High Fertilizer Prices: What Can Be Done?

By José Espinosa and Juan Pablo García

In tropical areas of the Andean countries, Central America, and Mexico, thousands of hectares are cultivated with corn and rice, but low average yields are common. Production of corn grain is utilized to satisfy dietary needs of the population, but there is also an increasing demand for corn grain to be used as animal feed. From the standpoint of human and animal feed, this crop is strategic for all the countries in the region. During the last few years, global market conditions and low yields made corn production unattractive because corn grain could be imported at cheaper price than the grain produced locally. Conditions were more or less similar for rice in many countries of the region.

Unforeseen conditions in the global market have substantially increased international corn and rice prices and grain production has become profitable and essential for each country. However, the substantial increase in prices of fertilizer and other agricultural inputs has added pressure to agricultural production, causing questions and reservations of farmers and technicians regarding fertilizer management.

Corn and rice production in the region have faced several limitations over the last decades which explain the low productivity. Perhaps the more important limitation was the lack of incentive to produce which in turn depressed local markets and provided little motivation to develop and adopt technology.

Fertilizer recommendations used in the different corn producing areas of the region do not satisfy the nutrient needs of high yielding corn required to satisfy the public demand and to allow farmers to transform grain production in a profitable activity. Most of these recommendations are based on soil test calibration work conducted many years ago with different corn germplasm and in different growing conditions. In many cases, only one fertilizer recommendation is used for extensive areas of production, assuming that nutrient need is constant in time and space. Experience indicates that in general, corn and rice growers of the region don't use soil testing.

The lack of technology and the need to improve grain production in the region called for a new dynamic approach which quickly generates the information required to design fertilizer recommendations and nutrient management schemes to take advantage of the potential of the new corn hybrids and rice varieties developed for the tropics.

In the tropics, yield potential and nutrient needs differ among agro-ecological zones. This situation results in different growing conditions with different attainable yields which require different nutrient recommendations. The magnitude of the yield goal determines the total nutrient requirement. In 2006, a project to test a site-specific nutrient management approach (SSNM)…based on the omission plot technique (Witt, et al., 2006)…was initiated in the region. The goal was to study the influence of local agro-ecological conditions on nutrient requirements as a tool to develop fertilizer recommendations for achieving high sustainable yields in the particular conditions of tropical America. Projects were initiated in Colombia and Ecuador and later expanded to Mexico, Honduras, and El Salvador.

SSNM is an approach based on the plant that utilizes the omission plot technique to determine the yield obtained with only the soil reserves (omission plots) compared to the attainable yield obtained when nutrients are not limiting. The

Nitrogen omission plot beside a P omission plot at Santander, Colombia.

attainable yield becomes the yield goal for the next growing season. The N fertilizer requirement is then calculated from the yield difference between the complete plot and the N omission plot assuming an N agronomic efficiency (NAE) of 25 to 35 for corn and 18 to 25 for rice (AE = kg of grain/kg N).

Requirements for P and K are calculated based on yield goal, grain yield response to the nutrient, and nutrient removal. The recommended rate of fertilizer is tested and refined the following year along with other management practices which can improve fertilizer use efficiency. However, the rate can be used by farmers in the surrounding fields as the first approach to evaluate a recommendation which is based on a yield goal attainable for the site. This is a sound approach to cope with high fertilizer prices and to make grain production profitable in areas where soil testing is not used regularly (Dobermann et al., 2005).

Example for Colombia

Here is an example of the approach tested in Colombia. **Table 1** shows average yields of -N, -P, and -K omission plots, the complete treatment, and the farmer treatment for 2006 and 2007 at three sites in Colombia with different yield potential. This situation is common in the tropics where microclimates can markedly influence yield potentials. The Espinal site is located at the bottom of the Valley of the Magdalena River and is characterized for having high day and night temperatures which restrict yield accumulation. The other two sites (Antioquia and Bugalagrande) are at higher altitude and have cooler nights, conditions which allow greater yield potentials. The

Abbreviations and notes for this article: N = nitrogen; P = phosphorus; K = potassium.

average yields of the two growing seasons (2006 and 2007) at the complete NPK plots define attainable yield, which is then set as the yield goal for the next cropping season. This is a reasonable yield target because it reflects the effect of climate in yield accumulation. Yield goal also defines the magnitude of nutrient requirements. **Table 1** shows the calculated nutrient requirements to reach attainable yields at the different sites.

Farmers in the region are enjoying higher grain prices, but they also face a substantial increment in the prices of fertilizers and other agricultural inputs. Only high sustainable yields will allow farmers to take advantage of the situation and make grain production a profitable activity. **Table 2** shows a comparison of the cost and income of the attainable yield and the yield obtained with the farmer practice. Once an attainable yield goal is determined by field experimentation, the magnitude of the nutrient requirement and the fertilizer recommendation can be set. This recommendation can be refined over the years to make more efficient use of agricultural inputs.

The problems that corn cultivation has faced in tropical Latin America during the past decades have prevented the

Table 1. Grain yield in the omission plots and the complete treatment and calculated nutrient requirements for three sites located at different ecosystems in Colombia (2-year averages).

Treatments	Yield, t/ha	Yield increase, t/ha $R_X - R_0$
Espinal		
-N	1.6	4.8
-P	5.3	1.1
-K	5.8	0.6
NPK	6.4	
Farmer	4.8	
Yield goal = 6.4 t/ha		
Fertilizer recommendation (kg/ha) to reach yield goal = 160 N-56 P_2O_5-48 K_2O		
Antioquia		
-N	3.2	4.9
-P	6.3	1.8
-K	7.3	0.8
NPK	8.1	
Farmer	4.9	
Yield goal = 8.1 t/ha		
Fertilizer recommendation (kg/ha) to reach yield goal = 163 N-92 P_2O_5-64 K_2O		
Bugalagrande		
-N	3.7	5.7
-P	7.8	1.6
-K	8.7	0.7
NPK	9.4	
Farmer	6.9	
Yield goal = 9.4 t ha-1		
Fertilizer recommendation (kg/ha) to reach yield goal = 190 N-81 P_2O_5-56 K_2O		

NAE = 30; PAE = 45; KAE = 15 (elemental basis)
R_X = yield of the complete treatment;
R_0 = yield of omission plot
P and K rates were calculated using the same procedure (R_x-R_0). There are exceptions when calculated P_2O_5 is lower then 25 kg/ha and K_2O is lower than 30...not the case here.

Table 2. Comparison of cost and income of attainable yield and yield obtained with farmer practice at three sites located at different ecosystems in Colombia (2-year averages).

Fertilizer recommendation, kg/ha	Fertilizer type	Fertilizer amount, kg/ha	Fertilizer cost[1], US$/ha	Other input costs[2], US$/ha	Corn yield, t/ha	Grain price, US$/t	Total income, US$/ha	Net income, US$/ha
Espinal								
Farmer practice								
N = 90	Urea	153	90					
P_2O_5 = 50	DAP	109	144					
K_2O = 70	KCl	117	87					
			321	1,300	4.8	470	2,256	635
SSNM								
N = 160	Urea	300	177					
P_2O_5 = 56	DAP	121	161					
K_2O = 48	KCl	80	60					
			398	1,300	6.4	470	3,008	1310
Antioquia								
Farmer practice								
N = 120	Urea	218	128					
P_2O_5 = 50	DAP	109	144					
K_2O = 50	KCl	83	62					
			334	1,300	4.9	470	2,303	669
SSNM								
N = 163	Urea	276	162					
P_2O_5 = 92	DAP	200	265					
K_2O = 64	KCl	107	80					
			507	1,300	8.1	470	3,807	2,000
Bugalagrande								
Farmer practice								
N = 140	Urea	270	159					
P_2O_5 = 40	DAP	87	115					
K_2O = 90	KCl	150	112					
			386	1,600	6.9	470	3,243	1,257
SSNM								
N = 190	Urea	344	202					
P_2O_5 = 81	DAP	176	233					
K_2O = 56	KCl	93	70					
			505	1,600	9.4	470	4,418	2,313

[1]Assumed costs per metric ton of product, US$: urea = 588; DAP = 1,324; KCl = 748.
[2]Source: National Association of Cereal Growers (FENALCE), Colombia.

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IPNI Crop Nutrient Deficiency Photo Contest—2008

While the classic symptoms of crop nutrient deficiencies are not as common in fields as they were in the past, they do still occur. To encourage field observation and increase understanding of crop nutrient deficiencies and other conditions, the International Plant Nutrition Institute (IPNI) is sponsoring a photo contest during 2008.

"We hope this competition will appeal to practitioners working in actual production fields," said IPNI President Dr. Terry Roberts. "Researchers working under controlled plot conditions are also welcome to submit entries. We encourage crop advisers, and others to photograph and document deficiencies in crops."

Some specific supporting information is required for all entries, including:

- The entrant's name, affiliation, and contact information.
- The crop and growth stage, location, and date of the photo.
- Supporting and verification information related to plant tissue analysis, soil test, management factors, and additional details that may be related to the deficiency.

There are four categories in the competition: Nitrogen (N), Phosphorus (P), Potassium (K), and Other. Entries are limited to one per category (one individual could have an entry in each of four categories). Cash prize awards are offered in each of the four categories as follows:

- First place = US$150
- Second place = US$75
- Third place = US$50

Photos and supporting information can be submitted until December 15, 2008 and winners will be announced in January of 2009. Winners will be notified and results will be posted at the website.

Entries are encouraged from all regions of the world. However, entries can only be submitted electronically as high resolution digital files to: **>www.ipni.net/photocontest<**.

For questions or additional information, please contact:

Mr. Gavin Sulewski, IPNI
Agronomic and Technical Support Specialist
102-411 Downey road
Saskatoon, SK S7N 4L8 Canada
Phone: 306-652-3536
E-mail: gsulewski@ipni.net

Shown at right are some photos as examples of deficiency symptoms. BC

Nitrogen deficiency in corn.

Phosphorus deficiency in cotton.

Potassium deficiency in soybeans.

Sulfur deficiency in canola.

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development of local technology. The sudden increase in the international grain price represents both an opportunity and a challenge for local producers. Simple techniques like the omission plots can provide a robust way of generating solid information to develop site specific fertilizer recommendations which can be implemented and refined immediately. BC

Dr. Espinosa (e-mail: jespinosa@ipni.net) is Director, IPNI Northern Latin America Program, located at Quito, Ecuador. Ing. García (e-mail: jgarcia@fenalce.org) is Soils Research Coordinator, National Association of Cereal Growers (FENALCE), Colombia.

Nitrogen omission plot beside the complete treatment at San Carlos, Ecuador.

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