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RESEARCH PAPER

Effect of different sources and levels of potassium on yield, quality and nutrient uptake by lilium (*Lilium longiflorum*) grown under polyhouse condition

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Abstract : The polyhouse experiments were conducted at High-Tech Floriculture and Vegetable Project, College of Agriculture, Pune during 2007-09 to study the effect of different sources and levels of potassium fertilizers on yield, quality and nutrient uptake by lilium (*Lilium longiflorum*) grown under polyhouse conditions with 12 treatments was conducted in clay loam soil having pH 6.07. Application of potash (through sulphate of potash @ 200 mg plant^{-1} week^{-1}) to lilium flower crop (var. pollyanna) recorded maximum yield (7992 flower stalk per polyhouse) and net monetary returns (Rs. 77694 per polyhouse) which were at par with K^+ (through sulphate of potash @ 250 mg plant^{-1} week^{-1}) to lilium flower crop. Like number of leaves per plant, plant height, stem diameter, plant spread, number of flower stalk per m^2, number of flowers per stalk, vase life of flower was also recorded higher with treatment of sulphate of potash @ 200 mg plant^{-1} week^{-1} while other treatment of sulphate of potash @ 250 mg plant^{-1} week^{-1} followed it closely. The uptake of nitrogen, phosphorus and potassium was recorded maximum at recommended potash fertilizer practice *i.e.* @ 200 mg plant^{-1} week^{-1}. The nutrient status of the soil after the harvest was better when both sulphate of potash and @ 200 mg plant^{-1} week^{-1} were applied to lilium crop. Thus, it would be better to apply potash through sulphate of potash @ 200 mg plant^{-1} week^{-1} to lilium crop for higher productivity and profitability along with good quality as well as good soil condition.

Key Words : Sulphate of potash, Muriate of potash, Nitrate of potash, Lilium, Days after planting

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INTRODUCTION

Lilium (*Lilium longiflorum*) flower crop bulbs can be planted successfully upto 12 November 2007 at High-Tech Floriculture and Vegetable Project, College of Agriculture, Pune. For obtaining maximum yield of lilium nutrient management is very important, potassium plays an important role in maintaining the stalk length, yield, quality and vase life of flower crops, but in Maharashtra the study on use of potassium to lilium was very limited. The present polyhouse experiment study was undertaken to find the effect of different sources and levels of potassium fertilizers on yield, quality and nutrient uptake by lilium (*Lilium longiflorum*) grown under polyhouse conditions.

MATERIAL AND METHODS

A polyhouse experiment was conducted at High-Tech Floriculture and Vegetable Project, College of Agriculture, Pune during 2007-09 at fixed site. The experiment soil was clay

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loam in texture, medium in organic carbon (0.67%), medium in available nitrogen (236 kg/ha); high in available phosphorus (24 kg/ha) and very high in available potassium (388 kg/ha) with slightly acidic reaction (pH 6.07) initially. The experiment consisting 12 treatments was laid out in Factorial Completely Randomized Block Design with three replications. There were three sources of potassium *viz.*, muriate of potash (S_1), sulphate of potash (S_2) and nitrate of potash (S_3) with four levels *i.e.*, 75 per cent (L_1), 100 per cent (L_2), 125 per cent (L_3) and 150 per cent (L_4) K of recommended practice under polyhouse conditions. Farm yard manure (2.4 t per 5 R *i.e.* 0.05 ha.) was applied and mixed well with the soil. The lilium flower crop 'cv. Pollyanna' bulbs were transplanted at a spacing of 15 cm × 30 cm during second week of November and the observations were recorded at 15, 30, 45, 60 and 75 days after planting of lilium plants. The lilium flower crop harvested during second week of February. During the span of study, the morphological observations such as number of leaves per plant, plant height, average fresh and dry weight of flower, diameter of stem, number of buds per plant, vase life, number of flower per plant and number of flowered plant per sq.m. were recorded. Cost of cultivation and net monetary returns were based on prevailing market price of inputs (fixed capital for 4 months = Rs. 45746/-, working capital for 4 months = Rs. 66666/- and interest for 4 months = Rs. 29540/-) and produce of actual sticks of each treatment were taken in flower market of Pune at different five flower merchants and rate of flower was decided (by taking mean of all rates). The yield of lilium was not taken into account for the purpose, because it not reuse in cultivation in this area, whereas, B:C ratio was calculated by dividing net monetary return with cost of cultivation.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Morphological parameters :

Number of leaves per plant (No) :

The perusal of data revealed that there was no significant influence of sources of potassium on number of leaves up to 45 DAP (Table 1). However, at 60 DAP the application of K_2SO_4 recorded significantly higher number of leaves (72.2) over KCl and KNO_3 application, while at 75 DAP the application of K_2SO_4 recorded significantly higher number of leaves (76.4), over other two sources of potassium. There was no significant influence of levels of potassium on number of leaves of lilium upto 45 DAP and at 75 DAP. However, application of 200 mg K_2O per plant per week at 60 DAP (70.6) was statistically superior over level L_1 and L_4, and at par with level L_3. The interaction effects between sources and levels of potassium were found to be non-significant at all the crop growth stages. The numerical increase in number of leaves due to K_2SO_4 application might be due to combined supply of potassium and sulphur, both might have enhanced growth of lilium resulted in more number of leaves. These results are in close agreement with earlier findings of Bose and Jana (1978) and Tredar (2005).

Plant height (mm) :

As regards sources of potassium there was no significant influence on plant height of lilium at 15, 30 and 45 DAP (Table 1). However, at 60 and 75 DAP, the application of potassium through K_2SO_4 recorded significantly higher plant height of lilium (730 and 775 mm, respectively) over other two sources. The perusal of data (Table 1) revealed that there was no significant influences of levels of potassium on plant height of lilium up to 45 DAP. However, application of potassium @ 200 mg K_2O per plant per week at 60 DAP recorded significantly more height (724 mm) over 200 mg K_2O per plant per week. However it was on par with levels of L_1 and L_3.The interaction effect of sources and levels of potassium was non-significant at all crop growth stages. It was observed that the height of lilium plant increased with increase in the number of days after planting. It was observed that the levels of potassium fertilizers did not exert their influence on height of plants during the initial growth and development period. Once the period of establishment is over, change in the rate of growth would bring in difference among the sources of potassium fertilizers with respect to height of plants. Choi *et al.* (2004) and Tredar (2005) were also reported the nearly similar observations in lilium.

Diameter of plant stem (mm) :

The data clearly indicated that there was significant influence of sources of potassium on diameter of plant stem (Table 1). Amongst the different sources, the application of potassium through K_2SO_4 noticed significantly higher diameter of plant stem from 30 DAP (7.32 mm) to 75 DAP (9.82 mm) over remaining sources. The perusal of data revealed that there was no significant influence of levels of potassium on diameter of plant stem at 15 DAP, 30 DAP, 60 DAP and 75 DAP. However, application of potassium @ 200 mg K_2SO_4 per plant per week (L_2) at 45 DAP (7.97 mm) was statistically significant over L_1 and on par with level of L_3 (7.72 mm) and L_4 (7.37 mm).The interaction effect of sources and levels of potassium was found to be non-significant at all crop growth stages.

Increase in plant diameter with K_2SO_4 might be due to increase in cell size. The diameter of plant stem increased by the use of $MgSO_4$, it improved water uptake and chlorophyll formation. It is evident that the adequate amount of K failed to increase the diameter of plant stem. Besides the better utilization of optimum level of K increased the plant stem diameter. These results are in agreement with the findings of Gindina (1976) and Choi *et al.* (2004).

Table 1 : Number of leaves per plant, height of Lilium (mm), stem diameter of Lilium (mm) and plant spread of Lilium (mm) at 15, 30, 45, 60 and 75 days after planting grown under poly house condition

Treatments	Number of leaves per plant (No)					Height of Lilium (mm)					Stem diameter of Lilium (mm)					Plant spread of Lilium (mm)				
	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP
Sources (S)																				
KCl (S_1)	42.3	48.2	59.1	63.3	69.4	302	432	537	646	704	5.23	6.13	7.10	7.35	8.20	63.3	70.4	79.1	84.1	87.0
K_2SO_4 (S_2)	43.7	49.9	61.1	72.2	76.4	268	476	590	730	775	5.71	7.32	8.33	8.94	9.82	71.1	79.0	86.3	89.2	90.6
KNO_3 (S_3)	43.8	52.2	59.9	67.2	72.1	313	454	565	697	740	5.38	6.12	7.10	7.48	8.20	65.4	75.8	80.5	83.3	86.3
S.E.±	0.82	1.24	1.31	1.30	1.37	13.5	13.6	16.8	11.5	11.7	0.193	0.265	0.187	0.249	0.26	2.22	2.60	1.98	3.49	2.61
C.D. (P=0.05)	N.S.	N.S.	N.S.	3.62	3.80	N.S.	N.S.	N.S.	32.0	32.8	N.S.	0.734	0.520	0.692	0.72	N.S.	N.S.	5.50	N.S.	N.S.
Levels (mg plant^{-1} week^{-1})																				
150 (L_1)	42.7	48.7	60.1	65.6	72.7	296	447	559	698	734	5.39	6.19	6.99	7.62	8.54	67.4	75.0	80.7	84.8	87.3
200 (L_2)	44.4	51.3	62.0	70.6	73.9	292	469	578	724	755	5.80	6.74	7.97	8.22	9.03	69.1	78.4	86.6	88.7	91.2
250 (L_3)	43.3	49.6	61.0	69.5	73.3	288	446	561	693	737	5.47	6.63	7.72	8.00	8.77	65.2	73.9	83.5	85.2	87.2
300 (L_4)	42.8	50.8	57.2	64.5	70.7	302	454	558	649	732	5.10	6.52	7.37	7.84	8.63	64.6	72.8	77.0	83.4	86.1
S.E.±	0.95	1.44	1.52	1.51	1.58	15.6	15.7	19.5	13.3	24.0	0.223	0.306	0.216	0.288	0.30	2.56	3.00	2.29	4.03	3.01
C.D. (P=0.05)	N.S.	N.S.	N.S.	4.18	N.S.	N.S.	N.S.	N.S.	37.0	N.S.	N.S.	N.S.	0.600	N.S.	N.S.	N.S.	N.S.	6.35	N.S.	N.S.
Interaction																				
S_1L_1	43.3	50.6	61.4	63.0	70.8	308	435	535	673	710	4.73	5.47	6.27	6.93	8.00	67.8	75.0	79.9	83.1	86.6
S_1L_2	41.6	48.7	58.4	62.7	67.8	301	425	538	678	710	5.92	6.47	7.27	7.60	8.48	62.8	70.0	79.4	83.1	86.6
S_1L_3	41.3	47.0	58.4	65.6	70.5	298	415	538	643	696	5.57	6.47	7.27	7.93	8.00	61.2	68.3	81.8	85.2	86.6
S_1L_4	43.2	46.7	58.4	62.0	68.5	301	452	535	592	700	4.72	6.13	7.60	6.93	8.33	61.2	68.3	75.3	84.8	88.3
S_2L_1	41.6	45.8	59.8	67.0	73.8	275	466	563	723	753	6.18	7.43	8.17	8.78	9.63	69.5	75.2	84.2	85.2	86.1
S_2L_2	47.6	53.3	67.4	80.4	81.3	248	503	623	771	810	5.62	7.47	8.83	8.92	9.78	79.5	90.2	97.0	98.2	101.
S_2L_3	45.6	51.6	64.7	76.0	78.9	258	476	593	736	777	5.58	7.07	8.50	8.59	10.3	69.5	76.9	86.1	87.0	87.7
S_2L_4	39.9	48.8	52.7	65.4	71.5	291	460	583	689	760	5.44	7.47	7.83	9.45	9.55	66.1	73.6	77.9	86.2	87.4
S_3L_1	43.3	49.6	59.2	67.0	73.4	304	440	580	700	740	5.25	5.78	6.54	7.15	8.00	65.0	75.0	78.1	86.0	89.3
S_3L_2	43.9	52.0	60.2	68.7	72.4	327	480	573	724	746	5.85	6.37	7.80	8.15	8.82	65.0	75.0	83.6	84.6	85.9
S_3L_3	42.9	50.3	59.9	67.0	70.4	307	446	553	700	740	5.25	6.37	7.40	7.48	8.00	65.0	76.6	82.7	83.4	87.4
S_3L_4	45.2	57.1	60.5	66.0	72.1	314	450	556	666	736	5.15	6.03	6.67	7.15	8.00	66.6	76.6	77.8	79.3	82.6
S.E.±	1.65	2.49	2.63	2.61	2.74	27.1	27.3	33.7	23.1	41.5	0.223	0.533	0.375	0.499	0.52	4.44	5.20	3.97	6.98	5.22
C.D. (P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. = Non-significant

Plant spread (mm) :

As regards sources of potassium application had no significant influence on plant spread of lilium at 15, 30, 60 and 75 DAP (Table 1). However, at 45 DAP, the application of potassium through K_2SO_4 recorded significantly higher plant spread of lilium (86.3 mm) over other two sources. The perusal of data revealed that there was no significant influences of levels of potassium on spread of plant at 15, 30, 60 and 75 DAP. However application of potassium @ 200 mg K_2SO_4 plant^{-1} week^{-1} recorded significantly higher plant spread at 45 DAP (86.6 mm) over other levels of K and it was found at par with L_1 (80.7 mm) and L_3 (83.5 mm). The interaction effect of sources and levels of potassium were found to be non-significant at all crop growth stages.

Quality parameters :

Length of flower bud :

The data clearly indicated that there was significant influence of sources of potassium on length of flower bud (Table 2). Amongst the different sources, the application of potassium through K_2SO_4 had significantly higher length of flower bud (51.0 mm) over remaining sources. Further, it was also noticed that the application of potassium through KNO_3 (47.1 mm) was significantly superior over the application of potassium through KCl (44.0 mm). Amongst different levels, the application of potassium @ 200 mg K_2O plant^{-1} registered significantly higher length of flower bud (49.5 mm) over all other levels. The data indicated that the interaction effect was found to be non-significant. The increase in length of flower buds due to K_2SO_4 application might be due to combined supply of potassium and sulphur to lilium. Potassium and sulphur both might have enhanced growth of lilium resulted in maximum length of flower buds. These results are in agreement with the observations made by Gindina (1976).

Table 2 : Quality, yield and vase life parameters of lilium grown under poly house condition

Treatments	Quality parameters of lilium					Yield and vase life parameters of lilium		
	Length of flower bud (mm)	Fresh wt. of leaves (g)	Fresh wt. of flower (g)	Dry wt. of leaves (g)	Dry wt. of flower (g)	No. of flower stalks/m^2	No. of flowers/plants	Vase life (days)
Sources (S)								
KCl (S_1)	44.0	32.9	22.0	6.58	4.42	20.2	3.33	7.19
K_2SO_4 (S_2)	51.0	35.9	23.9	7.18	5.38	24.0	4.08	8.02
KNO_3 (S_3)	47.1	35.1	23.4	7.02	4.96	21.9	3.33	7.94
S.E. ±	0.10	0.672	0.440	0.134	0.169	0.22	0.17	0.162
C.D. (P=0.05)	0.27	1.87	1.11	0.403	0.471	0.62	0.48	0.450
Levels (mg plant^{-1} week^{-1})								
150 (L_1)	45.0	33.6	22.4	6.73	4.83	21.5	3.44	7.89
200 (L_2)	49.5	35.8	23.8	7.16	5.06	22.2	4.22	8.04
250 (L_3)	49.0	35.7	23.8	7.14	5.06	21.6	4.00	7.52
300 (L_4)	45.6	33.4	22.2	6.68	4.72	21.1	3.44	7.42
S.E. ±	0.10	0.78	0.52	0.150	0.196	0.25	0.20	0.187
C.D. (P=0.05)	0.32	N.S.	N.S.	N.S.	N.S.	0.71	0.60	N.S.
Interaction								
S_1L_1	38.3	32.7	21.8	6.65	4.17	21.0	3.67	7.33
S_1L_2	40.0	32.5	21.7	6.51	4.83	20.0	3.33	7.15
S_1L_3	40.0	34.5	23.0	6.91	4.33	20.0	3.33	7.08
S_1L_4	41.7	31.8	21.2	6.36	4.33	19.6	3.00	7.19
S_2L_1	56.7	34.8	23.2	6.96	5.33	23.0	3.67	8.00
S_2L_2	66.7	37.8	25.2	7.56	5.67	24.0	5.33	9.15
S_2L_3	61.7	36.9	21.6	7.39	5.33	23.9	3.67	7.75
S_2L_4	53.3	34.2	22.8	6.84	5.17	22.3	3.67	7.19
S_3L_1	40.0	33.6	22.2	6.67	5.00	20.6	3.00	8.33
S_3L_2	41.7	37.2	24.8	7.44	4.67	21.0	3.33	7.82
S_3L_3	45.0	35.5	23.7	7.11	5.50	20.3	3.67	7.75
S_3L_4	41.7	34.2	22.8	6.84	4.67	21.3	3.33	7.86
S.E. ±	2.00	1.35	0.90	0.27	0.339	0.278	0.35	0.325
C.D. (P=0.05)	5.55	N.S.	N.S.	N.S.	N.S.	0.812	N.S.	N.S.

N.S.=Non-significant

Fresh and dry weight of leaves :

The results revealed that the fresh and dry weight of leaves influenced by different sources and levels of potassium (Table 2). Among the sources of potassium application through K_2SO_4 (35.9 g and 7.18 g) and KNO_3 (35.1 g and 7.02 g) were statistically on par with each other and superior over potassium application through KCl. As regards the different levels of potassium application on fresh and dry weight of leaves the results were found to be non-significant. The interaction effect of sources and levels of potassium application on fresh and dry weight of leaves were found to be non-significant.

Fresh and dry weight of flower :

The results revealed that the fresh and dry weight of flower were influenced by different sources and levels of potassium (Table 2). Among the sources of potassium application through K_2SO_4 (23.9 g and 5.38 g) and KNO_3 (23.4 g and 4.96 g) were statistically at par with each other and superior over potassium application through KCl. As regards the different levels of potassium application on fresh and dry weight of flower the results were found to be non-significant. The interaction effect of sources and levels of potassium application fresh and dry weight of flower were found to be non-significant.

Yield and vase life parameters :

Number of flower stalks per square meter :

The perusal of data revealed that there was significant influence of sources of potassium on number of flower stalks per square meter (Table 2). As regards sources of potassium application of potassium through K_2SO_4 recorded significantly higher number of flower stalks per square meter (24.0) as compared to rest of the sources. The application of potassium through potassium nitrate was also beneficial for increase in number of flower stalks per m^2 as compared with muriate of potash, it is because of addition of nitrogen through potassium nitrate. The significant decrease in number of flower stalks per m^2 was noticed in potassium application through muriate of potash as compared with potassium nitrate and potassium sulphate. It indicates the adverse effect of chloride on plant growth. There was significant influence of levels of potassium on number of flower stalks per m^2 of lilium. The highest (22.2) flower stalks was recorded with the application of potassium @ 200 mg K_2O plant^{-1} week^{-1} as compared with 150 and 300 mg K_2O plant^{-1} week^{-1}. However, it was at par with the application of 250 mg K_2O plant^{-1} week^{-1}. The results showed that the higher level *i.e.* 300 mg K_2O plant^{-1} week^{-1} was not beneficial for increase in the number of flowers. There was significant influence of sources and levels of potassium on number of flower stalks per square meter of lilium. However, application of K_2SO_4 @ 200 mg K_2O per plant per week S_2L_2 showed significantly higher flower stalks/m^2 (24.0) which was on par with S_2L_3 (23.9). Application of potassium sulphate (S_2) with recommended fertilizer practice (200 mg) resulted in higher ratio between flower yield and fertilizers applied higher efficiency of fertilizers associated with the lower level of application revealed the tendency of plants to take up as much nutrients as possible without exceeding the limits under limited supply of nutrients and higher efficiency associated with water solubility could be attributed to their higher solubility properly and quicker availability of nutrients as they get as

Table 3 : Economics from different treatment combination sources and levels potash of lilium grown under poly house condition

Sr. No.	Treatments	No. of flowered stalks/m^2	No. of flower stalks /greenhouse (333 m^2)	Rate of flowers (Rs.)	Total income of greenhouse (Rs.)	Cost of greenhouse excluding potash fertilizer (Rs.) (A)	Cost of potassium fertilizer for greenhouse (Rs.) (B)	Total cost (Rs.) (A+B)	Net profit (Rs.)	Benefit : cost ratio
1.	$S_1 L_1$	21.0	6993	27.5	192307	166860	120	166980	25327	1.15
2.	$S_1 L_2$	20.0	6660	27.7	184482	166860	160	167020	17462	1.10
3.	$S_1 L_3$	20.0	6660	27.7	184482	166860	200	167060	17422	1.10
4.	$S_1 L_4$	19.6	6526	28.2	184033	166860	240	167100	16933	1.10
5.	$S_2 L_1$	23.0	7659	30.6	234356	166860	1200	168060	66296	1.39
6.	$S_2 L_2$	24.0	7992	30.8	246154	166860	1600	168460	77694	1.46
7.	$S_2 L_3$	23.9	7958	30.8	245106	166860	2000	168860	76246	1.45
8.	$S_2 L_4$	22.3	7425	30.6	227205	166860	2400	169260	57945	1.34
9.	$S_3 L_1$	20.6	6859	28.0	192052	166860	1152	168012	24040	1.14
10.	$S_3 L_2$	21.0	6993	28.2	197203	166860	1536	168396	28807	1.17
11.	$S_3 L_3$	20.3	6759	28.0	189252	166860	1920	168780	20472	1.12
12.	$S_3 L_4$	21.3	7092	27.8	197158	166860	2304	169164	27994	1.16

Note -
Cost of KCl fertilizer = Rs. 10 / kg K_2O
Cost of K_2SO_4 fertilizer = Rs. 100 / kg K_2O
Cost of KNO_3 fertilizer = Rs. 96 / kg K_2O

disassociated faster in the solvent and reduce losses under levels of potassium fertilizers. Nearly similar findings were also reported by Merick (1973) and Giustiniani *et al.* (1988).

Number of flowers per stalks :

The data clearly indicated that there was significant influence of sources of potassium on number of flowers per plant (Table 2). Amongst the different sources, the application of potassium through K_2SO_4 recorded significantly higher number of flowers per stalks at harvest (4.08). The data indicated that there was significant influence of levels of potassium on number of flowers per stalks at harvest. Amongst the different levels, the application of potassium @ 200 mg K_2O plant^{-1} week^{-1} registered significantly higher number of flowers per plant at harvest (4.22). However, application of 200 mg K_2O per plant per week (L_2) was statistically at par with level L_3 and L_1. The interaction combinations of sources and levels of potassium application were found to be non-significant. Application of potassium sulphate (S_2) with recommended fertilizer dose (L_2) resulted in higher efficiency of fertilizers associated with water solubility property and quicker availability of nutrients as they get as dissociated faster in the solvent and reduce losses under levels of potassium fertilizers. These results are in agreement with the findings of Merick (1973) in various flower crops.

Vase life :

The perusal of data revealed that there was significant influence of sources of potassium on vase life of lilium flower plant (Table 2). The application of potassium through K_2SO_4 (S_2) recorded significantly higher vase life (8.02 days) and was statistically at par with application of potassium through KNO_3 (S_3) (7.94 days). The levels of potassium did not influence on the vase life of flower. However, application of potassium @ 200 mg per plant per week showed slightly increase in vase life of flower. The interaction effect of sources and levels of potassium application were found to be non-significant. Optimum amount of inorganic salts like K_2SO_4,

Table 4 : Effect of different sources and levels of potassium on nutrient uptake by lilium plant

Treatments	Nutrient uptake of lilium (mg/plant)		
	N	P	K
Sources (S)			
KCl (S_1)	312	71	331
K_2SO_4 (S_2)	387	77	397
KNO_3 (S_3)	375	72	317
S.E.±	0.60	0.127	0.857
C.D. (P=0.05)	1.76	0.372	2.51
Levels (mg plant^{-1} week^{-1})			
150 (L_1)	346	71	329
200 (L_2)	380	77	360
250 (L_3)	372	76	362
300 (L_4)	335	69	341
S.E.±	0.69	0.147	0.990
C.D. (P=0.05)	2.04	0.430	2.90
Interaction			
S_1L_1	309	70	312
S_1L_2	325	75	340
S_1L_3	325	74	340
S_1L_4	290	65	331
S_2L_1	375	75	376
S_2L_2	405	83	413
S_2L_3	401	79	402
S_2L_4	368	72	398
S_3L_1	354	68	300
S_3L_2	410	74	328
S_3L_3	390	76	344
S_3L_4	347	69	295
S.E.±	1.20	0.254	1.71
C.D. (P=0.05)	3.53	0.744	5.02

KCl, and KNO_3 delayed senescence by maintaining the osmotic potential in petal tissues and substituted metabolic sugars in extending vase life of lilium. There was significant influence of water soluble potassium sulphate fertilizer obtaining longer vase life.

Nutrient uptake of lilium plant at harvest :

The perusal of data (Table 4) revealed that there was significant influence of sources of potassium on uptake of N, P and K. The application of potassium through K_2SO_4 (S_2) recorded significantly higher N (387 mg/plant), P (77 mg/plant) and K (397 mg/plant) uptake than rest of sources, which might be due to higher dry matter production in these treatments. Amongst different levels of potassium, the application of potassium @ 200 mg K_2O $plant^{-1}$ $week^{-1}$ (L_2) significantly higher N (380 mg/plant) and P (77 mg/plant) uptake. As the levels K_2O increased the uptake of K_2O was also increased up to L_3 level. However the uptake was reduced in L_4 level which might be due to misbalancing of nutrients at higher concentration of K_2O, which in turn influenced on total dry matter production in this level. There was significant influence of sources and levels of potassium on uptake of N, P and K. However, the application of potassium through KNO_3 @200 mg K_2O $plant^{-1}$ $week^{-1}$ showed significantly higher N uptake (410 mg/plant), while the application of potassium through K_2SO_4 @ 200 mg K_2O $plant^{-1}$ $week^{-1}$ showed significantly higher P and K uptake (83 and 413 mg/plant, respectively).

Economics :

The total expenditure for 4 months excluding cost of potash fertilizer was Rs.1,66,860/- (Table 3). The fixed capital expenditure for total life period of lilium was Rs.30,000/-, with Rs. 1,200/- interest on fixed capital @ 12 per cent for four months. Working capital expenditure for lilium was Rs. 1,33,000/-, including cost of planting bulbs, labourers, supervision etc. with Rs.2,660/- interest on working capital @ 12 per cent for 2 months (half life period of lilium). In the Table 5 the highest no. of flowers (7,992), total income (Rs.2,46,154/-), net profit (Rs.77,694/-) and B:C ratio (1:46) was observed in treatment combination S_2 L_2 (sulphate of potash) with recommended dose of potassium. Among different treatment combinations of potassium fertilizers, T_6 (S_2 L_2) recorded their maximum revenue, net profit and benefit : cost ratio. The profit depends not only on the productivity of the crop but also the quality of the produce in association with the competitive price in the market. Thus S_2 L_2 treatment was economical for lilium. The lower benefit:cost ratio was observed due to various treatments, it is because of Rs.96,000 are required for the purchase of bulbs *i.e.* Rs.12/plant (bulb).

Conclusion :

Looking to all data on yield, quality and nutrient uptake following conclusions can be drawn.

– Sulphate of potash was the best source of K and the sources can be ranked as K_2SO_4 > KNO_3 > KCl.
– Use of muriate of potash showed poor performance as compared to other sources on yield, quality and nutrient uptake of lilium, which was mainly due to accumulation of higher chlorides near the root zone.
– Application of 400 mg N and with 200 mg K_2O per plant per week through K_2SO_4 along with other nutrients up to first 45 days and there after application of 200 mg N and 200 mg K_2O per plant per week through K_2SO_4 along with other nutrients 45 days after planting was found better for obtaining higher yield and quality of lilium.

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