Cocoa *with Vitazyme application*

Researchers: Arthur and J. A. Dogbatse

Research organization: Cocoa Research Institute of Ghana, New Tafo-Akim, Ghana

Cocoa production in Ghana (835,466 tonnes/year) is second in the world only to Cote d'Ivoire (1,448,992 tonnes/year), according to available data.

Background information: Decrease in soil fertility after prolonged cocoa cultivation on many farms has led to yield decline and abandonment of large tracts of cocoa farms. Investigations at the Cocoa Research Institute of Ghana indicated that cocoa yield responded positively to synthetic fertilizer application (Appiah *et al.*, 2000). However, these fertilizers have sometimes contributed to environmental problems, are expensive and out of the reach of many small scale cocoa farmers. In view of this, researchers are still looking for ways to reduce the cost of on-farm inputs while maintaining or increasing yields in an environmentally sustainable manner. Currently the demand for organic agricultural products including cocoa is on the ascendancy but current production is unable to meet this niche market. Organic Vitazyme is an all-natural bio-stimulant for soil organisms and plants which contain metabolic triggers (i.e. vitamins, enzymes and growth stimulators) that may enter the plant through either the leaves in the form of foliar spray or the roots when applied to the soil. The metabolic triggers stimulate photosynthesis resulting in more translocation into the root zone which enhances root growth and exudation which then activates the metabolism of the teeming population of rhizosphere organisms, triggering greater synthesis of growth-benefiting compounds and a faster release of minerals for plant uptake (Vital Earth Resources, 2017). Organic Vitazyme foliar fertilizer manufactured by Vital Earth Resources, Gladewater, Texas, USA was submitted to the Cocoa Research Institute of Ghana through COCOBOD by Agrimat Limited in March, 2017. The objective was to ascertain the efficacy of Organic Vitazyme on mature cocoa.

Phytotoxicity Evaluation for Vitazyme and Fertilizer

Four rates of Vitazyme—100 ml, 150 ml, 200 ml, and 250 ml in 11 liters of water—were sprayed on the leaves of ten two-month-old cocoa seedlings, and observed for two months. There were no phytotoxic effects noted for the ten cocoa seedlings. On the other hand, the fertilizer dilutions—30, 200, and 250 ml in 11 liters of water—when sprayed on ten cocoa seedlings, showed leaf burning at the two higher rates. These higher rates were therefore not included in the trial.

Field Trials on Mature Cocoa Trees

Trial Locations: Farmers' fields for both the 2017/2018 and 2018/2019 trials were utilized in eight locations. Each farm served as a block in the statistical analysis.

Ashanti Region- Anyinasosu and Foase-Nikawe Farm
Brong Ahafo Region- Kwasu, Binkyem-Duayaw Nkwanta, and Owne Kkwanta Farms
Eastern Region- Gyaha and Akenkarno Farms
Western Region- Wasa Sowodadzem Farm

Tree age: 10 to 15 years

Tree variety: mixed hybrid cocoa varieties

Experimental design: A 0.8 hectare plot area of each of the eight farms was selected and divided into four equal 0.2 hectare areas, to apply each of the four treatments. The experiment was arranged statistically in a randomized complete block design, with the farms representing the replications for each treatment. Fermentable and unusable cocoa pods was tallied at harvest time.

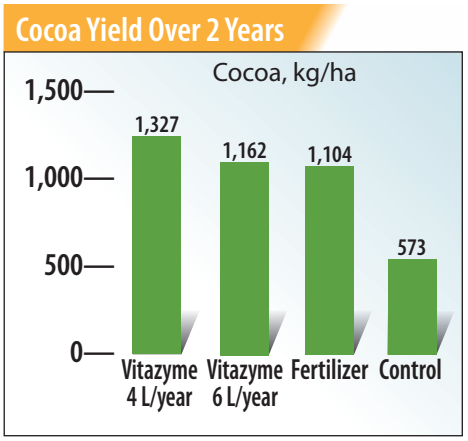
Treatment	Vitazyme[1]		Fertilizer[2]		Application time
	per time	total	per time	total	
1.	1 L/ha	4 L	—	—	May, June, July, August
2.	1.5 L/ha	6 L	—	—	May, June, July, August
3.	—	—	300 ml/ha	1.8 L	May, June, July, August, September, October
4.	—	—	—	—	None

[1]Applied using two tank fillings to cover the 0.2 ha plot, with a motorized sprayer.
[2]A foliar fertilizer recommended by the Cocoa Research Institute of Ghana, applied with a motorized sprayer.

Harvest results:

Treatment	2017/2018 crop		2018/2019 crop		Total
	Fermentable pods	Unusable	Fermentable pods	Unusable	
	Plot yield	Plot yield	Plot yield	Plot yield	
1. Vitazyme, 4 liters/year	17,220	979	19,949	984	1,327*
2. Vitazyme, 6 liters/year	12,596	1,009	19,929	898	1,162*
3. Foliar fertilizer, 1.8 liters/year	11,228	688	19,678	951	1,104*
4. Control	7,251	758	8,799	577	573
LSD (P=0.05)	—	—	—	—	213

*Significantly greater than the control at P=0.05 (ANOVA).



Increased yield above the control

Vitazyme, 4 L/year 132%
Vitazyme, 6 L/year 103%
Fertilizer only 93%

Conclusion: Significantly (p<0.05) higher number of fermentable pods were obtained from the fertilizer treated plots in the 2017/2018 and 2018/2019 cropping seasons than that of the unfertilized control plots. There was no significant difference (p>0.05) between the two rates of Organic Vitazyme foliar fertilizer and the reference fertilizer.

Unusable pods did not differ significantly (p>0.05) between the treatments in the 2017/2018 cropping season. Organic Vitazyme applied at 4 L ha^{-1} yr^{-1} and the reference foliar fertilizer recorded a significantly (p<0.05) higher number of unusable pods compared to the unfertilized control treatment in the 2018/2019 season.

The two-year cumulative dry cocoa bean yield was significantly(p>0.05) higher in both Organic Vitazyme treatments and in the fertilizer only treatment than in the control. Furthermore, the 4 L/year Vitazyme treatment was also significantly and 20% higher (the difference of 223 is greater than the LSD of 213) than the fertilizer only treatment.

Recommendations: The application of Organic Vitazyme foliar fertilizer resulted in higher dry cocoa bean yield compared to the unfertilized control. Organic Vitazyme foliar fertilizer applied at 4 L ha^{-1} yr^{-1} was superior to the reference foliar fertilizer in terms of dry cocoa bean yield. The foliar fertilizer had no adverse effectoncocoatreesduringthetestingperiod.Basedonthe comparative performance from the trials, Organic Vitazyme fertilizer is recommended for use on mature cocoa in Ghana. The application of Organic Vitazyme foliar fertilizer should be done at the fieldrateof100mlin11litersofwater(1,000mlha $^{-1}$ $month^{-1}$) at monthly intervals from May-August using a motorized spraying machine at restrictor nozzle number 3.

This trial did not evaluate the effect of Vitazyme along with the full or reduced fertilizer rate. It is likely that further yield improvements would have been noted had this combination been used.

References:

1. Appiah M.R., Ofori-Frimpong, K. and Afrifa A.A. (2000). Evaluation of fertilizer application on some peasant cocoa farms in Ghana. *Ghana J. Agric. Sci.* 33: 183-190.
2. Opoku-Ameyaw, K., Baah, F., Gyedu-Akoto, E.. Anchirinah, V., Dzahini-Obiatey, H.K., Cudjoe, A.R., Acquay, S. and Opoku, S.Y. (2010). *Cocoa manual: A source book for sustainable cocoa production*. Cocoa Research Institute of Ghana. pp. 168.
3. Vital Earth Resources (2017). *User's guide. The Vitazyme Program*. www.vitalearth.com

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2014 Crop Results

Vitazyme on Cocoa

Farmer: Nguyen Kim Dinh
Location: Ea Po, Dak Nong, Viet Nam
Tree age: year six of bearing
Planting density: 1,100 trees/ha

Experimental design: A cocoa plantation was selected to evaluate the effects of Vitazyme on tree growth and yield. Fifty trees of three varieties were treated with Vitazyme, while an adjoining 100 trees were left untreated to serve as a control.

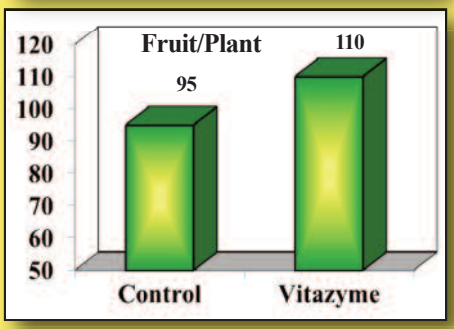
1. Control **2. Vitazyme**

Fertilization: unknown

Vitazyme application: The 50 treated trees received 500 ml of Vitazyme in 200 ml of water five times in a year, applied on April 4, August 22, and October 24 of 2012, and January 24 and March 19 of 2013. The total application was 2.5 liters for the 50 trees, or 50 ml of Vitazyme per tree per year in a 0.5% dilution.

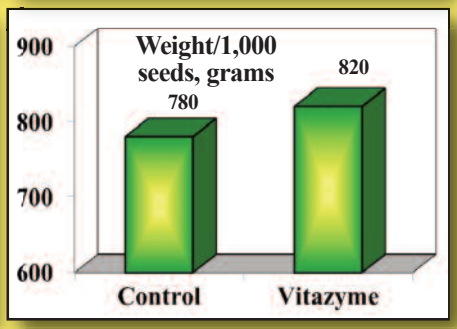
Variety TD3

Fruit Per Tree



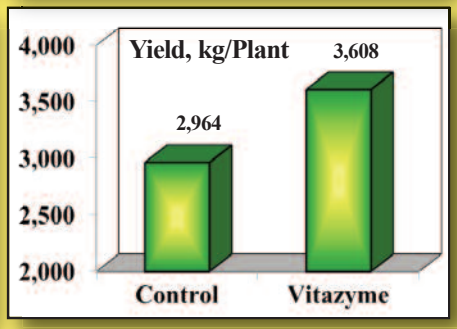
Increase in fruit/tree with Vitazyme: 16%

Weight Per 1,000 Seeds



Increase in 1,000-seed weight with Vitazyme: 5%

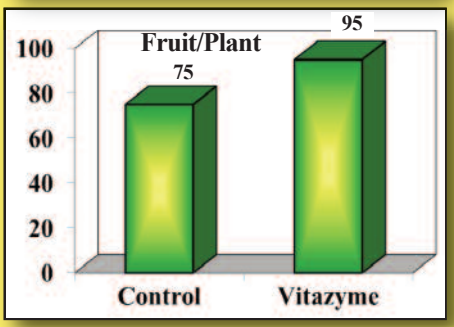
Seed Yield



Increase in yield with Vitazyme: 22%

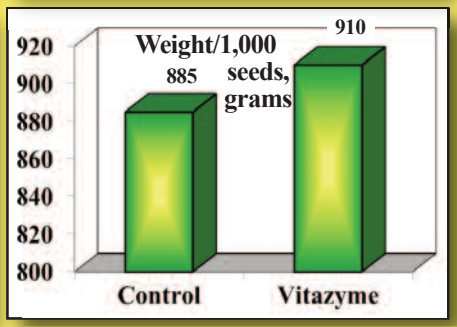
Variety TD5

Fruit Per Tree



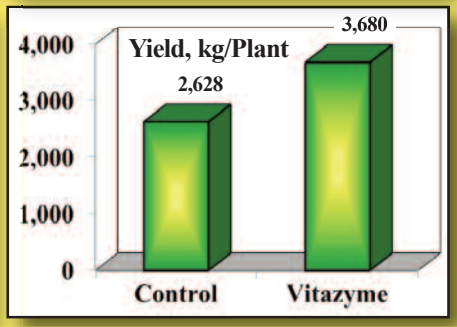
Increase in fruit/tree with Vitazyme: 27%

Weight Per 1,000 Seeds



Increase in 1,000-seed weight with Vitazyme: 3%

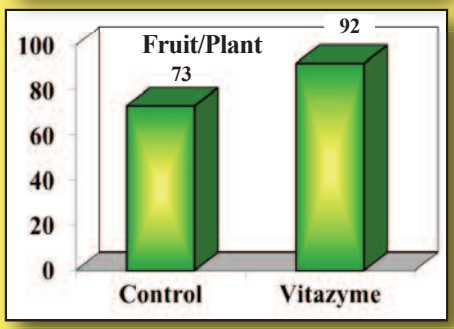
Seed Yield



Increase in yield with Vitazyme: 40%

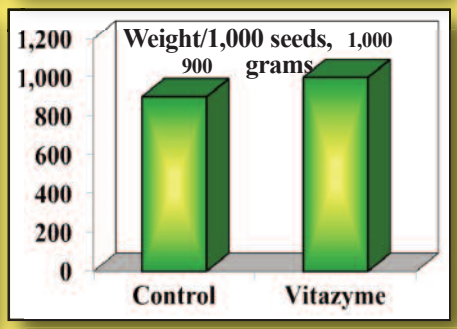
Variety TD9

Fruit Per Tree



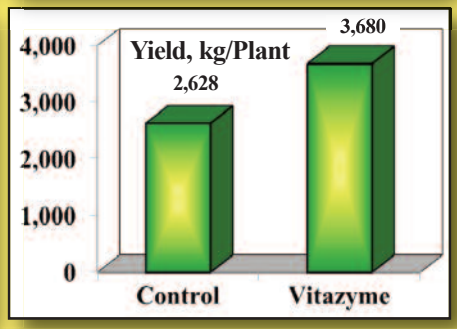
Increase in fruit/tree with Vitazyme: 26%

Weight Per 1,000 Seeds



Increase in 1,000-seed weight with Vitazyme: 11%

Seed Yield



Increase in yield with Vitazyme: 40%

Conclusions: A summary of the results for the three varieties of cocoa, utilized in this Viet Nam Vitazyme trial, is given below.

	Income with Vitazyme		
Treatment	**TD3**	**TD5**	**TD9**
Fruit per tree	16%	27%	26%
Weight per 1,000 seeds	5%	3%	11%
Seed yield	22%	40%	40%

All three varieties of cocoa responded favorably to Vitazyme, the fruit per tree increasing by 16 to 27% over the course of five treatments for a year. Seed weight increased by 3 to 11%, while the all-important yield was improved by 22% to 40%. These yield responses were highly profitable. The cost for 2.5 liters of Vitazyme for 50 trees was 700,000 Vietnamese dollars (VND), and the spraying cost was 20,000 VND. Net income increases were as follows.

	Increase income with Vitazyme		
	TD3	**TD5**	**TD9**
Fifty trees	**1,147,000**	**1,608,000**	**2,330,800**
Per hectare,VND	**25,247,200**	**35,391,400**	**51,277,600**
Per hectare, USD[1]	**1,262.36**	**1,769.57**	**2,563.88**

[1]1 Vietnamese Dong = 0.00005 U.S. dollar.

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2013 Crop Results

Vitazyme on Cocoa

A Testimonial

MARIA PIEDAD ESTATE
MP1 Oil Palm- Passion Fruit-Cocoa- Fattening Cattle

Santo Domingo, May 26, 2013

Gentlemen
Summer Zone
Quito, Ecuador

From my consideration:

According to your request and for your knowledge I share the results obtained with the use of the following products; Nitro 30, TKO, Pacha Mama, Novaplex, Caltec, Essentlal, Vltazyme, and Companion according to the protocols agreed since 2008.

Cocoa:

Fine aroma cocoa plants have formed very well, they look agronomically healthy and strong. In just over 20 months they already have blooms and many with fruit set. It is very unusual, as the norm is 36 months to production.

These products are important and their use is positive for the crops I manage. The production achieved with the economic balance of costs is excellent. However, the most outstanding is the recovery of the soil and the elimination of the use of chemical products for sustainable production.

Sincerely,
Rodrigo H. Yépez, Proprietor

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2012 Crop Results

Vitazyme on Cocoa

A Nursery and Field Study

Researcher: S. Acquaye, K. Ofori-Frimpong, A.A. Afrifa, and A. Arthur *Location*: Ghana

Nursery Study

Experimental design: Cocoa beans were planted in 18 cm x 25 cm polyethylene bags filled with potting soil. Of these seedlings, 20 were selected for each replicate, each treatment having four replicates (80 plants per treatment). Three Vitazyme concentrations were sprayed on the soil of each treatment at 40-day intervals to compare with an untreated control, and determine several growth parameters.

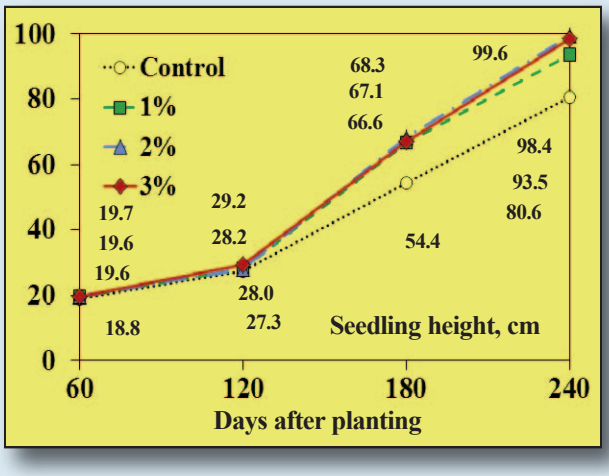
Treatment	Vitazyme concentration
1	0
2	1%
3	2%
4	3%

Fertilization: none

Vitazyme application: Treatment 2, 1% Vitazyme (150 ml in 15 liters of water) sprayed on the soil surface of each pot every 40 days using a hand sprayer; Treatment 3, 2% Vitazyme (300 ml in 15 liters of water) every 40 days; Treatment 4, 3% Vitazyme (450 ml in 15 liters of water) every 40 days

Growth results: Evaluations were made 60, 120, 180, and 240 days after planting.

Seedling Height



Treatment	Increase over the control			
	60 days	120 days	180 days	240 days
	cm	cm	cm	cm
1. Control	—	—	—	—
2. 1% spray	0.9 (5%)	0.7 (3%)	12.2* (22%)	12.9* (16%)
3. 2% spray	0.8 (4%)	0.9 (3%)	13.9* (26%)	19.0* (24%)
4. 3% spray	0.8 (4%)	1.9 (7%)	12.7* (23%)	17.8* (22%)
$LSD_{0.05}$	ns	ns	7.1	8.0

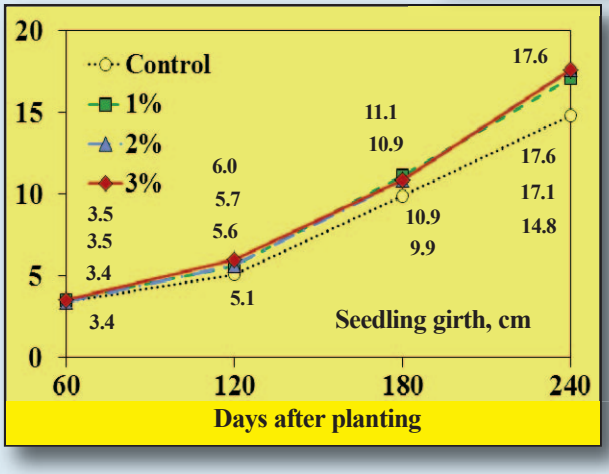
*Significantly greater than the control at P = 0.05.

Vitazyme did not significantly increase plant height at 60 and 120 days after planting (3 to 7% increases), but did at 180 and 240 days after planting.

Increase in plant height at 240 days with Vitazyme

1% spray	16%
2% spray	24%
3% spray	22%

Seedling Girth



Treatment	Increase over the control			
	60 days	120 days	180 days	240 days
	cm	cm	cm	cm
1. Control	—	—	—	—
2. 1% spray	0.1 (3%)	0.5 (10%)	1.2* (12%)	2.3* (16%)
3. 2% spray	0	0.6* (12%)	1.0* (10%)	2.8* (19%)
4. 3% spray	0.1 (3%)	0.9* (18%)	1.0* (10%)	2.8* (19%)
$LSD_{0.05}$	ns	0.6	0.8	1.0

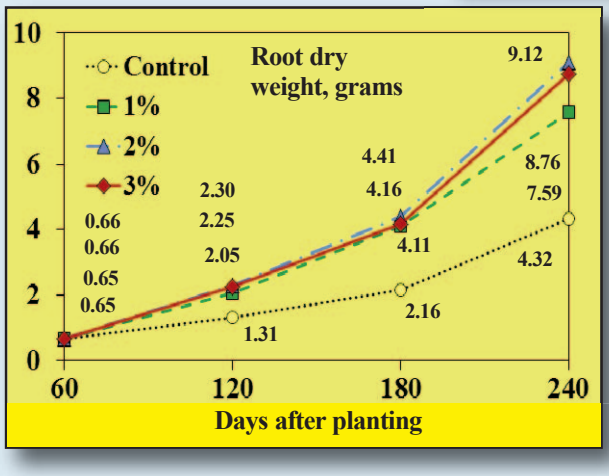
*Significantly greater than the control at P = 0.05.

At 60 days after planting there was no increase in plant girth with any rate of Vitazyme, but at 120, 180, and 240 days after planting there were significant increases in every case except one (1% spray at 120 days).

Increase in plant girth at 240 days with Vitazyme

1% spray	16%
2% spray	19%
3% spray	19%

Root Weight (dry)



Treatment	Increase over the control			
	60 days	120 days	180 days	240 days
	grams	grams	grams	grams
1. Control	—	—	—	—
2. 1% spray	(-) 0.01	0.74* (56%)	1.95* (90%)	3.27* (76%)
3. 2% spray	(-) 0.01	0.99* (76%)	2.25* (104%)	4.89* (113%)
4. 3% spray	0	0.94* (72%)	2.00* (93%)	4.44* (103%)
$LSD_{0.05}$	ns	0.43	0.56	0.63

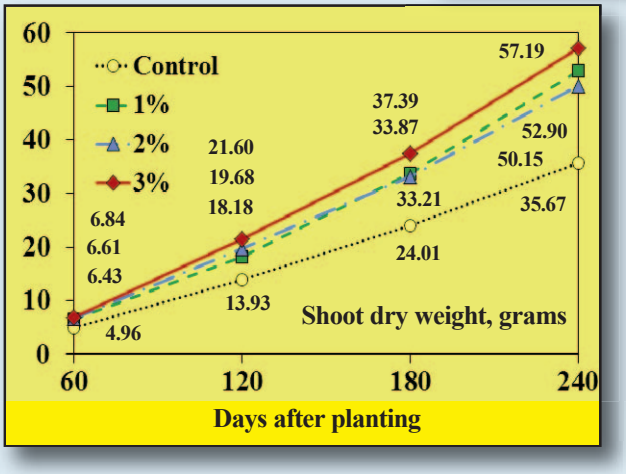
*Significantly greater than the control at P = 0.05.

All root dry weight values were significantly greater with Vitazyme at all concentrations for 120, 180, and 240 days after planting. The 2% spray gave the greatest increase. All increases were massive.

Increase in root dry weight at 240 days with Vitazyme

1% spray	76%
2% spray	113%
3% spray	103%

Shoot Weight (dry)



Treatment	Increase over the control			
	60 days	120 days	180 days	240 days
	grams	grams	grams	grams
1. Control	—	—	—	—
2. 1% spray	1.47* (30%)	4.25* (31%)	9.86* (41%)	17.23* (48%)
3. 2% spray	1.65* (33%)	5.75* (41%)	9.20* (38%)	14.48* (41%)
4. 3% spray	1.88* (38%)	7.67* (55%)	13.38* (56%)	21.52* (60%)
$LSD_{0.05}$	0.63	3.57	3.99	6.08

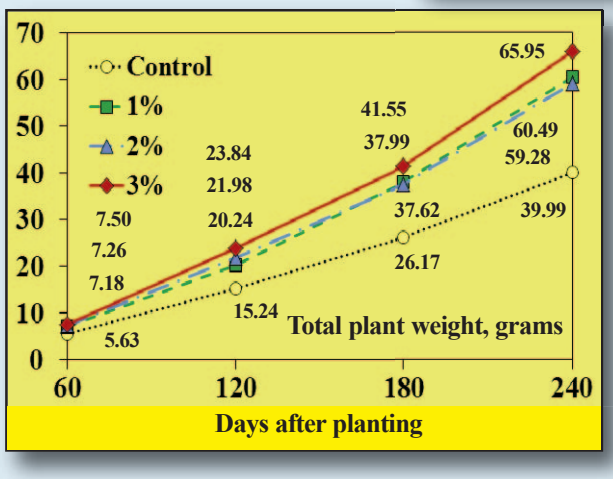
*Significantly greater than the control at P = 0.05.

In all cases, Vitazyme at all concentrations significantly increased the dry shoot weight above the control, especially the 3% spray that produced 60% more shoot weight at 240 days after planting.

Increase in shoot dry weight at 240 days with Vitazyme

1% spray 48%
2% spray 41%
3% spray 60%

Total Plant Weight (dry)



Treatment	Increase over the control			
	60 days	120 days	180 days	240 days
	grams	grams	grams	grams
1. Control	—	—	—	—
2. 1% spray	1.55 (28%)	5.00 (33%)	11.82 (45%)	20.50 (51%)
3. 2% spray	1.63 (29%)	6.74 (44%)	11.45 (44%)	19.29 (48%)
4. 3% spray	1.87 (33%)	8.60 (56%)	15.38 (59%)	25.96 (65%)
$LSD_{0.05}$	0.62	3.64	4.35	5.84

*Significantly greater than the control at P = 0.05.

As with the root and shoot weight, total plant and dry weight was improved markedly above the control when Vitazyme at all levels was applied. Increases for all times and percentages were significant at P=0.05, especially at 240 days after planting.

Increase in total plant weight at 240 days with Vitazyme

1% spray 51%
2% spray 48%
3% spray 65%

Field Study

Tree age: 10 to 25 years

Variety: hybrid cocoa

Experimental design: Farms were selected for this study at 10 sites in four cocoa regions: Becham and Onwe Nkwanta (Brong Ahafo Region), Wassa Saamang and Wantram (Western Region), Assin Jakai, Awurabo, and Asikuma (Central Region), and Asamankese, Oda Nkwanta, and Kyenkyenku (Eastern Region). Vitazyme was applied with 50% of two major fertilizers used on the farms, and by itself, alongside 100% of the two fertilizers without Vitazyme plus a control, to determine effects on yield parameters. The locations served as replicates, and each plot was 0.2 ha.

Treatment	Fertilizer		Vitazyme
	Type	Rate	
1	0	0	0
2	0	0	1.5
3	A	375 kg/ha (100%)	0
4	B	375 kg/ha (100%)	0
5	A	187.5 kg/ha (50%)	1.5
6	B	187.5 kg/ha (50%)	1.5

Fertilization: Treatments 3 and 4, 375 kg/ha of type A and B broadcast in May of 2010; Treatments 5 and 6, 50% of fertilizers A snd B (187.5 kg/ha) applied in May of 2010

Vitazyme application: 1.5 liters/ha sprayed on the leaves and trunks of the trees in May, July, and September

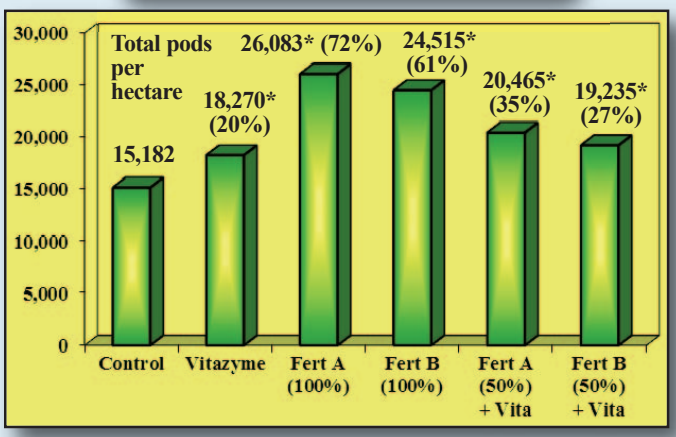
Weed control: standard

Black pod disease control: Ridomil Gold (Mefonoxam + copper) applied five times monthly from June to October, 2010

Mirid control: Confidos (Imidacloprid) applied four times from August to December, 2010

Harvest results:

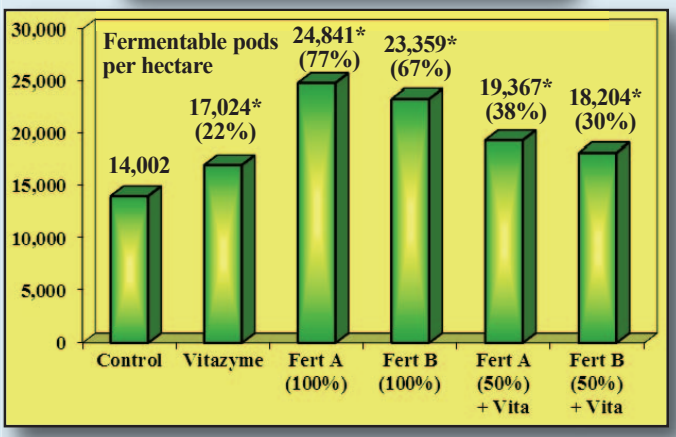
Total Pods



*Significantly greater than the control at P = 0.05. $LSD_{0.05}$ = 2,287.

Increase in total pods with Vitazyme: 20%

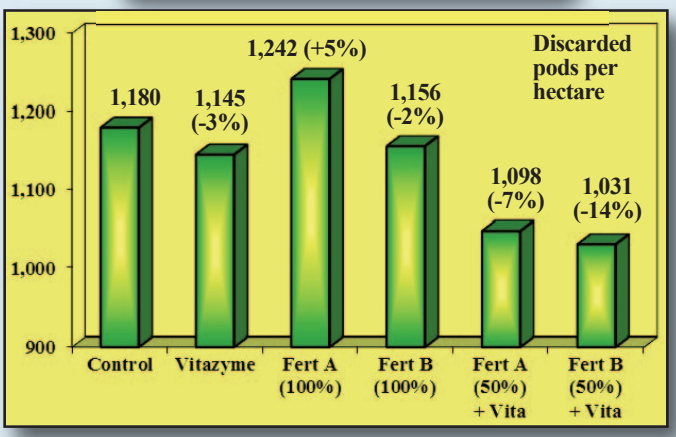
Fermentable Pods



*Significantly greater than the control at P = 0.05. $LSD_{0.05}$ = 2,159.

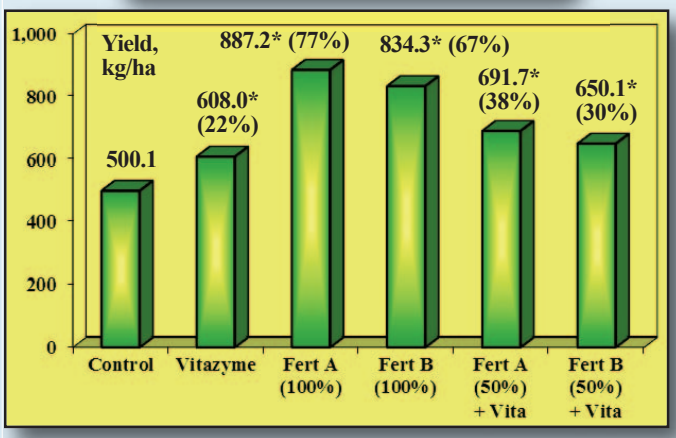
Increase in fermentable pods with Vitazyme: 22%

Discarded Pods



Values are not significantly different at P = 0.05.

Cocoa Yield



*Significantly greater than the control at P = 0.05. $LSD_{0.05}$ = 77.1 kg/ha.

Reduction in discarded pods with Vitazyme: -3%

Increase in cocoa yield with Vitazyme: 22%

All yield parameters displayed a highly positive response to Vitazyme, the total increasing by 20%, fermentable pods by 22%, and discarded pods by -3%. Yield was increased by a full 22%. Fertilizers A nd B at 100% both increased pods and yield substantially, and yield was boosted by 77% and 67%, respectively, above the control. However, there was no Fertilizer A or B without Vitazyme to evaluate the effects of this fertilizer level without Vitazyme.

Conclusions: A replicated nursery and field evaluation of cocoa in Ghana revealed that Vitazyme greatly improved the growth of cocoa seedlings when applied to the soil of polyethylene liners as a 1, 2, or 3% spray. Seedling height and girth were significantly increased with all three percentage sprays, especially at 180 ad 240 days after planting. The 2% spray did as well as, or better than, the 1% and 3% sprays. Increases were from 16 to 24% at 240 days. Roots were greatly expanded with Vitazyme at 120, 180, and 240 days after planting, up to 113% over the control at 240 days. Shoot weight was significantly improved at all times from 60 to 240 days (41 to 60%), and total plant weight was boosted by 65% with the 3% spray at 240 days, though all Vitazyme percentages did well. These results show how remarkably well Vitazyme improves the growth of young cocoa plants.

The field study likewise proved the efficacy of Vitazyme to increase total and fermentable pods (20 to 22%), reduces discarded pods (by 3%), and increase cocoa yield (22%). Both fertilizers A and B at 100% usage increased pods and yield, by up to 77% for yield; 50% levels of these fertilizers plus Vitazyme improved pod growth (27 to 35%) and fermentable pods (30 to 38%), while reducing discarded pods (-7 to -14%) and increasing yield (30 to 38%). However, interpretations of the study were limited by the absence of a 100% fertilizer plus Vitazyme treatment, as well as a 50% fertilizer treatment without Vitazyme. With such an excellent response from Vitazyme alone, it would be expected – based on previous results with the products – that a synergism would appear at both the 50% and 100% fertilizer levels with Vitazyme application. No such determination could be made by the design of this study.

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2012 Crop Results

Vitazyme on Cocoa

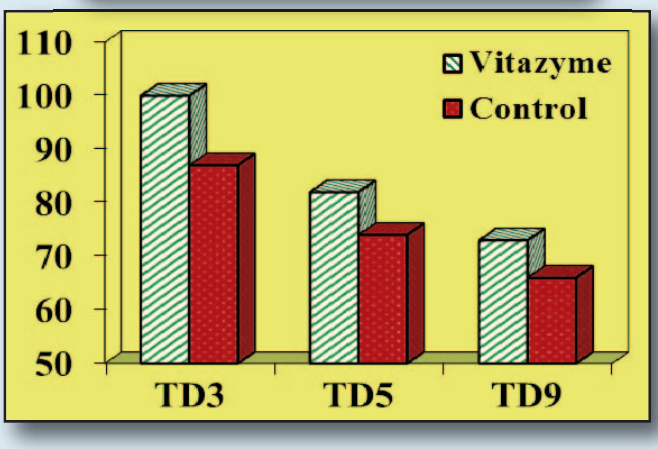
Researcher: Nguyen Kim Dinh
Location: Village 8, Eapo District, Dak Nong Province, Viet Nam *Variety*: TD3 (purple), TD5 (light purple), and TD9 (green) *Soil type*: greenhouse mix
Experimental design: A cocoa plantation having three varieties was divided into Vitazyme treated and untreated areas for each variety. Five applications were made on a 500 m^2 area for each type. Observations on plant growth and yield were made over approximately a six month period.

1. Control **2. Vitazyme**

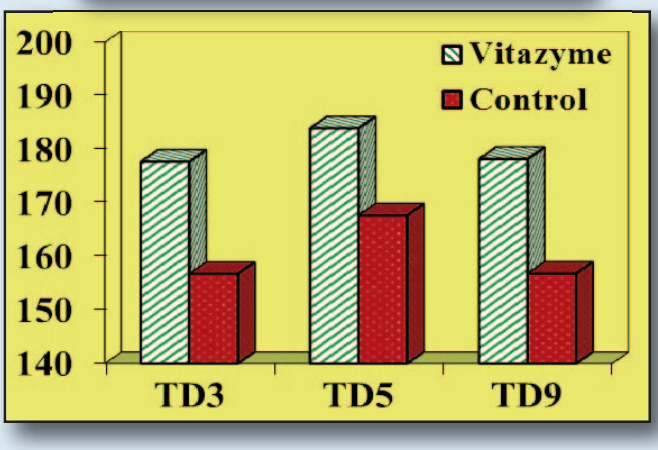
Fertilization: unknown
Vitazyme application: 500 ml of Vitazyme in 200 liters of water for each 500 m^2 block (1 liter/ha), applied to the leaves on July 24 (flowering), September 24 (small fruit), October 24 of 2011, and January 26 (beginning of harvest) and March 23 of 2012
Yield results: Harvests were conducted in January, March, and April of 2012, and totaled for each variety.

Parameter	Vitazyme			Control			Change with Vitazyme		
	TD3	TD5	TD9	TD3	TD5	TD9	TD3	TD5	TD9
Fruit per plant	100	82	73	87	74	66	13 (+15%)	8 (+11%)	7 (+11%)
Dry weight, 1,000 fermented seeds, g	830	105	111	819	103	108	11 (+1%)	2 (+2%)	3 (+3%)
Yield, dry weight of fermented seeds, kg/500 m^2	177.70	183.92	178.20	156.75	167.64	156.81			
Yield increase	20.95 (+13%)	16.28 (+10%)	21.39 (+14%)	—	—	—			

Fruit Per Plant



Yield Per 500 m^2, kg

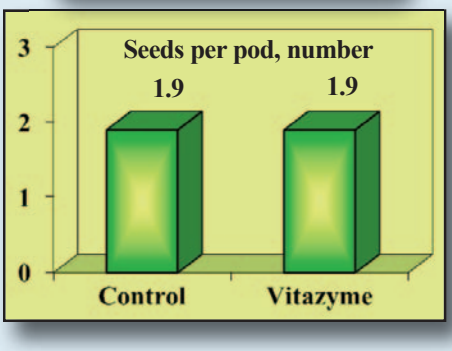


Increase in fruit per plant with Vitazyme	
TD3	15%
TD5	11%
TD9	11%

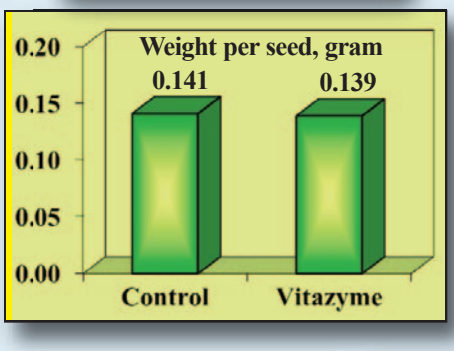
Increase in cocoa yield with Vitazyme	
TD3	13%
TD5	10%
TD9	14%

Conclusions: This Vietnamese study on cocoa response to five Vitazyme applications over a six-month period revealed a consistent yield increase for all three varieties, a reflection of more fruit per plant. Fruit number increases ranged from 11 to 15%, and yield increases from 10 to 14%, fine responses for this high-value crop.

Seeds Per Pod



Weight Per Seed



Increase with Vitazyme

Seeds per plant 47%
Pods per plant 48%
Weight per plant 44%

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2012 Crop Results

Vitazyme on Cocoa

Researcher: unknown *Location*: Viet Nam *Variety*: unknown

Experimental design: In a cocoa preparation facility, cocoa seeds were planted to produce "mother plants", a number of which were treated with Vitazyme to compare with untreated plants. Then these plants were grafted to the other rootstock to comprise the field-ready plants. Applications of Vitazyme were made to the grafted plants as well to evaluate effects on growth and budding.

1. Control **2. Vitazyme**

Fertilization: unknown

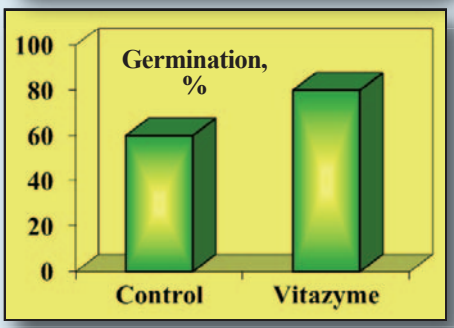
Vitazyme application: "Mother" plants, a 5% seed treatment, and a 1% Vitazyme spray at 10, 30,60, and 90 days after planting; grafted plants, a 1% spray over the root zone 3 days after planting, and a 1% spray over the entire plants 14 days after planting.

Growth results:

Mother Cocoa Plants

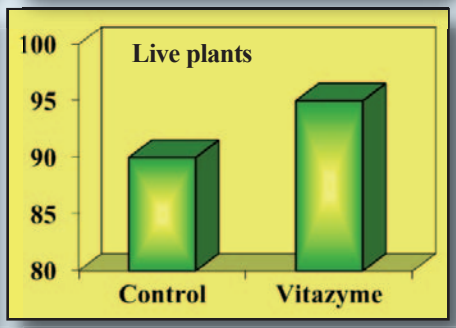
Parameter	Control	Vitazyme	Change with Vitazyme
Germination 7 days after planting	60%	80%	+20 %-points
Live plants 15 days after planting	90%	95%	+5 %-points
Plant height 30 days after planting	10.0 cm	12.5 cm	+2.5 cm (+25%)
Leaf number 30 days after planting	2	4	+2 (+100%)
Plant height 60 days after planting	21.5 cm	24.0 cm	+3.5 cm (+16%)
Plant height 90 days after planting	32.5 cm	42.5 cm	+10.0 cm (+31%)
Grafting date	March 28 to 30	May 1	33 days earlier

Germination at 7 Days



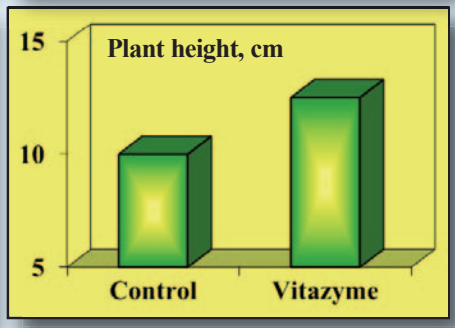
Increase with Vitazyme: 20 %-points

Live Plants at 15 Days



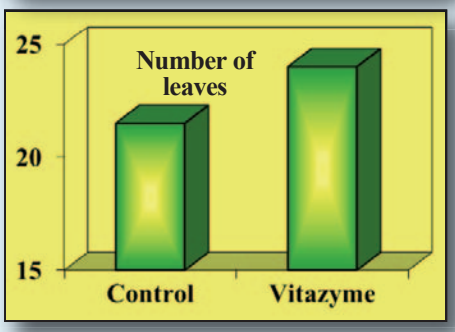
Increase with Vitazyme: 5 %-points

Plant Height at 30 Days



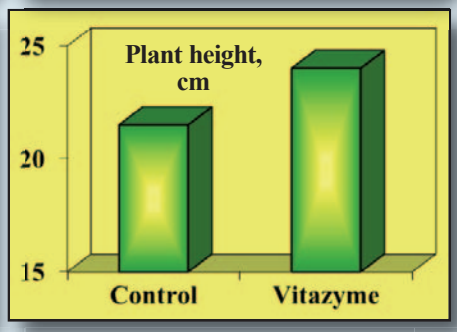
Increase with Vitazyme: 25%

Leaf Number at 30 Days



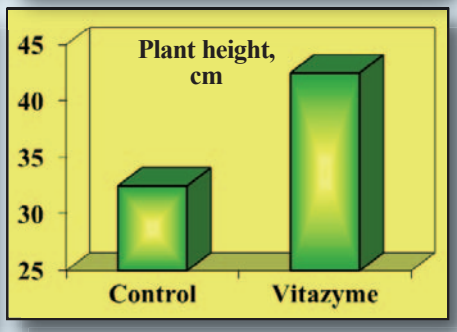
Increase with Vitazyme: 100%

Plant Height at 60 Days



Increase with Vitazyme: 16%

Plant Height at 90 Days



Increase with Vitazyme: 31%

Days reduced to grafting: 33 days

It is clear that a Vitazyme seed treatment, and 1% spray at 10, 30, 60, and 90 days after planting greatly stimulated plant development in all cases, including with germination, rate of growth, and time to grafting size.

Plants After Grafting

All plants were grafted on the dates at which grafting size was reached, which was March 28 to 30 for the Vitazyme treatment, and May 1 for the untreated control. Each treatment utilized 2,000 plants.

Parameter	Control	Vitazyme
Emerging shoots	none	April 8 to 10
Live shoots	none	97%
Shoot length	none	11 cm

Because of a 33-day later time to grafting, the control plants had no shoots yet at the time these data were collected.

Conclusions: In a Viet Nam cocoa nursery study, Vitazyme produced a remarkedly good result by improving early seed germination (+20%), plant height (+31% at 90 days after planting), and rate of maturity of the developing plants. Treated plants were ready for grafting 33 days before the untreated control "mother" plants. After grafting, the treated plants were growing very well on the measurement date, but no values could be determined for the control plants because they were far behind the Vitazyme treated plants. These results prove the great value of this product to improve the growth, maturity, and early development of cocoa plants in the nursery environment.

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2011 Crop Results

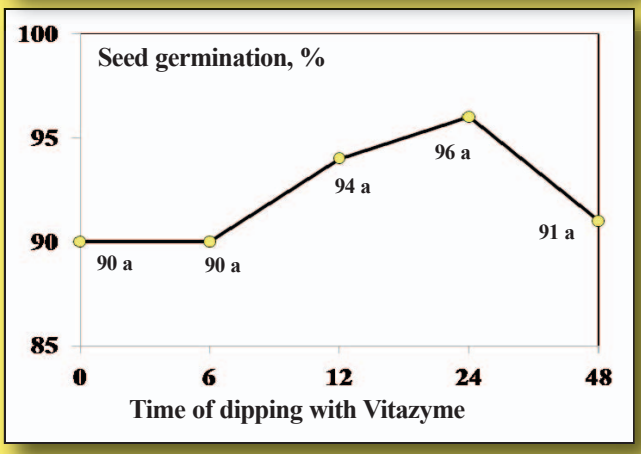
Vitazyme on Cocoa

Researcher: Carlos Bustamante Gonzalez, Ph.D., and Maritza I. Rodriguez Castro, M.S.
Research institution: Ministry of Agriculture, Central Coffee and Cocoa Research Station, Santiago de Cuba, Cuba
Location: "The Mandarin" Farm, Cruce de los Baños, Third Front Municipality
Varieties: unknown
Soil types: Typic Ustropept (U.S. classification), or Orthi-Eutric Cambisol (U.N. classification); pH = 6.24 to 7.63 (water extraction), organic matter = 3.4 to 5.7%, P_2O_5 = 7.2 to 191.9 mg/100g, K_2O = 26.6 to 183.1 mg/100g, K^+ = 0.97 to 6.67 meq/100 g, Ca^{+2} = 36.3 to 53.8 meq/100 g, Mg^{+2} = 9.1 to 38.4 meq/100 g, Na^+ = 1.4 to 2.1 meq/100 g.
Experimental design: A series of trials with cocoa was undertaken to evaluate the effects of Vitazyme on the germination and growth of cocoa seeds, the production of cocoa cuttings, the growth of the plants during their developmental stage, and the production and quality of fruit on mature trees. Replicated plots were used for these studies, and the data were statistically analyzed.

Trial on Cocoa Seedlings Originating from Seeds

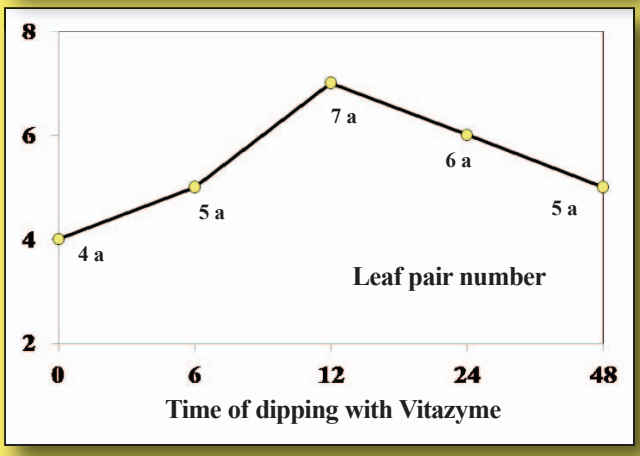
Treatments: 1. Control (water only)
2. Seed dipping, 5% Vitazyme for 6 hours
3. Seed dipping, 5% Vitazyme for 12 hours
4. Seed dipping, 5% Vitazyme for 24 hours
5. Seed dipping, 5% Vitazyme for 48 hours

Germination



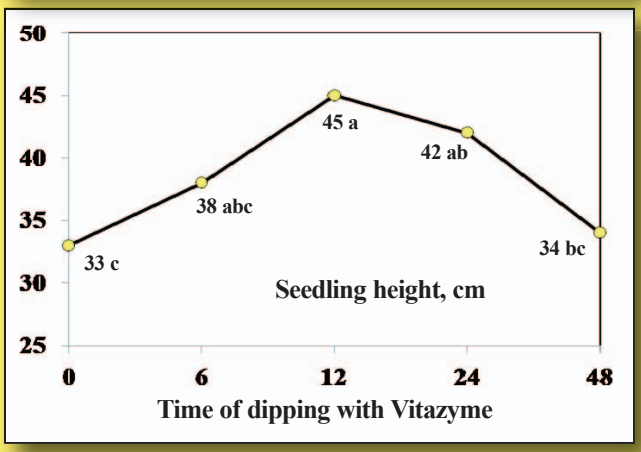
Means followed by the same letter are not significantly different at P=0.05.
No differences are significant, but all but the 6 hour dip increased seed germination.

Pairs of Leaves



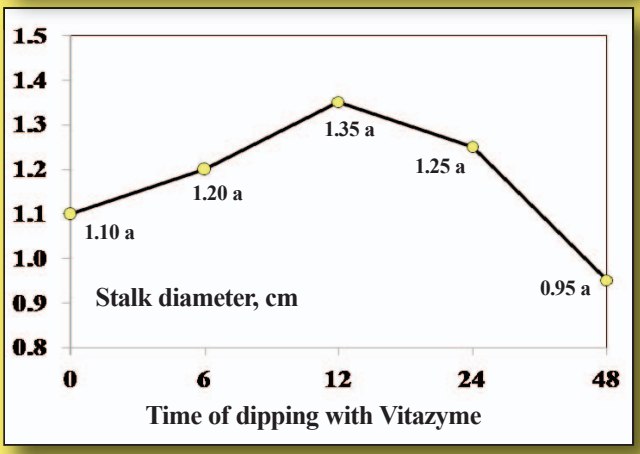
Means followed by the same letter are not significantly different at P=0.05.
Though differences are not significant from the control, all Vitazyme treatments increased the number of leaf pairs.

Seedling Height



CV=23.4%, SE=1.23, P=0.05
Means followed by the same letter are not significantly different at P=0.05

Stalk Diameter



Means followed by the same letter are not significantly different at P=0.05.
All but the 48 hour dip increased stalk diameter, though no increases were significant.

Increase in plant height with Vitazyme

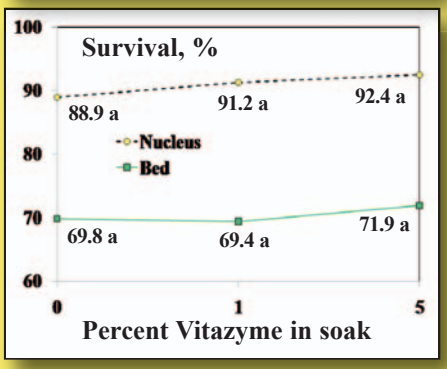
Dipping 6 hours ..... +15%
Dipping 12 hours ..... +36%
Dipping 24 hours ..... +27%
Dipping 48 hours ..... +3%

Both the 12 and 24 hour dips significantly increased plant height.

Trial on the Production of Cocoa Cuttings

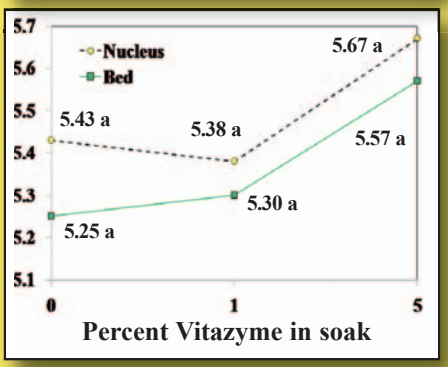
Treatments: The "bed" and "nucleus" methods (different bag types) were used, with the three treatments below.
1. Control
2. Cutting soak, 1% Vitazyme
3. Cutting soak, 5% Vitazyme

Survival



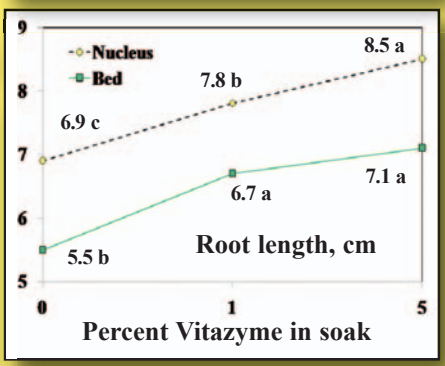
Means followed by the same letter are not significantly different at P=0.05
There was a slight trend of better survival for the nucleus system.

Root Number



Means followed by the same letter are not significantly different at P=0.05
For both methods of growing there was a non-significant spike in root numbers with the 5% Vitazyme soak.

Root Length



Nucleus: CV=9.36%, SE=0.874, P=0.05
Bed: CV=12.09%, SE=0.918, P=0.05
Means followed by the same letter are not significantly different at P=0.05
Both mehtods of growing cutting responded significantly to Vitazyme at both the 1% and 5% soak concentrations, especially at 5%.

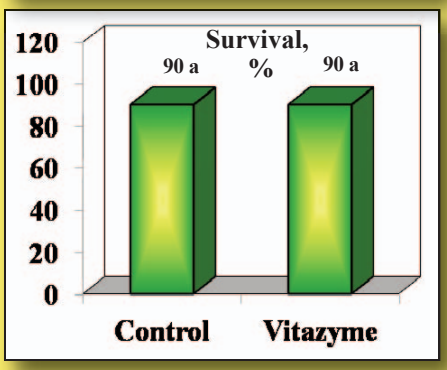
Root length increases with Vitazyme

	Nucleus	Bed
1% soak	+ 13%	+22%
5% soak	+23%	+29%

Trial on the Survival of Cocoa Grafts

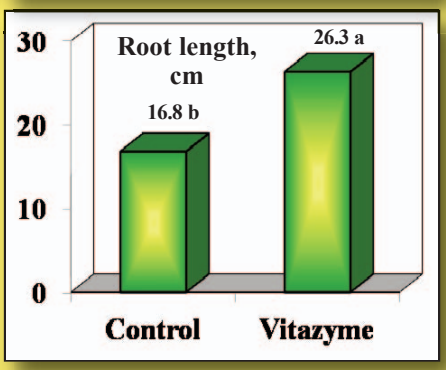
Treatments: 1. Control
2. 1% Vitazyme on the soil and plant

Bud Survival, %



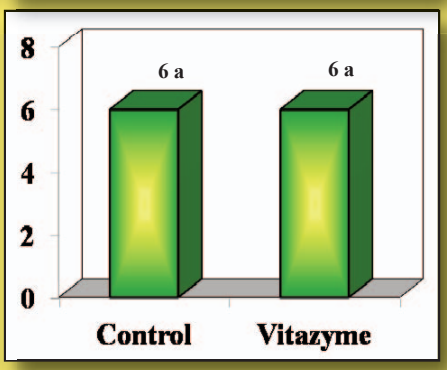
Means followed by the same letter are not significantly different at P=0.05.

Graft Length



CV=13.83%, SE=0.84, P=0.05
Means followed by the same letter are not significantly different at P=0.05.

Pairs of Leaves



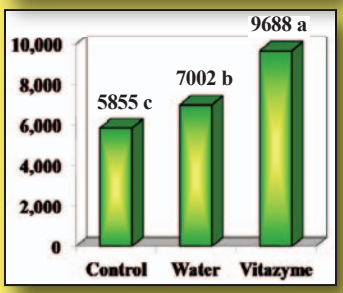
Means followed by the same letter are not significantly different at P=0.05.

Increase in graft length with Vitazyme: 57%

Trial on Cocoa Growth During the Developmental Stage

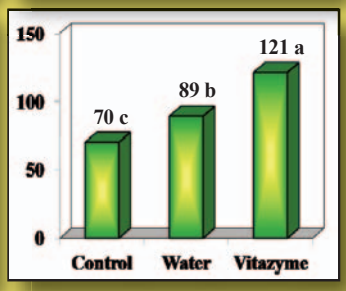
Treatments: 1. Control 2. Water every 60 days 3. Vitazyme (1 liter/ha) every 60 days

Flowers Per Plant



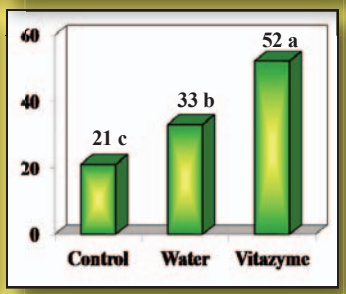
CV=11.84%, SE=0.902, P=0.05
Means followed by the same letter are not significantly different at P=0.05

Pod Set Per Plant



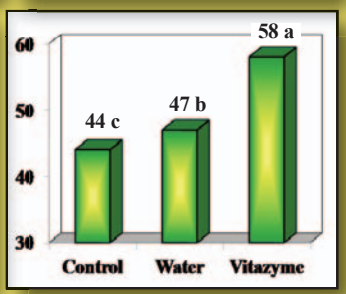
CV=10.00, SE=0.892, P=0.05
Means followed by the same letter are not significantly different at P=0.05

Harvested Pods/Plant



CV=13.83, SE=0.980, P=0.05
Means followed by the same letter are not significantly different at P=0.05

Vigor (Diameter)



CV=10.16, SE=0.770, P=0.05
Means followed by the same letter are not significantly different at P=0.05

Increase in flowers/plant with Vitazyme: 65%

Increase in pods/plant with Vitazyme: 73%

Increase in harvested pods/plant with Vitazyme: 148%

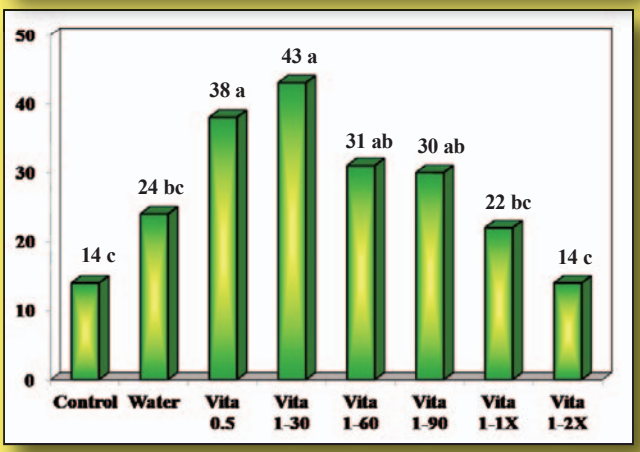
Increase in diameter with Vitazyme: 32%

Vitazyme significantly increased flowers per plant, pod set per plant, harvested pods per plant, and plant diameter. Interestingly, water sprayed on the plants also increased each parameter, but only by a fraction of the Vitazyme increase.

Trial on Yield and Quality of Cocoa

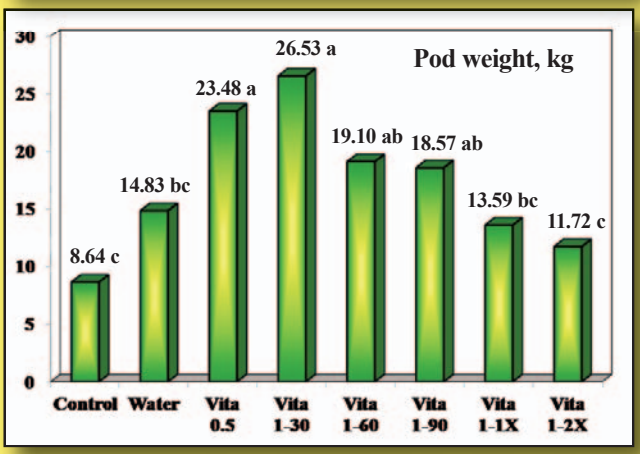
Treatments: 1. Control
2. Water only
3. Vitazyme, 0.5 liter/ha every 30 days
4. Vitazyme, 1.0 liter/ha every 30 days
5. Vitazyme, 1.0 liter/ha every 60 days
6. Vitazyme, 1.0 liter/ha every 90 days
7. Vitazyme, 1.0 liter/ha Sept.-Dec.
8. Vitazyme, 0.5 liter/ha Sept.-Dec. and April-June

Pod Number Per Tree



Means followed by the same letter are not significantly different at P=0.05.

Pod Weight Per Tree



Means followed by the same letter are not significantly different at P=0.05.

The best results on yield and pod number were for Vitazyme at 1 liter/ha applied every 30 days, with the 0.5 liter/ha rate nearly as high; both were significantly greater than for the control and for Vitazyme applied only twice during the season. All Vitazyme treatments applied monthly were statistically equal. Water sprayed on the trees by itself gave a nonsignificant increase above the untreated control.

Increase in pod weight/tree with Vitazyme

0.5 liter/ha every 30 days ..... +172%
1.0 liter/ha every 30 days ..... +207%
1.0 liter/ha every 60 days ..... +121%
1.0 liter/ha every 90 days ..... +115%

Conclusions: According to the researchers ...

1. Seeds dipped for 12 and 24 hours in a Vitazyme solution increased by 44% the height of cocoa seedlings.
2. Vitazyme increased root length of cocoa cuttings produced in litter beds and in bags with nucleus.
3. Vitazyme increased the length of cocoa grafts, which shortened the nursery period.
4. Vitazyme increased the number of flowers, fruit set, harvested pods, and stalk diameter in various stages of growth of cocoa plants.
5. The use of Vitazyme in established cocoa plantations doubled the number of pods per plant and consequently yields.