

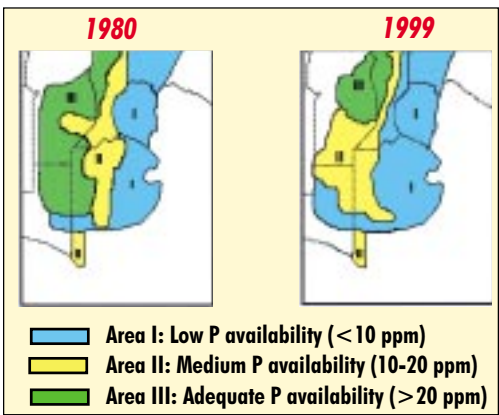
Phosphorus Balance in the Argentinean Pampas

By Fernando O. García

Increased crop production and limited phosphorus (P) fertilizer use have diminished soil P levels and created negative soil P balances in the Argentinean Pampas. Maximum economic yields require adequate soil P supply. Research has quantified the decline in soil available P under low P replenishment management and is highlighting the benefits of adequate fertilization programs.

Soil tests in the Pampas region of Argentina, the main grain producing area of the country, show continual declines in soil P levels (Figure 1). This decrease is attributed to increased crop production and

Figure 1. Soil P availability in the Pampas of Argentina for 1980 and 1999...parts per million (ppm). Source: N. Darwich (1983) and N. Darwich (personal communication, 2000).

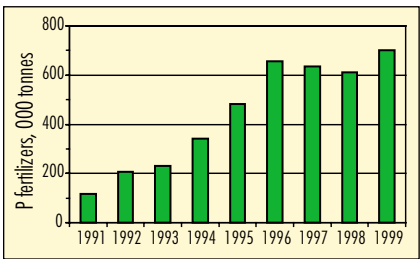


limited use of P fertilizers. Low P replenishment has not been overcome by the observed increase in fertilizer consumption during the 1990s (Figure 2).

An estimate of P removal by harvested grain for the four main grain crops of the Pampas (soybeans, corn, wheat and sunflower) is compared with actual P consumption

in Figure 3. Phosphorus consumption represented 43 to 56 percent of the P removal by grain for the last three years. Levels of fertilizer use by these crops would need to be approximately 1.2 million tonnes of diammonium phosphate (DAP) to reach a zero balance (i.e., 100 percent replenishment).

Figure 2. Apparent consumption of phosphate fertilizers in Argentina during the period 1991-1999. Source: SENASA-SAGPyA. (National Service of Agricultural Health – Secretary of Agriculture, Livestock, Fisheries, and Food).



At the farm level, P balance between grain removal and fertilizer application varies, depending on the technical level of the farmer, the crop, and primarily, the price of grain. Table 1 shows P balances for typical three-year rotations of northern

Buenos Aires-southern Santa Fe and southern Buenos Aires. The losses of soil P are 36 and 15 kg P/ha for the northern and southern areas, respectively.

Research carried out at Balcarce (Buenos Aires Province, southern Pampas) by Angel Berardo and co-workers shows the effect of decreasing soil P levels on grain yields of corn, soybeans, and wheat (Figure 4). Residual P studies in a seven-year continuous wheat sequence estimated an imbalance of negative 9 kg P/ha (difference between P removal in grain and P applied), which resulted in an average annual decrease of 1 ppm soil Bray P-1 (Berardo and Grattone, 1998). Considering this rate of soil P loss, farmers following Situation A in Table 1 are losing 4 ppm every three years, and farmers following Situation B are losing 1.7 ppm P every three years.

This research also showed how decreasing soil P levels (Figure 5) resulted in steady declines in wheat yield (Figure 6). In comparison to the 22R treatment (annual applications of 22 kg P/ha during seven years of the study), relative grain yields for the 0 (control) and 88 kg P/ha (applied in the first year only) treatments decreased by 2.4 and 5.2 percent per year, respectively.

Summary

Field research and experimentation have shown the agronomic and economic advantages of P fertilization

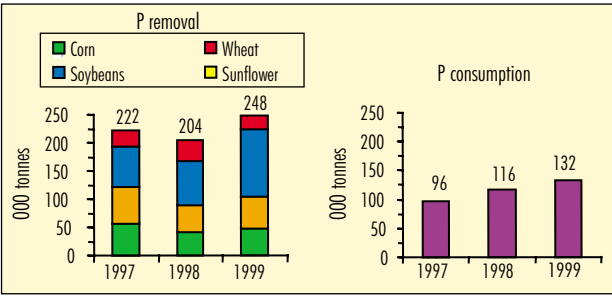


Figure 3. Estimated P removal in grain and apparent P consumption in the four main grain crops of the Pampas in 1997, 1998 and 1999. Extracted from data of SENASA-SAGPyA and Project INTA Fertilizar.

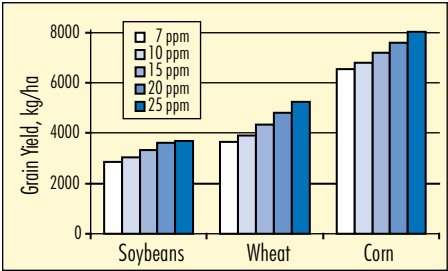


Figure 4. Grain yields of soybeans, wheat and corn at different levels of soil Bray P-1 content at southeastern Buenos Aires (Argentina). Adapted from Berardo et al. (1999), Berardo et al. (2000) and A. Berardo (personal communication, 2000).

Table 1. Phosphorus balances for two typical three-year rotations of the northern Pampas (A) and the southern Pampas (B).

A. Northern Pampas, Rotation Wheat/Soybeans-Corn-Soybeans						
Crop	Yield, t/ha	P uptake, kg P/tonne	P harvest index	P grain removal, kg P/ha	P applied ¹ , kg P/ha	Difference, kg P/ha
Wheat	2.5	5	0.75	9.4	16	
Soybeans II	2.2	8	0.80	14.1		
Corn	8.0	4	0.75	24.0	16	
Soybeans I	3.2	8	0.80	20.5		
Total				67.9	32	-35.9
B. Southern Pampas, Rotation Wheat-Corn-Soybeans						
Crop	Yield, t/ha	P uptake, kg P/tonne	P harvest index	P grain removal, kg P/ha	P applied, kg P/ha	Difference, kg P/ha
Wheat	4.0	5	0.75	15	20	
Corn	8.0	4	0.75	24	20	
Soybeans	2.5	8	0.80	16		
Total				55	40	-15.0

¹P applied was estimated at 80 kg/ha of DAP for wheat and corn in the northern Pampas and 100 kg/ha of DAP for wheat and corn in the southern Pampas.

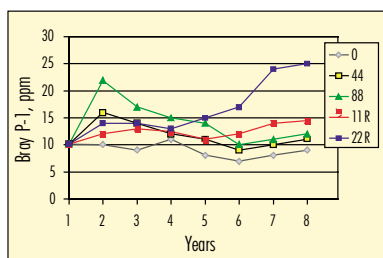


Figure 5. Changes of soil Bray P-1 in five P fertilization treatments in a seven-year sequence of continuous wheat in the southern Pampas. Treatment 0 is the control; 44 and 88 are applications of 44 and 88 kg P/ha in the first year; and 11R and 22R are annual applications of 11 and 22 kg P/ha. Balcarce (Buenos Aires). Adapted from Berardo and Grattone (1998).

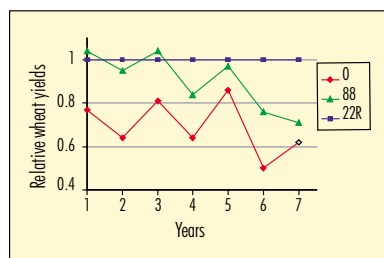


Figure 6. Relative wheat yields of three P fertilization treatments in a seven-year sequence of continuous wheat in the southern Pampas. Treatment 0 is the control; 88 is one application of 88 kg P/ha in the first year; and 22R is an annual application of 22 kg P/ha. Balcarce (Buenos Aires). Adapted from Berardo and Grattone (1998).



Without adequate fertilizer application based on soil testing, soil P levels will drop and yields of wheat and other crops will decrease in the Pampas region of Argentina.

experimentation. However, soil sampling is the first step to improving soil P management. **BCI**

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