No-Tillage in the Pampas of Argentina: A Success Story

By Fernando O. García, Martín Ambroggio, and Victor Trucco

No-tillage (NT) in Argentina has developed into a successful management system in the Pampas region. AAPRESID (Asociacion Argentina de Productores en Siembra Directa), a national no-tillage farmer and agronomist association, has driven this expansion with the collaboration of the Instituto Nacional de Tecnologia Agropecuaria (INTA) and other agricultural institutions and companies. Sustainable higher yields under NT require improved nutrient management.

The Pampean region, originally a temperate subhumid grassland, is the main cropland area of Argentina with approximately 34 million ha, one third cropped to annual cereal and oil crops. The region includes part of Buenos Aires, La Pampa, Santa Fe, Córdoba, and Entre Ríos provinces. Mean annual temperature is 17 to 18°C in the north and 14°C in the south. Average annual precipitation varies from 500 to 600 mm in the southwest to more than 1,000 mm in the northeast, mainly concentrated between December and March, with July and August being the driest months (Hall et al., 1992).

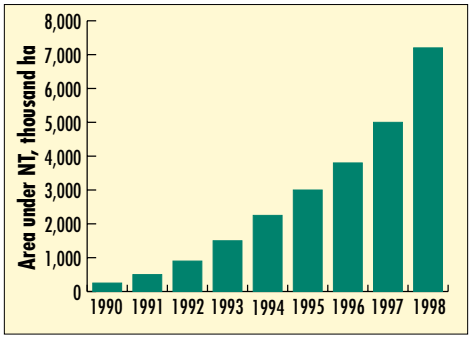

Figure 1. Evolution of the area planted under no-tillage in Argentina during the period 1990-98. Source: AAPRESID (1999).

Soils are classified as Mollisolls of udic and thermic regimes. The most representative soils in a northeast-southwest transect are Vertic Argiudolls, Typic Argiudolls, Typic Hapludolls, and Entic Hapludolls according to the gradient of precipitation and texture of the parent material (loess). The southern Typic Argiudolls are associated with soils developed over caliche (calcium carbonate) with depth limitations for root development.

The Growth of No-Tillage in Argentina

The first experiences under NT in Argentina started at INTA experiment stations at Anguil (La Pampa) and Pergamino (Buenos Aires) in the 1960s (Panigatti, 1998). The main problems observed at that time were related to weed control, residue management, and seeding equipment. Introduction of the herbicide glyphosate, the development of planters and drills, and the technologies developed and adapted by INTA and other governmental and private institutions have allowed the sustained increase of area under NT since the early 1990s (**Figure 1**).

Table 1. Area under NT for several annual crops in the main producing provinces/regions of Argentina during the 1998/99 growing season.

Province/ Region	Crop: Wheat	Soybean	Corn	Sorghum	Sunflower	Ann. Forages	Total
	ha						ha
Santa Fe	291,300	1,492,700	225,700	62,000	27,300	19,700	2,118,700
Buenos Aires	518,300	829,700	286,500	8,700	106,200	155,000	1,904,400
Córdoba	230,600	1,035,900	352,100	97,000	130,300	118,100	1,964,000
Entre Ríos	135,500	187,600	93,800	21,100	33,800	87,000	558,800
La Pampa	57,400	600	83,100	16,700	58,800	93,000	309,600
Santiago del Estero	2,400	92,800	39,100	27,500	–	500	162,300
Northwest	28,700	138,100	65,500	3,900	–	4,100	240,300
Northeast	3,000	5,100	2,300	1500	–	–	11,900
Total under NT	1,267,200	3,782,500	1,148,100	238,400	356,400	477,400	7,270,000
Total area	5,870,415	6,873,930	3,522,280	809,700	3,302,310	2,517,600	22,896,235
Percent under NT	22	55	33	29	11	19	32

Source: AAPRESID (1999).

Presently, the total area under NT is estimated at 7.2 million ha, which represents more than 30 percent of the total annually cropped area (AAPRESID, 1999).

Over 80 percent of the total national area under NT is in the provinces of Santa Fe, Córdoba, and Buenos Aires in the Pampean region (**Table 1**). The province of Entre Ríos has greatly increased NT in the last three years with approximately 50 percent of the total cropped area under NT, mainly because of the introduction of soybean varieties resistant to glyphosate. Other regions in the country with high adoption of NT are the northwest provinces of Tucumán and Salta.

Highest NT adoption has been with soybean at approximately 55 percent of the total soybean area (**Table 1**). Seventy percent of the double-cropped soybean area (after wheat harvest) is planted under NT. Corn and sorghum follow soybean with the next highest adoption at approximately 30 percent of their respective total cropped areas. For wheat and other winter crops, the area under NT is estimated at approximately 20 percent of the total area dedicated to these crops. Sunflower is the crop least affected, occupying about 10 percent of its total area (AAPRESID, 1999).

The growth of NT in the Pampas has been based on technical as well as economic aspects. The direct costs for establishing crops such as corn, soybean and wheat under NT are lower than or similar to conventional tillage (**Table 2**), and the income is greater because of higher yields (**Table 3**). Several studies have shown greater and more stable fertilization responses for NT, especially under low water availability.

Table 2. Direct costs for corn, soybeans and wheat under conventional and no-tillage in the Pampas region.

Crops	Direct costs: Conventional tillage	No-tillage
	US$/ha	
Corn	226	209
Soybean	184	169
Wheat	122	121

Source: Agromercado, September 1999.
Does not include harvest and commercialization costs.

AAPRESID: A Net of Innovative Farmers

AAPRESID has driven the expansion of the NT system with the

Table 3. Corn and soybean yields under different tillage systems. Field experiments at EEA INTA Marcos Juárez (Córdoba) and EEA INTA Famaillá (Tucumán).

	EEA Marcos Juárez – Corn yields, kg/ha[1]		
	Conventional tillage	Reduced tillage	No-tillage
Corn/soybean rotation	8,467	8,988	9,334
	EEA Famaillá – Corn yields, kg/ha[2]		
	Conventional tillage	Vertical tillage	No-tillage
Corn/soybean rotation	3,072	2,874	3,352
Soybean/soybean/corn rotation	3,038	2,991	3,232
Continuous soybean	2,647	2,841	2,969

Source: Ferrari, 1998 and Sánchez et al., 1998.
[1]Typic Argiudoll
[2]Typic Haplustoll

support of INTA and several agricultural companies and institutions. The objective of the association is to exchange knowledge and experiences on NT systems among farmers and agronomists. To fulfill this purpose, AAPRESID organizes field days, seminars, technical meetings, and an annual congress in which local and foreign specialists, farmers and agronomists participate (**Figure 2**). The information of these different meetings is reported in publications such as bulletins, books and proceedings.

Crop Fertilization under No-Tillage

In general, soils of the Pampean region are deficient in nitrogen (N) and phosphorus (P), but well provided with potassium (K), calcium (Ca), and magnesium (Mg) under native conditions. In recent years, sulfur (S) responses have been observed in several crops, mainly in areas under intensive cropping (high grain yields and longer periods under row crop agriculture).

Fertilizer use has sharply increased in Argentina in the last seven years, from 0.3 million tons in 1991 to almost 1.5 million tons in 1998. However, despite this increase, nutrient replacement from fertilization is still much below crop removal in the Pampas. An estimated 25 percent of the N and 45 percent of the P exported in grains by the four main annual crops of the Pampas are replaced by fertilization. Fertilizer rates are usually low and, generally, only N and P are applied. The low nutrient replacement has resulted in a considerable decrease of the native soil fertility; thus, fertilization is a necessary practice to get optimum yields.

Figure 2. A field day organized by AAPRESID: Seminar presentation (left) and field demonstration (right).

Field trials conducted by AAPRESID in collaboration with other institutions (INTA, INPOFOS, AACREA) and several companies have shown significant responses to N, P and S fertilization under conditions in which farmers usually will not fertilize or use reduced nutrient rates.

Fertilization trials carried out at southern Santa Fe show excellent responses to P. A soybean trial (**Figure 3**) compares the usual practice of fertilization [70 kg/ha diammonium phosphate (DAP) at planting] with an extra application of 150 kg/ha DAP as a pre-plant in a low P soil. A wheat trial (**Figure 4**) showed the need for balancing preplant N and S with adequate P to obtain higher yields and increased fertilizer use efficiency.

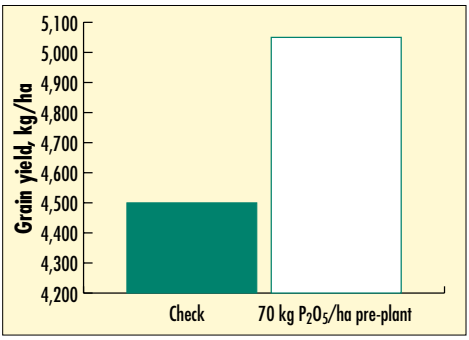

Figure 3. Response of full-season soybean to pre-plant P fertilization (D. Sebastian farm, Santa Fe). Both treatments had 32 kg P_2O_5/ha applied at planting. Source: AAPRESID

Higher yields obtained under NT require improved nutrient management. AAPRESID is working with INTA, INPOFOS and fertilizer companies in a series of long-term fertilization experiments to improve crop nutrition in high yielding cropping systems. **BCI**

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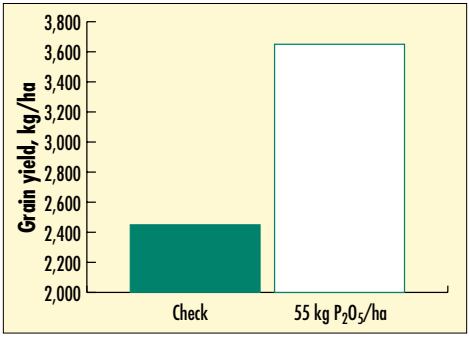

Figure 4. Response of wheat to P fertilization (Nonino farm, Santa Fe). Both treatments had 120 kg/ha of urea and 80 kg/ha of ammonium sulfate applied at pre-planting. Source: AAPRESID