RESEARCH PROJECT – BPC and IPNI BRAZIL

RATES AND RESIDUAL EFFECT OF POTASSIUM FERTILIZATION IN A BRAZILIAN OXISOIL

RESULTS FOR SOYBEAN 2012-2013

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This Report

This report refers to the agronomic results for the crops of soybean and maize 2nd crop 2012-2013 (third project year). The research project is funded by BPC, coordinated in Brazil by IPNI Brazil, and has the field partner as Research Foundation MT.

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Introduction

The requirement for worldwide abundant food, feed, fiber, and more recently biofuel, leads to higher amounts of fertilizer utilized in agriculture in diverse parts of the globe. Potassium (K) is, most generally, the second nutrient in terms of plant demand (after nitrogen, N). Potassium is highly mobile in most soils and relatively mobile in the plants. This nutrient is responsible for several vital mechanisms for plant development and high yields (enzyme activation, translocation and stock of compounds, osmotic regulation, water maintenance, etc). Potassium fertilizers are very commonly a must in terms of plant nutrition in acid soils of the tropics, including Brazil. In many areas farmers are cutting back on fertilizer expenses, which could compromise good yields, profit and food safety in the future. Farmers expect that the soil supply will be sufficient to provide the ideal conditions for plant development and yield, even with lower or no supply of K fertilizers. Studying the impacts of K fertilizer cut back on Brazilian soils is essential as to demonstrate the effects in the medium to long run.

Objectives

The main objective of the study is to verify the effects of cutting back K fertilizer rates in some Brazilian soils. Also, it will be possible to study other important factors which may affect the K fertilizer effectiveness in tropical soils.

Material and Methods

A. General Information

The experiment takes place having soybean as the main crop and is located in Mato Grosso at the experimental station of the Research Foundation MT. The K fertilizer used is KCl. The study is initially planned for six years. During the 2012-2013 crop season, maize was grown as a second crop after the soybean harvest. The independent (input) variables studied will apply for both crops: soybean (1st crop) and maize (2nd crop). The soil is an Oxisol with the initial chemical and granulometric properties described in Table 1 (medium in K bioavailability).

Table 1. Chemical and physical soil properties prior to the trial establishment in 2010 (0 - 20 cm).

Soil		P	K	S	Ca	Mg	Al	H	V	OM	Clay	Sand	Silt
H_2O	$CaCl_2$	mg dm^{-3}			cmol$_c$ dm^{-3}				%	g dm^{-3}	g kg^{-1}		
5.6	4.9	20.4	57	18.6	2.9	0.7	0.0	5.4	41.0	38.9	639	152	209

Zn	Cu	Fe	Mn	B
mg dm^{-3}				
4.4	1.3	91	26.3	0.46

B. Treatments

The treatments are shown on Table 2 and legends for the variables studied can be found in Table 3. In summary the experiment outline proposes: (1) 4 rates of K in interaction with suppression or not of K after third year, (2) 3 rates of base saturation (BS), (3) 3 rates of phosphogypsum application (PG), (4) suppression of P in different levels after third year, (5) 2 levels of time of application, and (6) 2 levels of locality effect. The experiment is designed mainly to study K rates and its residual effect after the third year. Secondarily, the experiment is designed to evaluate other important variables that affect K fertilization, having the regular rate of K (K3) as a standard. The experiment will study the residual effect of K fertilization in interaction with liming and phosphogypsum. Also, the outline will make possible to investigate the phosphorus (P) residual effect and the effect of KCl, regarding time of K application and locality effect. Table 4 summarizes the variables studied. The regular practices in terms of rates, time of application, locality effect, liming and phosphogypsum application will be N3, P3, K3, TA1, LE1, BS L2 and PG L2. Nitrogen is of course not a problem for soybean (due to N fixation when seeds are properly inoculated with *Bradyrhizobium japonicum*) and will not be studied. Variations in rates and other variables will permit several important comparisons as outlined in Table 5.

Some important local decisions related to the input variables for the treatments were made. They are:

1. *Rates of K_2O*: K3 was defined as 90 kg/ha. K_2O was applied in all treatments, except 23 and 24, by splitting the proper rate in two applications: half at seeding and half in top dressing right after plant emergency.
2. *Rate of N*: not applicable to soybean (inoculation).
3. *Rate of P_2O_5*: P3 was defined as 45 kg/ha P_2O_5.
4. *Lime rates*: Due to soil properties (pH H_2O 5.6) the decision was to start up the experiment by varying the rate only for treatments 14 and 15 (BS L3). These two treatments received 4.5 t/ha of dolomitic lime in 2010. All other treatments received no lime at any time.
5. *Phosphogypsum rates (PG)*: Similarly to the lime rates the decision was to start the experiment by varying the PG rates only for treatments 18 and 19 (PG L3). These two treatments received 2 t/ha of phosphogypsum in 2010. All other treatments received no phosphogypsum at any time.
6. *Time of application (TA)*: Regular TA was to regularly split the K_2O rates in two applications (half at seeding and half right after plant emergency). The alternative (treatment 23) was to split in three applications (1/3 at seeding, 1/3 at emergency and 1/3 fifteen days after emergency).
7. *Locality effect (LE)*: Regular LE was to apply half of the K_2O rate at seeding (5 cm besides and 5 cm bellow the seeds) and half in top dressing right after plant emergency. The alternative (treatment 24) was to apply all K_2O rate at the soil surface right after plant emergency.

The above mentioned decisions were based on soil, crop and regional knowledge at the region (previous agronomic experimentation). Soybean variety used in 2012-2013 was TMG1176 and maize hybrid was 2B587 HX.

C. Plots, replicates and statistics

The plot size (6.3 m x 9.5 m; 59.85 m^2) was planned as to permit future subdivisions in case necessary. This will allow new variables to be studied in case of interest. The number of replicate is four per treatment. The statistics will follow proper procedures as to allow the conclusions necessary for the study. For this season (2012-2013), statistics are for the main output variables studied, i.e., **grain yield, K leaf content, soil K availability, weight of seeds, and plant height**.

D. Evaluations (Output variables)

(1) Soil K status with time. (2) Plant K status with time. (3) Weight of 1000 seeds, (4) Grain yield, (5) Plant height.

For soil test, samples were collected in number of 12 subsamples per plot (8 between plant lines and 4 on the plant line) from the first 8 inches of depth.

For grain yield, all soybean plants or maize ears were harvested out of a 3.6 m^2 area in two points of each plot.

For plant nutrient status, twenty random leaves of soybean or maize were collected at each plot.

For plant height, ten plants of soybean or maize of each plot were measured before harvest.

For seeds weight, five subsamples with 100 seeds each were weighed per plot after harvest.

Table 2. Experiment Outline.

Treat #	Treat #	Year (Rates of N)						Year (Rates of P_2O_5)						Year (Rates of K_2O)						Time App (TA)	Locality Effect (LE)	Liming BS Level	PG Level
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6				
1	1	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	0	0	0	0	0	0	TA1	LE1	BSL2	PGL2
2	2A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K1	K1	K1	K1	K1	K1	TA1	LE1	BSL2	PGL2
3	2B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K1	K1	K1	0	0	0	TA1	LE1	BSL2	PGL2
4	3A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K2	K2	K2	K2	K2	K2	TA1	LE1	BSL2	PGL2
5	3B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K2	K2	K2	0	0	0	TA1	LE1	BSL2	PGL2
6	4A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL2
7	4B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	0	0	0	TA1	LE1	BSL2	PGL2
8	4C	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K1	K1	K1	TA1	LE1	BSL2	PGL2
9	4D	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K2	K2	K2	TA1	LE1	BSL2	PGL2
10	5A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K4	K4	K4	K4	K4	K4	TA1	LE1	BSL2	PGL2
11	5B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K4	K4	K4	0	0	0	TA1	LE1	BSL2	PGL2
12	6A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL1	PGL2
13	6B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	0	0	0	TA1	LE1	BSL1	PGL2
14	7A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL3	PGL2
15	7B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	0	0	0	TA1	LE1	BSL3	PGL2
16	8A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL1
17	8B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	0	0	0	TA1	LE1	BSL2	PGL1
18	9A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL3
19	9B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	0	0	0	TA1	LE1	BSL2	PGL3
20	11A	N3	N3	N3	N3	N3	N3	P3	P3	P3	0	0	0	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL2
21	11B	N3	N3	N3	N3	N3	N3	P3	P3	P3	P1	P1	P1	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL2
22	11C	N3	N3	N3	N3	N3	N3	P3	P3	P3	P2	P2	P2	K3	K3	K3	K3	K3	K3	TA1	LE1	BSL2	PGL2
23	12A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA2	LE1	BSL2	PGL2
24	13A	N3	N3	N3	N3	N3	N3	P3	P3	P3	P3	P3	P3	K3	K3	K3	K3	K3	K3	TA1	LE2	BSL2	PGL2

Table 3. Legends for variables in Table 2.

Variable	Specification	Definitions/Observations
Treat	Treatment	
N	Nitrogen	N3 = ideal rate of N for specific crop and region.
P	Phosphorus	Rates of P_2O_5 = 0, P1, P2, P3, with P3 = ideal rate of P_2O_5 for specific crop and region. P1 = P3/4, P2 = P3/2.
K	Potassium	Rates of K_2O = 0, K1, K2, K3, K4, with K3 = ideal rate of K_2O for specific crop and region. K1 = K3/4, K2 = K3/2, K4 = 1.5*K3.
TA	Time of Applicaton	TA 1 = regular practice (ex.: ½ K3 at planting and ½ K3 in top dressing); TA 2 = variation for time of application (1/3 at planting and two top dressings of 1/3 K3 each).
Year		1 to 6
LE	Locality Effect = Placement of K as related to the seed	LE 1 = regular practice (ex.: ½ 5 cm besides and bellow the seeds at planting and ½ at plant emergency); LE 2 = variation for locality effect (all quantity at soil surface).
BS	Base Saturation	Levels of liming BS L1, BS L2, BS L3.
PG	Phosphogypsum	Levels of Phosphogypsum PG L1, PG L2, PG L3.

Table 4. Summary of variables studied at the present experiment outline.

Var #	Specification
1	K rate
2	K residual effect
3	K and base saturation/liming
4	K and phosphogypsum application
5	P rate and P residual effect
6	K time of application
7	K placement

Table 5. Possible comparisons with experiment outline suggested in Table 1.

Comp #	Comparison	Treatments Involved
1	Response curve to K_2O with continuous application of K and regular practices for N, P, K time of application, K locality effect, liming and PG level.	T1, T2, T4, T6 and T10 (A).
2	Response curve to K_2O with K application up to 3rd year and regular practices for N, P, K time of application, K locality effect, liming and PG level (B)	T1, T3, T5, T7 and T11 (B).
3	A vs B = Effect of suspension of K application after 3rd year at regular practices	
4	Effect of different rates of K in residual effect as related to ideal rate (K3)	T6, T7, T8 and T9 (C).
5	Effect of liming on K fertilization with continuous application of K and regular practices	T12, T6 and T14 (D).
6	Effect of liming on K fertilization with application of K up to 3rd year and regular practices	T13, T7 and T15 (E).
7	D vs E = Effect of liming on suspension of K application after 3rd year at regular practices	
8	Effect of phosphogypsum on K fertilization with continuous applicaton of K at regular practices	T16, T6 and T18 (F).
9	Effect of phosphogypsum on K fertilization with application of K up to 3rd year at regular practices	T17, T7 and T19 (G).
10	F vs G = Effect of phosphogypsum on suspension of K application after 3rd year at regular practices.	
11	Response curve to P with full P only up to 3rd year and regular practices	T20, T21, T22 and T6.
12	Effect of timing of K application at regular practices	T6 and T23.
13	Placement effect of K application at regular practices	T6 and T24.

Regular practices = N3, P3, K3, TA1, LE1, BS L2 and PG L2

Results and discussion

Tables 6 to 9 show, respectively, the raw data obtained for 2012-2013 soybean grain yield, soybean seeds weight, soybean plant height, and soybean K leaf content, respectively. Tables 6 to 9 also provide mean comparisons, $p<0.05$, where applicable (comparisons 5, 6, 8, 9, 12 and 13 of Table 5). Mean comparisons at $p<0.10$ were also done for 2012-2013 results with no significant difference. Some comparisons do not make sense now because they were planned to produce feasible results only with time (after suspension of K_2O application in some of the treatments). For example, comparison # 3 do not make sense at this stage once differences among these two response curves (comparing 1 and 2, Table 5) will only make sense after suspension of K application to study the residual effect. The same applies to comparisons # 7 and # 10 of Table 5.

Tables 10 to 13 show, respectively, the raw data obtained for 2012-2013 maize grain yield, maize seeds weight, maize plant height, and maize K leaf content, respectively. Tables 6 to 9 also provide mean comparisons, $p<0.05$, where applicable (comparisons 5, 6, 8, 9, 12 and 13 of Table 5). Mean comparisons at $p<0.10$ were also done for 2012-2013 results with no significant difference.

Tables 14 to 17 show, respectively, the raw data obtained for soil K availability, soil pH H_2O, soil Al availability, and soil bases saturation, respectively, from soil sampling made after the 2012-2013 maize 2nd crop harvest. Tables 14 to 17 also provide mean comparisons, $p<0.05$, where applicable (comparisons 5, 6, 8, 9, 12 and 13 of Table 5). Mean comparisons at $p<0.10$ were also done with no significant difference.

As mentioned, due to soil properties, only two, and not three, rates of lime and phosphogypsum were applied in 2010. Therefore, the decision was to evaluate such comparisons by mean average and not by model regression as initially expected.

Figures 1 and 2 show the soybean yield response curves for K application as a function of rates. While Figure 1 shows comparisons 1 and 2 (according to Table 5), Figure 2 combines the data. This is due to the fact that there is still no absence of K to study the residual effect. It is clear, as also observed in the previous crop seasons (1st and 2nd year), that there is a response to K for soybean (for example, from 3176 kg/ha when no K_2O was applied to around 3656 kg/ha when 90 kg/ha of K_2O was used), which would be expected in a soil with a medium initial content of K (57 mg/dm^3). In terms of data analysis, there was statistical significant rate effect of K_2O application for soybean yield (Figure 3) and for soybean K leaf content (Figure 4). In both cases, a logarithmic model was adjusted to fit the data presenting high values for the coefficient of determination (R^2). For other parameters, such as soybean seeds weight (Figure 5) and plant height (Figure 6), no significant rate effect for K_2O application was observed.

Figures 7 and 8 show the maize 2nd crop yield response curves for K application as a function of rates. While Figure 7 shows comparisons 1 and 2 (according to Table 5), Figure 8 combines the data. This is due to the fact that there is still no absence of K to study the residual effect. It is clear that there is a response to K for maize 2nd crop (for example, from 5573 kg/ha when no K_2O was applied to around 6129 kg/ha when 90 kg/ha of K_2O was used), which would be expected in a soil with a medium initial content of K (57 mg/dm^3). In terms of data analysis, there was no statistical significant rate effect of K_2O application for maize 2nd crop yield (Figure 9) and for maize 2nd crop K leaf content (Figure 10). Nevertheless, statistical significant rate effect for K_2O application was observed for maize 2nd crop seeds weight (Figure 11, quadratic model adjusted, $R^2 = 0.36$) and for maize 2nd crop plant height (Figure 12, linear model adjusted, $R^2 = 0.45$).

Figure 13 shows the soil K availability response curve for K application as a function of rates. In terms of data analysis, there was statistical significant rate effect for K_2O application and a linear model was adjusted to fit the data ($R^2 = 0.75$).

From all other possible comparisons (lime application, phosphogypsum application, time of application and locality effect; comparisons 5, 6, 8, 9, 12 and 13 of Table 5) regarding soybean, only the effect of locality (LE) showed statistical difference, with all quantity of K applied at soil surface (treatment 24) leading to higher leaf K content, as related to regular practice (½ of K rate is band applied, while other ½ is broadcast at soil surface after seedling emergence) adopted for treatment 6 (Table 9). Regarding maize 2nd crop, phosphogypsum application (comparisons 8 and 9) showed statistical difference leading to higher grain yield (treatment 19) and plant height (treatment 18) compared to the absence of application (treatments 6 and 7). Also, lime application (comparison 5) showed statistical difference leading to higher maize 2nd crop grain yield (treatment 14) compared to no lime application (treatments 6 and 12). Liming presented effect on soil features, as well, showing statistical difference leading to higher values of soil pH and bases saturation (comparisons 5 and 6).

The fact that other comparisons did not lead to differences is still not important once this is the third crop year. It will be interesting to find out what effects for the different treatments will occur with time, most especially those related to the comparison of treatments with continuous K versus suppression of K. Some of the questions we seek answers are:

(1) For how long will the suppression of K not influence crop yields?
(2) What will be the response curves to K previously applied, with suppression or not of K_2O application?
(3) What will be the effect of liming in K response (with and without suppression of K_2O application)?
(4) What will be the effect of phosphogypsum application in K response (with and without suppression of K_2O application)?

(5) For how long will the suppression of P not influence crop yields?
(6) Will there be an effect of timing of K application at regular practices?
(7) Will there be a continuous effect of K placement at regular practices?

Conclusions for third year (2012 – 2013):

(1) Response to K rates was statistically significant for soybean grain yield and K leaf content.
(2) Response to K rates was statistically significant for maize 2nd crop seeds weight and plant height.
(3) Response to K rates was statistically significant for soil K availability.
(4) There was locality effect for soybean K leaf content.
(5) There was effect of lime and phosphogypsum application for maize 2nd crop grain yield and plant height.
(6) There was effect of lime and phophogypsum application for soil pH and bases saturation.
(7) Results are in agreement with initial expectations.

Propositions for next season

After discussions between IPNI Brazil and BPC representative in Brazil regarding the latest results and the objectives of the project, some propositions were made, as follows:

(1) In order to create 3 levels of soil acidity, as initial proposal, lime will be applied at the rate of 2 t/ha (unincorporated) to all plots of treatments with BS L2 and BS L3;
(2) In order to create 3 levels of soil amelioration, as initial proposal, phosphogypsum will be applied at the rate of 2 t/ha (unincorporated) to all plots of treatments with PG L2 and PG L3;
(3) Maize 2nd crop fertilization will remain as only N application.

Table 6. Soybean grain yield (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			kg/ha					kg/ha							
1	1		3153.8	3304.5	2835.8	3411.5		**3176.4**							
2	2A		3393.4	3498.9	3470.4	3675.3		**3509.5**							
3	2B		3604.2	3722.2	3670.0	3585.0		**3645.4**							
4	3A		3582.9	3507.5	3820.0	3535.2		**3611.4**							
5	3B		3951.5	3045.3	3778.7	4017.8		**3698.3**							
6	4A		3362.9	3658.2	3935.6	3533.4		**3622.5**		A		A		A	A
7	4B		3840.0	3719.4	3590.4	3609.8		**3689.9**			A		A		
8	4C		3896.8	3546.9	3465.8	3585.9		**3623.9**							
9	4D		3552.3	3585.0	3755.0	3599.5		**3623.0**							
10	5A		3892.2	3685.4	3526.2	3485.2		**3647.3**							
11	5B		3645.7	3585.0	3483.4	3522.9		**3559.3**							
12	6A		3590.2	3805.9	3592.9	3801.1		**3697.5**		A					
13	6B		3535.0	3667.9	3833.1	3511.6		**3636.9**			A				
14	7A		4101.8	3755.2	3912.2	3523.3		**3823.1**		A					
15	7B		3657.3	3881.2	3883.1	4144.5		**3891.5**			A				
16	8A		3353.8	3646.6	3455.0	3661.0		**3529.1**				A			
17	8B		3527.8	3581.2	3365.5	3586.8		**3515.3**					A		
18	9A		3655.4	3573.7	3733.4	3436.4		**3599.7**				A			
19	9B		3476.1	3518.4	3822.0	4027.8		**3711.1**					A		
20	11A		3524.7	3471.0	3701.7	3503.3		**3550.2**							
21	11B		3511.2	3482.5	3815.2	3673.6		**3620.6**							
22	11C		3754.0	3597.3	3373.2	3643.2		**3591.9**							
23	12A		3339.4	3233.8	3890.1	3367.2		**3457.6**						A	
24	13A		3964.6	3786.2	3628.3	3876.5		**3813.9**							A
								CV, %		5,86	4,98	4,91	5,42	3,67	7,31
								msd		469	404	382	428	293	612

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 7. Weight of soybean seeds (2012-2013).

Treat #	Treat #	Replicate 1	2	3	4	Average	Comparison 5	6	8	9	12	13
		g/1000				g/1000						
1	1	116.4	117.9	114.2	117.2	**116.4**						
2	2A	117.3	118.3	126.3	123.0	**121.2**						
3	2B	126.2	114.8	120.8	120.2	**120.5**						
4	3A	120.5	117.9	122.9	122.0	**120.8**						
5	3B	120.5	118.0	121.8	119.6	**120.0**						
6	4A	118.0	120.4	120.2	122.6	**120.3**	A		A		A	A
7	4B	119.7	120.8	122.6	118.5	**120.4**		A		A		
8	4C	123.6	119.9	118.7	119.4	**120.4**						
9	4D	122.3	117.6	122.3	120.9	**120.8**						
10	5A	123.5	118.8	122.0	119.2	**120.9**						
11	5B	124.6	120.3	122.0	118.4	**121.3**						
12	6A	121.0	120.1	120.2	119.6	**120.2**	A					
13	6B	123.0	119.4	124.3	116.1	**120.7**		A				
14	7A	118.2	122.2	121.8	119.5	**120.4**	A					
15	7B	121.6	122.4	118.8	121.6	**121.1**		A				
16	8A	123.4	118.7	118.6	117.4	**119.5**			A			
17	8B	117.4	122.0	119.7	118.0	**119.3**				A		
18	9A	120.6	120.0	119.5	124.4	**121.1**			A			
19	9B	122.5	119.0	120.6	122.6	**121.2**				A		
20	11A	117.5	124.8	119.1	117.9	**119.8**						
21	11B	119.4	118.7	120.6	119.7	**119.6**						
22	11C	118.2	123.6	121.6	117.3	**120.2**						
23	12A	121.8	120.3	119.8	121.2	**120.8**					A	
24	13A	123.9	120.7	120.4	120.9	**121.5**						A
						CV, %	1,74	2,14	2,11	1,77	1,34	1,91
						msd	4,53	5,61	5,51	4,64	3,63	5,22

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 8. Soybean plant height (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			cm					cm							
1	1		52.5	45.8	53.8	55.5		**51.9**							
2	2A		51.7	47.8	52.5	55.0		**51.7**							
3	2B		56.3	49.2	56.7	55.0		**54.3**							
4	3A		48.3	52.5	59.2	60.0		**55.0**							
5	3B		62.5	45.8	51.7	60.8		**55.2**							
6	4A		51.7	50.8	59.2	56.7		**54.6**		A		A		A	A
7	4B		62.5	55.8	58.3	49.2		**56.5**			A		A		
8	4C		59.5	59.2	53.3	55.0		**56.8**							
9	4D		51.7	55.8	55.8	60.0		**55.8**							
10	5A		56.7	53.3	59.2	53.3		**55.6**							
11	5B		56.7	53.3	57.5	58.3		**56.5**							
12	6A		53.3	55.8	60.8	55.8		**56.5**		A					
13	6B		59.2	61.2	52.5	55.0		**57.0**			A				
14	7A		57.5	65.0	60.0	66.2		**62.2**		A					
15	7B		53.3	63.3	69.2	59.2		**61.2**			A				
16	8A		50.0	54.2	60.8	65.0		**57.5**				A			
17	8B		53.3	53.3	60.8	60.8		**57.1**					A		
18	9A		58.3	60.0	60.8	60.0		**59.8**				A			
19	9B		58.3	56.7	62.5	60.8		**59.6**					A		
20	11A		56.0	48.3	59.2	57.5		**55.3**							
21	11B		59.2	60.8	51.7	57.7		**57.3**							
22	11C		61.7	58.3	57.5	55.2		**58.2**							
23	12A		51.7	51.7	52.5	54.2		**52.5**						A	
24	13A		52.5	50.8	55.0	57.5		**54.0**							A
								CV, %		6,47	10,21	5,72	7,92	4,49	3,12
								msd		8,24	12,9	7,11	9,91	5,41	3,81

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 9. Soybean leaf K content (2012-2013).

Treat #	Treat #	Replicate 1	2	3	4	Average	Comparison 5	6	8	9	12	13
		g/kg				g/kg						
1	1	18.7	17.2	18.8	17.4	**18.0**						
2	2A	19.6	20.4	19.4	20.8	**20.1**						
3	2B	19.2	20.4	20.8	19.0	**19.9**						
4	3A	19.8	19.0	22.2	21.2	**20.6**						
5	3B	21.9	19.6	21.0	21.4	**21.0**						
6	4A	21.5	19.6	21.0	20.9	**20.8**	A		A		A	B
7	4B	20.8	20.0	19.8	21.0	**20.4**		A		A		
8	4C	20.2	19.8	22.2	18.8	**20.3**						
9	4D	19.4	19.2	21.4	20.6	**20.2**						
10	5A	22.8	21.6	20.4	22.6	**21.9**						
11	5B	21.6	21.8	21.0	20.8	**21.3**						
12	6A	18.8	21.6	18.2	19.8	**19.6**	A					
13	6B	20.2	19.0	20.2	19.2	**19.7**		A				
14	7A	19.4	19.6	18.6	18.6	**19.1**	A					
15	7B	19.0	17.2	21.0	19.6	**19.2**		A				
16	8A	19.2	18.2	20.4	20.4	**19.6**			A			
17	8B	20.2	21.6	19.0	18.8	**19.9**				A		
18	9A	19.6	21.0	22.6	21.2	**21.1**			A			
19	9B	20.6	21.5	19.0	21.0	**20.5**				A		
20	11A	20.8	21.0	20.6	19.0	**20.4**						
21	11B	18.6	21.0	20.0	21.8	**20.4**						
22	11C	19.0	20.6	21.8	21.2	**20.7**						
23	12A	21.2	19.6	20.6	19.6	**20.3**					A	
24	13A	22.2	22.4	24.0	22.0	**22.7**						A
						CV, %	6,55	4,75	4,26	4,30	1,93	3,80
						msd	2,76	2,04	1,89	0,89	1,86	

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 10. Maize grain yield (2012-2013).

Treat #	Treat #	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Average	Comparison 5	Comparison 6	Comparison 8	Comparison 9	Comparison 12	Comparison 13
		kg/ha				kg/ha						
1	1	6048.3	5854.6	4642.8	5745.3	**5572.7**						
2	2A	5810.6	5476.0	6086.1	5580.4	**5738.3**						
3	2B	6133.4	5369.9	5983.4	5775.4	**5815.5**						
4	3A	5679.7	5748.5	5879.3	6012.8	**5830.1**						
5	3B	6089.7	6035.0	5910.3	5844.6	**5969.9**						
6	4A	6253.0	6218.2	6300.4	5742.9	**6128.6**	B		A		A	A
7	4B	6264.8	6202.3	6103.3	6121.3	**6172.9**		A		B		
8	4C	5863.3	6377.2	5958.6	6499.6	**6174.7**						
9	4D	5730.3	6088.5	6025.8	6258.6	**6025.8**						
10	5A	6083.4	5997.3	5971.3	6082.9	**6033.7**						
11	5B	6600.3	6312.9	5961.8	5505.0	**6095.0**						
12	6A	6154.7	6034.7	6314.5	6168.0	**6168.0**	B					
13	6B	6170.7	6166.3	6218.0	6316.8	**6218.0**		A				
14	7A	6639.8	6466.3	6612.1	6367.7	**6521.5**	A					
15	7B	6453.9	6430.9	6725.9	6204.9	**6453.9**		A				
16	8A	5972.4	6065.1	6294.4	6253.8	**6146.4**			A			
17	8B	6235.7	6187.5	6163.8	6358.6	**6236.4**				AB		
18	9A	6196.3	6318.4	6123.5	6112.4	**6187.6**			A			
19	9B	6438.7	6377.2	6404.7	6308.1	**6382.2**				A		
20	11A	5993.6	6271.0	6223.7	6201.2	**6172.4**						
21	11B	5974.8	6399.5	5858.0	5954.5	**6046.7**						
22	11C	5876.1	6123.7	6127.9	6366.9	**6123.7**						
23	12A	5862.4	5593.9	5986.6	5742.7	**5796.4**					A	
24	13A	6121.8	6201.5	6110.2	6546.2	**6244.9**						A
						CV, %	1,87	2,42	3,17	1,24	3,05	5,29
						msd	254,6	330,7	423,5	168,9	410,1	737,7

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Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 11. Weight of maize seeds (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			g/1000					g/1000							
1	1		250.4	248.5	255.3	262.8		**254.2**							
2	2A		259.6	251.1	254.8	263.0		**257.1**							
3	2B		256.4	247.8	256.1	255.7		**254.0**							
4	3A		263.6	259.8	252.2	256.8		**258.1**							
5	3B		262.7	256.9	259.9	255.6		**258.7**							
6	4A		258.9	267.7	263.6	268.1		**264.6**		A		A		A	A
7	4B		255.3	265.1	260.0	257.3		**259.4**			A		A		
8	4C		256.4	263.4	264.5	269.2		**263.4**							
9	4D		265.5	267.9	255.3	262.4		**262.8**							
10	5A		257.0	259.0	264.0	268.8		**262.2**							
11	5B		260.2	264.7	262.2	252.9		**260.0**							
12	6A		265.8	265.3	261.5	270.1		**265.7**		A					
13	6B		267.8	266.5	266.4	258.8		**264.9**			A				
14	7A		263.1	258.4	267.5	253.6		**260.6**		A					
15	7B		254.2	258.2	266.5	257.9		**259.2**			A				
16	8A		269.2	271.3	270.0	271.3		**270.5**				A			
17	8B		261.5	269.6	270.3	270.3		**267.9**					A		
18	9A		264.9	279.5	264.4	274.8		**270.9**				A			
19	9B		279.6	267.1	271.3	263.6		**270.4**					A		
20	11A		264.2	263.2	256.6	252.5		**259.1**							
21	11B		259.6	261.1	256.1	252.4		**257.3**							
22	11C		258.2	264.2	265.2	259.6		**261.8**							
23	12A		270.9	256.6	261.8	264.2		**263.4**						A	
24	13A		268.7	257.3	256.2	270.8		**263.3**							A
								CV, %		1,82	1,56	1,30	2,31	2,59	2,49
								msd		10,62	8,85	7,61	13,33	15,37	14,79

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Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 12. Maize plant height (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			cm					cm							
1	1		191.7	199.2	200.0	198.3		**197.3**							
2	2A		200.0	189.2	199.2	198.0		**196.6**							
3	2B		207.5	192.5	188.3	197.5		**196.5**							
4	3A		198.0	200.0	200.8	204.2		**200.7**							
5	3B		206.7	210.8	198.3	197.5		**203.3**							
6	4A		207.5	204.2	207.5	200.8		**205.0**		A		B		A	A
7	4B		210.0	201.7	202.5	208.3		**205.6**			A		A		
8	4C		205.8	203.3	204.0	209.2		**205.6**							
9	4D		210.0	203.3	201.0	208.3		**205.7**							
10	5A		204.2	208.3	207.5	199.2		**204.8**							
11	5B		202.5	200.8	206.7	210.0		**205.0**							
12	6A		214.0	209.2	208.3	209.2		**210.2**		A					
13	6B		200.0	210.8	207.5	213.3		**207.9**			A				
14	7A		215.8	221.7	218.3	209.2		**216.3**		A					
15	7B		215.8	218.3	223.3	210.8		**217.1**			A				
16	8A		214.2	208.0	207.5	205.8		**208.9**				AB			
17	8B		200.0	203.3	213.3	205.0		**205.4**					A		
18	9A		215.8	214.2	214.2	202.5		**211.7**				A			
19	9B		213.3	204.2	215.8	206.7		**210.0**					A		
20	11A		210.8	217.5	211.7	215.0		**213.8**							
21	11B		215.0	212.5	197.5	205.0		**207.5**							
22	11C		198.3	207.5	212.5	212.5		**207.7**							
23	12A		188.3	204.2	201.7	211.7		**201.5**						A	
24	13A		202.5	202.5	208.3	204.2		**204.4**							A
								CV, %		1,65	2,89	1,28	2,42	4,36	1,24
								msd		7,58	13,18	5,79	10,87	19,94	5,70

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Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 13. Maize leaf K content (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			g/kg					g/kg							
1	1		19.6	14.8	18.0	17.5		**17.5**							
2	2A		15.2	18.0	16.0	19.6		**17.2**							
3	2B		15.4	18.0	24.0	20.6		**19.5**							
4	3A		17.6	14.0	16.0	23.0		**17.7**							
5	3B		18.6	23.0	21.0	23.4		**21.5**							
6	4A		21.4	18.0	20.6	20.6		**20.2**		A		A		A	A
7	4B		22.0	14.0	21.4	20.2		**19.4**			A		A		
8	4C		18.8	21.0	18.8	23.0		**20.4**							
9	4D		21.8	19.2	19.2	22.4		**20.7**							
10	5A		14.4	24.0	18.3	22.6		**19.8**							
11	5B		14.4	17.8	23.6	27.8		**20.9**							
12	6A		23.0	18.0	19.0	22.4		**20.6**		A					
13	6B		18.6	20.6	21.0	20.4		**20.2**			A				
14	7A		21.2	18.8	19.0	21.4		**20.1**		A					
15	7B		20.0	14.0	20.2	23.6		**19.5**			A				
16	8A		16.6	20.8	19.2	21.0		**19.4**				A			
17	8B		19.2	18.6	20.8	21.2		**20.0**					A		
18	9A		18.2	18.8	22.6	19.2		**19.7**				A			
19	9B		21.2	18.2	18.0	18.4		**19.0**					A		
20	11A		20.6	20.0	19.0	21.8		**20.4**							
21	11B		21.6	22.0	21.8	27.2		**23.2**							
22	11C		14.0	21.2	16.6	17.8		**17.4**							
23	12A		23.0	15.4	14.0	19.0		**17.9**						A	
24	13A		19.0	17.0	21.0	15.0		**18.0**							A
								CV, %		10,00	13,37	9,84	10,66	12,58	9,52
								msd		4,35	5,70	4,21	4,49	5,38	4,09

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Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 14. Soil K availability (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			mg/dm^3					mg/dm^3							
1	1		31	30	32	35		**32**							
2	2A		40	39	35	32		**37**							
3	2B		41	31	32	36		**35**							
4	3A		42	46	36	36		**40**							
5	3B		50	40	30	54		**44**							
6	4A		36	42	42	45		**41**		A		A		A	A
7	4B		35	48	58	36		**44**			A		A		
8	4C		54	48	47	55		**51**							
9	4D		51	45	55	38		**47**							
10	5A		62	53	58	68		**60**							
11	5B		56	69	48	79		**63**							
12	6A		44	40	40	58		**46**		A					
13	6B		46	37	42	43		**42**			A				
14	7A		39	36	37	48		**40**		A					
15	7B		30	40	36	31		**34**			A				
16	8A		35	43	40	41		**40**				A			
17	8B		42	35	41	37		**39**					A		
18	9A		31	41	50	32		**39**				A			
19	9B		44	32	32	55		**41**					A		
20	11A		50	45	43	50		**47**							
21	11B		52	42	36	43		**43**							
22	11C		36	40	35	37		**37**							
23	12A		47	36	48	34		**41**						A	
24	13A		54	47	52	43		**49**							A
								CV, %		11,26	19,70	12,36	26,27	17,53	13,19
								msd		10,20	15,59	10,68	23,51	16,28	13,40

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 15. Soil pH_{H2O} (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
1	1		5.4	5.7	5.2	5.3		**5.4**							
2	2A		5.6	5.7	5.3	5.5		**5.5**							
3	2B		5.7	5.7	5.3	5.4		**5.5**							
4	3A		5.6	5.4	5.5	5.3		**5.5**							
5	3B		5.7	5.8	5.6	5.3		**5.6**							
6	4A		5.3	5.4	5.6	5.5		**5.5**		B		A		A	A
7	4B		5.6	5.3	5.2	5.5		**5.4**			B		A		
8	4C		5.2	5.4	5.6	5.2		**5.4**							
9	4D		5.6	5.3	5.5	5.3		**5.4**							
10	5A		5.4	5.3	5.6	5.5		**5.5**							
11	5B		5.5	5.6	5.8	5.7		**5.7**							
12	6A		5.3	5.4	5.4	5.7		**5.5**		B					
13	6B		5.1	5.5	5.3	5.6		**5.4**			B				
14	7A		5.9	6.0	6.2	5.8		**6.0**		A					
15	7B		6.1	5.8	6.0	6.1		**6.0**			A				
16	8A		5.3	5.6	5.4	5.2		**5.4**				A			
17	8B		5.2	5.5	5.7	5.3		**5.4**					A		
18	9A		5.2	5.6	5.7	5.5		**5.5**				A			
19	9B		5.4	5.4	5.6	5.6		**5.5**					A		
20	11A		5.2	5.2	5.6	5.8		**5.5**							
21	11B		5.6	5.3	5.7	5.6		**5.6**							
22	11C		5.4	5.2	5.6	5.4		**5.4**							
23	12A		5.6	5.7	5.3	5.4		**5.5**						A	
24	13A		5.6	5.4	5.2	5.7		**5.5**							A
								CV, %		3,30	3,36	2,47	3,86	3,87	4,00
								msd		0,40	0,41	0,29	0,46	0,48	0,49

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 16. Soil Al availability (2012-2013).

Treat #	Treat #	Replicate 1	2	3	4	Average	Comparison 5	6	8	9	12	13
		$cmol_c/dm^3$				$cmol_c/dm^3$						
1	1	0.3	0.0	0.4	0.3	**0.3**						
2	2A	0.0	0.2	0.3	0.0	**0.1**						
3	2B	0.0	0.2	0.3	0.0	**0.1**						
4	3A	0.0	0.2	0.3	0.3	**0.2**						
5	3B	0.0	0.0	0.3	0.0	**0.1**						
6	4A	0.3	0.2	0.0	0.3	**0.2**	A		A		A	A
7	4B	0.0	0.1	0.4	0.3	**0.2**		A		A		
8	4C	0.2	0.0	0.4	0.4	**0.3**						
9	4D	0.3	0.2	0.3	0.0	**0.2**						
10	5A	0.2	0.0	0.3	0.3	**0.2**						
11	5B	0.0	0.0	0.0	0.2	**0.1**						
12	6A	0.3	0.3	0.0	0.3	**0.2**	A					
13	6B	0.3	0.0	0.2	0.5	**0.3**		A				
14	7A	0.0	0.0	0.0	0.0	**0.0**	A					
15	7B	0.0	0.0	0.0	0.0	**0.0**		A				
16	8A	0.3	0.0	0.3	0.4	**0.3**			A			
17	8B	0.3	0.0	0.2	0.4	**0.2**				A		
18	9A	0.4	0.2	0.0	0.0	**0.2**			A			
19	9B	0.3	0.0	0.0	0.3	**0.2**				A		
20	11A	0.4	0.0	0.0	0.4	**0.2**						
21	11B	0.0	0.0	0.0	0.3	**0.1**						
22	11C	0.3	0.0	0.4	0.3	**0.3**						
23	12A	0.0	0.0	0.4	0.3	**0.2**					A	
24	13A	0.0	0.3	0.3	0.0	**0.2**						A
						CV, %	87,4	99,4	81,6	80,1	116,7	121,2
						msd	0,30	0,32	0,35	0,33	0,49	0,49

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

Table 17. Soil bases saturation (2012-2013).

Treat #	Treat #		Replicate 1	2	3	4		Average		Comparison 5	6	8	9	12	13
			%					%							
1	1		34.8	42.1	30.7	33.7		**35.3**							
2	2A		39.6	43.5	32.4	37.7		**38.3**							
3	2B		41.7	41.2	34.5	37.2		**38.7**							
4	3A		39.8	35.5	37.1	32.5		**36.2**							
5	3B		41.7	44.0	39.1	32.9		**39.4**							
6	4A		31.5	37.0	39.5	36.7		**36.2**		B		A		A	A
7	4B		39.1	32.0	26.7	38.3		**34.0**			B		A		
8	4C		29.8	37.4	40.7	30.6		**34.6**							
9	4D		39.9	34.0	37.8	30.5		**35.6**							
10	5A		35.7	33.1	39.5	37.5		**36.5**							
11	5B		38.3	40.3	46.2	41.9		**41.7**							
12	6A		33.8	35.6	36.4	41.6		**36.9**		B					
13	6B		23.1	37.2	33.4	39.2		**33.2**			B				
14	7A		48.8	51.8	57.3	45.1		**50.8**		A					
15	7B		51.7	45.5	52.6	50.8		**50.2**			A				
16	8A		32.4	40.5	34.8	27.0		**33.7**				A			
17	8B		23.9	38.6	42.3	30.7		**33.9**					A		
18	9A		29.1	39.2	43.0	37.3		**37.2**				A			
19	9B		34.0	36.9	40.3	40.6		**38.0**					A		
20	11A		30.3	28.2	39.1	47.2		**36.2**							
21	11B		41.0	32.2	41.1	39.6		**38.5**							
22	11C		35.8	27.3	39.6	36.9		**34.9**							
23	12A		39.2	40.9	30.3	34.5		**36.2**						A	
24	13A		39.6	37.0	30.8	41.3		**37.2**							A
								CV, %		12,10	15,92	10,68	20,00	14,44	14,01
								msd		10,59	13,51	8,26	15,26	11,76	11,56

Same capital letters in the column indicate no statistical mean difference at p<0.05.
Comparisons 1 relates, with proper statistics, to Figures and not single average comparisons.
Comparison # 5 = treatments 12, 6 and 14 = lime application.
Comparison # 6 = treatments 13, 7 and 15 = lime application.
Comparison # 8 = treatments 16, 6 and 18 = phosphogypsum application.
Comparison # 9 = treatments 17, 7 and 19 = phosphogypsum application.
Comparison # 12 = treatments 6 and 23 = effect of time of application.
Comparison # 13 = treatments 6 and 24 = effect of K locality effect.
For details in such comparisons refer to Table 5.

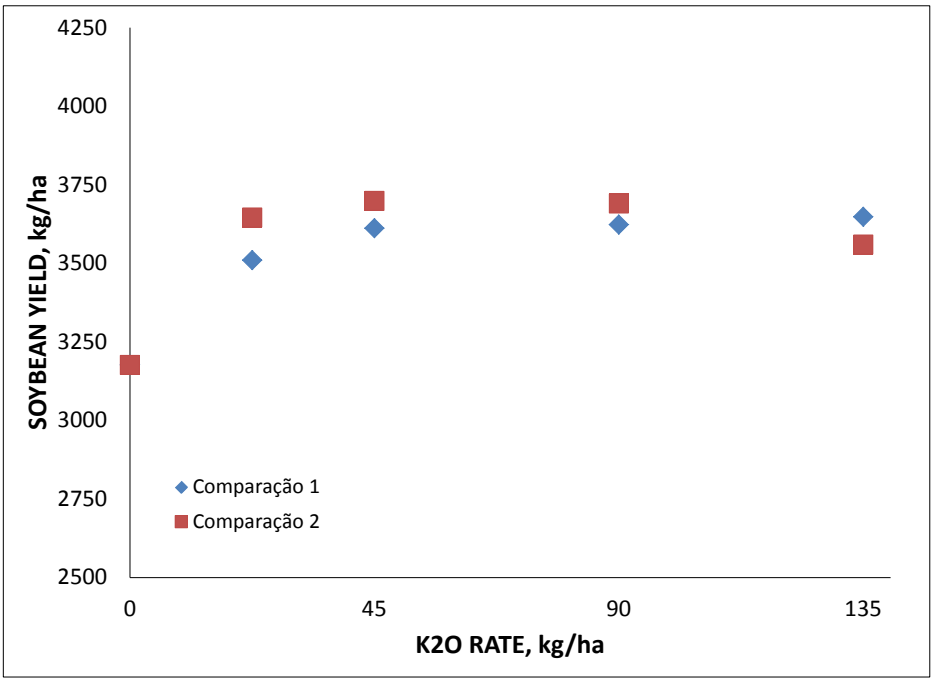

Figure 1. Soybean grain yield in response to K_2O rates (separate data for comparisons 1 and 2 at Table 5). Crop season 2012-2013.

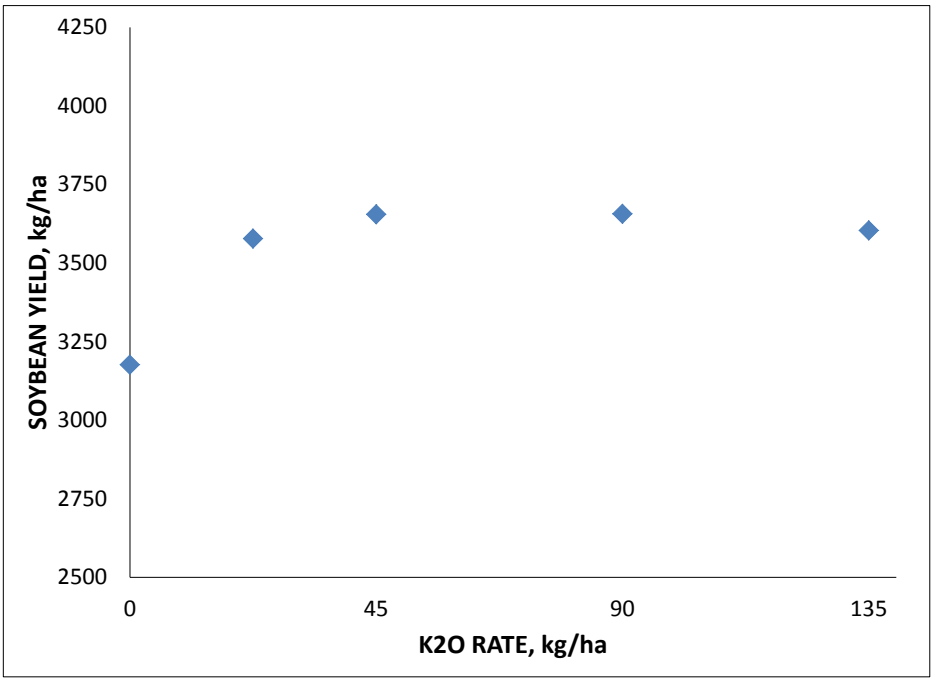

Figure 2. Soybean grain yield in response to K_2O rates (average for comparisons 1 and 2 at Table 5). Crop season 2012-2013.

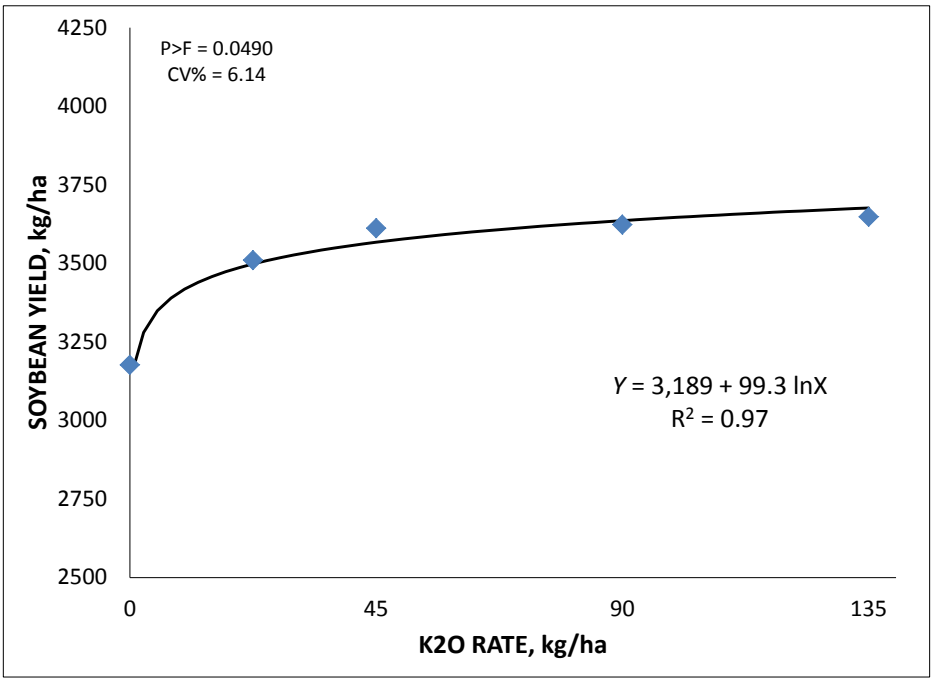

Figure 3. Soybean grain yield response curve to K_2O rates with logarithmic model adjusted (comparison 1). Crop season 2012-2013.

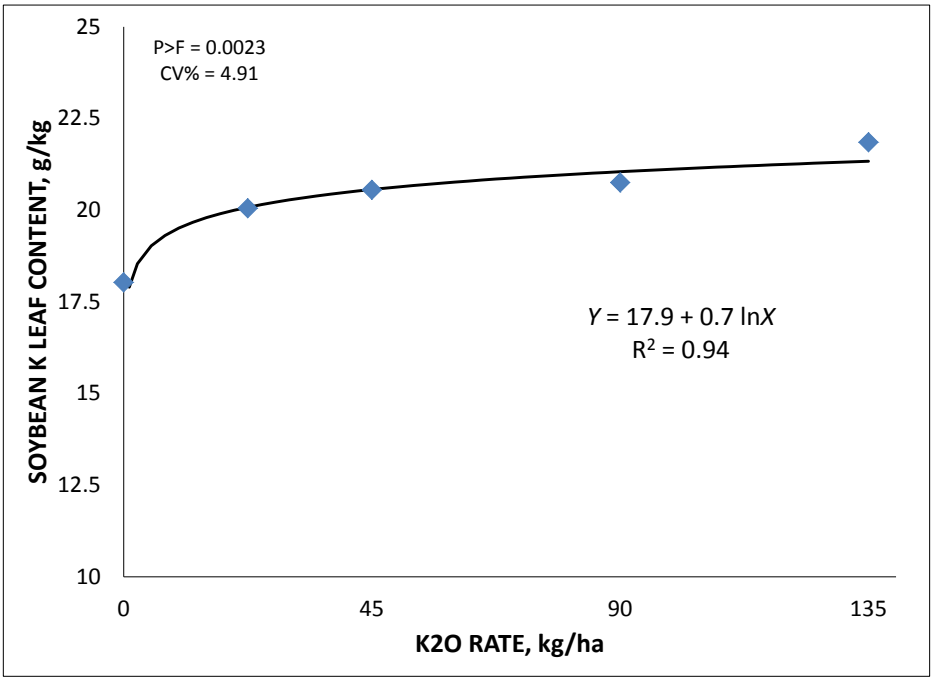

Figure 4. Soybean leaf K content response curve to K_2O rates with logarithmic model adjusted (comparison 1). Crop season 2012-2013.

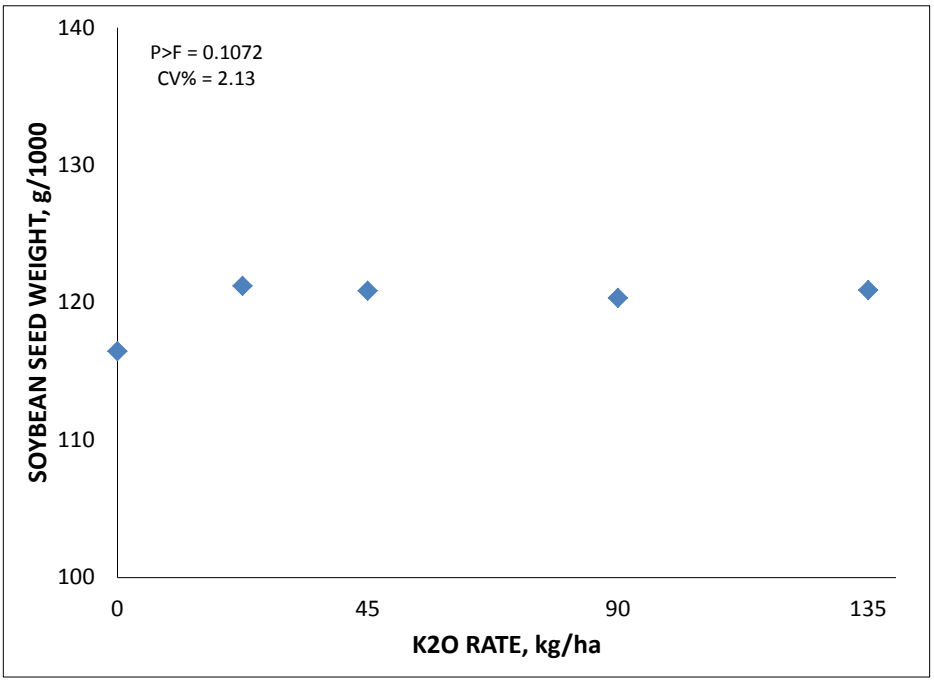

Figure 5. Soybean seeds weight in response to K_2O rates (comparison 1). P>F not significant. Crop season 2012-2013.

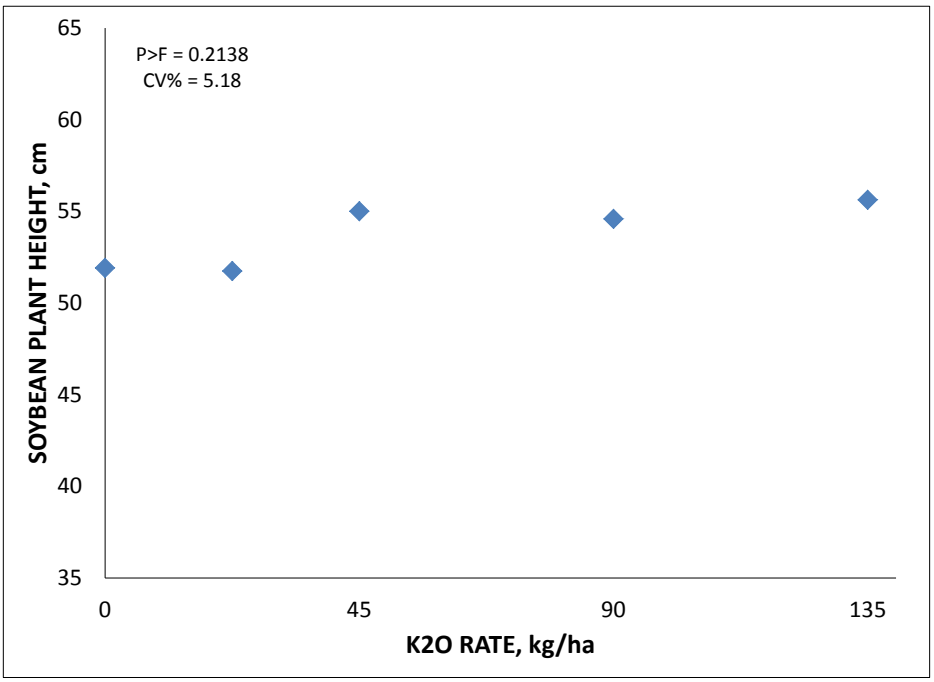

Figure 6. Soybean plant height in response to K_2O rates (comparison 1). P>F not significant. Crop season 2012-2013.

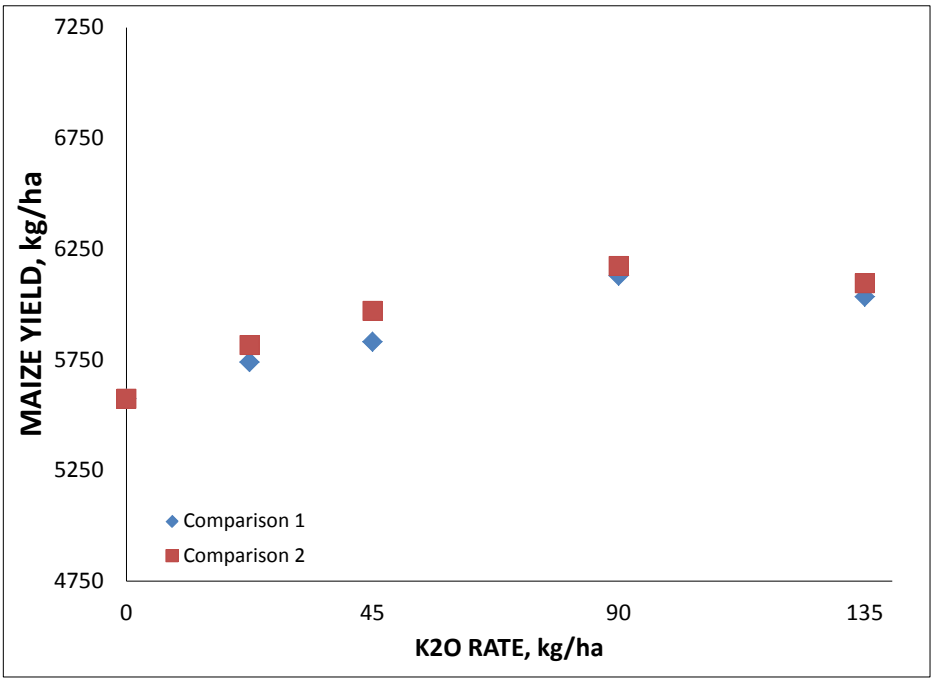

Figure 7. Maize grain yield in response to K_2O rates (separate data for comparisons 1 and 2 at Table 5). Crop season 2012-2013.

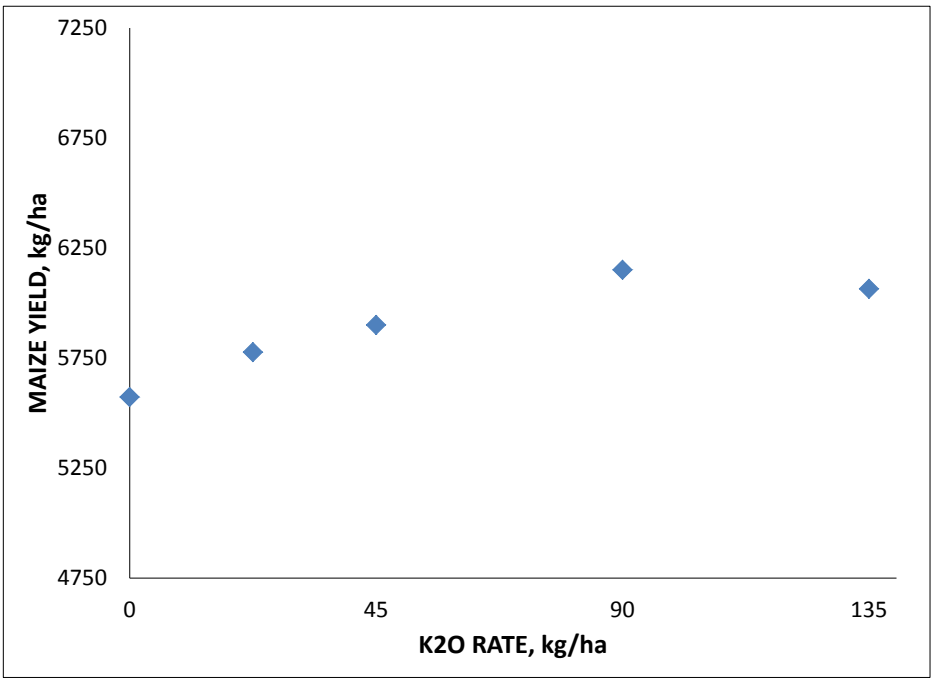

Figure 8. Maize grain yield in response to K_2O rates (average for comparisons 1 and 2 at Table 5). Crop season 2012-2013.

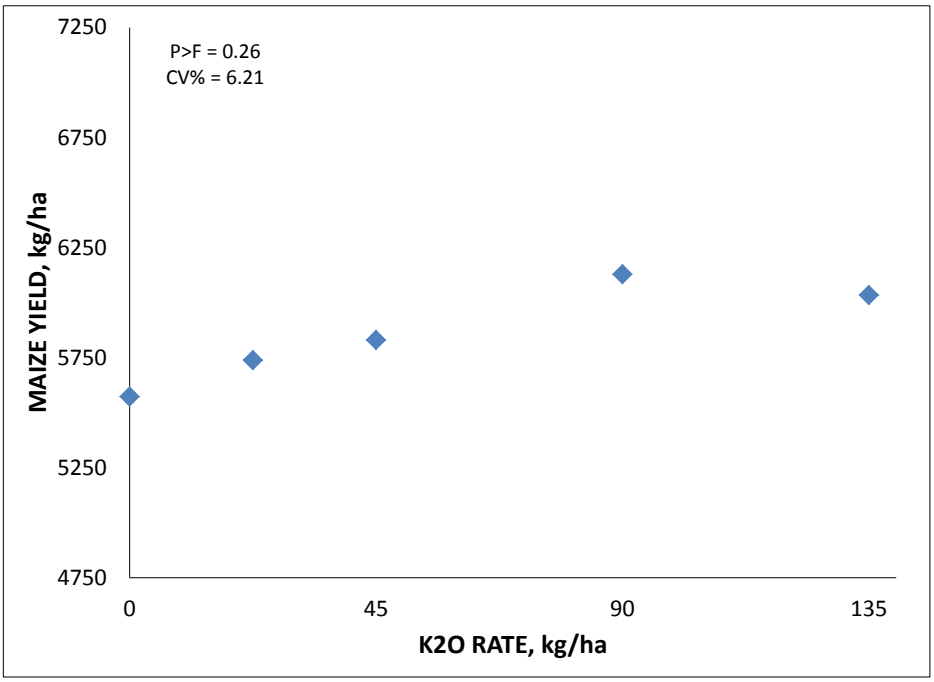

Figure 9. Maize grain yield in response to K_2O rates (comparison 1). P>F not significant. Crop season 2012-2013.

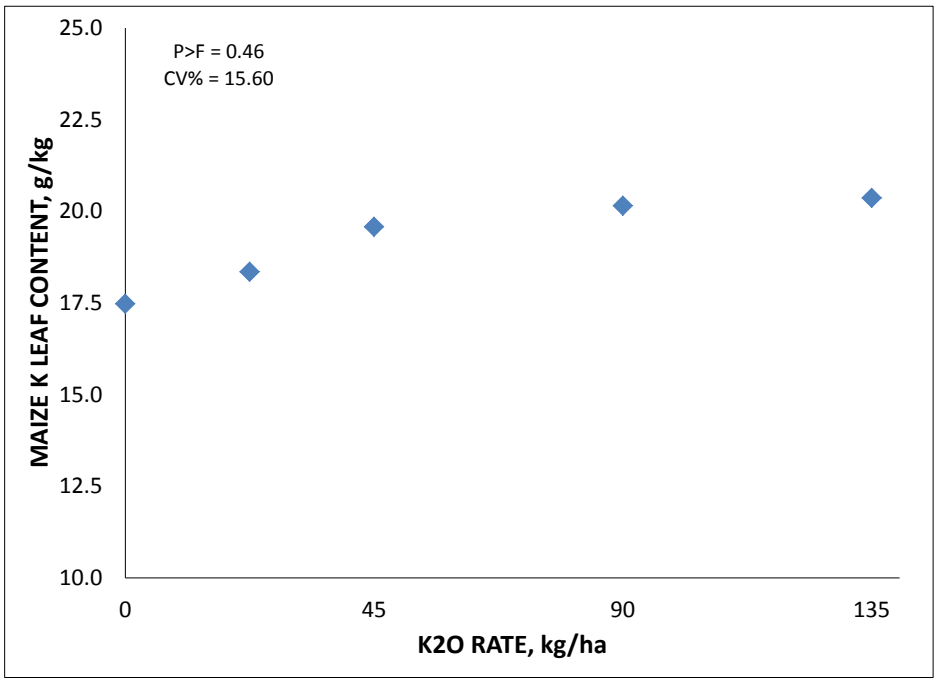

Figure 10. Maize leaf K content in response to K_2O rates (comparison 1). P>F not significant. Crop season 2012-2013.

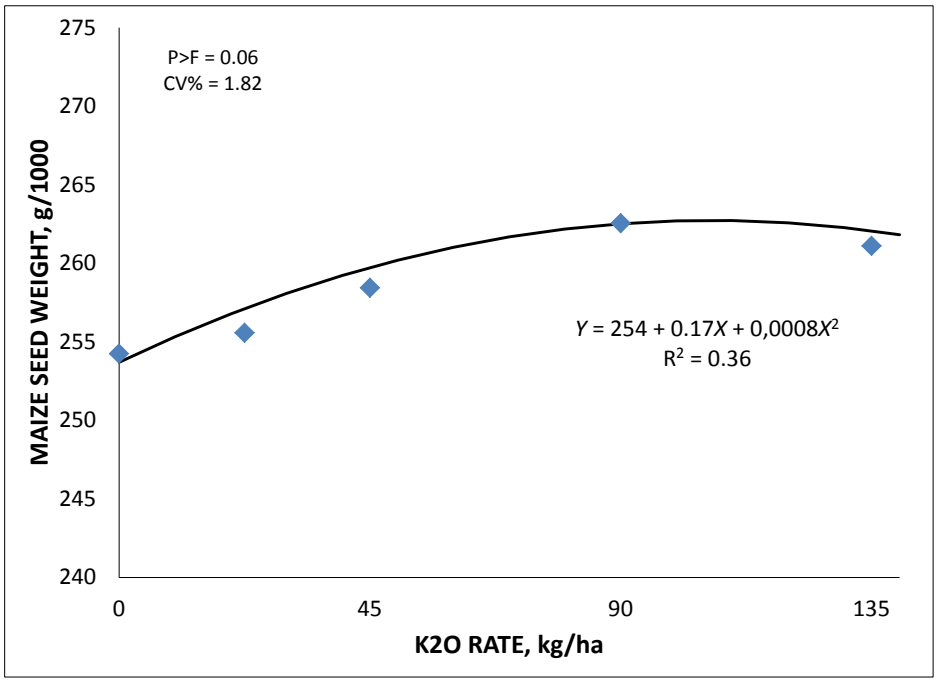

Figure 11. Maize seeds weight response curve to K_2O rates with quadratic model adjusted (comparison 1). Crop season 2012-2013.

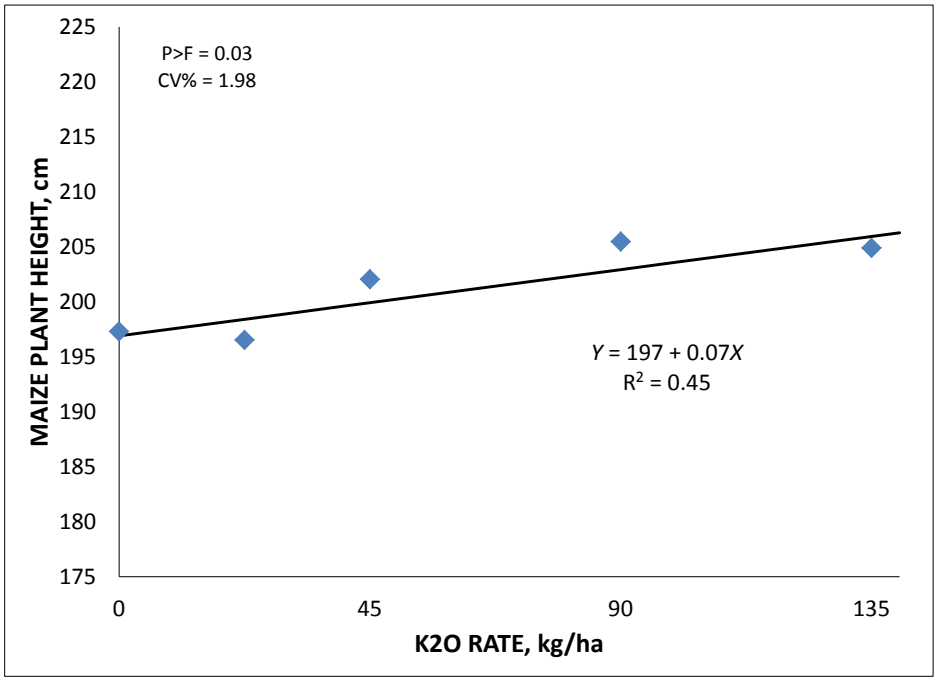

Figure 12. Maize plant height response curve to K_2O rates with linear model adjusted (comparison 1). Crop season 2012-2013.

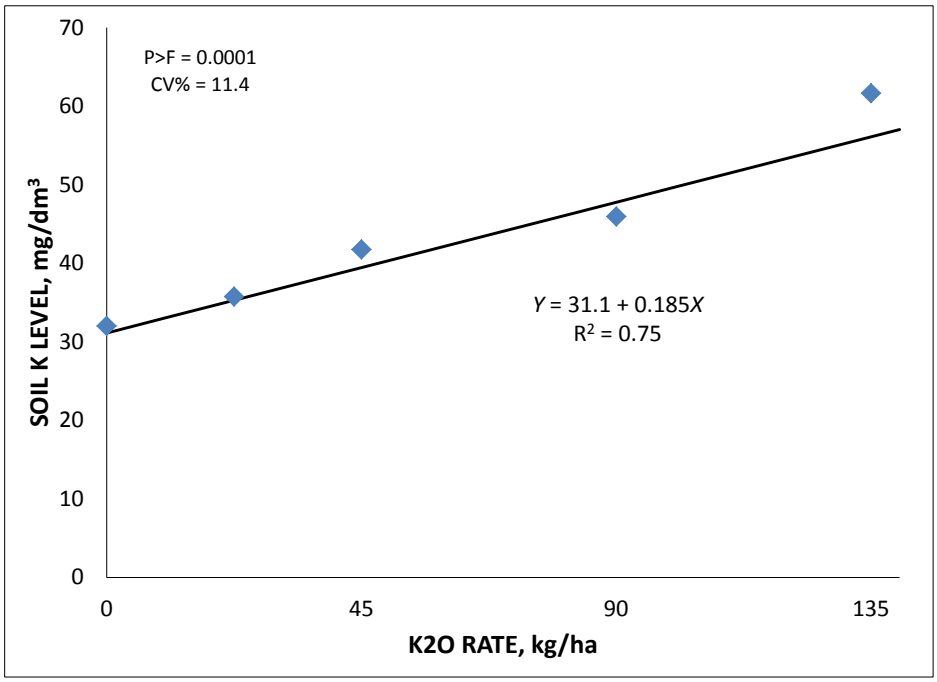

Figure 13. Soil K availability response curve to K_2O rates with quadratic model adjusted (comparison 1). Crop season 2012-2013.

Appendix A. Raw data of Soybean agronomical features and nutritional status, season 2012-2013.

T#	T#	Rep	Plot#	Yield (kg/ha)	SW[(1)] (g/1000)	PH[(2)] (cm)	Nutrient leaf status (g/kg)					
							N	P	K	Ca	Mg	S
1	1	1	1083	3153.8	116.4	52.5	49.0	2.8	18.7	8.55	5.55	2.40
1	1	2	1086	3304.5	117.9	45.8	56.0	3.3	17.2	9.15	6.00	2.21
1	1	3	1088	2835.8	114.2	53.8	56.0	2.7	18.8	8.70	5.85	2.85
1	1	4	1089	3411.5	117.2	55.5	46.2	3.4	17.4	8.40	5.25	2.14
2	2A	1	1065	3393.4	117.3	51.7	43.4	2.5	19.6	7.80	5.40	2.65
2	2A	2	1053	3498.9	118.3	47.8	54.6	2.9	20.4	9.00	5.70	2.72
2	2A	3	1062	3470.4	126.3	52.5	43.4	2.6	19.4	7.65	5.25	2.21
2	2A	4	1057	3675.3	123.0	55.0	58.8	3.1	20.8	7.20	5.55	2.20
3	2B	1	1066	3604.2	126.2	56.3	47.6	3.1	19.2	9.30	5.70	2.49
3	2B	2	1054	3722.2	114.8	49.2	43.4	2.4	20.4	8.25	5.55	2.65
3	2B	3	1061	3670.0	120.8	56.7	53.2	2.8	20.8	9.15	5.55	2.45
3	2B	4	1058	3585.0	120.2	55.0	43.4	2.9	19.0	10.20	6.00	2.30
4	3A	1	1052	3582.9	120.5	48.3	42.0	2.6	19.8	9.30	6.00	2.65
4	3A	2	1063	3507.5	117.9	52.5	44.8	2.9	19.0	9.00	5.70	2.30
4	3A	3	1056	3820.0	122.9	59.2	57.4	2.7	22.2	7.80	5.70	2.41
4	3A	4	1060	3535.2	122.0	60.0	44.1	3.2	21.2	8.40	5.70	2.52
5	3B	1	1051	3951.5	120.5	62.5	56.0	3.0	21.9	8.10	5.85	2.49
5	3B	2	1064	3045.3	118.0	45.8	56.0	2.7	19.6	8.70	5.55	2.62
5	3B	3	1055	3778.7	121.8	51.7	56.0	3.3	21.0	9.15	5.85	2.62
5	3B	4	1059	4017.8	119.6	60.8	56.0	3.3	21.4	8.40	5.85	2.64
6	4A	1	1099	3362.9	118.0	51.7	44.1	2.4	21.5	7.50	4.65	2.14
6	4A	2	1111	3658.2	120.4	50.8	56.0	2.8	19.6	6.45	4.50	2.21
6	4A	3	1110	3935.6	120.2	59.2	53.2	2.4	21.0	7.50	4.95	2.38
6	4A	4	1106	3533.4	122.6	56.7	56.0	2.4	20.9	7.35	4.95	3.21
7	4B	1	1100	3840.0	119.7	62.5	56.0	3.2	20.8	6.75	4.80	2.57
7	4B	2	1112	3719.4	120.8	55.8	53.2	2.1	20.0	6.75	5.10	2.35
7	4B	3	1109	3590.4	122.6	58.3	49.0	3.0	19.8	7.80	5.10	2.32
7	4B	4	1105	3609.8	118.5	49.2	50.4	2.6	21.0	7.20	4.80	2.24
8	4C	1	1113	3896.8	123.6	59.5	49.0	2.8	20.2	6.60	4.95	2.45
8	4C	2	1101	3546.9	119.9	59.2	54.6	2.6	19.8	6.30	4.95	2.25
8	4C	3	1104	3465.8	118.7	53.3	49.0	2.8	22.2	6.00	4.20	3.27
8	4C	4	1108	3585.9	119.4	55.0	44.8	2.9	18.8	7.35	4.80	2.31
9	4D	1	1114	3552.3	122.3	51.7	46.2	3.2	19.4	6.90	4.50	2.54
9	4D	2	1102	3585.0	117.6	55.8	53.2	2.7	19.2	7.35	4.80	2.58
9	4D	3	1103	3755.0	122.3	55.8	56.0	3.0	21.4	6.60	4.95	2.45
9	4D	4	1107	3599.5	120.9	60.0	47.6	2.3	20.6	7.80	5.10	2.43
10	5A	1	1082	3892.2	123.5	56.7	44.8	3.4	22.8	7.05	5.25	2.46
10	5A	2	1079	3685.4	118.8	53.3	43.4	2.7	21.6	7.65	5.55	2.88
10	5A	3	1077	3526.2	122.0	59.2	57.4	3.0	20.4	7.95	5.55	2.56
10	5A	4	1076	3485.2	119.2	53.3	53.2	2.6	22.6	7.35	5.40	2.41
11	5B	1	1081	3645.7	124.6	56.7	43.4	3.3	21.6	7.65	5.40	2.07
11	5B	2	1080	3585.0	120.3	53.3	44.8	2.9	21.8	8.55	5.25	2.51
11	5B	3	1078	3483.4	122.0	57.5	56.0	2.8	21.0	6.75	4.95	2.23
11	5B	4	1075	3522.9	118.4	58.3	44.8	3.0	20.8	7.20	5.70	2.53
12	6A	1	1115	3590.2	121.0	53.3	49.0	2.6	18.8	7.05	4.95	2.39
12	6A	2	1118	3805.9	120.1	55.8	56.0	2.5	21.6	7.20	5.10	2.34
12	6A	3	1125	3592.9	120.2	60.8	43.4	2.9	18.2	6.75	4.80	2.15
12	6A	4	1123	3801.1	119.6	55.8	49.0	3.0	19.8	7.05	4.80	2.46
13	6B	1	1129	3535.0	123.0	59.2	43.4	3.0	20.2	7.20	5.25	2.37
13	6B	2	1127	3667.9	119.4	61.2	44.8	3.1	19.0	7.05	5.10	2.30
13	6B	3	1119	3833.1	124.3	52.5	53.2	2.8	20.2	6.45	5.10	2.38
13	6B	4	1124	3511.6	116.1	55.0	44.8	3.1	19.2	7.35	5.25	2.38

(1) Seed weight. (2) Plant height.

Continuing …

T#	T#	Rep	Plot#	Yield (kg/ha)	SW[(1)] (g/1000)	PH[(2)] (cm)	Nutrient leaf status (g/kg)					
							N	P	K	Ca	Mg	S
14	7A	1	1116	4101.8	118.2	57.5	56.0	2.8	19.4	6.60	5.10	2.39
14	7A	2	1128	3755.2	122.2	65.0	53.2	2.9	19.6	8.10	5.25	2.73
14	7A	3	1120	3912.2	121.8	60.0	49.0	3.0	18.6	7.65	5.25	2.30
14	7A	4	1122	3523.3	119.5	66.2	44.8	2.6	18.6	6.75	5.40	2.49
15	7B	1	1130	3657.3	121.6	53.3	46.2	3.2	19.0	6.30	4.95	2.72
15	7B	2	1117	3881.2	122.4	63.3	50.4	2.8	17.2	7.05	5.25	2.43
15	7B	3	1126	3883.1	118.8	69.2	53.2	3.0	21.0	6.45	5.25	1.95
15	7B	4	1121	4144.5	121.6	59.2	50.4	2.6	19.6	7.35	5.25	2.16
16	8A	1	1131	3353.8	123.4	50.0	49.0	3.1	19.2	7.50	4.65	2.49
16	8A	2	1134	3646.6	118.7	54.2	46.2	3.5	18.2	6.45	4.80	2.61
16	8A	3	1135	3455.0	118.6	60.8	44.8	2.6	20.4	7.35	6.30	2.51
16	8A	4	1140	3661.0	117.4	65.0	49.0	2.5	20.4	7.80	9.30	2.23
17	8B	1	1146	3527.8	117.4	53.3	49.0	2.7	20.2	8.25	4.95	1.99
17	8B	2	1144	3581.2	122.0	53.3	44.8	2.5	21.6	6.30	3.15	2.07
17	8B	3	1142	3365.5	119.7	60.8	43.4	2.8	19.0	7.20	6.00	2.43
17	8B	4	1137	3586.8	118.0	60.8	44.1	2.9	18.8	7.50	10.50	2.83
18	9A	1	1132	3655.4	120.6	58.3	44.1	2.4	19.6	7.35	4.35	2.59
18	9A	2	1143	3573.7	120.0	60.0	58.1	2.9	21.0	6.60	7.20	2.71
18	9A	3	1141	3733.4	119.5	60.8	56.0	2.8	22.6	6.75	4.80	2.39
18	9A	4	1138	3436.4	124.4	60.0	51.8	3.1	21.2	6.00	3.30	2.43
19	9B	1	1145	3476.1	122.5	58.3	56.0	2.6	20.6	8.55	4.35	2.12
19	9B	2	1133	3518.4	119.0	56.7	44.8	2.5	21.5	7.05	4.95	2.17
19	9B	3	1136	3822.0	120.6	62.5	47.6	2.8	19.0	7.65	9.90	2.19
19	9B	4	1139	4027.8	122.6	60.8	44.8	2.4	21.0	6.75	3.60	2.47
20	11A	1	1098	3524.7	117.5	56.0	58.8	3.0	20.8	6.75	4.80	2.23
20	11A	2	1085	3471.0	124.8	48.3	51.8	2.8	21.0	7.35	5.70	2.34
20	11A	3	1094	3701.7	119.1	59.2	43.4	2.6	20.6	9.00	5.85	2.49
20	11A	4	1092	3503.3	117.9	57.5	44.8	3.2	19.0	8.25	4.95	2.76
21	11B	1	1084	3511.2	119.4	59.2	56.0	3.3	18.6	8.25	5.85	2.39
21	11B	2	1095	3482.5	118.7	60.8	44.8	3.1	21.0	7.95	5.70	2.83
21	11B	3	1087	3815.2	120.6	51.7	53.2	3.4	20.0	8.55	5.55	2.19
21	11B	4	1091	3673.6	119.7	57.7	54.6	2.8	21.8	7.80	5.10	2.91
22	11C	1	1097	3754.0	118.2	61.7	43.4	3.2	19.0	6.90	4.95	2.17
22	11C	2	1096	3597.3	123.6	58.3	56.0	2.7	20.6	6.75	5.10	2.14
22	11C	3	1093	3373.2	121.6	57.5	49.0	3.3	21.8	8.70	5.25	2.13
22	11C	4	1090	3643.2	117.3	55.2	43.4	2.7	21.2	8.70	5.55	2.51
23	12A	1	1068	3339.4	121.8	51.7	43.4	2.8	21.2	8.10	5.40	2.32
23	12A	2	1069	3233.8	120.3	51.7	44.8	3.0	19.6	10.05	5.55	2.33
23	12A	3	1072	3890.1	119.8	52.5	43.4	3.0	20.6	7.20	5.40	2.23
23	12A	4	1073	3367.2	121.2	54.2	54.6	3.3	19.6	9.75	5.55	2.49
24	12B	1	1067	3964.6	123.9	52.5	42.0	2.8	22.2	7.80	5.40	2.45
24	12B	2	1070	3786.2	120.7	50.8	53.2	3.2	22.4	7.50	5.40	2.31
24	12B	3	1071	3628.3	120.4	55.0	56.0	2.4	24.0	6.90	5.25	2.39
24	12B	4	1074	3876.5	120.9	57.5	56.0	3.1	22.0	7.50	5.85	2.54

[(1)] Seed weight. [(2)] Plant height.

Appendix B. Raw data of Maize agronomical features and nutritional status, season 2012-2013.

T#	T#	Rep	Plot#	Yield (kg/ha)	SW[(1)] (g/1000)	PH[(2)] (cm)	Nutrient leaf status (g/kg)					
							N	P	K	Ca	Mg	S
1	1	1	1083	6048.3	250.4	191.7	30.1	2.20	19.6	3.45	2.85	2.38
1	1	2	1086	5854.6	248.5	199.2	29.4	2.30	14.8	3.75	2.40	2.35
1	1	3	1088	4642.8	255.3	200.0	32.2	2.30	18.0	3.60	2.85	2.01
1	1	4	1089	5745.3	262.8	198.3	33.6	2.50	17.5	2.55	2.40	2.41
2	2A	1	1065	5810.6	259.6	200.0	33.6	2.20	15.2	3.00	2.25	1.84
2	2A	2	1053	5476.0	251.1	189.2	29.4	2.00	18.0	3.15	2.25	2.57
2	2A	3	1062	6086.1	254.8	199.2	33.2	2.10	16.0	3.00	2.25	2.59
2	2A	4	1057	5580.4	263.0	198.0	30.8	2.30	19.6	3.45	2.70	2.47
3	2B	1	1066	6133.4	256.4	207.5	34.3	2.40	15.4	3.30	2.10	1.77
3	2B	2	1054	5369.9	247.8	192.5	30.8	2.00	18.0	3.90	2.55	2.48
3	2B	3	1061	5983.4	256.1	188.3	30.8	2.20	24.0	3.15	2.10	2.15
3	2B	4	1058	5775.4	255.7	197.5	31.5	2.10	20.6	3.30	2.55	1.71
4	3A	1	1052	5679.7	263.6	198.0	32.2	2.20	17.6	3.30	2.40	2.42
4	3A	2	1063	5748.5	259.8	200.0	29.4	1.90	14.0	3.40	2.85	2.08
4	3A	3	1056	5879.3	252.2	200.8	30.8	2.00	16.0	2.85	1.95	2.27
4	3A	4	1060	6012.8	256.8	204.2	28.0	2.50	23.0	2.85	1.95	2.10
5	3B	1	1051	6089.7	262.7	206.7	29.4	2.60	18.6	3.75	1.95	2.04
5	3B	2	1064	6035.0	256.9	210.8	30.8	2.50	23.0	3.45	1.95	1.81
5	3B	3	1055	5910.3	259.9	198.3	28.0	2.20	21.0	2.70	2.10	2.00
5	3B	4	1059	5844.6	255.6	197.5	32.2	2.60	23.4	3.30	2.25	1.78
6	4A	1	1099	6253.0	258.9	207.5	28.0	2.50	21.4	2.55	1.65	2.13
6	4A	2	1111	6218.2	267.7	204.2	31.1	2.30	18.0	2.40	1.50	1.76
6	4A	3	1110	6300.4	263.6	207.5	30.8	2.60	20.6	2.25	1.80	1.88
6	4A	4	1106	5742.9	268.1	200.8	28.7	2.70	20.6	2.55	1.65	2.07
7	4B	1	1100	6264.8	255.3	210.0	31.5	2.70	22.0	2.85	1.60	2.31
7	4B	2	1112	6202.3	265.1	201.7	30.8	2.40	14.0	3.00	1.65	2.31
7	4B	3	1109	6103.3	260.0	202.5	29.4	2.30	21.4	2.40	1.95	2.13
7	4B	4	1105	6121.3	257.3	208.3	27.9	2.50	20.2	2.70	1.80	2.19
8	4C	1	1113	5863.3	256.4	205.8	28.0	2.30	18.8	2.55	1.65	2.02
8	4C	2	1101	6377.2	263.4	203.3	29.4	2.60	21.0	3.00	2.10	1.96
8	4C	3	1104	5958.6	264.5	204.0	30.8	2.70	18.8	3.00	1.66	2.13
8	4C	4	1108	6499.6	269.2	209.2	31.5	2.50	23.0	2.70	1.80	2.04
9	4D	1	1114	5730.3	265.5	210.0	28.7	2.00	21.8	2.25	1.80	1.91
9	4D	2	1102	6088.5	267.9	203.3	28.0	2.40	19.2	2.40	1.80	2.07
9	4D	3	1103	6025.8	255.3	201.0	29.4	2.20	19.2	2.70	1.65	2.02
9	4D	4	1107	6258.6	262.4	208.3	30.8	2.70	22.4	2.40	1.50	2.13
10	5A	1	1082	6083.4	257.0	204.2	36.4	2.00	14.4	2.25	1.65	1.89
10	5A	2	1079	5997.3	259.0	208.3	32.2	1.90	24.0	2.40	1.95	1.95
10	5A	3	1077	5971.3	264.0	207.5	30.8	2.20	18.3	2.55	2.10	2.12
10	5A	4	1076	6082.9	268.8	199.2	31.5	2.70	22.6	2.70	1.80	1.84
11	5B	1	1081	6600.3	260.2	202.5	35.0	1.90	14.4	2.40	1.80	2.03
11	5B	2	1080	6312.9	264.7	200.8	32.9	2.00	17.8	2.70	2.10	1.82
11	5B	3	1078	5961.8	262.2	206.7	29.4	2.20	23.6	2.40	2.10	2.07
11	5B	4	1075	5505.0	252.9	210.0	30.8	2.40	27.8	2.25	1.95	1.89
12	6A	1	1115	6154.7	265.8	214.0	34.8	2.30	23.0	2.55	2.10	1.96
12	6A	2	1118	6034.7	265.3	209.2	29.4	2.40	18.0	2.40	1.60	1.62
12	6A	3	1125	6314.5	261.5	208.3	29.1	2.70	19.0	2.70	1.65	2.02
12	6A	4	1123	6168.0	270.1	209.2	31.5	2.50	22.4	3.00	1.65	1.76
13	6B	1	1129	6170.7	267.8	200.0	30.8	2.60	18.6	2.85	1.73	2.25
13	6B	2	1127	6166.3	266.5	210.8	30.8	2.20	20.6	3.00	1.50	2.07
13	6B	3	1119	6218.0	266.4	207.5	30.8	2.50	21.0	3.30	2.18	1.86
13	6B	4	1124	6316.8	258.8	213.3	30.8	2.30	20.4	3.90	2.40	2.38

(1) Seed weight. (2) Plant height.

Continuing …

T#	T#	Rep	Plot#	Yield (kg/ha)	SW[(1)] (g/1000)	PH[(2)] (cm)	Nutrient leaf status (g/kg)					
							N	P	K	Ca	Mg	S
14	7A	1	1116	59027.8	263.1	215.8	32.2	2.60	21.2	2.25	1.60	1.81
14	7A	2	1128	64583.3	258.4	221.7	30.1	2.50	18.8	3.00	2.10	2.00
14	7A	3	1120	61805.6	267.5	218.3	29.4	2.60	19.0	3.15	1.95	2.02
14	7A	4	1122	65972.2	253.6	209.2	29.4	2.60	21.4	2.70	1.80	2.13
15	7B	1	1130	62500.0	254.2	215.8	28.7	1.90	20.0	2.40	1.65	1.76
15	7B	2	1117	68055.6	258.2	218.3	30.1	2.60	14.0	3.00	2.10	1.89
15	7B	3	1126	61805.6	266.5	223.3	30.2	2.60	20.2	2.70	1.80	1.91
15	7B	4	1121	63194.4	257.9	210.8	30.8	2.90	23.6	3.15	1.50	2.02
16	8A	1	1131	55555.6	269.2	214.2	29.4	2.60	16.6	3.30	2.18	2.21
16	8A	2	1134	68055.6	271.3	208.0	29.4	2.30	20.8	3.15	2.10	1.85
16	8A	3	1135	60416.7	270.0	207.5	28.7	2.00	19.2	3.75	2.55	2.14
16	8A	4	1140	60416.7	271.3	205.8	28.0	2.40	21.0	3.15	2.10	1.88
17	8B	1	1146	59027.8	261.5	200.0	29.4	2.80	19.2	3.30	2.25	1.87
17	8B	2	1144	61111.1	269.6	203.3	32.2	2.00	18.6	3.00	1.88	1.75
17	8B	3	1142	60250.0	270.3	213.3	30.8	2.00	20.8	3.30	2.10	2.24
17	8B	4	1137	61111.1	270.3	205.0	33.6	1.90	21.2	2.70	1.65	2.00
18	9A	1	1132	60416.7	264.9	215.8	32.2	2.70	18.2	3.75	1.80	2.37
18	9A	2	1143	56250.0	279.5	214.2	30.1	2.90	18.8	3.75	2.40	1.96
18	9A	3	1141	62500.0	264.4	214.2	30.8	2.10	22.6	3.15	1.95	1.97
18	9A	4	1138	55555.6	274.8	202.5	29.4	2.00	19.2	3.00	1.65	1.87
19	9B	1	1145	65277.8	279.6	213.3	29.4	2.70	21.2	3.60	1.95	2.15
19	9B	2	1133	61805.6	267.1	204.2	30.1	2.10	18.2	3.45	1.80	2.01
19	9B	3	1136	57638.9	271.3	215.8	30.8	2.00	18.0	3.45	2.25	2.27
19	9B	4	1139	64583.3	263.6	206.7	28.0	2.30	18.4	3.60	1.95	2.01
20	11A	1	1098	63194.4	264.2	210.8	28.7	2.60	20.6	2.40	1.60	1.86
20	11A	2	1085	61805.6	263.2	217.5	26.6	2.70	20.0	2.85	1.95	2.02
20	11A	3	1094	61111.1	256.6	211.7	30.8	2.40	19.0	2.25	2.10	2.44
20	11A	4	1092	61805.6	252.5	215.0	30.6	2.20	21.8	2.55	2.25	2.27
21	11B	1	1084	61111.1	259.6	215.0	33.6	2.50	21.6	2.85	2.40	2.29
21	11B	2	1095	63194.4	261.1	212.5	29.4	2.60	22.0	2.40	1.80	2.02
21	11B	3	1087	65972.2	256.1	197.5	32.2	2.00	21.8	2.55	1.60	2.35
21	11B	4	1091	61805.6	252.4	205.0	30.8	2.70	27.2	2.55	2.10	2.35
22	11C	1	1097	59027.8	258.2	198.3	30.8	1.90	14.0	2.70	2.10	2.35
22	11C	2	1096	65277.8	264.2	207.5	30.1	2.20	21.2	2.10	1.50	2.38
22	11C	3	1093	62500.0	265.2	212.5	29.4	2.20	16.6	3.00	2.70	2.40
22	11C	4	1090	61805.6	259.6	212.5	30.8	2.20	17.8	2.70	2.25	1.95
23	12A	1	1068	61111.1	270.9	188.3	30.8	1.90	23.0	2.55	2.10	2.26
23	12A	2	1069	68055.6	256.6	204.2	29.4	2.30	15.4	2.85	2.25	2.48
23	12A	3	1072	62500.0	261.8	201.7	30.8	2.10	14.0	3.00	1.95	2.30
23	12A	4	1073	61805.6	264.2	211.7	32.2	2.30	19.0	3.60	2.55	2.25
24	12B	1	1067	63888.9	268.7	202.5	33.6	2.60	19.0	2.70	1.80	2.21
24	12B	2	1070	61805.6	257.3	202.5	35.0	2.20	17.0	3.45	2.40	1.80
24	12B	3	1071	61805.6	256.2	208.3	29.4	1.90	21.0	3.15	1.80	2.01
24	12B	4	1074	63194.4	270.8	204.2	33.6	2.10	15.0	2.25	1.95	1.89

[(1)] Seed weight. [(2)] Plant height.

Appendix C. Raw data of soil testing after the Maize harvest, season 2012-2013.

T#	T#	Rep	Plot#	Soil pH		P	K	Ca	Mg	Al	H	CEC	OM	BS
				H_2O	$CaCl_2$	mg/dm^3		cmol$_c$/dm^3					g/kg	%
1	1	1	1083	5.4	4.6	13.0	31	2.3	0.9	0.3	5.9	9.5	41.0	34.8
1	1	2	1086	5.7	4.9	16.4	30	3.0	1.1	0.0	5.8	9.9	42.2	42.1
1	1	3	1088	5.2	4.5	13.0	32	1.9	0.7	0.4	5.7	8.7	36.8	30.7
1	1	4	1089	5.3	4.6	15.9	35	2.3	0.9	0.3	6.1	9.8	42.2	33.7
2	2A	1	1065	5.6	4.9	16.9	40	2.8	1.0	0.0	5.9	9.9	42.2	39.6
2	2A	2	1053	5.7	5.0	20.7	39	3.2	1.2	0.2	5.9	10.4	43.3	43.5
2	2A	3	1062	5.3	4.5	19.0	35	2.2	0.9	0.3	6.3	9.8	42.2	32.4
2	2A	4	1057	5.5	4.7	19.0	32	2.8	1.0	0.0	6.2	10.3	42.2	37.7
3	2B	1	1066	5.7	4.9	22.5	41	3.1	1.1	0.0	6.0	10.3	44.5	41.7
3	2B	2	1054	5.7	4.9	19.0	31	2.9	1.0	0.2	5.7	9.7	41.0	41.2
3	2B	3	1061	5.3	4.6	17.9	32	2.3	0.9	0.3	5.9	9.5	41.0	34.5
3	2B	4	1058	5.4	4.7	17.4	36	2.6	1.0	0.0	6.0	9.9	41.0	37.2
4	3A	1	1052	5.6	4.8	16.9	42	2.7	1.0	0.0	5.8	9.6	39.9	39.8
4	3A	2	1063	5.4	4.6	19.6	46	2.3	0.9	0.2	5.8	9.3	39.9	35.5
4	3A	3	1056	5.5	4.7	14.4	36	2.7	1.0	0.3	6.2	10.2	43.3	37.1
4	3A	4	1060	5.3	4.5	16.4	36	2.2	0.8	0.3	6.1	9.5	37.8	32.5
5	3B	1	1051	5.7	4.9	14.4	50	2.8	1.0	0.0	5.5	9.5	43.3	41.7
5	3B	2	1064	5.8	5.0	23.8	40	3.3	1.2	0.0	5.9	10.5	43.3	44.0
5	3B	3	1055	5.6	4.8	14.9	30	2.7	1.0	0.3	5.9	9.7	41.0	39.1
5	3B	4	1059	5.3	4.6	17.9	54	2.1	0.8	0.0	6.0	9.4	38.9	32.9
6	4A	1	1099	5.3	4.5	12.6	36	2.1	0.8	0.3	6.2	9.5	41.0	31.5
6	4A	2	1111	5.4	4.7	17.9	42	2.6	1.0	0.2	6.1	10.0	42.2	37.0
6	4A	3	1110	5.6	4.9	24.5	42	2.7	1.0	0.0	5.8	9.6	41.0	39.5
6	4A	4	1106	5.5	4.7	25.2	45	2.5	1.0	0.3	6.1	9.9	42.2	36.7
7	4B	1	1100	5.6	4.8	14.0	35	2.7	1.0	0.0	5.9	9.7	42.2	39.1
7	4B	2	1112	5.3	4.5	20.7	48	2.2	0.8	0.1	6.3	9.7	39.9	32.0
7	4B	3	1109	5.2	4.4	13.0	58	1.7	0.7	0.4	6.6	9.6	42.2	26.7
7	4B	4	1105	5.5	4.8	14.9	36	2.8	1.0	0.3	6.1	10.2	44.5	38.3
8	4C	1	1113	5.2	4.5	15.9	54	1.9	0.7	0.2	6.1	9.2	39.9	29.8
8	4C	2	1101	5.4	4.7	18.5	48	2.4	1.0	0.0	5.7	9.4	39.9	37.4
8	4C	3	1104	5.6	4.9	14.3	47	3.0	1.1	0.4	6.2	10.4	43.3	40.7
8	4C	4	1108	5.2	4.5	14.4	55	1.9	0.7	0.4	6.0	9.1	36.8	30.6
9	4D	1	1114	5.6	4.9	20.7	51	2.8	1.0	0.3	5.9	9.9	43.3	39.9
9	4D	2	1102	5.3	4.6	23.2	45	2.2	0.9	0.2	6.0	9.5	41.0	34.0
9	4D	3	1103	5.5	4.7	14.0	55	2.6	1.0	0.3	5.9	9.8	41.0	37.8
9	4D	4	1107	5.3	4.6	13.5	38	2.0	0.7	0.0	6.1	9.2	38.9	30.5
10	5A	1	1082	5.4	4.6	15.9	62	2.3	0.9	0.2	5.8	9.4	39.9	35.7
10	5A	2	1079	5.3	4.5	18.9	53	2.1	0.8	0.0	5.7	9.1	36.8	33.1
10	5A	3	1077	5.6	4.8	13.5	58	2.7	1.0	0.3	5.9	9.8	42.2	39.5
10	5A	4	1076	5.5	4.7	14.4	68	2.6	1.0	0.3	6.1	10.1	43.3	37.5
11	5B	1	1081	5.5	4.7	16.4	56	2.6	1.0	0.0	5.8	9.8	42.2	38.3
11	5B	2	1080	5.6	4.9	16.4	69	2.7	1.0	0.0	5.8	9.6	41.0	40.3
11	5B	3	1078	5.8	5.1	19.6	48	3.4	1.2	0.0	5.5	10.2	43.3	46.2
11	5B	4	1075	5.7	4.9	14.0	79	3.0	1.1	0.2	6.0	10.3	44.5	41.9
12	6A	1	1115	5.3	4.5	15.9	44	2.2	0.8	0.3	5.8	9.2	37.8	33.8
12	6A	2	1118	5.4	4.6	20.7	40	2.5	1.0	0.3	6.3	10.1	42.2	35.6
12	6A	3	1125	5.4	4.7	14.4	40	2.3	0.9	0.0	5.5	9.1	37.8	36.4
12	6A	4	1123	5.7	4.9	15.9	58	2.7	1.0	0.3	5.4	9.3	39.9	41.6
13	6B	1	1129	5.1	4.4	11.3	46	1.2	0.5	0.3	5.4	7.8	33.0	23.1
13	6B	2	1127	5.5	4.7	21.9	37	2.7	1.0	0.0	6.2	10.2	43.3	37.2
13	6B	3	1119	5.3	4.6	10.5	42	2.2	0.8	0.2	5.9	9.3	38.9	33.4
13	6B	4	1124	5.6	4.9	17.4	43	2.7	1.0	0.5	5.9	9.7	41.0	39.2

Continuing …

T#	T#	Rep	Plot#	Soil pH		P	K	Ca	Mg	H	CEC	OM	BS
				H_2O	$CaCl_2$	mg/dm^3		cmol$_c$/dm^3				g/kg	%
14	7A	1	1116	5.9	5.2	17.9	39	3.2	1.1	0.0	4.6	9.0	38.9
14	7A	2	1128	6.0	5.3	14.0	36	3.0	1.1	0.0	3.9	8.1	32.1
14	7A	3	1120	6.2	5.5	11.3	37	3.3	1.2	0.0	3.4	8.0	33.0
14	7A	4	1122	5.8	5.0	17.9	48	2.9	1.0	0.0	4.9	8.9	37.8
15	7B	1	1130	6.1	5.3	17.0	30	2.7	1.0	0.0	3.5	7.3	29.5
15	7B	2	1117	5.8	5.0	14.0	40	2.8	1.0	0.0	4.7	8.6	35.8
15	7B	3	1126	6.0	5.3	10.1	36	3.1	1.1	0.0	3.9	8.2	33.0
15	7B	4	1121	6.1	5.2	14.4	31	3.4	1.2	0.0	4.5	9.2	37.8
16	8A	1	1131	5.3	4.6	15.9	35	2.2	0.8	0.3	6.1	9.5	39.9
16	8A	2	1134	5.6	4.9	16.4	43	2.8	1.0	0.0	5.8	9.7	39.9
16	8A	3	1135	5.4	4.6	17.9	40	2.4	1.0	0.3	6.3	10.1	42.2
16	8A	4	1140	5.2	4.5	21.3	41	1.8	0.7	0.4	6.7	9.7	42.2
17	8B	1	1146	5.2	4.4	15.4	42	1.5	0.6	0.3	6.6	9.2	38.9
17	8B	2	1144	5.5	4.8	16.9	35	2.7	1.0	0.0	5.8	9.8	42.2
17	8B	3	1142	5.7	4.9	15.9	41	3.1	1.1	0.2	5.9	10.2	42.2
17	8B	4	1137	5.3	4.5	19.0	37	2.1	0.8	0.4	6.4	9.7	41.0
18	9A	1	1132	5.2	4.5	19.7	31	1.8	0.7	0.4	5.9	8.9	37.8
18	9A	2	1143	5.6	4.8	16.4	41	2.7	1.0	0.2	5.9	9.7	41.0
18	9A	3	1141	5.7	5.0	17.4	50	3.1	1.1	0.0	5.8	10.1	43.3
18	9A	4	1138	5.5	4.7	12.6	32	2.7	1.0	0.0	6.1	10.1	43.3
19	9B	1	1145	5.4	4.6	17.4	44	2.3	0.9	0.3	6.1	9.7	39.9
19	9B	2	1133	5.4	4.7	14.4	32	2.7	1.0	0.0	6.2	10.3	44.5
19	9B	3	1136	5.6	4.8	14.4	32	2.7	1.0	0.0	5.6	9.4	38.9
19	9B	4	1139	5.6	4.8	14.0	55	2.8	1.0	0.3	5.8	9.7	41.0
20	11A	1	1098	5.2	4.5	15.4	50	2.0	0.7	0.4	6.2	9.4	41.0
20	11A	2	1085	5.2	4.5	13.5	45	1.8	0.7	0.0	6.3	9.3	39.9
20	11A	3	1094	5.6	4.8	12.6	43	2.8	1.0	0.0	6.1	10.0	43.3
20	11A	4	1092	5.8	5.1	19.0	50	3.6	1.2	0.4	5.5	10.5	43.3
21	11B	1	1084	5.6	4.9	20.7	52	2.9	1.0	0.0	5.8	9.8	42.2
21	11B	2	1095	5.3	4.5	14.9	42	2.1	0.8	0.0	6.0	9.3	39.9
21	11B	3	1087	5.7	5.0	15.9	36	2.9	1.0	0.0	5.7	9.7	42.2
21	11B	4	1091	5.6	4.8	15.9	43	2.8	1.0	0.3	6.0	9.9	43.3
22	11C	1	1097	5.4	4.7	17.9	36	2.4	1.0	0.3	6.0	9.8	43.3
22	11C	2	1096	5.2	4.4	10.9	40	1.8	0.7	0.0	6.6	9.5	38.9
22	11C	3	1093	5.6	4.9	22.5	35	2.9	1.0	0.4	6.1	10.1	43.3
22	11C	4	1090	5.4	4.7	14.4	37	2.8	1.0	0.3	6.4	10.6	47.1
23	12A	1	1068	5.6	4.9	18.5	47	2.9	1.0	0.0	6.3	10.3	42.2
23	12A	2	1069	5.7	4.9	13.5	36	2.7	1.0	0.0	5.5	9.3	39.9
23	12A	3	1072	5.3	4.5	14.9	48	1.8	0.7	0.4	5.7	8.7	36.8
23	12A	4	1073	5.4	4.6	17.4	34	2.3	0.9	0.3	5.9	9.5	39.9
24	12B	1	1067	5.6	4.8	23.2	54	3.0	1.1	0.0	6.6	10.8	44.5
24	12B	2	1070	5.4	4.7	14.4	47	2.4	1.0	0.3	5.8	9.5	41.0
24	12B	3	1071	5.2	4.5	14.0	52	2.0	0.7	0.3	6.2	9.4	38.9
24	12B	4	1074	5.7	4.9	15.4	43	2.7	1.0	0.0	5.4	9.2	37.8

Experimento BPC												
Estação Experimental Cachoeira												
	SAFRA 2012/2013											
	75,6 m											
	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m	6,3 m
95 m	**3** NPK1 1058	**5** NPK2 1059	**24** NPK3 (sup) 1074	**11** NPK4 1075	**22** NPK3 1090	**21** NPK3 1091	**6** NPK3 1106	**9** NPK3 1107	**14** NPK3 1122	**12** NPK3 1123	**18** NPK3 1138	**19** NPK3 1139	9,5 m
	corredor de 3 m												
	2 NPK1 1057	**4** NPK2 1060	**23** NPK3 (2cob) 1073	**10** NPK4 1076	**1** NPK0 1089	**20** NPK3 1092	**7** NPK3 1105	**8** NPK3 1108	**15** NPK3 1121	**13** NPK3 1124	**17** NPK3 1137	**16** NPK3 1140	9,5 m
	corredor de 1 m												
	4 NPK2 1056	**3** NPK1 1061	**23** NPK3 (2cob) 1072	**10** NPK4 1077	**1** NPK0 1088	**22** NPK3 1093	**8** NPK3 1104	**7** NPK3 1109	**14** NPK3 1120	**12** NPK3 1125	**19** NPK3 1136	**18** NPK3 1141	9,5 m
	corredor de 3 m												
	5 NPK2 1055	**2** NPK1 1062	**24** NPK3 (sup) 1071	**11** NPK4 1078	**21** NPK3 1087	**20** NPK3 1094	**9** NPK3 1103	**6** NPK3 1110	**13** NPK3 1119	**15** NPK3 1126	**16** NPK3 1135	**17** NPK3 1142	9,5 m
	corredor de 1 m												
	3 NPK1 1054	**4** NPK2 1063	**24** NPK3 (sup) 1070	**10** NPK4 1079	**1** NPK0 1086	**21** NPK3 1095	**9** NPK3 1102	**6** NPK3 1111	**12** NPK3 1118	**13** NPK3 1127	**16** NPK3 1134	**18** NPK3 1143	9,5 m
	corredor de 3 m												
	2 NPK1 1053	**5** NPK2 1064	**23** NPK3 (2cob) 1069	**11** NPK4 1080	**20** NPK3 1085	**22** NPK3 1096	**8** NPK3 1101	**7** NPK3 1112	**15** NPK3 1117	**14** NPK3 1128	**19** NPK3 1133	**17** NPK3 1144	9,5 m
	corredor de 1 m												
	4 NPK2 1052	**2** NPK1 1065	**23** NPK3 (2cob) 1068	**11** NPK4 1081	**21** NPK3 1084	**22** NPK3 1097	**7** NPK3 1100	**8** NPK3 1113	**14** NPK3 1116	**13** NPK3 1129	**18** NPK3 1132	**19** NPK3 1145	9,5 m
	corredor de 3 m												
	5 NPK2 1051	**3** NPK1 1066	**24** NPK3 (sup) 1067	**10** NPK4 1082	**1** NPK0 1083	**20** NPK3 1098	**6** NPK3 1099	**9** NPK3 1114	**12** NPK3 1115	**15** NPK3 1130	**16** NPK3 1131	**17** NPK3 1146	9,5 m

Appendix C. Field trial layout.