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Short Communication

Agromenas: new eficiente fertilizer on tomato (*Solanum lycopersicum* L.) crop

Agromenas: nuevo fertilizante eficiente para el cultivo del tomate (*Solanum lycopersicum* L.)

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ABSTRACT: Agromenas are obtained from organo-mineral products with controlled release nutritional properties, they are applicable to various crops in different production systems, and, in addition, they are harmonic products with the environment and compatible with herbicides and fungicides, constituting alternatives for the substitution of imports of mineral fertilizers (complete soluble formulas of high costs). The objective of this work was to determine the effectiveness of Agromenas fertilizer on yield and its components on tomato crop. For this, an experiment was conducted where three treatments were evaluated under a completely randomized design, using the dose of 1.0 t ha^{-1} of the fertilizer. It was shown that Agromenas increase the crop yield by 26 % with respect to the control treatment; likewise, the yield components are increased, which shows the efficiency of the organo-mineral fertilizer.

Key words: productivity, yield, vegetable, zeolites.

RESUMEN: Las Agromenas se obtienen de productos órgano-minerales con propiedades nutricionales de liberación controlada, son aplicables a diversos cultivos en diferentes sistemas productivos y, además, son productos armónicos con el medio ambiente y compatibles con herbicidas y fungicidas, constituyendo alternativas para la sustitución de importaciones de fertilizantes minerales (fórmulas completas solubles de altos costos). El objetivo del presente trabajo fue determinar la efectividad del fertilizante Agromenas en el rendimiento y sus componentes en el cultivo del tomate. Para ello, se condujo un experimento donde se evaluaron tres tratamientos bajo un diseño completamente aleatorizado, utilizándose la dosis de 1,0 t ha^{-1} del fertilizante. Se demostró que las Agromenas incrementan el rendimiento del cultivo en un 26 % con respecto al tratamiento control; igualmente, se incrementaron los componentes del rendimiento, lo que evidencia la eficiencia del fertilizante órgano-mineral.

Palabras clave: hortalizas, productividad, rendimiento, zeolitas.

INTRODUCTION

Cuba has geological knowledge and large reserves of minerals such as zeolites, phosphate limestones, bentonites, carbonates, magnesite, silica sand and potassium tuffs, which contribute to agriculture and constitute strengths to provide fertilization alternatives in the actions of transformation of the natural environment, inorder to achieve more favorable conditions for the soil substrate and the development of crops (1, 2). Specifically, zeolites were among the first essential mineral elements for the nutritional balance of plants through the soil and have the property of acting as an ion exchanger to retain cations such as NH^{4+}, K^{+} and Ca^{++} (3).

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Agromenas are obtained from organo-mineral products with controlled release nutritional properties, are applicable to various crops in different productive systems, and, in addition, are environmentally friendly products and compatible with herbicides and fungicides, constituting alternatives for the substitution of mineral fertilizer imports (4).

Organic matter is one of the fundamental constituents of soil fertility; its deficiency determines low levels of nitrogen, phosphorus, potassium, as well as some microelements (5). There are many soils in the country that will benefit from the application of Agromenas, particularly the Alitic, Ferrallitic and Sialitic Brown soils, which are intensively used in agricultural production, which has led to the gradual deterioration of their fundamental properties, causing their degradation and demanding increasing amounts of organic matter and other minerals (4).

Natural materials such as zeolitic rocks do not present the problems and disadvantages of conventional fertilizers, so their use to promote sustainable agriculture is convenient, mainly in countries that have deposits of these minerals. Zeolites are easy to produce in terms of energy costs and benefit to improve the structure and availability of soil nutrients, as well as to promote ecological food production (6).

This fertilization alternative is a palliative to the problem of the lack of fertilizers demanded by Cuban agriculture, making it possible to respond to the strategy proposed on the urgent need for food production in the face of the country's economic limitations to satisfy it (7, 8).

Tomato (*Solanum lycopersicum* L.) is the most widely spread vegetable in the world, its demand increases continuously and with it its cultivation, production and trade (9). In Cuba, it is one of the most produced nationally, reaching an average yield of 12.02 t ha^{-1} (10, 11), which is affected by biotic and abiotic factors that cause a considerable decrease in harvests (12), hence the need to find national solutions to minimize the effects on its production.

Therefore, the objective of this study was to determine the effectiveness of Agromenas fertilizer on yield and its components in tomato crops.

MATERIALS AND METHODS

The experimental work was carried out in the areas of the National Institute of Agricultural Sciences (INCA), located at kilometer 3 ½ of Tapaste road, San José de las Lajas, Mayabeque province, in the period from September to December 2021. The experiment was developed on a Ferrallitic Red Lixiviated Agrogenic distric Ferrallitic soil, according to the Cuban Soil Classification (13).

To study the response of Agromenas in the tomato crop (var. Mara), three treatments were studied: control (without fertilizer), Agromenas (1.0 t ha^{-1}) and NPK 9-13-17 complete formula (1.0 t ha^{-1}), whose composition is shown in Table 1 (4).

The seedling stage was developed in a traditional bed and transplanting was carried out 30 days after germination. In the transplanting stage, the experimental plots had an area of 9 m^2. The beds measured 10 m long x 1 m wide, to which mineral fertilizers were applied in the background. Two rows per bed were transplanted at a distance of 0.30 cm. The experiment was conducted under a completely randomized design with three treatments and 15 replications. Cultural attentions were carried out as recommended by the Technical Manual of the crop (14).

Evaluations at the flowering-fruiting stage were carried out on 15 plants per treatment taken at random 75 days after sowing (DAS) and were as follows: No of flowers plant^{-1}; No of bunches plant^{-1}; No of fruits plant^{-1}; Average fruit mass (g); Agricultural yield/surface area (t ha^{-1}) and Relative Agricultural Efficiency (EAR) (15) which was calculated through the following expression:

$$EAR = \frac{R.F.zeo - R.parc.no\ fert}{R.F.compl. - R.parc.no\ fert} * 100$$

Where:

R.F.zeo: average yield (t ha^{-1}) of plots where fertilizer with natural zeolite was applied.

R.parc.no fert: average yield (t ha^{-1}) of the unfertilized plot.

R.F.compl.: average yield (t ha^{-1}) of plots where the complete NPK formula was applied.

Statistical processing was carried out through an Analysis of Variance (ANOVA) of simple classification using the Statgraphics Centurion program (version 15.1). In cases where significant differences were found between means, these were compared using Duncan's test for 5 % significance, after verifying that they complied with the normal distribution adjustment and homogeneity of variance.

RESULTS AND DISCUSSION

Table 2 shows the results of the flowering-fruiting stage, where a similar behavior is observed among the treatments corresponding to the application of mineral fertilizers, which are not statistically different for the three variables that were evaluated.

The evaluations of agricultural yield and its components carried out in this experiment show the positive effect of the product (Table 3). In terms of yield, number and mass of fruits, significant differences were obtained among the three treatments, showing a superior performance of the fertilizers in relation to the control without mineral fertilizer,

Table 1. Physical-chemical composition of the organo-mineral formula

Composition	Nt,	$P_2 0_5$ %	K_2O %	MgO %	CaO %	pH	Pe g/cm^3	Moisture %
Value (%)	2.0- 2.5	7 -10	2.0	0.64	12.7	6.5-6.9	1.0	20-25

Table 2. Effectiveness of the Agromenas fertilizer on flowering-fruiting of the tomato crop (Mara var)

Treatments	Plants		
	No. Bunches	No. Total flowers	No. Total fruits
Control	17.5 b	9.45 b	9.36 b
Agromenas	23.2 a	13.8 a	12.6 a
FC-NPK	21.2 a	12.2 a	11.4 a
SE x	0.005*	0.045*	0.038*

Means with the same letters do not differ according to Duncan's Multiple Range Test p<0.05

Table 3. Effect of the application of Agromenas on agricultural yield and its components in tomato cultivation (Mara var)

Treatments	Fruits/ plot	Fruit mass average (g)	Yield (t ha^{-1})	EAR (%)
Control	324.76 c	68.53 c	20.23 c	--
Agromenas	571.56 a	83.36 a	32.60 a	218
FC-NPK	568.50 b	81.53 b	30.63 b	--
SE x	0.39*	0.12*	0.10*	--

Means with the same letters do not differ according to Duncan's Multiple Range Test p<0.05

which is exceeded by 61 %, increasing the relative agricultural efficiency by 218 %. This result demonstrates that Agromena fertilizer is an efficient substitute for mineral fertilizers, which will allow the substitution of imports for the country.

This behavior may be attributed to the beneficial action of minerals in the soil-plant system, which could accelerate the recycling process of nutrients available to plants and guarantee a higher yield. Similar results in tomato cultivation with the use of a zeolite-based product (Zeofert) increased crop yield by 38 % (6). Also, the mixture of zeolite with mineral fertilizer in the cultivation of *Solanum tuberosum* L. increased the crop yield by more than 29 t ha^{-1} (16).

CONCLUSIONS

Agromena fertilizer proved to be an efficient organo-mineral fertilizer in boosting tomato crop yields, with a similar result to NPK-based mineral fertilizer.

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