Soil Potassium and Potassium Fertilizer Use in Northern China

By Jin Ji-yun

Increased crop production from greater use of nitrogen (N) and phosphorus (P) in northern China has depleted soil potassium (K). Crop demands can no longer be met with application of manures. As a result, significant responses to K have been shown on a variety of crops. Potash fertilizers have not been used because of the false belief that northern China soils do not respond to K. The result, which can be corrected only with the import and use of more K, has been reduced efficiency of N and P, along with declining yields.

In northern China, with increased crop production resulting from greater N and P fertilizer use on better varieties, more K has been removed from soils than returned through applications of organic or inorganic fertilizers. Long-term field trials in Shandong and Hebei provinces showed that application of manure at normal rates resulted in soil K depletion rates of 71 to 225 kg K/ha/yr for grain crops while vegetable crops in Tianjin depleted soil K at 378 to 498 kg K/ha/season. Based on estimations, about 5 million tonnes of soil K_2O are removed by crops annually in China, while the highest and most recent application rates do not exceed 3 million tonnes annually. In fact, most soils receiving K fertilizer have a negative output-input balance, as shown in Table 1. Thus, K deficiency is now frequently found in northern China.

Table 1. Balance sheet of soil K in wheat-corn double cropping system in Yutian, Hebei, 1987-1991.

Treatment[1]	K removed, kg/ha	K added, kg/ha	Balance kg/ha
NP	711	0	-711
NPK	1,357	841	-516
NPM	920	126	-794
NPKM	1,592	967	-625

[1]K = 112.5 kg K_2O/ha/season; manure (M) = 11.7t/ha only for wheat.

Crop responses to applied fertilizer K are becoming prevalent in northern China. The average spring corn yield increase with K fertilizer in five trials in northeastern China was between 7.5 and 10.4 percent (Table 2). In the country's north central area, a wheat-corn rotation at eight sites showed wheat and corn yield increases of 6.4 and 12.3 percent, respectively.

Research in Shandong, Henan and Hebei showed that even though available soil K was 112 mg K/kg, well above the critical level, and slowly available K was 507 mg K/kg, potash application increased corn yields between 8.4 and 10.8 percent. These results indicate that critical soil test K levels currently used may be too low when high crop yields are desired. Similar findings were obtained on different soil types in Heilongjiang province.

In Jilin province, K application increased corn yield by 1.2 to 1.6 t/ha. In Tianjin, watermelon and Chinese cabbage yields were increased 12.1 and 9.2 to 41.4 percent, respectively, while cotton yields in Hebei were increased 13.3 percent. Soybean yields in Henan were increased by 28.8 to 51 percent. It is clear from these results that since the 1980s, reports

Soybeans in Heilongjiang show K deficiency symptoms and reduced yield.

of K deficiency expanded quickly and responses to applied K have become significant in northern China.

In 14 field and demonstration trials in north eastern and north central China, cotton yields increased by 28 percent, demonstrating that large increases in domestic cotton production are possible by adding K to normally applied levels of N and P. Potassium is noted for increasing fiber strength and quality. This indicates that domestic production could replace large quantities of imported cotton if adequate K fertilizer is applied to the crop.

Table 2. Spring corn yield response to K fertilizer in the north eastern region, 1993-1994.

Treatment, K_2O rate, kg/ha	Yield, t/ha	Yield increase, %
0	9.1	–
112	9.8	7.5
225	10.0	10.4

Average of five sites in two years.

In general, the supply of K fertilizers to northern China has been inadequate to meet agronomic needs and efficient N and P fertilizer use. With further development of agriculture, K requirements in northern China will grow. By the years 2000 and 2005, K_2O use in the six north eastern and north central provinces will have to be 1.05 and 1.50 million tonnes, respectively. Most of this supply will have to be met by imports since native potash supplies are limited.

Table 3. Ratios of $N:P_2O_5:K_2O$ use in China and several provinces, 1994.

	$N : K_2O : P_2O_2$
China	1 : 0.32 : 0.125
Shandong	1 : 0.29 : 0.124
Henan	1 : 0.45 : 0.101
Hebei	1 : 0.34 : 0.067
Jilin	1 : 0.08 : 0.071
Liaoning	1 : 0.18 : 0.057
Heilongjiang	1 : 0.57 : 0.087

Source: China Agriculture Yearbooks.

Increasing food and fiber demands of a large and growing population on China's agriculture and development of high yield and high quality crops will result in larger areas of K deficiency in northern China unless immediate increases in potash supplies are made available. Until this occurs, the efficiency of N and P fertilizer use will remain low because of imbalances in NPK use as shown in Table 3. Soil K will be further depleted, economic returns to farmers reduced and the cost of restoring soil K to productive levels will become extremely expensive for future generations. Presently, this imbalance can only be overcome by importing large tonnages of potash to balance present N and P used from domestic and imported fertilizers. BCI

Dr. Jin is Deputy Director, PPI/PPIC-Beijing Office, People's Republic of China.