Influence of *Brachiaria* as winter cover crop on K use efficiency and soybean yield under no-till in the Brazilian Cerrado

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INTRODUCTION

Brazil is the world third largest consumer of potash (K) fertilizers. The annual consumption of K fertilizers reached more than 4,7 million metric tons of K_2O last year. However, the Brazilian domestic K production was less than 10% of the total country consumption. Most of this K fertilizer is applied to grain production, manly soybeans and corn. The large amounts of K exported by grain crops make its replacement essential to keep a high soil productivity levels, in particular soybeans. Grain production in Brazil is concentrated in areas where indigenous K soil reserves are low. Significant yield losses may be observed after 3 or 4 successive harvests if no proper K replacement is given to the system. Therefore, this work aims to identify management strategies that could increase K use efficiency and soybean yield in tropical soils by means of an experiment to evaluate these agronomic variables influenced by brachiaria as winter cover crop.

METHODS

The study was conducted in the experimental area of the Technological Center of COMIGO, Rio Verde – GO, Brazil (17 ° 45'49 .13 "S and 51 ° 01'57 .47" W; 604 m a.s.l.) The soil in the experimental area was characterized as clayey Red Oxisol (Table 1). This soil was cultivated over 10 years for grain production before settling down the experiment.

Table 1. Average chemical attributes and textural analysis of the experimental area before settling down the experiment (n = 8).

layer	pH[1]	OM[2]	P[3]	Ca	Mg	Al	H+Al	K	BS	CEC
(cm)		g dm^{-3}	mg kg^{-3}	------------------------------- cmolc dm^{-3} -------------------------------						
0-20	4,93	25,51	10,47	2,56	0,54	0,05	3,13	0,10	3,20	6,33
20-40	4,48	20,45	1,84	1,21	0,27	0,26	3,74	0,08	1,56	5,30

1 -pH $CaCl^2$; 2- Soil Organic Matter; 2- P Mehlich 1,

Treatments were arranged in 2 x 4 factorial experiment in a split plot design with four replications. The first factor was depicted into two different treatments (*B. brizantha* as winter cover crop and bare soil) on 240m^2 plots (12 x 20 m). In bare soil treatment the weeds were desiccated after soybean harvesting, keeping no soil cover vegetation during the winter. The second factor was depicted into 4 KCl doses (0, 20, 40 and 60 kg K_2O ha^{-1}) applied 15 days after seeding on the split plots of 60m^2 (6 x 10 m).

Soybean crops were cultivated during the summer after total area desiccation. Temporal data was gathered from 3 cropping seasons from 2009 to 2012. Soybean leaves were sampled at flowering stage to determine leaf K content. Soybean yield was measured for 6 m^2, and the grain weight adjusted to 13% moist.

RESULTS AND DISCUSSION

Results have shown that soybean sown during summer over brachiaria straw resulted in significant yield gains of compared to bare soil. There was an average increase of soybean yield of 502.8, 572.5 and 640.0 kg/ha after brachiaria as winter cover in 2009/2010, 2010/2011 and 2011/2012 seasons, respectively. These values show a stable increase in soybean yield during the 3 cropping seasons comparing with the soybean in bare soil, respectively 18, 14 and 22 %. (Figure 1).

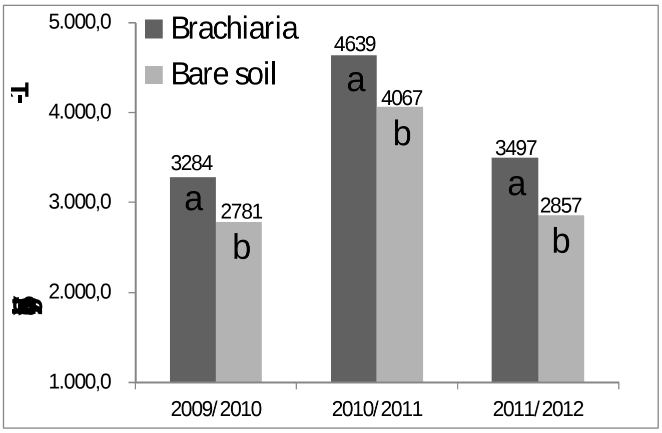

Fig. 1. Average soybean yield (3 cropping seasons) influenced by winter cover (n=8)

Potash doses applied did not influence significantly the soybean yield. Nevertheless, during the 2010/2011 season, it has been observed a slight increase on soybean yield related to the increase of K fertilizer doses. It was probably due to high K demand as a matter of high yield (Table 2). Soybeans sown after brachiaria have shown an improved K use efficiency. The yield of soybean after brachiaria was higher than the yield of soybean sown on bare soil for the same K doses. The partial factor productivity of applied K was very high, indicating a high indigenous K supply. This effect is readily seen on brachiaria treatments where a higher K use efficiency is observed and there is no agronomic response to applied K fertilizer. The leaf K content increased with increasing K fertilizer doses, but it did not influence soybean yield. Average leaf K content of soybean after brachiaria was higher than on bare soil, suggesting that brachiaria straw in K recycling has increased K absorption by soybean (Table 2). Leaf K content was optimum even in control suggesting that the soil K critical level has not been reached after 3 successive harvests.

Table 2. Soybean yield and soybean leaf K of three crop seasons with different winter cover crops.

Winter cover	2009/2010				2010/2011				2011/2012			
	0	20	40	60	0	20	40	60	0	20	40	60
	kg K_2O/ha				kg K_2O/ha				kg K_2O/ha			
	soybean yield, kg ha^{-1}											
Brachiaria	3.277	3.273	3.259	3.328	4.491	4.551	4.804	4.710	3.513	3.498	3.509	3.468
Bare soil	2.633	2.651	2.886	2.955	3.872	4.080	4.177	4.138	2.837	2.896	2.819	2.875
	leaf K content, g kg^{-1}											
Brachiaria	21,4	20,8	21,4	22,8	nd	nd	nd	nd	19,4	19,8	20,8	20,4
Bare soil	18,0	18,6	18,8	19,9	nd	nd	nd	nd	18,1	18,4	20,2	20,2
	partial factor productivity of K, kg soybean kg^{-1} K_2O											
Brachiaria		163,6	81,5	55,5		227,5	120,1	78,5		174,9	87,7	57,8
Bare soil		132,5	72,2	49,2		204,0	104,4	69,0		144,8	70,5	47,9

CONCLUSIONS

The use of brachiaria as a winter cover crop has provided a significant increase on summer soybean yield, in part reflecting an increased K use efficiency. This crop succession has proven potential in the tropics, in particular where it is not possible to grow a second crop during the same season and farmers were used to maintain bare soil during winter.

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