FINAL REPORT

EVALUATION OF BIOLOGICAL EFFECTIVENESS OF THE PRODUCT **BRASINOFORTE (BIO SHOT IN USA)**, AS A GROWTH REGULATOR , IN AVOCADO CROP, IN PERIBAN, MICHOACAN .

a) NAME, CURP AND ADDRESS OF THE RESPONSIBLE FOR THE STUDY:

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INTERESTED COMPANY : **QUÍMICA LUCAVA, SA de CV** Carretera Panamericana, Km 284, 2da. Fracción de Crespo, CP 38110, Celaya, Gto. Mexico .

b) Institution that will carry out the Biological Effectiveness study.

Autonomous University of Aguascalientes. Jesús María Agricultural Science Center, Aguascalientes, Mexico.

c) Type of Input

()	Growth regulator	()	Organic or biological soil improver
(X)	Growth regulator	()	Inoculant
()	Moisturizer	()	Rooter
( )	Nutrient		

d) Paper Title:

Biological effectiveness evaluation study of BRASINOFORTE product, as a growth regulator in avocado crop, in Periban, Michoacán .

e) Introduction

1. Importance of the crop

The crop of avocado (*Persea americana* Mill) has acquired great importance in the international market, ceasing to be an exotic fruit to join the diet of many countries. In this way, worldwide production has increased by 550,000 t during the last 15 years, generating jobs by demanding labor, irrigation, nutritional and phytosanitary care, harvesting, mobilization, packaging, selection, transport, market and wholesale and retail sales (Teliz & Mora, 2007).

1.1 Production in Mexico

Avocado production in Mexico is approximately 1,889,353.60 tons; The main avocado producer in Mexico is the state of Michoacán, which produces 1,477,263.54 MT per year equivalent to 78.18% of the national production, followed by the state of Jalisco with a production of 143,504.57 MT that corresponds to 7.59%; the state of Mexico produces 5.78% with a production of 109,209.09 MT (SIAP, 2016) .

e) Objectives:

1. Evaluate the biological effectiveness of BRASINOFORTE product , as a growth regulator, in avocado crop .

2. Determine the possible phytotoxic effects of BRASINOFORTE product , as a growth regulator in avocado crop .

f) Commercial and / or experimental name.

- BRASINOFORTE

g) Guaranteed Composition:

Guaranteed composition	Concentration
Triacontanol	0.200%
Brassinosteroids	0.005%

MATERIALS AND METHODS

LOCATION OF THE EXPERIMENTAL SITE.

The study was installed in a commercial avocado plot in the municipality of Peribán, Michoacán, Mexico.

h) Start date of the study: December 4, 2020

i) Study completion date: March 18, 2021

j) Crop in which the study was carried out :

Avocado **Variety:** Hass (over 5 years old)

k) Phenological (growth) stage of the plant:

In vegetative growth, flowering, fruit-set in marble and fruit-set in egg.sizes.

l) Trial layout

1. The trial was established under a completely randomized blocks layout, with four replicates.
2. The unit experimental (plot) was comprised of two trees, planted at a distance of 4 m and 7 m between rows, for an area of 56 m^2 per plot and 224 m^2 (8 trees) per treatment.
3. The useful (evaluation) plot comprised the inner side of each tree.

m) Distribution of treatments

The distribution of treatments in the field after randomization was as follows.

Table 1 . Distribution of treatments in the field:

BLOCK I	BLOCK II	BLOCK III	BLOCK IV
T2	T3	T1	T5
T4	T5	T2	T2
T3	T2	T5	T1
T1	T4	T3	T4
T5	T1	T4	T3

Arabic numerals = Treatments

n) Rate, time and number of applications

The treatments that were evaluated are indicated in Table 2 .

Table 2 . Treatments of BRASINOFORTE as growth regulator , in the crop of avocado .

TRAT	**PRODUCT**	**Rate mL / ha**
1	Absolute untreated control	-
2	BRASINOFORTE	100
3	BRASINOFORTE	150
4	BRASINOFORTE	200
5	VITAZYME (regional standard)	1000

o) Timing and number of applications

Four applications were made with an interval of 30 days between each. The first application was made in vegetative growth stage.

Application method: It was applied in a foliar way (to leaves), always.

Application equipment : A motorized sprayer with adjustable cone nozzle, was used.

Volume or water consumption: 1000 L . ha^{-1} (Reference volume of the zone)

p) Other inputs used in the evaluation:

No other type of input which could interfere with the development of this trial, was used.

r) Variables for estimating biological effectiveness and evaluation method.

1. Phytotoxicity . We assessed the 30 days after each application by the percentage scale proposed by the European Weed Research Society (Table 3).

Table 3 . E scala percentage given by the European Weed Research Society , to evaluate the possible effect phytotoxic of the product BRASINOFORTE in growing avocado .

EFFECTS ON CROP	**Crop Phytotoxicity (%)**
No effect on crop	0.0-1.0
Very mild symptoms	1.1-3.5
Mild symptoms	3.6-7.0
Moderate symptoms, but without effect of yields	7.1-12.5**
Intermediate damage	12.6-20.0
High damage	20.1-30.0
Very high damage	30.1-50.0
Extremely high damage	50.1-99.0
Complete destruction of crop	99.1-100

Transformation of the logarithmic percentage scale of EWRS to a percentage scale. ** Limit of acceptability.

2. Weight of the fruit: 5 fruits were weighted in each marked point at harvest. The variable is shown as g per fruit.

3. Fruit length: 5 fruits were measured in each point marked at harvest. The variable is shown as cm per fruit.

4. Fruit diameter: 5 fruits from each cardinal point marked were measured at harvest. The variable is shown as cm per fruit

5. Yield (MT per hectare). The fruits of each tree (experimental unit) were harvested and weighed on a 500 g scale at harvest.

ANALYSIS OF DATA. From the data obtained of the variables: fruit weight, fruit length, fruit diameter, were statistically analyzed through analysis of variance and Tukey's mean comparison test ($\alpha = 0.05$), using the SAS statistical package.

t) Sample size and sampling method. The sample size was previously specified for each variable.

u) CALENDAR OF ACTIVITIES. It is shown in Table 4 .

Table 4 . Calendar of activities of the evaluation study of biological effectiveness of the product BRASINOFORTE in the crop of avocado .

ACTIVITY	**DATE**
Start date and 1 ra application	December 04, 2020
2nd application (30 dd1a) and Phytotoxicity	January 03, 2021
3rd application (30 dd2a) and Phytotoxicity	February 02, 2021
4th application (30 dd3a) and Phytotoxicity	March 04, 2021
Yield and quality stage evaluation	March 18, 2021

Ddpa : days after the first application.

RESULTS AND DISCUSSION

1. Fruit weight

The analysis of variance of the **weight of the fruit** data in the crop of avocado showed significant differences between treatments and the absolute control. This was corroborated by carrying out a comparison of means (with $\alpha = 0.05$). A greater weight was observed where the growth regulator Brasinoforte was applied in its rates of 100, 150 and 200 mL.ha^{-1} compared to the absolute control.

Table 5 . Evaluation of the **fruit weight** variable in avocado crop.

TREATMENTS	Fruit weight (g)
T1. Absolute control (Testigo absoluto in graph)	133.5 C
T2. Brasinoforte (100 mL.ha $^{-1}$)	153.5 BC
T3. Brasinoforte (150 mL.ha $^{-1}$)	181.2 AB
T4. Brasinoforte (200 mL.ha $^{-1}$)	206.6 A
T5. Vitazyme * (1000 mL.ha $^{-1}$)	192.5 A

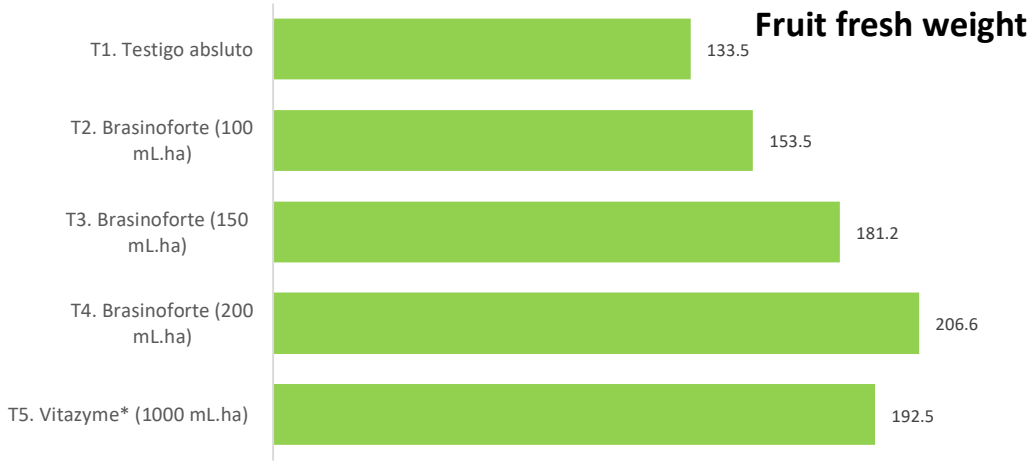

Figure 1 . Fruit weight

2. Fruit length

The analysis of variance of the data of the **length of the fruit** in the avocado crop showed significant differences between the evaluated treatments and the absolute control. This was corroborated by carrying out a comparison of means (with $\alpha = 0.05$). A greater length of the fruit was observed where the growth regulator Brasinoforte was applied in its rates of 100, 150 and 200 mL.ha^{-1} compared to the absolute control.

Table 6 . Evaluation of the variable **length of the fruit** in the crop of avocado.

TREATMENTS	Fruit length (m m)
T1. Absolute control (Testigo absoluto in graph)	85.8 B
T2. Brasinoforte (100 mL.ha $^{-1}$)	94.2 A
T3. Brasinoforte (150 mL.ha $^{-1}$)	97.0 A
T4. Brasinoforte (200 mL.ha $^{-1}$)	100.8 A
T5. Vitazyme * (1000 mL.ha $^{-1}$)	95.7 A

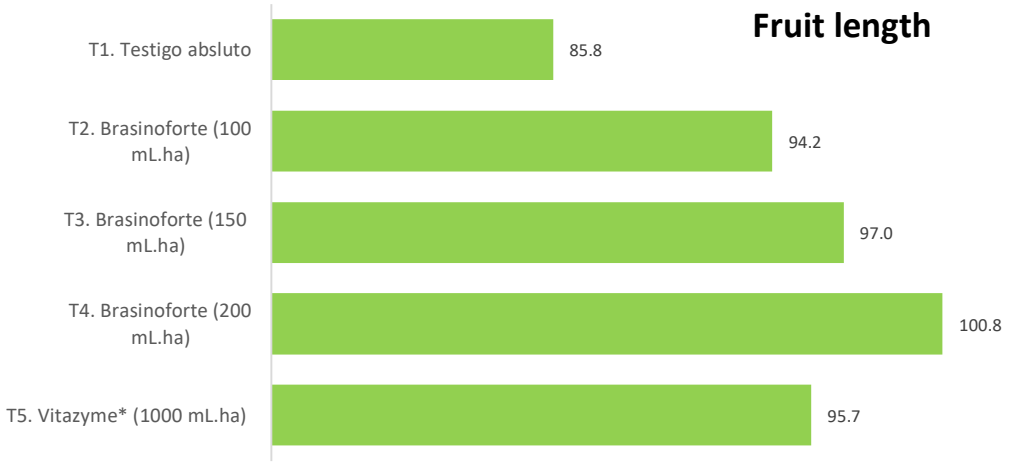

Figure 2 . Fruit length

3. Fruit diameter

The analysis of variance of the data of **diameter of the fruit** in the avocado crop showed significant differences between the evaluated treatments and the absolute control. This was corroborated by carrying out a comparison of means (with $\alpha = 0.05$). A greater fruit diameter was observed where the growth regulator Brasinoforte was applied in its rates of 100, 150 and 200 mL.ha^{-1} compared to the absolute control.

Table 7. Evaluation of the variable **diameter of the fruit** , in the avocado crop .

TREATMENTS	Fruit diameter (m m)
T1. Absolute control (Testigo absoluto in graph)	50.4 B
T2. Brasinoforte (100 mL.ha $^{-1}$)	58.1 A
T3. Brasinoforte (150 mL.ha $^{-1}$)	56.8 A
T4. Brasinoforte (200 mL.ha $^{-1}$)	60.3 A
T5. Vitazyme * (1000 mL.ha $^{-1}$)	57.0 A

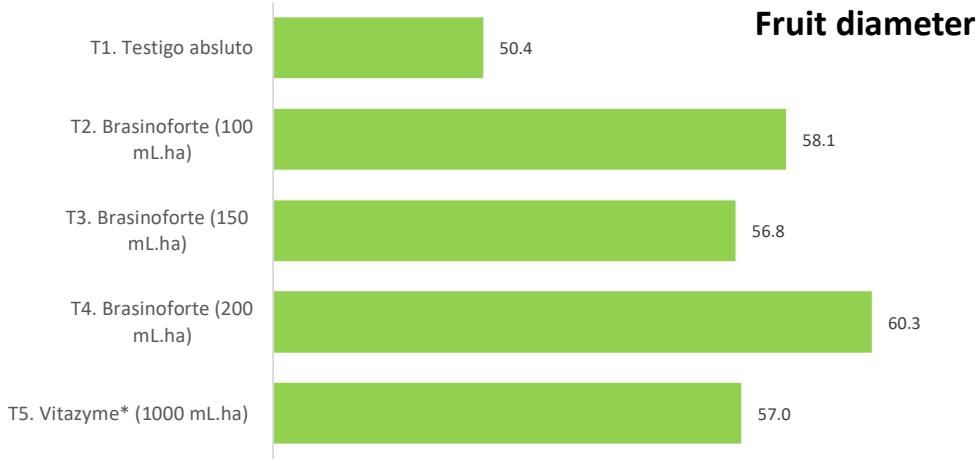

Figure 3 . Fruit diameter

4. Yield per hectare

The variance analysis carried out of the **Yield per hectare** data in the avocado crop showed significant differences between the evaluated treatments and the absolute control. This was corroborated by carrying out a comparison of means (with $\alpha = 0.05$). A greater yield per hectare was observed where the growth regulator Brasinoforte was applied in its rates of 100, 150 and 200 mL.ha^{-1} compared to the absolute untreated control.

Table 8 . Evaluation of the **Yield** variable in avocado crop .

TREATMENTS	avocado yield MT/ha	yield increase	
		MT/ha	%
T1. Absolute untreated control	6.88 C	-	-
T2. Brasinoforte (100 mL.ha $^{-1}$)	7.92 BC	1.03	15
T3. Brasinoforte (150 mL.ha $^{-1}$)	9.34 AB	2.46	36
T4. Brasinoforte (200 mL.ha $^{-1}$)	10.65 A	3.77	55
T5. Vitazyme * (1000 mL.ha $^{-1}$)	9.93 A	3.04	44

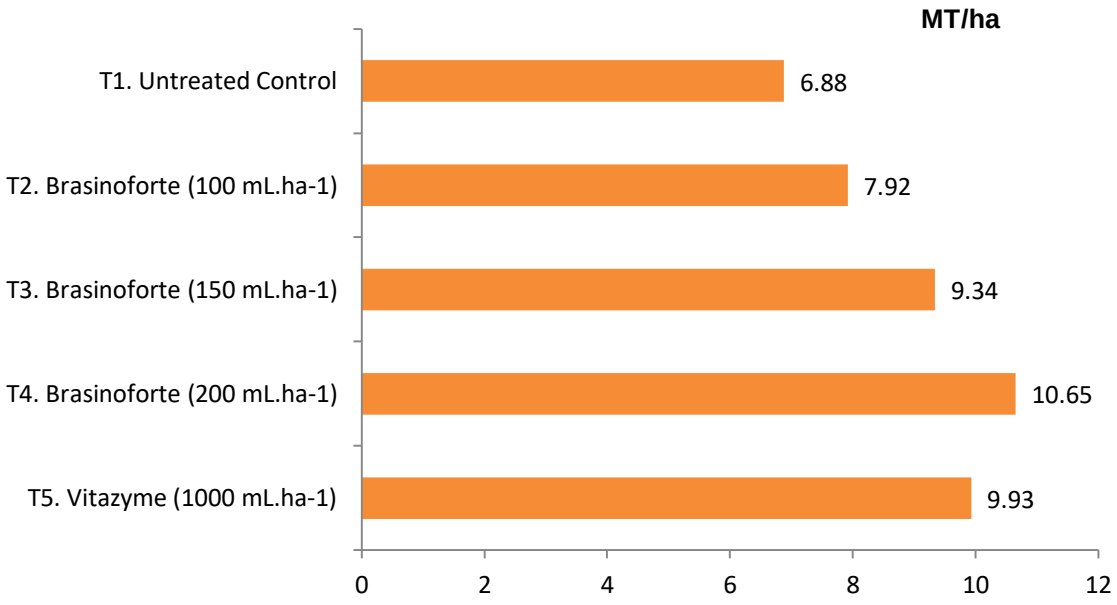

Figure 4. Avocado Yield per Hectare

PHYTOTOXICITY

The product Brasinoforte in rates of 100, 150 and 200 mL.ha^{-1} was not phytotoxic in the avocado crop .

CONCLUSIONS

The product **Brasinoforte** as growth regulator, in rates of 100, 150 & 200 mL.ha^{-1}, achieved positive effects on the weight, diameter and length of the fruit and on the yield, in avocado crop .

RECOMMENDATION

In summary, the recommendation for the product Brasinoforte , is as follows:

Crop	**Rate (mL .ha $^{-1}$)**	**Observations**
Avocado	100-200	Carry out 4 foliar applications with an interval of 30 days between each application. Make the first application in vegetative growth. Use an approximate mixing volume of 1000 L.ha^{-1}