Yield and Quality of Fruits of Solanaceous Crops as Affected by Potassium Fertilization

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Potassium (K) fertilization of eggplant, tomato, sweet pepper, and chili produced higher yields and better quality fruit in Zhejiang province of China.

Solanaceous crops such as eggplant, tomato, sweet pepper, and chili are important fruits grown intensively in summer and autumn in the vegetable gardens of south China. They have a high K demand and the harvested fruit removes a large amount of K from the soil.

Generally, input of K fertilizer to these crops is much less than amounts removed. Furthermore, organic manure use, previously the main K sources, has diminished over the last decade, intensifying the depletion of available soil K in most garden soils. As a result, crop yield and quality have fallen (Jiang Xianming, 1990; Zhan Changgeng, 1991).

Consumption of solanaceous crops has increased along with urban, non-agricultural population expansion in China. For consumers, produce quality is a major concern needing consideration in research. This paper documents a series of field experiments where the effects of K fertilization on fruit yield and quality of eggplant, tomato, sweet pepper, and chili were investigated with the purpose of satisfying demand and identifying a rational K fertilization program.

Field experiments were carried out on two silty loam soils with eggplant, tomato, sweet pepper, and chili. Soil test results are given in **Table 1**. Potassium treatments were 0 (K_0), 112.5 (K_1), 225 (K_2), and 450 (K_3) kg K_2O/ha for eggplant, tomato, and sweet pepper, while chili received 0, 67.5, 135, and 270 kg K_2O/ha. Except for the check (Ck) treatment (no fertilizer) the doses of nitrogen (N) as urea and P as single superphosphate were constant for eggplant, tomato, and sweet pepper,

Table 1. Soil test results for two field sites growing solanaceous crops, Zhejiang, China.

Crop	pH H_2O	Organic matter	Total N	Total P	Total K	Hydrolizable N	Available P	Exchangeable K
					mg/kg			
Eggplant	6.5	11.4	0.94	0.56	16.4	134	57	47
Tomato	6.7	11.6	1.21	0.57	15.4	107	40	42
Sweet pepper	Same as tomato experiment							
Chili	Same as tomato experiment							

Table 2. Fruit yields (t/ha) and coefficient of variation (CV) of K treatments on four test crops, Zhejiang, China.

Treatment	Eggplant yield, t/ha	CV, %	Tomato yield, t/ha	CV, %	Sweet pepper yield, t/ha	CV, %	Chili yield, t/ha	CV, %
Ck	3.6 e D**	12.4	-	-	-	-	-	-
K_0	9.9 d C	11.0	27.2 D	5.7	16.8 D	8.9	7.8 D	17.1
K_1	10.6 d C	6.0	33.0 C	4.6	27.0 C	5.6	16.6 C	9.7
K_2	13.7 c B	2.2	38.1 B	4.2	33.1 B	5.7	24.0 B	5.5
K_3	16.8 a A	2.9	44.8 A	3.9	39.2 A	3.7	29.5 A	5.5
K_3*	14.8 b B	6.9	-	-	-	-	-	-

*Muriate of potash used as the source of K.
**Means followed with a different letter are significantly different at $p<0.01$ (a, b, c, d, e) or 0.05 (A, B, C, D) level in Duncan's test.

at 345 kg N and 105 kg P_2O_5/ha, while chili received 207 kg N and 63 kg P_2O_5/ha. Potassium was applied as potassium sulfate (K_2SO_4) for all treatments. In the eggplant trial there was an additional treatment of 450 kg K_2O/ha as potassium chloride (KCl). A randomized complete block design was used for eggplant and a latin square design for tomato, sweet pepper, and chili. All trials had four treatment replications. Important crop quality characteristics determined were dry matter (calculated from the weight difference before and after oven drying at 80ºC), sugar content, and vitamin C content.

Potassium fertilization significantly increased fruit yield of eggplant, tomato, sweet pepper, and chili. There was no yield difference between treatment K_1 and treatment K_0 (zero K) in the eggplant experiment (**Table 2**). Potassium application also stabilized yield as the CV of fruit yield diminished with higher rates of K. Comparing treatment K_0 (no K fertilizer) with treatment K_3 (450 kg K_2O/ha), the yield increases obtained were: eggplant, 6.9 t/ha; tomato, 17.6 t/ha; and sweet pepper, 22.4 t/ha. For chili, the difference between treatment K_0 and treatment K_3 (270 kg K_2O/ha) was 21.7 t/ha.

Fruit dry matter content significantly increased with higher rates of K (**Table 3**). However, fruit dry matter content of tomato and sweet pepper decreased at the highest K level (450 kg K_2O/ha). This is likely related to increased water absorption by plants supplied with high K fertility (Mengel and Kirkby, 1987). Fruit vitamin C contents of tomato, sweet pepper, and chili exhibited similar increases with higher rates of K fertilization. Potassium rates above 225 kg K_2O/ha tended to lower dry matter and vitamin C content of tomato and sweet

Table 3. Dry matter and vitamin C contents of fruits of solanaceous crops as affected by various rates of K fertilizers, Zhejiang, China.

Treatment	Dry matter content, %				Vitamin C content, mg/100g fresh weight		
	Eggplant	Tomato	Sweet pepper	Chili	Tomato	Sweet pepper	Chili
Ck	7.02 b c**	-	-	-	-	-	-
K_0	6.50 c	5.82 b	6.02 b	10.6 c	22.8 b	126 b	195 c
K_1	7.25 a b	6.67 a	6.89 a	12.8 b	26.1 a	158 a	222 b
K_2	7.79 a	7.15 a	7.47 a	14.1 a b	28.3 a	173 a	239 a b
K_3	7.86 a	6.94 a	7.22 a	14.5 a	27.8 a	164 a	251 a
K_3*	7.33 a b	-	-	-	-	-	-

*Muriate of potash used as the source of K
**Means followed with a different letter are significantly different at $p<0.05$ level in Duncan's test.

Table 4. Effects of K fertilization on sugar content, titratable acidity, and S:A ratio of tomato, Zhejiang, China.

Treatment	Sugar content, %	Titratable acidity, %	S:A ratio
K_0	3.45 c*	0.46 c	7.50 a
K_1	3.67 b c	0.58 b	6.33 b
K_2	3.84 a b	0.66 a b	5.82 b
K_3	4.09 a	0.72 a	5.68 b

*Means followed with a different letter are significantly different at $p<0.05$ level in Duncan's test.

pepper. In addition, K application increased sugar content and titratable acidity levels of tomato and decreased the ratio of sugar content to titratable acidity (S:A) as shown in **Table 4**. A lower S:A ratio translates into better tasting tomato fruit. These results confirm previous reports.

At the high rate of K fertilization (450 kg K_2O/ha), K_2SO_4 was found more effective than KCl on eggplant fruit yield, yield stability (**Table 2**), and eggplant fruit quality (**Table 3**). This agrees with Vlasyuk and Klimovitskaya (1955), who found K_2SO_4 increased dry matter, sugar, and vitamin C contents, and the proportion of marketable fruit. Few studies have examined the effect of K source on eggplant.

Potassium not only increased fruit yields of solanaceous crops, but also improved fruit quality by increasing dry matter and vitamin C contents, as well as increasing sugar content and titratable acidity levels of tomato to reduce the S:A ratio. Potassium sulfate was found more effective on eggplant yield and quality at high rates of K. The additional yield and quality attributable to K_2SO_4 gives farmers sufficient profit to cover the additional cost of this K fertilizer source. Eggplant growers under high K fertilization regimes, using the same soil conditions as this trial in Zhejiang, should apply K_2SO_4 for maximum yield and quality. **BCI**

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