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Impact of the Use of Viusid Agro® On the Production And Post-Harvest Conservation Of Garlic (*Allium Sativum* L.)

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Abstract

In Cuba, the production of garlic (*Allium sativum* L.) has a low productivity, due to biotic and abiotic factors that affect the seed quality. Garlic is used for multiple purposes, therefore its production and post-harvest conservation are of vital importance, not only for marketing, but also to have an optimum seed quality. Taking into account the above mentioned, it was carried out studies to evaluate the effect of VIUSID Agro® on yield and garlic post-harvest conservation. Three treatments were carried out after sprouting with a weekly frequency. A random sample of 400 plants (100 plants per replications) were selected at harvest to evaluate the yield. During post-harvest conservation, data were recorded from 500 cloves selected at random from different bulbs of each treatment, starting the observation from 90 days until 270 days with a monthly frequency. The best yield (6,0 tha^{-1}) was obtained when five applications of VIUSID Agro® were made after sprouting with a weekly frequency of 200 ml/ha of the product, with a final dose of 400 liters of water, exceeding significantly the control that was 3.4 tha^{-1} . There were not affected cloves in the treatment where five applications of VIUSID Agro® were made; however in the control, the affectation got to 25%, increasing this situation in such a way, that it got to 45% of affected cloves after 270 days. This shows the potential of VIUSID Agro® as an alternative to solve the problems of this crop in our country.

Keywords: post-harvest, sprouting, seed, yield

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I. Introduction

Garlic (*Allium sativum* L.) is an herbaceous plant, consisting of an underground bulb, formed by joined cloves at their base around the true stem and covered by white or purple edges, whose tonality varies, depending on the variety and the height of the planting site. It is a widespread popular crop with various functions to people (second vital cultivated *Allium* species after onion worldwide) and it is widely consumed as a spice form, flavoring and seasoning dishes, pickles and sauces (Abdel-Razzak and El-Sharkawy, 2013). The leaves are elongated, flat and sheathed; the flowers are pink or green and they do not produce seeds. The root system consists of numerous simple, thin, unbranched adventitious roots that grow in the soil superficially (IIH "Liliana Dimitrova", 2010).

In Cuba, garlic production has a low productivity index, which is affected by the viruses presence in its bulbs, which contaminate the seed and reduce its yields (Izquierdo-Oviedo, 2017). A viral complex infests this crop and it causes a drastic reduction of the vegetative vigor and productivity of the crop (Velásquez-Valle *et al.*, 2017). The disease symptoms are visible, in mosaic form or yellow striations on the leaves which cause a decrease in the bulbs productivity, which depends on the variety and the amount of virus present in the seed; significant increases of productivity and quality of bulbs provided by the use of virus-free garlic seed have been observed (Marodin *et al.*, 2019).

Garlic is used for multiple purposes, therefore its production and everything related to post-harvest are of vital importance (Gubb and Tavis, 2002). Environmental factors have a marked influence on everything

related to the overall behavior of garlic crop (Galaz, 2008). Poor management of fertilizers, could increase the physiological disorders of crops after harvest, due to some minerals deficiencies and toxicity of others, leading to a negative effect on crop quality (Hewett, 2006). In recent years, the use of biostimulants in sustainable agriculture has been growing so (Abdel-Lattif et al., 2018). VIUSID Agro® is a growth promoter that, according to Catalysis (2014), acts as a natural bioregulator and it is basically composed of amino acids, vitamins and minerals (Peña et al., 2017).

In Cuba, there are good results with the use of VIUSID Agro® on several crops (Peña et al., 2015a; Peña et al., 2016). Taking into account the importance of garlic, and the problems detected with its yield and the post-harvest limitations, VIUSID Agro® is an alternative to increase the yield and the quality of the garlic conservation. Keeping in view the importance of this crop, the present investigation is the first attempt with the objective to study the effect of VIUSID Agro® on garlic yield and its post-harvest conservation.

II. Materials And Methods

The work was carried out at the Research Institute of Tropical Roots and Tuber Crops (INIVIT), located in Santo Domingo municipality, Villa Clara province, Cuba, from November 2016 to November 2017.

Plant material and experimental design

Garlic bulbs from the commercial ‘Blanco Criollo’ cultivar were used as plant material.

Randomize complete block design with four replications were followed. The attention to the crop was made, according to the recommendations of the Technical Guide for garlic production (Marrero, 2010), but no fertilizers were applied.

Three treatments were studied which consisted of:

A- Five applications from sprouting at a rate of 200 ml/ha with a final dose of 400 litres of water every seven days.

B- Three applications from sprouting at a rate of 200 ml/ha with a final dose of 400 litres of water every seven days.

C- Without application of VIUSID Agro® (control).

Data collecting

A random sample of 400 plants (100 plants per replications) was selected at harvest to evaluate the yield. During post-harvest conservation, data were recorded from 500 cloves selected at random from different bulbs of each treatment, and the observation began from 90 days of harvesting until 270 days with a monthly frequency; the evaluation consisted to determine the total affected cloves per treatment. The statistical analysis was done using statistical package “R” (2018) (<http://www.R-project.org/>).

III. Results And Discussion

Yield of any crop is based on number of plant in unit area, and if plant population is complete in the unit area then the production should be the expected greatest. The two treatments with applications of VIUSID Agro® showed a good sprouting and optimal development of plantation.

When analyzing the effect of the bioproduct, with respect to the yield (t/ha) (table 1), it can be seen that there are statistical differences between the treatments used and from these ones with respect to the control one. The treatment A resulted with the best response on the basis of growth, development and average yield performance (6.0 tha⁻¹), followed by the treatment B that reached an average of 4.2 tha⁻¹; both were much higher than the control one, which was 3.4 tha⁻¹.

Table 1. Effect of VIUSID Agro® on garlic cv. ‘Blanco Criollo’ yields (tha⁻¹).

Treatment	R-I	R-II	R-III	R-IV	Average
A	5.8 a	6.3 a	6.2 a	5.3 a	6.0 a
B	4.1 b	4.4 b	4.0 b	4.3 b	4.2 b
C (control)	3.2 c	3.6 c	3.0 c	3.8 c	3.4 c
LSD at 5 %	3.621	4.254	4.457	3.012	3.223

Means within columns followed by the same letter are not significantly different (Duncan LSD, $p \leq 0.05$)

The commercial quality of the bulb depends of many factors and those without visual defects are better accepted (Mathew et al., 2011). Despite of the final yield (in Cuba yields are low according to ONEI (2018)), more important is the post-harvest conservation, and Hewett (2006) concluded that a poor management of fertilizers produces negative effects on crop quality and therefore, from the bulb after harvest.

As it can be seen in Table 2, in the case of treatment A, no affected cloves were ever observed. However, in treatment B from 180 days onwards, 15 % of affected cloves were appreciated and in the control treatment, it got to 25 % with an increase of up to 45 % at 270 days.

Table 2. Effect of VIUSID Agro® on the post-harvest conservation of garlic cv. ‘Blanco Criollo’ based on the amount of affected cloves (%).

Treatment	Days after harvest							Affected cloves (%)
	90	120	150	180	210	240	270	
A	0	0	0	0 a	0 a	0 a	0 a	0
B	0	0	0	75 b	100 b	128 b	140 b	28
C (control)	0	0	0	125 c	153 c	187 c	225 c	45
LSD at 5 %	ns	ns	ns	4.112	2.453	3.802	2,564	

Means within columns followed by the same letter are not significantly different (Duncan LSD, $p \leq 0.05$)

The effect of VIUSID Agro® applications on plantations after sprouting and the results in terms of yields has its explanation because roots are the main synthesis site in plants, since they have an endogenous concentration of auxins that combined with VIUSID Agro® reaches the adequate balance for its development. This product is rich in some amino acids that plants need, such as the arginine that has the function of stimulating the roots growth, being one of the main amino acids of the rhizosphere, besides the aspartic acid, which is involved in almost all the metabolic processes of the plant. Kowalczyk and Zielony (2008) determined that amino acids are well known as biostimulants, which have positive effects on plant growth, yield and significantly mitigate the injuries caused by abiotic stresses.

In consequence, results of this research are the first scientific report about the use of VIUSID Agro® as an alternative to solve the main problems of garlic crop related with low yields and post harvest losses.

IV. Conclusions

1. To make five applications of VIUSID Agro® after sprouting, favors the increase of yields in garlic cultivation with a weekly frequency.
2. The use of VIUSID Agro® for post-harvest conservation in garlic crop is a new and valuable alternative, since it reduces losses due to cloves deterioration and guarantees its quality, not only for its conservation and commercialization, but also to guarantee the seed quality for the next plantation.

RECOMMENDATIONS

To generalize the use of VIUSID Agro® in the garlic crop at a rate of 200 ml/ha with a final dose of 400 liters of water for the increase of yields and the quality of the post-harvest conservation.

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COMPETING INTEREST STATEMENT

The authors declare no conflict of interest.

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