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**Short communication**

# Agronomic response of the tomato crop (*Solanum lycopersicum* L.) to the combined application of national biostimulants

## Respuesta agronómica del cultivo tomate (*Solanum lycopersicum* L.) a la aplicación combinada de bioestimulantes nacionales

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**ABSTRACT:** The application and use of local bioproducts for the benefit of agriculture is expanding very strongly in Cuba. It represents a necessary practice, aimed at improving crop efficiency, substituting imports and achieving food sovereignty. Tomato (*Solanum lycopersicum* L.) is one of the vegetables in greatest demand; its production with national bioproducts such as Fitomas EC and Gluticid constitutes an alternative to the lack of financing that limits its production. In this sense, an experiment was designed with the objective of evaluating the effect of the combined application of Fitomás-EC® and Gluticid®, as stimulators of tomato yield. The study was carried out on an Agrogenic Red Ferralitic soil under field conditions, in the experimental areas of the National Institute of Agricultural Sciences (INCA). Four treatments were studied under a randomized block design with four replications. Both bioproducts were applied by foliar spray at a rate of 6 g $L^{-1}$ and 2.8 ml $L^{-1}$ respectively. The results obtained showed a positive response on performance and its components. Fitomas-EC® and Fitoglu treatments achieved a statistically superior performance than the control. Both stimulated the number of clusters and flowers, as well as crop productivity by 44 and 49 % respectively with respect to the control. The variables evaluated in each of the phenological stages showed positive results between both bioproducts, which is why their combined application is proposed.

**Key words:** agroecological, tomato, phytostimulant, bioproducts.

**RESUMEN :** La aplicación y uso de bioproductos locales en beneficio de la agricultura se expande con mucha fuerza en Cuba. La misma representa una práctica necesaria, orientadas a mejorar la eficiencia de los cultivos, sustituir importaciones y lograr soberanía alimentaria. El tomate (*Solanum lycopersicum* L.) es una de las hortalizas de mayor demanda, su producción con bioproductos nacionales como Fitomas-EC® y Gluticid® constituye una alternativa ante la falta de financiamiento que limita la producción del mismo. En este sentido se diseñó un experimento con el objetivo de evaluar el efecto de la aplicación combinada de Fitomas-EC® y Gluticid®, como estimuladores del rendimiento del tomate. El estudio se realizó sobre un suelo Ferralítico Rojo Agrogénico en condiciones de campo, en las áreas experimentales del Instituto Nacional de Ciencias Agrícolas (INCA). Se estudiaron cuatro tratamientos bajo un diseño de bloques al azar con cuatro réplicas. Ambos bioproductos fueron aplicados por aspersión foliar a razón de 6 g $L^{-1}$ y 2,8 ml $L^{-1}$ respectivamente. Los resultados obtenidos mostraron una respuesta positiva sobre el rendimiento y sus componentes. Los tratamientos Fitomas-EC® y Fitoglu alcanzaron un comportamiento estadísticamente superior al control. Ambos estimularon el número de racimos y flores, así como la productividad del cultivo en 44 y 49 % respectivamente con respecto al control. Las variables evaluadas en cada una de las etapas fenológicas, mostraron resultados positivos entre ambos bioproductos por lo que se propone su aplicación combinada.

**Palabras claves:** agroecológica, tomate, bioproductos, fitoestimulante.

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## INTRODUCTION

In view of the rising price of mineral fertilizers in the international market and the scarce natural reserves of some nutrients, the use of biological alternatives is increasingly necessary. The current Cuban context demands the search for national solutions to minimize costs in agriculture. The application and use of local bioproducts for the benefit of agricultural food production is expanding strongly in Cuba; it represents a necessary practice aimed at improving crop efficiency, substituting imports and achieving food sovereignty.

The national bioproducts Fitomas-EC® and Gluticid® are considered successful phytostimulants in Cuban agriculture. Fitomas-EC is a derivative of the sugar industry, conceived from high-energy biochemical substances of higher plants, mainly amino acids, nitrogenous bases, saccharides and bioactive polysaccharides (1-3). Fitomas-EC® is a concentrated formulation of Fitomas-E®, with a change in the nitrogen source from Urea to $NH_4NO_3$. It is a stable formulation that provides nitrogen in its two important assimilable ionic forms: $NH_4^+$ and $NO_3^-$ (4).

Gluticid® is a biologically developed foliar biofungicide based on metabolites of the bacterium *Pseudomonas aeruginosa* strain PSS, which contains active metabolites effective for the control of phytopathogenic fungi. This product alone has shown a very positive effect in the control of fungal diseases (2,5).

The application of the new formulation Fitomas-EC®+Gluticid® (Fitoglu) is intended to increase yield and resistance to pest attack. It is designed to achieve a double biostimulant/protective effect in the same application (1).

Tomato (*Solanum lycopersicum* L.) production with national bioproducts such as Fitomas EC® and Gluticid® is an alternative to the lack of financing that limits production and yield reduction. It is considered one of the most demanded and consumed vegetables worldwide. In Cuba, it can be produced in all provinces of the country, although its average yield has decreased in recent years (6). In this sense, an experiment was designed with the objective of evaluating the effect of the combined application of Fitomas EC® and Gluticid®, as stimulators of tomato yield.

## MATERIALS AND METHODS

The study was carried out in the period January-February 2023, in the experimental areas of the National Institute of Agricultural Sciences (INCA), in a Ferrallitic Red compacted Agrogenic soil according to the Cuban Soil Classification (7). Four treatments (Table 1) were studied under a randomized block design with four replications.

**Table 1.** Identification and description of treatments

| No. | Treatments |
|---|---|
| T1 | Fitomas-EC® |
| T2 | Gluticid®. |
| T3 | FitoGlu |
| T4 | Control (without bioproducts) |

Applications were made at 15, 28 and 35 days after planting (DAP) by foliar spraying at a rate of 2.8 mL $L^{-1}$ of Fitomas-EC® and 6.0 g $L^{-1}$ of Gluticid®. The experimental plots had a total area of 15 $m^2$, in a spatial arrangement of 1.20 m x 0.30 m. The cultivar studied was 'Mariola'. The cultivar studied was 'Mara' from the INCA's Breeding Program. Cultural attentions were carried out as recommended by the Technical Manual of the cultivar (8).

Evaluations carried out on 15 plants per treatment at 15 and 30 (DAT) are shown below:

- No of bunches plant$^{-1}$: visual count.
- No. of flowers plant$^{-1}$: visual count.
- At harvest time, the following were evaluated:
- No. of fruits plant$^{-1}$: visual count
- Average fruit mass (g): result of dividing the total fruit mass by the number of fruits in the plot.
- Agricultural yield/area (t ha$^{-1}$).

The statistical processing of the experimental data was carried out through a double Analysis of Variance (ANOVA). In cases where significant differences were found between the means, these were compared using Duncan's dummy for 95 % significance. The analysis were performed with the Statgraphics Centurion program (version 15.1).

## RESULTS AND DISCUSSION

Table 2 shows the effect of the applications studied on the yield components 15 days after planting. The variable number of bunches is similar in the three bioproducts, exceeding the control by 46 %. The number of flowers per plant also showed a statistically similar behavior, although the treatments applied with Fitomas-EC® and FitoGlu showed an increase that significantly doubled the control treatment.

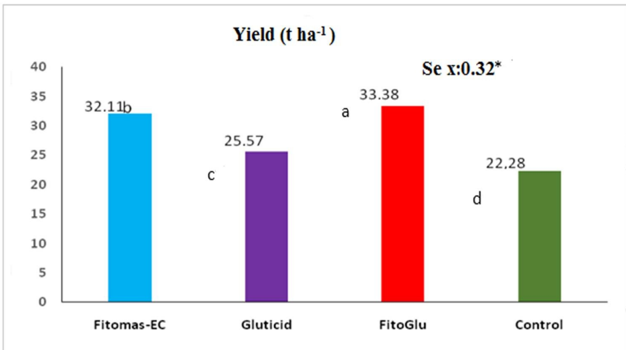
**Table 2.** Effect of bioproduct applications on tomato yield components (cultivar. *Mara*) at 15 (DAP)

| Treatments | Number of bunches per plant$^{-1}$ | Number of flowers per plant$^{-1}$ |
|---|---|---|
| Fitomas-EC® | 6.50 a | 5.60 a |
| Gluticid®. | 6.20 a | 4.60 ab |
| FitoGlu | 6.60 a | 5.60 a |
| Control (without bioproducts) | 4.50 b | 2.80 b |
| **SE x** | 0.56* | 0.56* |

Means with common letters do not differ according to Duncan's Multiple Range (p<0.05). DAP: days after planting)

The effect of the application of the bioproducts studied at 30 (DAP) (Table 3), showed for the two variables evaluated a more noticeable effect of the bioproducts on the crop, compared to the previous evaluation. The number of bunches per plant reached similar values between the simple application of Fitomas-EC® and FitoGlu.

Crop yield (Figure 1) shows statistical differences between treatments, being highly significant for the FitoGlu treatment, which increased crop productivity by 49 %. Also, the application of Phytomas-EC® alone outperformed the control by 44 % and the application of Gluticid® by 14 %.




Means with common letters do not differ according to Duncan's Multiple Range (p<0.05)

**Figure 1.** Bioproduct effects on the yield of tomato (var. *Mara*) crop

In general, the results show the positive effect of the combination of both bioproducts in (FitoGlu) on yield and its components. This result corroborates the criteria of other authors who assure that the application of biostimulants improves plant growth, development and yields. Besides, it provides greater resistance of plants to biotic and abiotic stress conditions such as extreme temperatures, hydric stress caused by insufficient or excessive humidity, salinity, toxicity, presence of pests, among other aspects, due to its components such as auxins, gibberellins, cytokinins, abscisic acid, jasmonic acid or other plant hormones (9). Also, it is proposed that they act in the physiology of plants in different ways and by different routes to promote their growth and development. (10,11).

The response found by the crop in terms of yield could be related, among other aspects, to the contribution of nitrogen in its two assimilable ionic forms offered by this formulation of Fitomas-EC®. In addition, this dual-purpose application (biostimulant and bioprotection) offers plants greater resistance to fungal diseases. In this case, not only because of the added effect conferred by the application of biostimulants, but also because of the application of Gluticid®, which is a foliar biofungicide containing active metabolites, effective for the control of phytopathogenic fungi. From a practical point of view, reducing the number of applications represents a significant saving in time, human resources and fuel.

## CONCLUSIONS

The results showed that it is feasible to combine the bioproducts Fitomas-EC® and Gluticid® (FitoGlu) to achieve a double effect of the application, from the mechanism of action as a biostimulant and bioprotection, which allowed increasing the yield and its components in the tomato crop.

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**Table 3.** Effect of bioproduct applications on tomato yield components (cultivar. *Mara*) at 30 (DAP)

| Treatments | Number of bunches/plant | Number of fruits/plant |
|---|---|---|
| Fitomas-EC® | 12.5 a | 20.9 b |
| Gluticid®. | 9.8 b | 9.60 c |
| FitoGlu | 11.4 ab | 26.6 a |
| Control (without bioproducts) | 8.9 b | 12.0 c |
| **Esx** | 0.84* | 0.99* |

Means with common letters do not differ according to Duncan's Multiple Range (p<0.05). DAP: days after planting)

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