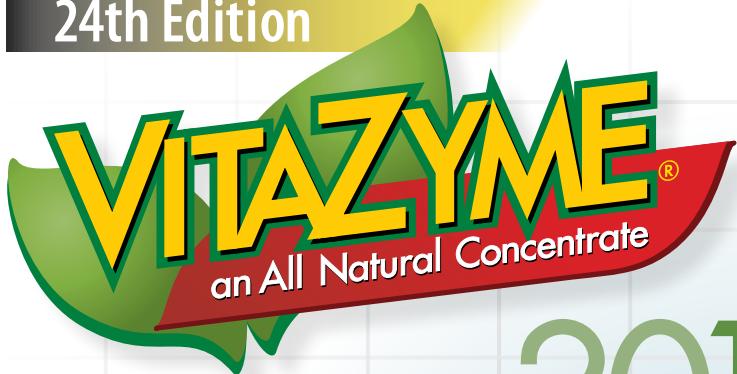


24th Edition



2019 FIELD TESTS RESULTS



A SUMMARY OF EXPERIMENTS
USING VITAZYME SOIL, SEED, & PLANT TREATMENT
ON FIELD, ORCHARD, & GREENHOUSE CROPS

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Introduction

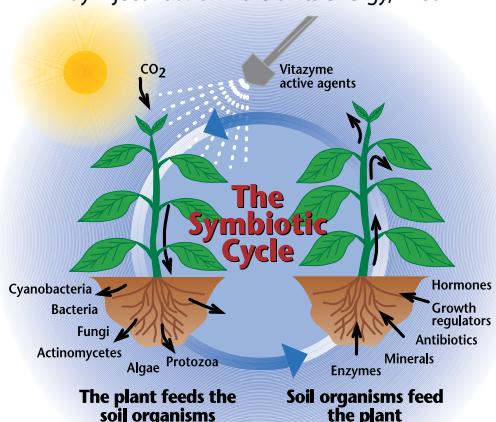
How Vitazyme works within the plant-soil system.

This is the twenty-fourth edition of Vitazyme crop reports, documenting research results from around the world on the successful use of this versatile biostimulant for all soils and climates.

For those unfamiliar with Vitazyme soil and plant biostimulant and its recommended program, please review the information given below to understand how the material works within the plant-soil system.

Improved Symbiosis: The Secret of Vitazyme's Action

All plants that grow in soils develop an intimate relationship between the roots and the organisms that populate the root zone. The teeming billions of bacteria, fungi, algae, cyanobacteria, protozoa, and other organisms that grow along the root surfaces—the rhizosphere—are much more plentiful than in the bulk of the soil. This is because roots feed the organisms with dead root epidermal cells as well as compounds exuded from the roots themselves. The plant may inject 25% or more of its energy, fixed in



the leaves as carbohydrates, amino acids, and other compounds, into the root zone to feed the organisms, for a very good purpose.

The microorganisms which feed on these exuded carbon compounds along the root surfaces benefit the plant in many ways, creating a beautiful symbiotic relationship. The plant feeds the bacteria, fungi, algae, and other microbial species in the rhizosphere, which in turn secrete enzymes, organic acids, antibiotics, growth regulators, hormones, and other substances which are absorbed by the roots and transported to the leaves. The acids help dissolve essential minerals, and reduced iron releases anionic elements. Organism types include mycorrhizae,

cyanobacteria and various other bacteria, fungi, and actinomycetes.

Vitazyme contains "metabolic triggers" that stimulate the plant to photosynthesize more efficiently, fixing more sunlight energy in the form of carbon compounds to increase the transfer of carbohydrates, proteins, and other growth substances into the root zone. These active agents may enter the plant through either the leaves or the roots. Root growth and exudation are both enhanced. This enhancement activates the metabolism of the

2. Treat the seeds, transplant roots, or seed pieces whenever possible at planting. To treat seeds, typically use 250 ml/ha in the minimum water for good seed coverage. Mixing 1 liter/ton of seeds is also very effective. Dip roots or transplants in a 0.5 to 1% solution, or spray with a 5% solution.

3. Apply Vitazyme to the soil and/or leaves according to recommendations. In most cases use 1 to 1.5 liters/ha per application, from one to three times during the growing season.

Nitrogen Fertilizer Reduction Guide with Vitazyme

Obtain a score for each of these four items

Soil Organic Matter			Previous Crop		Compaction		Soil NO ₃ -N Test		
Low (<1.5%) 1	Medium (1.5-3%) 2	High 3	Non-legume 1	Legume 3	Much 1	Little 3	Low 2	Medium 4	High 6
Add the scores above to find the N-reduction									
Total score	15	14	13	12	11	10	9	8	7
% of optimum N to apply	←	50-60%	→	←	60-70%	→	←	70-80%	→

teeming population of rhizosphere organisms to a higher level, triggering a greater synthesis of growth-benefiting compounds and a faster release of minerals for plant uptake. Thus, the plant-microbial symbiosis is stimulated.

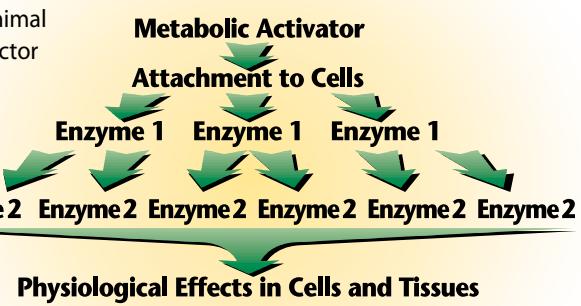
Very small amounts of these metabolic triggers in Vitazyme are needed to greatly improve plant and rhizosphere microbe response. This is because of the **enzyme cascade effect**. Successive tiers of enzymes are activated in plant and microbial tissues to give a large physiological response from very little activator.

In short, Vitazyme enables the plant to better express its genetic potential by reducing the stresses that repress that expression.

Vitazyme may be used for crop production at any degree of technology, from animal power and low inputs to GPS-guided tractor power and high fertility inputs. Please consult the Vitazyme User's Guide for details.

General use for field crops with less than optimal fertilization levels, when soil testing is not possible:

1. Apply normal levels of organic and commercial fertilizers.



Vitazyme Highlights from throughout the world.

Vitazyme Highlights for 2019

The following highlights of research on Vitazyme for 2019 from around the world are summarized in the following seven segments. As in past years the results are excellent, and show the consistent responses to be expected with this program.

1. For over a decade the Vitazyme program has been trialed in Ukraine to prove its efficacy under the varied soil and climatic conditions of that Eastern European country. Corn trials gave yield increases of from 7 to 11%, even though some applications were at reduced rates. Winter wheat responses were especially notable in northern, western, and central Ukraine where yield responses were up to 22%, and gluten and protein responses reached 2.4 and 1.3 percentage points, respectively. Sunflower yields improved by about 9%, pea yields by 20%, and winter barley yields by up to 28%. With winter canola the yield increased 13%. Vitazyme Cold Start was very effective with wheat and barley.

2. A compilation of results with Vitazyme on corn and soybeans at the University of Missouri over several years, summarizing effects of the product when mixed with glyphosate on the prevalence of Fusarium root infection as well as populations of beneficial and non-beneficial rhizosphere bacteria, root growth, and overall soil health, showed impressive benefits of the program. Vitazyme reduced the deleterious effects of

glyphosate on Fusarium, Pseudomonads, and IAA-producing bacteria, and increased Mn-reducing bacteria to improve nutrient uptake. These results were presented at the Fourth International Biostimulant Conference in Barcelona, Spain, in November.

3. A cocoa experiment conducted over two years by the Cocoa Research Institute of Ghana proved that Vitazyme increased the yield of cocoa by an amazing 132% over the control. The 4 liter/ha rate did somewhat better than the 6 liter/ha rate, showing that higher rates are not always more beneficial. Fertilizer alone, by contrast, gave a 93% cocoa yield increase versus the untreated control.

4. Cotton grown in Uganda in trials conducted from 2015 to 2018, and reported in the 2018 trial reports, responded remarkably well to Vitazyme along with a commercial chemical seed fungicide treatment. These results were reported this year in The ICAC Recorder (June, 21019) by the International Cotton Advisory Committee. Root vigor was markedly increased, and the yield and fiber characteristics of the cotton were also greatly improved. The best results were with the 5% Vitazyme concentration for seed dressing, coupled with one foliar spray on cotton plants using 1 l/ha of Vitazyme at full bloom.

5. A coffee trial from Kenya, which was conducted in 2010 with the data just being made available, revealed the great efficacy of the program by more than

doubling the yield of coffee beans by 0.99 ton/ha. This result was achieved with only three 1 liter/ha applications when coupled with Twin N, a microbial supplement that proved to be highly synergistic with Vitazyme. Coffee grade and income were also improved markedly with the program.

6. Studies on corn, tomatoes, strawberries, and lemons in Mexico, Guatemala, and Dominican Republic showed excellent results, continuing the fine and consistent responses noted for many years in Latin America. The yield increase for corn reached 33% in one trial, and tomatoes produced higher quality of fruit and up to 16% greater yield. Income increases were commensurate with yield and grade improvements. Some remarkable results for a strawberry trial in Mexico showed a 23% yield increase and nearly 2 percentage points increase in fruit brix, with a much-improved shelf life.

7. Further studies at Agricenter International, Memphis, Tennessee, revealed the excellent synergism between Vitazyme and the seed inoculant Bio Seed for rice and soybeans. Rice yields were improved by up to 20% compared to the control, while soybeans increased in yield by a remarkable 40% when Bio Seed and Vitazyme were combined in-furrow, and an additional Vitazyme application was made at the flag leaf stage. Both rice and soybeans gave excellent income increases with the combined products.

Barley (Winter) Use of the Cold Start variation of Vitazyme

Researcher: V.V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: ALLC "Dnipro", Pogrebyshcne District, Vinnytsia Region, Monchin Village, Ukraine; Central Ukraine(440-590 mm of precipitation per year) **Variety:** Naomi, F1 generation

Planting date: October 5, 2018

Planting rate: 4 million seeds/ha **Previous crop:** sunflowers

Soil type: Podzolized Chernozem (humus=3.5%)

Field preparation: cultivation with a heavy cultivator to 20-22 cm, disking to 10-12 cm

Experimental design: A winter barley field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme Cold Start on the yield of grain..

1 Control **2 Vitazyme Cold Start**



Root development has been greatly improved with Vitazyme applied to the plants in this trial. The yield has consequently been noticeably improved.

Fertilization: 20-52-52 kg/ha of N-P₂O₅-K₂O applied during fall cultivation, 15-15-15 kg/ha of N-P₂O₅-K₂O during planting, and 85 kg/ha of N in the spring

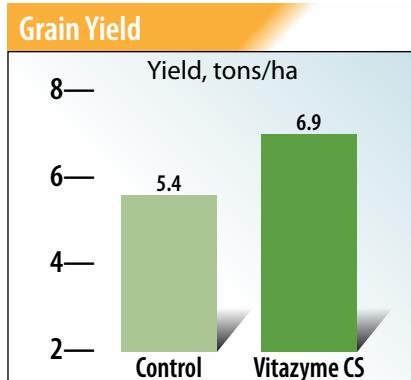
Vitazyme Cold Start application:

1 liter/ha sprayed on the leaves and soil at greenup on April 30, 2019

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	5.4	—
2. Vitazyme Cold Start	6.9	1.5 (+28%)

Increase in yield with Vitazyme Cold Start: 28%



Conclusions: This winter barley trial with Vitazyme Cold Start revealed that a single 1 liter/ha spring application to the greening leaves increased the grain yield by a full 28%. This result illustrates the great efficacy of this product to boost barley yields in Ukraine.

Barley (Winter) With a Vitazyme Cold Start Spring Application



Researcher: V.V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "VKAF Maiaky", Odessa Region, Maiaky Village, Ukraine; Southern Ukraine (270-350 mm of precipitation per year)

Variety: Luran, F1 generation

Planting date: October 1, 2018

Planting rate: 4.5 million seeds/ha

Previous crop: peas

Soil type: Typical chernozem (humus=4.1%)

Field preparation: disking to 6-8 cm, a second disking to 14-16 cm

Experimental design: A winter barley field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme + Vitazyme Cold Start on the yield of grain.

① Control

② Vitazyme + Vitazyme Cold Start

Fertilization: 21 kg/ha of N and 24 kg/ha of S during disking; 10-20-12 kg/ha of N-P₂O₅-K₂O at planting; 80 kg/ha of N as KAS urea-ammonia mixture in the spring, with Vitazyme Cold Start

Vitazyme and Vitazyme Cold Start application:

0.5 liter/ha of Vitazyme on the seeds before planting; 0.3 liter/ha of Vitazyme Cold Start sprayed on the leaves and soil at early tillering on February 2, 2019



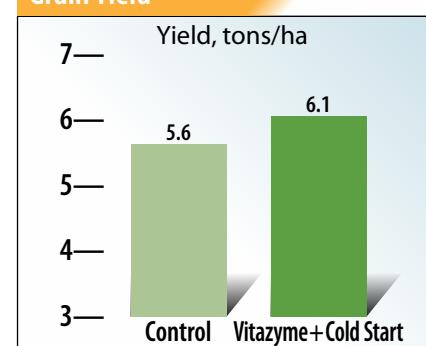
The brassinosteroids, triacontanol, and B vitamins in Vitazyme have triggered much better root and leaf development in this barley trial, leading to a 9% yield increase.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	5.6	—
2. Vitazyme + Cold Start	6.1	0.5 (+9%)

Increase in yield with Vitazyme + Vitazyme Cold Start: 9 %

Grain Yield



Income results: The extra 0.5 ton/ha of yield gave added income of \$76/ha.

Conclusions: This winter barley trial in Ukraine, using Vitazyme on the seeds (0.5 liter/ha) and Vitazyme Cold Start on the leaves and soil in the spring at early tillering (0.3 liter/ha), showed a very respectable yield increase of 0.5 ton/ha, giving the farmer \$76/ha greater income. This program is seen to be an excellent adjunct to barley production in Ukraine.

Barley (Winter) with Vitazyme application

Researcher: V.V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "APK Nastashka", Rokyme District, Kyiv Region, Nastashka Village, Western Ukraine (550-620 mm of precipitation per year)

Variety: Hannelore, F1 generation **Planting date:** September, 30, 2018

Planting rate: 4 million seeds/ha **Previous crop:** sunflowers **Soil type:** Podzolized chernozem (humus=3.3%)

Field preparation: disking to 10-12

cm, deep cultivation with a heavy cultivator to 20-22 cm

Experimental design: A barley field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield of the barley grain.

① Control ② Vitazyme

Fertilization: 13-39-34 kg/ha of N-P₂O₅-K₂O applied during fall cultivation; 5-14-20 kg/ha of N-P₂O₅-K₂O at planting in the spring

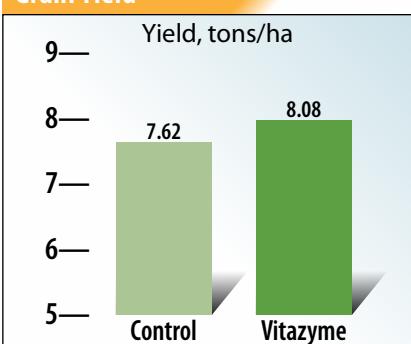
Vitazyme application: Four days before planting, on September 26, 2018, the barley seeds were treated with Vitazyme to give 1.0 liter/ha

Yield results:

Treatment	Yield		Yield change
	tons/ha	tons/ha	
1. Control	7.62	—	
2. Vitazyme	8.08	0.46 (+6%)	

Increase in yield with Vitazyme: 6%

Grain Yield



Income results: A 6% yield increase (0.46 ton/ha) gave an additional \$74/ha income.

Conclusions: Vitazyme at 1.0 liter/ha, applied to the seeds, increased barley grain yield by an acceptable 0.46 ton/ha (6%), giving the farmer \$74/ha more income. This result illustrates the value of this program for complementing the growth of barley in Ukraine.

Canola (Winter) with Vitazyme application

Researcher: V.V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "Spelta", Bilgorod-Dnistrovsk District, Odesa Region, Petrivka Village, Ukraine; Southern Ukraine (270-350 mm of precipitation per year)

Variety: Sherpa, **Planting date:** August 30, 2018

Planting rate: 0.5 million seeds/ha

Previous crop: winter wheat

Soil type: Typical chernozem (humus=4.1%)

Field preparation: disking to 10-12 cm plowing to 20-22 cm, cultivation to 3-4 cm

Experimental design: A winter canola field was divided into conventionally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield of the seeds.

① Control ② Vitazyme

Fertilization: 32-52-24 kg/ha of N-P₂O₅-K₂O applied during fall plowing; 20 kg/ha of N applied at planting; 170 kg/ha of N and 36 kg/ha of S applied in the spring

Vitazyme application: 1.0 liter/ha sprayed on the leaves and soil at early flowering on April 28, 2019

Yield results: See table to the right

Income results: An extra 0.4 ton/ha of canola seeds produced added income of \$140/ha.

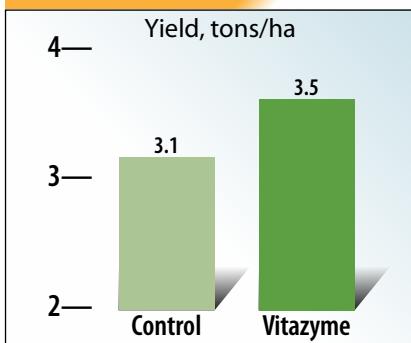


Tall, well-branched plants having well-filled seeds is the result of the Vitazyme program for this canola field, which yielded 13% more than the untreated control.

Treatment	Yield		Yield change
	tons/ha	tons/ha	
1. Control	3.1	—	
2. Vitazyme + Cold Start	3.5	0.4 (+13%)	

Increase in yield with Vitazyme: 13 %

Seed Yield



Conclusions: A winter canola trial conducted in Ukraine in 2018-2019, using a single Vitazyme foliar/soil spray at early flowering of 1.0 liter/ha, produced an excellent 13% yield increase, grossing \$140/ha more income for the farmer. This result points to the excellent responses farmers can expect with canola in Ukraine using the Vitazyme program.

Carrots with Vitazyme application

Researcher: Agronomist Palemon Ledesma

Research organization: Quimica Lucava, Mexico

Farmer: Eng. Juan Pablo Rendon Reina

Location: El Trangenio Farm, Dolores, Hidalgo, Guanajuato, Mexico

Variety: unknown

Experimental design: A two-hectare portion of a carrot field was treated with Vitazyme to determine the effect of the product on plant growth and yield. This trial was conducted from June to August of 2012.

① Control ② Vitazyme

Fertilization: Unknown



Control

Control carrots have much smaller roots than the treated carrots.

Vitazyme application: two foliar sprays: (1) 1 liter/ha 45 days after planting; (2) 1 liter/ha 75 days after planting

Yield results: No yield data is available, but due to severe flooding the control area was severely damaged by *Altemaria dauci*, reducing the yield to only 50% of the Vitazyme treated area. The product produced larger, disease-free roots which doubled the yield of marketable carrots.

Conclusions: This carrot trial near Guanajuato, Mexico, proved that Vitazyme can greatly improve the top and root growth of carrots and reduce disease pressure, especially under oversaturated soil conditions, compared to untreated carrots. This program is shown to be a powerful addition to the agronomic program of carrot growers in Mexico.



Vitazyme

The treated carrot roots are seen to be thriving, with much larger roots.



Note how the Vitazyme treated carrot tops are vigorous and dense, producing excellent roots as seen in the accompanying photo.



Untreated carrot plants are not as vigorous and dense in leaf cover as the treated plants.



The size of the Vitazyme treated carrots is noticeably greater than the untreated roots.

Cocoa with Vitazyme application

Researchers: Arthur and J. A. Dogbatse

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

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.



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.

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.	—	—	30 ml/ha	1.8 L	May, June, July, August, September, October
4.	—	—	—	—	None

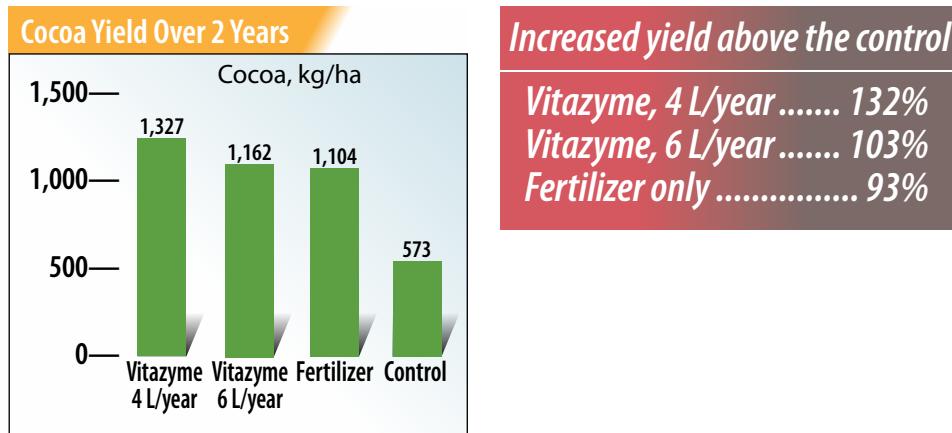
¹Applied using two tank fillings to cover the 0.2 ha plot, with a motorized sprayer.

²A 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).



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 $4 \text{ L ha}^{-1} \text{ yr}^{-1}$ 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 fertilizer treated plots compared to the unfertilized control. There was no significant difference ($p>0.05$) between the two rates of Organic Vitazyme foliar fertilizer and the reference foliar fertilizer.

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 $4 \text{ L ha}^{-1} \text{ yr}^{-1}$ was comparable with the reference foliar fertilizer in terms of dry cocoa bean yield. The foliar fertilizer had no adverse effect on cocoa trees during the testing period. Based on the 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 field rate of 100 ml in 11 liters of water ($1,000 \text{ ml ha}^{-1} \text{ month}^{-1}$) 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:

- 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.
- 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.
- Vital Earth Resources (2017). *User's guide. The Vitazyme Program*. www.vitalearth.com

Coffee with Vitazyme application—A Study on Synergism with Twin N



Researcher: unknown

Research organization: Lachlan Kenya Ltd., Kenya

Location: Muthaite Estate, Ruiru, Kenya **Variety:** unknown **Years conducted:** 2007-2010

Experimental design: Several coffee blocks of a large plantation were treated with a combination of Vitazyme and Twin N to evaluate the effect of this combination on coffee yield and quality, as well as on treatment costs.

① Fertilizer ② Vitazyme ③ Twin N

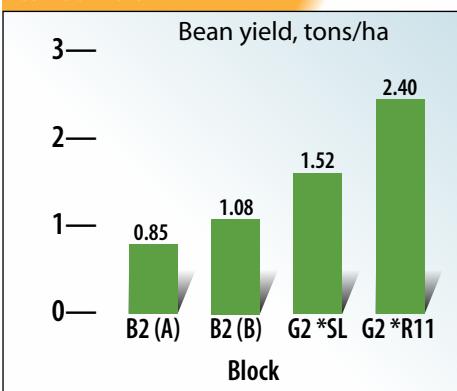
Fertilizer, Vitazyme, and Twin N applications:

Block	Area	Fertilizer ¹	Vitazyme	Twin N	Yield	Total cost	Cost/Ton ²	
					tons/ha	ksh	ksh	\$U.S.
B2 (A)	3.89 ha	Rock phosphate CAN in three equal applications: pre-flower, at flower, fruit expansion	0	0	0.85	52,899	16,079	195
B2 (B)	3.57 ha	Rock phosphate 22-6-12% N-P ₂ O ₅ -K ₂ O replaces CAN; same as B2(A)	0	0	1.08	97,546	25,337	306
G2 *SL	1.20 ha	Rock phosphate	1 L/ha pre-flower, at flower, fruit expansion	1 ha vial pre-flower, at flower, fruit expansion	1.52	15,600	8,159	99
G2 *R11	0.50 ha	Rock phosphate	1 L/ha pre-flower	1 L/ha vial pre-flow	2.40	5.200	4,125	50

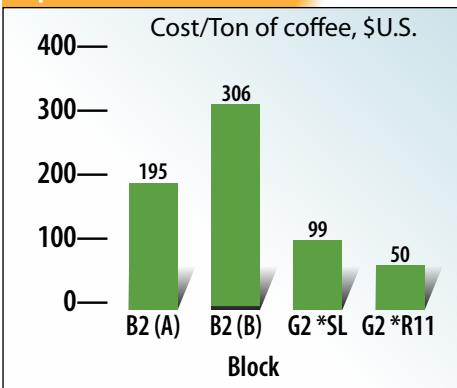
¹Costs: CAN = 1,603 ksh/bag; 22-6-12 = 2,567 ksh/bag; TwinN = 3, 400 ksh/vial; Vitazyme = 1,800 ksh/liter.

²\$1.00 U.S. = 82.5 ksh.

Coffee Yield



Input Cost/Ton of Coffee



Average yield of B2(A) and B2(B): 0.97 tons/ha
 Average yield of G2 *SL and G2 *R11: 1.96 tons/ha
 Change in average yield with Vitazyme+TwinN: 0.99 tons/ha

Quality results:

Block	Coffee grade	
	AA	A8
	%	%
B2 (A)	12	48
B2 (B)	6	51
G2 *SL and G2 *RII*	20	44

*Averaged values.

Conclusion: A coffee trial in Kenya, comparing conventional fertilizers with Vitazyme and TwinN, revealed that a single 1 liter/ha Vitazyme + 1 vial/ha TwinN application greatly improved the yield of coffee beans, by 147% over the average of the untreated conventional blocks. The average of the two treated blocks produced a 102% yield increase, while input costs were greatly reduced. Conventional block input costs were \$185 to \$306 U.S., while Vitazyme+TwinN costs dropped to only \$50 to \$99 U.S. The program also improved the grades of the coffee beans.

Comments by Lachlan Kenya Ltd. personnel are as follow:

"These nutrition programs have been used for three consecutive years and the farmer comments that he can no longer afford to NOT use the Lachlan program due to cost saving, yield increase and improvement in quality. Vitazyme is now being applied with all foliar fertilizers, with the estate now looking at complimenting the Rock Phosphate application with 4 timed foliar sprays of a soluble P (Amcopaste 20:50:10) per year. Summary conclusions are:

- Vitazyme+TwinN increased yields by > 50% compared to the conventional fertilizer program (with some varietal differences indicating up to 180% increase).
- Vitazyme+TwinN greatly reduced the cost of production.
- Vitazyme+TwinN improved the percentage of AA grade beans (higher payment premium).
- Workers reported dark green leaves, uniform flowering, and full bearing at fruiting in Vitazyme plots compared to the conventional plots.

Vitazyme Field Tests for 2019



Corn with Vitazyme application

Researchers: Leonel Yaeggy and Luis Pedro Barneond

Research company: Duwest Guatemala **Grower:** Agronomist Manolo Tuna

Location: Valle Oro (Golden Valley) Farm, Taxisco, Santa Rosa, Guatemala

Variety: Pioneer Biogene **Planting date:** December 10, 2018

Experimental design: A seven-hectare corn field was divided into treated and untreated areas to evaluate the effect of Vitazyme on the yield of leaves and ears.

① Control ② Vitazyme

Fertilization: All fertilizers were water soluble, applied through the irrigation system.

Days after planting	Fertilizer	
10 (December 20)	Nutrex (20-20-20 % N-P ₂ O ₅ -K ₂ O) at 17.9 kg/ha	
20 (December 30)	Nitro-Xtend (46-0-0 % N-P ₂ O ₅ -K ₂ O) at 77.8 kg/ha	
30 (January 9)	Hidrosol N-Calcio (calcium nitrate: 25.5% Ca + 14% nitric N + 1.5% NH ₄ -N) at 17.9 kg/ha	
40 (January 19)	Hidrosol K-NO (K-nitrate; 46-0-46% N- P ₂ O ₅ -K ₂ O at 17.9 kg/ha + 77.8 kg/ha later	

Vitazyme application: (1) Seed treatment with 125 ml on 18 kg of seeds;

(2) 1.4 liters/ha foliar spray 24 days after planting on January 3, 2019

Harvest dates: March 4 to 15, 2019

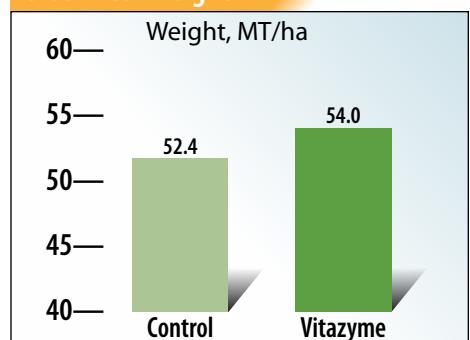
Yield results: Values given are the average of the plots harvested.

Treatment	Green leaves	Green leaf	Corn ears	Ear change
		MT/ha		
1. Control	52.4	—	10.22	—
2. Vitazyme	54.0	1.6 (+3%)	11.00	0.78 (+8%)

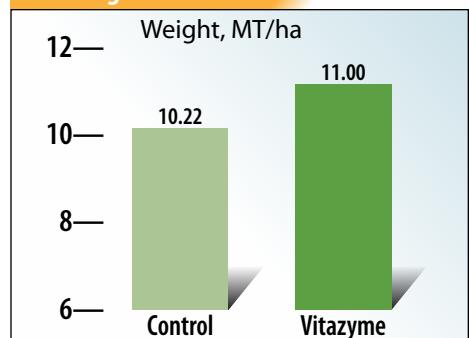
Increase in green leaf yield with Vitazyme: 3%

Increase in ear yield with Vitazyme: 8%

Green Leaf Weight



Ear Weight



Conclusions: This Guatemala corn trial, using two Vitazyme applications (seed and foliar), showed that small but significant increases in leaf and ear yields were obtained. Largest increases were in ear weight so that the ear/forage ratio was increased from 19.5% (Control) to 20.4% (Vitazyme). This program thus is shown to provide valuable increases in corn production in Guatemala.

Corn with Vitazyme application—A Study on Synergism with Bio Seed & Environoc 401



Researchers: Steve Schmidt and Bert Schou, Ph.D.

Research organization: ACRES Research, Cedar Falls, Iowa **Location of trial:** Denver, Iowa

Variety: P0574AM Roundup Ready **Planting date:** May 13, 2019 **Planting depth:** 2 inches **Row spacing:** 30 inches

Soil type: Floyd loam and Clyde silty clay loam; pH=5.7, organic matter = 2.2%, cation exchange capacity = 12.7 meq/100g of soil; N = 64 lb/acre, S = 13 ppm, P₂O₅ = 139 lb/acre, Ca = 2,672 lb/ha, Mg = 450 lb/ha, K = 175 lb/acre, Na = 10 lb/acre, B = 1.6 ppm, Fe = 320 ppm, Mn = 26 ppm, Cu = 1.4 ppm, Zn = 5.8 ppm, Percent base saturations: Ca = 53%, Mg = 15%, K = 1.8%, Na = 0.2%, H = 25%.

Planting rate: 35,600 seeds/acre **Tillage:** strip-tillage

Experimental design: A small-plot corn trial, using plots that were 15 x 30 feet (five replications), was established in a randomized complete block design, using seven treatments with different methods and rates of Vitazyme application, plus the addition of two microbial products for two treatments, to evaluate their effects on corn grain yield.

Treatment
1. Control
2. Vitazyme in-furrow at 13 oz/acre (1 liter/ha)
3. Vitazyme in-furrow at 26 oz/acre (2 liters/ha)
4. Vitazyme in-furrow at 13 oz/acre (1 liter/ha) + Bio Seed in-furrow at 50g/acre
5. Vitazyme in-furrow at 13 oz/acre (1 liter/ha) + Environoc 401 in-furrow at 16 oz/acre (1.3) liters/ha)
6. Vitazyme sprayed on the leaves and soil at V8, at 13 oz/acre (1 liter/ha)
7. Vitazyme pre-treated on the seeds at 5 oz/acre (0.4 liter/ha)



In this trial there is a noted progression in ear development from seed, to foliar, to seed plus foliar treatment.



The corn treated with Vitazyme on both the seeds and the leaves displays much greater vigor in the root systems than the control.



This replicated trial with ACRES Research proved the value of Vitazyme as a yield promoter, during a wet year.

Fertilization: At planting, 11 gal/acre of 28% UAN; side-dressed on June 11, 11.5 gal/acre of 32% UAN. Total application of N was about 70 lb/acre for all areas.

Vitazyme application: All in-furrow treatments occurred on May 13, and foliar/soil treatments at V8 were made on July 2.

Bio Seed application: Bio Seed is an array of beneficial bacteria and fungi that populate the root zone. It was applied in-furrow along with Vitazyme for Treatment 4.

Environoc 401 application: Environoc 401 is a selection of beneficial microbes that populate the root zone. It was applied in-furrow along with Vitazyme for Treatment 5.

Hericide treatments: Pre-emergent on May 18: Corvus (5.6 oz/acre), Roundup (1 quart/acre), and Atrazine (1 lb/acre).

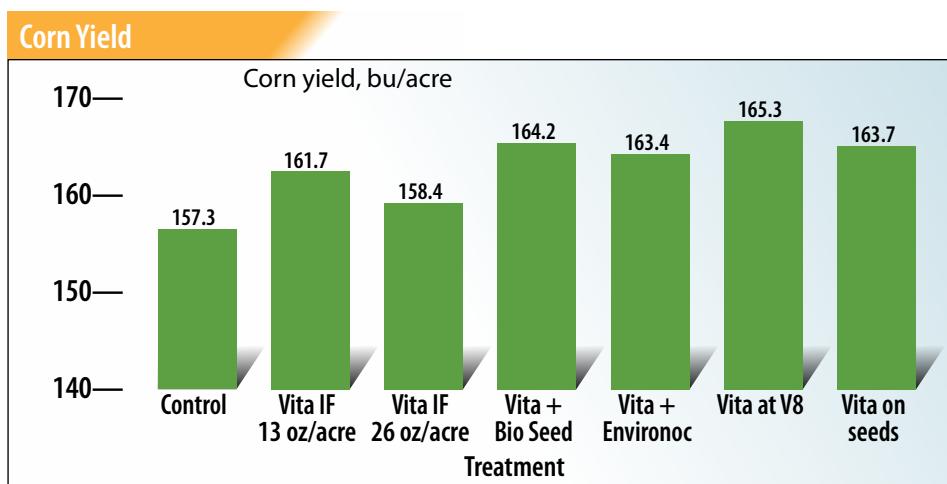
Post-emergent on June 17: Callisto (3 oz/acre), Atrazine (0.5 lb/acre), and Spray-Tec Fulltec (1.6 oz/acre).

Harvest date: November 4, 2019, using an MF 8 plot combine, harvesting the inner two rows of each plot

Yield results: There were no significant differences among all treatments for plant population and grain moisture content.

Treatment	Grain yield ¹	Yield change
	bu/acre	bu/acre
1. Control	157.3	—
2. Vitazyme in-furrow, 13 oz/acre	161.7	4.4 (+3%)
3. Vitazyme in-furrow, 26 oz/acre	158.4	1.1 (+1%)
4. Vita + Bio Seed in-furrow	164.2	6.9 (+4%)
5. Vita + Environoc 401 in-furrow	163.4	6.1 (+4%)
6. Vitazyme at V8, at 13oz/acre	165.3	8.0 (+5%)
7. Vitazyme on seeds, 5 oz/acre	163.7	6.4 (+4%)

¹Adjusted to 15.5% moisture. LSD = 10.1 bu/acre.



Weather for the growing season: wetter than normal in the early and latter part of the growing season

Conclusions: A small-plot replicated corn trial in eastern Iowa in 2019 revealed that small but consistent increases in yield were realized for all six Vitazyme treatments. The largest increase was 8 bu/acre (5%) with the 13 oz/acre (1 liter/ha) foliar spray at V8. All other responses were 3 to 4%, including the Bio Seed and Environoc 401 treatments, except for Vitazyme in-furrow at 26 oz/acre (2 liters/ha). This cooler and wetter year produced a slightly greater response from a foliar spray than for seed and in-furrow applications.

Corn with Vitazyme application

Researchers: Luciano Frias (Quimica Lucava), Guillermo Cisneros (Magussa), and Dr. Juan Carlos Diaz (Ag Biotech)

Growers: Gustavo Figueroa Ramirez and Gustavo Figueroa Reulas

Location: El Fresno Farm, Cofradia de Lepe, Jalisco, Mexico

Variety: Asgrow **Planting date:** June 28, 2018

Experimental design: A 4-hectare portion of a corn field was treated with Vitazyme to evaluate the effect of the product on corn growth and yield in a field setting.

1 Control 2 Vitazyme

Fertilization: unknown

Vitazyme application: (1) Seed treatment on June 28 of

0.25 liter of Vitazyme in 0.25 liter of water (50% solution) to coat seeds for 1 hectare;

(2) 1 liter/ha sprayed by backpack sprayer at the 6-leaf stage;

(3) 1 liter/ha sprayed by backpack sprayer at the 9-leaf stage.

Six days after planting (July 4): Vitazyme treated seeds had much better root development, 6 roots vs. 3.5 roots.

Thirteen days after planting (July 1): Again Vitazyme showed much better root and leaf development.

Twenty-eight days after planting (July 26): Treated plants were larger and darker green, having more chlorophyll.

Sixty-two days after planting (August 29): Vitazyme treated plants were observed to have greater stalk diameters and taller plants. Part of the control area was drought-affected, but no such stress was noted in the treated area.

111 days after planting (October 17): Vitazyme treated plants had.

- Taller plants
- Greater leaf area
- Better root development
- Improved ear fill

Yield and income results: The plots were harvested on January 10, 2019.

Parameter	Control	Vitazyme
Plant fresh weight, grams	1,020	2,720 (+167%)
Ear fresh weight, with husk, grams	340	530 (+56%)
Ear fresh weight no husks, grams	250	350 (+40%)
Shelled corn yield, tonnes/ha	10.5	14.0 (+33%)
Shelled corn yield, bu/acre	167	223 (+33%)
Total income, U.S. \$/acre	839	1,118 (+33%)
Cost of Vitazyme, U.S. \$/acre	—	25.41
Net, U.S. \$/acre	839	1,093 (+30%)
Cost: Benefit Ratio		10:1



The Vitazyme treated corn (above) displays excellent ear development, with filling to the tip and large kernels, giving a 35% greater yield than the control.

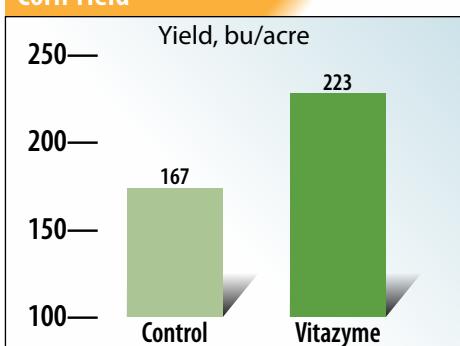
Growth was enhanced greatly in this Mexican corn trial.



A seed treatment (right) on corn in Mexico caused considerably better rooting, right from the beginning of the growth cycle, as is evidenced only days after planting. The yield increase was 33%, and the net return was 30% higher with Vitazyme.



Corn Yield



Conclusion: This Mexican corn trial revealed that Vitazyme, applied to the seeds, and then 1.0 liter/ha to the leaves at both the 6 and 9-leaf stages, produced an excellent 33% yield increase. Signs of this improvement were evident throughout the growing season, since root development, plant height, and leaf mass were all improved with these three applications. These results show the great value of the Vitazyme program for corn production in Mexico, as evidenced by a 33% yield increase and a cost: benefit of 10:1.

Corn with Vitazyme application



The experimental corn plots at South Dakota State University reveal good growth, but with excessive rains the fertilizer nitrogen was leached or denitrified to a large degree, giving mixed results for the lower application rates.

Researcher: David Clay Ph. D., and Graig Reicks

Research institution: Department of Plant Sciences, South Dakota State University, Brookings, South Dakota

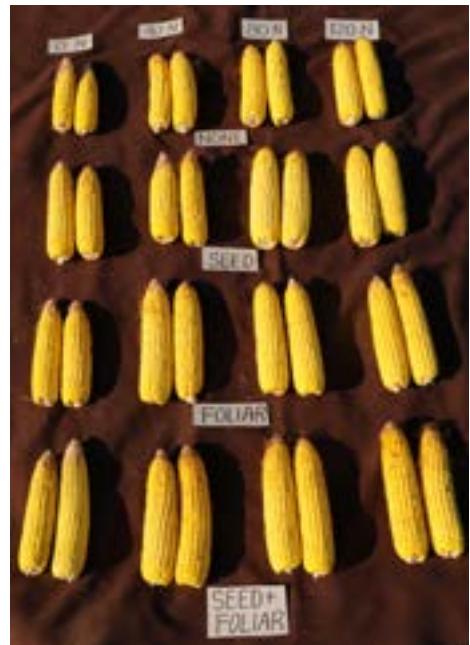
Location: South Dakota State University, Field Research Facility, Aurora, South Dakota

Variety: **Planting date:** May 17, 2019

Planting rate: 33,500 seeds/acre **Planting depth:** 2 inches

Row spacing: 30 inches **Soil type:** Brandt silty clay loam

Experimental design: A small plot corn study, with plots six rows wide (15 feet) and 20 feet long using four replications, was arranged in a randomized complete block design. At harvest a 20-foot section of each plot, using the two middle rows, was harvested by hand. Four nitrogen rates and three Vitazyme application variations were used to determine the effects of nitrogen and Vitazyme regimes on the yield of corn grain. Nitrogen and water use efficiency will be evaluated during the coming months once ^{15}N and ^{13}C analyses are completed.



Sample corn ears from all 16 treatments reveal a progressive improvement in ear development moving towards the lower right corner, which has the seed plus foliar Vitazyme treatment and a 43% yield increase.

	Nitrogen rate lb/acre	Vitazyme treatment	
		Seeds	Foliar
1.	120	x	x
2.	120	o	x
3.	120	x	o
4.	120	o	o
5.	80	x	x
6.	80	o	x
7.	80	x	o
8.	80	o	o
9.	40	x	x
10.	40	o	x
11.	40	x	o
12.	40	o	o
13.	0	x	x
14.	0	o	x
15.	0	x	o
16.	0	o	o



Note the excellent responses to all Vitazyme applications at the 120 lb/acre nitrogen rate, with yield increases of 22 to 43%. The combined seed plus foliar application did the best.

Fertilization: Nitrogen fertilizer was applied by hand to the soil surface as urea (46% N) to appropriate plots on June 19, 2019. The corn was at the V3 growth stage. The urea was coated with Factor urease inhibitor, at 3.25 quarts/ton of urea.

Vitazyme application: (1) **Seed treatment:** 8 oz/acre of Vitazyme equivalent applied to the seeds of appropriate plots just before planting. (2) **Foliar treatment:** 13 oz/acre sprayed on appropriate plots on July 2, with 22.4 gal/ha using TTI II003 nozzles at 30 PSI. Interlock drift retardant was added at 0.75%. The corn was at VG growth stage.

Growing season weather: The year was very cold and wet in the spring, with record rainfall for the season. Nutrient leaching and denitrification were active.

Yield results: An Analysis of Variance was performed on the data from all 64 plots

Vitazyme Effects at Nitrogen Levels			
N rate	Vitazyme treatment	Yield ¹	Yield change ²
lb/acre	lb/acre	bu/acre	bu/acre
120	Seed + Foliar	203 a	+ 43
	Foliar	182 b	+ 22
	Seed	183 b	+ 23
	None	160 c	—
	Mean	185	
80	Seed + Foliar	163 a	-11
	Foliar	165 a	-9
	Seed	164 a	-10
	None	174 a	—
	Mean	167	
40	Seed + Foliar	165 a	-2
	Foliar	149 a	-18
	Seed	157 a	-10
	None	167 a	—
	Mean	160	
0	Seed + Foliar	124 b	-24
	Foliar	142 ab	-6
	Seed	158 a	+ 10
	None	148 a	—
	Mean	143	

¹Means followed by the same letter are not significantly different at P=0.10.

²Comparisons are made within the same N level.

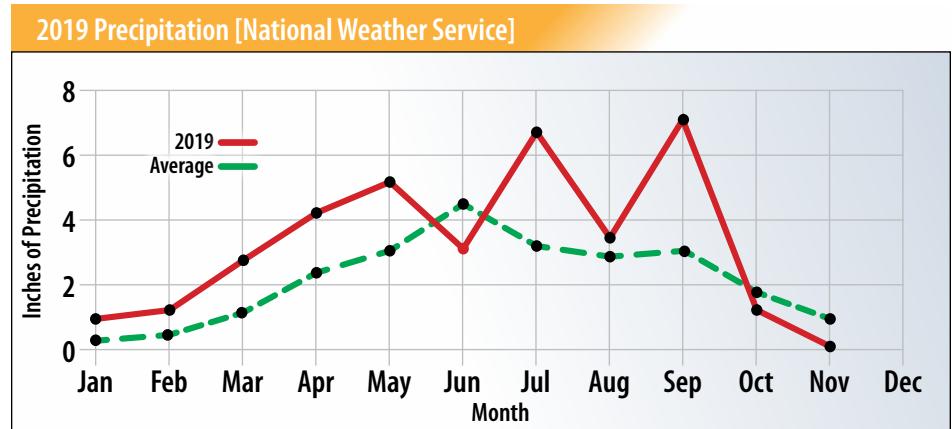
Nitrogen Effects at Vitazyme Levels			
Vitazyme treatment	N rate	Yield ¹	Yield change ²
lb/acre	lb/acre	bu/acre	bu/acre
None	120	180 ab	+32
	80	174 a	+26
	40	167 ab	+19
	0	148 b	—
	Mean	167	
Seed	120	183 a	+25
	80	164 a	+6
	40	157 a	-1
	0	158 a	—
	Mean	166	
Foliar	120	182 a	+40
	80	165 b	+23
	40	149 bc	+7
	0	142 c	—
	Mean	160	
Seed & Foliar	120	203 a	+79
	80	163 b	+39
	40	165 b	+41
	0	124 b	—
	Mean	164	

¹Means followed by the same letter are not significantly different at P=0.10.

²Comparisons are made within the same Vitazyme application regime.

Conclusions: The results of this Vitazyme study on corn at South Dakota State University were quite different than with previous years' studies, when the yields were promoted by Vitazyme applications at all nitrogen levels. It is apparent that severe leaching and/or denitrification of nitrogen occurred during this extremely wet year, in fact the wettest on record. The rainfall amounts are given in the accompanying table.

Note that the growing season rainfall was 30.43 inches, far above the average rainfall for that period by 61%. This excessive rainfall surely caused significant nitrate leaching and denitrification, which is strongly indicated by the Vitazyme Effects table: the average yields for 40 and 80 lb/acre N were 160 and 167 bu/acre, respectively, not a great deal more than the 143 bu/acre average for the 0 N rate. There was apparently not enough N for Vitazyme to work with at these two N rates after excessive leaching and denitrification had occurred. On the other hand, at the highest N rate of 120 lb/acre there was enough N remaining after losses to allow Vitazyme to improve N efficiency, as has been observed with ¹⁵N studies at South Dakota State University during previous studies. The excellent responses at this N rate are shown in the graph.



Total precipitation for 2019 (minus December): 36.96 in.

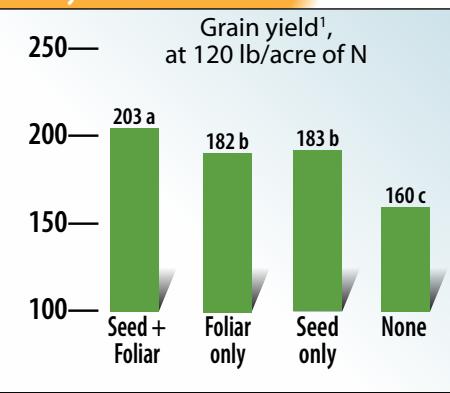
Average precipitation (minus December): 23.77 in.

Total growing season precipitation (April to September): 30.43 in.

Average growing season precipitation (April to September): 18.90 in.

Excess growing season precipitation above average: 11.53 in. (+61%)

Vitazyme Effects on Corn



Vitazyme Corn Grain Yield Increases with 120 lb/acre of N

<i>Seed + Foliar treatment.....</i>	43%
<i>Foliar treatment</i>	22%
<i>Seed treatment.....</i>	23%

These results illustrate the unpredictability of the weather to influence corn productivity, in South Dakota or anywhere. Nitrogen losses caused lower than average corn yields throughout the Brookings area in 2019, as well as in many areas of the Corn Belt affected by heavy precipitation. Nitrogen leaching and denitrification, as well as late planting from the excessive rains, contributed greatly to yield declines in 2019, and for many acres the inability to plant a crop. The results also demonstrate Vitazyme's ability to assist the crop in making better use of nitrogen that yet remains in the root zone due to high rainfall.

Corn with Vitazyme application

Vitazyme Field Tests for 2019



Researcher: V. V. Plotnikov

Research organizations:

Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: ALLC "Lan", Smila District, Cherkasy Region, Plosky Village, Ukraine; Central Ukraine (440-590 mm of precipitation per year)

Variety: DKS 5141, FAO 430 **Planting date:** April 22, 2019

Planting rate: 70,000 seeds/ha

Previous crop: winter wheat

Soil type: typical Chernozem (humus = 4.0 %)

Field preparation: disking to 6-8 cm, plowing to 22-24 cm, harrowing to 5-6 cm

Experimental design: A corn field was divided into conventionally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield of the corn grain.

① Control ② Vitazyme

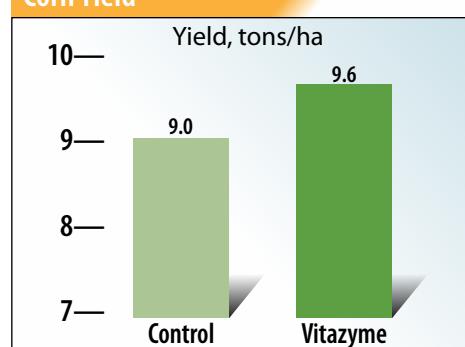
Fertilization: 123 kg/ha of N applied before planting; 8-24-24 kg/ha of N-P₂O₅-K₂O applied at planting

Vitazyme application: 0.5 liter/ha sprayed on the leaves and soil at the 5 to 6-leaf stage on May 22.

Yield results:

Treatment	Yield tons/ha	Yield change tons/ha
Control	9.0	—
Vitazyme	9.6	0.6 (+7%)

Corn Yield



As for other corn trials in Ukraine in 2019, root and ear development were noticeably enhanced when Vitazyme was applied, even at less than optimal rates.

Income results: The extra 0.6 tons/ha gave \$81/ha more income.

Conclusion: A corn trial using Vitazyme in Central Ukraine, the product applied once at 0.5 liter/ha at the 5 to 6-leaf stage, revealed that this reduced application rate nevertheless produced a highly profitable \$81/ha income increase from a 7% yield increase. This program is shown to be a valuable adjunct to corn growing programs in Ukraine.

Increase in grain yield with Vitazyme: 7%

Corn with Vitazyme application



Improved leaf and chlorophyll development is an expected response to the Vitazyme program in Ukraine, as for all countries under a diversity of climatic and soil conditions.



Corn grown with Vitazyme in Ukraine displays considerably better ear development than the untreated control. The yield with Vitazyme was 11% greater.

Researcher: V. V. Plotnikov

Research organizations:

Plant Designs International,
Rochester, New York, and Agro Expert
International, Kaharlyk, Ukraine

Location: Drabiv District, Cherkasy
Region, Novomykolaivka Village,
Ukraine; Central Ukraine (440-590 mm
of precipitation per year)

Variety: ES Method, FAO 380

Planting date: April 26, 2019

Planting rate: 70,000 seeds/ha

Previous crop: winter wheat

Soil type: typical Chernozem (humus = 4.1%)

Field preparation: disking to 6-8 cm,
harrowing to 22-24 cm, cultivation to 5-6 cm

Experimental design: A corn field was
divided into conventionally treated and
Vitazyme treated portions to evaluate the
effects of Vitazyme on the yield of the grain.

1 Control 2 Vitazyme

Fertilization: 123 kg/ha of N applied

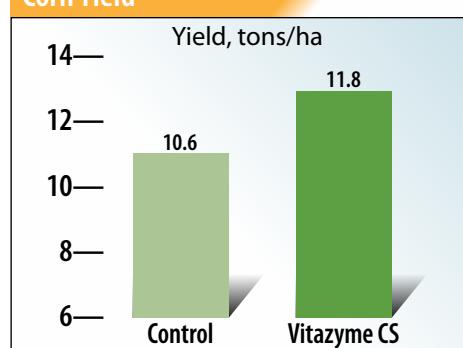
before planting and cultivated in;
8-24-24 kg/ha of N-P₂O₅-K₂O at planting

Vitazyme application: Seeds were
treated with Vitazyme on April 23 to
give an equivalent of 0.5 liter/ha as
planted; then 1 liter/ha was sprayed
on the leaves and soil at the 7 to 8-leaf
stage on May 29.

Yield results:

Treatment	Yield tons/ha	Yield change
		tons/ha
Control	10.6	—
Vitazyme	11.8	1.2 (+11%)

Corn Yield



Increase in grain yield
with Vitazyme: 11%

Income results: The additional 1.2 tons/ha of corn grain with Vitazyme created \$175/ha more income.

Conclusion: A corn trial in Ukraine utilizing Vitazyme on both the seeds and leaves produced an excellent gain in yield of 11%, showing the efficacy of this program for improving corn production. Income increased by \$175/ha.

Corn and Soybeans with Vitazyme application



A Summary of Research at the University of Missouri: From a paper presented at the Fourth International Congress on Biostimulants—Barcelona, Spain, November, 2019

Vitazyme Improves Plant Growth, Soil Health, & Tolerance to Glyphosate Stress

Authors: Manjula V. Nathan, Robert J. Kremer, Paul W. Syltie, Timothy M. Reinbott, Kelly A. Nelson, and Xiaowei Pan

Research organization: Division of Plant Sciences, University of Missouri, Columbia, Missouri, USA

Objectives:

- Determine effects of Vitazyme on selected soil health indicators
- Determine effects of Vitazyme on rhizosphere biology in transgenic soybean and maize treated with glyphosate

Experimental Methods:

- Field trials conducted at Columbia (2014) and Novelty (2016-17) Missouri on Mexico silt soil (fine, smectitic, mesic Vertic Epiaqualfs)
- Maize and soybean planted conventionally using minimum tillage; plants and soils collected at R2 soybean & V10 maize growth stage
- Root-colonizing *Fusarium* assessed by selective culture technique (Levesque et al. 1993)
- Rhizosphere pseudomonads determined using S1 agar medium (Gould et al. 1985)
- Indoleacetic acid-producing (IAA) bacteria detected on nitrocellulose membranes reacted with Salkowski reagent for color development (Bric et al. 1991)
- Mn-transforming bacteria detected on Gerretsen's medium (Huber & Graham 1992)
- Glucosidase activity detected using enzyme assay of Eivazi & Tabatabai (1988)
- Soil microbial components and biomass determined using phospholipid fatty acid (PLFA) analysis (Buyer & Sasser 2012; Pritchett et al. 2011)

Root growth results: Vitazyme improved soil health indicators and overcame glyphosate effects on maize and soybean

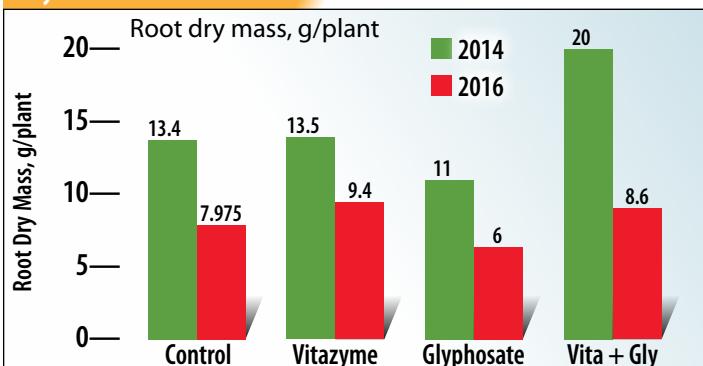


Soybean root biomass enhanced by Vitazyme

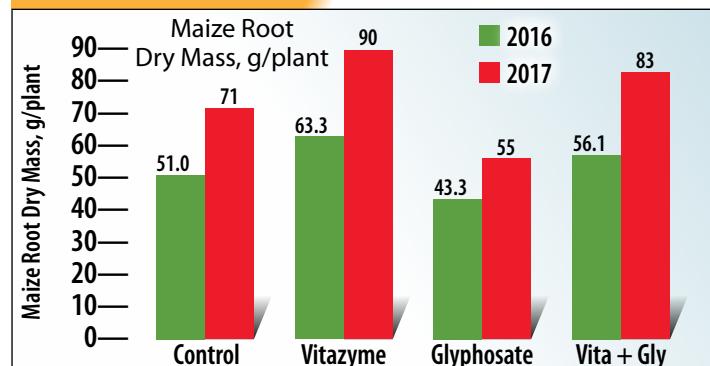


Maize root biomass enhanced by Vitazyme

Soybean Root Biomass



Maize Root Biomass



Biostimulant improved root biomass in both soybean and maize each year relative to no treatment. Biostimulant overcame detrimental effects of glyphosate on root growth in both crops.

Root Fusarium colonization results: Vitazyme significantly reduced colonization of roots by potentially pathogenic *Fusarium* fungal species.

Soybean root colonization by *Fusarium* spp.

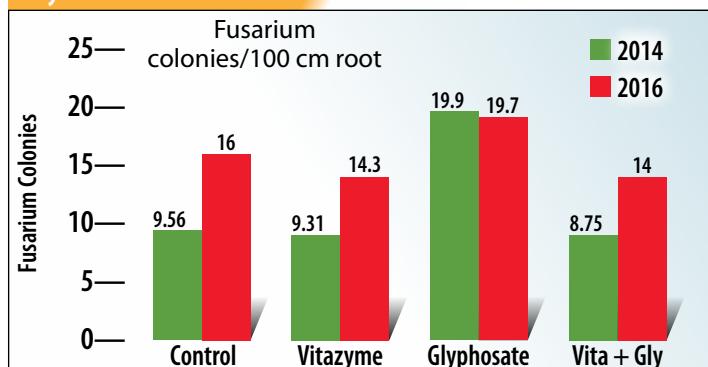


Maize root colonization by *Fusarium* spp.

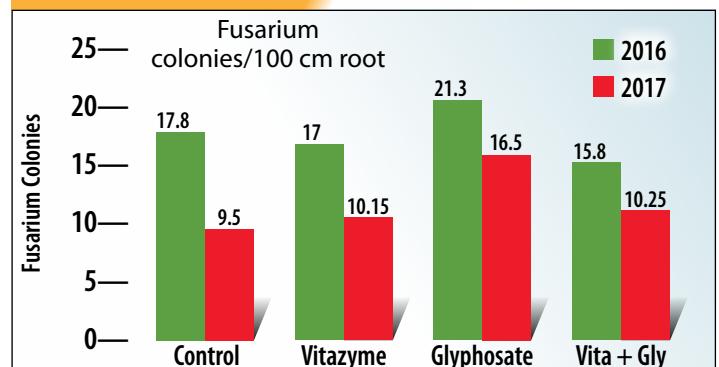


Note reduced fungal growth density on field-collected root by Vitazyme treatment compared with roots from plants receiving glyphosate herbicide. Glyphosate induces colonization and infection of roots of both transgenic and non-transgenic crops by soilborne pathogenic fungi (Johal & Huber 2009; Kremer & Means 2009)

Soybean Fusarium



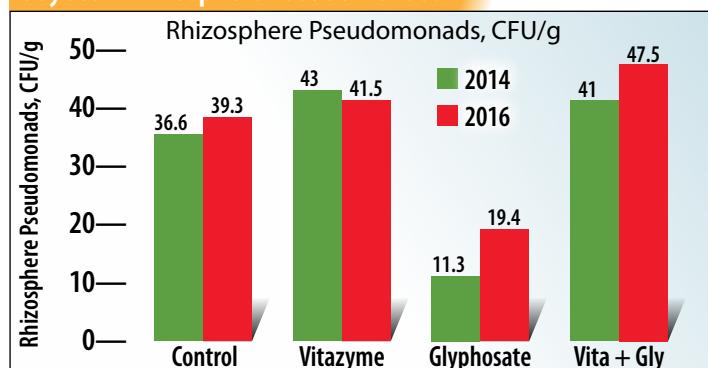
Maize Fusarium



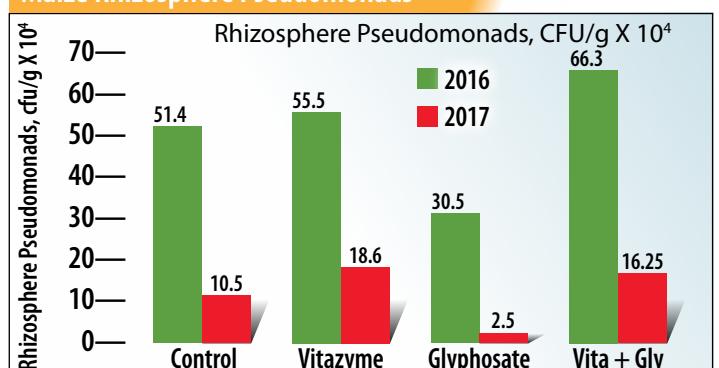
Vitazyme reduced *Fusarium* colonization of roots on both soybean and maize each year relative to no treatment. Vitazyme overcame detrimental effects of glyphosate in reducing root *Fusarium* in both crops. Values above bars are colonization density per 100 cm root or % colonization.

Rhizosphere Fluorescent Pseudomonad results: Vitazyme improved rhizosphere fluorescent pseudomonads, which are soil bacteria that contribute beneficial plant growth-promoting functions, and were significantly increased in both glyphosate-treated crops

Soybean Rhizosphere Pseudomonads

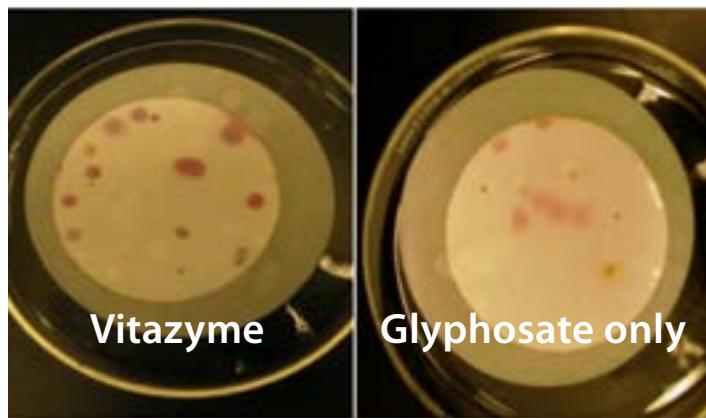


Maize Rhizosphere Pseudomonads

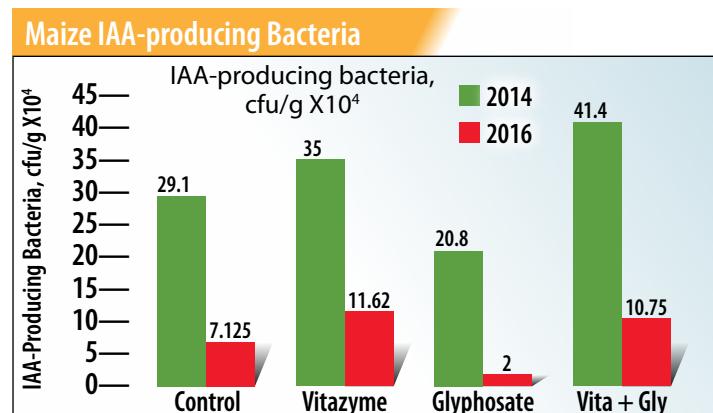
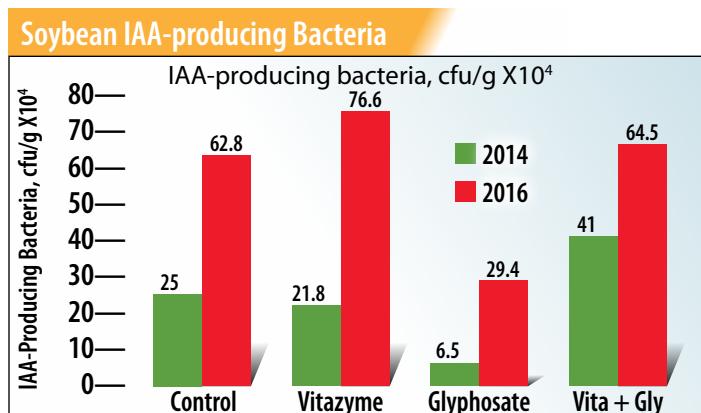


Vitazyme improved rhizosphere pseudomonads. Vitazyme was very effective in overcoming detrimental effects of glyphosate on pseudomonad abundance.

Rhizosphere IAA-producing bacteria results: Vitazyme improved rhizosphere indole-acetic acid producing (IAA) rhizobacteria, which are soil bacteria that provide IAA for various plant functions including root growth stimulation.



Bacterial colonies attached to membrane show IAA production detected via pink color reaction with Salkowski reagent saturated in the membrane. Intensity of color also indicates IAA concentration.



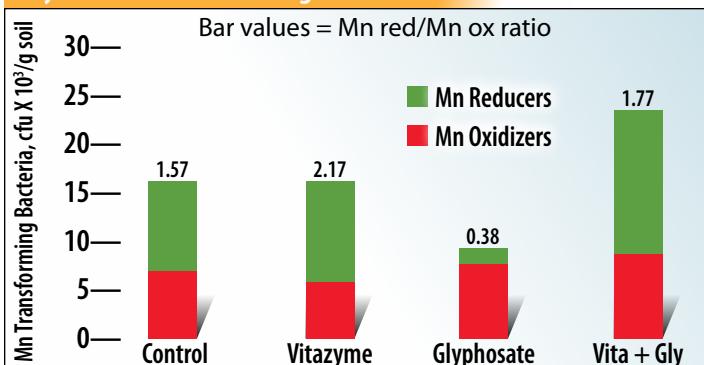
Vitazyme enhanced rhizosphere IAA bacteria abundance on both soybean and maize. Vitazyme was very effective in overcoming detrimental effects of glyphosate on IAA-producing rhizobacteria.

Rhizosphere Mn-transforming bacteria results: Mn-reducing microorganisms provide available Mn (reduced) for plant and microbial uptake. Glyphosate increases Mn-oxidizing microorganisms and limits Mn availability in the rhizosphere.

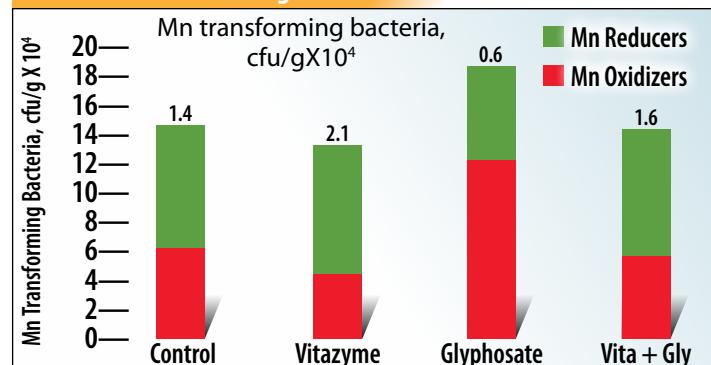


Mn-transforming bacteria on selective medium; Mn oxidizers appear black; Mn reducers are white and form halos.

Soybean Mn Transforming Bacteria



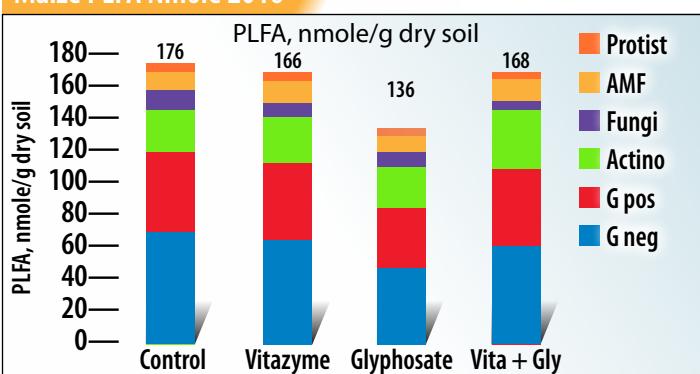
Maize Mn Transforming Bacteria



For soybean and maize, Mn reducers and Mn-reducer: Mn-oxidizer ration increased with Vitazyme; Mn-reducers significantly decreased by glyphosate; Vitazyme overcame glyphosate effects—increasing Mn-reducers and the ratio.

Soil microbial community results: Vitazyme maintained soil microbial community composition (phospholipid fatty acid [PLFA] groups) and total microbial biomass in glyphosate-treated crops.

Maize PLFA Nmole 2016



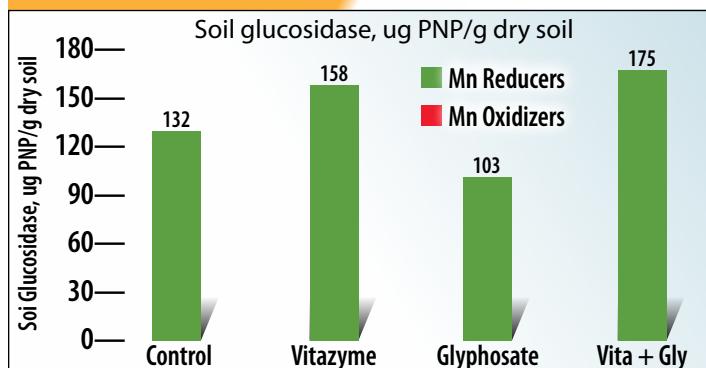
Key:

- Protist—protozoa
- AMF—arbuscular mycorrhizal fungi
- Fungi—non-mycorrhizal fungi
- Actino—actinobacterial or actinomycetes
- G pos—Gram-positive bacteria
- G neg—Gram-negative bacteria

Maize rhizosphere soil microbial diversity. Vitazyme significantly increased diversity of microbial groups and total microbial biomass in the glyphosate treatment. Abundance of mycorrhizae, the symbiotic fungi involved in P and water translocation, was improved with Vitazyme. NOTE: Values above each bar = Total PLFA (representative of microbial biomass)

Soil glucosidase activity results: Vitazyme enhanced glucosidase activity, a bioindicator of soil health and soil biological activity, in both control and glyphosate treatments.

Maize Soil Glucosidase 2016

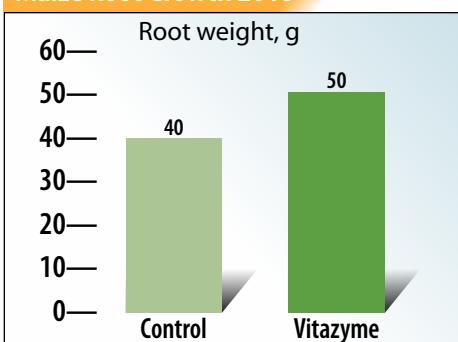


Soybean rhizosphere soil microbial activity indicated by soil glucosidase, a carbon -cycling enzyme.

Conclusions: Vitazyme supplements soil health function and plant growth.



Maize Root Growth 2018



Root mass of Pioneer hybrid: 25%
Increase with biostimulant (2018)

- Multiple assessments of sensitive biological indicators of soil health successfully evaluated Vitazyme as a factor in suppressing effects of glyphosate on root growth and rhizosphere biology in transgenic cropping systems and improving soil health.
- Soil microbial diversity (PLFA groups) was restored by Vitazyme in soils planted to maize and soybean treated with glyphosate. High soil microbial diversity is essential to maintain a stable ecosystem and crop productivity.
- Vitazyme use can be a major management factor for addressing productivity problems and declining soil health associated with transgenic crops in current crop production systems.

References:

- Bric, J.M., Bostock, R.M., Silverstone, S.E., 1991.** Rapid in situ assay for indoleacetic acid production by bacteria immobilized on a nitrocellulose membrane. *Applied & Environmental Microbiology* 57:535-538.
- Buyer, J.S., Sasser, M., 2012.** High throughput phospholipid fatty acid analysis of soils. *Applied Soil Ecology* 61:127-130.
- Eivazi, F., Tabatabai, M.A., 1988.** Glucosidases and galactosidases in soils. *Soil Biology & Biochemistry* 20:601-606.
- Gould, W.D., Hagedorn, C., Bardinelli, T.R., Zablotowicz, R.M., 1985.** New selective medium for enumeration and recovery of fluorescent pseudomonads from various habitats. *Applied & Environmental Microbiology* 49:29-32.
- Huber, D.M., Graham, R.D., 1992.** Techniques for studying nutrient-disease interactions. In Singleton, L.L. et al. (eds.), *Methods for Research on Soilborne Phytopathogens*, APS Press, St. Paul, MN. pp. 204-214.
- Kremer, R.J., Means, N.E. 2009.** Glyphosate and glyphosate-resistant crop interactions with rhizosphere microorganisms. *European Journal of Agronomy* 31:153-161.
- Levesque, C.A., Rahe, J.E., Eaves, D.M., 1993.** Fungal colonization of glyphosate-treated seedlings using a new root-plating technique. *Mycological Research* 97:299-306.
- Pritchett, K.A., Kennedy, A.C., Cogger, C.G., 2011.** Management effects on soil quality in organic vegetable systems in western Washington. *Soil Science Society of America Journal* 75:605-615.



The ICAC Recorder

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 International Cotton Advisory Committee

Boosting Yields in Africa, What Technologies Work?

Serunjogi Lastus Katende, Jolly K. Sabune (Mrs.) and Ben Anyama,
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Michael A. Ugen, National Semi-arid Resources Research Institute (NaSARRI),
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Full Paper of a Presentation made at the 6th Breakout Session, during the 77th Plenary Meeting of the International Cotton Advisory Committee (ICAC), Abidjan, Ivory Coast, 2nd – 7th December, 2018

Page 10. Growth Regulators

A few growth-regulating chemicals have been tested and some were found to be useful in boosting plant growth and for insect pest management. In Uganda a chemical called 'Vitazyme' was tested on cotton for three seasons. Vitazyme is known to be a cotton root vigor inducing chemical. It contains highly active bio-stimulating agents from natural plant sources that lead to luxuriant plant growth. Its active ingredients include B-vitamins, folic acid, and other unquantified growth regulators (Syltie, 1985). Vitazyme was tested in combination with the already approved commercial seed dressing chemical "Ctuiser Extra Cotton" used for control of seed borne diseases, like bacterial blight, and known for enhancement of root vigor. Vitazyme was found to be effective in boosting vigor of cotton roots which enabled deeper penetration and wider coverage of soils for tapping of water and nutrients by the cotton crops. In addition to improving plant vigor in the study, Vitazyme led to enhanced seed cotton yields and fiber characteristics compared to the controls. The best results were from the 5% Vitazyme concentration for seed dressing, coupled with one foliar spray on cotton plants using 1 l/ha of Vitazyme at full bloom (Elobu et al, 2018).

Lemons with Vitazyme application

Researchers: Candelario Gomez and Jhony Sanlate

Research organization: Duwest Dominicana, Dominican Republic

Location: Nicolas de los Santos Farm, El Jobo, Padre de las Casas Municipality,

Azua Province, Dominican Republic **Variety:** Persian lemon

Experimental design: A lemon grove was divided into a 0.5 ha area and an adjoining area of similar size, with one parcel treated with Vitazyme and the other serving as an untreated control, to evaluate the effect of this product on lemon yield and quality.

① Control ② Vitazyme

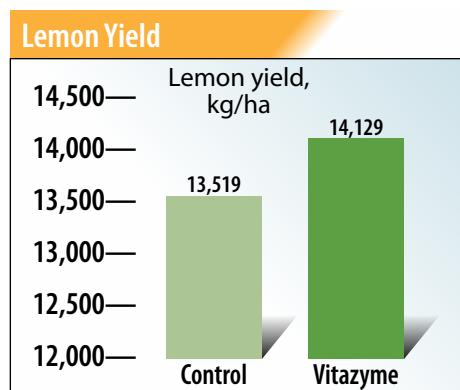
Fertilization: unknown

Vitazyme application: three 1 liter/ha foliar applications of Vitazyme from February to April, 2019

Yield results and observations: Four pickings from March to June, 2019, were totaled.

Treatment	Fruit yield	Yield change
	lb/ha	lb/ha
1. Control	13,519	—
2. Vitazyme	14,129	610 (+5%)

Increase in lemon yield with Vitazyme: 5%



Quality observations:

- Larger fruit size and weight with Vitazyme
- Improved visual quality (color and shape) with Vitazyme
- No phytotoxic effects with Vitazyme

Income results: The added yield gave \$483/ha more income, and with a product cost of U.S. \$60/ha the extra income from the lemon crop was U.S. \$423/ha.

Conclusion: A Persian lemon trial conducted in the Dominican Republic in 2019, using three Vitazyme applications at 1.0 liter/ha each time, produced a 5% yield increase of higher quality fruit (sizes, weight, color, and shape), with no phytotoxic effects from the product. This yield increase gave the farmer U.S. \$423/ha more income. It was anticipated that future pickings would reveal a greater yield improvement for the Vitazyme treated area, and such data may be reported in the future. These results show the very good efficacy of this program for lemon production in the Dominican Republic.

Peas with Vitazyme application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: APC Vlivsianytskii, Koziatyn District, Vinnytsia Region, Vivianky Village, Ukraine; Central Ukraine (440-590 mm of precipitation per year)

Variety: Audit, F2 generation **Planting date:** March 14, 2019 **Planting rate:** 1.1 million seeds/ha

Previous crop: winter wheat **Soil type:** typical Chernozem (humus = 3.9 %)

Field preparation: disking to 6-8 cm, plowing to 22-24 cm, harrowing to 5-6 cm

Experimental design: A pea field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield of the peas.

① Control ② Vitazyme

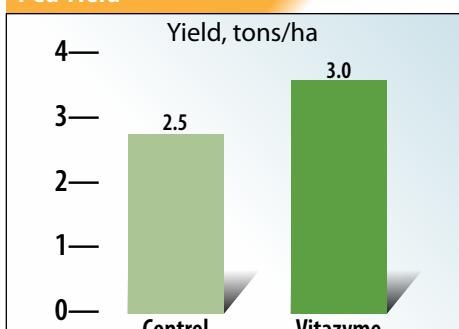
Fertilization: 69 kg/ha of N during cultivation before planting, and 6-26-0 kg/ha of N-P₂O₅-K₂O during planting

Vitazyme application: 1 liter/ha sprayed on the leaves and soil at flower budding, on May 8.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	2.5	—
Vitazyme	3.0	0.5 (+20%)

Pea Yield



Increase in yield with Vitazyme: 20%

Income results: The extra 0.5 ton/ha gave \$81/ha more income.

Conclusion: Peas grown in a field trial in central Ukraine responded very well to a 1 liter/ha foliar-soil spray at flower bud formation. The yield was improved by 0.5 ton/ha (20%), giving an income increase of \$81/ha, showing the effectiveness of this program for pea growers.

Rice with Vitazyme application—A Synergism Study with Bio Seed



This rice trial in Tennessee showed visually improved plant size and grain development for the Vitazyme and Bio Seed treatment on the left.



Notice the heavier grain on the Vitazyme and Bio Seed treated plot to the left. This treatment yielded 20% more than the control plot on the right.

Researchers: E. Bruce Kirksey, Ph.D. **Research organization:** Agricenter International, Memphis, Tennessee

Location: Memphis, Tennessee **Variety:** CL 152 **Planting date:** May 27, 2019

Planting depth: 1.0 inch **Row spacing:** 7.5 inches **Row per plot:** 9

Soil type: Falaya silt loam, pH = 6.5, organic matter = 1.8%, cation exchange capacity = 7.8 meq/100 g of soil, fertility level = good, drainage = good **Planting rate:** 1.5 million seeds/acre

Experimental design: A small-plot dry-seeded paddy rice trial was conducted on the Mississippi River flood plain, using a randomized complete block design with four replications. Each plot was 6 x 30 feet (180 ft²), using five treatments with Bio Seed and Vitazyme to determine the ability of these products to improve rice yield.

Treatment	Bio Seed on seeds	Vitazyme		
		On seeds	Foliar 1 ^a	Foliar 2 ^b
1. Control	0	0	0	0
2. Vitazyme	0	101 ml/acre	0	0
3. Vitazyme + Bio Seed	136 g/cwt	101 ml/acre	0	0
4. Vitazyme + Bio Seed	136 g/cwt	101 ml/acre	13 oz/acre	0
5. Vitazyme + Bio Seed	136 g/cwt	101 ml/acre	13 oz/acre	13 oz/acre

^a13 oz/acre = 1 liter/ha; applied foliar pre-flood.

^b13 oz/acre = 1 liter/ha; applied at the flag leaf stage.

Fertilization: unknown

Vitazyme application: See the table above. Seed treatments were applied using a seed treater on May 27, at planting. Foliar treatments were applied with a sprayer at 28 days after planting (Foliar 1) on June 24, before flooding, and at 58 days after planting (Foliar 2) on July 24.

Bio Seed application: See the table above. Seed treatments were applied using a seed treater on May 27, at planting. Bio Seed is a mixture of bacteria and fungi that are beneficial to seed germination and plant development.

Harvest date: September 11, 2019, using an Almaco plot combine that harvested a 5 x 30 foot (150 ft²) portion of each plot.

Test weight results: Test weights for the five treatments varied from 43.4 to 44.5 lb/bu and did not vary significantly.

Grain moisture results: Grain moisture for the five treatments varied from 19.0 to 19.9 %, and did not vary significantly.

Yield results:

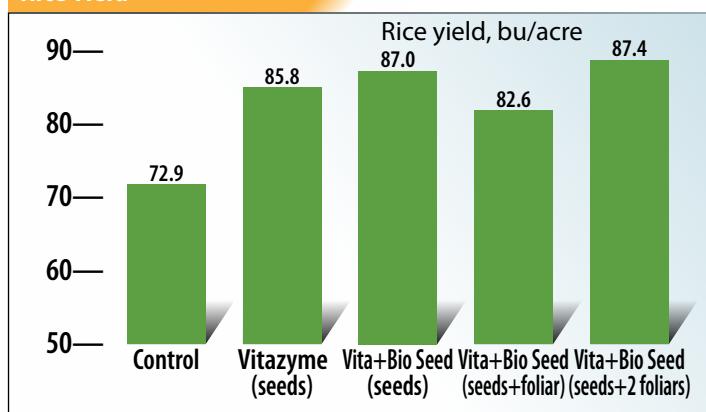
Treatment	Grain yield bu/acre	Yield change	
		bu/acre	bu/acre
1. Control	72.9	—	
2. Vitazyme (seeds)	85.8	12.9 (+18%)	
3. Vitazyme (seeds)+ Bio Seed (seeds)	87.0	14.1*(+19%)	
4. Vitazyme (seeds)+ Bio Seed (seeds)+ Vitazyme (foliar early)	82.6	9.7 (+ 13%)	
5. Vitazyme (seeds)+ Bio Seed (seeds)+ Vitazyme (foliar early)+ Vitazyme (foliar late)	87.4	14.5*(+20%)	
LSD (P=0.05)	13.5		

*Significantly greater than the control at P = 0.18.

Rice yield increase

Vitazyme on seeds	+18%
Vitazyme + Bio Seed on seeds	+19%
Vitazyme + Bio Seed on seeds +Vitazyme foliar pre-flood	+13%
Vitazyme + Bio Seed on seeds + Vitazyme foliar pre-flood + Vitazyme foliar flag leaf	+20%

Rice Yield



Income results: A comparison of income from Treatments 1, 4, and 5 is given below.

Treatment	Extra income	Extra costs	Net increase
			-----U.S. \$/acre-----
1. Control	—	—	—
4. Vitazyme (seeds) + Bio Seed (seeds) + Vitazyme (foliar early)	116.40	23.41	92.99
5. Vitazyme (seeds) + Bio Seed (seeds) + Vitazyme (foliar early) + Vitazyme (foliar late)	174.00	32.04	141.96

Conclusion: This flooded paddy rice small-plot trial in Tennessee revealed large yield increases, from 13 to 20%, to Vitazyme alone or Vitazyme + Bio Seed on the seeds, and also this combined seed application + Vitazyme applied foliar pre-flood, or at pre-flood + at the flag leaf stage. These results, though significant at P=0.17, reveal the ability of both products to stimulate rice production in the Mississippi Delta region, and increase income by up to \$141.96/acre.

Roses with Vitazyme application—A Testimonial

Rose growers: Eng. Esteban Garcia R.

Cooperating dealer: Paolo Parducci,
Summer Zone, Quito, Ecuador

Location: Ecuador

Testimonial (with some transliteration):

I want to make known the excellent results that we have had with Vitazyme in the cultivation of roses. The product has been used for a few years, and is applied through a drip irrigation system. We have used 2 liters/ha/month, which has resulted in a prolific root mass with a lot of white, active absorbent root hairs, which has translated into greater rose productivity and quality. We began some months ago to apply Vitazyme as a foliar spray at 0.3 to 0.5 cc per area, and this application has positively influenced the plant hormonal systems to reduce the number of undeveloped shoots and increase the number of flowers. Because of the better nutritional status of the plants, the roses have better resistance to disease. In my opinion, Vitazyme is the best organic product available, with a unique

content of brassinosteroids which allows a natural hormonal balance in the plant.

After two months of treatment there were about 80% more absorbent roots. After three months of treatment there were about 150% more absorbent roots.

I am entirely convinced of the great value of Vitazyme for roses, especially for increasing absorbent roots.

Esteban Garcia R.



(above) The use of Vitazyme on roses in Ecuador has produced stronger plants and more prolific blossoming, with excellent flower quality.



(left) The improved plant vigor and flower quality is directly related to the promotion of vigorous rooting due to increased photosynthesis, stimulated by the brassinosteroids and other growth promoters in the product.

Soybean with Vitazyme application

Researchers: E. Bruce Kirksey, Ph.D. **Research organization:** Agricenter International, Memphis, Tennessee

Location: Memphis, Tennessee **Variety:** P4255RR2X **Planting date:** July 12, 2019 **Planting rate:** 140,000 seeds/acre

Planting depth: 1.0 inch **Row spacing:** 30 inches

Soil type: Falaya silt loam, pH = 6.3, organic matter = 2.4%, fertility level = good, drainage = good

Experimental design: A small-plot soybean trial was established, using 10 x 30-foot plots (300 ft.²) and five treatments with four replications in a randomized complete block design.

Treatment	Bio Seed application		Vitazyme applicaton ¹	
	On seed	In-furrow	In-furrow	foliar
1. Control	0	0	0	0
2. Bio Seed	136 g/cwt	0	0	0
3. Bio Seed	0	50 g/acre	0	0
4. Bio Seed + Vitazyme in-furrow	0	50 g/acre	13 oz/acre	0
5. Bio Seed + Vitazyme in-furrow and foliar	0	50 g/acre	13 oz/acre	13 oz/acre

¹13 oz./acre = 1 liter/ha



Bean pods removed from three plants of both the Vitazyme and Bio Seed treatment and the control reveal more pods and potential yield for the treated plants...up to 40% more yield for Treatment 5.

Fertilization: none

Vitazyme application: 13 oz/acre (1 liter/ha) in-furrow at planting

for treatments 4 and 5; 13 oz/acre (1 liter/ha) sprayed foliar 30 days after planting at early bloom.

Bio Seed application: Bio Seed is a formulation of bacteria and fungi that stimulates rhizosphere microbial populations. 136 g/100 lb of seed applied before planting for Treatment 2; 50 g/acre in-furrow at planting for Treatments 3, 4, and 5.

Harvest date: November 5, 2019, of the middle two rows of each plot with an Almaco plot combine

See moisture: There were no significant differences in seed moisture content (8.13 to 8.48%).

Seed Test weight: There were no significant differences among treatments for test weight (55.98 to 58.32 lb/bu).

Yield results:

Treatment	Yield		Yield change
	bu/acre	bu/acre	
1. Control	41.7 c	—	
2. Bio Seed on seeds	51.0 b	9.3 (+22%)	
3. Bio Seed in-furrow	48.7 b	7.0 (+17%)	
4. Bio Seed in-furrow +Vitazyme in-furrow	48.5 b	6.8 (+ 16%)	
5. Bio Seed in-furrow +Vitazyme in-furrow +Vitazyme foliar	56.7 a	15.0 (+40%)	
LSD (P=0.05)	3.68		
CV	4.85		
Treatment F -value	0.0001		

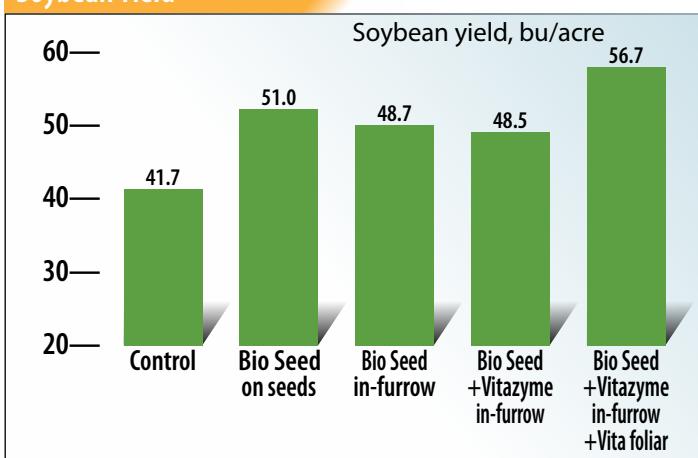


This soybean trial with Vitazyme and Bio Seed produced excellent and highly significant responses in a small plot setting.



Notice the taller, stronger soybean plants on the right that have received Vitazyme and Bio Seed. Their leaf area is greater, root development is more extensive, and leaf chlorophyll level is better than for the untreated control.

Soybean Yield



Income results: Income increase data is given for Treatments 1, 4, and 5.

Treatment	Extra income	Extra costs	Net increase
	U.S. \$/acre		
1. Control	—	—	—
4. Bio Seed in-furrow +Vitazyme in-furrow	63.72	21.13	42.58
5. Bio Seed in-furrow +Vitazyme in-furrow +Vitazyme foliar	140.55	29.77	110.78

Increase in soybean yield

Bio Seed on seeds	22%
Bio Seed in-furrow.....	17%
Bio Seed + Vitazyme in-furrow	16%
Bio Seed + Vitazyme in-furrow + Vitazyme foliar	40%

Conclusion: A small-plot soybean study conducted with Bio Seed and Vitazyme in Memphis, Tennessee, revealed that, while test weight and seed moisture at harvest were not significantly affected, Bio Seed seed pre-treatment and in-furrow treatment increased the yield by 22 and 17%, respectively. When Vitazyme was applied together with Bio Seed in-furrow, the yield improved by 16%, which was statistically the same as the Bio Seed treatments alone at P=0.05. However when a foliar Vitazyme treatment was added to the in-furrow Bio Seed and in-furrow Vitazyme treatment, the yield shot up to 40% greater than the control. These results show the great efficacy of Bio Seed alone either pre-treated on the seeds or in-furrow, but especially Vitazyme applied foliar along with Bio Seed and Vitazyme added in-furrow. Income was increased by up to \$110.78/acre with Bio Seed and Vitazyme. This experiment reveals the great value of the products for soybean growers.

Strawberries with Vitazyme application

Researcher: Eng. Francisco Camacho

and MC. Lucero Fernandez

Research organizers: Agrocamdel and

Grupo Lucava, Mexico

Location of trial: Tarandacua, Guanajuato, Mexico

Variety: Albion

Experimental design: A greenhouse of first-year strawberry plants (1 hectare) was treated with Vitazyme and compared to untreated strawberries to evaluate effects on yield, brix, shelf life, and revenue.

① Control ② Vitazyme

Fertilization: unknown

Vitazyme application: 1 liter/ha of

Vitazyme four times at one-month intervals during blossoming

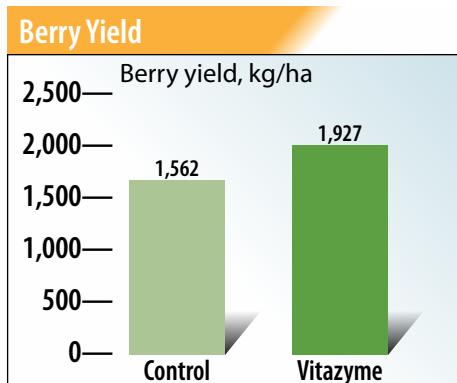


Vitazyme was sprayed on these strawberries four times at monthly intervals, producing 23% more yield and nearly 2 brix more sugar.

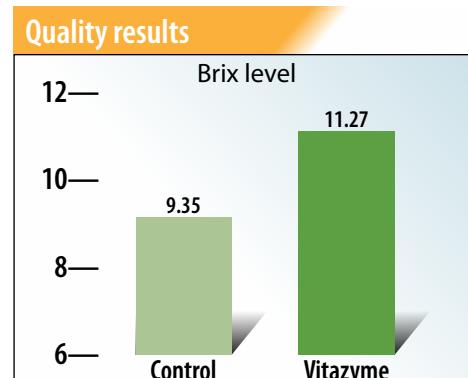
Yield results: The average yield per picking was determined.

Treatment	Berry yield	Yield change
	kg/ha	kg/ha
1. Control	1,562	—
2. Vitazyme	1,927	365 (+23%)

Increase in strawberry yield with Vitazyme: 23%



Quality results: Brix determinations were made on a number of berries for each treatment.



Shelf-life results: There was a remarkable improvement in shelf-life with the Vitazyme treated strawberries, as can be seen in this series of photos taken at 24, 48, 72, and 96 hours after harvest.



24 hours after picking, the Vitazyme treated strawberries on the left are better formed and shiny.



48 hours after picking, the treated berries on the left are still intact and show no deterioration, as do the control berries.



72 hours after picking the control berries are rapidly being consumed by fungi, while the Vitazyme treated fruit on the left has little damage.



96 hours after picking, fungi has totally overwhelmed the untreated strawberries on the right, and the treated berries still have considerably less damage.

Income results: The strawberries were valued at \$12 MXN/kg.

Treatment	Revenue	Revenue change
	\$MXN/ha	\$MXN/ha
1. Control	18,749.25	—
2. Vitazyme	23,124.08	4,374.83 (+23%)

**Increase in revenue with Vitazyme:
\$4,375 MXN/ha (23%)**

Conclusions: This Mexican strawberry trial, using four Vitazyme foliar sprays at one-month intervals, proved that the product increased fruit brix by a remarkable 1.92 percentage points (21%), while increasing the yield by 23%. Revenue was also increased by 23% (\$4,375 MXN/ha), but perhaps the most remarkable effect of Vitazyme was the marked improvement in shelf-life, as evidenced by the photo display shown in this study. The Vitazyme program for strawberries in Mexico is thus shown to be an excellent adjunct to conventional production practices..

Sugar Beets with Vitazyme application



Sugar beets treated with Vitazyme in-furrow, and then twice more along with fungicide applications (on the right), produced a small yield increase but a sizable 0.84% increase in sugar.



The Vitazyme treated sugar beets show greater leaf and root development at this stage of growth, which led to a 0.84% sugar increase, giving a 0.278 ton/acre sugar yield increase, which was 6% greater than the control.

Researcher: Matthew Huhnerkoch

Location: Huhnerkoch Farms, Belview, Minnesota

Variety: Beta 9475

Planting date: May 15 and 16, 2019

Soil type: unknown

Experimental design: A sugar beet field was partially treated with Vitazyme, the rest of the field left untreated to serve as a control, to determine the effect of the product on beet yield and sugar content.

① Control ② Vitazyme

Fertilization: fall of 2018, 50-0-0-24 lb/acre of N-P₂O₅-K₂O-S, plus hog manure at 3,200 gallons/acre to give 65-20-80 lb/acre of N-P₂O₅-K₂O.

Vitazyme application: (1) in-furrow at 12.8 oz/acre at planting; (2) with a fungicide application at 12.8 oz/acre in late July; (3) with a fungicide application at 12.8/acre in mid-August

Weather for 2019: extremely wet spring delayed planting, a wet June inhibited growth, and July, August, and September were fairly normal in terms of rainfall and temperature

Harvest dates: October 14 to 19, 2019

Yield results: A load of sugar beets from each treatment was harvested and weighed, and the sugar content was determined.

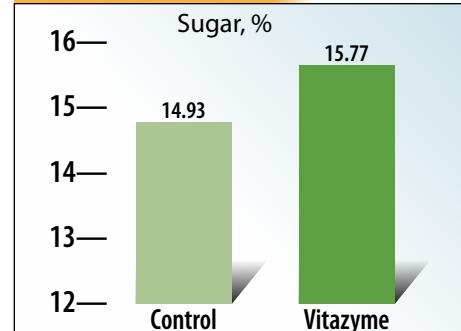
Treatment	Beet yield	Yield change	Sugar content	Sugar change	Sugar yield	Sugar change
	tons/acre	tons/acre	%	%	tons/acre	tons/acre
1. Control	30.06	—	14.93	—	4.488	—
2. Vitazyme	30.22	0.16 (+1%)	15.77	+ 0.84	4.766	0.278 (+6%)

Increase in sugar yield with Vitazyme: 6%

Increase in beet sugar content with Vitazyme: 84 %-points

Conclusions: As a result of Vitazyme use on a sugar beet field in southern Minnesota, the best yield was nominally increased, but the sugar content of the beets was improved by 0.84 percentage points. This led to a total sugar yield increase of 6% revealing the great value of this program to improve the sugar yield of beets.

Beet Sugar Content



Sunflowers with Vitazyme application



Notice the enhanced head size and development with the Vitazyme program in this Ukraine trial. The yield has been substantially improved and very profitably.



Supple heads that are well-filled are the hallmark of Vitazyme use with Sunflowers, which is a major oilseed crop in Ukraine. In this trial yield was increased by 9%.

Researcher: V. V. Plotnikov

Research organizations:

Plant Designs International,
Rochester, New York, and Agro Expert
International, Kaharlyk, Ukraine

Location: Cherkasy Experiment Station
of Bioresources, Drabiv District,
Cherkasy Region, Drabovo-Bariatynske
Village; Central Ukraine (440-590 mm of
precipitation per year)

Variety: CI Diamantis

Planting date: April 19, 2019

Planting rate: 50,000 seeds/ha

Previous crop: winter wheat

Soil type: typical Chernozem (humus = 3.9%)

Field preparation: disking to 6-8 cm,
plowing to 22-24 cm, cultivating in two
tracks to 5-6 cm

Experimental design: A sunflower field was
divided into conventionally treated and Vitazyme
treated portions to evaluate the effects of Vitazyme
on the yield of the crop.

① Control ② Vitazyme

Fertilization: 46 kg/ha of N cultivated in before planting; 4-10-20 kg/ha of N-P₂O₅-K₂O applied during planting

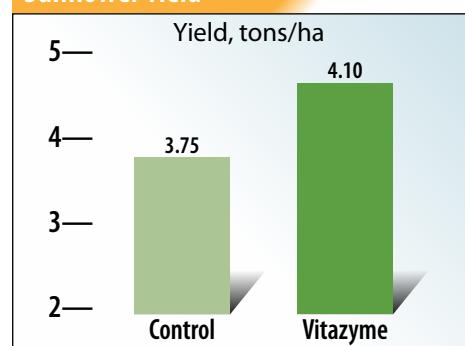
Vitazyme application: 0.5 liter/ha sprayed on the leaves and soil at the eight-leaf stage on May 30.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	3.75	—
Vitazyme	4.10	0.35 (+9%)

Increase in seed yield
with Vitazyme: 9%

Sunflower Yield



Income results: The extra 0.35 ton/ha gave an addition \$95/ha income.

Conclusion: Sunflowers grown in a Vitazyme trial in central Ukraine, using 0.5 liter/ha sprayed at the eight-leaf stage, gave an additional 0.35 ton/ha yield (9%), that provided \$95/ha more income. This program is thus shown to be highly effective in increasing the yield and income for sunflower growers, even when used at lower than normal rates.

Sunflowers with Vitazyme application

Researcher: V. V. Plotnikov

Research organizations:

Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "Herron Invest", Yarmolyni District, Khmel'nytskii Oblast, Tarasivka Village, Ukraine; Western Ukraine (550-750 mm at precipitation per year)

Variety: P62 LL 109 **Planting date:** April 4, 2019

Planting rate: 62,000 seeds/ha **Previous crop:** winter wheat

Soil type: Podzolic Chernozem (humus = 3.3%)

Field preparation: disking to 6-8 cm, plowing to 22-24 cm, cultivating in two tracks to 5-6 cm

Experimental design: A sunflower field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield of the sunflower seeds.

① Control ② Vitazyme



Enhanced overall plant metabolism producing larger stalks, larger leaves and heads, and greater photosynthetic capacity from Vitazyme application has produced the plants shown in this trial.

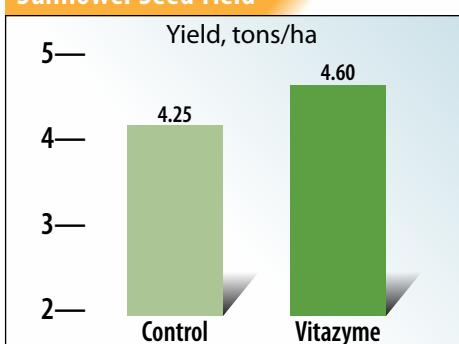
Fertilization: 80-0-30 kg/ha of N-P₂O₅-K₂O applied during plowing;
12-52-0 kg/ha of N-P₂O₅-K₂O applied during planting
Vitazyme application: 1.0 liter/ha sprayed on the leaves and soil at the eight-leaf stage on May 15.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	4.25	—
Vitazyme	4.60	0.35 (+8%)

Increase in seed yield with Vitazyme: 8%

Sunflower Seed Yield



Income results: An extra 0.35 tons/ha gave an additional \$84/ha income.
Conclusion: This Ukrainian study on sunflowers, using 1 liter/ha of Vitazyme sprayed on the crop at the eight-leaf stage, resulted in an excellent 0.35 ton/ha seed increase (8%). This yield increase resulted in \$84/ha extra income, showing the considerable value of this program for sunflowers in Ukraine.

Tomatoes with Vitazyme marketed as Vitazyme Foliar in this region.



Researchers: Daniel Pená and Candelario Gomez

Research organization: Duwest Dominicana, Dominican Republic

Location: Juan Carlos Perez Farm, Navarette, Santiago Province, Dominican Republic

Variety: salad tomato **Trial initiation:** March, 2019

Experimental design: A 0.25 hectare plot of salad tomatoes was treated with Vitazyme Foliar, and compared to an adjoining untreated area, to evaluate the effect of the product on yield, quality, and phytotoxicity.

① Control ② Vitazyme

Fertilization: unknown

Vitazyme Foliar application: three foliar sprays of 1 liter/ha each time

Yield results:

Treatment	Tomato Yield			Total Yield	Yield Change
	Picking 1	Picking 1	Picking 1		
-----lb/ha-----					
Control	12,495	5,923	13.819	32,237	—
Vitazyme Foliar	11,684	11,353	14,400	37,437	5,200 (+16%)

Quality results:

The fruit number per plant was about equal for these treatments, but fruit size was larger and the fruit more uniform with Vitazyme Foliar application, allowing for a better price. Treated plants were also healthier and were still growing actively at the conclusion of the trial.

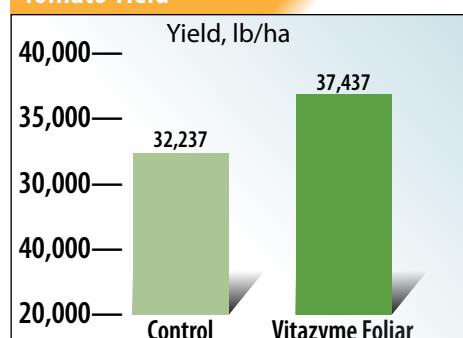
Income results:

The added income from the 16% yield increase was a substantial US\$1,820/ha, which gives a net increase after a US\$60/ha Vitazyme cost of US\$1,740/ha.

Conclusion:

- The Vitazyme Foliar treated plot showed a 5,200 lb/ha or 16% greater yield than the untreated commercial control.
- The application of Vitazyme Foliar biostimulant positively impacts fruit quality by improving fruit shape, size, and color.
- The added yield provided a substantial US\$1,740/ha more net return to the farmer.
- For the grower, Vitazyme Foliar biostimulant is a good tool, because, in addition to increasing yield, it improves quality, and thus allows negotiating better prices.

Tomato Yield



Increase in tomato yield with Vitazyme Foliar: 16%

Tomatoes with Vitazyme application

Researcher: Leonel Yaeggy

Research organization: Duwest Guatemala, Guatemala

Farmer: Juan Canel

Location: Tejar, Department of Chimaltenango, Guatemala

Variety: Atitlan

Planting date: November 14, 2018

Experimental design: A tomato field was treated in part with Vitazyme, applied to 2,500 plants, in an effort to compare the effect of the product on plant characteristics (roots, height, branches, and fruit number), yield, and disease resistance as compared to a Kelpak treated area alongside.

① Kelpak ② Vitazyme

Fertilization: unknown

Vitazyme application: four times: (1) 1 liter/ha as a root drench at transplanting on November 14, 2018; (2) 1 liter/ha foliar spray 30 days later on December 14, 2018; (3) 1 liter/ha foliar spray 61 days after transplanting on January 14, 2019; (4) 1 liter/ha foliar spray 95 days after transplanting on February 17, 2019

The Vitazyme treated tomatoes on the left show excellent color and growth, whereas the untreated plants on the right are afflicted with bacterial wilt and canker.

Kelpak application: Kelpak is a seaweed extract, and was applied according to company specifications which were 2.85 liters/ha per application.

Growth results:

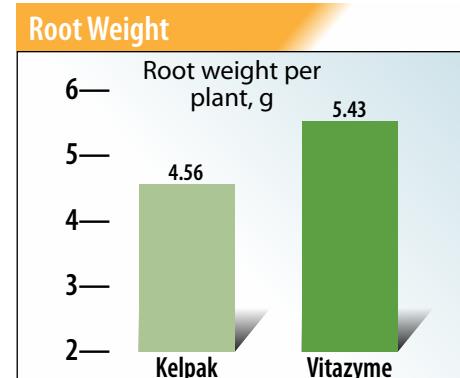


Evaluation of roots at 30 days after transplanting

Treatment	Root weight ¹		Weight change g/plant
	g/plant	g/plant	
1.Kelpak	4.56	—	
2. Vitazyme	5.43	0.87 (+19%)	

¹Average of three plants, fresh weight.

Increase in root weight per plant: 19%



Evaluation of stem height and diameter at 60 days after transplanting

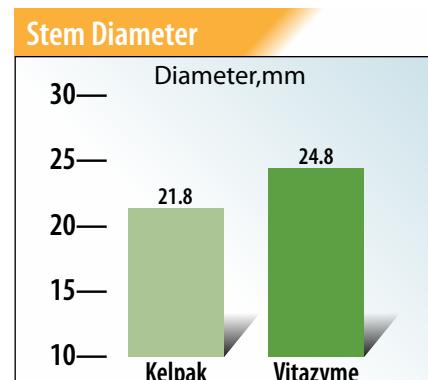
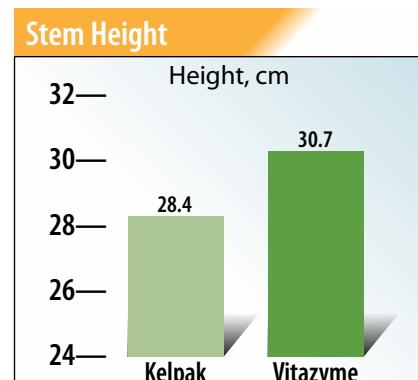
Treatment	Stem height ¹	Height change	Stem diameter ²	Diameter change
	cm	cm	mm	mm
1. Kelpak	28.4	—	21.8	—
2. Vitazyme	30.7	2.3 (+8%)	24.8	3.0 (+14%)

¹From ground level to the plant top, average of 10 plants.

²The widest part of the stem, average of 10 plants.

Increase in stem height with Vitazyme: 8%

Increase in stem diameter with Vitazyme: 14%



Evaluation of plant height and floral branches at 90 days after transplanting

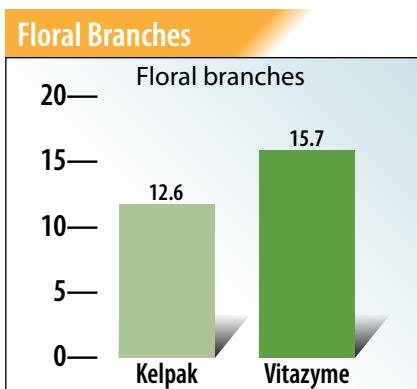
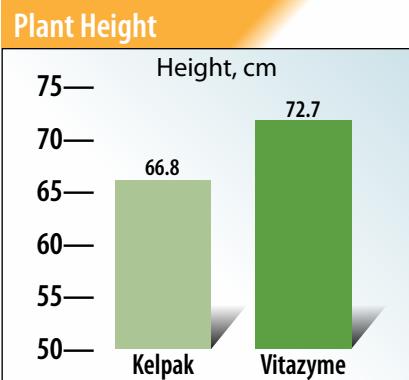
Treatment	Plant height ¹ cm	Height change cm	Floral branches ² number	Branch change number
1. Kelpak	66.8	—	12.6	—
2. Vitazyme	72.7	6.1 (+9%)	15.7	3.1 (+25%)

¹From ground level to the plant top, average of 10 plants.

²Number of floral branches with well-formed fruit, average of 10 plants.

Increase in plant height with Vitazyme: 9%

Increase in floral branches with Vitazyme: 25%

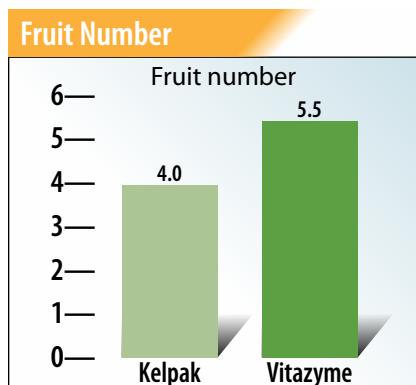


Evaluation of fruit on the first floral branch

Treatment	Fruit number ¹ number	Number change number
	number	number
1. Kelpak	4.0	—
2. Vitazyme	5.5	1.5 (+38%)

¹Average of 10 plants for the fruit number on the first floral branch.

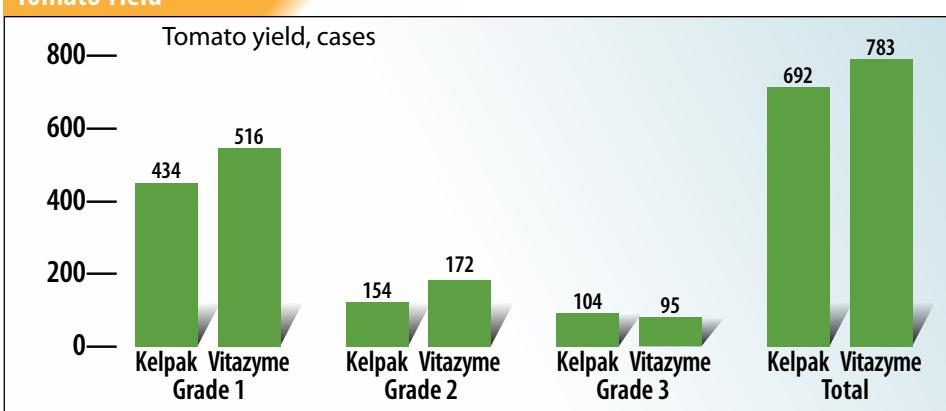
Increase in fruit number on the first floral branch with Vitazyme: 38%



Yield results: Harvest began 120 days after transplanting on March 14, 2019.

Treatment	Grade of harvested fruit						Total yield	Yield change
	Grade 1	Change	Grade 2	Change	Grade 3	Change		
-----cases-----								
Kelpak	434	—	154	—	104	—	692	
Vitazyme	516	82 (+19%)	172	18 (+12%)	95	-9 (-9%)	783	91 (+13%)

Tomato Yield



Yield Change with Vitazyme

Grade 1	+19%
Grade 2	+12%
Grade 3	-9%
Total	+13%

Treatment	Non-uniform quality evaluation		
	Percent of fruit grade		
	Grade 1	Grade 2	Grade 3
-----% of total-----			
Kelpak	4	12	25
Vitazyme	4	8	18

Conclusions: This tomato trial in Chimaltenango, Mexico, using four Vitazyme applications and compared with standard Kelpak applications, showed the following.

- 19% more roots 30 days after transplanting
- Taller plants (+8%) with thicker stems (+14%) 60 days after transplanting
- Taller plants (+9%) with more floral branches (+25%) 90 days after transplanting
- More fruit on the first floral branch (+38%)

- Greater total yield of fruit (+13%), with more fruit in the best grades: 19% more of Grade 1, and 12% more of Grade 2
 - Fewer “non-uniform” or stained fruit
 - Considerably less incidence of bacterial wilt and canker (*Clariabacter michiganensis*)
- The Vitazyme program for tomatoes is shown to be considerably superior to the Kelpak program in terms of all plant growth, yield, and disease parameters measured.

Vitazyme Field Tests for 2019



Winter Wheat With a Vitazyme Cold Start Application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: “Kolyvalo” Farm, Vinnytsia District, Vinnytsia Region, Miziakivs’ki Khutory Village, Ukraine; Central Ukraine (440-590 mm of precipitation per year)

Variety: Coloniiia, F1 generation **Planting date:** October 10, 2018

Planting rate: 6 million seeds/ha **Previous crop:** sunflowers

Soil type: gray-brown podzolic (humus = 2.0%)

Field preparation: disking to 6-8 cm, cultivation in two tracks to 4-5 cm

Experimental design: A winter wheat field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme Cold Start on the yield and quality of the grain.

① Control ② Vitazyme Cold Start

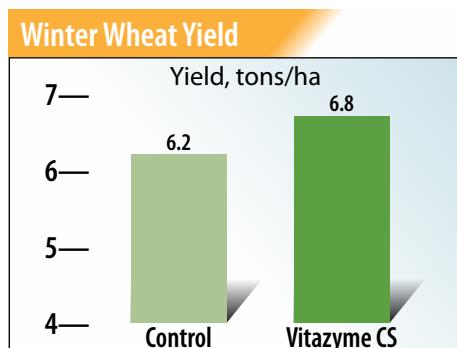
Fertilization: 30-30-30 kg/ha of N-P₂O₅-K₂O applied during fall disking; 184 kg/ha of N applied in the spring

Vitazyme Cold Start application: Two days before planting, on October 8, 2018, the wheat seeds were treated with Vitazyme Cold Start to give 0.7 liter/ha.

Yield results:

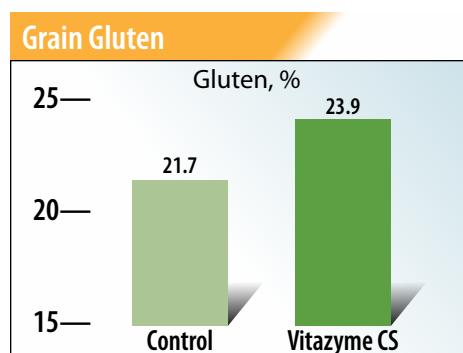
Treatment	Yield tons/ha	Yield change tons/ha
Control	6.2	—
Vitazyme Cold Start	6.8	0.6 (+10%)

**Increase in yield
with Vitazyme Cold Start: 10%**

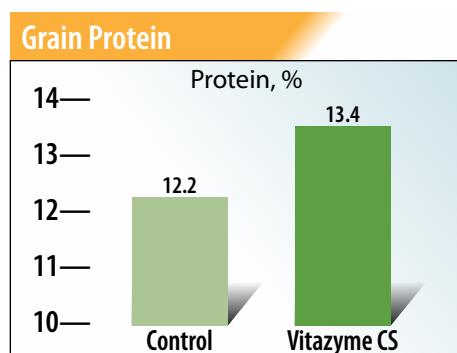


Note the superior stem, leaf, and head development for the Vitazyme treated wheat on the right compared to the untreated control on the left.

Quality results:



**Increase in grain gluten with
Vitazyme Cold Start: 2.2 %-points**



**Increase in grain protein with
Vitazyme Cold Start: 1.2 %-points**

Income results: The added 0.6 ton/ha yield netted an extra \$111/ha income.

Conclusion: This Ukraine winter wheat study, using a Vitazyme Cold Start seed treatment to give 0.7 liter/ha actual product, revealed that the yield was increased by 10%, while grain gluten was improved by 2.2 %-points and protein by 1.2 %-points. Added income from the program was \$111/ha, showing the great value of this product, for winter wheat production in Ukraine.

Winter Wheat with Vitazyme application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC Mriia Farming Ternopil, Pidvolochysk District, Ternopil Region, Skalit City, Ukraine; Western Ukraine (550-750 mm of precipitation per year)

Variety: Mulan, F3 generation

Planting date: November 4, 2018

Planting rate: 6 million seeds/ha

Previous crop: spring rape

Soil type: dark-gray podzolic (humus = 3.5%)

Field preparation: disking to 10-12 cm, deep cultivation with a heavy cultivator to 20-22 cm

Experimental design: A winter wheat field was divided into normally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield and quality of the grain.



A more abundant root mass shown here on the right is the result of the activity of Vitazyme's brassinosteroids, resulting in greater nutrient uptake and higher yields.

① Control ② Vitazyme

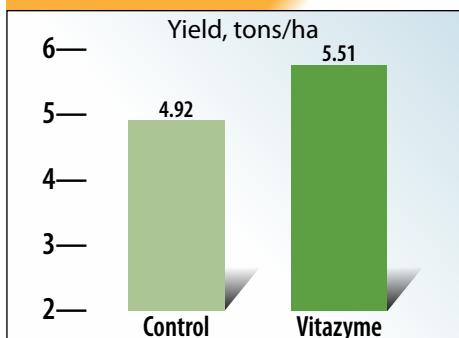
Fertilization: 10-26-26 kg/ha of N-P₂O₅-K₂O applied during fall planting; 150 kg/ha of N applied in the spring

Vitazyme application: Five days before planting, on October 31, 2018, the wheat seeds were treated with Vitazyme to give 1.0 liter/ha.

Yield results:

Treatment	Yield tons/ha	Yield change tons/ha
Control	4.92	—
Vitazyme	5.51	0.59 (+12%)

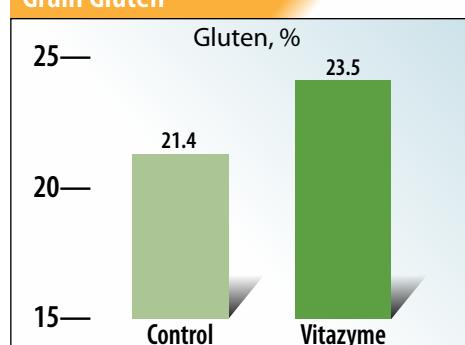
Winter Wheat Yield



Increase in yield with Vitazyme: 12%

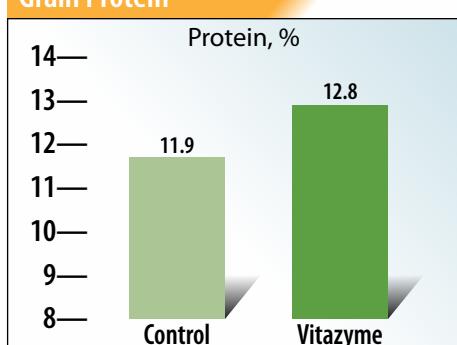
Quality results:

Grain Gluten



Increase in grain gluten with
Vitazyme: 2.1 %-points

Grain Protein



Increase in grain protein with
Vitazyme: 0.9 %-points

Income results: The added 0.59 ton/ha yield netted an extra \$107/ha income.

Conclusion: A Ukraine winter wheat study, using a Vitazyme seed treatment to give 1.0 liter/ha actual product, revealed that the yield was increased by 12%, while grain gluten was improved by 2.1 %-points and protein by 0.9 %-point. Added income from the program was \$107/ha, showing the great value of this product for winter wheat production in Ukraine.

Winter Wheat with Vitazyme application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "Zakhid Agro", Vyzhnytsia District, Chemivisi Region, Vashkivtsi Village, Ukraine; Western Ukraine (550-750 mm of precipitation per year)

Variety: Tobak, F1 generation **Planting date:** September 20, 2018 **Planting rate:** 5 million seeds/ha

Previous crop: spring rape **Soil type:** dark-gray podzolic (humus = 3.0%)

Field preparation: disking to 6-8 cm, plowing to 20-22 cm, cultivating to 5-6 cm

Experimental design: A winter wheat field was divided into conventionally treated and Vitazyme treated portions to evaluate the effects of Vitazyme on the yield and quality of the grain.

① Control ② Vitazyme

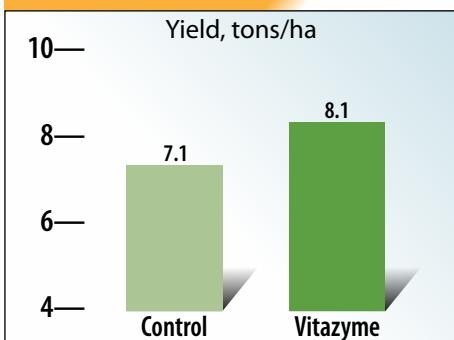
Fertilization: 8-24-24 kg/ha of N-P₂O₅-K₂O applied during fall planting; 120 kg/ha of N applied in the spring

Vitazyme application: 1.0 liter/ha sprayed on the leaves and soil at the tillering stage, on March 30, 2019.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	7.1	—
Vitazyme	8.1	1.0 (+14%)

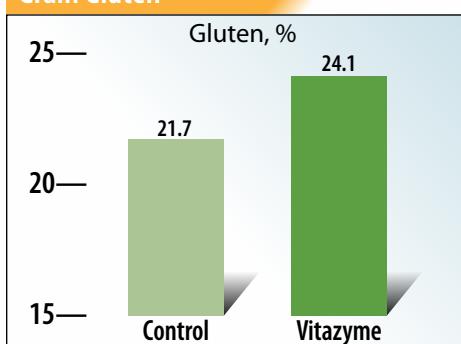
Winter Wheat Yield



Increase in yield with Vitazyme: 14%

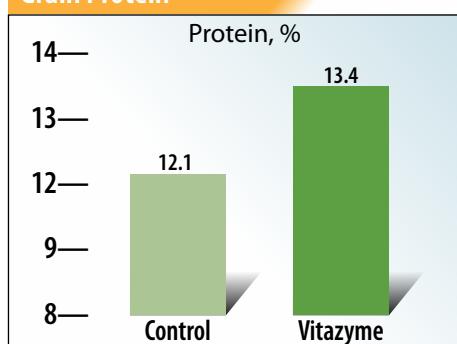
Quality results:

Grain Gluten



Increase in grain gluten with Vitazyme: 2.4 %-points

Grain Protein



Increase in grain protein with Vitazyme: 1.3 %-points

Income results: The added 1.0 ton/ha yield netted an extra \$169/ha income.

Conclusion: This Ukraine winter wheat study, using a Vitazyme soil and foliar spray of 1.0 liter/ha at the tillering stage, revealed that the yield was increased by 14%, while grain gluten was improved by 2.4 %-points and protein by 1.3 %-points. Added income from the program was \$169/ha, showing the great value of Vitazyme to complement winter wheat production in Ukraine.

Winter Wheat with Vitazyme application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: "Blagodiyny Soiuz Radomyshi", Radomyshi District, Zhytomyr Region, Maia Racha Village, Ukraine; Northern Ukraine (550-620 mm at precipitation per year)

Variety: Colonia, F1 generation

Planting date: November 7, 2018

Planting rate: 6 million seeds/ha

Previous crop: sunflowers

Soil type: gray podzolic (humus = 1.7%)

Field preparation: disking to 6-8 cm, plowing to 20-22 cm, cultivation in two tracks to 4-5 cm

Experimental design: A winter wheat field was divided into two parts, a normally treated and a Vitazyme treated portion to evaluate the effects of Vitazyme on the yield and quality of the grain.



With greater root development and overall plant metabolism from Vitazyme application (plants on the right), a 22% yield improvement was obtained, as well as higher grain gluten and protein.

① Control ② Vitazyme

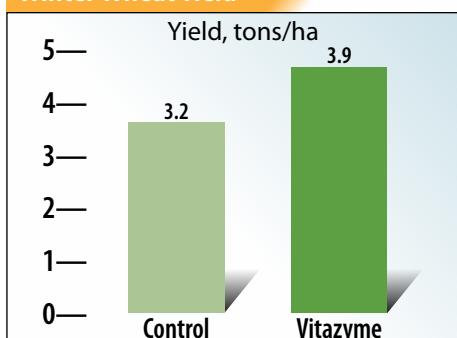
Fertilization: 10-26-26 kg/ha of N-P₂O₅-K₂O applied during fall disking; 62 kg/ha of N applied in the spring

Vitazyme application: Two days before planting, on November 5, 2018, the wheat seeds were treated with Vitazyme to give 1.0 liter/ha

Yield results:

Treatment	Yield tons/ha	Yield change tons/ha
Control	3.2	—
Vitazyme	3.9	0.7 (+22%)

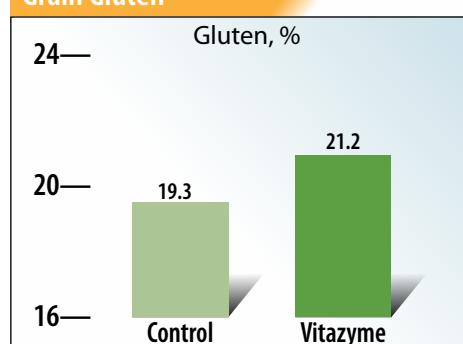
Winter Wheat Yield



Increase in yield with Vitazyme: 22%

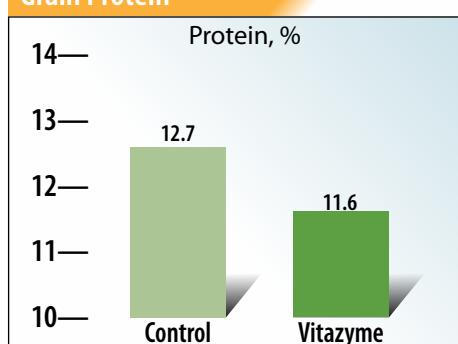
Quality results:

Grain Gluten



Increase in grain gluten with
Vitazyme: 1.9 %-points

Grain Protein



Increase in grain protein with
Vitazyme: 0.9 %-points

Income results: The added 0.7 ton/ha yield netted an extra \$128/ha income.

Conclusion: This Ukraine winter wheat study, using a Vitazyme seed treatment to give 1.0 liter/ha actual product, showed that the yield was increased by an excellent 22%, while grain gluten was improved by 1.9 %-points and protein by 0.9 %-point. Added income from the program was \$128/ha, showing the great supplemental value this product adds to winter wheat production in Ukraine.

Winter Wheat With a Vitazyme Cold Start Application

Researcher: V. V. Plotnikov

Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine

Location: LLC "VKAF Maiaky", Biliaivka District, Odessa Region, Maiaky Village, Southern Ukraine (270-350 mm at precipitation per year)

Variety: Lira Odeska, F1 generation

Planting date: September 22, 2018

Planting rate: 4 million seeds/ha

Previous crop: chick peas

Soil type: Typical Chernozem (humus = 4.1%)

Field preparation: disking to 6-8 cm, disking a second time to 14-16 cm

Experimental design: A winter wheat field was divided into conventionally treated and Vitazyme treated portions to evaluate the effects of Vitazyme + Vitazyme Cold Start on the yield and quality of the grain.

① Control ② Vitazyme + Vitazyme Cold Start

Fertilization: 21 kg/ha of N and 24 kg/ha of S during disking; 10-20-12 kg/ha of N-P₂O₅-K₂O at planting; 80 kg/ha of N as a KAS urea-ammonia mixture in the spring, with Vitazyme Cold Start

Vitazyme and Cold Start application: 0.5 liter/ha of Vitazyme on the seeds before planting; 0.3 liter/ha Vitazyme Cold Start sprayed on the leaves and soil at early tillering on February 17, 2019

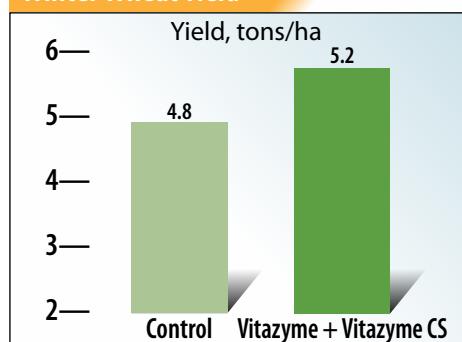
Yield results:

Treatment	Yield		Yield change
	tons/ha	tons/ha	
Control	4.8	—	
Vitazyme + Vitazyme Cold Start	5.2	0.4 (+8%)	



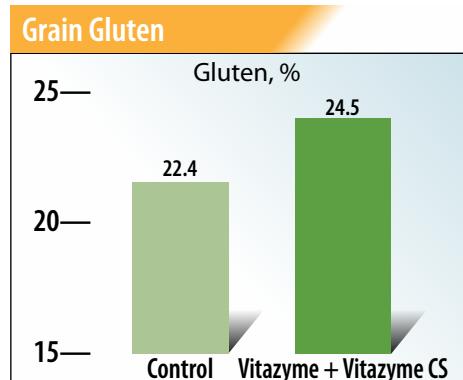
As for the other winter wheat trials in Ukraine in 2019, Vitazyme improved root and leaf development, in this case resulting in an 8% yield increase, along with concurrent gluten and protein increases.

Winter Wheat Yield

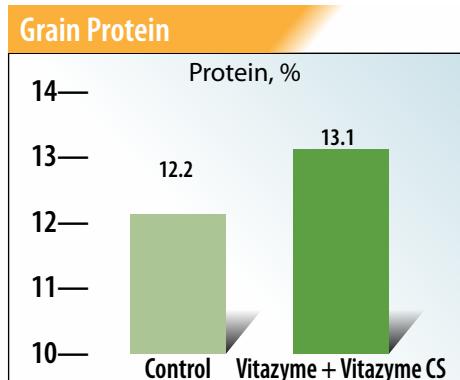


Increase in yield with Vitazyme + Vitazyme Cold Start: 8%

Quality results:



Increase in grain gluten with
Vitazyme + Vitazyme Cold Start:
2.1 %-points



Increase in grain protein with
Vitazyme + Vitazyme Cold Start:
0.9 %-points

Income results: The added 0.4 ton/ha yield netted an extra \$67/ha income.

Conclusion: This Ukraine winter wheat study, using Vitazyme on the seeds plus Vitazyme Cold Start in the spring at early tillering, produced a yield increase of 8%, while grain gluten was improved by 2.1%-points and protein by 0.9%-point. Added income from the program was \$67/ha, giving respectable yield and income increases when both products are used together.

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