Effect of nitrogen, phosphorus and potassium fertilizer on bulb development of wild lily

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Background

China is rich in lily resources. Lily lily and Lily lily are two cold-tolerant wild species. They can survive the winter in the open field in Heilongjiang and have strong resistance to salt-alkali and other adverse environments. In recent years, a large number of new lily varieties have been artificially hybridized. Cultivated. Therefore, the protection, utilization and development of wild original species suitable for parents are particularly important. Lilium lily also has medicinal value. Nitrogen, phosphorus and potassium play a major role in the normal growth and morphology of plants. The different ratios of nitrogen, phosphorus and potassium in the growth process of lily macroscopically affect the growth and development of bulbs and the quality of bulbs [1]. In the process of fertilizer application, the problem of unreasonable nitrogen, phosphorus and potassium fertilizer ratio will affect the actual yield and quality of lily, causing it to deviate from the expected target in production practice. Phosphorus is often involved in the physiological and biochemical processes of lily growth and metabolism, nitrogen metabolism and fat synthesis in various forms [2]. A large number of studies have shown that under the established conditions, a reasonable combination of N, P, and K has great benefits for the yield and quality of various crops, and can also increase the utilization rate of N, P, and K fertilizers, save fertilizer costs, reduce environmental pollution, and protect the environment [3]. Sun Hongmei [4] believes that K is greater than NP for the development of lily bulbs. Huang Peng [5] research shows that NPK is beneficial to the growth and development of lily bulbs, and the combined application of K and NPK has a better effect. Previous studies have shown that the effects of different fertilizer ratios on different lily varieties are very different. In this experiment, under open field cultivation conditions, the effect of different NPK ratios on the quality and yield of wild species of Lilium lily and Lilium lily was studied for guidance. The production of lily adapted to local growth provides a scientific basis.

Methods

In this experiment, wild species of lily lily and Lilium lily bulbs were planted in the experimental base of Heilongjiang Bayi Agricultural University in early May 2020, with bulbs of 4-6 cm. The test fertilizer used Urea (N ≧ 46%), Calcium superphosphate (P2O5 ≧ 12%), and Potassium sulphate (K_2SO_4≧33%). There are 5 treatments in the experiment.

CK：Urea 0kg/hm^2、Calcium superphosphate 0kg/hm^2、Potassium sulphate 0kg/hm^2

NP：Urea 0kg/hm^2、Calcium superphosphate 90kg/hm^2、Potassium sulphate 120kg/hm^2

NK：Urea 120kg/hm^2、Calcium superphosphate 0kg/hm^2、Potassium sulphate 120kg/hm^2

PK：Urea 120kg/hm^2、Calcium superphosphate 90kg/hm^2、Potassium sulphate 0kg/hm^2

NPK：Urea 120kg/hm^2、Calcium superphosphate 90kg/hm^2、Potassium sulphate 120kg/hm^2

Results

It can be seen from Table 1 that compared with the control, the NPK treatment of *Lilium pumilum* increased the yield by 56.09%, the PK and NK treatments of *Lilium pumilum* increased the yield by 12.47% and 16.15%, respectively, while the NP treatment decreased the yield by 4.39% compared with the control CK. The PK, NK and NP treatments of *Lilium pumilum* had finer yields. The yield analysis of *Lanceleaf Lily Bulb* showed that they were significantly lower than the yield of NPK treatment. The results of NPK treatment of Lilium lily bulbs showed a significant increase in yield by 31.02%

compared with the control. PK and NK treatments increased yield by 11.02% and 15.18% respectively compared with the control. The difference in the data was not significant. The NP treatment showed a 7.46% reduction in yield compared with the CK treatment of the control group, and the yield of the lizard bulbs of the NP treatment was significantly lower than that of the NPK treatment.

Table .1 Effect of different fertilizers on lily bulb yield and stem biomass

Treatment	Bulb yield（kg/hm^2）		Bulb stem biomass（kg/hm^2）	
	Lilium pumilum	*Lanceleaf Lily Bulb*	*Lilium pumilum*	*Lanceleaf Lily Bulb*
CK	3810.4±575.37b	3333±652.76b	1447.95±218.64b	1236.54±242.17b
NP	3643.2±599.37b	3084.4±381.99b	1420.85±233.75b	1181.33±146.30b
NK	4285.6±582.07b	3700.4±363.61ab	1542.82±209.54b	1361.75±133.81ab
PK	4426.4±651.1b	3839±554.67ab	1673.18±246.12b	1470.34±212.44ab
NPK	5610±407.86a	4367±516.27a	2187.9±159.06a	1711.86±202.38a

Note: Different lowercase letters represent 5% significant level, the same letter means the difference is not significant, the same below

It can be seen from Table 1 that under the control of the relevant conditions of the experimental design, the different fertilizer ratios also have different effects on the dry bulb biomass of the two test subjects of *Lilium pumilum* and ***Lanceleaf Lily Bulb***. Compared with the control and PK and NK treatments, the NPK treatment of *Lilium pumilum* was significantly increased, 51.1% higher than the control, while the NP treatment data was reduced by 1.87% compared with the control CK, and the ***Lanceleaf Lily Bulb*** NPK treatment was significantly increased by 38.44% compared with the control. CK decreased by 4.46%. The analysis of NPK treatment and PK and NK treatment showed that the difference was not significant.

It can be seen from Table 2 that in this experiment, the effects of different fertilizer ratios on the accumulation of N, P, and K nutrients in the bulbs of *Lilium pumilum* and ***Lanceleaf Lily Bulb*** are not completely the same. Except for the accumulation of P of ***Lanceleaf Lily Bulb*** treated with NP, which was slightly lower than that of the control, the accumulation of N, P, and K nutrients in the bulbs of the two lilies under other treatments were significantly higher than those of the control group. The N, P, and K nutrient accumulations of the bulbs of the NPK treatment were significantly higher than those of other treatments. The N, P, K nutrient accumulations of the bulbs of the *Lilium pumilum* increased by 173.38%, 85.01%, and 194.03% respectively compared with the control. The cumulative amounts of, P, K nutrients in ***Lanceleaf Lily Bulb*** increased by 149%, 62.53%, and 161.59% respectively compared with the control. The accumulation of N in the bulbs of the two lily bulbs treated with NK, NP and PK was also significantly higher than that of the control. N accumulation amount NK treatment>PK treatment>NP treatment. The accumulation of P in lily bulbs treated with PK was also significantly higher than that in the control group. The P cumulative data shows PK treatment>NK treatment>NP treatment. The N accumulation value of lily bulbs in the NK and PK treatment groups was also significantly higher than that of the control. K cumulative amount PK treatment>NK treatment>NP treatment.

Table .2 Effects of different fertilizers on N,P,K nutrient accumulation in lily bulbs

Treatment	Bulb nitrogen accumulation（kg/hm^2）	Phosphorus accumulation in bulbs（kg/hm^2）	Bulb Potassium Accumulation（kg/hm^2）

	Lilium pumilum	*Lanceleaf Lily Bulb*	*Lilium pumilum*	*Lanceleaf Lily Bulb*	*Lilium pumilum*	*Lanceleaf Lily Bulb*
CK	22.73±0.66d	16.08±1.31d	4.07±0.11c	4.35±0.16c	21.28±1.15d	21.27±0.57c
NP	26.43±0.89c	19.26±0.74c	4.15±0.12c	4.28±0.06c	22.88±1.07d	22.68±1.03c
NK	37.49±1.87b	25.74±0.85b	4.22±0.10c	4.64±0.19c	28.23±1.23c	33.49±1.03b
PK	27.61±1.1c	21.32±1.42c	5.57±0.28b	5.72±0.32b	32.13±0.93b	34.99±3.51b
NPK	62.14±1.58a	40.06±3.04a	7.53±0.04a	7.07±0.15a	62.57±4.02a	55.64±2.53a

It can be seen from Table 3 that the effects of different NPK fertilizer ratios on the soluble sugar content, soluble starch and protein content of the two lily bulbs are not the same. The soluble sugar accumulation of NP-treated lily and the soluble starch accumulation of NP-treated two lilies were slightly lower than the control. The data of other treatments showed that the soluble sugar, soluble starch, and protein accumulation of the two lily bulbs Both are higher than the control group value. The bulbs of NPK treated lily bulbs contained higher cumulative amounts than other treatments. The bulb-related cumulative amounts of *Lilium pumilum* increased by 8.91%, 8.87%, and 14.29% respectively compared with the control. The soluble sugar, soluble starch, and protein in the bulbs of *Lanceleaf Lily Bulb* compared with the control, the cumulative amount increased by 12.48%, 15.3%, and 9.09%.

Table .3 Effect of different fertilizers on soluble sugar,starch,soluble protein of lily bulbs

Treatment	Cumulative amount of soluble sugar（g/kg）		Starch accumulation（g/kg）		Protein accumulation（g/kg）	
	Lilium pumilum	*Lanceleaf Lily Bulb*	*Lilium pumilum*	*Lanceleaf Lily Bulb*	*Lilium pumilum*	*Lanceleaf Lily Bulb*
CK	78.6±5.99b	100.2±2.74b	145.4±3.97b	126.8±1.65b	11.2±0.26c	12.1±0.26b
NP	78.2±2.75b	101.3±0.87b	144.5±4.89b	125.6±5.08b	11.6±0.17c	12.5±0.36b
NK	83.5±1.04ab	103.8±4.75b	149.8±6.46ab	131.2±5.57b	12.1±0.26b	12.6±0.1b
PK	82.8±1.45ab	104.9±2.5b	152.4±8.27ab	134.7±5.41b	11.3±0.17c	12.3±0.17b
NPK	85.6±1.42a	112.7±2.1a	158.3±6.26a	146.2±6.38a	12.8±0.26a	13.2±0.44a

It can be seen from Table 4 that there is a certain positive correlation between the accumulation of N, P and K nutrients and the yield of starch, soluble sugar, protein and bulbs. The accumulation of N nutrient and the yield of starch, soluble sugar, protein and bulb also showed a positive correlation. The correlation coefficients of N nutrient accumulation and the soluble protein of *Lilium pumilum* and *Lanceleaf Lily Bul*b were 0.965 and 0.962, respectively, and the correlation was significant. The correlation coefficient between the accumulation of P and K nutrients and the soluble starch content of the two lilies also reached a significant level. The N, P, K nutrient accumulation in the bulbs of the two lily bulbs are not correlated with soluble sugars, and they are significantly correlated in *Lanceleaf Lily Bulb*. The N, P, K nutrient accumulation of the two lilies had no significant correlation with the yield.

Table. 4 Correlation analysis of nutrient accumulation and quality yield of lily bulbs

	Accumulation	Soluble starch	Soluble sugar	Soluble protein	Yield
Lilium pumilum	N	0.865	0.827	0.965**	0.845
	P	0.941*	0.780	0.698	0.480
	K	0.934*	0.817	0.846	0.676
Lanceleaf Lily Bulb	N	0.930*	0.968**	0.962**	0.843
	P	0.984**	0.965**	0.752	0.496
	K	0.989**	0.995**	0.876	0.676

Note: ** and * indicate a significant correlation at the level of 0.01 and 0.05 respectively, the same below.

Conclusion

Potassium fertilizer can increase the yield of lily bulbs and dry biomass. The order of the relative influence of fertilizer ratio on lily yield is potassium fertilizer> nitrogen fertilizer> phosphate fertilizer. The N, P, K nutrient accumulation of the lily bulbs treated with NPK was significantly higher than that of other treatments, the N accumulation was NK treatment>PK treatment>NP treatment. P cumulative amount PK treatment>NK treatment>NP treatment. K cumulative amount PK treatment>NK treatment>NP treatment. If potassium fertilizer is not applied, the yield of lily will be correspondingly reduced, and the ratio of different fertilizers with different components has different effects on the biomass of lily bulbs. The NPK treatment increased significantly compared to the control, while the NP treatment decreased compared to the control CK treatment. NPK treatment can increase the soluble sugar, soluble protein and starch content of lily bulbs. The accumulation of N, P and K nutrients has a certain positive correlation with starch, soluble sugar, protein content and bulb yield.

Under the conditions of this experiment, the effects of various indexes of lily bulbs treated with NPK were higher than those of other treatments. NPK had a certain promotion effect on lily bulb development, yield and quality, accumulation of carbohydrates and protein content. Through nutrient analysis From the relationship between accumulation and bulb content quality, it is concluded that the accumulation of N, P and K nutrients has a certain positive correlation with starch, soluble sugar, protein and bulb yield. The combined application of nitrogen, phosphorus and potassium is more advantageous. Therefore, in order to increase the accumulation of nutrients and further improve the yield and quality of lilies in production, three elements are indispensable in actual production. Reasonable fertilization can not only improve the quality of lily in the process of lily cultivation, but also affect the soil fertility of the cultivated land and the economic benefits obtained[6]. The production should be adapted to local conditions, and the fertilization should be reasonably adjusted according to the growth environment of each region to master the soil The interaction between fertilizer supply capacity and nutrients can not only ensure high quality and high yield, but also use energy to protect the ecological environment and carry out sustainable development. The experiment analyzed the effects of different fertilizer ratios on the nutritional quality and yield of lily bulbs, hoping to provide a reference for the production and cultivation of wild lilies.

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