data on plant height is presented in (Table 1 a, b). A perusal of data in Table 1a shows that maximum plant height was recorded In Polyhouse maximum plant height (11.21cm) at 30 DAP, was recorded with treatment reported that the 150 kg/ha nitrogen, 100 kg/ha phosphorus and 80 kg/ha potassium were found suitable doses for the commercial cultivation of African marigold western plain. Birade *et al.* (2003) reported that the effects of graded levels of NPK (00:00:00; 100:75:50; 150:100:75; and 200:125:100 kg/ha.) on the growth, quality and flower production of China aster. Were found to be beneficial for profuse growth, quality and flower production of China aster. Devi *et al.* (2010) reported that the effect of different nitrogen levels resulted in superior growth, flowering and yield of bulbs. Nitrogen at 220 kg/ha gave maximum number of leaves' plant, number of tillers/plant, plant height, number of spikes/plant, spike length, rachis length, number of florets/spike, duration of flowering, number of bulbs/clump and weight of bulbs/clump and was at par with that of treatment 200 kg N/ha. Gani *et al.* (2007) reported that the three levels of each N (0, 50 and 80 Kg/ha) and P2O5 (0. 40 and 60 Kg/ha) to find out the optimum doses of N and P205 for better growth and flower production of dahlia cv. "Kenya yellow". Kadu *et al.* (2009) reported that the effect of nitrogen, phosphorus and potassium on growth, flowering and bulb production in tuberose cv. Single, an experiments were conducted in two season to study the effect of four levels, each of nitrogen (0,100,200 and 300 kg/ha) and phosphorus (0.100.200 and 300 kg/ha-1) with a fixed levels of potassium @ l00kg/ha-1 in tuberose. Kazemi *et al.* (2011) [5] reported that several documents based on using different treatments in postharvest for delaying senescence and enhancing cut flower vase life such as *Eustoma grandiflorum*. Kishore *et al.* (2010) [6] reported that the effect of different levels of nitrogen, phosphorus and potassium on growth and flowering of African marigold cv. Pusha Narangi. Khalighi *et al*. (2007) reported that the effects of N, P and K fertilizer ratio on the bulb quality and yield of tulip. Nair *et al*. (2000) reported that the P. tuberosa cv. Double plants were treated with varying NPK rates (15 : 30 : 15, 30: 30 : 15, 15 : 60 : 15, 30 : 60 ; 15, 15 : 90 : 15. 30 : 90 : 15g/m2) 1997-98 to standardize the P and N requirements for the optimum growth and yield of flowers and bulbs of tuberose. Jamshidi *et al.* (2012) reported that that a flower's vase life when held in a solution containing 1 mM SA and 2 mM MA was significantly higher than that of the control treatments.

Memon *et al.*, (2013) [7] concluded that potassium nitrate solution upto 3% concentration as presoaking treatment and foliar application on gladiolus plants positively influenced almost all the parameters including extended vase life of out flowers. Niedziela *et al.* (2008) reported that effect of N.P and K resulted in stem bulb fresh weight, stem plus leaf fresh weight, number of flower and stem root fresh weight, And only when all three nutrients were omitted in lily plant. Singh and Kumar (2010) [9] studied the effect of nitrogen with combination of phosphorus and potassium on growth, flower yield and quality of four indigenous cut flower rose varieties namely Pusa Gaurav. Growth and flower yield was increased significantly with application of optimum level of nitrogen in combination with phosphorus and potassium (9 g N+8 g P_2O_5+8 g K_2O/m^2/week) through top dressings (1,100,200and 300kg/ha) and recorded highest plant height. Singh *et al.* (2008) reported that effect of four level each of nitrogen (100.15030 and 250kg/ha) and potassium (120,180,240 and 300kg/ha) with a fixed level of phosphorus@50kg/'ha in Asiatic hybrid lily, the NPK combination treatment of 250+50+300kg/ha. Respectively showed highest length and diameter of flowering shoot, number of leaves per shoot, diameter and of flower buds per shoot. As the combination of NPK treatment were given 45 days after planting of bulbs. There was significant effect on plant height, it is well known that chemical fertilizer could enhance plant growth due to the role of nitrogen in nucleic acid and protein synthesis and phosphorus as an essential component of the energy compounds (ATP and ADP) and potassium as an activator of many enzymes (Helgi and Rolfe, 2005) [4] in the apical meristem plants have meristic tissue in several location, both roots and shoots, cell division and cell elongation in the apical meristem is called primary growth and result in an increase in

plant height. The combination of NPK increase intensity of cell division and cell elongation, Increasing shoot length makes the plant taller, thus allowing it better access to sunlight for photosynthesis In Polyhouse maximum plant height (34.29 cm) at 60 DAP, was recorded with treatment T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) closely followed by (33.91cm) T_3 (Foliar application of NPK 10:10:10 @ 5g/l twice a week) and the minimum (27.84 cm) was recorded with T_1 (Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area). In open condition maximum plant height (12.21cm) at 30 DAP, was recorded with treatment T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) closely followed by (8.85cm) T_3 (Foliar application of NPK 10:10:10 @ 5g/l twice a week) and the minimum (5.31cm) was recorded with T_1 (Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area). In open condition maximum plant height (22.15 cm) at 60 DAP, was recorded with treatment T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) closely followed by (19.86 cm) T3 (Foliar application of NPK 10:10:10 @ 5g/l twice a week) and the minimum (16.18 cm) was recorded withT_1 (Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area. Polyhouse was found to be better for plant growth (height) of *Lilium* under of Odisha conditions.

Flowering characters

A perusal of data in Table b shows that maximum flowering. In polyhouse flower length (139.30mm),, flower diameter (133.62mm), bud length (106.21mm), bud diameter (5.11mm), first flower senescence (14.67 days), number of bud per plant (3.66), vase life of *Lilium* (14.67 days), of *Lilium* was maximum in the treatment T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week).In open condition flower length (145.57 mm) flower diameter(141.41mm), bud length (17.45 mm), bud diameter (2.67mm), days to bud emergence (38.36 days), first flower senescence (10.00 days), number of bud per plant (2.33), vase life (10.00 days), of *Lilium* was maximum in the treatment T_2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) Foliar application of NPK must have resulted in higher translocation of carbohydrates from vegetative parts to the reproductive parts which quality may have resulted in better development of flower size. Followed by treatment T_3 (Foliar application of NPK 10:10:10 @ 5g/l twice a week) (129.57 mm) and the minimum (120.43 mm) was recorded with T_1 (Control (FYM mixed to the soil @ 1cum per 100 m^2 area) Similar trend was observed at subsequent growth stages also. As the combination of NPK treatment was given to the planting of bulbs. There was significant effect on spike length due to the role of nitrogen in nucleic acid and protein synthesis and phosphorus as an essential component of the energy compounds (ATP and ADP) and potassium as an activator of many enzymes (Helgi and Rolfe, 2005 [4]. Polyhouse was found to be better for flower quality (Flower length) of *Lilium* under Odisha conditions. The results of the study revealed that application of T2 (Foliar application of NPK 10:10:10 @ 5g/l thrice a week) recorded significantly higher.

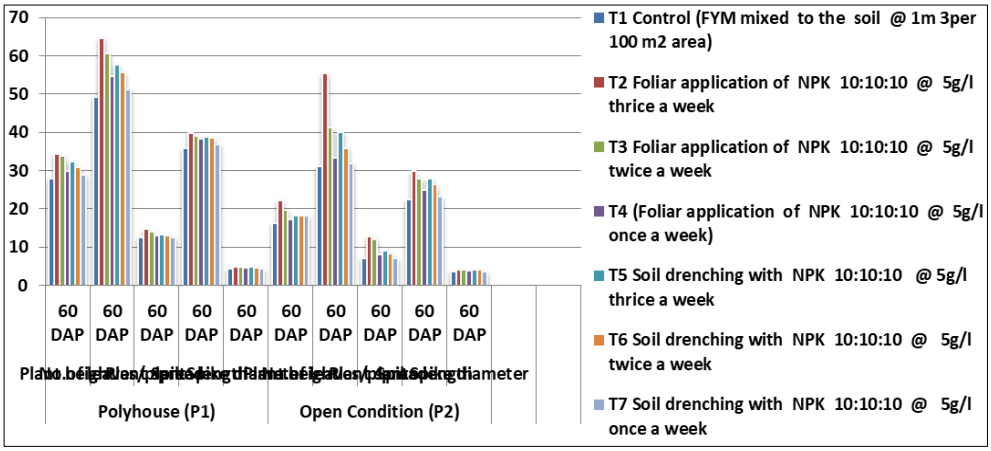

Fig 1: Effect of foliar application and fertigation of NPK on Lilium and comparison between polyhouse P1 and open condition P2

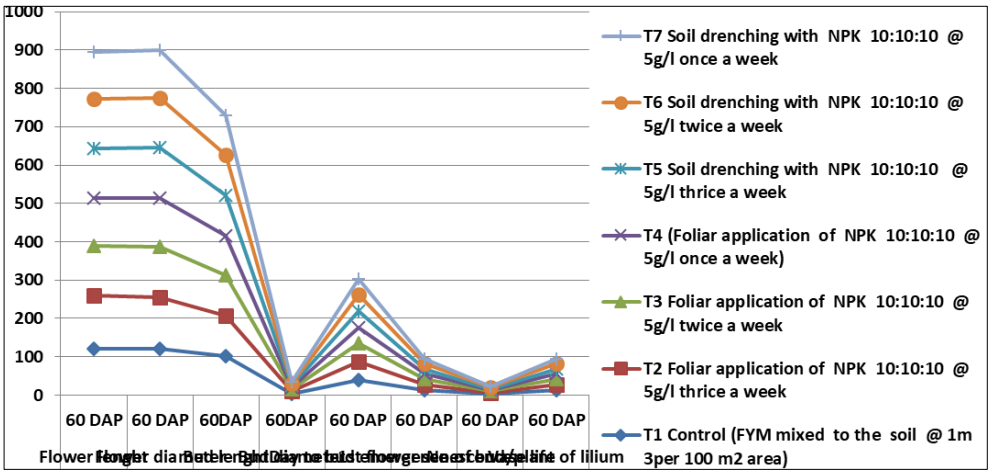

Fig 2: Effect of foliar application and fertigation of NPK on *Lilium* polyhouse P1

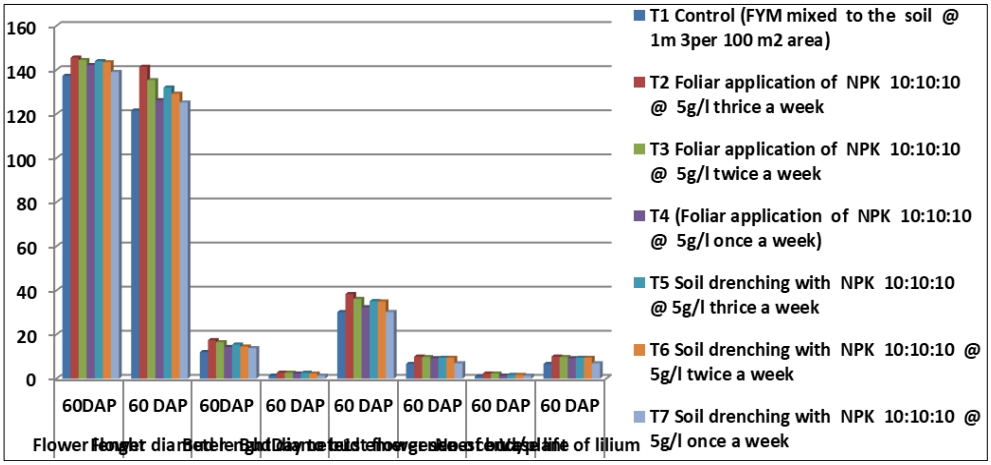

Fig 3: Effect of foliar application and fertigation of NPK on *Lilium* open condition P2

Table 1: Effect of foliar application and fertigation of NPK on *Lilium* and comparison between polyhouse P1 and open condition P2 (*Growth Characters*)

Treatments		Polyhouse (P1)					Open Condition (P2)				
		Plant height	No. of leaves/plant	Plant spread	Spike length	Spike diameter	Plant height	No. of leaves/plant	Plant spread	Spike length	Spike diameter
T_1	Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area)	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP
		27.84	49.27	12.45	35.75	4.33	16.18	31.15	7.00	22.58	3.54
T2	Foliar application of NPK 10:10:10 @ 5g/l thrice a week	34.29	64.68	14.67	39.73	4.95	22.15	55.36	12.68	29.98	4.14
T_3	Foliar application of NPK 10:10:10 @ 5g/l twice a week	33.91	60.65	14.00	38.96	4.88	19.86	41.20	12.00	27.98	4.04
T_4	(Foliar application of NPK 10:10:10 @ 5g/l once a week)	29.82	54.68	12.97	38.44	4.56	17.25	33.36	8.16	24.94	3.86
T_5	Soil drenching with NPK 10:10:10 @ 5g/l thrice a week	32.31	57.67	13.21	38.83	4.85	18.36	40.15	9.15	27.84	4.03
T_6	Soil drenching with NPK 10:10:10 @ 5g/l twice a week	30.77	55.69	13.03	38.66	4.69	18.15	35.87	8.36	26.37	4.02
T_7	Soil drenching with NPK 10:10:10 @ 5g/l once a week	28.92	51.15	12.57	36.86	4.50	18.15	32.00	7.21	23.29	3.74
	F- test	S	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.486	0.746	0.614	0.971	0.147	0.542	0.626	0.688	2.360	0.409
	C. D. (P = 0.05)	1.003	1.540	1.267	2.004	0.303	1.118	1.292	1.420	4.872	0.844

Table 2: Effect of foliar application and fertigation of NPK on Lilium and comparison between polyhouse P1 and open condition P2 (flowering Characters)

	Treatments	Polyhouse (P1)							
		Flower lenght	Flower diameter	Bud lenght	Bud diameter	Day to bud emergence	1st flower senescence	No. of bud/plant	Vase life of lilium
		60 DAP	60 DAP	60DAP	60DAP	60 DAP	60 DAP	60 DAP	60 DAP
T_1	Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area)	120.43	121.53	101.86	4.42	39.35	12.77	2.77	12.77
T2	Foliar application of NPK 10:10:10 @ 5g/l thrice a week	139.30	133.62	106.21	5.11	48.33	14.67	3.66	14.67
T_3	Foliar application of NPK 10:10:10 @ 5g/l twice a week	129.57	132.25	105.06	4.89	47.33	14.22	3.33	14.22
T_4	(Foliar application of NPK 10:10:10 @ 5g/l once a week)	125.36	127.16	103.60	4.78	40.21	13.22	2.98	13.22
T_5	Soil drenching with NPK 10:10:10 @ 5g/l thrice a week	129.14	131.79	104.87	4.89	43.66	13.44	3.22	13.44
T_6	Soil drenching with NPK 10:10:10 @ 5g/l twice a week	128.31	128.47	104.22	4.78	43.15	13.22	3.11	13.22
T_7	Soil drenching with NPK 10:10:10 @ 5g/l once a week	123.95	126.05	102.54	4.55	40.00	13.00	2.78	13.00
	F- test	S	S	NS	S	S	S	S	S
	S. Ed. (±)	4.812	3.101	3.415	0.177	0.725	0.541	0.209	0.541
	C. D. (P = 0.05)	9.932	6.401	7.048	0.366	1.497	1.117	0.431	1.117

Table 3: Effect of foliar application and fertigation of NPK on *Lilium* and comparison between polyhouse P1 and open condition P2

Treatments		Open Condition (P2)							
		Flower lenght	Flower diameter	Bud lenght	Bud diameter	Day to bud emergence	1st flower senescence	No. of bud/plant	Vase life of lilium
		60DAP	60 DAP	60DAP	60 DAP	60 DAP	60 DAP	60 DAP	60 DAP
T_1	Control (FYM mixed to the soil @ 1m ^{3}per 100 m^2 area)	137.31	121.57	12.06	1.33	30.18	6.67	1.00	6.67
T2	Foliar application of NPK 10:10:10 @ 5g/l thrice a week	145.57	141.41	17.45	2.67	38.36	10.00	2.33	10.00
T_3	Foliar application of NPK 10:10:10 @ 5g/l twice a week	144.46	135.36	16.51	2.67	36.15	9.79	2.33	9.79
T_4	(Foliar application of NPK 10:10:10 @ 5g/l once a week)	142.22	126.26	14.34	2.33	32.36	9.26	1.33	9.26
T_5	Soil drenching with NPK 10:10:10 @ 5g/l thrice a week	143.96	132.00	15.47	2.67	35.15	9.46	1.67	9.46
T_6	Soil drenching with NPK 10:10:10 @ 5g/l twice a week	143.45	129.19	14.56	2.33	35.00	9.45	1.67	9.45
T_7	Soil drenching with NPK 10:10:10 @ 5g/l once a week	139.08	125.23	13.84	1.33	30.21	6.96	1.33	6.96
	F- test	S	S	S	S	S	S	S	S
	S. Ed. (±)	1.951	4.026	1.974	0.437	0.577	0.945	0.393	0.945
	C. D. (P = 0.05)	4.028	8.309	4.074	0.903	1.192	1.950	0.811	1.950

Conclusion

Polyhouse was found to be better for flower quality (flower length) of *Lilium* under Odisha conditions. The results of the study it could be inferred that the effect of Foliar application of NPK 10:10:10 @ 5g/l thrice a week on growth, flowering lilium hybrid showed best response on applying Foliar application of NPK 10:10:10 @ 5g/l thrice a week foliar spray on plants, thus it could be concluded that the plants of lilium hybrid will show best growth, flowering and yield response under Polyhouse. Foliar application of NPK 10:10:10 @ 5g/l thrice a week foliar spray.

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