Beneficial Effects of Potassium Application on Upland Soils of Hunan Province

By Zheng Shengxian

Upland soils are an important land resource for sustaining China's rural economy. However, in the upland soils of Hunan, potassium (K) deficiency is a limiting factor in the production of high yielding, good quality crops. Currently, two-thirds of Hunan's 768,826 ha of cultivated upland is considered deficient (critical level < 70 mg/kg) in available K.

Between 1989 and 1993, 204 field experiments were conducted in Hunan province to evaluate the benefit of K application in upland soils. Overall, K fertilization resulted in significant improvement in crop yield and quality while positively affecting crop resistance to disease and stress.

Yield

Results of field trials conducted in more than 80 counties showed K had a positive effect on the yield of cereal, fiber, oil, fruit, vegetable, and medical crops (**Table 1**). The degree to which crops responded to K varied. However, at equal application rates, a higher economic benefit for K was found with cotton, ramie, citrus, chili, tobacco, and medical crops than the other upland crops. Since supply of K fertilizers in Hunan is limited, initial emphasis for its use should be placed on crops with the highest potential economic return.

Professor Zheng Shengxian examining a high yield corn demonstration field plot.

Quality

Essential improvements in crop quality were observed by balancing nitrogen (N) and phosphorus (P) with adequate K. Experiments demonstrated improvements in length, strength, and fineness of fiber in cotton and ramie; in the contents of oil, protein, and essential amino acid in corn and barley; oil and essential aliphatic acids in rapeseed; oil and protein in soybean and peanut; sucrose and reducing sugar in sugarcane; and sugar, soluble solids, and vitamin C in citrus (**Table 2**). Higher levels of essential amino acids in corn are beneficial to both

humans and other animals. Good fiber quality in cotton and ramie is important for China to compete in the world textile industry. Overall, the production of high quality crops is essential for farmers and the nation, as both need to increase profits and compete in world markets.

Disease Resistance

Potassium also showed a beneficial influence on improving disease resistance in Hunan's upland crops. It helped reduce anthracnose, root rot, and red leaf stem wilt infections on cotton (**Table 3**). Additional research has shown that potassium chloride (KCl) may have a significant effect in reducing the severity of diseases in corn, soybean and ramie. In Hunan, farmers often state: "KCl fertilizer acts just like a pesticide; once K is added, the disease is removed."

Stress Tolerance

It was evident from an extended drought period in northwest Hunan that K can help reduce lodging of corn in dry years. In June and July of a recent production year, the area received only 20 mm of rainfall, compared with over 150 mm in a normal year. Five experiments with corn in Cili county demonstrated that K application significantly reduced corn lodging and contributed to higher yields (**Table 4**). On average, K application increased corn yield by 135 percent, compared with the no K treatment (data not shown). The magnitude of yield response was much greater than response in normal years.

Table 1. Effect of K application on yield of main upland crops (1989-1993) in Hunan province.

Crop	Number of experiments	Yield, t/ha		Yield increase, %
		Without K	With K	
Corn	26	5.15	6.60	28.2
Barley	14	1.59	2.16	35.8
Cotton	28	0.95	1.13	18.9
Ramie	15	2.59	3.04	17.4
Rapeseed	29	0.99	1.32	33.3
Soybean	24	1.53	1.80	17.6
Peanut	25	1.97	2.49	26.4
Citrus	4	25.38	28.51	12.3
Watermelon	12	30.06	40.32	34.1
Day lily	4	1.21	1.32	9.1
Chili	15	15.56	18.49	18.8
Sugarcane	16	83.20	96.63	16.1
Tobacco	11	1.44	1.78	23.6
Lily	17	2.84	3.37	18.7

Table 2. Effect of K fertilizer application on the quality of some upland crops in Hunan province.

Crop	Item analyzed	Without K	With K	Quality change, %
Corn	Protein, %	9.5	10.3	8.4
	Oil, %	4.0	4.4	10.0
	Essential acids, %	3.4	3.8	11.8
Barley	Protein, %	16.3	16.2	-0.6
	Essential acids, %	4.9	5.1	4.1
Cotton	Ginning output, %	40.0	41.7	4.2
	Fiber length, mm	28.4	30.5	7.4
Ramie	Strength, kg/g	32.6	37.3	14.4
	Rind thickness, mm	1.3	2.0	53.8
Rapeseed	Oil, %	36.9	37.8	2.4
	Essential aliphatic acid, %	24.2	25.5	5.4
	Protein, %	21.8	20.4	-6.4
Soybean	Fat, %	18.4	20.9	13.6
	Protein, %	40.2	42.4	5.5
Peanut	Fat, %	49.0	52.0	6.1
	Essential amino acids, %	8.7	9.4	8.0
Sugarcane	Sucrose, %	10.0	11.8	18.0
	Reducing sugar, %	2.1	1.5	-28.6
Citrus	Total sugar, %	9.5	10.1	6.3
	Vitamin C, mg/100g	24.8	26.9	8.5
	Soluble solids, %	9.0	11.5	27.8

Table 3. Chi-square test results of the effect of K application on the index of three cotton diseases.

Treatment, kg N-P_2O_5-K_2O/ha	Anthrac-nose	Root rot	Red leaf stem wilt
195-75-0	—	—	—
195-75-75	4.83*	3.21^{NS}	12.3**
195-75-150	5.20*	9.43**	18.9**
195-75-225	5.89*	10.38	30.6**

^{NS}, *, ** = non-significant, significant at 5%, and significant at 1%, respectively.

Table 4. Effect of K on reducing premature plant death and lodging in corn during 1989 drought, Hunan.

Treatment, kg N-P_2O_5-K_2O/ha	Lodging, %	Premature death, %
200-90-0	73.0	51.7
240-90-270	1.3	13.2

Conclusion

Potassium fertilizer has proven to be extremely important for crop growth on Hunan's K-deficient upland soils. This has been manifested in higher crop yields, improved crop quality, and increased farmer profit when K fertilizer was applied compared to no K application, but with N and P fertilizer applied at optimal rates.

For the majority of crops grown on these soils, an application of 150 kg K_2O/ha was considered to be a minimum to achieve high crop yield and quality, while higher rates often proved better for the high K demanding crops. **BCI**

The author is Professor, Soil and Fertilizer Institute, Hunan Academy of Agricultural Sciences, Changsha, China.

India: Response of Some Rabi Pulses to Boron, Zinc and Sulfate Application in Farmer Fields

Series of field trials were conducted on calcareous soils in the northern part of Bihar. A high percentage of these soils exhibit sulfur (S), boron (B) and zinc (Zn) deficiencies. Test crops were chickpea, lentil and broadbean. Boron application at 2 kg/ha and Zn application at 5 kg/ha on chickpea produced grain yield responses of 750 (60 percent yield increase) and 400 (28 percent yield increase) kg/ha, respectively. Boron application rate of 1 kg/ha increased lentil yields by 300 kg/ha, or 24 percent. Broadbean yield response to S applied at a rate of 40 kg/ha was 700 kg/ha, a 32 percent increase. In addition to yield responses, plant uptake of all three nutrients was increased by fertilization. **BCI**

Source: Fertiliser News, *Vol. 43 (11), p. 37, 39-40, November 1998.*