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Evaluation of two biostimulants in soybean production

Summary

The results of a study of soybean (*Glycine max*, (L.)) are presented, which was developed in areas of the Basic Sugarcane Seed Bank of the province of Cienfuegos, located in areas of the Espartaco community with the variety INIFAT- 70. The study was planted on May 24 and harvested on September 12 with 111 days, the application of biostimulants was carried out on July 19 at 55 days after planting, the randomized block design was used with 3 treatments (Control, FitomasEC and Fitomasplus) and 5 replicates, in plots of 36 m2. The seed used was basic from the bank itself with more than 95% germination and the study area was not fertilized. The treatments used were: Witness and/or control, FitomasEC an application at 2 liters ha-1, Fitomasplus an application 2.0052 liters ha-1 (tank mix 2 liters ha-1 of FitomasEC and 5.2 milliliters ha-1 of enerplant), The variables evaluated were ton ha-1 and the economic valuation. A simple classification analysis of variance (ANOVA) was performed and as there were significant differences between the treatments, the mean comparison test was performed using the multiple range test with Tukey's $p<0.05$ test. For data analysis, the statistical package Statgraphics Plus 5.0 was used. It was obtained as a result that the application of biostimulants increased soybean production, resulting significant with Fitomasplus, which achieved increases compared to the control of 25% and compared to FitomasEC of 22%, the Benefit/Cost ratio reported a positive effect of 1.02 for the FitomasEC and 1.25 for Fitomasplus with respect to the control.

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Introduction

The national and international situation currently characterized by the food crisis, the greatest efforts have been made to guarantee higher levels of efficiency in the agri-food sector, as a way to reduce dependence on food imports. Agriculture faces the challenge of the sustainable production of safe food to supply the world's population. The Food and Agriculture Organization of the United Nations (FAO) estimates a growth of the world population of 13% in 2030 and 30% in 2050, for which a 70% increase in production will be necessary agriculture to solve malnutrition problems and guarantee food security.[1] Soybeans represent an important crop in the economy, as they have a high nutritional value, with values of 38-42% protein and 18-20% oil. Its consumption increases every day, due to the need to use the grain as a raw material in the production of concentrated feed for animals and for human consumption.[2] Nitrogen (N) and phosphorus (P) are considered two of the elements with the greatest influence on crop production and soybean in particular.[3] However, the use of these nutrients in chemical form is limited, mainly due to their high cost and the incompatibility of their excessive use with the conservation of the environment, reasons for which sustainable alternatives are used capable of maintaining production levels and their quality, without damaging agroecosystems.[4] Among the agroecological alternatives that are proposed today in Cuba and the world, is the application of biostimulants.

The Cuban Institute for Research on Sugar Cane Derivatives (ICIDCA) developed FitoMas-E, derived from by-products of the sugar industry with marked anti-stress properties, made from high-energy biochemical substances, typical of superior plants. , mainly amino acids, nitrogenous bases, saccharides and bioactive polysaccharides).[5] Biotec developed Enerplant®, which is a product made with different types of oligosaccharides that are obtained from exclusive extraction processes and where selected plant materials are used as raw material. The new FitoMas-Plus formulation (factory or tank mix of FitoMas-EC + Enerplant) is also a new alternative for agricultural crops. The objective of this work is to show the results achieved in the Cienfuegos sugarcane Basic Seed Bank with the biostimulants FitomasEC and FitomasPlus in soybean cultivation.

Materials and methods

The work was carried out in areas of the Basic Sugar Cane Seed Bank of the province of Cienfuegos, located in areas of the Espartaco community, municipality of Palmira, on vertic Brown soils without carbonate Hernández et al.,[6] with the INIFAT- 70 whose characteristics are described in Table 1.[7] The study was planted on May 24 and harvested on September 12 with 111 days, the application of biostimulants was carried out on July 19, 55 days after planting.

Table 1 Characteristics of the variety used in the study

Variety	Planting time	Life cycle	Yield (Ton/ha)
INIFAT-70	Spring	100-115	2.0-3.0

The setup of the experiment was carried out in a randomized block design with 3 treatments (Control, FitomasEC and Fitomasplus) and 5 replicates, in plots of 36 m^2 (10 m long with 4 furrows wide, at a distance between furrows of 0 .90m). The distance between plants of 0.05 m for a total of 20 plants per linear meter.

The seed used was basic from the bank itself with more than 95% germination and the study area was not fertilized.

The treatments used were:

I. Witness and/or control.

II. FitomasEC one application at 2 liters ha^{-1}

III. Fitomasplus one application 2.0052 liters ha-1 (tank mix 2 liters ha^{-1} of FitomasEC and 5.2 milliliters ha^{-1} of enerplant).

A single application of the biostimulants was made 55 days after sowing when the crop had sufficient leaf area, with backpacks fitted with Flood jet nozzles (in bands on the furrow) with a final calibrated solution of 200 L ha^{-1}. The variables evaluated were ton ha^{-1} and economic valuation. For this last variable, the price of

soybeans established was the one proposed in Resolution 125/2021 of the Production and Marketing Company of MINAGRI, the cost of FitomasEC is the one paid by the producer to AZUMAT, the application cost is determined by The service provided by the company, the production base, and that of the Enerplant corresponds to the proposal of Resolution 313/2020 of the Ministry of Finance and Prices for sale to producers. The plots were harvested by hand and threshed by a Creole harvester (semi-mechanized harvest) where each replica of the studied treatments was weighed directly (Figure 1). A simple classification analysis of variance (ANOVA) was performed and since there were significant differences between the treatments, the mean comparison test was performed using the multiple range test with Tukey's test $p<0.05$. For data analysis, the statistical package Statgraphics Plus 5.0 was used.

Figure 1 Soybean Trial Harvest.

Results

The results of the analysis of variance showed significant differences between the treatments (Table 2), where Fitomasplus significantly exceeded FitomasEC and the Witness, between the latter two there were no differences, although FitomasEC increased the performance compared to the control by 2.3% (Figure 2). The economic evaluation (Table 3) showed that the cost-benefit ratio was satisfactory for treatments with biostimulants and although the increase in FitomasEC production was only 2.3%, the price of soybeans is attractive (58.07 the Kg) in addition the costs of Biostimulants and their application are not high, unlike Fitomasplus, however their productive and economic results are encouraging. Cobas et al. (2016) achieved fruitful results in cane production with the use of the mixture of FitomasEC and Enerplant and 50% of the fertilization recommended by the Service for the Recommendation of Fertilizers and Amendments (SERFE)

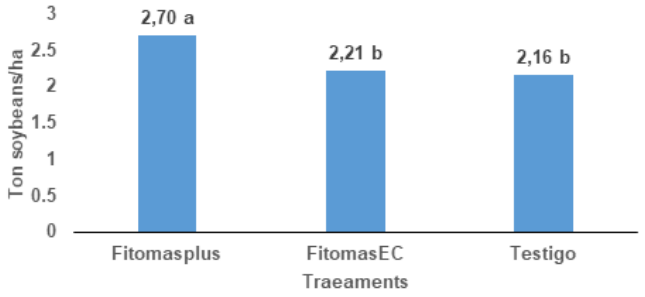
Table 2 Results of the Analysis of variance between the treatments studied

F.Variatión	G.L	S. Squares	C. Means	Sign.
Treatments	2	1.003	0.5	**
Error	12	0.54	0.05	
X ± ES	2.36 ± 0.01			

Table 3 Economic Valuation

Cost of thel Enerplant	**537.59/cup**	**5.2 milliliters**	
Cost of the FitomasEC	32/cup	Liters	
Costo of the Fitomasplus	569.59/cup	Liters	
Aplication Cost	32/cup	$	
Treatmentsatamientos	Witness	FitomasEC	Fitomasplus
t soybean ha-1	2.16	2.21	2.7
Difference	-	0,05	0,54
Price t Soybean	58070	58070	58070
T value soybeans ha-1	125431.2	128334.7	156123.3
Product Cost + Aplicación		96	665.69
Total cup	125431.2	128238.7	156123.3
Cup Benefit		2807.5	30692
Benefit/Cost		1.02	1.24

Figure 2 Difference between treatments in the variable soybean ha^{-1}.



Conclusion

I. The application of biostimulants increased soybean production, resulting significant with Fitomasplus, which achieved increases with respect to the control of 25% and with respect to FitomasEC of 22%.

II. The Benefit/Cost ratio reported a positive effect of 1.02 for FitomasEC and 1.25 for Fitomasplus compared to the control.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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