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EVALUATION OF THE EFFECT OF DIFFERENT DOSES OF POTASSIUM ON YIELD OF SOYBEAN

[1]Willian Cleber Oliveira Chicaroli, [2]Daniele Fernanda Felipe, [2]Graciene de Souza Bido, [2]André Ribeiro da Costa, [2]Ricardo Andreola and *[2]Anny Rosi Mannigel

[1]Graduate in Agronomy at the University Center of Maringá - UNICESUMAR, 1610 Guedner Ave Maringá, Paraná, Brazil
[2]PhD, Professor of the Master's Program in Science, Technology and Food Safety at the University Center of Maringá - UNICESUMAR, Maringá-Paraná. Researcher at ICETI - Cesumar Institute of Science, Technology and Innovation, 1610 Guedner Ave Maringá, Paraná, Brazil

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ABSTRACT

The soybean culture has a significant role for the Paraná state, not only due the facto of being the second lasgest producer, but also for having climate favorable to planting.The adequate supply of Potassium has showed to be a complicate issue due to problems like leaching on sandy soils on the northeast of Paraná and its importance for the good development of the soybean. This paper sought to evaluate how availability of Potassium supplied in the ground after the plant germination through mineral fertilization by cover, Potassium with dosage of (0, 60, 90 and 120 kg ha-1), through factors such as production per hectare, number of pods per soybean plant and thousand grain mass. Factors that could influence the development of the plants such as nutrition, water availability, plague control and diseases were controlled with corrective and regular fertilizations, sprinkler irrigation and chemical and cultural control for pests. It was verified significative results where was used the dose of Potassium chloride fertilizer, in the control treatment were symptoms of culture deficiency and low productivity. The best dose was the 90kg ha-1 ofPotassium chloride and it was found the relation between the number of pods and productivity.

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INTRODUCTION

Soybean production went from 26 million tonnes in 1996 to 113 million tonnes in the 2017 harvest and had a total increase in production in relation to productivity increase per hectare (Balbinot*et al*., 2017).In the state of Paraná, soy is produced in practically all regions, accounting for the largest source of agricultural income in most municipalities, producing grains, bran and oils. Bulhões (2003) states that although the agricultural production of Paraná is quite diversified, there is a dynamic market for soybeans. Between the various nutrients that are absorbed by the plant, Potassium is the second most required by the soybean plant, being surpassed only by the Nitrogen that is already supplied by the biological fixation, while Potassium is to be applied via fertilizers (Silva and Lazarini, 2014). Potassium fertilization in soybean can be carried out either through furrow seeding or throwing.

***Corresponding author:* Anny Rosi Mannigel**
PhD, Professor of the Master's Program in Science, Technology and Food Safety at the University Center of Maringá - UNICESUMAR, Maringá-Paraná. Researcher at ICETI - Cesumar Institute of Science, Technology and Innovation, 1610 Guedner Ave Maringá, Paraná, Brazil

Serafim (2012) reports that Brazilian soils are generally deficient in Potassium (K) and when cultivated with soybean (*Glycine max* L.) require Potassium fertilization to feed the plants well and achieve the wanted yields. The change of potassium from the exchangeable to the non-exchangeable form can be rapid, depending on the amount of nutrient in the soil solution, making it possible to leach losses due to the natural tendency of soil balance (Rosolem *et al*., 2006). The retention energy of the Ca^{2+}, Mg^{2+} and K^{+}exchangeable cations in the soil colloids follows a series called lyotrophic, resulting in higher K leaching in well drained soils, especially in soils with lower Cation-exchange capacity (CEC), as found in the northwest of the state from Paraná (Raij, 1991; Werle *et al*., 2008). Potassium can be lost by leaching, that is, transported to depths distant from the roots (Oliveira; Villas Boas, 2008).This movement in the soil profile will depend mainly on the soil texture (Neves *et al*., 2009),water regime, fertilizer dose and solubilityand the cation exchange capacity (CEC) of the soil (Rosolem *et al*., 2006).

Table 1. Averages of thousand grain mass, yield, number of pods per plant with different doses of Potassium

Treatment	Thousand Grain Mass (kg)	Yield ($Kg.ha^{-1}$)	Number of Pods Per Plant
	0.15 b	1809.00 d	68.67 d
2 (60 $kg.ha^{-1}$ K_2O)	0.20 a	2556.00 c	109.33 c
3 (90 $kg.ha^{-1}$ K_2O)	0.20 a	4137.00 a	166.88 a
4(120 $kg.ha^{-1}$ K_2O)	0.20 a	3757.20 b	133.42 b
C.V.(%)	1.09	5.41	5.46

Means followed by the distinct letters in a column, differ significantly by the Tukey test ($p \leq 0.05$). C.V. = coefficient of variation

The objective of the present work was to evaluate the productivity, number of pods and mass of a thousand grains in the soybean crop submitted to different doses of Potassium.

MATERIALS AND METHODS

The experiment was conducted in the municipality of Lobato, State of Paraná, Brazil, in the 2016/2017 harvest in sandy soil classified as typical Dystrophic Red Argisol (Ultisol), according to Santos *et al.* (2013). The climate of the region was classified as subtropical - Cfa, according to Köppen (1938). The soybean was sown on October 13, 2016, using 14.5 seeds per linear meter with 300kg.ha-1 of the formulated 09-40-00, the fertilization in mulch was carried out after 25 days of planting in 4 treatments with 4 replicates resulting in 16 completely randomized block plots with 5 soybean rows containing 5 meters in length, spacing 0.45 m, resulting in a 3 m floor area and with 3 central lines with 0.90 m distance from each other. The treatments evaluated were: Treatment 1 (control) with application of 0.0 $kg.ha^{-1}$ de K_2O, Treatment 2 with application of 60.0 $kg.ha^{-1}$ de K_2O, Treatment 3 with application of 90.0 $kg.ha^{-1}$ de K_2O and Treatment 4 with application of 120.0 $kg.ha^{-1}$ de K_2O. The results were evaluated during the crop harvest, taking into account the productivity ($kg.ha^{-1}$), number of pods and the thousand grain mass (g). The data were statistically evaluated through the test of variance and then carried out on average (Tukey 5%) tests to classify the effect of the dosages used on the culture. All the tests were analyzed through the statistical program SISVAR (Ferreira, 2014). The chemical analysis of the soil performed before the implantation of the experiment showed the following results:5.6 pH H_2O; 9.38g dm^{-3}Organic matter, 28.85mg dm^{-3}P, 0.05$cmol_c$ dm^{-3}K; 0.89$cmol_c$ dm^{-3}Ca; 0.36$cmol_c$ dm^{-3}Mg; 2.36 $cmol_c$ dm^{-3} H+Al; 6.10mg dm^{-3}Zn; 21.38 mg dm^{-3}Fe;20.81 mg dm^{-3} Mn e1.16 mg dm^{-3} Cu. Data were obtained from the Maringá Rural Laboratory. The pH correction was carried out 30 days before soybean planting, using calcareous limestone at the dose of 1.83 $ton.ha^{-1}$. Phytosanitary treatments were conducted equally. The fields were harvested manually and the production was weighed with the help of a precision balance. The results analyzed during the cycle of the cultivar in 122 days, were evaluated through the following factors: number of pods, thousand grain mass and productivity.

RESULTS AND DISCUSSION

Regarding the values reached by soybean at the end of its productive cycle of 122 days after emergence of the plant, statistical differences in productivity and number of pods were obtained (Table 1). However, for the variable thousand grain mass, it was verified that the treatments that providedK differed statistically from the control (Table 1), reaching the genetic potential of the cultivar.However, contrary to the data obtained by Guareschi *et al.* (2008) that did not detect differences in the thousand grain mass where Potassium was used in the soybean crop. Thought the data in Table 1, it was found in the productivity variable that treatment 3 allowed an increase of 128.7% in relation to treatment 1. In addition, in the variable number of pods, there was an increase of 142.3% in these two treatments. Folini and Rosolem (2008) also found significant responses to potassium fertilization in the soybean crop when they tested different doses of K_2O, obtained the highest result when adding approximately 90 kg ha^{-1} of K_2O. Guareschi *et al.* (2008) verified a significant difference in the productivity variable, corroborating with the data of the present research. According to Borkert *et al.* (1994), the absence of nutrient K results in hidden hunger, that is, there is a reduction of the growth rate of the plant, with reduction of soybean yield and sanity. With the statistical results presented, it was determined that, where K_2O was applied, there was an increase in the number of pods and consequently an increase in productivity, and thus, productivity is directly linked to the number of pods. In the experiment conducted by Lana *et al.* (2002), it was observed that the dose of 90 $kg.ha^{-1}$ of Potassium resulted in increased productivity, plant height, and first pod insertion, thus presenting significant differences compared to other dosages used in the study. In the current study, it was found that the dose that obtained the best results are the same as those reported by Lana *et al.* (2002) in his experiment. The means obtained in the experiment showed that, where potassium fertilization was performed in a quantity of 90 $kg.ha^{-1}$, the productivity exceeded or equaled the averages of the region, which reached levels of 3350 $kg.ha^{-1}$ of soybean, according to IBGE (2016). The controlfeltwith the deficiency of Potassium present in the soil. According Naiff (2007) the nutrient K plays a relevant role in various physiological and biochemical processes in the plant. However, in the presented data it can be seen that in the dosage of 120 kg.ha-1 a decrease effect occurred in the production, which would probably have occurred due to the excess availability of the nutrient. Malavolta (1997) showed that excess Potassium causes salinization and consequently foliar necrosis and thus leading to a fall in soybean production.

Conclusion

The data showed that the ideal dose to be used of potassium in the soybean crop in the studied sandy soil was 90 $kg.ha^{-1}$, allowing the rural producers to increase productivity. Above this dosage, reductions occurred due to a possible phytotoxic effect.

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