Research Findings

Field day in LEM experimental area. Photo by T. Wiendl.

Economic Viability of Potassium Fertilization in Corn Production on Tropical Soils under No-Tillage System

Wander, A.E.[1], O.F. da Silva[1], and T. Wiendl[2]

Introduction

Improving nutrient efficiency is a worthy goal and a fundamental challenge facing the fertilizer industry, and agriculture in general. The opportunities are there and tools are available to accomplish the task of improving the efficiency of utilizing applied nutrients. However, caution is needed to ensure that improvements in efficiency do not come at the expense of farmers' economic viability or the environment. Judicious application of fertilizer best management practices, which include the slogan 'right rate, right time, right place' targeting both high yields and nutrient efficiency will benefit farmers, society, and the environment alike (Roberts, 2008).

This paper is therefore aimed at assessing the economic viability of different potassium (K) fertilizing practices in corn (maize) production under a no-tillage system.

[1]Embrapa Rice and Beans, P.O.Box 179, 75375-000 Santo Antonio de Goias, GO, Brazil. alcido.wander@embrapa.br; osmira.silva@embrapa.br
[2]International Potash Institute (IPI), Latin America Coordination, São Paulo, SP, Brazil. toni.wiendl@ipipotash.org

Methodology

Polidoro and Teixeira (2013) are carrying out a long-term field experiment in Luís Eduardo Magalhães (Bahia State, Brazil) on corn (maize) cultivation under no-tillage. We have therefore used corn yields obtained for the 2011/2012 season of this work for the eight treatments (Table 1).

Table 1. Treatments analyzed for economic viability.

Treatment		N	P_2O_5	K_2O	S	Applied as	Time of application
		----------*kg ha^{-1}*----------					
T_1	Farm practice	8.3	83	62	0	415 kg ha^{-1} of 2-20-15	Basal
T_2	SSP only	0	86	0	58	480 kg ha^{-1} of SSP	Basal
T_3	SSP+K90$_{TD}$	0	86	90	58	480 kg ha^{-1} of SSP 150 kg ha^{-1} KCl	Basal Top
T_4	SSP+K90$_{BD/TD}$	0	86	90	58	480 kg ha^{-1} of SSP 150 kg ha^{-1} KCl	Basal 50% basal 50% top
T_5	SSP+K45	0	86	45	58	480 kg ha^{-1} of SSP 75 kg ha^{-1} KCl	Basal Basal
T_6	SSP+K90$_{BD}$	0	86	90	58	480 kg ha^{-1} of SSP 150 kg ha^{-1} KCl	Basal Basal
T_7	Control	0	0	0	0		
T_8	Farm practice + K45$_{TD}$	8.3	83	107	0	415 kg ha^{-1} of 2-20-15 75 kg ha^{-1} KCl	Basal Top

Note: SSP: Single super phosphate; KCl: Potassium chloride; TD: Top dressing; BD: Basal dressing.

For economic analysis, partial budgeting (PB) analysis was used. This form of analysis is best adapted to small changes that may be considered in the business depending on the analysis of two or more alternative practices. This analysis does not determine whether these two practices are the most desirable for the farm, it only indicates the change that will occur in farm income (increase, decrease or no change). The positive and negative effects have to then be separated and listed in different sections of the PB as developed by Lessley *et al.* (1991).

The PB measures the positive and negative effects of changes of a farm practice. The left side of PB shows the positive effects on net income, including additional income and reduced costs. To counterbalance this positive effect, the right side includes reduced income and additional costs or the negative effects of the proposed change (Table 2).

PB has four categorical parts: additional income, reduced costs, reduced income and additional costs (Lessley *et al.*, 1991).

We compared each treatment T_2 to T_8 (new treatments) against farm level practice (T_1).

The costs of the fertilizers were as follows: SSP (18% P_2O_5, 19% Ca and 12% S) at Brazilian dollars (R$) 1,112.58 and KCl (60% K_2O) at R$ 1,792.78 per ton (IEA, 2013). Corn price refers to average prices in November 2013: R$ 20.86 per 60 kg bag of corn (IEA, 2013).

Left T_3, right T_2. Photo by T. Wiendl.

Positive effects of changing farm practice

Additional income: Represents the value of the incremental corn yield after the adoption of a new fertilizing practice.

Reduced costs: In the case of new farm practices replacing another practice in use by farmer, the expenses associated with the replaced fertilizing practice are reduced costs. These are either variable or fixed. If a variable input is no longer used, or less of it is used (such as fertilizer), costs are reduced. In the case where the change results in reduced labor time and there is a productive use for this released labor force, the value of released labor should also be recorded. It may be possible to reduce the fixed costs of depreciation, taxes and insurance, as well as interest on average value of some repairs if there

is a reduction or elimination of investments in land, buildings, equipment or machinery. Total additional income and reduced costs have the same positive effect on net income.

Negative effects of changing farm practice

Reduced income: A proposed change in the farm practice may reduce farm income because of decreased yield.

Additional costs: This portion of PB includes any new costs associated with a proposed change. These costs can be fixed or variable. Additional variable costs can be involved where the change includes increased machinery operations, labor, fertilizers amounts, etc. If the proposed change requires new investments, e.g. machinery and equipment, the costs related to depreciation, interest, repairs and taxes fall into this category. If an asset has a useful life of more than one year, this investment should be distributed over its useful life. When change does not require any additional investments, there is no additional cost.

Total reduced income and total additional costs have the same negative effect on net income.

Net income after changing farm practice

The effect of the proposed change in net income was carried out by comparing the sum of additional income and the reduced costs with the sum of reduced income and reduced costs. In the case where the additional income and reduced costs are greater than the reduced income and reduced costs, an increase in net income will result. Yet once the increase in net income is positive, there is still a need to evaluate it with the additional labor, investment and risk associated with the proposed change.

Table 2 illustrates the partial budget approach used in this study.

Results

Table 3 describes the yields and the economic results due to changes in income and costs.

Our findings showed a strong correlation (R2=0.9853) between farm net income change and obtained corn yields.

Conclusions

1. K_2O fertilization is economically important and greatly raises farmers' net income.
2. All tested options using K_2O fertilization improved farm net income compared to farmer standard K_2O fertilizing practices.
3. The best economic option (T_6) was using 480 kg ha^{-1} of SSP and 90 kg ha^{-1} of K_2O as basal dressing.
4. The second best option (T_4) was using 480 kg ha^{-1} of SSP plus 90 kg ha^{-1} of K_2O divided into 50% as basal dressing and 50% as top dressing.
5. Adding N through NPK brought no additional economic benefit. Replacement of 2-20-15 by SSP and KCl resulted in higher income even for less K applied per ha.
6. Changes in farm net income are directly linked to the yield changes.

Table 2. PB structure for a corn-producing farm to analyze alternative fertilizing practices.

Proposed change: Should the farmer replace his current K_2O fertilizing practice (A) with a new one (B)?	
Positive effects	*Negative effects*
Additional income (yield increases)	Reduced income (yield decreases)
Reduced costs (saved fertilizer, machinery and labor)	Additional costs (additional fertilizer, machinery and labor)

Table 3. Yields and the changes in net income (R$ ha^{-1}) of each treatment related to farm level standard in Luís Eduardo Magalhães (Bahia State, Brazil).

Treatment (K_2O fertilization practice)		Corn yield	Yield change over control	Change in net income over control	PB comments
		Number of 60 kg bags ha^{-1}		*R$ ha^{-1}*	
T_1	Farm practice	93	0	-	
T_2	SSP only	75	-18	-472.53	Yields decreased more than the saved costs
T_3	SSP+K90$_{TD}$	136	43	496.43	Significant yield increase
T_4	SSP+K90$_{BD/TD}$	150	57	788.47	Significant yield increase
T_5	SSP+K45	136	43	665.68	Significant yield increase. Yield level was the same as T_3, but with lower costs
T_6	SSP+K90$_{BD}$	156	63	948.63	Highest yield increase observed in all treatments
T_7	Control	39	-54	-690.69	Significant yield reduction
T_8	Farm practice + K45$_{TD}$	130	37	602.57	Yield increases, but also higher costs

Note: TD: Top dressing; BD: Basal dressing.

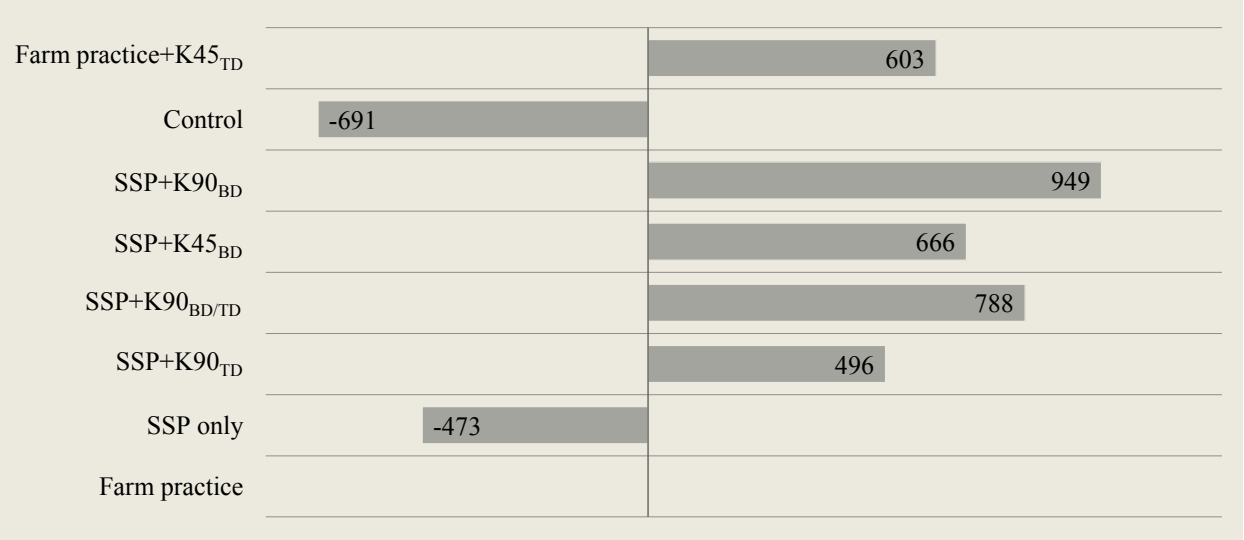

Fig. 1. Economic effect of each fertilizing practice in corn production on farmer's net income (BRL) in Luís Eduardo Magalhães (BA, Brazil), 2011/2012.

References

Bernardi, A.C.C., M.C.S. Carvalho, J.C. Polidoro, and V.M. Benites. 2013. Potassium Fertilization in Tropical Soils under No-Tillage System. *e-ifc* 34:8-12.

Instituto de Economia Agricola (IEA). 2013. Prices for Corn and Fertilizer. Nov. 2013.

Lessley, B.V., D.M. Johnson, and J.C. Hanson. 1991. Using the Partial Budget to Analyze Farm Change, 1990-1991 edition, University of Maryland System. 7 p.

Polidoro, J.C., and P.C. Teixeira. 2013. Adubação Potássica em Solos Leves. Presentation at Workshop on Support of Balanced Potash Use in Brazilian Agriculture - 10 Years of Collaboration between IPI and Embrapa, Piracicaba, SP, Brazil, October 10, 2013.

Roberts, T.L. 2008. Improving Nutrient Use Efficiency. Turkish Journal of Agriculture and Forestry 32(3):177-182.

The paper "Economic Viability of Potassium Fertilization in Corn Production on Tropical Soils under No-Tillage System" also appears on the IPI website at:

Regional activities/Latin America