Phosphorus and Sulfur Fertilization of Corn in the Northern Pampas

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Research shows that higher phosphorus (P) rates are needed for high yielding corn in the northern Pampas of Argentina. Sulfur (S) responses are significant in intensively cropped soils.

This study evaluated the effect of S fertilization on corn yields and its interaction with P fertilization under no-tillage in central Santa Fe province.

Nitrogen (N) and P are commonly deficient for crop production in this area of the country. Preliminary work indicated that S may also be deficient in these soils. High crop yields and intense row crop production have decreased native soil fertility because rates of nutrient extraction are usually higher than nutrient application. Although P deficiency has been recognized in the area, P application rates are usually low. It is also expected that responses to S could generate higher demands for nutrients such as P.

Sulfur, essential for plant growth and development, is considered a secondary nutrient because it is generally required in lower amounts than N, P, and potassium (K). Most of the S in soil is in organic form. Thus, decreases in soil organic matter will lower S availability. High yield production systems that sustain soil organic matter content and fertilizer management practices which replace S and other nutrients removed in the grain and stover are critical to maintaining efficient cropping systems.

Materials and Methods

A field experiment was established at San Carlos, Santa Fe, an area with an intense cropping history and reported responses to N and P in crops such as corn, wheat and grain sorghum.

Corn, *cv. Tilcara*, was planted September 9, 1998 at a density of 62,000 seeds/ha in 70 cm rows. Soybean was the previous crop. At planting, the soil contained 3.0 percent organic matter, 0.16 percent total N, 6.8 parts per million (ppm) nitrate-N (NO_3-N), 19.4 ppm P (Bray-1), 7.0 ppm sulfate-S (SO_4-S), and had a pH of 6.2. Available soil water was 82 mm, and 612 mm of precipitation fell between August 1998 and March 1999.

Experimental corn trial in vegetative stages, San Carlos, Santa Fe.

Treatments included two P rates: 10 kg P/ha (P10), the rate generally used in the area, and 30 kg P/ha (P30), a replacement rate based on expected

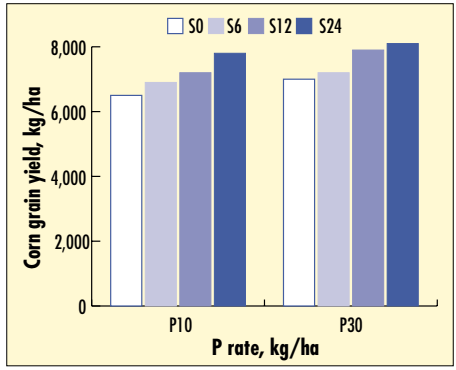

Figure 1. Grain yield for the different P and S combinations at San Carlos, Santa Fe. Tukey value (5%) 301 kg/ha; CV 9%.

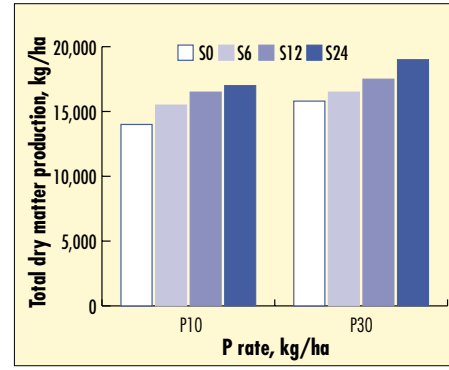

Figure 2. Dry matter production at harvest at San Carlos, Santa Fe. Tukey value (5%) 545 kg/ha; CV 11%.

corn yield. Phosphorus rates were combined with four S rates: 0, 6, 12, and 24 kg/ha (S0, S6, S12, S24), in a factorial arrangement. The experiment used small plots (3.5 x 10 m) in a randomized complete block design with three replications. Phosphorus was applied as triple superphosphate (TSP), S as ammonium sulfate [$(NH_4)_2SO_4$]. Calcium nitrate [$Ca(NO_3)_2$] was used to bring the N rate of all treatments up to 90 kg/ha.

Experimental corn trial during grain filling, San Carlos, Santa Fe.

Results and Discussion

Phosphorus and S fertilization significantly increased grain yields and total dry matter production at harvest. The highest values for both variables were observed with the 30 kg P/ha and 24 kg S/ha rates. There was no interaction between P and S for either grain yield or dry matter (**Figures 1** and **2**). The harvest index (grain yield/total dry matter production) averaged 0.45 and was not affected by P or S fertilization.

Grain yield response to S fertilization was 67, 69, and 48 kg per kg S applied for the S6, S12, and S24 rates, respectively. Such a response may be expected from the lower levels of soil SO_4-S at planting and the previous history of intense cropping that could decrease labile organic S pools. Average response to P was 26 kg grain per kg of P. This response was significant even though soil test P was medium to high, indicating that higher rates than normal should be considered for a sustainable and profitable corn production system.

The use of low P rates results in soil P losses. In this experiment, it is estimated that 20 kg P was removed by the 6,500 kg/ha grain produced by the P10 and S0 treatment. Thus, a soil P loss of 10 kg was generated. Application of 30 kg P contributed to soil P buildup even with high yields; an extraction of 24 kg P in grain was estimated for the P30 and S24 treatment (8,160 kg/ha).

Economic Analysis

The net margin for the different P and S combinations was estimated

from nutrient and crop prices, nutrient rates, and yield responses. The calculation assumed Argentina prices as of December 1999: US$1.50/kg P, US$0.89/kg S, and US$0.06/kg corn (includes all discounts for commercialization).

Net margin increased with the increase in P and S rates (**Figure 3**). The highest net profit was obtained with the P30 and S24 combination. The increase in grain yield will also result in a lower impact from other costs (for example, land, seed, tillage operations, herbicides, insecticides, etc.), and thus higher profits.

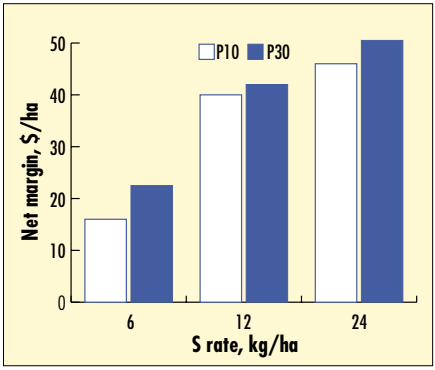

Figure 3. Net margin for the P and S treatments evaluated in the experiment at San Carlos, Santa Fe.

Conclusion

This study has shown that with any high yielding crop, the use of low P rates results not only in soil P losses but also in decreased profitability. Results also encourage fertilization studies with S. Future research should determine guidelines to predict S deficiencies. Ongoing field experiments at other locations of the Pampean region of Argentina indicate a weak relationship between soil SO_4-S availability at planting and S fertilization response. **BCI**

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World Population Reaches 6 Billion

The world's population increased to over 6 billion people on October 12, 1999, according to the United Nations. While the population growth appears to be slowing, it is still adding more than twice as many people as were added annually at the middle of the 20th century.

In 1950, world population reached a total of 2.56 billion. The graph shown here tracks the number at each decade since then. While tremendous progress in food and fiber production has eased concerns in many areas of the world, the challenge of improving practices and developing more efficient crop and soil management systems continues. **BCI**