Identifying Fertilization Needs for Soybean in Argentina

By F.H. Gutiérrez-Boem, J.D. Scheiner, and R.S. Lavado

This research shows that phosphorus (P) and sulfur (S) fertilizers can increase soybean yields in a region where few farmers fertilize this crop. However, current information is insufficient to develop a fertilizer recommendation program.

Soybean is a relatively new crop in Argentina. In 1970, only 37,000 ha were produced in the country. Since then, the area planted has grown steadily, reaching 7.8 million ha in 1998. The main production region is the Pampas, where the predominant soils are Typic Argiudolls and Hapludolls.

Traditionally, fertilizer use has been very low due to high fertilizer:grain price ratios (two to three times higher than in U.S.) and the popular belief that soils of the Pampas have unlimited fertility. During the last two decades, increasing cropland at the expense of pastures and low levels of fertilization has led to nutrient depletion of Argentine soils. Farmers have shown an increasing concern about soil fertility and the potential for economic crop response to balanced fertilization. Consequently, fertilizer use has increased five-fold since 1991, greatest increases being in wheat and corn.

Soybean is currently the most important grain crop in Argentina, but few Argentine farmers fertilize their soybeans. They are reluctant to adopt this practice because of a lack of information about the crop's response to fertilization. Therefore, studies to assess the effects of nitrogen (N), P and S fertilization are considered quite timely.

Figure 1. The Pampas region has great potential for intensive crop production.

Three field experiments were conducted during the 1998-1999 season, at the center of the Pampean Region (**Figure 1**). Sites were located at Junin on a sandy loam soil with 5 parts per million (ppm) Bray P-1 and 14 ppm sulfate-S (SO_4-S), at Viamonte on a loam soil with 12 ppm P and 18 ppm SO_4-S, and at Obligado on a loam soil with 22 ppm P.

There was no yield response to the use of starter N (18 kg N/ha) on any soil. Starter N increased aboveground biomass by 14 percent, leaf area by 13 percent, and radiation interception by 10 percent at Viamonte at flowering, but this enhancement of early growth by N addition did not translate into higher grain yields. Differences in radiation interception

disappeared two weeks after flowering, suggesting that the effect of N was most evident during vegetative growth, a period not too important for yield formation in soybean.

Another alternative for N management is late-season application. Here, the objective is to retard N translocation from leaves to seeds and, consequently, leaf senescence. As N fixation decreases during seed filling, it was hypothesized that late-season fertilization would not affect symbiotic fixation, but would still provide a source of N to match seed demand. To test this hypothesis, 50 and 100 kg N/ha were applied as urea at pod formation (R3) or beginning of seed filling (R5) at Obligado. Neither rate nor application time had any effect on yield. Seed yields approached 2,600 kg/ha. Other researchers have reported positive response to late-season N fertilization in higher yielding environments. It seems that N fixation provided enough N for our level of yields.

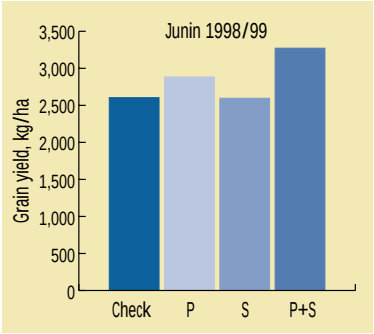

Figure 2. Soybean grain yield as influenced by the addition of P (20 kg/ha) and S (10 kg/ha) at Junin.

Figures 2 and **3** show results of a factorial combination of P (as triple superphosphate) and S (as calcium sulfate) at Junin and Viamonte. Both fertilizers were applied at planting. Phosphorus was banded to the side and below the seed. Sulfur was applied as a broadcast application.

Phosphorus fertilization increased yields by 300 kg/ha, or 11 percent above the check at Junin, where soil P level was 5 ppm (**Figure 2**). However, at Viamonte where soil P was 12 ppm, there was no response to P (**Figure 3**). Other researchers working in the region have reported that the probability of a yield response to applied P increased when soil test P was below 9 ppm.

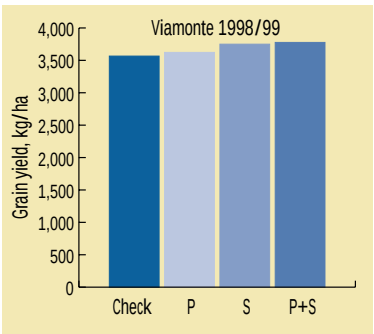

Figure 3. Soybean grain yield as influenced by the addition of P (20 kg/ha) and S (10 kg/ha) at Viamonte.

Sulfur fertilization increased yields at both locations. At Viamonte, adding S increased yield by 200 kg/ha, or 5 percent above the check (**Figure 3**). At Junin, where soybeans responded positively to applied P, a combination of S+P yielded 670 kg/ha more than the non-fertilized check (**Figure 2**), a 25 percent yield increase. More than half of that yield gain could be attributed to S addition (difference between P and P+S treatments). It seems that yield response to S fertilization took place only when P requirements were satisfied either by the soil (Viamonte) or by the fertilizer (Junin).

These results show that it is reasonable to expect significant yield increases due to P or S fertilization in a region where farmers have not traditionally used these nutrients. They also demonstrate the additive effect of balanced fertilization. Further experimentation is needed to develop appropriate recommendation programs. **BCI**

The authors are researchers at the College of Agronomy, University of Buenos Aires, Av. San Martín 4453, 1417 Buenos Aires, Argentina. E-mail: gutierre@mail.agro.uba.ar; scheiner@mail.agro.uba.ar; lavado@ifeva.edu.ar. Phone/Fax: (54-11) 4524-8076.