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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 16 (22): 1503-1509, 2013
ISSN 1028-8880 / DOI: 10.3923/pjbs.2013.1503.1509

Effect of Bio-regulator and Foliar Fertilizers on Chemical Composition and Yield of Soybean

[1]Gleberson Guillen Piccinin, [1]Alessandro Lucca Braccini, [2]Luiz Henrique da Silva,
[1]Giovanna Emanuêlle Gonçalves Mariucci, [1]Andréia Kazumi Suzukawa,
[1]Lilian Gomes de Morais Dan and [1]Telmo Antônio Tonin
[1]Department of in Agronomy,
[2]Department of Genetic and Breeding, State University of Maringá-UEM,
Maringá, Paraná State, Brazil

Abstract: Current study evaluates the effects of bio-regulator associated with foliar fertilizers on the yield components, productivity and chemical composition of soybean. The experimental design was entirely randomized blocks, with four replications. The treatments consisted of: T1-absolute control, T2-application of 0.25 L h^{-1} Stimulate® in R_1 stage of development, T3-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1, T4-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1 and 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in $R_{5.1}$; T5-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1 and 2 L h^{-1} Mover® in $R_{5.1}$, T6-application of 3 L h^{-1} Sett® in R_1 and 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in $R_{5.1}$ and T7-application of 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in R_1. Application of Sett® and Mover® is a potentially efficient handling as it favors the soybean agronomic performance in R_1 stage. Chemical composition of processed grains has influence with applying bio-regulator and foliar fertilizers.

Key words: Bio-regulator, soybean, foliar fertilizers, productivity, stage

INTRODUCTION

Soybean has achieved significant productivity gains in recent years in Brazil and worldwide. Last growth season, soybean crops experienced a new level of productivity achieved before only by developed countries and high technologies holders. Having regard the yield levels of normal harvests, last growth season the production estimated in the country was 21% higher (83.4 million tons) than the volume of 68.75 million tons produced in 2011/12 (Conab, 2013). Considering the global consumption growth of primary raw material, such as soybean meal, Brazil ranks as the country with the best conditions to expand production and meet the expected increase in demand and become for the first time, the world's largest soybean producer.

New technologies have been employed to obtain increments in the soybean production, including the increasing use of improved seeds, associated with application of fungicides, insecticides, bio-regulator and polymers, through seed treatment. Soybean crop has presented intense research activity driven to obtain information that enable yield increases, associated with improved chemical composition, providing to obtain soybean meal richer in minerals and vitamins. Therefore, constant reformulation and adaptation of technologies are required, such as handling of foliar nutrient and bio-regulator.

According to Albrecht *et al.* (2011), plant growth regulators or bio-regulator have wide agricultural applicability on numerous crops and can be named as substances or associations with the presence of chemical analogs of plant hormones. Presently five groups are recognized: auxins, gibberellins, cytokinins retarders and inhibitors, as well as ethylene (Castro and Vieira, 2001). Bio-regulators are organic compounds, which in low concentrations, inhibit, promote or modify morphological and physiological processes in plants.

Bio-regulators are natural or synthetic substances applied to seeds and other parts of plant (leaves and fruits) causing modifications in the vital and structural processes, in order to increase plant productivity, improve grain quality and chemical composition. Interference can occur when applying these substances through seed treatment, soil or foliar (Castro and Melotto, 1989; Vieira and Castro, 2001). These substances' action depends on environmental conditions, as well as the characteristics and potential of plant genetic (Vieira and Monteiro, 2002). According to Larcher, (2004), plant hormones' action

Corresponding Author: Gleberson Guillen Piccinin, Department of Agronomy, State University of Maringá, Block J45, Maringá, Paraná State, Brazil Tel: +55 44 3261 8940

depends on the development stage and plant activity, external stimuli, which part of the plant receives the stimulus and the time of the impact.

Experimental studies have demonstrated the effect of bio-regulators with promoter action on soybean like those of Klahold *et al.* (2006), Moterle *et al.* (2008), and Avila *et al.* (2008), listed among others, whose results regarding the performance of plants (Albrecht *et al.*, 2011), production components (Albrecht *et al.*, 2009, 2011; Bertolin *et al.*, 2010) and on the seeds' quality (Albrecht *et al.*, 2010; Moterle *et al.*, 2011). However, few studies, like Avila *et al.* (2007), cover aspects on the association of bio-regulators and foliar fertilizers on soybean.

Nutrient supply can occur in various forms. Usually, in grains and fibers cash crops, is common the use of foliar nutrients especially to correct symptoms of deficiency elements. Studies on the effects of fertilizers application methods containing micronutrients are still very incipient in Brazil (Ceretta *et al.*, 2007).

Broch and Ranno (2005) verified a productivity increase associated with the nitrogen increment in soybean leaves, through the use of Cobalt (Co) and Molybdenum (Mo), given the importance of these elements on Biological Nitrogen Fixation (BNF). According to the Brazilian Agricultural Research Company (Embrapa, 2008), Co and Mo are essential for BNF, for most soils where soybeans are grown, being indicated on seed treatment or foliar spray in the development stages V_3-V_5. Applications may result in a rise of productivity and grains protein levels (Meschede *et al.*, 2004).

Chemical element Boron is slightly movable in the phloem and does not redistribute on the plant, thus nutritional deficiency in younger organs is presented (Malavolta *et al.*, 1997). Boron is important in translocation of sugars and cell wall formation, carbohydrate metabolism, cell membranes functioning and aid in the proper production and distribution of the hormone auxin (AIA), cytokinin and abscisic acid (ABA) (Mengel and Kirkby, 1987). Boron balance, promotes correct ABA production, increases cell membrane permeability, allows the unloading sugars from leaves and phloem loading, resulting in reduction of flowers' abortion. It is essential for pollen germination, pollen tube growth, seed formation and cell walls. It is also important for the proteins synthesis, contributing to the greater weight of fruits and grains, better seed quality and higher productivity (Malavolta *et al.*, 1997).

Positive results have been obtained on soybean regarding to the use of Calcium (Ca) and Boron (B). In accordance with results achieved by Bevilaqua *et al.* (2002), with foliar application of Ca and B through foliar sprays, an increase was observed in the number of pods per plant and number of seeds per pod, when applied at blossoming in two soybean cultivars. Working with soybean crop, Avila *et al.* (2007) have observed that associated applications of liquid fertilizer Sett® (Ca+B) with Stimulate® at different soybean reproductive stages promoted productivity gains, which vary from 34.09 to 47.91% and from 32.86 to 40.67%, for isolated applications of Stimulate® and conjugated applications of Stimulate®+Sett®, respectively.

Micronutrients are essential elements for plant growth and development and are characterized by being absorbed in small amounts, unlike macronutrients. This is due to the fact they do not participate in plant structures, but the enzymes constitution or act as their activators (Dechen and Nachtigall, 2006). It mentions the Mo example, which is a cofactor of nitrogenize enzyme, involved in the BNF (Taiz and Zeiger, 2004). Therefore, the balance of whatever nutrient should be studied, as well as measures to minimize the unbalance, as the foliar fertilizers application. Thus, the experimental practices implementation that seeks results and answers to issues related to the use of bio-regulators and foliar fertilizers management, are arguably valid for a crop science viewpoint.

Therefore, current study evaluates the yield components, productivity and chemical composition, in response to the use of bio-regulators associated with foliar fertilizers application on soybean crop.

MATERIALS AND METHODS

Field experiment: Field experiment was conducted during the growth season 2011/2012, in an area located at Iguatemi Experimental Farm (FEI), State University of Maringá (UEM), Maringá, Paraná State, Brazil, located at latitude 23°25' south and longitude 51°57' west of Greenwich, with an average altitude of 540 m. Region prevailing climate is a Cfa, mesothermal humid, with abundant rainfall during the summer and dry winter with hot summers, according to the Köppen classification (IAPAR, 1987). Rainfall local data, daily maximum and minimum temperature data, referring to field experiment period duration are presented in Table 1. Experimental area is classified as dystrophic Red Argisol (Empresa, 1999) medium texture. Chemical and soil physical analysis results, conducted prior to the experiment, are shown in Table 2.

Experiment establishment: Experimental crop setup and conduction was in accordance with Embrapa (2008) assumptions. For fertilization were used 80 kg $h^{-1}$of P_2O_5 as superphosphate form and 70 kg h^{-1} de K_2O as KCl form, being 30 kg ha^{-1} at sowing and 40 kg h^{-1} in coverage, applied at 30 days after sowing. Right after seed

Table 1: Monthly rainfall and maximum and minimum temperatures, in Maringá, Paraná State, Brazil, 2011/2012

	Atmospheric temperature (°C)		
Months	Max.	Min.	Rainfall (mm)
October	28.26	18.00	196.40
November	28.90	17.77	107.00
December	31.10	18.38	62.10
January	28.85	19.65	125.30
February	30.50	20.05	217.70
March	29.75	20.26	55.40

Table 2: Experimental area chemical and physical analysis results, before the culture deployment, Maringá, Paraná State, Brazil, 2011/2012 growth season

Parameters	Values	Parameters	Values
Depth (m)	0-0.20	^{5}S-SO_4^{2-} (mg dm^{-3})	3.22
^{1}P (mg dm^{-3})	7.9	Zn^{2+} (mg dm^{-3})	3.44
^{2}pH		Fe^{2+} (mg dm^{-3})	109.50
$CaCl_2$	4.7	Cu^{2+} (mg dm^{-3})	10.06
H_2O	5.6	Mn^{2+} (mg dm^{-3})	141.79
H^++Al^{3+} (cmol dm^{-3})	3.42	Coarse sand (%)	51
Al^{3+} (cmol dm^{-3})	0	Fine sand (%)	16
$^1K^+$ (cmol dm^{-3})	0.36	Clay (%)	28
$^3Ca^{+2}$ (cmol dm^{-3})	2.68	Silt (%)	5
$^3Mg^{+2}$ (cmol dm^{-3})	0.99		
SB (cmol dm^{-3})	4.03		
CEC (cmol dm^{-3})	7.45		
V (%)	54.1		
^{4}C (g dm^{-3})	9.12		

^{1}Melich extractor 1, $^2CaCl_2$ 0.01 mol L^{-1}, ^{3}KCl 1 mol L^{-1}, ^{4}Walkley-Black method, ^{5}Monocalcium phosphate method

treatment sowing was performed, on October 28, 2011, in furrows with 0.45 m spacing between rows with three centimeters depth and seeding density of 17 seeds per linear meter, no-tillage area. Plots consisted of nine five feet long rows. For evaluations, we used a 5.4 m^2 usable area, which we considered only two central rows, discarding 0.50 m from each end of the rows as borders. During the crop development were performed every cultural practices needed for the experiment proper development.

Active ingredients following concentrations: 0.005% indole-3-butyric acid (auxin analog), 0.009% the kinetin (cytokinin) and 0.005% gibberellin acid. Foliar fertilizers Sett® is composed of 5% nitrogen, 10% calcium and 2% boron as homogeneous suspension with 1.45 g mL^{-1} density and Mover® is composed of 5% nitrogen, 4% boron, 0.17% copper, 0.015% molybdenum and 3% zinc as homogeneous suspension with 1.26 g mL^{-1} density, used in the beginning of flowering stage (R_1) and beginning of grain filling stage ($R_{5.1}$).

Treatments and experimental design: The experimental design was entirely randomized blocks, with four replications and seven treatments. The treatments consisted of: T1-absolute control, T2-application of 0.25 L h^{-1}Stimulate® in R_1 stage of development, T3-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1, T4-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1 and 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in $R_{5.1}$; T5-application of 0.25 L h^{-1} Stimulate® and 3 L h^{-1} Sett® in R_1 and 2 L h^{-1} Mover® in $R_{5.1}$, T6-application of 3 L h^{-1} Sett® in R_1 and 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in $R_{5.1}$ and T7 - application of 0.25 L h^{-1} Stimulate® and 2 L h^{-1} Mover® in R_1.

Foliar spraying: Foliar applications performed in R_1 and $R_{5.1}$ stages using a CO_2 propelled sprayer, with 2 BAR (or 29 PSI) constant pressure, 0.65 L min.$^{-1}$ flow rate, equipped with spear which contains one fanshaped nozzle, Teejet series, type XR 110 02, which, working at 50 cm height from the target at a speed of 1 m sec^{-1}, reaching an applied of 50 cm width strip, provided a 200 L h^{-1} of liquid volume.

Parameters measured: At R_8 stage, that is, when 95% of the pods had the typical mature pod color (Fehr *et al.*, 1971), the following measurements were made: plant height average, first pod height, number of pods per plant, mass of 1,000 grains, yield and Spad.

Plant height and first pod height: Ten plants were randomly chosen from plots' usable area and evaluated using a millimetric wooden ruler and the results are expressed in centimeters.

Mass of 1,000 grains: The mass of a thousand grains was determined through the weighing of eight subsamples with 100 seeds, for each field repetition, using an analytical scale with one milligram accuracy and the results were multiplied by 10.

Yield: Plants were manually harvested, five to eight days after the development stage R_8. After harvesting, the seeds were threshed using a stationary thresher machine. From the seed yield in plots was calculated the productivity in kg h^{-1}, for each treatment.

Indirect chlorophyll determination (SPAD): The data on chlorophilometer SPAD (Soil Plant Analysis Development) were performed with the device Minolta SPAD-502 three days after spraying the products. SPAD index measure adopted the indirect measurement of chlorophyll (g dm^{-2}), the same shall be done in the middle third of the plant, avoiding over or underestimated readings values.

Grains chemical composition: The grains chemical composition was evaluated after nitric-perchloric digestion. Levels of K were determined by flame photometry; Ca, Mg, Fe, Zn, Cu and Mn by atomic absorption spectrometry, P by vitamin C colorimetry method, with a spectrophotometer (Braga and Defelipo, 1974) and S turbidimetrically with barium sulfate (Blanchar *et al*., 1965). Nitrogen determination was conducted using the Kjeldahl method in the total nitrogen quantification, as recommended by the Association of Helrich (1990), with modifications. Boron was quantified by dried digestion, burning the sample in an electric muffle at 550°C, using the azomethine-H method. Boron reading was performed on UV-VIS spectrophotometer, brand, model 2100, with a wavelength of 410 nm (Empresa, 1999).

Statistical analysis: After meeting the analysis of variance basic assumptions data were evaluated by ANOVA and regardless of significance, F test ($p<0.05$) was evaluated as well. Initially, the results collected were submitted to tests of Shapiro-Wilk (Shapiro and Wilk, 1965) ($p>0.05$) and Levene (Box, 1953) ($p>0.05$), for normality verification and residual homoscedasticity, respectively, using the statistical software SAS (Der and Everitt, 2002). Subsequently, the results collected were submitted to analysis of variance and, when the "F" test was significant at the 5% probability the treatment averages were compared using LSD through the statistical software SAS (Der and Everitt, 2002; Banzatto and Kronka, 2008).

RESULTS AND DISCUSSION

Table 3 shows data related to first pod height, plants height and number of pods per plant. The variance analysis of data revealed that characters evaluated were influenced significantly ($p<0.05$), except for first pod height.

The results for plants height and number of pods per plant show evidenciates that the application of Stimulate® as well as the combined application of Sett® and Mover® (T2, T3, T4, T6 and T7) provided significant additions in this characteristic when compared to control (T1). The smallest results obtained for plant height and number of pods per plant was observed for treatment 1, in other words, absolute control (Table 3).

For plants height (Table 3) treatments 2 and 4 averages were superior to treatment 1. Common fact for both is the application of Stimulate® in stage R_1, dose 0.250 L h^{-1}. However, treatment 4 presents application of Sett® (R_1) and Mover® ($R_{5.1}$).

Results obtained for the variable number of pods in T1 was smaller than those found in other treatments. This result corroborate with those obtained by Albrecht *et al.* (2011) which found significant differences in application with bio-regulator Stimulate® in different phenological stages in soybean crop. Bertolin *et al.* (2010), working with bio-regulator in different vegetative stages (V_5 R_1 and R_5) had an increase in number of pods per plant and grain yield under both via seeds and foliar application. However, higher productivity is not related to the higher growth of shoot, considering plant height, branches per plant and first pod height. In relation to increased productivity, the bio-regulator was more effective when applied during reproductive phase.

The use of bio-regulator associated with foliar fertilizer application in stage R_1 provides conditions of elevation in potential yield that will be consolidated in the reproductive phase (Table 3).

In Table 4 mean results are presented for SPAD, weight of 1,000 grains and productivity variables with significative differences ($p<0.05$). About the SPAD results, T7 presented higher number of gdm^{-2} of chlorophyll. Thus the application of Mover® can assist in the translocation of photoassimilates by the plant (Table 4). According to Campos *et al*. (2008) worked with different sources of bio-regulator, found few differences between treatments for chlorophyll content.

Applications of 3 L ha^{-1} in R_1 of Sett®+application of 0.25 L h^{-1} of Stimulate®+2 L h^{-1} of Mover ® in $R_{5.1}$ and application of 0.25 L h^{-1} of Stimulate®+2 L h^{-1} of Mover® in R_1 (T6 and T7) resulted in higher thousand grains weight when compared to others. It is an substantial yield component in cases of increase in productivity. The results of this test indicated that bio-regulator and foliar fertilizers showed beneficial effect in increasing the thousand grain weight in T6 and T7, which were reflected in higher grain yield.

Table 3: Mean height of height of first pod, plants height and number of pods per plant from cultivar BRS 255 RR, Maringá, Paraná State, Brazil, 2011/2012 crop season

Treatment	Height of 1st pod (cm)	Plants height (cm)	No. of pods (und.)
T1	16.12^{a}	141.82^{c}	46.93^{b}
T2	15.81^{a}	150.87^{a}	68.00^{a}
T3	17.62^{a}	148.12^{ab}	68.68^{a}
T4	14.93^{a}	149.43^{a}	66.43^{a}
T5	16.93^{a}	143.50^{bc}	68.81^{a}
T6	16.62^{a}	147.50^{ab}	72.15^{a}
T7	12.81^{a}	147.18^{ab}	81.81^{a}
Mean	15.83	146.92	67.54
CV (%)	14.08	2.64	16.55

CV: Coefficient of variation, Means followed by same letter in column do not differ significantly by t test (LSD), in 5% level of probability

Table 4: Result in spad, 1,000 grains weight and yield of cultivar BRS 255 RR, Maringá, Paraná State, Brazil, 2011/2012 crop season

Treatment	SPAD (g dm^{-2})	1,000 grains weight (g)	Yield (kg ha^{-1})
T1	43.45^{c}	173.09^{c}	3860.01^{c}
T2	48.30^{ab}	182.11^{ab}	4438.92^{b}
T3	46.90^{b}	182.44^{ab}	4882.96^{ab}
T4	47.20^{ab}	179.40^{ab}	4578.54^{ab}
T5	46.50^{b}	176.38^{bc}	4506.82^{ab}
T6	47.22^{b}	182.81^{a}	4604.53^{ab}
T7	49.55^{a}	182.87^{a}	5007.83^{a}
Mean	47.01	180.01	4554.23
CV (%)	3.59	2.40	8.17

CV: Coefficient of variation, Means followed by same letter in column do not differ significantly by t test (LSD), in 5% level of probability

As for the yield variable, significant differences were identified; in this case there is a clear superiority of T7 when compared to T1 and T2. This difference reflects the purpose of the application of Mover®.

According to Taiz and Zeiger (2004), hormones and nutrients are substances that control the source/sink of assimilates in plants. The highest yield achieved in the reproductive stage R_1 can be explained by this relationship. Probably when the stimulant is applied at this stage serves as a sink for the release and/or remobilization of carbohydrates, resulting in true grains and positively influencing yield.

Moreover, Albrecht *et al.* (2012) found no difference in yield, but in the chemical composition of soybean (oil and protein) in response to application of the product at different stages in soybean crop.

Hence another possible hypothesis would be that the application of Mover® contributes in increasing the of production components, so it is plausible to assume that metabolic/hysiological functions of mineral elements found in the product composition (B, Zn, Co and Mo) were significant and representative.

With respect to nutrients in grains (Table 5), all variables showed significant differences ($p<0.05$) exception for S.

Regarding Mg, the interference of products was positive with a significant increase in the amount of Mg in grains due to the applications of foliar fertilizer and plant growth regulator. Note that treatments T3, T4, T5, T6 and T7 showed an average 15% increase compared to T1. An interesting result, magnesium has various functions among them, as a structural component of chlorophyll, enzyme regulator of several enzymes (Malavolta, 2006; Taiz and Zeiger, 2009; Kerbauy 2004; Castro *et al*., 2005).

As for Ca levels (Table 5), it is observed that treatments T6 and T7 showed an increase of 20% when compared to T1. This positive influence on calcium content is directly related to the applications of Stimulate®, Sett® and Mover®.

Overall, for the K content in treatments T2, T3, T4, T5, T6 and T7 when compared with T1 yielded 4.6% increase of this nutrient in soybean grains. Important result, since K is directly related to higher transportation and storage of photoassimilates in grains, its content also tends to increase as it participates in the transportation of saccharose and photoassimilates towards the source to the sink (Marschner, 1995).

Regarding N, treatments T5, T6 and T7 were significantly superior to treatments T1, T2 and T3. Thus, the results obtained allow us to conclude that applying Stimulate®, Sett® and Mover® is a favorable practice to increase levels of nutrients in grains that are directly related to the yield of soybean as well as economically viable by increasing in 21% yield (Table 4). According to Marschner (1995), the nitrogen absorbed by plants combines with carbon skeletons for the production of amino acids which results in proteins that are stored in plant tissues. During the filling phase of grains, these reserves are broken, translocated and stored in these organs, as proteins and amino acids conferring the increase in the yield.

Table 5 presents data on the levels of micronutrients in grains. For levels of Fe, Zn and B were not observed significant differences.

The phosphorus content increased with application of foliar fertilizers for treatments T4, T5, T6 and T7, which were superior to the other treatments. Probably, this is due to the fact that P partition to grains increased with foliar application of fertilizer, in other words, the rate of translocation of P for the grains depends on the level of supply of other nutrients such as N to the plant.

Referring to the copper content (Table 6), only the presence of bio-regulator was enough to provide meaningful answers, leading the other treatments (T5, T6 and T7) to have higher levels of the nutrient. Similar behavior was observed with the N levels (Table 5). For Mn with Stimulate®, Sett® and Mover® application provided a reverse effect decreasing significantly the levels of Mn.

Table 5: Mean results in levels of Mg, Ca, K, N, P and S in g kg^{-1} of seeds in response to applications of bio-regulator and foliar fertilizers on cultivar BRS 255 RR, Maringá, Paraná State, Brazil, 2011/2012 crop season

Treatment	Mg	Ca	K	N	P	S
	------------	------------	---g kg^{-1}---	------------	------------	------------
T1	1.93^{b}	1.35^{c}	14.66^{b}	62.57^{b}	2.94^{b}	2.00^{a}
T2	2.01^{ab}	1.49^{b}	15.00^{a}	61.32^{b}	3.22^{b}	2.17^{a}
T3	2.17^{a}	1.34^{c}	15.26^{a}	63.22^{b}	3.17^{b}	2.14^{a}
T4	2.22^{a}	1.20^{d}	15.43^{a}	69.15^{ab}	3.48^{a}	2.32^{a}
T5	2.41^{a}	1.42^{c}	15.49^{a}	70.42^{a}	3.62^{a}	2.22^{a}
T6	2.03^{a}	1.62^{a}	15.37^{a}	81.85^{a}	3.51^{a}	2.45^{a}
T7	2.33^{a}	1.62^{a}	15.51^{a}	71.92^{a}	3.59^{a}	2.51^{a}
Mean	2.16	1.43	15.24	68.63	3.36	14.32
CV (%)	7.43	5.64	2.41	10.75	8.27	2.25

CV: Coefficient of variation, Means followed by the same letter in the column do not differ significantly by t-test (LSD) at 5% probability

Table 6: Mean values on levels of Fe, Cu, Mn, Zn and B (mg kg^{-1}) in seeds in response to different applications of bio-regulator and foliar fertilizers on cultivar BRS 255 RR, Maringá, Paraná State, Brazil, 2011/2012 crop season

Treatment	Fe	Cu	Mn	Zn	B
	------------	------------	---(mg kg^{-1})---	------------	------------
T1	180.50^{a}	12.82^{b}	37.37^{a}	32.70^{a}	29.80^{b}
T2	174.50^{a}	13.23^{b}	32.50^{b}	33.15^{a}	29.83^{a}
T3	134.75^{a}	13.07^{b}	31.57^{c}	32.70^{a}	31.85^{a}
T4	120.50^{a}	12.97^{b}	31.42^{c}	32.90^{a}	32.09^{a}
T5	107.75^{a}	13.62^{a}	32.92^{b}	32.97^{a}	32.20^{a}
T6	99.72^{a}	13.57^{a}	33.25^{b}	32.52^{a}	31.08^{a}
T7	115.00^{a}	13.65^{a}	31.25^{c}	31.92^{a}	29.59^{a}
Mean	133.24	13.40	32.90	32.69	29.88
CV (%)	24.79	3.42	3.44	2.99	6.54

CV: Coefficient of variation, Means followed by the same letter in the column do not differ significantly by t-test (LSD) at 5% probability

CONCLUSION

The foliar product Sett®, Stimulate® and Mover® is a potentially efficient management indicated to increase the yield and agronomic performance of soybean.

Applications of bio-regulator and foliar fertilizer improve chemical composition in grains in stage R_1.

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