

**Evaluation of the effect of the product VITAZYME® as a  
growth regulator in the production of dry bean crop**

**RESEARCHER IN CHARGE:**

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**a) Name, ID and address of the responsible of the study:**

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**( b) Institution that conducts the study of biological effectiveness:**

Autonomous University of Puebla

**( c) Input type:**

ORGANIC FERTILIZER

ORGANIC OR BIOLOGICAL SOIL IMPROVER

GROWTH REGULATOR

INOCULANT

MOISTURIZER

**( d) Title of the Research:**

Evaluation of the effect of the product VITAZYME® as growth regulator on quality and yield in dry bean crop.

**(e) General objective:**

1- To determine the effect of VITAZYME ® as a growth regulator on yield and quality of dry bean crop.

**Specific objectives:**

1.- To evaluate growth, yield and quality of plants, flowers, pods and seeds in dry bean crop treated with VITAZYME® in different dosages.

2.-To determine possible phytotoxicity of VITAZYME ® to dry bean crop.

**(f) Commercial and/or Experimental Name:**

VITAZYME ®

**(g) Guarantee of Composition:**

<b>Composition:</b>	<b>% w/v</b>
1-Triacontanol...	0.01300%
Brassinosteroids..... (homobrassinolide, dolicholide homodolicholide and brassinone)	0.00220%
Vitamin B1(thiamin)...	0.00035%
Vitamin B2 (riboflavin).....	0.00002%
Vitamin B6 (pyridoxine)...	0.00015%

Contains 0.1572 grams of active ingredient per liter of commercial product.

**(h) Date of beginning of the trial**

Aug 13/2013

**(i) Date of end of the trial**

Oct 20/2013

**(j) Crop in which the input was tested**

Dry bean, var Strike

**(k) Phenological stage of the plant, in case the product is not applied throughout all its physiological development:**

Planting, vegetative growth, flowering and fruit set of dry bean plants

**(l) Soil Type**

The soil is pellic vertisol type. Its main distinction is that it is rich in clay, of good fertility and dark color.

**(m) Trial layout, area and number of plots**

Latin square, 4 treatments with four replications. The experimental plot was of 5 rows of 1.0 m spacing by 5 m length, which gives an experimental area of 25 m<sup>2</sup>. An analysis of variance and a Tukey test between means, both at 95% reliability, were performed. In total 16 experimental plots were used.

Two applications, the first pre planting and one in early boom to the foliage, were carried out. The pH of the final solution was determined, which was neutral or slightly acid.

## (n) Dosages, timing and methods of application

### Treatments evaluated

Product	Treatment of seed immediately before planting		Rate Vitazyme to foliage L / ha at early flowering
	Rate of Vitazyme seed treatment (mL/30 kg of seed / hectare)	Dosage of water to dilute the previous Vitazyme (mL)	
1 VITAZYME ®	200	300	0.5
2 VITAZYME ®	250	250	1.0
3 VITAZYME ®	300	200	1.5
4 Control	---	---	---
Product	Rate Vitazyme in 4 plots (mL/100 m <sup>2</sup> ) (300 g of seed)	Dosage of water in 4 plots (mL/100 m <sup>2</sup> )	Rate Vitazyme in 4 plots (mL in 2 L water / 100 m <sup>2</sup> )
1 VITAZYME ®	2.0	3.0	5
2 VITAZYME ®	2.5	2.5	10
3 VITAZYME ®	3.0	2.0	15
4 Control	---	---	---

In each VITAZYME® treatment (1, 2, and 3) for the area of 4 plots (25 m<sup>2</sup> x 4 = 100 m<sup>2</sup>), prior to planting, according to the experimental design, 2, 2.5 and 3 mL, diluted in 3, 2.5 and 2 mL of water, respectively, were applied to treat 300 g of seeds for the 4 plots. For this end, in a plastic bag, 5 mL of each of the three previous Vitazyme plus water blends + 300 g of seed were mixed thoroughly, and left to dry for 15 - 30 minutes, and then planted immediately or the following day. Later, at early bloom, in treatments 1, 2 and 3, rates of 5, 10 and 15 mL of Vitazyme, respectively, diluted in 2 liters of water each, for the 4 plots of each treatment, were applied to the foliage. A backpack sprayer, attached with a cone-jet nozzle, calibrated previously with water to a volume of around of 200 liters per hectare, was used.

### (o) Other inputs used in the evaluation

The product Confidor 350 SC was used to control whitefly and Manzate 80 WP was used for the control of bean the rust, which, as inputs for the control of pests and diseases, did not interfere nor interacted with the evaluation of the studied product.

**( p) Method of evaluation and variables for estimation of the biological effectiveness**

**Days to flowering, days to physiological maturity, and days to harvest**

The number of days to flowering, days to complete formation of pods (physiological maturity) and days to harvest from the emergence of plants, were determined.

**Number of pods per plant**

At 20 days after beginning of flowering, the number of pods produced per plant was evaluated, in 10 plants at random in each experimental plot.

**Length of pods**

An assessment of size of pods through the determination of the length of these at physiological maturity was conducted in each plot. The length was determined from the base of the stem to the tip of each pod, in 10 pods per experimental plot.

**Seeds per pod**

The number of seeds per pod, in 10 pods randomly chosen, mainly from the middle of the plants, per experimental plot, was determined

**Weight of 100 seeds**

The weight of 100 seeds per experimental plot, at the harvest of the crop, was determined

**Phytotoxicity**

In order to determine if the product had any phytotoxic effect on the dry bean crop, we evaluated any abnormal symptoms of plants, flowers and fruits as compared to those observed in the untreated control, using the EWRS scale.

**Yield in tons / hectare**

The weight of grains produced by 10 plants per experimental plot was assessed to determine the yield.

### **% of grain protein**

The percentage of protein by the Kjeldahl method (Kjedhal AOAC method, 1995) was determined.

AOAC. Association of Official Analytical Chemists. 1995 16th ed. Arlington, USA. 684 pp.

### **% moisture and % ash**

The percentage of moisture was determined by the AOAC method (1995). The percentage of dry basis ash was determined by calcination.

AOAC. Association of Official Analytical Chemists. 1995. Official methods of analysis. (16th ed.).Washington, D.C., USA.

### **Method of evaluation that allows statistical analysis according to the design of the experiment and evaluation scale**

To each of the evaluated parameters an SAS<sup>®</sup> package (Statistical Analysis System) statistical analysis and a Tukey test for separation of means, were applied.

### **Sample size and sampling method**

10 pods per experimental plot, 100 grains for grain weight, 100 g of grain for the variables of quality.

### **Location where the trial was conducted**

The trial was conducted in a commercial field of dry bean crop in the municipality of Tepalcingo, Morelos.

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## RESULTS AND DISCUSSION

### Days to bloom.

Table 2 shows two treatments (3 and 2), with no significant statistical differences between them, which achieved the shortest periods for the formation of flowers, which were the Vitazyme rates of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, with 34.05 days and 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray with an average of 35.55 days. Then followed 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray, with 37.1 days, and the untreated Control, with 41.7 days.

**Table 2. Comparison of means of days to flowering, in the evaluation of the effect of VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Days to bloom	Significance Tukey at 95%
1	VITAZYME	200	0.5	37.10	B
2	VITAZYME	250	1.0	35.55	C
3	VITAZYME	300	1.5	34.05	C
4	CONTROL	-----	-----	41.75	A

### Days to maturity.

In regards to days to maturity, the highest mean was that of the untreated control with 65.3 days. In contrast, the shortest were the Vitazyme treatments of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray with 55.45 days, Vitazyme 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray with 57,15 days and Vitazyme at 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray which registered 60.35 days, the four evaluated treatments showed significant statistical differences.

**Table 3. Comparison of average days to maturity, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Days to maturity	Significance Tukey at 95%
1	VITAZYME	200	0.5	60.35	BA
2	VITAZYME	250	1.0	57,15	B
3	VITAZYME	300	1.5	55.45	B
4	CONTROL	-----	-----	65.30	A

### Days to harvest .

The shortest means were the Vitazyme treatment of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray with an average of 75.45 days and Vitazyme 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray, which recorded 76.7 days, with no significant statistical differences between them. The lengthiest means were in the untreated Control with 83.55 days and Vitazyme 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray with 78.4 days.

**Table 4. Comparison of days to harvest, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Days to harvest	Significance Tukey at 95%
1	VITAZYME	200	0.5	78.40	B
2	VITAZYME	250	1.0	76.70	C
3	VITAZYME	300	1.5	75.45	C
4	CONTROL	-----	-----	83.55	A

### Number of pods per plant .

In regards to the number of pods per plant, only two treatments surpassed the average of thirty, Vitazyme at 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, with 34.5, and Vitazyme 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray with 32.1. Very close to the latter ranked the Vitazyme treatment 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray with 29.3 pods and the least in the Control, with 24.3 pods per plant.

**Table 5. Comparison of number of pods per plant, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Number of pods per plant	Significance Tukey at 95%
1	VITAZYME	200	0.5	29.32	B
2	VITAZYME	250	1.0	32.12	BA
3	VITAZYME	300	1.5	34.55	A
4	CONTROL	-----	-----	24,37	C



### Length of pods.

In the variable length of pods, the largest sizes were recorded in the Vitazyme treatments of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray with 13.5 cm, followed by 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray in which the mean was 12.5 cm, followed by Vitazyme at 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray with a mean length of 11.5 cm and the shortest in the untreated Control with a mean 8.3 cm.

**Table 6. Comparison of mean length of pods, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Length of pods	Significance Tukey at 95%
1	VITAZYME	200	0.5	11.55	B
2	VITAZYME	250	1.0	12.55	BA
3	VITAZYME	300	1.5	13.50	A
4	CONTROL	-----	-----	8.35	C

### Seeds per pod.

Only the Vitazyme treatment of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray exceeded the average of six grains per pod, reaching 6.2; then followed two treatments in which the mean was higher than five, which were the Vitazyme treatments of 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray, with 5.7, and Vitazyme at 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray, with 5.2 mean seeds. The fewest seeds corresponded to the untreated Control, with 4.1 seeds per pod.

**Table 7. Comparison of seeds per pod, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Seeds per pod	Significance Tukey at 95%
1	VITAZYME	200	0.5	5.22	B
2	VITAZYME	250	1.0	5.77	BA
3	VITAZYME	300	1.5	6.22	A
4	CONTROL	-----	-----	4.12	C

### Weight of 100 seeds.

In regards to the weight of 100 seeds, the Vitazyme treatment of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, with 25.6 g, and the Vitazyme at 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray, which averaged 24.8 grams, were statistically higher (heavier seeds) than the untreated Control, which registered 18.6 g, while the Vitazyme 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray with 22.3 g, ranked third among the Vitazyme treatments.

**Table 8. Comparison of mean weight of 100 seeds, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Weight of 100 seeds	Significance Tukey at 95%
1	VITAZYME	200	0.5	22.37	BA
2	VITAZYME	250	1.0	24.82	A
3	VITAZYME	300	1.5	25.60	A
4	CONTROL	-----	-----	18.65	B

### Yield in tons per hectare .

The treatment that achieved the highest yield per hectare was that of Vitazyme treatment 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, which reached a mean 1.87 tons per hectare, followed by the Vitazyme treatment of 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray, with 1.73 tons, then the Vitazyme treatment 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray, with a mean 1.54 tons and the lowest yield was recorded in the untreated control, with 1.32 tons per hectare.

**Table 9. Comparison of yield per hectare, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Yield ton per hectare	Significance Tukey at 95%
1	VITAZYME	200	0.5	1.5475	BC
2	VITAZYME	250	1.0	1.7322	BA
3	VITAZYME	300	1.5	1.8723	A
4	CONTROL	-----	-----	1.3279	C

### Percentage of protein.

The lowest protein content was in the untreated Control which presented a mean 21.6%; in contrast, the highest content was in the Vitazyme treatment of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray with 27.2%. There were two treatments with no statistical differences with the latter: Vitazyme at 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray in which the mean was 25.5% and the Vitazyme 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray, with 24.6%.

**Table 10. Comparison of percentage of protein, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	% of protein	Significance Tukey at 95%
1	VITAZYME	200	0.5	24.67	BA
2	VITAZYME	250	1.0	25.55	BA
3	VITAZYME	300	1.5	27.27	A
4	CONTROL	-----	-----	21.60	B

### Percentage of moisture.

Three of the evaluated treatments showed moisture percentages below fourteen percent: Vitazyme 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, with 14.3%, Vitazyme at 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray, with a mean 14.5%, and Vitazyme 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray, with 14.8%. The highest mean recorded was that of the untreated control, with 16.5%.

**Table 11. Comparison of percentage of moisture, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	% of moisture.	Significance Tukey at 95%
1	VITAZYME	200	0.5	14.80	BA
2	VITAZYME	250	1.0	14.57	BA
3	VITAZYME	300	1.5	14.30	B
4	CONTROL	-----	-----	16.57	A

## Percentage of ash.

In regards to percentage of ash, two of the evaluated treatments showed significantly higher statistical differences with the control (which showed the lowest mean of 3.6%), which were the Vitazyme treatments of 300 ml per hectare seed treatment plus 1.5 liter per hectare foliar spray, with 4.6%, and the 250 ml per hectare seed treatment plus 1 liter per hectare foliar spray with 4.4%, while Vitazyme at 200 ml per hectare seed treatment plus 0.5 liter per hectare foliar spray with 4.1%, ranked in third position.

**Table 12. Comparison of percentage of ash, in the evaluation of the effect of the VITAZYME in the production of dry bean crop.**

Treat.	Product	Rate ml of Vitazyme /30 kg of seed/ hectare	Vitazyme foliar rate L / hectare	Percentage of ash	Significance Tukey at 95%
1	VITAZYME	200	0.5	4.17	BA
2	VITAZYME	250	1.0	4.45	A
3	VITAZYME	300	1.5	4.67	A
4	CONTROL	-----	-----	3.62	B

## CONCLUSIONS

1.- The product VITAZYME®, applied in seed treatment at dosages of 200, 250 and 300 mL / 30 kg of seeds / hectare, followed by leaf spray in early bloom at 0.5, 1.0 and 1.5 L / ha, respectively, induced a significant effect on the variables days to flowering, days to physiological maturity and days to harvest, as well as on number of pods per plant, length of pods, number of seeds per pod, recording significant statistical differences as compared to the untreated control.

2. There was a significant effect of the VITAZYME®, applied in seed treatment at dosages of 200, 250 and 300 mL / 30 kg of seeds / hectare, followed by leaf spray in early bloom at 0.5, 1.0 and 1.5 L / ha, respectively, on grain yield, since it recorded statistically higher values than the untreated control.

3. With regards to grain quality variables, only the rate of 300 mL / 30 kg of seeds / hectare seed treatment followed by leaf spray of 1.5 L / ha, induced statistical differences with the Control; however, all Vitazyme treatments in every tested rate recorded better values than the untreated Control.

4.-There were no toxic effects on the dry bean crop after applying VITAZYME®, in seed treatment in rates of 200, 250 and 300 mL / 30 kg of seeds / hectare, followed by foliar spray in early bloom at 0.5, 1.0 and 1.5 L / hectare, respectively.