High Quality Maize Response to Nitrogen, Phosphorus, and Potassium in Jilin

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Recently, high oil maize and high starch maize hybrids have been introduced to northeastern China. Gradually, more attention is being given to management practices to boost their performance.

Jilin Province is often considered the "maize belt of China" since the crop accounts for 50 to 60% of its cultivated area. Maize also consumes 65 to 75% of the total amount of commercial fertilizers applied in the province. Although significant scientific and technological achievements have been made regarding the fertilization of maize in Jilin, little fertilization research on high oil and high starch maize has been conducted. This research investigates if and how starch or oil content can be altered in these maize types through specific nutrient applications on Jilin's black soils.

All experimental treatments were arranged in a randomized complete block design with three replications. Plots were 20 m^2 with ridges set at distances of 0.6 to 0.65 m. The soil was characterized as having 2.1% organic matter (OM) and a pH of 5.5. Available soil nitrogen (N), phosphorus (P), and potassium (K) were 113.7, 20.3, and 123.4 mg/kg, respectively. A high oil hybrid, Tongyou 1, was planted at a density of 45,000 plants/ha; the high starch hybrid Zhengdan 21 was planted at 50,000 plants/ha. The fertilizers used were urea, diammonium phosphate (DAP), and potassium chloride (KCl).

The experimental treatments are shown in **Table 1**. All of the P and K and one-fourth of the N were applied at planting, with the remaining N applied as topdressing. The crop was planted in late April and harvested in late September. Plots were hand weeded and disease and insect problems managed with pesticides, as needed.

Potassium deficiency is shown on the right in each of these photos. The hybrids are Zhengdan 21 (high starch) in photo at left and Tongyou 1 (high oil) in photo at right.

Yield and Income Benefit

Nitrogen, P, and K uptake by the two maize hybrids was substantially greater than by hybrids used for normal purposes. The yield increase produced by the balanced NPK application was significantly higher than the treatment without fertilizer in both maize hybrids. However, both the yield increase (2,637 kg/ha or 39.6%) and profit (US$155/ha) in Zhengdan 21 were higher than those realized in

Table 1. Average yield and profit for specialty maize hybrids, Jilin.

	Yield, kg/ha		Yield increase, kg/ha		Net profit, US$/ha	
N-P_2O_5-K_2O, kg/ha	Tongyou 1	Zhengdan 21	Tongyou 1	Zhengdan 21	Tongyou 1	Zhengdan 21
0-0-0	5,947	6,665	0	0	0.0	0.0
195-75-90	7,589	9,302	1,642	2,637	52.0	155.4
0-75-90	6,871	8,573	924	1,908	51.6	153.8
195-0-90	6,341	7,667	394	1,002	-54.2	9.0
195-75-0	7,194	8,923	1,247	2,558	31.8	136.8

Tongyou 1 $LSD_{0.01}$ = 1,012, $LSD_{0.05}$ = 696; Zhengdan 21 $LSD_{0.01}$ = 1,312, $LSD_{0.05}$ = 902
Prices: N= US$0.38/kg, P_2O_5 = US$0.31/kg, K_2O= US$0.23/kg, Maize= US$0.10/kg

Tongyou 1 (1,642 kg/ha or 27.6% and US$52/ha) when balanced formulations of NPK fertilizers were applied. The response of the high starch type to N, P, and K was different from the response of the high oil maize hybrid. The salient results are presented in **Table 1** and summarized as follows.

- Under the zero N treatment (0-75-90), both the high oil and high-starch types responded to P and K by significantly increasing yields by 924 kg/ha and 1,908 kg/ha, (15.5% and 28.6%), respectively, as well as profits by US$51.6 and 153.8/ha.
- With the zero K treatment (195-75-0), yields were somewhat lower than, but not significantly different from, the yields obtained with the full NPK treatment. This indicates lesser responses to K, although the effect of omitting K appeared to be greater in the high oil hybrid type. The same trend was evident when considering economic impact of omitting K.
- In the zero P treatment (195-0-90), yield was significantly restricted in Tongyou 1, which resulted in a net loss in income. Although both yield and net profit were comparatively higher in Zhengdan 21, the omission of P had the greatest impact of all the nutrients on yield and profitability.
- The order of impact of N, P, and K, in the various combinations used and for both maize types, was NPK>NP>PK>NK.

Conclusions

The 'fertilizer nutrient susceptible' characteristics were different for high oil and high starch maize. Application of NPK fertilizers had significant yield increase effects on both types. Although omitting either N or K had substantial yield and income reducing effects, they had less impact than the omission of P. The best yields and profits were realized with full and balanced NPK fertilization. The high oil hybrid Tongyou 1 was lower-yielding than the high starch hybrid and was more responsive to N and P than to K, whereas the high starch hybrid was less affected by the omission of K. BC

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