Corn Response to Potash on a Gongzhuling Black Soil, Jilin Province

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Potash fertilizer applied to moderately fertile black soil of the northeastern province of Jilin failed to increase corn yields in the 1950s and 1960s. Thus, any yield improvements in this region have been achieved, in part, through use of nitrogen (N) and phosphorus (P) fertilizers, improved crop varieties, and native soil potassium (K) supply. Limited use of K fertilizer and continued nutrient removal have gradually depleted K levels to the point where, during the past two decades, soils and crops in Jilin have shown response to K.

Experiments were conducted at three locations in Liufangzi township, Gongzhuling city, Jilin province, to show the positive effect of K fertilizer on corn production in this northeastern province of China.

Mr. Wu Wei is shown in corn field in Gongzhuling.

All treatments in each field (**Tables 1**, **2** and **3**) were arranged in a randomized complete block design with four replications. Treatments occupied 40 m^2, with each ridge 0.6 to 0.65 m apart. Organic matter content of the experimental soils ranged from 1.8 to 2.2 percent, pH from 6.2 to 6.5, available N, P and K between 89 to 101, 10 to 20.5, and 113 to 139 mg/kg, respectively.

Corn varieties were Danyu 13, Yedan 13, and Yedan 12, each planted at its optimum plant population of 45,000, 70,000, and 70,000 plants/ha, respectively. Experimental fields were plowed, fertilized and ridged in spring. Fertilizer sources for N, P and K were urea, triple superphosphate (TSP) and potassium chloride (KCl). All P and K and one-third of the N were applied basally, while the remaining N was top-dressed at one time. Fields were seeded in late April by horse-drawn single body seeders. Weed control was carried out by hand, while pesticides were used for disease and pests. The three trials were conducted under rain-fed conditions.

The systematic approach used for measuring initial soil nutrient status (Portch, 1988) determined all three experimental soils to be deficient in K with slightly different K fixation patterns. Thus, examination of crop response to K fertilizer involved using constant levels of N and P_2O_5 that were prescribed according to site-specific yield potentials. Profits were calculated on the basis of the following Yuan/kg values: N=2.39; P_2O_5=1.63; K_2O=1.5; and corn=0.5 (8.2 Yuan=1 US$). **Tables 1, 2** and **3** present the three-year average corn yield results.

Table 1. Average corn yield responses and net profit to K applications (Field 1), Gongzhuling city, Jilin.

Treatments $N-P_2O_5-K_2O$, kg/ha	Average yield, kg/ha	Yield increase, kg/ha	Net profit, Yuan/ha	Coefficient of variation, %
200-100-0	8,614	–	–	3.71
200-100-75	8,908	294	34	11.40
200-100-150	10,242	1,628	589	7.11
200-100-225	9,861	1,247	286	10.96

$LSD_{0.05}$ = 1,774.

Profit-based Potassium Fertilizer Recommendations

Potash application increased corn yields harvested from all three fields. Yield increases ranged from 294 to 1,950 kg/ha with a best average yield increase of 1,633 kg/ha for the three fields. (Yields in Field 1 were not significantly different.) The relative yield increases ranged between 3.4 to 25.6 percent, which was consistent with results of pot experiments conducted earlier with the same soils.

The most profitable yield was not always the highest yield since the added cost of K fertilizer did not always produce that value in additional crop. The most profitable, therefore, recommended rates of K application for fields 1, 2 and 3 were 150, 150, and 169 kg/ha K_2O, respectively, giving respective profits of 589, 560, and 338 Yuan/ha.

Conclusions

Using the systematic approach to determine the soil nutrient status as proposed by the PPI/PPIC China Program disproved local scientific and official opinion that K supplies are adequate in these northern China soils. In fact, the black soils of moderate fertility at Liufangzi, Gongzhuling city had already become deficient in K and were limiting corn production.

The application of 150 to 169 kg/ha K_2O could increase corn yield by 1,200 to 1,600 kg/ha (12 to 21 percent). These data show that, at the recommended rate of potash, 1 kg of K_2O increases corn yield by 10.8 kg. Net profit to farmers was increased by 338 to 589 Yuan/ha. If this recommendation could be used on only 20 percent of the corn crop grown on similar black soils, 751,000 t of additional corn would be produced, providing farmers an additional 228 M Yuan in income. BCI

Table 2. Average corn yield responses and net profit to K applications (Field 2), Gongzhuling city, Jilin.

Treatments $N-P_2O_5-K_2O$, kg/ha	Average yield, kg/ha	Yield increase, kg/ha	Net profit, Yuan/ha	Coefficient of variation, %
360-120-0	7,614	–	–	9.91
360-120-150	9,183	1,569	560	4.07
360-120-300	9,564	1,950	525	6.95

$LSD_{0.05}$ = 1,416.

Table 3. Average corn yield responses and net profit to K applications (Field 3), Gongzhuling city, Jilin.

Treatments $N-P_2O_5-K_2O$, kg/ha	Average yield, kg/ha	Yield increase, kg/ha	Net profit, Yuan/ha	Coefficient of variation, %
240-120-0	10,026	–	–	6.58
240-120-113	10,615	589	125	3.40
240-120-169	11,208	1,182	338	1.00
240-120-263	10,626	600	-94	3.57
240-120-375	11,346	1,320	98	0.73

$LSD_{0.05}$ = 981.

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Reference

Portch, S. 1988. Greenhouse/Screenhouse Soil Nutrient Survey Procedures. (Mimeograph), Potash & Phosphate Institute, Hong Kong.