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Effect of Different Doses of *QuitoMax* on the Growth of Cucumber (*Cucumis sativus* L.) Seedlings

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ABSTRACT

The experiment was carried out in the laboratory at the Faculty of Agricultural Sciences, University of Granma. The aim of the experiment was to evaluate the effect of *QuitoMax* on seed germination and the growth of cucumber seedlings. Four experimental variants were evaluated: 1.5, 1, 0.5, and 0.25 $g\ L^{-1}$ concentrations, in which the seeds were imbibed for 4 hours. The dynamics of germination, height, and fresh mass of the seedlings were evaluated 15 days after. The results showed the effect of *QuitoMax* on germination dynamics. The seeds in the 1.5 $g\ L^{-1}$ concentration underwent the shortest germination time, and showed the best effect on plant height. The fresh mass increased in the 1.5 $g\ L^{-1}$ concentration.

KEY WORDS: / Cucumis sativus, growth regulators, germination.

INTRODUCTION

Torres *et al*. (2018) pointed out that in a developing economy like Cuba's, agriculture is the basis of production; therefore, the utilization of new alternatives and methods to enhance agriculture is critical to achieve higher yields within the required quality standards and minimum use of mineral fertilizers, which are costly and pollute soils.

Moreover, Muzzarelli, R. *et al.* (2012) claimed that now agricultural practices are more focused on products that stimulate crop growth and development, and increase yields. Moreover, the active principles must be natural, biodegradable, and environmentally friendly, which is the case of *QuitoMax*, a partial derivative of chitin deacetylate, which is a widely distributed polysaccharide in nature as a component of invertebrate structures.

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QuitoMax's capacity to form film has been demonstrated by Kiirika, Stahl, & Wydra (2013). This property has allowed its use in farmland for seed coating with enhanced plant height and crop dry mass.

Cucumber is an outstanding garden crop in Cuba with a large daily demand and high economic relevance (Rodríguez & Castillo, 2010). In that context, the aim of this paper is to evaluate the effect of *QuitoMax* on cucumber germination, plant height, and fresh mass at different concentrations.

MATERIALS AND METHODS

Location and design of the experimental trial

The experiment was carried out in the laboratory, at the Faculty of Agricultural Sciences, University of Granma, in April 2018. The cucumber seeds were imbibed for 4 hours at different concentrations of *QuitoMax*. Then they were dried at room temperature for 24 hours, and were placed in RTOP chamber for germination, with variable temperature values day/night of 28/24 ºC, respectively; relative humidity was 80%.

The seeds were inoculated into Petri dish with filter paper dampened in distilled water (20 seeds per dish, and 4 repetitions per treatment). The dynamics of germination was determined at 24, 48, and 72 hours, based on root emergence criteria. Five plants were taken at random to measure plant height (PH) and fresh mass (FM) on day 15 after seed germination.

Experimental variants

The treatments were performed as follows

Table 1. Description of the treatments applied

Variants	*Imbibition time* (h)	*Product*	*Dose* ($g\ L^{-1}$)
T1	4	*Water*	-
T2	4	*QuitoMax*	0.25
T3	4	*QuitoMax*	0.50
T2	4	*QuitoMax*	1.00
T5	4	*QuitoMax*	1.50

Statistical analysis

One-way analysis of variance was made to determine if there were significant differences between the means at different concentrations of *QuitoMax*. A follow up analysis was performed when the significant P-values in the ANOVA table were shown, to determine the significantly different means by the Multiple Range Test, using Tukey's honestly significant difference (HSD), at 95% confidence interval. The *STATISTICA* suit, 6.0, for Windows 2000 was used.

RESULTS AND DISCUSSION

Seed germination is an oxidative process, which is influenced by internal and external factors. Table 2 shows the influence of different concentrations of *QuitoMax* on the speed of germination of cucumber seeds.

Table 2. Dynamics of cucumber seed germination

Treatments	Time (h)			Germination (%)
	24	48	72	
T1	-	31	42	73
T2	-	35	37	93
T3	15	41	40	95
T4	16	40	40	96
T5	31	49	49	99

Treatments T3, T4, and T5 produced germinated seeds 24 hours later, which demonstrates that the presence of *QuitoMax* at those concentrations had the highest stimulating effect on the speed of germination. All the *QuitoMax* treatments, including T2 (the lowest number of germinated seeds) were better than the control treatments; therefore, it can be assured that the germination speed of seeds in T1 was slower than the other treatments.

The response observed is explained by the capacity of *QuitoMax* to stimulate seedling growth (Table 3), which is closely linked to the concentrations used, the molecular size, and the way in which the product was applied to the crop, including the time of contact with the seed. It has been demonstrated (Falcón *et al*., 2015) that *chitosan* stimulates the protein level in the leaves, as well as the enzymatic levels.

Rodríguez *et al.* (2009) and Pérez, Rodríguez & Ramírez (2015) corroborated the increase in germination produced by *QuitoMax* in certain crops by stimulating secondary metabolism enzymes, such as *chitinase*, *cellulase*, *and B*-1,3 *glucanase.* Furthermore, the treatment using *QuitoMax*can stimulates a number of events in the seeds, like protein hydration, sub-cellular structural changes, respiration, synthesis of macromolecules, and cell elongation. All these processes transform a resting dehydrated embryo, with a barely perceivable metabolism, into one with an active metabolism that ends in the growth of the embryonic axis.

Table 3. Effect of *QuitoMax* on height and fresh mass of cucumber seedlings

Treatments	$AP(cm)$	$MF(g)$
T1	12.20^{a}	3.95^{a}
T2	12.65^{ab}	4.00^{b}
T3	13.30^{b}	4.32^{b}
T4	13.45^{b}	4.63^{b}
T5	15.50^{c}	5.61^{c}
Cv	13.76	14.72

Note: treatments with equal letters show no minimum significant difference ($p<0.05$).

The 1.50 $g\ L^{-1}$ dose (T5) was significantly higher than all the other treatments, as shown in Table 2. Treatments T2, T3, and T4 showed no significant differences between them, except with the control treatment, whereas T2 was not different from the control. El Hadrami *et al.* (2010) observed the stimulating effect of *QuitoMax* on the growth of cereal seeds; whereas Kirika, Stahl, and Wydra (2013) observed an increase in stem thickness of tomato after using this biostimulant;

and Muzzarelli *et al.* (2012) reported increases in foliage and plant growth. All these effects may be caused by the property of *QuitoMax* that favors the production of enzymes linked to plant growth and development; namely cellulose, which stimulates height in plants.

Similar results were achieved in s*olanaceae*, particularly in mini potato tubers, whose yields were favored by the application of various concentrations of chitosan by seed imbibition. As a result, certain favorable effects were observed in the field, like enhanced plant growth and induced germination, as well as improved tolerance to abiotic stress (Jerez *et al.*, 2017).

González *et al.* (2016) observed a behavior similar to this study when they evaluated the effect of *QuitoMax* on plant height; Sharathchandra *et al.*, (2004) reported favorable results with *QuitoMax*, which stimulated seedling strength.

Moreover, authors like Karlova and de Vries (2006) reported that biostimulants are capable of stimulating growth in stems, leaves, and fruit, thus increasing crop yields, in comparison to other plants where the product was not applied.

The 1.5 $g\ L^{-1}$ dose was the best treatment that produced fresh mass in the seedlings. Besides, there was a correspondence between the volume of *QuitoMax* applied and the fresh mass. This correspondence was directly proportional to increases or decreases of fresh mass and increases or decreases of *QuitoMax* doses, respectively. A higher concentration means more active substance applied and stronger stimulating effects.

Terry *et al*. (2017) used seeds imbibed at equal concentrations to this study, with similar results, but in tomato. They achieved more fresh mass where the highest concentration was applied.

González *et al*. (2016) on evaluation of *QuitoMax* in tomato, found a positive effect on the production of fresh mass; the best results were observed where the highest doses were applied, similar to this study. Other authors, such as Rodríguez & Araujo (2013), reported a positive incidence of this and other biostimulants after evaluating the effects of different doses of the polymer on different crops.

Their research demonstrated the positive response of plants to the application of the polymer, which represented an increase in the variables evaluated and therefore, in cucumber seedling quality. This result suggests the viability of *QuitoMax* use as an ecologically safe alternative to speed up the growth of seedlings.

CONCLUSIONS

The utilization of *QuitoMax* in cucumber seeds produced germination percentages between 93 and 99%, whereas the control was 73%.

The height of seedlings varied between 12.65 and 15.5 cm, whereas the fresh mass varied between 4.00 and 5.61 g. The highest dose (T5), 1.5 $g\ L^{-1}$ showed the best results

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