Rice Management and Fertilization in Entre Ríos Province

By Juan José De Battista

In the Entre Ríos rice production area, nitrogen (N) is the most limiting nutrient. Phosphorus (P) is usually supplied by the soil due to flooding. Response to potassium (K) is usually minimal.

Table 1. Rice in Argentina: area and production (1999/2000).

	Area		Production	
Province	'000 ha	% of country total	'000 t	% of country total
Entre Ríos	90.0	50.8	371.0	47.8
Corrientes	60.0	33.9	310.0	40.0
Santa Fe	15.6	8.8	50.5	6.5
Chaco	6.0	3.3	22.8	2.9
Formosa	5.1	2.9	20.1	2.6
Others	0.5	0.3	1.4	0.2
Total	**177.0**	**100.0**	**776.0**	**100.0**

Rice in Argentina is grown primarily in the region between 27° and 33° south latitude and predominantly in the provinces of Entre Ríos and Corrientes, where almost 85 percent of total production is located (**Table 1**). The highest concentrations of production are in the north and central zones (**Table 2**).

Rice area and production in Entre Ríos in the 1992-99 period increased through 1998 then declined in 1999 because of low prices (**Figure 1**).

Approximately 400,000 tonnes of rice are annually consumed in the Argentinean market, with the remaining being exported mainly to Brazil, Iran and Peru.

Table 2. Area and production in Entre Ríos rice zones, 1999/2000.

Zone	Area, ha	Production, t
Northwest	5,400	17,000
North	35,100	160,000
Central	45,000	177,000
South	4,500	17,000

Mean yields have been trending upward and increased from 4.6 t/ha in 1992 to 5.5 t/ha in 1999, with variations from year to year associated with climatic conditions. Low temperatures and rainy and cloudy days between the boot stage through to ripening diminish the percentage of matured grain and increase diseases such as *Pyricularia oryzae*.

Climate Entre Ríos can generally be characterized as having a wet, temperate climate, although the northern zone has a wet subtropical climate. Daily mean temperature is 18.5°C, with a maximum of 25°C in January and a minimum of 12.3°C in June. Annual precipitation of 1,200 mm is concentrated from October to April (73 percent of the total). Air humidity is greater than 70 percent.

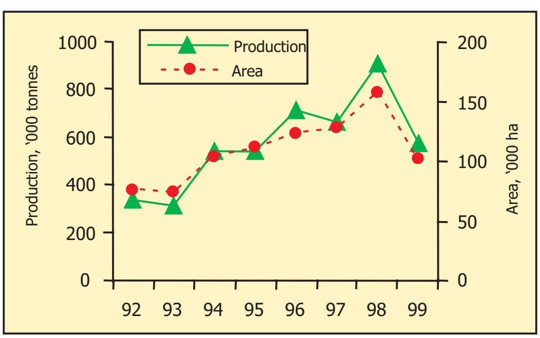
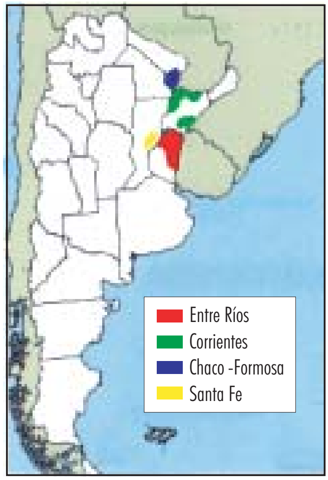


Figure 1. Rice in Entre Ríos: area and production, 1992 to 1999.

Soils Northwest and north zone plains are Alfisols and Vertisols, characterized by a high montmorillonitic clay (40 to 50 percent) content in the B horizon, slow permeability, and hydromorphic conditions. Central and southern zone soils are undulating (slopes, 0.3 to 2 percent) Vertisols and Mollisols. The Vertisols show "gilgai" micro relief produced by expansion and contraction caused by changes in soil moisture. Mollisols have a silty clay loam, superficial horizon, and a clay B horizon similar to Vertisols. Vertisols are characterized by variable organic matter content (3 to 7 percent), higher than Mollisols, a low level of available P—less than 8 parts per million (ppm) Bray & Kurtz P-1—medium to high level of exchangeable K (greater than 250 ppm), and a total N content associated with soil use history (0.17 to 0.22 percent).



Rice producing zones in Argentina.

Production practices Rice is planted over a period of four months, from September to December. Drained soils are cultivated and leveled, and ditches are built six months prior to planting so pre-plant vegetation establishes before seeding. In the last decade, the availability of no-till seed drills has modified tillage practices whereby pre-plant vegetation is controlled with the herbicide glyphosate, and rice is seeded directly into the desiccated vegetation. Most commonly, 50 kg/ha of diammonium phosphate is applied with the drill at planting and 50 kg/ha of urea is top-dressed at panicle differentiation by aerial application. The irrigation schedule consists of one or two flushes during seedling growth to establish an adequate rice stand. Permanent flooding is established 30 to 40 days after emergence with 5 to 10 cm of water table until 15 days before harvest. In 70 percent of the rice area, irrigation water is pumped from deep wells (70 to 100 m) while the remaining area is irrigated with surface water, 25 percent from reservoirs and 5 percent from rivers.

Fertilization trials conducted during a 10-year period established the relationship between soil nutrient availability and rice yield response to N, P, and K fertilization. Randomized complete block experiments (three replications) were conducted on 50 farmer fields using four predetermined rice varieties: *San Miguel INTA, El Paso 144, IRGA 417,* and *Don Juan INTA*. Nitrogen rates of 0, 25, and 50 kg N/ha, as urea, were split-applied at tillering and panicle differentiation. Phosphorus rates of 0 and 30 kg P_2O_5/ha, as triple superphosphate, and K rates of 0 and 45 kg K_2O/ha, as potassium chloride (KCl), were applied at seeding.

Nitrogen fertilization improved yields in more than 70 percent of the trials. Mean responses were 23.4 and 15.7 kg rice per kg N for 25 and 50 kg N/ha rates, respec-

Rice fertilization trial at the central zone of Entre Ríos (variety IRGA 417, 20-day-old seedlings).

Table 3. Response frequency and mean yield response to N, Entre Ríos.

Varieties	N rate, kg/ha	Frequency R/N[1]	Frequency %	Mean response kg/ha	Mean response kg of rice/kg N
San Miguel INTA	25	6/8	75.0	453	18.1
	50	18/25	72.0	550	11.0
El Paso 144	25	9/12	75.0	540	21.6
	50	9/13	69.2	870	17.4
Don Juan INTA	25	3/7	42.9	710	28.4
	50	5/7	71.4	779	15.6
IRGA 417	25	3/5	60.0	632	25.3
	50	5/5	100.0	946	18.9

[1]R=response; N=number of trials

tively (**Table 3**). Yield increase was affected by variety, soil N supply capacity, amount of radiation during the reproductive phase, and management practices such as weed control and plant density.

Rice response to N was closely correlated with soil organic matter content. In 85 percent of the sites, yield responses to 50 kg N/ha were observed when soil organic matter was lower than 4.5 percent (**Figure 2**).

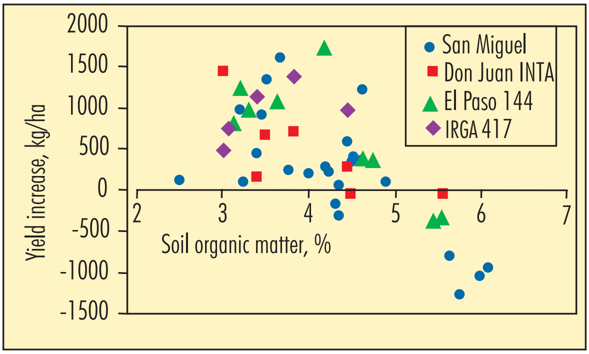


Figure 2. Relationship between soil organic matter content and rice yield increase with applications of 50 kg N/ha at Entre Ríos.

Phosphorus fertilization increased yields at 35 percent of the sites. The mean yield response varied from 8.7 to 29 kg rice per kg of applied P_2O_5. In most cases, soil P content was less than 8 ppm, and yield response was not associated with soil P content. When soils are flooded, reducing conditions mobilize P from ferric iron (Fe^{3+}) and aluminum (Al) phosphates to more labile forms and increases P mineralization from soil organic matter, both acting to satisfy the crop's P requirement.

Potassium fertilization increased yields in 20 percent of the trial sites. The mean yield response was 10.6 kg rice per kg of K_2O applied. The general lack of response to K application is attributed to high (greater than 250 ppm) soil exchangeable K content of the rice-growing soils.

Harvest of experimental plots at a farmer field.

Conclusions

Nitrogen is by far the most limiting nutrient in the Entre Ríos rice producing area. Results show it is reasonable to expect significant yield increases from N fertilization when soil organic matter content is below 4.5 percent. In most cases, P requirements are supplied by the soil, a positive effect due to soil flooding. Starter applications increase P uptake by the rice crop. Response to K fertilization was infrequent and minimal because of high soil exchangeable K contents. **BCI**

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