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Evaluation Of The Use Of Mountain Micro-Organisms In The Peanut Crop Yield (Arachis Hypogaea L.) In The Province Of Guayas-Ecuador

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Abstract

The objective of this research was to determine if the use of mountain microorganisms at different doses could generate significant responses in agronomic variables of importance in the peanut crop in the province of Guayas, Ecuador. For this purpose, the experiment was carried out at the "Dr. Jacobo Bucaram" experimental center in the canton of Milagro. The experimental design used was completely randomized blocks (DBCA) comprising four treatments with four replications consisting of different doses of MM and a control, the doses were 1000cc for the control, 2000cc for T1, 3000cc for T2 and 4000cc for T3. The experimental units were established in plots of 3.5 m by 2.5 m, with a total of 16 plots. The results obtained showed that the treatment that obtained the greatest significant difference in the crop response variables was T3, the most important being the yield, which reached 5564.28 kg/ha in this treatment, above the average estimated for the area, which oscillates between 4000 kg/ha. Thus, finding a viable alternative in the implementation of MM in the peanut crop to stimulate the development of the crop and increase its production, being consistent with the environment with ecological agricultural practices that are based on sustainable agriculture.

Resumen

La presente investigación tuvo como objetivo determinar si el uso de microorganismos de montaña a diferentes dosis podría generar respuestas significativas en variables agronómicas de importancia en el cultivo de maní en la provincia del Guayas, Ecuador. Para lo cual se desarrolló el experimento en el centro experimental “Dr. Jacobo Bucaram” en el cantón Milagro. Para el diseño experimental se utilizó bloques completamente al azar (DBCA) que comprendió de cuatro tratamientos con cuatro repeticiones que consistían en diferente dosis de MM y un testigo, las dosis fueron 1000cc para el testigo, 2000cc para el T1, 3000cc para el T2 y 4000cc para el T3. Las unidades experimentales se establecieron en parcelas de 3,5m por 2,5m, con un total de 16 parcelas. Los resultados obtenidos arrojaron que el tratamiento que mayor diferencia significativa en las variables de respuesta del cultivo obtuvo fue el T3 siendo la de mayor importancia el rendimiento que alcanzó los 5564,28 Kg/ha en este tratamiento por encima de la media estimada para la zona que oscila en los 4000kg/ha. Encontrando así una alternativa viable en la implementación de MM en el cultivo de maní para estimular el desarrollo del cultivo y aumentar su producción, siendo consecuente con el medio ambiente con prácticas agrícolas ecológicas que se fundamentan en una agricultura sostenible.

Introduction

The peanut is a plant belonging to the fabaceae family, also known as legumes, because of its high oil content in its seed, that belongs to the group of oilseeds. It is a food with great potential and fundamental for the nutrition of many countries such as Argentina, India, China and Nigeria among others (Pedelini, 2012).

According to the North Carolina Department of Agriculture and Consumer Service in its fact sheet (2020) states that peanuts provide the best source of concentrated proteins in the vegetable kingdom, contributing to the diet

considerable values of magnesium, fiber, copper, vitamin E and amino acids. It has become imperative to study and develop its cultivation.

In Ecuador, peanuts are grown in tropical and subtropical regions, adapting to the climates of these areas. Among the peanut-producing provinces are Loja, El Oro, Manabí and Guayas. The peanut is a crop that shows tolerance to areas with extended periods of drought with average temperatures ranging between 24 and 27 ° C, in Ecuador are grown approximately 12000 to 15000 hectares of peanuts per year, obtaining yields in shell of up to 1000Kg / ha. (Carrillo, Carvajal, Álvarez, Solórzano, & Castro, 2007)..

According to Guamán (2008), the most cultivated variety in the country is INIAP-380 also known as Tarapoto, which can reach with proper care and technical developments about 3000 kg/hectare, below current average yields due to the lack of implementation of technologies and good agricultural practices, including irrigation and specialized fertilization programs.

To achieve production based on the foundation of sustainable agriculture, it is necessary to analyze alternatives that increase the productivity of horticultural crops, among these alternatives is considered the use of microorganisms that inhabit the soil rhizosphere, whose capabilities to promote the productive capacities of crops is of interest and scientific importance in the agricultural field (Solaiman, Abbott, & Varma, 2014). The study of these alternatives includes the use of biofertilizers, environmentally friendly and at the same time an effective ally at the time of increasing crop yields.

There are native microorganisms or those native to mountainous areas, little altered by anthropic factors, with their contribution to the environmental balance, these microorganisms can be captured from their habitat and reproduced to be applied in various crops, of which the present research will study them in the peanut crop. The colonies of beneficial fungi and bacteria stand out for promoting plant growth and in the case of arbuscular mycorrhizal fungi that act in the soil-root relationship protecting from pathogenic agents (Camargo, Montaño, De La Rosa, & Montaño, 2012).

In previous research carried out by Mujica, Medina and Rodríguez (2017) on the use of beneficial microorganisms in peanut cultivation showed positive effects reaching yields of 1658 kg per hectare finding a viable alternative for sustainable production with the use of biofungicides and biofertilizers.

Based on the described background, this research proposes to implement mountain microorganisms, captured from their natural environment to be used in the peanut crop, evaluating their response to the yield and benefits that they can provide in symbiosis, with the objective of promoting economically sustainable ecological agricultural practices that allow tracing an alternative route for local agriculture. With the final objective of determining the agronomic behavior and response of the peanut crop with the application of mountain mycoorganisms in different concentrations.

Methodology

The present study is of an experimental nature, focused on evaluating the development and yield of the peanut crop with the application of different doses of mountain mycoorganisms. It was carried out using a completely randomized block experimental design (DBCA) comprising four treatments with four replicates each, then the statistical difference was evaluated by means of an analysis of variance (ANDEVA) and a Tukey test with an alpha of 0.05 probability was implemented.

Table 1. Andeva Schematic

Source of Variation	Degrees of freedom
Treatments (t - 1) (4 - 1)	3
Repetitions (r - 1) (4 - 1)	3
Error t(r - 1) 3(4 - 1)	9
Total (t* r - 1) (4*4 - 1)	15

Source: Own elaboration.

As for the trial area, plots were delimited at a distance of two meters each with a planting frame of 0.5 by 0.7m with a plot width of 2.5m and a length of 3.5m, making a total area per plot of 9.8m^2 with a number of plants of 40 per plot and a total population for the study of 640 plants. The sketch of the test units can be seen in Figure 1.

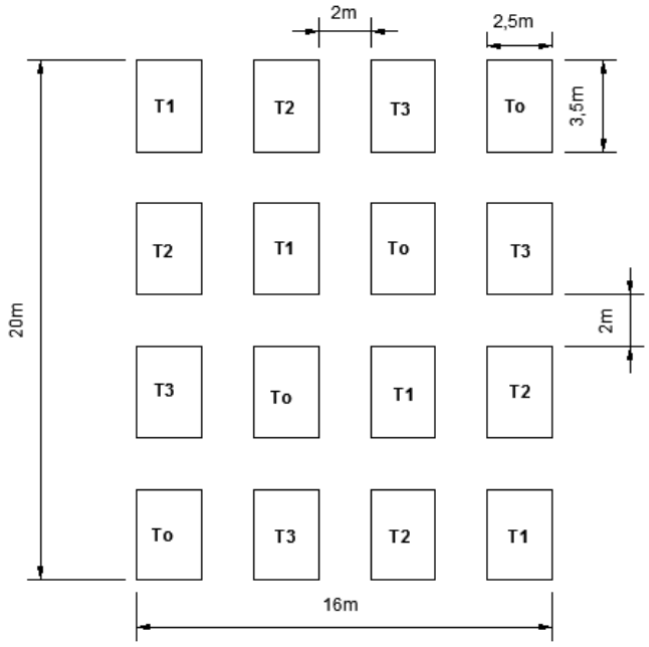

Figure 1. Sketch of the trial

The main variable to be evaluated is the crop yield, for which it is necessary to evaluate agronomic variables of importance, for the present study the following characteristics are evaluated: plant height (cm), number of grains per plant, weight of 100 grains, husk/grain ratio (%) and yield (Kg/Ha).

The treatments were defined with different doses, using a control treatment with the use of the minimum dose considered by local farmers for this type of product. Table 2 shows the scheme of the treatments under study.

Table 2. Treatments under study

Treatments	Product	Dosage/Ha	Dose/parcel	Frequency

T1	Mountain microorganisms (MM)	2000cc	1,96cc	7 days
T2	Mountain microorganisms (MM)	3000cc	2,94cc	7 days
T3	Mountain microorganisms (MM)	4000cc	3,92cc	7 days
To (Witness)	Mountain microorganisms (MM)	1000cc	0.98cc	7 days

Source: Prepared by authors.

Crop management

The corresponding work within the crop was carried out, including a land preparation prior to planting, it was done by direct seeding using two seeds per hole, weed control was done manually, pest incidence was evaluated within the plots, at the time of the trial rainfall was monitored for which it was not necessary to implement an additional irrigation. When the plants reached physiological maturity, harvesting was carried out, previously recording all the characteristics of interest.

The hypothesis of the trial is that at least one of the treatments directly influenced the yield and response of the peanut (Arachis hypogaea L.) crop through the use of mountain microorganisms (MM) in the province of Guayas, Ecuador.

Results

Silver height

Figure 2 shows the average results obtained in the measurements of the plants in centimeters, according to the statistical analysis showed that the treatment with a significant statistical difference was T3 with an average height of 50.58 cm.

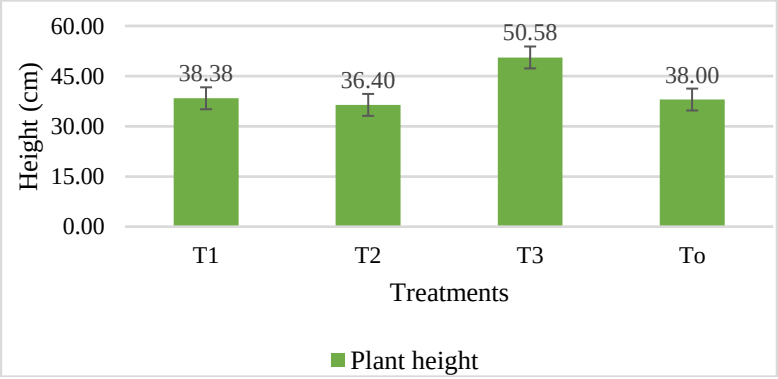

Figure 2. Plant height in centimeters.
Source: Prepared by authors

Number of grains per plant

Figure 3 shows that the treatment with a statistically significant difference according to the applied test was treatment T3 with a total of 209.88 grains on average per plant, based on the number of grains counted per plant.

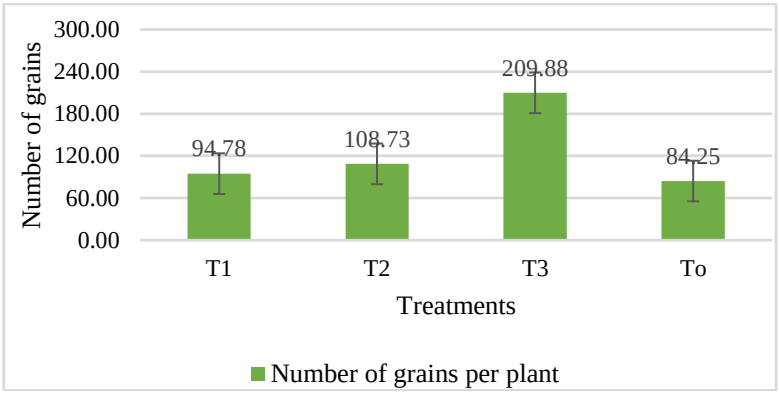

Figure 3. Number of grains per plant
Source: Prepared by authors

Weight of 100 seeds

According to the weight obtained per 100 seeds, this response indicator was evaluated and it was shown in Figure 4. The treatment that obtained the best weight was the T3 treatment with an average of 370.35 gr/100granes, according to the statistical analysis applied, which is statistically significant in comparison with the other treatments.

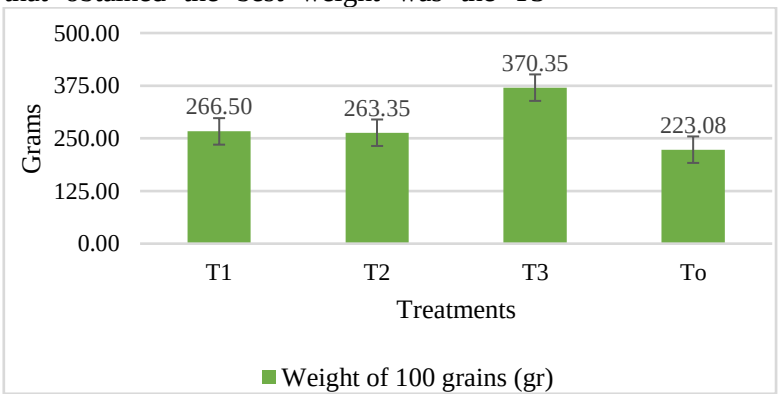

Figure 4. Average weight per 100 grains
Source: Prepared by authors

Ratio shell/grain

The husk/grain ratio is used to determine the amount of husk produced in the crop, and thus to know the percentage of loss per grain; the higher the ratio, the more husk the crop produces. Figure 4 shows that the behavior of this ratio is similar, with a significant exception of the control treatment To, which had a lower percentage of husk/grain with an average value of 0.15%.

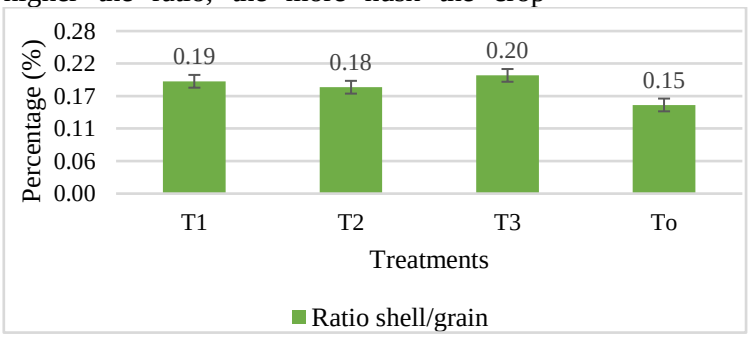

Figure 4. Ratio shell/grain

Source: Prepared by authors

Performance

Based on the study, excellent yields were obtained in all the study units, showing a significant difference in the T3 treatment that presented the highest yield among the experimental units reaching 5564.28 kg/ha followed by the T2 treatment that obtained 4674.99 kg/ha, as can be seen graphically in Figure 5.

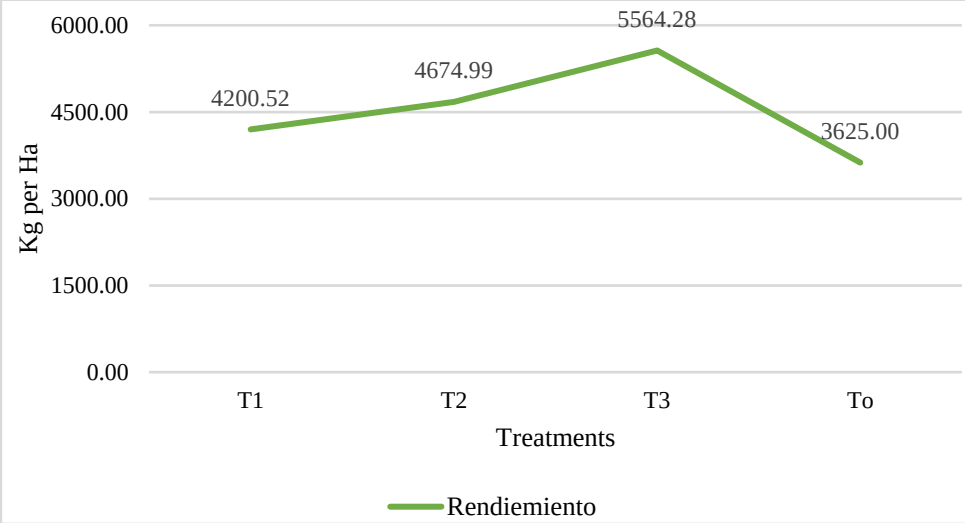

Figure 5. Crop yield
Source: Prepared by authors.

Discussion

In consideration with the results obtained in the study, it can be inferred that the treatments were significant in the agronomic responses of the peanut crop, which are similar to the results obtained by Medina, Arroyo, Herrera and Abundis (2018) who obtained significant results using beneficial microorganisms, finding a source of effective biofertilizers that contribute to the fixation of carbon and nitrogen in the soil, as well as enzymes that stimulate leaf and fruit development in the cabbage crop.

On the other hand, the research defines that there are no negative effects in the implementation of microorganisms as a source of fertilization, as in the case of the research conducted by Camacho et al. (2018) which managed to optimize the composting process with the use of MM to improve the physical and chemical properties of organic fertilizers.

The highest yields obtained in the present study were the T3 treatment with a MM dose of 4000cc per hectare, by combining this source of organic fertilization in conjunction with conventional chemical fertilizers, yield levels could be exceeded, and be sustainable over time, as in the results obtained by Garcia, Quevedo and Socorro (2019) who obtained their best results in the treatment with the use of MM and chemical fertilizers in the banana crop, because the demand of the crop requires it.

The mountain microorganisms demonstrated a beneficial behavior for the peanut crop, accelerating the decomposition of organic matter available in the soils and becoming assimilable for the crop, which is why their yields were much higher than those predicted by local information sources. These results are directly related to the capacity of these microorganisms to accelerate composting processes, as demonstrated by the biologist Méndez Paula (2019) who concluded that the addition of MM decreases the time in composting processes due to the degradation of organic matter, obtaining significant differences in plant biomass and growth, being

a viable alternative for a sustainable agriculture model.

Finally, it is essential to mention that positive results in the use of biofertilizers have an important echo in environmental care, improving fruit and vegetable production worldwide as we can see in the Popayan plateau in Mexico in the research conducted by Campo, Acosta, Morales and Alonso (2014) where they evaluated MM isolated from different sources or locations, having as a result that the treatment with the highest incidence was T1, thus improving the responses of the variables under study, as evidenced in this research.

Conclusion

The use of mountain microorganisms (MM) in different doses to evaluate the response of the peanut crop in the province of Guayas in Ecuador was significantly representative for the variables evaluated, having as main results that the treatment with the best response was the T3 whose dose was 4000cc followed by the T2 whose dose was 3000cc, and the treatment with the lowest response was the control treatment to whose dose was 1000cc.

As for the variable plant height, the treatment that achieved the best result was T3 with an average height of 50.58 cm, for the variable number of grains per plant, the same treatment reached average values of 209.88. Similarly, the weight of 100 seeds was higher in the T3 treatment with an average of 370.35 gr. The yield was higher for T3 compared to the other treatments, reaching 5564.28 kg/ha, above the expected averages for this crop at the local level, which ranges from 4000 kg/ha.

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