

Effect of K Fertilizer on Absorption of Mineral Elements in Greenhouse-grown Strawberry Fruits

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Abstract [Objectives] The paper was to explore the effect of K fertilizer on the absorption of mineral elements in greenhouse-grown strawberry fruits. [Methods] A systematic investigation was conducted on the effects of K fertilizer dosage levels on the absorption of mineral elements in Fengxiang strawberries, an excellent variety suitable for cultivation in Anhui Province. The investigation was carried out under medium N and P conditions in a greenhouse. [Results] The N content of strawberry fruits increased as the K_2O dosage increased within the range of 0–250 kg/hm². Similarly, the P content of strawberry fruits increased gradually with the increase of K_2O dosage within the range of 0–125 kg/hm². [Conclusions] This study presents a basis for enhancing the absorption of mineral elements in strawberry fruit by applying K appropriately.

Key words K fertilizer; Strawberry; Mineral element

1 Introduction

In recent years, the cultivation area of greenhouse strawberries has been increasing. However, producers tend to over-fertilize, which results in a decline in strawberry quality. Mineral elements are essential for the growth, development, yield, and quality of horticultural crops. Their content is primarily determined by plant absorption and accumulation. The significance of K as a vital mineral element is evident. However, numerous studies have shown that insufficient potash fertilizer has little effect on the absorption of mineral elements, while excessive amounts not only increase fertilizer input but also have a negative impact on the absorption of mineral elements in horticultural crops. Liu Dongbi *et al.*^[1] investigated the impact of K on the accumulation of dry matter in rapeseed and the absorption of K, Ca and Mg by rapeseed using pond soil culture, and the results showed that the application of K fertilizer significantly improved the accumulation of dry matter in plants and promoted the absorption of K, Ca and Mg in rapeseed. According to Li Lujie *et al.*^[2], the application of K fertilizer increased the N content of stems and leaves in the aerial part of ginger, as well as the P and K nutrient content of stem and leaf, ginger lumps and the whole plant, but it had little effect on the N content of the whole plant. The uptake of K, N, and P in the aboveground stem and leaves, tuber, and whole plant of ginger increased with higher K application at two different N levels. The objective of this study was to investigate the impact of K fertilizer levels on the absorption of mineral elements in greenhouse-grown strawberry fruits. The findings will provide a basis for enhancing the absorption of mineral elements in strawberry fruit by applying K appropriately.

2 Materials and methods

2.1 Materials and treatments The test was conducted in a plastic greenhouse at the Garden and Horticulture Base of Anqing Vocational and Technical College from September 2020 to May 2021. The test variety selected was Fengxiang, an excellent strawberry variety. Prior to planting, the soil fertility was analyzed, revealing a soil pH of 6.94, organic matter content of 2.03%, available N of 67 mg/kg, available K of 103 mg/kg, and available P of 36 mg/kg.

The test was in randomized block arrangement with 3 replicates, and each plot covered an area of 3 m × 1.2 m. Five treatments were designed in the test, including T0 (CK), T1 at 75 kg/hm² K_2O , T2 at 125 kg/hm² K_2O , T3 at 250 kg/hm² K_2O , and T4 at 300 kg/hm² K_2O . The fertilizers used in this study were urea (46% N), diammonium phosphate, and K sulfate (50% K_2O). A base fertilizer of P was applied once before colonization, while N and K fertilizers were applied twice in equal amounts as base fertilizer and topdressing. Fruit thinning was conducted after fruit setting, retaining only 5 fruits per strawberry plant for harvest measurement after maturity.

2.2 Methods The mineral element content was determined using Liu Chunsheng's method^[3]. Fresh samples were picked, digested with $H_2SO_4 \cdot H_2O_2$, filtered, and then set to a constant volume. Kjeldahl method was employed to determine the N content in the product; vanadate-molybdate-yellow colorimetry was applied to determine the P_2O_5 content; flame photometry was used to determine the K_2O content; and atomic absorption spectrometry was applied to determine Ca, Mg, and Fe elements^[3].

3 Results and analysis

3.1 Effect of K fertilizer dosage on absorption of N, P and K As shown in Table 1, with an increase in K_2O dosage, the macroelement content, including N, P, and K, in strawberry

fruits of all treatments increased to varying degrees compared to the control. This suggests that a moderate increase in the application of P fertilizer can promote the absorption and accumulation of N, P and K in strawberries to some extent. The N content in strawberry fruits increased as the K₂O dosage increased within the range of 0 – 250 kg/hm². The P content of strawberry fruits increased gradually with the increase of K₂O dosage within the range of 0 – 125 kg/hm². However, when the dosage of K₂O exceeded 125 kg/hm², strawberry's P absorption decreased. K ions are cations that are highly permeable and pass quickly and selectively through biological membranes, while being taken up by cells. When the concentration of K ions in the soil solution increases, crops can absorb K ions more efficiently. As shown in Table 1, the K content in strawberry fruits treated with additional K fertilizer was significantly higher than that of T0 (control). The K content of fruits in T0 (control) was 1.82 mg/g, and those in T1, T2, T3, and T4 were 2.02, 2.15, 2.18, and 2.21 mg/g, respectively. This indicated that an increased application of P fertilizers had a positive effect on the K content in strawberry fruits.

Table 1 Effect of potassium fertilizer on the absorption of mineral element in greenhouse-grown strawberry fruits

Mineral content mg/g	K ₂ O content//kg/hm ²				
	0	75	125	250	300
N	2.62 c	2.71 c	2.85 b	3.02 a	2.92 b
P	0.28 c	0.34 b	0.45 a	0.37 b	0.32 bc
K	1.82 b	2.02 b	2.15 a	2.18 a	2.21 a
Ca	65.31 a	62.68 b	60.12 c	61.29 bc	60.23 c
Mg	55.82 a	51.57 a	45.27 b	39.91 c	35.16 d
Fe	4.87 a	5.06 a	5.32 a	4.19 b	3.98 b

Note: Different lowercase letters in the same column represent significant differences at 0.05 level.

3.2 Effect of K fertilizer dosage on absorption of Ca, Mg and Fe With an increase in K fertilizer, the content of Ca and Mg elements in strawberry fruits decreased to varying degrees, which may be because an increase in K fertilizer application leads to the antagonistic action of K ions with Ca and Mg ions, thus inhibiting the strawberry's absorption of Ca and Mg ions or promoting their metabolism and depleting them in the strawberry. This is consistent with the experimental results of Shang Xingjia *et al.* [4] on cluster redpepper, Li Juan *et al.* [5] on tobacco, and Guo Xisheng *et al.* [6] on cucumber. The content of Fe in strawberry fruit ranges from 3.98 to 5.32 mg/kg. The Fe content of strawberry

fruits increased as the K₂O dosage increased within the range of 0 – 125 kg/hm², but it decreased when the K₂O dosage exceeded 125 kg/hm². This indicated that strawberry has a good synergistic effect on the absorption of K and Fe.

4 Conclusions and discussion

Our test results demonstrated that K₂O dosage had a great impact on the absorption of mineral elements in greenhouse-grown strawberry fruits. The N content of strawberry fruits increased as the K₂O dosage increased within the range of 0 – 250 kg/hm². Similarly, the P content of strawberry fruits increased gradually with the increase of K₂O dosage within the range of 0 – 125 kg/hm², but it decreased as the K₂O dosage exceeded 125 kg/hm². The K content in strawberry fruits was significantly higher than that of T0 (control); the content of Ca and Mg elements in strawberry fruits decreased to varying degrees; the Fe content in fruits increased as the K₂O dosage increased within the range of 0 – 125 kg/hm², but it decreased as the K₂O dosage exceeded 125 kg/hm². Therefore, it is suggested that strawberry fruits have better absorption of mineral elements when the dosage of K₂O is 125 – 250 kg/hm². This K₂O dosage is basically available for reference application under similar soil conditions. Excessive amounts of K fertilizer not only increase fertilizer input but also have a negative impact on the quality of greenhouse-grown strawberry.

References

[1] LIU DB, CHEN F, LU JW, *et al.* Effect of K application on dry matter accumulation and absorption of K, Ca and Mg of oil rape[J]. *Soils and Fertilizers*, 2001(4): 24 – 28. (in Chinese).

[2] LI LJ, GUO XS, GAO JJ, *et al.* Effect of potassium application combined with nitrogen on ginger yield and nutrient uptake[J]. *Chinese Journal of Soil Science*, 2004, 35(2): 181 – 185. (in Chinese).

[3] LIU CS, YANG SX. *Agricultural chemical analysis* [J]. Beijing: China Agricultural University Press, 1996. (in Chinese).

[4] SHANG XJ, WANG MF, KONG FH, *et al.* Effect of N, P and K fertilizer on nutrient uptake and dry matter yield of cluster redpepper[J]. *Soils and Fertilizers*, 2002(5): 22 – 25. (in Chinese).

[5] LI J, ZHANG MQ, LIN Q, *et al.* Effects of interaction of potassium, calcium and magnesium on flue-cured tobacco growth and nutrient absorption [J]. *Journal of Anhui Agricultural University*, 2005, 32(4): 529 – 533. (in Chinese).

[6] GUO XS, ZHU HB, YE SY, *et al.* Effects of different sources and rates of K on the nutrient uptake and partition of cucumber[J]. *Journal of Anhui Agricultural University*, 2004, 31(4): 398 – 401. (in Chinese).