VITAZYME® an All Natural Concentrate

27TH EDITION

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

2022 VITAZYME FIELD TESTS RESULTS










COMPILED BY
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VitalEarth RESOURCES

Introduction

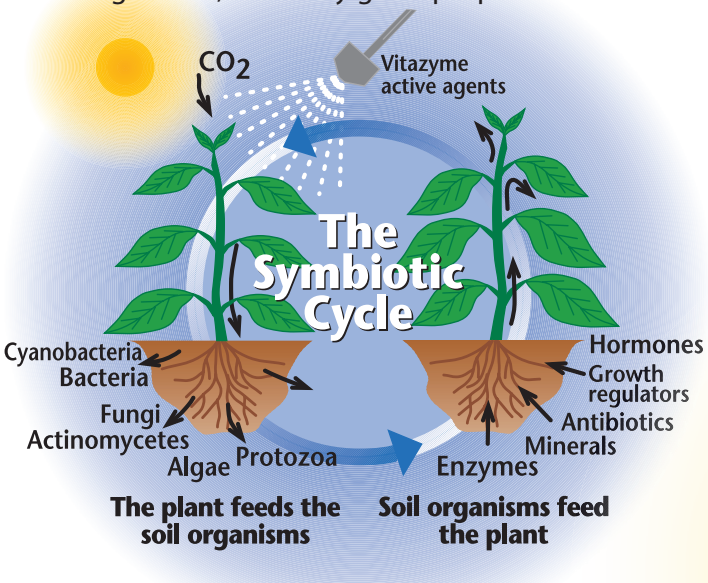
How Vitazyme works within the plant-soil system.

This is the twenty-seventh 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 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.

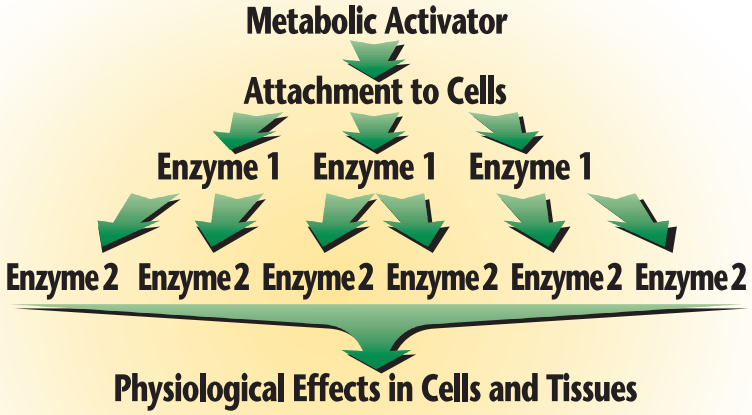
Nitrogen Fertilizer Reduction Guide with Vitazyme

Obtain a score for each of these four items

Soil Organic Matter			Previous Crop		Compaction		Soil NO_3-N Test		
Low (<1.5%)	Medium (1.5-3%)	High (>3%)	Non-legume	Legume	Much	Little	Low	Medium	High
1	2	3	1	3	1	3	2	4	6

Add the scores above to find the N-reduction

Total score	15 14 13 12	11 10 9 8	7 6 5
% of optimum N to apply	←50-60%→	←60-70%→	←70-80%→



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.
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.

General use for field crops with optimal fertilization and soil testing:

1. Test the soil at a reputable laboratory, and obtain expert fertilization recommendations.
2. Fertilizer nitrogen rates may be lowered somewhat, depending on soil conditions; refer to the table above.
3. Treat the seeds using a seed treater to achieve about 1 liter/ton of seed of actual product, or apply 1 liter/ha in-furrow at planting, with or without starter fertilizer.
4. Apply Vitazyme to the soil and/or leaves according to recommendations.

Remember that Vitazyme is a complement to other sound, sustainable crop management practices. Incorporate crop rotations, minimal tillage, erosion control, and adapted plant varieties whenever possible.

Vitazyme Field Tests for 2022

Vitazyme Highlights *from throughout the world.*

Vitazyme Highlights for 2022

In this 27th year of field, orchard, greenhouse, and laboratory trials with Vitazyme, the effectiveness of this unique biostimulant has shown through once again as a highly effective stimulator of crop yield and quality. Responses have been consistent across many soil and climatic conditions for all versions of the product tested, including the standard green product, as well as the organic version and Vitazyme Cold Start, the cold weather version.

This year a special effort was made to evaluate the effectiveness of the product to improve the utilization of fertilizer elements, in response to the great increases in the cost of fertilizers of all types. Note the first three entries.

1. **Fertilizer efficiency: University of Missouri, Columbia, Missouri.** A corn trial at the Bradford Research Farm near Columbia, Missouri, proved that a Vitazyme seed treatment, plus a foliar application at the 6 to 8-leaf stage, increased the yield of corn grain by up to 30%. This increase was at the 100% fertilizer level. Chlorophyll increases at all fertilizer levels—50, 75, and 100%—were substantial, proving that a greater biomass from more captured sunlight energy and carbon dioxide translated to bigger plants, with more extensive root systems which provided a larger rhizosphere root surface area for converting nutrients to available forms. The sugar levels of the leaves were also increased with Vitazyme at the 50 and 75% fertilizer rates.
2. **Fertilizer efficiency: AgriCenter International, Memphis, Tennessee.** Trials on corn and cotton in extreme western Tennessee revealed that reduced fertilizer rates plus Vitazyme increased fertilizer efficiency in terms of yield enhancement by a consistent 15 to 17%. Each of these increases was significantly greater than the control at P=0.05. Root mass increases with Vitazyme at each fertilizer level were considerable, showing that the rhizosphere was activated by increased photosynthesis to produce more available nutrients to support greater grain production. Cotton showed similar increases in productivity at 25, 50, 75, and 100% fertilizer rates, though because of extreme dryness during the summer most bolls were dropped, and yields could not be obtained. Nonetheless, plant vigor, height, and

weight were substantially and significantly increased at each fertilizer level.

3. **Fertilizer efficiency: ACRES Research, Cedar Falls, Iowa.** A corn trial in east central Iowa proved that Vitazyme dramatically increased fertilizer efficiency of use at the 25% application level, so much so that the yield was statistically the same as for the 100% nitrogen treatment:187.4 (25% fertilizer + Vitazyme) versus 198.1 bu/acre (100% fertilizer). Grain moisture at harvest was also reduced with Vitazyme application.

4. Studies in Hungary on corn and sunflowers showed similar excellent results as did work completed in 2021. Organic Vitazyme at either 1 or 2 liters/ha significantly increased grain yield by 7 to 10%, a reflection of greater leaf chlorophyll and consequential root mass production. Crop emergence was also significantly enhanced, as were plant height and cob length. Sunflowers responded well to these same two Organic Vitazyme levels, by increasing leaf chlorophyll up to a full SPAD unit, while crop height and root weight both increased.

5. Studies with e-Cultiver and the Carnegie Institute at Stanford University in California revealed an excellent response to Vitazyme in a tomato trial, a repeat of one conducted in 2021. The brassinosteroids enhanced tomato number and size and yield, and the lycopene and B-carotene levels in the fruit were increased by 14 and 45%, respectively. Future studies with these research groups will continue in 2023 to uncover the genetic triggers which produce the phenotypic responses within plants treated with Vitazyme. An Arabidopsis (a variety of cress) study proved conclusively that brassinosteroids are in Vitazyme, and will overcome the lack of brassinosteroids in the mutant strain of Arabidopsis called sdet2.

6. Studies on cherries at the University of Chile and Gama Company in Chile have shown how the product will enhance overall cherry productive parameters, including improving fruit quality and prolonging the life of flowers. With Avaocados, it was discovered that the leaf canopy temperature was reduced with Vitazyme, and stomatal conductance was increased, meaning that leaf stress was reduced and the leaves were more actively metabolizing during the hotter afternoon conditions. Avocado flowering was greatly increased above the control, and fruit ripening and quality were enhanced significantly .

7. Ukrainian studies continued in spite of the war, and showed excellent responses with several crops, as the program has consistently shown in previous years. Canola yields were increased by 16 to 24%, potatoes by 28%, soybeans by 47% (hailstorm recovery), sunflowers by 28% (herbicide damage recovery), and winter wheat by 17 to 25%. Both Vitazyme Cold Start and Vitazyme Bio were used for these farm field trials.

Vitazyme Arabidopsis Bioassay for Brassinosteroids

Researchers: Rajnish Khanna[1], Alexis Ortiz[2], Robert Reed[2], Pratigya Khatiwada[2], Zhiyong Wang[3], Paul W. Syltie[4]

Research organizations: [1]Founder & CEO, i-Cultiver, Inc. Manteca, CA, [2]Interns, Biotechnology Education & Specialized Training (BEST) Program, i-Cultivar, Inc., Manteca, CA, [3]Acting Director, Department of Plant Biology, Carnegie Institution for Science at Sanford University, Stanford, CA, [4]Director of Research, Vital Earth Resources, TX

Discussion on Brassinosteroids and Arabidopsis bioassay: Brassinosteroids (BR) are steroidal pant hormones involved in many critical processes, including plant development, adaptation to environment nutrient assimilation, and stress responses[1-7]. Plants lacking BR are dwarfed and exhibit multiple developmental defects, including delayed flowering, reduced male fertility, and shortened hypocotyls (part of the embryonic stem between roots and first leaves). These defects can be overcome by external application of BRs.

Biosynthesis of BR in plants. The BR biosynthesis has been well researched in the past forty years. Plants synthesize BR from sterols, such as cholesterol and camperstrol8. BRs are long carbon (C_{27}, C_{28}, C_{29}) chain molecules.

Both lower and higher plants synthesize nearly 70 naturally occurring BR compounds, present in all plant organs[8]. The first BR discovered was brassinolide (BL) in 1979 from *Brassica napus* L. (rapeseed), as a novel plant growth-promoting compound[9].

BR biosynthesis requires functional DET2 gene. The majority of research on BR biosynthesis pathway has been performed in a model plant *Arabidopsis thaliana* (mouse-ear cress). Defects in BR biosynthesis results in dwarfed Arabidopsis plants, which has enabled researchers to screen for, and discover all of the genes involved in BR production. One of these plant genes, called DET2, is responsible for making an enzyme (5a-reductase), which is required for converting cholesterol to cholestanol, the precursor to BR.

Plants carrying sdet2 mutation lack BR. The BR-deficient Arabidopsis mutant, *sdet2* displays abnormal growth, including extremely shortened hypocotyl length [10,11] in dark-grown seedlings. The hypocotyl length can be recovered in darkness by exogenous treatment with BR.

Purpose of the study: This study was performed to assess whether the Vitazyme product contains BR activity.

Materials and methods: *Arabidopsis thaliana* seeds of Columbia wild-type (Col-0) and the mutant strain (*sdet*2) lacking brassinoseroid were germinated on plates containing ½ MS (Murashige & Skoog Basal) Media containing various concentrations of Vitazyme, as indicated. Vitazyme was mixed directly into the media prior to pouring the plates. After plating, seeds were vernalized at 4° C for four days, exposed to 3 hrs. of white light to promote germination, and were grown in continuous darkness (Dc) in a growth chamber with controlled temperature for four days. Seedlings were imaged using a Canon DSLR camera. Lengths of hypocotyls (embryonic stem from above the root to below the cotyledons) were measured using software Image J (NIH). The data was analyzed using Microsoft Excel, including calculations of mean length values and Standard Error (SE).

Results: The wild-type (Col-0) seedlings containing the functional (*DET*2 gene had normal hypocotyl growth under 4-days in darkness (Fig. 2 and 3A). The *sdet*2 mutant seedings developed significantly shorter hypocotyl length in darkness in the absence of Vitazyme, but the average hypocotyl length of *sdet*2 mutants increased with increasing Vitazyme concentration (Fig. 2 and Fig. 3B). These results indicate that Vitazyme contains BR activity because *sdet*2 mutants lacking BR could be recovered in the presence of Vitazyme.

Conclusion: Vitazyme contains active plant growth promoting phytohormones in the Brassinosteroid category.

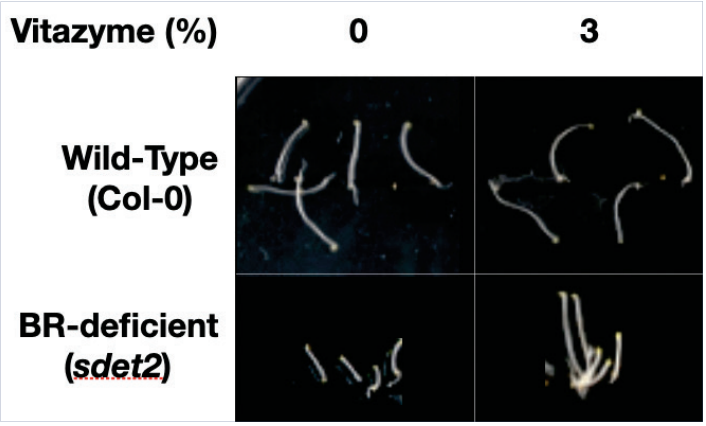
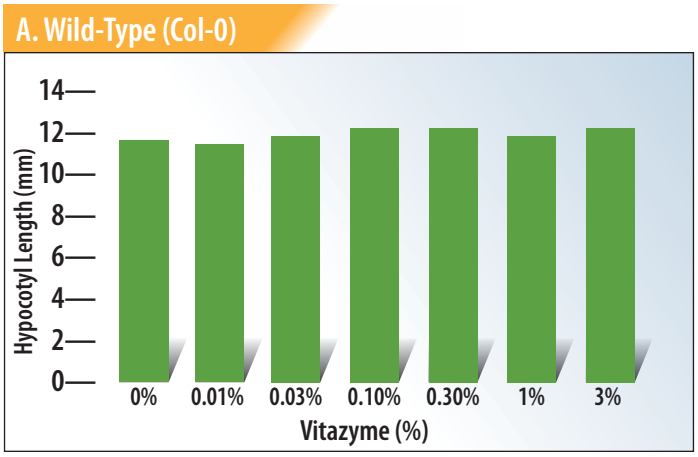


Figure 2. **Vitazyme treatment partially rescued hypocotyl length of *sdet*2 seedlings grown in darkness.** Seedlings were grown in darkness for 4 days on plates containing 0% (left) or 3% (right) Vitazmye. Images of representative wild-type (Col-0) and BR-deficient (*sdet*2 mutant) seedlings are shown under the indicated conditions. Experiments were repeated three times with various concentrations of Vitazyme with 10-30 seedlings per trial.



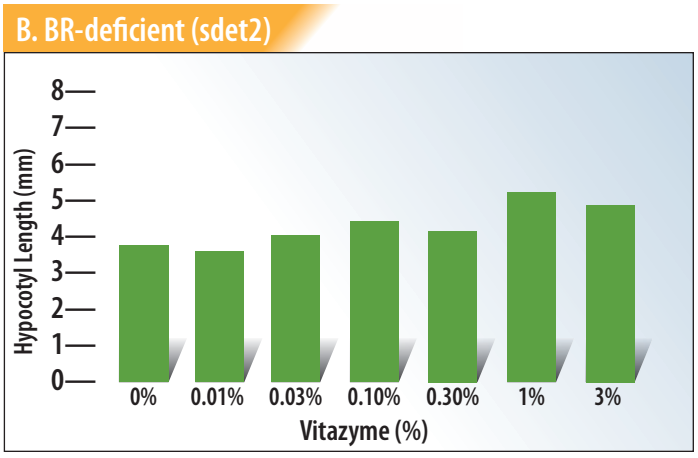


Figure 3. **Vitazyme contains BR activity.** Average hypocotyl lengths of wild-type (Col-0) seedlings (A), and *sdet*2 mutant seedlings (B) grown in darkness for 4-days. The *sdet*2 seedlings showed increased hypocotyl growth in a Vitazyme dose-dependent manner. Hypocotyl length (mm) is plotted against various Vitazyme concentrations tested (as indicated). P-values are indicated by * = 0.077 and ** = 0.016. Data are representative of three independent trials.

Discussion: Plant growth and development relies on the availability of nutrients and plant's internal hormonal signals regulating plant performance in its given environment. Under similar conditions as the wild-type, *sdet*2 mutant seedlings develop sort hypocotyls in darkness due to the absence of a key enzyme involved in BR biosynthesis. According to the manufacturer, application of Vitazyme delivers vitamins, enzymes and plant growth stimulators including brassinosteroids. This study was conducted to test whether the final product, Vitazyme liquid biostimulant, carries BR activity as claimed. The data indicated that treatment with increasing Vitazyme concentrations had the ability to recover *sdet*2 BR deficiency.

In a recent whole genome-wide gene-expression profiling of the effects of brassinosteroids (BR) on early vegetative development of soybean, it was reported that BR regulates a broad range of cellular and biological

processes[16]. BR networks with other plant hormones to modulate stress pathways[16]. Future studies focused on the effects of Vitazyme application on plant hormonal signaling and activity will reveal the mode of action of Vitazyme. Some of these studies are underway and will be informative in increasing Vitazyme stimulated performance in broad applications. As a foliar spray, Vitazyme is relatively easy to apply. There is a need for transitioning agricultural systems to naturally sourced amendments, reducing the need for synthetic chemical inputs. It is clear that an optimal growth program will involve multiple inputs, a combination of nutrients, biostimulants, and safer pesticides and herbicides. Previously, we reported that Vitazyme application on greenhouse-grown tomatoes increased fruit production over the grower's standard conventional program[17]. In the future, it will be of interest to test Vitazyme with other naturally-sourced nutrient inputs to establish a new grower's program for crops grown under controlled conditions and in the field. We hope that these efforts will lead to improved food production and minimize the environmental impact of agriculture on the planet.

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Avocados *with Vitazyme application*

Researcher: Personnel at Gama Company and Syngenta
Research organization: Gama Company and Syngenta, Santiago, Chile
Location: Panquehue, Valparaiso Region, Santa Blanca, Chile
Variety: Hass/Mexicola
Establishment date of the plantation: 2009
Experimental design: An avocado plant plantation was selected to evaluate the effect of Vitazyme on the yield and quality of avocado fruit. The trees were spaced 3 x 3 meters in the grove. Avocado trees were selected in a completely random distribution in the plantation, and were similar in size, health, vigor, and nutritional status.

1 *Control* 2 *Vitazyme*

Fertilization: unknown.
Vitazyme applications: A 1 liter/ha application was made each week throughout the flowering period, beginning when 10% of the flowers were open, on these dates: October 8, 15, and 25, and November 2, 9, and 16 of 2021. The application was made through the irrigation system during the last third of the irrigation time.
Leaf temperature results: Leaf surface temperatures were measured on November 25, 2021.

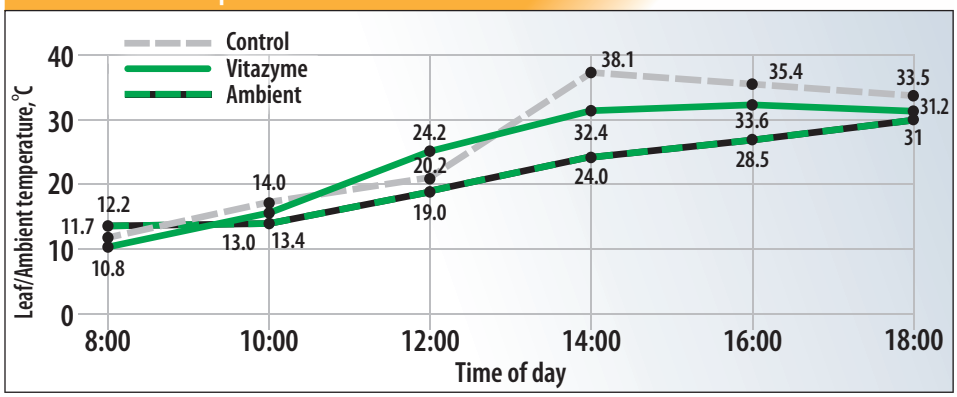
The avocado plantation at Panquehue at Santa Blanca, Chile, was the site of this avocado trial in 2021-22.

Vitazyme was applied to the avocado trees multiple times during the flowering stage, which is represented here at from 0 to 100% flowering.

	Time of day					
Treatment	**8:00**	**10:00**	**12:00**	**14:00**	**16:00**	**18:00**
	----------degrees Centigrade----------					
Control	11.73 ± 1.55	14.03 ± 1.62	20.23 ± 2.04	38.13 ± 3.27	35.40 ± 2.87	33.50 ± 3.47
Vitazyme	10.77 ± 0.93	13.37 ± 0.15	24.22 ± 5.93	32.43 ± 0.25	33.57 ± 4.45	31.17 ± 1.48
P-Value	0.423	0.551	0.386	0.095*	0.591	0.396

*Significantly different mean temperatures at P=0.10 by the Student T-test.

Leaf Ambient Temperature



Leaf temperature reduction with Vitazyme

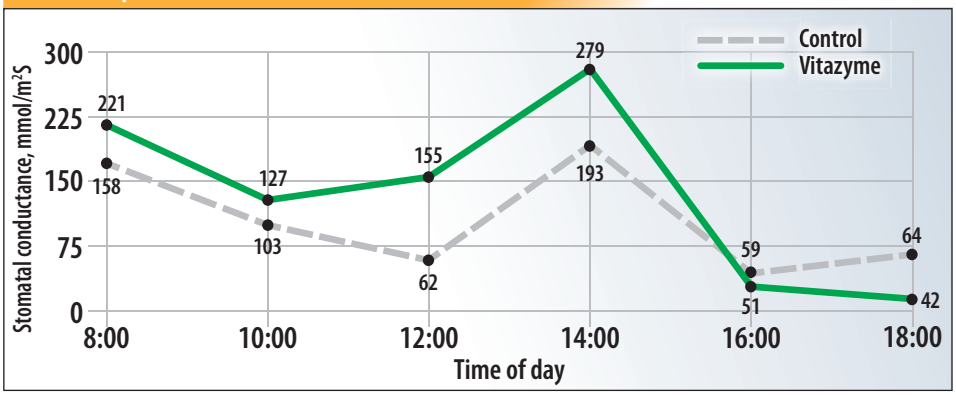
10:00 ..... 0.6 °C
14:00 ..... 5.7 °C
16:00 ..... 1.8 °C
18:00 ..... 2.3 °C

Stomatal conduction results: On November 25, 2021, an evaluation of the conductance of the leaf stomata was performed. This is a measure of the leaf stomatal opening.

	Time of day					
Treatment	**8:00**	**10:00**	**12:00**	**14:00**	**16:00**	**18:00**
	----------mmol/m²s----------					
Control	158.1 ± 53.7	103.1 ± 26.2	62.4 ± 48.4	193.1 ± 16.5	59.07 ± 4.37	64.4 ± 36.2
Vitazyme	221.0 ± 145.0	127.3 ± 87.8	154.6 ± 41.3	279.0 ± 145.0	51.47 ± 8.04	42.2 ± 13.2
P-Value	0.554	0.693	0.087*	0.416	0.246	0.422

*Significantly different mean stomatal conductance at P=0.10 by the Student T-test.

Leaf Temperature



Stomatal conductance increase with Vitazyme

8:00..... 63 mmol/m²S
10:00..... 24 mmol/m²S
12:00..... 93 mmol/m²S
14:00..... 86 mmol/m²S

Leaf analysis results: There were no significant difference between the two treatments for several nutrients measured. Leaves were collected on March 24, 2022

Leaf analysis results												
Treatment	**N**	**P**	**K**	**Ca**	**Mg**	**Na**	**Cl**	**Cu**	**Zn**	**Mn**	**Fe**	**B**
	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
Control	2.39	0.10	0.78	2.83	0.60	0.010	0.65	9.62	33.4	111.1	180.3	45.7
Vitazyme	2.11	0.13	0.69	2.83	0.65	0.012	0.84	9.38	26.2	121.0	241.3	50.4
Change	-0.28	+0.03	-0.10	0	+0.05	+0.002	+0.19	-0.24	-7.2	+9.9	+61.0	+4.7

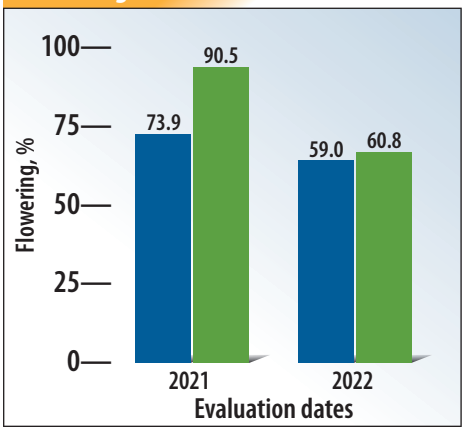
Tree vigor results: Evaluations for vigor were made on May 2, 2022. No significant difference between the treatments was found.

Flowering results: Measurements in flowering on a certain date in October were made both years: October 21, 2021, and October 24, 2022.

Treatment	**2021**	**2022**
	%	%
Control	73.9 ± 17.5	59.0 ± 16.5
Vitazyme	90.5 ± 7.9	60.8 ± 18.2
p-value	0.001*	0.752

*Significantly different means at P=0.05 by the Student T-test.

Flowering

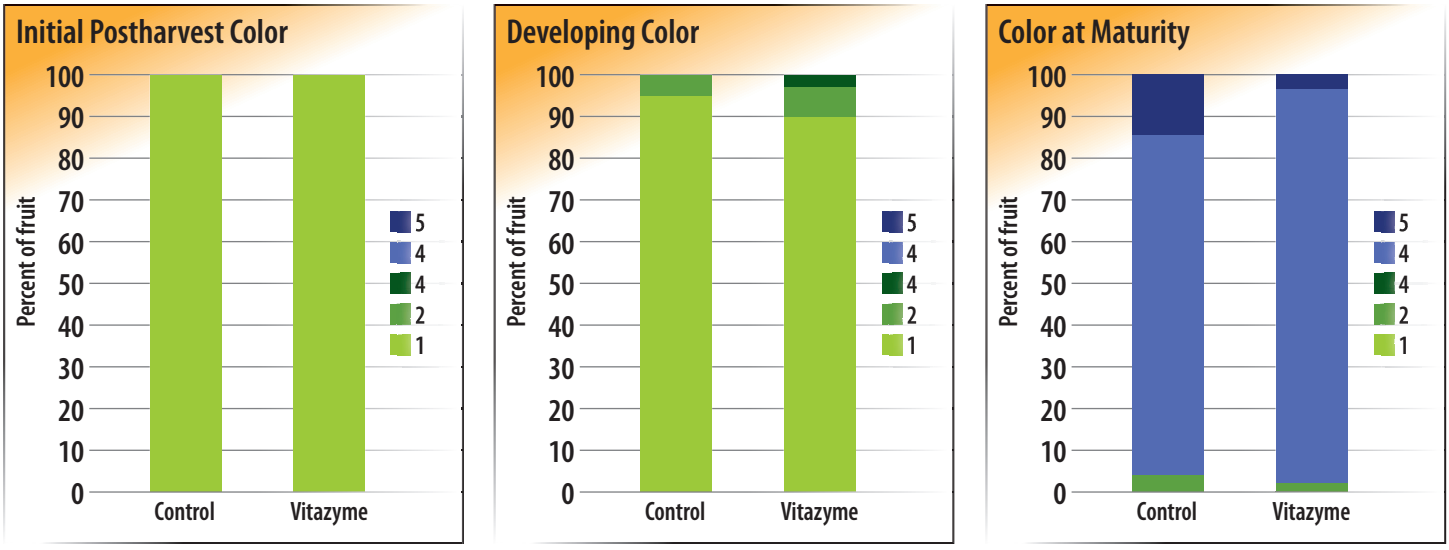


Increase in flowering with Vitazyme

2021....16.6 percentage-points
2022.....1.8 percentage-points

Vitazyme caused a great increase in flowering above the control in 2021, but in 2022 there was only a slight increase.

Fruit yield results: There was no significant effect on yield with Vitazyme
Fruit size results: There was no significant effect on fruit size with Vitazyme.
Fruit color results:



Fruit color is shown here as used to categorize fruit color development of the treated and untreated avocado fruit. Note the more uniformly dark mature color of the Vitazyme treated fruit when ready for consumption.

There were four stages of external browning of the avodado fruit that were measured for both treatments, as shown here. The Vitazyme treatment showed reduced external browning.

Fruit quality results: Vitazyme displayed some improvements in fruit quality.

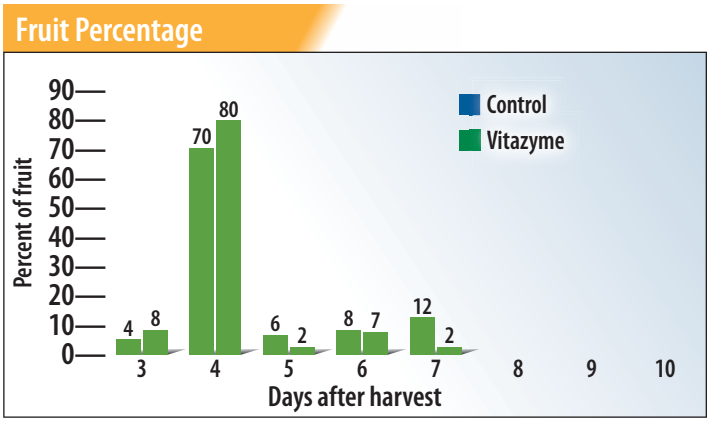
Vascular browning. Vitazyme produced 5 percentage points more of the highest fruit grade without vascular browning.

Pulp browning. Vitazyme revealed no pulp browning, while the control had 3 percentage points.

Stem end rot. Neither treatment had any stem end rot.

Blackspot. Neither treatment revealed any blackspot on the fruit.

Days to maturity: Both treatments were evaluated for the number of days it took for the fruit to ripen for consumer use.



Increase in ripened fruit after harvest

Three days ..... 4 percentage-points
Four days..... 10 percentage-points

Conclusions: A replicated avocado trial in Chile, using six 1 liter/ha applications spaced a week apart during blossoming, produced some good quality improvements in the fruit, though the yield was not significantly influenced. Leaf temperature and stomatal conductance were also improved, by up to 5.7°C lower at mid-afternoon, and up to 9.3 mmol/m²s. Flowering was advanced significantly by 16.6 percentage points in 2021, and fruit parameters were improved. Color at maturity was advanced with Vitazyme, and vascular and pulp browning were reduced. Days to marketable maturity were also reduced from the control. These results show the excellent quality improvements with Vitzyme for avocados in Chile.

Canola *with Vitazyme Cold Start application*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: PAE "Oleksandrivs'ke," Uman District, Cherkasy Region, Oleksandrivka Village, Ukraine
Variety: Temptation
Planting date: August 27, 2021
Planting rate: 4 million seeds/ha
Previous crop: winter wheat
Tillage: disking to 6-8 cm, plowing to 28-30 cm, cultivation to 2-3 cm
Soil type: typical chernozem (4.2% organic matter)
Experimental design: A canola field was divided into a Vitazym Cold Start treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Cold Start on canola yield.

This Vitazyme Cold Start treated canola in the Cherkasy Region yielded 24% more seed than the untreated control.

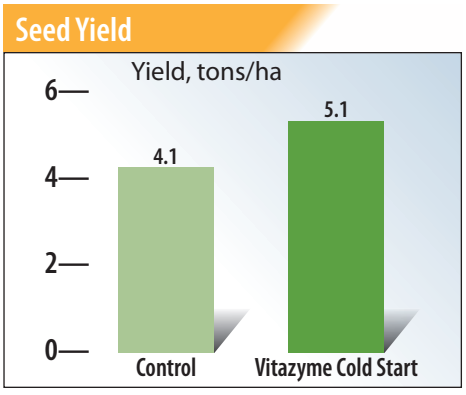
1 ***Control*** **2** ***Vitazyme twice***

Fertilization: 8-24-24 kg/ha of N-P_2O_5-K_2O in-furrow at planting; 108 kg/ha of N and 34 kg/ha of S broadcast in the spring
Vitazyme Cold Start application: 0.5. liter/ha sprayed foliar in the fall (October 12, 2021) at the BBCH 23 stage (6 leaves); 1.0 liter/ha sprayed foliar in the spring (April 30, 2022) at the BBCH 55 stage (budding). Vitazyme Cold Start is a cold and wet weather variation of regular Vitazyme.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	4.1	—
2. Vitazyme Cold Start	5.1	1.0 (+24%)

Yield increase with Vitazyme Cold Start: 24%



Income results: The effect of a 1.0 ton/ha yield increase was to increase the income to the farmer by $383/ha.

Conclusions: This winter canola field scale trial with Vitazyme Cold Start in Ukraine, using a fall foliar application of 0.5 liter/ha at the 6-leaf stage, and a spring foliar application of 1.0 liter/ha at the budding stage, provided an excellent 1.0 ton/ha yield increase (+24%). Such an increase provided the farmer an income increase of $383/ha, showing the great utility of this program for canola growers in Ukraine.

Canola *with Vitazyme Bio (Organic Vitazyme) application*

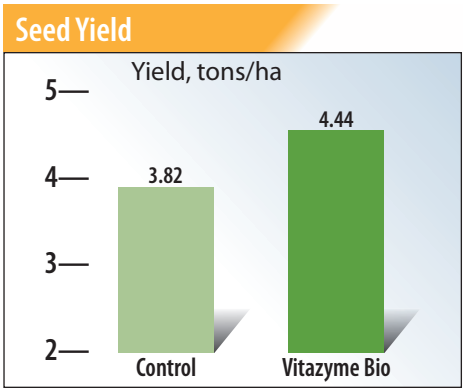
Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: PFC "Kolos," Bilhorod-Dnistrovsky District, Odessa Region, Marazliivka Village, Ukraine; southern Ukraine (270-350 mm of rain per year)
Variety: DK Impression KL
Planting date: August 8, 2021
Planting rate: 400,000 seeds/ha
Previous crop: winter wheat
Tillage: disking to 6-8 cm, direct seeding to 2 cm with a Mzuri planter
Soil type: typical Chernozem (4.0% organic matter)
Experimental design: A canola field was divided into a Vitazym Bio treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Bio on canola yield.

❶ ***Control*** ❷ ***Vitazyme Bio***

Fertilization: 9-45-25 kg/ha of N-$P_2 0_5$-$K_2 0$) in-furrow at planting; 180 kg/ha of N and 42 kg/ha of S broadcast in the spring
Vitazyme Bio application: 0.8. liter/ha sprayed on the leaves at BBCH 59 (bud stage), on April 29, 2022.
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	3.82	—
2. Vitazyme Bio	4.44	0.62 (+16%)

Yield increase with Vitazyme Bio: 16%



Income results: The additional 0.62 ton/ha yield with Vitazyme Bio produced an added $242/ha of income.

Conclusions: A field-scale canola trial conducted in southern Ukraine in 2022 revealed that a Vitazyme Bio application of 0.8 liter/ha, sprayed on the plants at the bud stage, produced an excellent yield increase of 0.62 ton/ha (+16%). This yield increase boosted net income to the farmer by $242/ha, showing the great value of the Vitazyme Bio program for Ukrainian farmers.

Cherries *with Vitazyme application—A Study by the University of Chile, Santiago, Chile*

Researcher: Faculty of Agronomic Sciences and personnel of Syngenta, Chile
Research organization: Laboratory of Deciduous Fruit Trees, University of Chile, Santiago, Chile, and Syngenta Chile, Santiago, Chile
Location: Chile ***Cropping year:*** 2021
Variety: Regina
Overall objective of the study: Evaluate the effect of different strategies of application of Vitazyme from flowering to maturity on fruit drop and fruit quality in cherry trees, for two seasons

Ripe cherries are shown here that have been treated with Vitazyme, giving superior yield and color.

ORCHARD TRIAL TREATMENTS

Treatment	Applications*	Number of application	Total product, liters/ha
1. Control	none	0	0
2. F-10-20-VP-P	flowering, 10 and 20 days after flowering, at pale green, and pinta	5	7.5
3. F-14-28-VP-P	flowering, 14 and 28 days after flowering, at pale green, and pinta	5	7.5
4. 14-21-28-VP-10	14, 21, and 28 days after flowering, at pale green, and 10 days later	5	7.5
5. 14-21-28-VP-P	14, 21, and 28 days after flowering, at pale green, and at pinta	5	7.5
6. VP-AP-P	at pale green, at straw yellow, and at pinta	3	3.5

*

Phenology	Date
30% flower	Sep 27
Full flower	Oct 5
14 days after full flower	Oct 19
21 days after full flower	Oct 26
28 days after full flower	Nov 2
Pale green	Nov 9
Straw yellow	Nov 19
Pinta	Nov 24

Location and Design of the Study

Location: The Niches, Maule Region, Chile
Variety: Regina ***Spacing:*** 3.5 x 1.5 meters ***Pollinator varieties:*** Skeena and Kordia
Experimental design: DBCA, with six treatments and two trees per experimental unit, and five replications

Sampling

1. Three subsamples per experimental unit were used to estimate fruit fall, final fruit set, and fruit quality.
2. For each experimental unit 500 grams of commercial quality, having fruit of 30 to 32 mm in diameter, were harvested for the different quality evaluations.
3. For each experimental unit, 1,000 grams of commercial quality colored fruit without defects were harvested, without discriminating the caliper, to evaluate the diameter and weight of the cherries.
4. One or two healthy mother branches were selected having at least 60 fruits, to evaluate the color distribution, and infer the uniformity and maturity of the fruit.

Evaluations

1. Three samplings per experimental unit were used to evaluate the following parameters.

Fruit drop	Fruit quality	Fruit dimensions
Final yield	Fruit firmness	Fruit weight
Shoot length	Soluble solids	Pedicel dimensions

2. Other parameters were also measured.

Fruit firmness	Fruit dry matter	Fruit volume and weight
Fruit color	Pedicel dimensions	Fruit diameter
Soluble solids	Pedicel color	
Pulp/caroza ratio	Skin Splitting by immersion	

3. Three additional measurements were made.

Size distribution	Weighted size index	Average weight

4. Two final evaluations were made.

Color distribution	Weighted maturity index

Results for the Orchard Trial

Measurements were made on fruit set, shoot length, fruit yield, cross-sectional trunk area, fruit dimensions (length, width, and diameter), fruit weight, and fruit quality of mahogany red commercial cherries with a 30 32 caliper, percentage of malic acid, percent of dry matter, and pulp ratio). Also measured was the percentage of split fruit after 4 hours of immersion in distilled water. Fruit color was measured in terms of hue, value, and chroma. The length and width of the stems of the commercial quality fruit were measured, and their color evaluated as well. Each treatment was evaluated in terms of the caliper of the fruit in various categories, from < 22 to > 32, for commercial quality fruit, as well as the weight of the fruit for each category. Data for the various parameters measured were not available for this report, though statistical analysis showed several favorable outcomes for the Vitazyme treatments.

LABORATORY FLOWERING TRIAL

Objective of the study: To evaluate the effect of Vitazyme on the longevity of flower organs

Trial description: Treatments were established to study the effect of early applications of Vitazyme, beginning at early white button under controlled conditions, on prolonging the life of flowers by monitoring their appearance over time

Materials and methods: Twenty twigs in the white button stage and 10 twigs in the balloon stage were collected from a healthy local orchard, not having a history of production problems, and taken to the Laboratory of Deciduous Fruit Trees at the University of Chile. The twigs were placed in floral foam in groups of 10 and identified clearly. There were three phenological states, each either receiving or not receiving Vitazyme. The product was applied on day 1 and 5 days later to the Vitazyme treated flowers with a sprayer, and distilled water was applied to the control flowers. The floral foam was periodically watered to maintain a good moisture level.

Treatment	Vitazyme spray
1. Early white button	Yes
2. Early white button	No
3. White button	Yes
4. White button	No
5. Full bloom	Yes
6. Full bloom	No

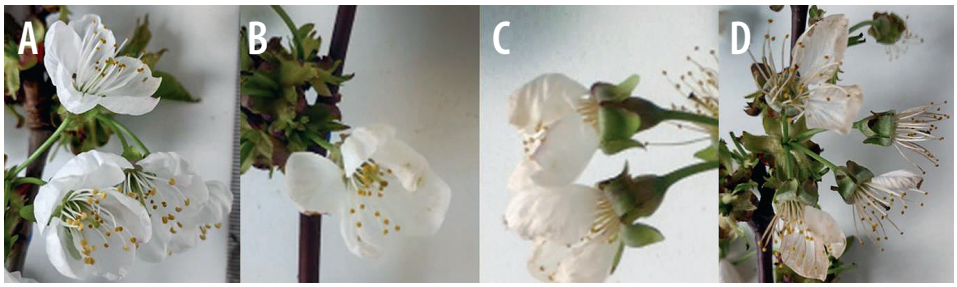
Results of flower longevity: Some favorable results were noted in promoting flower longevity with Vitazyme

The full bloom stage of the flower.

The three flowering stages: A and D, early button; B and E, button; C and F, full bloom.

Every 1 to 2 days photos were taken of the various treatments, and the blossoms were categorized into four groups:

a. Turgid
b. Beginning to wilt
c. Browned
d. Fallen petals



Petal condition is shown as turgid (A), beginning to wilt (B), browned (C), and fallen petals (D).

Conclusions:

1. Applications of Vitazyme at blossoming improve the overall behavior of productive parameters.
2. Early Vitazyme applications slightly delay ripening.
3. Applications spaced every 14 days seem to be more effective in terms of cherry fruit acidity, caliper, and reduction of bitterness.
4. Early Vitazyme applications are recommended, especially for self-incompatible varieties such as Kordia.
5. Applications at flowering are recommended for warm environments during flowering, since these applications prolong the life of the flower.

Corn *with Vitazyme application*

Researchers: Bence Kiraly, Natalia Simon, and Jeno Simon
Research organization: Syntech Research Group, 6636 Martely, hrsz.; 013818, Hungary; Vital Earth Resources, Inc., Gladewater, Texas, USA
Location: Hodmezovasarhely-Erzsebet, Csongrad-Csanad, Hungary
Variety: Pioneer P9903 (*Zea Mays*) ***Planting date:*** April 19,2022
Row spacing: 75 cm ***In-row spacing:*** 20 cm ***Planting depth:*** 5 cm
Planting rate: 66,665 seeds/ha ***Soil traits:*** clay loam chernozem; good fertility; fair drainage
Tillage: conventional
Experimental design: A small-plot experiment with corn was set up using plots that were 3 x 10 meters ($30m^2$), having six replications. Four treatments were applied in a randomized complete block design, with the objective of determining the effects of Organic Vitazyme and Terra-Sorb Foliar on the yield and other parameters of corn.

Organic Vitazyme and Terra-Sorb Foliar on the yield and other parameters of corn

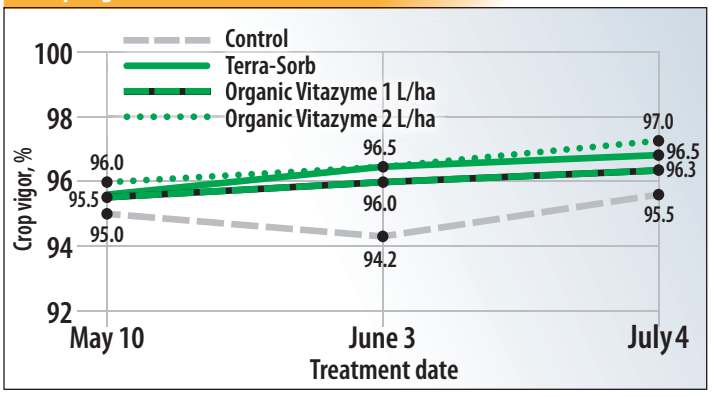
Treatment	Rate	Stage of growth	Date of treatment
1. Control	0	—	—
2. Terra-Sorb Foliar	1 liter/ 100 kg seed	Seed treatment	April 19
3. Organic Vitazyme	1 liter/ha	Seed treatment	April 19
4. Organic Vitazyme	2 liters/ha	Seed treatment	April 19

Fertilization: Unknown
Organic Vitazyme application: See the treatments above. Organic Vitazyme was applied as concentrated product on the seeds to achieve the desired 1 or 2 liters/ha rates.
Terra-Sorb Foliar application: Terra-Sorb Foliar is a formulation of mostly free amino acids that, when sprayed on leaves, will increase chlorophyll and photosynthesis, improve fruit set, and promote plant recovery during times of stress. It was applied at 1 liter/100 kg of seed.
Herbicide application: Laudis at 2 liters/ha on May 5
Insecticide application: Sumi Alfa 5 EC at 0.2 liter/ha on July 15
Growing season weather: normal
Phytotoxicity results: No phytotoxicity was detected for either product in the three treatments.
Crop vigor results:

Treatment	Rate	Assessment date*		
		May 10	June 3	July 4
	L/ha	%	%	%
1. Control	0	95.0 a	94.2 b	95.5 a
2. Terra-Sorb	1	95.5 a	96.5 a	96.5 a
3. Organic Vita	1	95.5 a	96.0 a	96.3 a
4. Organic Vita	2	96.0 a	96.5 a	97.0 a
LSD (P=0.10)		1.2	1.4	1.7
CV		1.19	1.43	1.72
Treatment F		0.5289	0.0296	0.4862

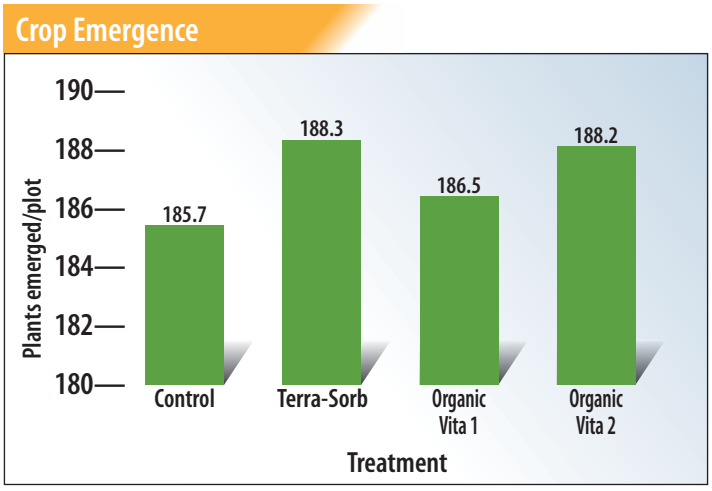
*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.

Crop Vigor



All three of the treatments improved crop vigor above the control, with the Organic Vitazyme application at 2 liters/ha showing the best overall effect over the two-month period assessed.

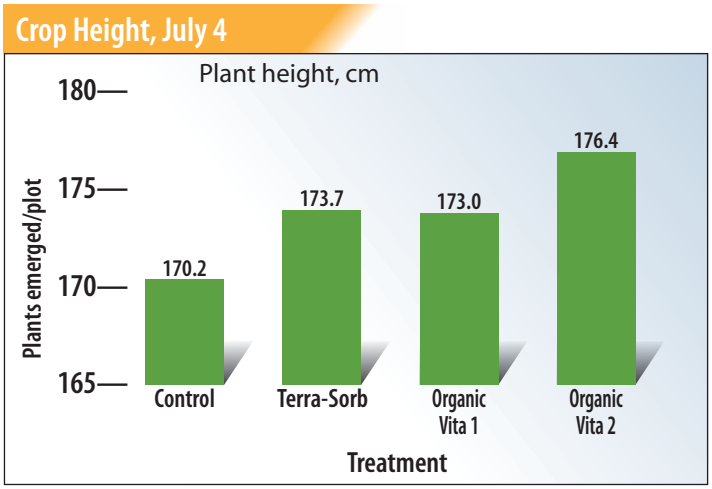
Crop emergence results: Although the differences in crop emergence on May 10 were not significant, all three treatments exceeded the control, as shown in the graph below.



Crop height results: Fifty plants were measured and averaged for each plot on each date.

Treatment	Rate	Assessment date*	
		May 10	July 4
	L/ha	cm	cm
1. Control	0	5.7 b	170.2 b
2. Terra-Sorb	1	5.9 a	173.7 ab
3. Organic Vita	1	5.8 b	173.0 ab
4. Organic Vita	2	5.9 a	176.4 a
LSD (P=0.10)		0.1	29.
CV		1.15	1.66
Treatment F		0.0010	0.0171

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.

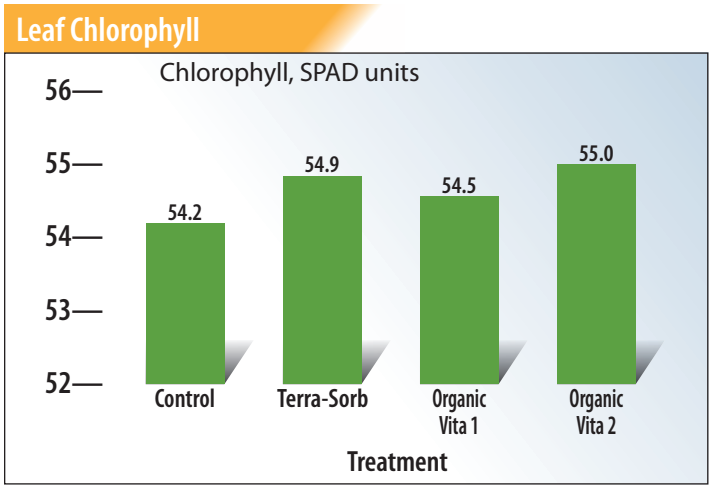


Organic Vitazyme at 2 liter/ha significantly increased corn height at both dates above the control, as did Terra-Sorb on May 10. All treatments produced taller plants on both dates.

Leaf chlorophyll results: On June 3 a Minolta SPAD meter was used to measure leaf chlorophyll of 20 plants per plot, and the results were averaged.

Treatment	Rate	Leaf chlorophyll*
	L/ha	SPAD units
1. Control	0	54.2 b
2. Terra-Sorb	1	54.9 a
3. Organic Vita	1	54.5 ab
4. Organic Vita	2	55.0 a
LSD (P=0.10)		0.5
CV		0.9
Treatment F		0.0592

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.

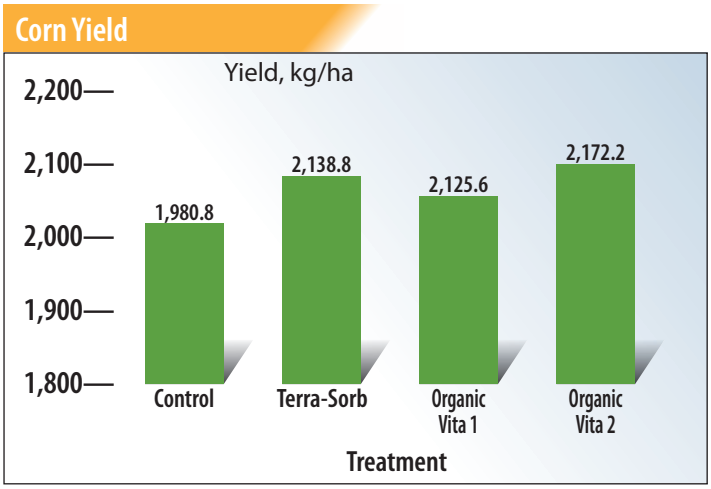


All treatments increased leaf chlorophyll in the small corn pants, 15 days after planting, especially the Terra-Sorb and Organic Vitazyme at 2 liters/ha, which increases were significant.

Grain yield results: The plots were harvested on September 13, 2022.

Treatment	Rate	Grain yield*
	L/ha	kg/ha
1. Control	0	1,980.8 b
2. Terra-Sorb	1	2,138.8 ab
3. Organic Vita	1	2,125.6 ab
4. Organic Vita	2	2,172.2 a
LSD (P=0.10)		180.0
CV		8.45
Treatment F		0.2926

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.



All treatments increased corn grain yield above the control, by 10% with Organic Vitazyme at 2 liters/ha — a significant increase — by 8% for Terra-Sorb, and by 7% for Organic Vitazyme at 1 liter/ha.

Increase in grain yield

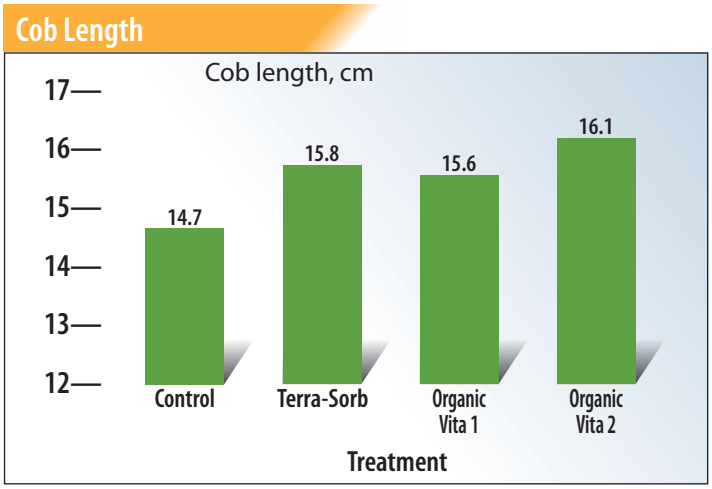
Terra-Sorb ..... 158.0 kg/ha (+8%)
Organic Vita, 1 liter/ha..... 144.8 kg/ha (+7%)
Organic Vita, 2 liters/ha ..... 191.4 kg/ha (+10%)

Grain moisture results: There were no significant differences in grain moisture at harvest for any of the treatments, although Terra-Sorb and organic Vitazyme at 1 liter/ha reduced grain moisture by 0.8 to 1.0%.

Cob length results: Fifty ears were measured and averaged for each plot.

Treatment	Rate	Cob length*
	L/ha	cm
1. Control	0	14.7 b
2. Terra-Sorb	1	15.8 a
3. Organic Vita	2	15.6 a
4. Organic Vita	2	16.1 a
LSD (P=0.10)		0.5
CV		2.89
Treatment F		0.0005

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.



The size of the cob was significantly increased above the control by all three treatments, but especially by the Organic Vitazme treatment at 2 liters/ha (+ 10%).

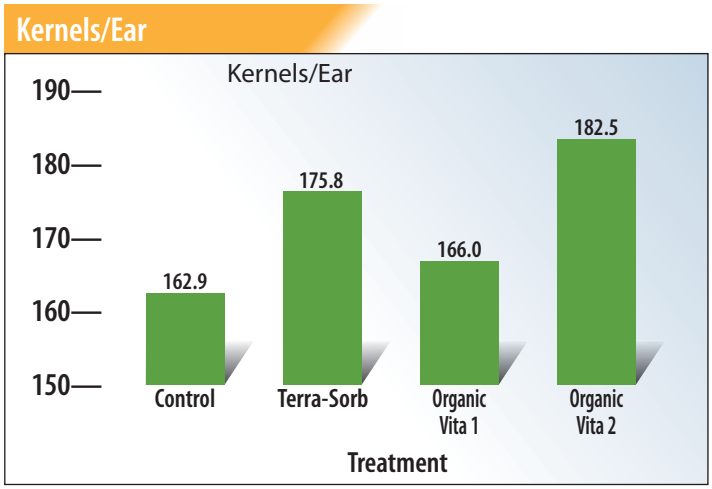
Increase in cob length

Terra-Sorb .....1.1 cm (+7%)
Organic Vita, 1 liter/ha.....0.9 cm (+6%)
Organic Vita, 2 liters/ha .....1.4 cm (+10%)

Kernels per ear results: The number of kernels per ear were counted for 50 plants per plot, and averaged.

Treatment	Rate	Kernels/ear*
	L/ha	number
1. Control	0	162.9 b
2. Terra-Sorb	1	175.8 ab
3. Organic Vita	1	166.0 b
4. Organic Vita	2	182.5 a
LSD (P=0.10)		12.8
CV		7.38
Treatment F		0.0620

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.



All treatments increased the number of corn kernels per ear, especially Organic Vitazyme at 2 liters/ha, which increased the number by 12% above the control.

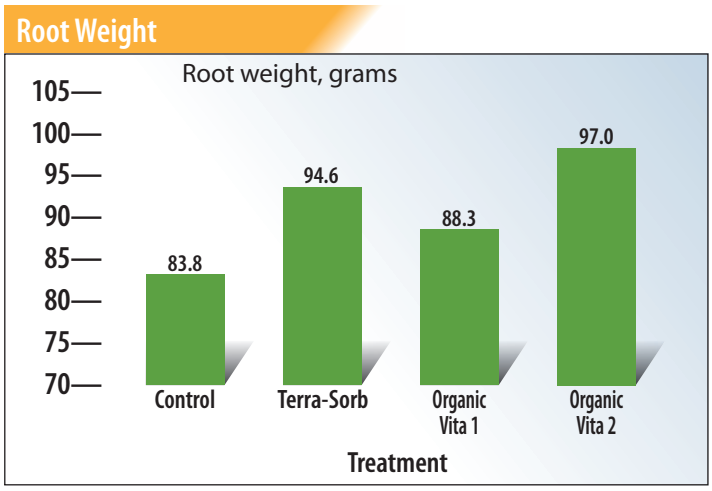
Increase in kernels/ear

Terra-Sorb..... 12.9 (+8%)
Organic Vita, 1 liter/ha ..... 3.1 (+2%)
Organic Vita, 2 liters/ha.... 19.6 (+12%)

Root weight results: Twenty corn plant root masses were weighed for each plot, and averaged.

Treatment	Rate	Root weight*
	L/ha	grams
1. Control	0	83.8 c
2. Terra-Sorb	1	94.6 ab
3. Organic Vita	1	88.3 bc
4. Organic Vita	2	97.0 a
LSD (P=0.10)		6.5
CV		7.01
Treatment F		0.0109

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.



All treatments exceeded the control for root weight increases, and both Terra-Sorb and Organic Vitazyme at 2 liters/ha significantly improved root mass, by 13% and 16%, respectively.

Increase in root weight

Terra-Sorb..... 10.8 (+13%)
Organic Vita, 1 liter/ha ..... 4.5 (+5%)
Organic Vita, 2 liters/ha.... 13.2 (+16%)

Grain starch content results: There were no significant differences among the treatments for grain starch content.

1,000-grain weight results: There were slight but non-significant increases in the 1,000-grain weight for all three treatments versus the control.

Conclusions: A small-plot corn study in Hungary in 2022 compared the crop's response to Terra-Sorb Foliar, Organic Vitazyme at 1 liter/ha, and Organic Vitazyme at 2 liters/ha, all three applied to the seeds at planting. The Organic Vitazyme at 2 liters/ha proved to be the superior treatment for all parameters that produced an improvement, including crop vigor (1.5 percentage points), crop height (6.2 cm), leaf chlorophyll (0.8 SPAD units), grain yield (+ 10%), cob length (+ 10%), kernels/ear (+ 12%), and root weight (+ 16%). Many of these responses were significant. The next best treatment was Terra-Sorb, followed by Organic Vitazyme at 1 liter/ha. These results show the efficacy of Organic Vitazyme, and to a lesser extent Terra-Sorb, as biostimulants for corn production in Hungary.

Corn *with Vitazyme application*

Researcher: Jonathan Jaschen ***Research organization:*** ACRES Research, Cedar Falls, Iowa
Location: Fairbank, Iowa ***Variety:*** P03390 ***Planting date:*** May 30, 2022 ***Planting depth:*** 2 inches
Row spacing: 30 inches ***Planting rate:*** 34,000 seeds/acre ***Previous crop:*** soybeans
Soil: Marshan clay loam; 3.7% organic matter, 6.5 pH, 24 meq/100g cation exchange capacity
Experimental design: A small-plot replicated corn trial, using five replications and plots that were 30 x 15 feet (six rows/plot) was established as a randomized complete block design in a field without a previous history of plot work. The purpose of the trial was to evaluate the effect of Vitazyme, applied at different times and ways, over four fertilizer rates, to determine the effect of the product on nitrogen utilization.

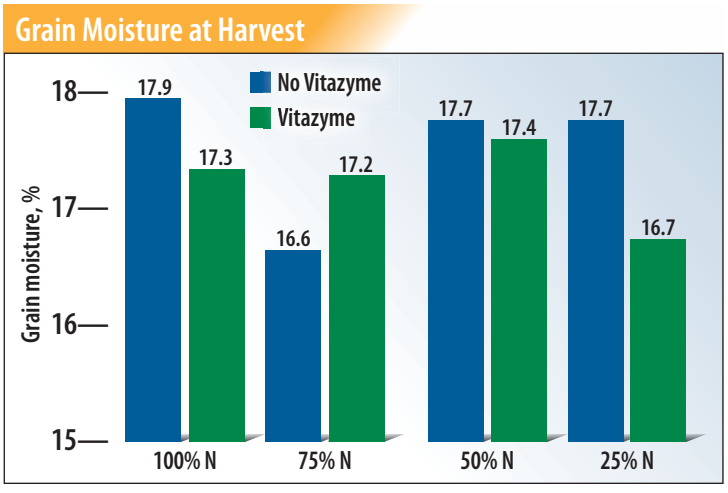
At 50% of the optimum nitrogen rate, Vitazyme greatly improved root and overall plant development.

Treatment	Nitrogen application	Vitazyme application[1]	Vitazyme timing[2]	Fertilizer nitrogen
	% of optimum	ounces/acre		lb of N/acre
1. 100%	100	0	0	180
2. 100% + Vitazyme	100	13	in-furrow + foliar	180
3. 75% N	75	0	0	120
4. 75% N + Vitazyme	75	13	in-furrow + foliar	120
5. 50%	50	0	0	90
6. 50% + Vitazyme	50	13	in-furrow + foliar	90
7. 25%	25	0	0	60
8. 25% N + Vitazyme	25	13	in-furrow + foliar	60

[1]13 oz/acre = 1 liter/ha; [2]in-furrow application applied at planting on May 30; foliar application sprayed on Juy 1 at the 6-leaf stage.


Even at 100% of the optimal nitrogen rate, Vitazyme improved ear fill (Vitazyme on the right, control on the left).

Fertilization: See the table above.
Herbicide applications: May 16, Harness Xtra (1.2 quarts/acre) + DiFlex (8 oz/acre) + AMS (17 lb/100 gal. of water); June 15, Harness Max (1.2 quarts/acre) + FS Max Supreme (2.8 pints/acre) + Infantry 4L (15 oz/acre) + Roundup Powermax 3 (22 oz/acre)
Growing season weather: favorable throughout the growing season.
Harvest date: November 4, 2022. An MF3 plot combine was used to harvest an area of 5 x 32 feet for each plot.
Grain moisture results: Values ranged from 16.6% to 17.9% with no significant differences among the eight treatments. However, except for the 75% N rate, Vitazyme tended to lower the moisture content at harvest.



Average grain moisture

No Vitazyme 17.5%
With Vitazyme 17.2%

Note the much greater ear size with Vitazyme at the 50% nitrogen level, showing improved N utilization with reduced N.

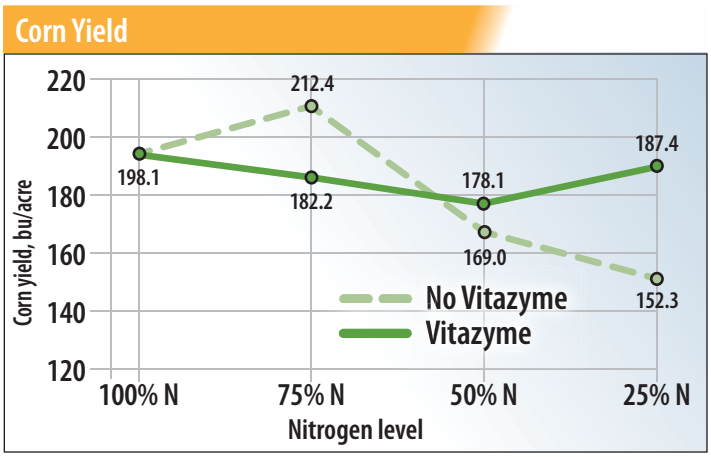
This replicated small plot corn trial in northeastern Iowa revealed the potential of Vitazyme to improve nitrogen efficiency of use.

Grain test weight results: Values for test weight ranged from 59.46 lb/bu to 60.40 lb/bu, with no significant differences or discernible pattern among the eight treatments.

Grain yield results:

Treatment	Grain yield*	Yield change at the same N level	
	bu/acre	bu/acre	
1. 100% N	198.09 ab	—	—
2. 100% N + Vitazyme	197.99 ab	(-) 0.10	(0%)
3. 75% N	212.36 a	—	—
4. 75% N + Vitazyme	182.19 ab	(-) 30.17	(-14 %)
5. 50% N	168.96 ab	—	—
6. 50% N + Vitazyme	178.13 ab	9.17	(+5%)
7. 25% N	152.30 b	—	—
8. 25% N + Vitazyme	187.35 ab	35.05	(+23%)
LSD (0.05)	33.41		
CV	13.97		
Replicate probability (F)	0.0003		
Treatment probability (F)	0.0306		

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.



Change in yield with Vitazyme % at same N level

100% N..... no change
75% N.....-14%
50% N..... + 5%
25% N..... + 23%

All yields but the 25% N treatment without Vitazyme were statistically equal, and showed the typical yield response increase with decreasing N levels. While the yields of both the untreated plots were the same at 100% N, the yield without Vitazyme at 75% N was anonalously high; the reason is unknown. At both the 50% and 15% N levels, the yield was boosted with Vitazyme, by 5% N and by 23% N.

Conclusions: A small-plot replication corn trial in east-central Iowa, using four levels of applied nitrogen (N) corresponding to 100, 75, 50, and 25% of the 180 lb/acre of N 100% rate, during a favorable cropping year, and using a Vitazyme seed treatment at 13 oz/acre plus a 13 oz/acre foliar treatment at V6 at each N level, revealed large yield increases with Vitazyme at the 50% N level (5%) and the 25% N level (23%). There was no yield change with Vitazyme at the 100% N level. At the 75% N level there was a grain yield increase without Vitazyme of 14.3 bu/acre above the 100% N yield; the reason for this anomaly is not known.

While no means were significantly different at P = 0.05, except for the 25% N treatment without Vitazyme being less than the 75% N treatment without Vitazyme, these results generally reveal the tendency of Vitazyme to improve the grain yield more at lower available N levels than at higher levels. These results show the trend for Vitazyme at less than optimum nitrogen levels to improve the efficiency of nitrogen use.

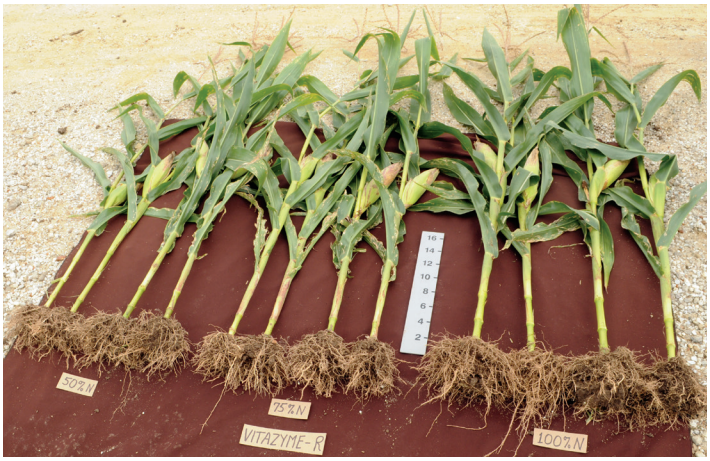
Grain moisture at harvest tended to be less with Vitazyme than without it, but test weight was not changed.

Corn *with Vitazyme application—A Preliminary Report On a Comprehensive Study*

Researcher: Robert Kremer, Ph.D., and Timothy Reinbolt
Research organization: School of Natural Resources and Division of Plant Science and Technology, University of Missouri, Columbia, Missouri
Location: Bradford Research Farm, Columbia, Missouri
Variety: yellow dent
Experimental design: A small-plot corn trial, with four replications in a randomized complete block design, was established, using three fertilizer levels, to determine the effects of Vitazyme on fertilizer use efficiency as well as yield and growth parameters.

Treatment	Percent of fertilizer	Vitazyme[1]	Fertilizer additions[2]		
			N	P	K
	%		lb/acre	lb/acre	lb/acre
1. 50% fertilizer	50	0	32.6	18.5	18.5
2. 50% fert + Vita	50	x	32.6	18.5	18.5
3. 75% fertilizer	75	0	24.4	13.8	13.8
4. 75% fert + Vita	75	x	24.4	13.8	13.8
5. 100% fertilizer	100	0	16.3	9.3	9.3
6. 100% fert + Vita	100	x	16.3	9.3	9.3

[1]See the Vitazyme application regime below.
[2]See the fertilizer application regime and materials below.



Corn plants dug from the three fertilizer rates reveal superior root and top growth for the Vitazyme treated palnts at each level. The treated plants are on the right for each fertilizer treatment

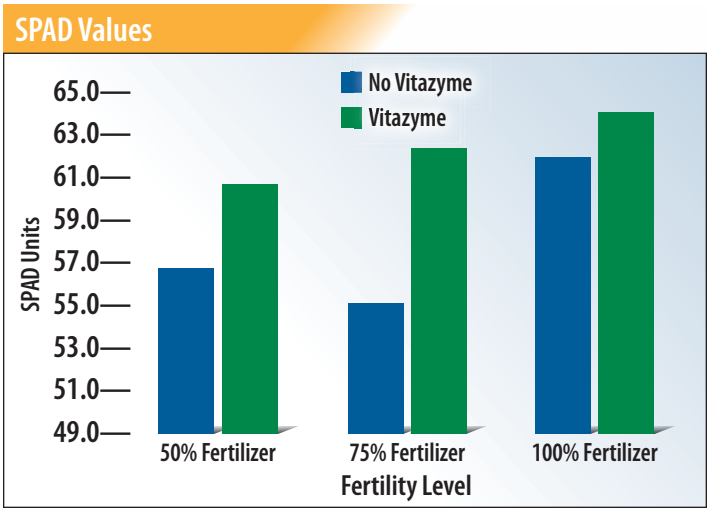
Notice the vastly superior root development of the Vitazyme treated plants after a seed and a foliar treatment

Ear development was greatly enhanced by Vitazyme treatment at each fertilizer level, as shown here at the 75% level. This improvement in yield was 30% for 100% fertilizer

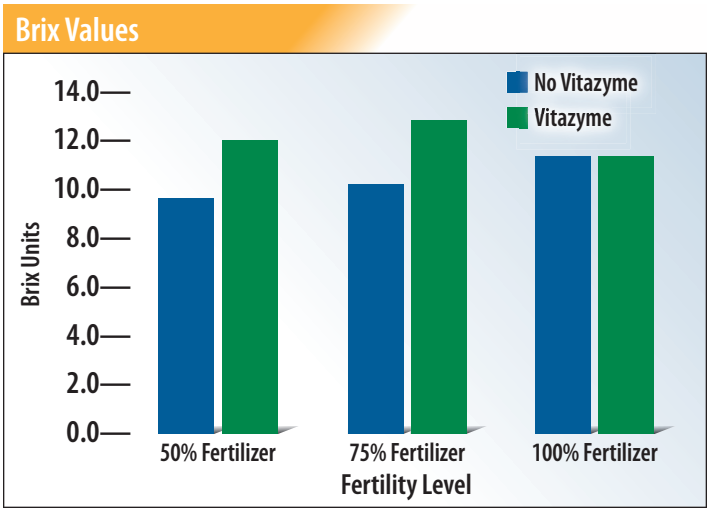

Notice the vastly superior root development of the Vitazyme treated plants after a seed and a foliar treatment

Fertilizer applications: Nitrogen (N) was applied as urea, phosphorus (P) was applied as diammonium phosphate (DAP),and potassium (K) was applied as potassium chloride (KCl). Values in lb/acre are as elemental.
Vitazyme treatments: Treatment 2, 4, and 6 received a Vitazyme seed treatment at 13 oz/acre (1 liter/ha), as well as a foliar treatment of 13 oz/acre (1 liter/ha) at the 6-leaf stage.

Leaf chlorophyll results: Minolta SPAD meter readings were taken for the six treatments during the vegetative stage, which showed increased leaf chlorophyll with Vitazyme above the respective untreated control treatments for all three fertilizer levels.



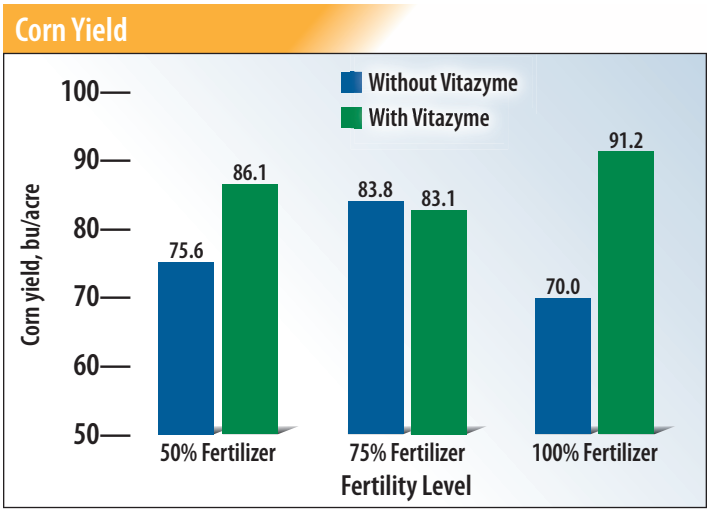
Tissue Brix results: During the vegetative state, tissue sap for each treatment was analyzed for dissolved solids, showing increased dissolved solids for the 50% and 75% fertilizer treatments, respective to the non-Vitazyme treated controls



Yield results:

Treatment	Corn yield[1]	Yield change
	bu/acre	bu/acre
1. 50% fertilizer	75.6 b	—
2. 50% fert + Vita	86.1 a	10.5 (+14%)
3. 75% fertilizer	83.8 a	—
4. 75% fert + Vita	83.1 a	(-) 0.7 (-1%)
5. 100% fertilizer	70.0 b	—
6. 100% fert + Vita	91.2 a	21.2 (+30%)

[1]Means followed by the same letter are not significantly different at P=0.10.
Using the data for 50% and 100% fertilizer only, the differences between Vitazyme-treated and untreated treatments is significant at P=0.03.



Yield increase with Vitazyme

50% fertilizer 14%
100% fertilizer 30%

Note: The values for 75% fertilizer are anomalous.

Conclusions: A replicated small-plot study at the University of Missouri, using Vitazyme as a seed and foliar treatment, revealed that this product significantly increased grain yield at the 50% fertilizer (+14%) and 100% fertilizer (+30%) applications. A lack of similar responses at the 75% fertilizer level is anomalous. Yields were reduced due to unfavorable planting conditions caused by excessive rainfall at planting time. Chlorophyll levels increased at all fertility levels with Vitazyme, and Brix values increased with the product at the 50 and 75% fertilizer applications. Analyses on rhizosphere organisms and grain quality were not available at the time of this report, but will be reported in future publications. Vitazyme is shown to be a highly effective means of improving the utilization of fertilizer applications for corn in Missouri.

Corn *with Vitazyme application*

Researcher: Bruce Kirksey,Ph.D. ***Research organization:*** AgriCenter International, Memphis, Tennessee
Location: Memphis Tennessee ***Variety:*** DK 64-69 ***Planting date:*** June 15, 2022
Planting population: 34,000 seeds/acre ***Planting depth:*** 1.5 inches ***Row spacing:*** 30 inches
Soil: Falaya silt loam, 1.8% organic matter, 6.5 pH, 7.8 meq/100 g cation exchange capacity, good drainage, excellent fertility
Experimental design: A small-plot randomized complete block experimental design was established, using four replications, with four rows per plot of 10 x 30 foot plots, to evaluate the effect of Vitazyme on the effectiveness of this product to improve the utilization of fertilizer with reduced fertilizer applications.

Treatment	Percent of optimum fertilizer	Vitazyme application		Fertilizer application			Nutrient level
		In-furrow	Foliar	Urea	18-46-0	KCl	$N-P_2O_5-K_2O$
	%	oz/acre	oz/acre	lb/acre	lb/acre	lb/acre	lb/acre
1. 100% fertilizer	100	0	0	391	130	100	203-60-60
2. 100% fertilizer + Vita	100	13	13	391	130	100	203-60-60
3. 75% fertilizer	75	0	0	293	98	75	152-45-45
4. 75% fertilizer + Vita	75	13	13	293	98	75	152-45-45
5. 50% fertilizer	50	0	0	195	65	50	102-30-30
6. 50% fertilizer + Vita	50	13	13	195	65	50	102-30-30
7. 25% fertilizer	25	0	0	98	32	25	51-15-15
8. 25% fertilizer + Vita	25	13	13	98	32	25	51-15-15

Fertilizer applications:
See the amounts in the table above.
Vitazyme applications: The in-furrow application was at 13 oz/acre (1 liter/ha) at planting on June 15. The foliar application was sprayed on at 13 oz/acre (1 liter/ha) at the 6 to 8-leaf stage on July 15.
Growing season weather:
Soil moisture at planting was good, but rainfall during June was only 0.94 inch (normal of 4.71 inches), causing considerable moisture stress. Added to this were high temperatures during June, July,and August, with 29 days in July between 90 and 100 degrees F.
Harvest date: November 14, 2022. The center two rows of each plot were harvested, for 30 feet.
Grain moisture results: There were no significant differences in grain moisture at harvest for all treatments. Values ranged from 13.80 to 14.14%.

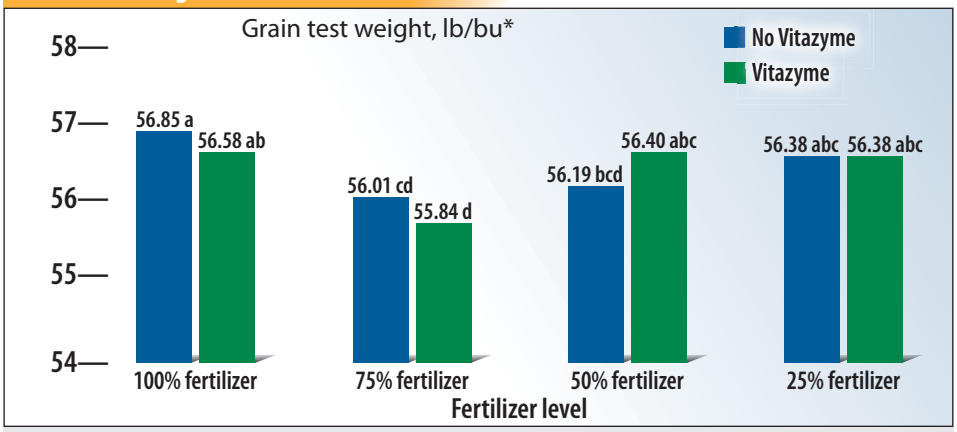
Note that at all fertilizer levels, Vitazyme increased the ear size and kernel weight compared to the untreated control.

At the 25% fertilizer level, Vitazyme greatly expanded the root mass, giving an excellent 15% grain increase above the untreated control.

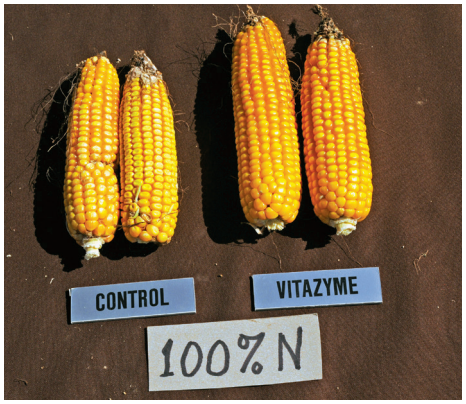
With 75% of the optimal fertilizer applied, Vitazyme increased the root mass significantly, as it did at all fertilizer levels.

Grain Test weight results: There were no significant differences in test weight among the eight treatments, the values ranging from 55.84 to 56.85 lb/bu.

Grain Test Weight



*Means followed by the same letter are not significantly different at P=0.05.
LSD (0.50 lb/bu
CV = 0.61
Treatment F = 0.0130



Even at 100% of the applied fertilizer, Vitazyme improved ear size, giving a 15% yield increase compared to the untreated control.

Though differences in grain test weight were small, there was a significantly lower test weight for the grain at 75% fertilizer, and at 50% with Vitazyme. The reason for this slight reduction is not known.

Grain yield results:

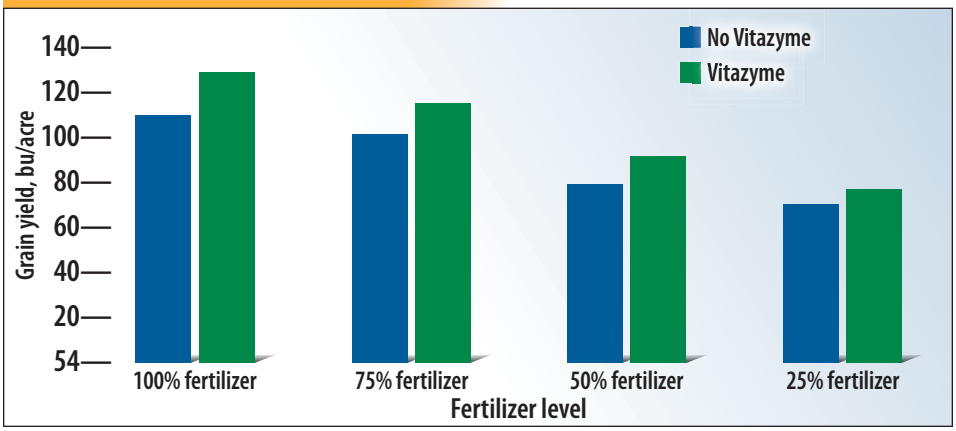
Treatment	Grain yield[1]	Yield change[2]
	bu/acre	bu/acre
1. 100% fertilizer	110.5 c	—
2. 100% fertilizer + Vitazyme	126.8 a	16.3 (+15%)
3. 75% fertilizer	101.2 d	—
4. 75% fertilizer + Vitazyme	118.3 b	17.1 (+17%)
5. 50% fertilizer	79.3 f	—
6. 50% fertilizer + Vitazyme	91.0 e	11.7 (+15%)
7. 25% fertilizer	68.6 g	—
8. 25% fertilizer + Vitazyme	78.9 f	10.3 (+15%)
LSD (P=0.05)	7.02	
CV	4.93	
Replicate probability (F)	0.2104	
Treatment probability (F)	0.0001	

[1]Means followed by the same letter are not significantly different at P=0.05.
[2]Comparisons are made at the same fertilizer level.

Grain yield increase with Vitazyme

100% fertilizer 15%
75% fertilizer 17%
50% fertilizer 15%
25% fertilizer 15%

Corn Grain Yield



There are major significant differences between the various treatments, and at each fertilizer level the grain yield was significantly increased (P = 0.05) by 15 to 17%. The increases ranged from 10.3 to 17.1 bu/acre.

Conclusions: A small-plot corn trial, using four replications in a randomized complete block design, was conducted in western Tennessee on a Falaya silt loam soil. Weather conditions were hot and dry during the mid-summer growth period, which limited yield responses compared to normal years, but during this stressful year Vitazyme, applied in-furrow, and foliar at the 6 to 8-leaf stage, proved to consistently increase the yield by 15 to 17% (10.3 to 17.1 bu/acre) at each of the four fertilizer levels utilized. All of these increases at all four fertilizer levels were highly significant, indicating the ability of Vitazyme's active agents — brassinosteroids, 1-triacontanol, and B-vitamins — to positively impact growth factors that reduce heat and moisture stress, and increase the utilization of fertilizer elements. This program is therefore shown to be an excellent adjunct to farmers' corn production programs in the lower Mississippi River Valley.

Cotton *with Vitazyme application*

Researcher: Bruce Kirksey, Ph.D. ***Research organization:*** AgriCenter International, Memphis, Tennessee
Location: Memphis Tennessee ***Variety:*** DP 1646B2FX upland cotton ***Planting date:*** May 16, 2022
Planting population: 55,000 seeds/acre ***Planting depth:*** 0.75 inch ***Row spacing:*** 38 inches
Soil: Falaya silt loam, 1.8% organic matter, 6.5 pH, 7.8 meq/100 g cation exchange capacity, good drainage, excellent fertility
Experimental design: A small-plot cotton study was established in a randomized complete block design, with four replications and four rows per plot. Each plot was 10 x 30 feet (32 total plots). Four fertility regimes from 100% to 25% of the recommended level for optimum yields were placed in the plots, each level with and without Vitazyme applied twice, to determine the effects of this biostimulant on the growth and yield of cotton, especially as the product can affect nitrogen use efficiency.

Treatment	Percent of optimum fertilizer	Vitazyme application		Fertilizer application, as elemental			
		In-furrow	Foliar	Urea N	18-46-0 N	18-46-0 P	KCl K
	%	oz/acre	oz/acre	lb/acre	lb/acre	lb/acre	lb/acre
1. 100% fertilizer	100	0	0	260	31	173	133
2. 100% fertilizer + Vita	100	13	13	260	31	173	133
3. 75% fertilizer	75	0	0	195	23	132	99
4. 75% fertilizer + Vita	75	13	13	195	23	132	99
5. 50% fertilizer	50	0	0	130	15	86	66
6. 50% fertilizer + Vita	50	13	13	130	15	86	66
7. 25% fertilizer	25	0	0	65	7	43	33
8. 25% fertilizer + Vita	25	13	13	65	7	43	33

Fertilizer applications: See the table above. The 18-46-0 and KCl were applied and incorporated before planting, and the urea was applied after planting.
Vitazyme applications: 13 oz/acre (1 liter/ha) in-furrow at planting on May 16, and 13 oz/acre (1 liter/ha) sprayed foliar at the 6 to 8-leaf stage 32 days after planting, on June 17.
Growing season weather: Soil moisture at planting was good, but rainfall was extremely limited in June, only 0.94 inch compared to the average of 4.71 inches. This deficit caused considerable stress on the plants, causing them to drop most of their bolls. Added to the moisture deficit were high temperatures during June, July, and August, with 29 days in July between 90 and 100 degrees F.

At 25% of the optimum fertilizer rate, Vitazyme applied twice to the plants produced an excellent growth response, as compared to the same fertilizer rate without it. This effect was seen at all fertilizer levels.

Notice the much greater root mass for the Vitazyme treated plants on the right at 25% of the optimum fertilizer rate, as compared to the untreated palnts on the left.

Plant growth results:

Yield results were unable to be collected, but plant growth parameters were evaluated: plant vigor, plant height, and plant weight.

This cotton trial in Tennessee produced excellent vegetative growth, but due to extreme midsummer drought the bolls were aborted. Nonetheless, plant growth was measured and showed excellent responses to Vitazyme.

Plant Vigor

Measure on June 17, 25 days after emergence.

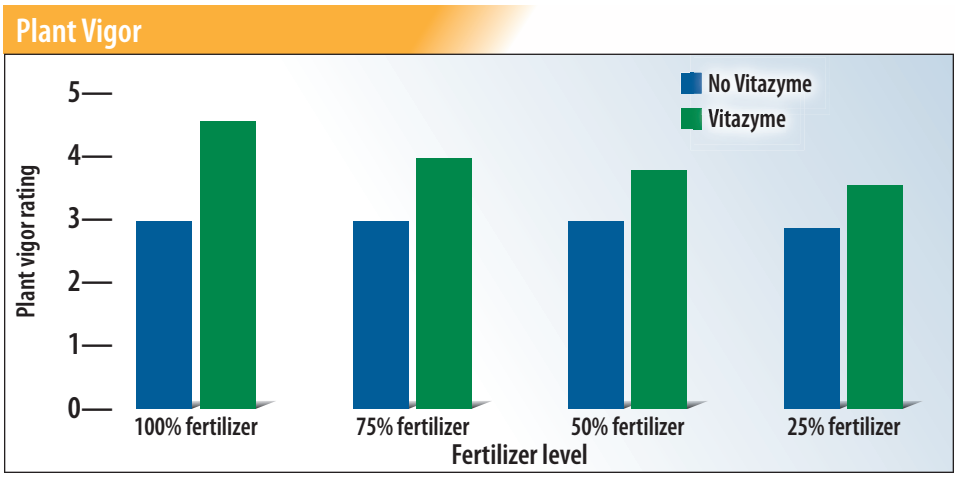
Treatment	Vigor rating[1]	Vigor change[2]
	1-5 scale[3]	1-5 scale[3]
1. 100% fertilizer	3.0 cd	—
2. 100% fertilizer + Vitazyme	4.5 a	1.5 (+50%)
3. 75% fertilizer	3.0 cd	—
4. 75% fertilizer + Vitazyme	4.0 ab	1.0 (+33%)
5. 50% fertilizer	3.0 cd	—
6. 50% fertilizer + Vitazyme	3.8 b	0.8 (+23%)
7. 25% fertilizer	2.8 d	—
8. 25% fertilizer + Vitazyme	3.5 bc	0.7 (+25%)
LSD (P=0.05)	0.6	
CV	11.22	
Replicate probability (P=0.05)	0.4872	
Treatment probability (P=0.05)	0.0001	

[1]Means followed by the same letter are not significantly different at P=0.05.
[2]Comparisons are made at the same fertilizer level.
[3]A scale of 1 to 5: 1 = poorest vigor; 5 = highest vigor.

Increase in cotton vigor with Vitazyme

100% fertilizer 50%
75% fertilizer 33%
50% fertilizer 23%
25% fertilizer 25%

At all three fertilizer levels, Vitazyme improved plant vigor significantly, from 23 to 50%



Plant Height

Measure on November, 21, 182 days after emergence.

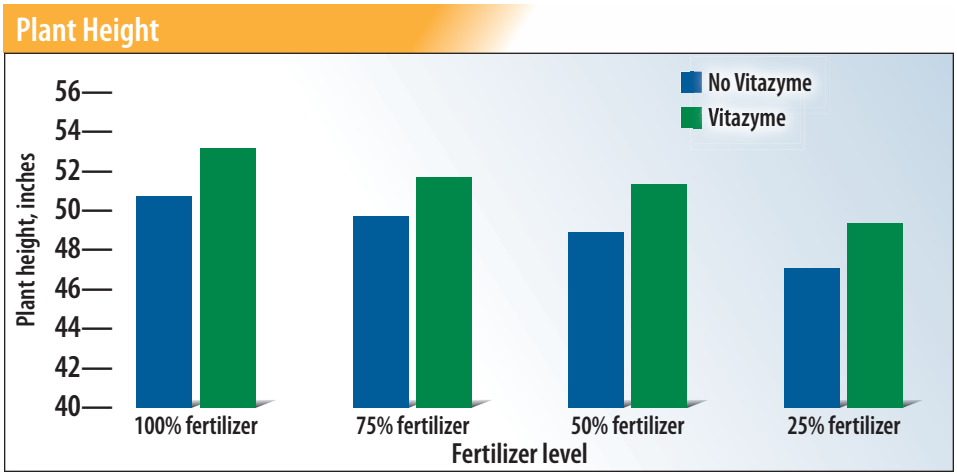
Treatment	Plant height[1]	Height change[2]
	inches	inches
1. 100% fertilizer	50.5 bcd	—
2. 100% fertilizer + Vitazyme	53.0 a	2.5 (+5%)
3. 75% fertilizer	49.5 cd	—
4. 75% fertilizer + Vitazyme	51.3 b	1.8 (+4%)
5. 50% fertilizer	49.0 d	—
6. 50% fertilizer + Vitazyme	51.0 bc	2.0 (+4%)
7. 25% fertilizer	47.0 e	—
8. 25% fertilizer + Vitazyme	49.3 d	2.3 (+5%)
LSD (P=0.05)	1.7	
CV	2.32	
Replicate probability (P=0.05)	0.3122	
Treatment probability (P=0.05)	0.0001	

[1]Means followed by the same letter are not significantly different at P=0.05.
[2]Comparisons are made at the same fertilizer level.

Increase in plant height with Vitazyme

100% fertilizer 5%
75% fertilizer 4%
50% fertilizer 4%
25% fertilizer 5%

At each fertilizer level, Vitazyme increased plant height by a consistent 4 to 5%



The Vitazyme treated cotton plants on the right display excellent leaf and stem growth, far greater than the control plants on the left.

Plant Weight

Measured on November 21, 182 days after emergence.

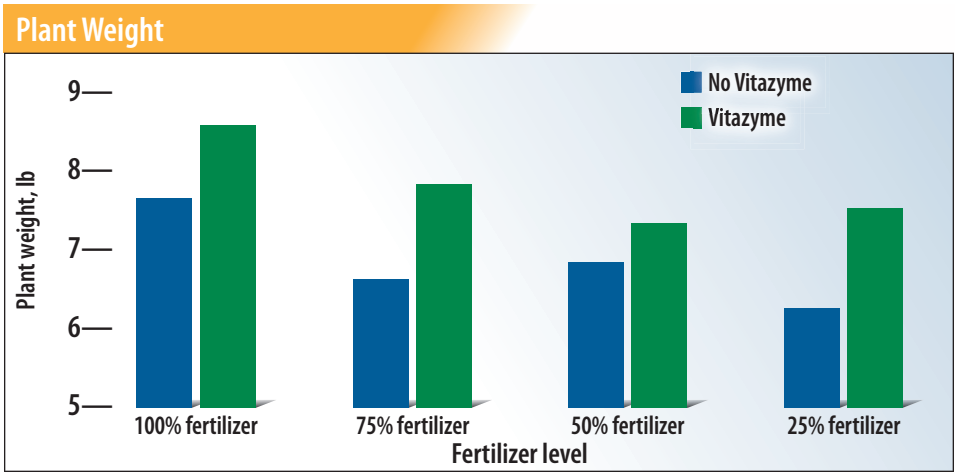
Treatment	Plant weight[1]	Weight change[2]
	lb	lb
1. 100% fertilizer	7.63 b	—
2. 100% fertilizer + Vitazyme	8.48 a	0.85 (+11%)
3. 75% fertilizer	6.68 cd	—
4. 75% fertilizer + Vitazyme	7.75 b	1.07 (+16%)
5. 50% fertilizer	6.75 cd	—
6. 50% fertilizer + Vitazyme	7.30 bc	0.55 (+8%)
7. 25% fertilizer	6.13 d	—
8. 25% fertilizer + Vitazyme	7.38 bc	1.25 (+20%)
LSD (P=0.05)	0.71	
CV	6.68	
Replicate probability (P=0.05)	0.5408	
Treatment probability (P=0.05)	0.0001	

[1]Means followed by the same letter are not significantly different at P=0.05.
[2]Comparisons are made at the same fertilizer level.

Increase in cotton plant wweight with Vitazyme

100% fertilizer 11%
75% fertilizer 16%
50% fertilizer 8%
25% fertilizer 20%

The weight of a typical plant for each of the four fertilizer levels showed an increase of from 8 to 20%



Conclusions: This small-plot cotton study in western Tennessee, using a randomized complete block design with four replications, and Vitazyme at 13 oz/ha (1 liter/ha) in-furrow at planting and at the 6 to 8-leaf stage, was greatly hindered by extremely hot and dry weather during the summer, so much so that the plants dropped most of their bolls. As a result, no yield data could be collected. However, data on plant vigor in mid-June, and on plant height and plant weight in November, gave excellent statistically significant data for all three parameters evaluated. At all four fertilizer levels, Vitazyme consistently improved plant vigor (23 to 50%), plant height (4 to 5%), and plant weight (8 to 20%) at the same fertilizer level above the no-Vitazyme treatment. These results show the very good consistency of plant growth stimulation at all fertilizer levels of the brassinosteroids, 1-triacontanol, and B-vitamins, increasing chlorophyll to cause a greater fixation of carbon dioxide and enhanced leaf, stem, and root growth. Such consistency across all plant parameters suggests that the yield would very likely have been boosted by this product had the bolls not dropped, and been able to reach maturity. The value of Vitazyme to increase the productivity of cotton farmers in the southern Mississippi Delta region is thus revealed by this study as fertilizer use efficiency has been improved.

Potatoes *with Vitazyme Bio (Organic Vitazyme) application*

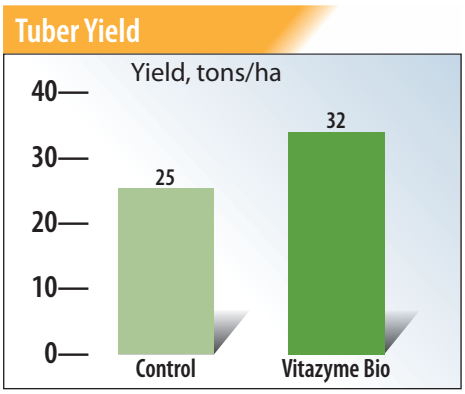
Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: National Academy of Agrarian Sciences of Ukraine, Podilla Institute of Fodder and Agriculture, Vinnytsia District, Vinnytsia Region, Bohonyky Village, Ukraine; central Ukraine (440-590 mm of rain per year)
Variety: Shchedryk Elite ***Planting date:*** May 22, 2022 ***Planting rate:*** 55,000 tubers/ha
Previous crop: winter wheat
Tillage: disking to 6-8 cm, plowing to 23-25 cm, harrowing, pre-plant cultivation to 10-12 cm
Soil type: gray podzolic (2.2% organic matter)
Experimental design: A potato field was divided into a Vitazyme Bio treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Bio on potato tuber yield.

1 *Control* 2 *Vitazyme Bio*

Fertilization: 100-50-50 kg/ha of N-P_2O_5-K_2O broadcast and incorporated by cultivation before planting
Vitazyme Bio application: 1 liter/ha sprayed foliar at BBCH 59 (budding) on July 6, 1.0 liter/ha sprayed foliar at BBCH 69 (flowering) on July 21
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	25	—
2. Vitazyme Bio	32	7 (+28%)

Yield increase with Vitazyme Bio: 28%



Income results: The 7 tons/ha yield increase netted a substantial income increase of $1,292/ha.

At harvest, the Vitazyme Bio treated potatoes yielded 28% more than the untreated control.

At midseason at the National Academy of Agrarian Sciences, these Vitazyme Bio treated potatoes are making good progress.

Conclusions: A potato split-field trial at the National Academy of Agrarian Sciences of Ukraine utilized two 1.0 liter/ha Vitazyme Bio applications spaced 15 days apart, at budding and flowering. These two foliar applications resulted in an excellent 7 ton/ha yield increase (28%), which netted the grower an additional $1,292/ha. These results reveal the great value of Vitazyme Bio to complement potato growers' management activities in Ukraine.

Soybeans *with Vitazyme application*

Researcher: Graig Reicks
Research organization: South Dakota Soybean Association, Brookings, South Dakota
Farm cooperator: Luke Holzwarth, Hazel, South Dakota
Location: Hazel, South Dakota
Variety: unknown
Experimental design: A soybean field was treated with Vitazyme in three alternate strips, with the intervening strips serving as untreated controls. The purpose of the trial was to evaluate the effect of this product on soybean yield.

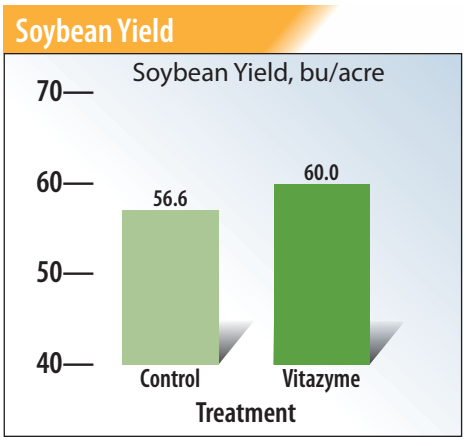
1 *Control* 2 *Vitazyme*

Vitazyme application: 13 oz/acre (1 liter/ha) at planting in the starter fertilizer

Yield results:

Field Strip	Bean yield		Yield change
	Control	Vitazyme	
	bu/acre	bu/acre	lb/acre
1	55.3	58.5	3.2 (+6%)
2	56.1	59.5	3.4 (+6%)
3	58.4	61.9	3.5 (+6%)
Average	56.6	60.0	3.4* (+6%)

*Significantly greater than the control at P=0.05.



Increase in bean yield with Vitazyme: 6%

The Vitazyme treated soybeans on the right in this photo reveal enhanced maturity right to the dividing line.

Soybean pods stripped from 10 representative plants from each treatment revealed not only a greater number of pods with Vitazyme, but enhanced maturity, as seen in the field photo above.

The Vitazyme treated soybean plants were taller, had more leaf area, and contained more pods, as can be clearly seen in this photo.

Conclusions: This South Dakota field-strip soybean trial, utilizing Vitazyme in alternating strips, resulted in a 3.4 lb/acre (6%) yield increase, revealing the efficacy of this simple program to boost soybean yields.

Soybeans *with Vitazyme Bio (Organic Vitazyme) application after hail damage*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: PE "Meleshkin," Kuzyatyn District, Vinnytsia Region, Zhurbyntsi Village, Ukraine; central Ukraine (440-590 mm of rain per year)
Variety: Kansas, F3 ***Planting date:*** May 21, 2022
Planting rate: 0.55 million seeds/ha
Previous crop: winter wheat
Tillage: disking to 8-10 cm, plowing to 23-25 cm, harrowing, cultivation to 4-5 cm
Soil type: podzolized chernozem (3.9% organic matter)
Experimental design: A soybean field that had been hail damaged on June 30, with 50% leaf loss, was divided into a Vitazyme Bio treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Bio on soybeans to bring recovery from the hail damage and produce a good yield.

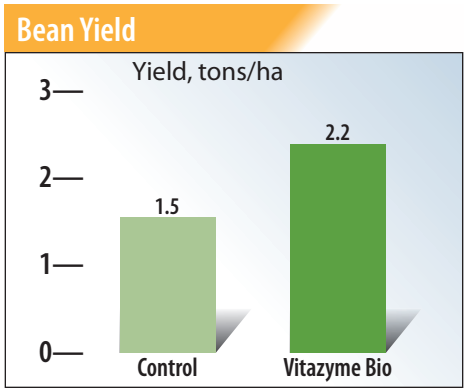
A hailstorm devastated this soybean test field on June 30, and was treated with Vitazyme Bio to help rejuvenate the crop.

1 ***Control*** **2** ***Vitazyme Bio foliar***

Fertilization: 35 kg/ha of N broadcast and harrowed in before planting
Vitazyme Bio application: 1 liter/ha sprayed over the leaves, which had lost 50% of the leaf canopy, at the third trifoliate stage on July 30.
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	1.5	—
2. Vitazyme Bio	2.2	0.7 (+47%)

Yield increase with Vitazyme Bio: 47%



The superiority of the soybeans that were treated with Vitazyme Bio after severe hail damage is clear in this photo, where the treated soybeans yielded 47% more than the control, a great recovery of yield

Income results: A great yield increase of 47% above the control treatment gave an income increase of $180/ha.
Conclusions: A soybean trial in Ukraine was initiated on a field which had been severely damaged by a hail storm (50% leaf loss) on June 30, 2022. A portion of the field was treated at the third trifoliate stage 30 days after the storm, with 1 liter/ha, which substantially aided crop recovery to produce a 47% yield increase. This increase translated to an income improvement of $180/ha, showing the great value of Vitazyme to aid in crop recovery after damage from hail.

Sunflowers *with Organic Vitazyme application*

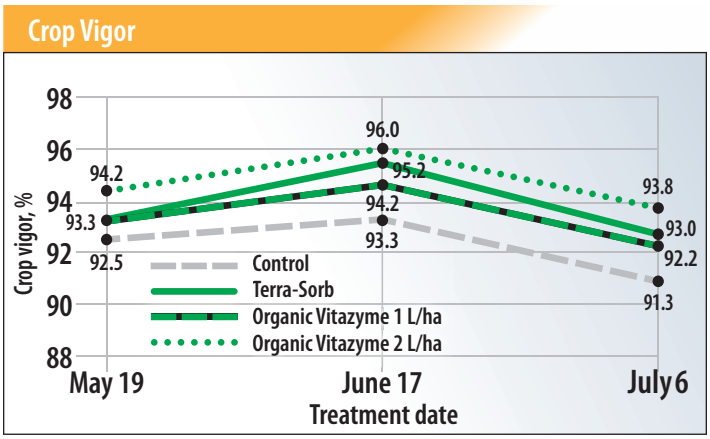
Researchers: Bence Kiraly, Natalia Simon, and Jeno Simon
Research organization: Syntech Research Group, 6636 Martely, hrsz.; 013818, Hungary; Vital Earth Resources, Inc., Gladewater, Texas, USA
Location: Hodmezovasarhely-Erzsebet, Csongrad-Csanad, Hungary
Variety: Duet CL *(Helianthus annuus)* ***Planting date:*** May 4, 2022 ***Row spacing:*** 75 cm
In-row spacing: 21.8 cm ***Plant depth:*** 5 cm ***Planting rate:*** 61,000 seeds/ha
Soil traits: clay loam chernozem; good fertility ***Tillage:*** conventional
Experimental design: A small-plot with sunflowers was established, with plots that were 3 x 10 meters (30 m^2), using six replications. Four treatments were applied in a randomized complete block design to determine the effect of Organic Vitazyme and Terra-Sorb Foliar on the yield and other parameters of sunflowers.

Treatment	Rate	Stage of growth	Date of treatment
1. Control	0	—	—
2. Terr-aSorb Foliar	1 liter/ 100 kg seed	Seed treatment	May 4
3. Organic Vitazyme	1 liter/ha	Seed treatment	May 4
4. Organic Vitazyme	2 liters/ha	Seed treatment	May 4

Fertilization: unknown
Organic Vitazyme application: See the treatments above. Organic Vitazyme was applied as concentrated product on the seeds to achieve the desired 1or 2 liter/ha rates.
Terra-Sorb Foliar application: Terra-Sorb Foliar is a formulation of mostly free amino acids that, when sprayed on leaves, will increase chlorophyll and photosynthesis, improve fruit set, and promote plant recovery during times of stress. It was applied at 1 liter/100 kg of seed.
Herbicide applications: Wing-P at 3.5 liters/ha on May 6; Pulsar 40 SL at 1.2 liters/ha on May 24; Mospilan 20 SG at 0.15 kg/ha on June 19.
Growing season weather: normal
Phytotoxicity results: Neither Organic Vitazyme nor Terra-Sorb were phytotoxic to the sunflower plants.
Crop vigor results:

Treatment	Rate	Assessment date*		
		May 19	June 17	July 6
	L/ha	%	%	%
1. Control	0	92.5 a	93.3 b	91.3 a
2. Terra-Sorb	1	93.3 a	95.2 ab	93.0 a
3. Organic Vita	1	93.3 a	94.2 ab	92.2 a
4. Organic Vita	2	94.2 a	96.0 a	93.8 a
LSD (P=0.10)		2.1	1.8	4.1
CV		2.26	1.88	4.37
Treatment F		0.6098	0.0945	0.7380

*Crop vigor assessment by the Student-Newman-Keuls method; means followed by the same letter are not significantly different at P=0.10.



While crop vigor on both May 19 and July 6 did not vary significantly among the three treatments, Organic Vitazyme at 2 liters/ha was significantly more vigorous than the other two treatments, and all treatments exceeded the control for all three dates.

Crop emergence results: There were no significant differences in crop emergence for all four treatments, although all three treatments slightly exceeded the control.

Crop height results:

Treatment	Rate	Assessment date*	
		May 19	July 6
	L/ha	cm	cm
1. Control	0	6.7 b	109.1 a
2. Terra-Sorb	1	6.9 ab	111.7 a
3. Organic Vita	1	6.8 ab	109.6 a
4. Organic Vita	2	7.0 a	112.1 a
LSD (P=0.10)		0.2	4.2
CV		3.19	3.77
Treatment F		0.1349	0.5281

*Crop height assessment by the Student-Newman-Keuls method; means followed by the same letter are not significantly different at P=0.10.

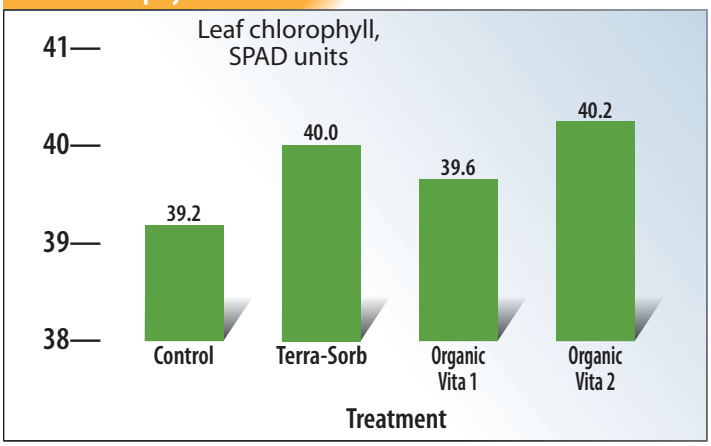
Organic Vitazyme at 2 liters/ha on the seeds significantly increased plant height shortly after emergence. However, the treatments did not differ significantly once the plants grew larger.

Chlorophyll results: The leaves were measured on 20 plants/plot on June 17.

Treatment	Rate	Leaf chlorophyll*
	L/ha	SPAD units
1. Control	0	39.2 c
2. Terra-Sorb	1	40.0 ab
3. Organic Vita	1	39.6 bc
4. Organic Vita	2	40.2 a
LSD (P=0.10)		0.5
CV		1.29
Treatment F		0.0166

*; Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test.

Leaf Chlorophyll



All treatments significantly exceeded the control, but Organic Vitazyme at 2 liters/ha gave the greatest leaf chlorophyll increase, at 1.0 SPAD unit greater than the control.

Heat diameter results: There was a slight increase in head diameter with all of the treatments, which was 0.9 cm for Organic Vitazyme at 2 liters/ha. This represented an 8% increase (12.0 cm vs. 11.1).

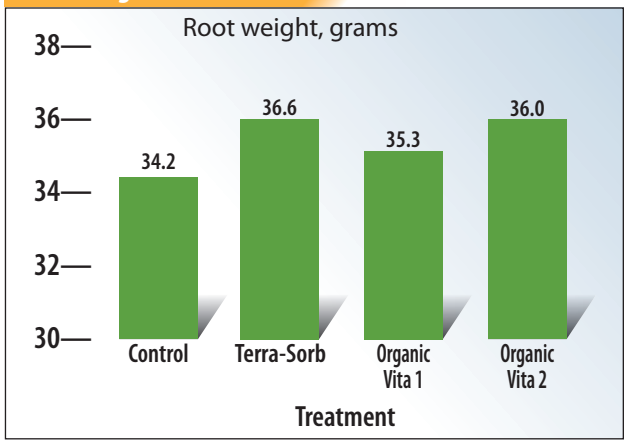
Seed yield results: The plants were harvested on September 13. All yield values were not significantly greater than the control.

Root weight results: There were no significant differences in root weight among the four treatments, although the three treatments gave heavier weights than the control. Sampling was made on 20 representative roots per plot, on September 13.

Oil content results: No significant differences were detected among the treatments.

1,000-grain weight results: There were no significant differences in 1,000-grain weight for the four treatments. However, the three treatments produced seeds that were slightly heavier than the control.

Root weight



Conclusion: This sunflower small-plot experiment in Hungry, comparing Organic Vitazyme at 1 and 2 liters/ha on the seeds and Terra-Sorb Foliar on the seeds, revealed that all three treatments produced small improvements in most-parameters measured, including crop vigor, crop emergence, crop height, leaf chlorophyll content, head diameter, seed yield, root weight, oil content, and 1,000-grain weight. In a few cases these increases were significant, especially for Organic Vitazyme at 2 liters/ha for crop vigor, crop height, and leaf chlorophyll. This treatment produced the best overall results in this study, followed by Terra-Sorb and Organic Vitazyme at 1 liter/ha.

Vitazyme Field Tests for 2022

Sunflowers *with Vitazyme Bio (Organic Vitazyme) application—Herbicide Stress Reduction*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: LLC "Sunvit," Berezivsky District, Odessa Region, Viktorivka Village, Ukraine; southern Ukraine (270-350 mm of rain per year)
Variety: LG5542KL
Planting date: May 2, 2021
Planting rate: 50,000 seeds/ha
Previous crop: winter wheat
Tillage: disking to 6-8 cm, plowing to 22-24 cm, harrowing, cultivation in two tracks to 5-6 cm
Soil type: podzolized chernozem (3.5% organic matter)
Experimental design: A sunflower field with serious herbicide stress was treated on 31 hectares with Vitazyme Bio to attempt to relieve the stress. One hectare was left untreated to serve as a control. The effects of the product on plant recovery and yield was measured to evaluate the effect of Vitazyme Bio on yield as affected by herbicide stress reduction.

Note the serious necrosis of the leaves of a sunflower plant mistakedly sprayed with a toxic herbicide.

The superior top growth of the Vitazyme Bio treated plants is reflected by a much greater root mass, that complements this increased leaf mass. The yield with the product was 28% greater than with the untreated plants.

❶ *Control* ❷ *Vitazyme Bio*

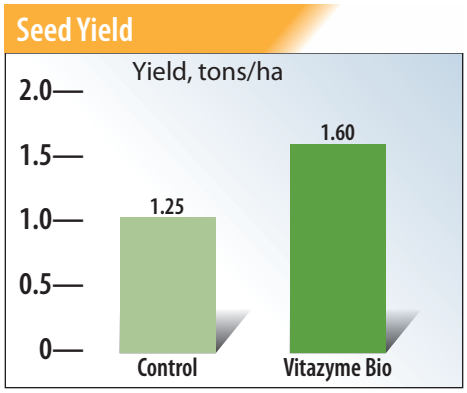
Fertilization: 6-12-12-4 kg/ha of N-P_20_5-K_20-S in-furrow at planting
Vitazyme Bio application: 1 liter/ha sprayed on the leaves of 31 hectares on June 8, at BBCH 18 (8-leaf stage)
Herbicide application: The sprayer was contaminated with a herbicide containing Prosulfuron and MCPA, which had been used to spray weeds in flax. The sprayer was then filled with Eurolightning herbicide (a.i. Imazamox at 33 g/liter and Imazapyr at 15 g/liter), and the field was sprayed on May 30 at 1 liter/ha. The crop was at BBCH 14 (four leaves). Strong herbicide damage ensued, causing much leaf necrosis, but the growing point was still alive on June 6.

These sunflowers have recovered by some weeks after Vitazyme Bio application to the right side of this photo. Note the superior growth compared to the untreated side.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	1.25	—
2. Vitazyme Bio	1.60	0.35 (+28%)

Yield increase with Vitazyme Bio: 28%



Growth results: Height measurements of the plants for both treatments were made late in the growth cycle, and gave the following results:

Vitazyme Bio plant height ..... 1.2 m
Untreated plant height ..... variable, from 0.4 to 0.8 m or less

Income results: As a result of Vitazyme Bio application to the severely herbicide stressed sunflowers, the yield increase of 0.35 ton/ha (+28%) from Vitazyme Bio gave an income increase of $104/ha.

Conclusions: A sunflower field of 32 hectares was sprayed in error with a herbicide that was contaminated with another herbicide that had been used on a flax field, and which was toxic to the sunflowers. Considerable leaf necrosis was noted within a week, and the farmer then sprayed 1 liter/ha of Vitazyme Bio over all but one hectare to attempt to relieve plant stress and recover the crop. The result was a fine recovery of the crop, and an increase in yield of 0.35 ton/ha (28%) from Vitazyme Bio, giving an income increase of $104/ha. These results indicate that the stress reduction properties of the brassinosteroids in Vitazyme Bio are highly effective in recovering herbicide damaged sunflower crops in Ukraine.

These sunflowers have recovered by some weeks after Vitazyme Bio application to the right side of this photo.Note the superior growth compared to the untreated side.

Tomatoes *with Vitazyme application*

Researchers: Rajnish Khanna[1], Julia Sherman[2], Robert Reed[1], Roberto Bogomolni[3] and Paul W. Syltie[4]

Research organizations:

[1]i-Cultiver, Inc. and Global Food Scholar, Inc., Manteca, CA; Carnegie Institution for Science, Stanford, CA,
[2]University of California, Berkeley, CA
[3]University of California, Santa Cruz, CA
[4]Vital Earth Resources, Gladewater,TX

Project abstract: Vitazyme is a liquid biostimulant consisting of vitamins, enzymes and other growth stimulating components. This study was conducted in part to determine the mechanisms involved in Vitazyme activity. Greenhouse-grown tomatoes treated with Vitazyme produced more fruit over multiple harvests. Preliminary data show increases in tomato lycopene and beta-carotene levels. Work was performed by i-Cultiver, Inc. which provides independent research and consultation services to agriculture, food, and forestry industries.

Background information: Vitazyme is produced by Vital Earth Resources, Inc., Gladewater, TX. I-Cultiver is conducting basic research to determine its mechanisms of activity in promoting crop production and quality.

Summary of previously reported work

- Khanna and Syltie, 2021 – Tomato plants (N=8) were grown in the greenhouse. Treatment with Vitazyme increased the number of tomatoes produced by 54% and the weight of tomatoes produced by 18%, beyond the standard grower's program.
- Khanna et al, 2022 – Brassinosteroids (BR) are well known plant growth regulating phytohormones and are listed as a major component of Vitazyme. We developed a bioassay to test BR activity. We used Arabidopsis *det*2-mutant (deficient in BR) seedlings, which exhibit stunted growth in darkness. We found that the BR-specific growth defects in *sdet*2 seedlings could be rescued by the addition of Vitazyme in growth medium, indicating that Vitazme influences plant growth and development in part through BR activity.

i-Cultiver's complete Vitazyme Reports are available: (https://i-cultiver.com/vitazyme/)

Purpose of the study: This study was performed to assess whether Vitazyme application increases tomato fruit production in the greenhouse.

Materialsand Methods:

Plant growth and Vitazyme application

Seeds of the Moneymaker var. of tomato (*Solanum lycopersicum*) were surface sterilized (Menhiferber et al., 2021). Seeds were germinated in soil (Sunshine Mix #1) and all plants were grown for 25 weeks in a greenhouse room under controlled conditions with supplemented light to maintain long days and fans to control high temperature fluctuations. Peters Professional 20/20/20 water soluble fertilizer was applied (1:64 ppm) once per week, as well as a disease suppression program consisting of Floramite and Decathlon at a rate of ¼ tsp per gallon of water, mixed/agitated, was applied through a controlled sprayer at the rate of 1-2 gal per 100 plants.

(a) Tomatoes growing in the trial greenhouse; (b) Vitazyme treated fruit is on the right; (c) The typical Vitazyme treated fruit on the right is larger than the control fruit.

Vitazyme (see Vitazyme webstite in ref.) plants were treated according to manufacturer's instructions by spraying a 1% solution (1 ML/100ML) on leaves and over soil surface (root zone) to the dripping point. It was applied every two weeks throughout the active growth phase, until flowering stage. The total volume of 1% spray needed per plant increased for each application as the plants grew bigger. The control plants did not receive Vitazyme spray.

Ripened fruit (2/3rd or more red) was harvested at week 19 after germination. Fruit was harvested four

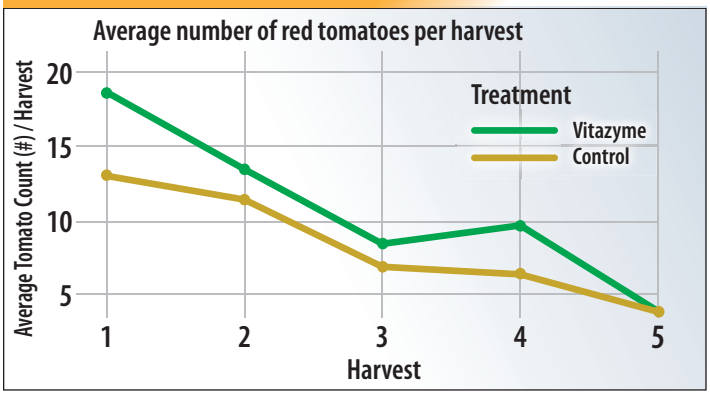
more times in weeks 21, 22, 24, and 25, with a total of five harvests in six weeks.

Lycopene and B-carotene quantification

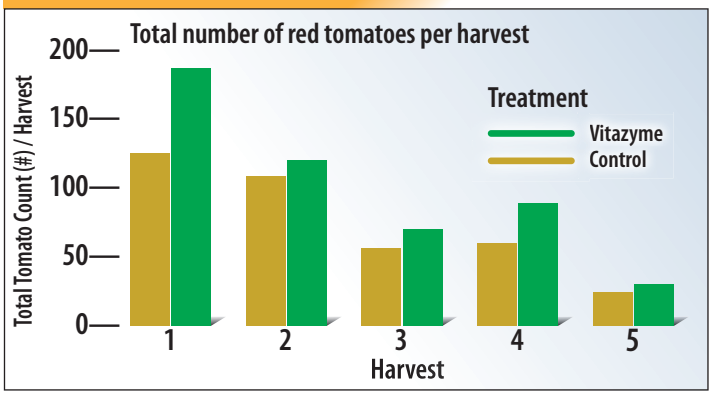
Fresh red-tomato fruit was randomly selected from non-treated and treated plants. Lycopene and B-carotene were quantified using a modified protocol based upon the standardized rapid spectrophotometric method described (Anthon and Barrett, 2007). Pigments were quantified by measuring absorbance at 444, 503, and 700 nm.

Results: Tomato Numbers

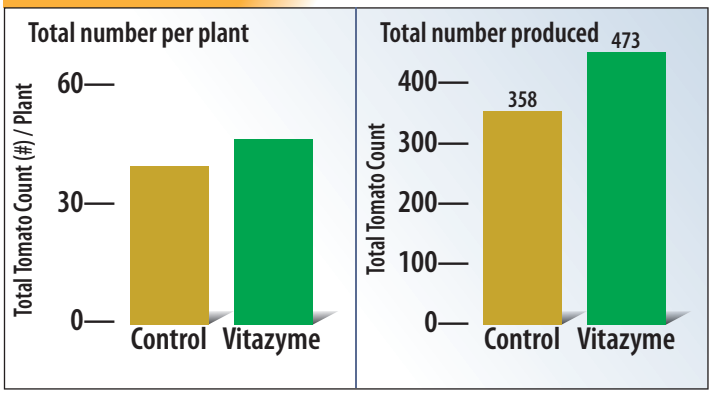
Tomato Numbers Total



Tomato Numbers Per Harvest



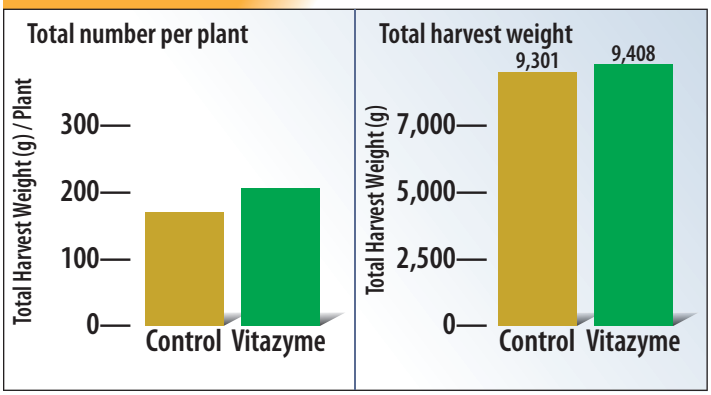
Tomato Numbers



Increase in tomato number with Vitazyme: 32%

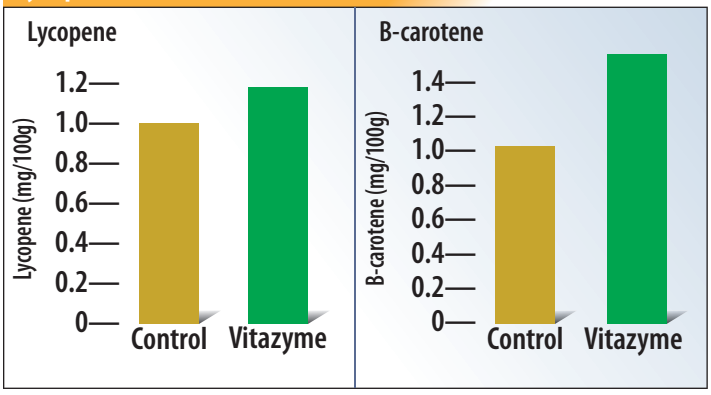
Plants treated with Vitazyme produced more tomatoes. After the first harvest in week 19, plants continued to produce new tomatoes, albeit with fewer tomatoes produced overall in later weeks. Vitazyme treated plants maintained higher number of fruit throughout the harvest period compared to controls. The total number of tomatoes produced per plant was higher with Vitazyme treatment. Overall, Vitazyme plants produced 32.12% more fruit than control plants.

Tomato Numbers



Tomato weight increased marginally with Vitazyme in this trial. In the previous trial (Khanna and Syltie, 2021), there was a 54.14% increase in the number of tomatoes produced and a 17.80% increase in total weight of red tomatoes produced with Vitazyme treatments. There was an incidence of powdery mildew during this trial, which may account for the overall reduction in tomatoes produced. However, the second trial is consistent with the previous test in increased number of tomatoes produced and a trend towards increased tomato weight. Future studies will confirm this trend.

Lycopene and B-Carotene Content



Increase in lycopene content with Vitazyme: 14%

Increase in B-carotene content with Vitazyme: 45%

Lycopene is a red carotenoid that gives tomatoes, carrots, strawberries and other fruits and vegetables their bright red color. Lycopene concentration changes during ripening and is impacted by environmental and other factors influencing tomato development. In this study, ripened tomatoes of matched developmental stage were randomly selected for lycopene quantification. Vitazyme treatment increased lycopene in the tomatoes tested by 14%.

B-Carotene is a yellow-orange carotenoid. Similarly to lycopene, there was an increase of 45% in B-carotene levels in Vitazyme treated tomatoes. These studies need to be repeated in the future with more tomatoes and different crops to establish the effect of Vitazyme on pigment biosynthesis.

Note: Both, lycopene and B-carotene have strong antioxidant properties. These pigments are chemoprotective substances and have been linked to the prevention of cancer (Marti et al., 2016).

Discussion: In 2020, fresh and processed tomatoes harvested in the U.S. were valued at approximately $1 billion (Tomatoes, Agricultural Marketing Resource Center, 2021). USDA 2012 Census report showed that total acreage for tomato production was reduced by 10%, while the number of growers increased by 20%. In the past 25 years, tomato yield has increased from 35,000 lb/acre to over 50,000 lb/acre, with still a significant untapped potential for increasing yields.

Plant performance is closely tied to environmental signals, stress responses, and nutrient availability. The plant's decision to flower and produce fruit is mediated through its inherent genetic capacity and ability to respond to its local environment.

Throughout it's life cycle, intrinsic chemical signals shape plant growth and development in response to the extrinsic conditions. Phytohormones, such as BR, were determined to be an active component of Vitazyme (Khanna et al., 2022). As a growth stimulant, Vitazyme is likely to mediate plant-intrinsic pathways. Plant growth responses are closely integrated to environmental cues and availability of nutrients.

Improved understanding at the molecular level of the interplay between local conditions, and plant responses to the added agricultural inputs, such as Vitazyme biostimulant, is crucial for realizing the maximal benefit product to manufacturers and the end users.

We are continuing to determine how Vitazyme acts in promoting crop performance. In the two trials, Vitazyme significantly increased fruit number and fruit weight (in the first trial), and preliminary results showed higher lycopene and B-carotene levels. Vitazyme is applied on other crops as well (see the Vitazyme website).

References and Notes:

Anthon, G., and Barrett, D.M. (2007) Standardization of a rapid spectrophotometric method for lycopene analysis. *Proc. Xth IS on the Processing Tomato.* Eds.: A. B'Chir and S. Colvine, *Acta Hort*. 758, ISHS 200.

Khanna, R. and Syltie, P.W. (2021) Vitazyme increased tomato (*Solanum lycopersicum*) fruit production. *i-Cultiver Technical Bulletin: 1121-VER*.

Khanna, R., Ortiz, A., Reed, R., Khatiwada, P., Wang, Z., and Syltie, P.W. (2021), Plant growth regulators, brassinosteroids are an active component of Vitazyme Biostimulant. *i-Cultiver Technical Bulletin: 0922-VER*.

Marti, R., Rosello, S., and Cebolla-Cornejo, J. (2016) Tomato as a source of carotenoids and polyphenois targeted to cancer prevention. *Cancers*, 8, 58: doi:10.3390/cancers8060058.

Mehiferber, E.C., McCue, K.F., Ferrel, J.E., Koskella, B., and Khanna, R. (2022) Temporally selective modification of the tomato rhizosphere and root microbiome by volcanic ash fertilizer containing micronutrients. *Applied and Environmental Microbiology* 12;88(7): doi:*http://10.0.4.104/aem.0049-22*.

Vitazyme. *https://vitalearth.com/vitazyme/*.

Manufacturer's User Guide, The Vitazyme Program. *https://vitalearth.com/wp-content/uploads/2015/12/Vitazyme-User-Guide.pdf*.

Winter Wheat *with Vitazyme Bio (Organic Vitazyme) application*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: SLLC "Dnipro," Vinnytsia District, Vinnytsia Region, Monchyn Village, Ukraine; central Ukraine (440-590 mm of rain per year)
Variety: Bonanza, F2
Planting date: October 20, 2021
Planting rate: 4 million seeds/ha
Previous crop: sunflowers
Tillage: disking to 20-22 cm, cultivation in two tracks to 3-4 cm
Soil type: podzolized chernozem (3.5% organic matter)
Experimental design: A winter wheat field was divided into a Vitazyme Bio treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Bio on winter wheat yield and quality, as well as added income.

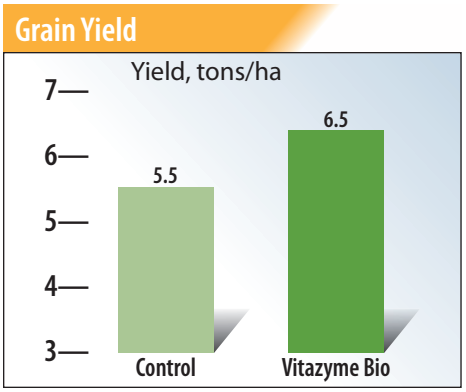
1 ***Control*** **2** ***Bio on the seeds at planting***

Fertilization: 50 kg/ha of nitrogen disked in before fall planting; 140 kg/ha of N broadcast over the leaves in the spring.
Vitazyme Bio application:
1.0. liter/ton of seed at planting

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	5.5	—
2. Vitazyme Bio	6.5	1.0 (+18%)

Yield increase with Vitazyme Bio: 18%

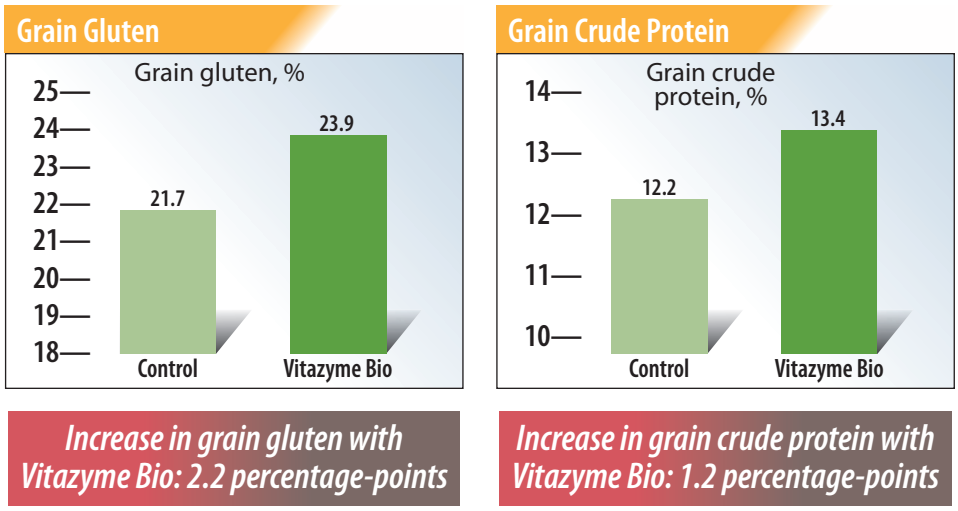


Note the denser plant stand, bigger heads, and taller stems of the Vitazyme Bio treated wheat compared to the untreated wheat in the other photo.

The untreated wheat in this trial was shorter with fewer heads than the Vitazyme Bio treated wheat in the accompanying photo.

The Vitazyme Bio treated wheat on the left side of the road is clearly better developed and yielding more than the untreated wheat on the right.

Grain quality results:



Increase in grain gluten with Vitazyme Bio: 2.2 percentage-points

Increase in grain crude protein with Vitazyme Bio: 1.2 percentage-points

Income results: The additional 1.0 ton/ha yield netted an income increase of $185/ha for the farmer.

Conclusions: This winter wheat field trial in Ukraine, which compared a seed treatment with Vitazyme Bio to no seed treatment — all other management factors being the same — showed that Vitazyme Bio increased the total grain yield by 1.0 ton/ha (+18%), while at the same time improving grain quality: grain gluten was elevated by 2.2 percentage points, while grain crude protein was raised by 1.2 percentage points. As shown from similar excellent yield and quality responses with Vitazyme Bio on winter wheat for several years in Ukraine, this program when applied to seeds produces consistent and reliable crop improvements for the farmer.

Winter Wheat *with Vitazyme Cold Start application*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: PE "Meleshkin, Kozyatyn District, Vinnytsia Region, Zhurbyntsi Village, Ukraine; central Ukraine (440-590 mm of rain per year
Variety: Oriyka, F3
Planting date: October 15, 2021
Planting rate: 5.5 million seeds/ha
Previous crop: soybeans

This wheat field trial reveals denser heads and taller plants with the Vitazyme Cold Start treatment on the right, compared to the untreated wheat on the left.

Tillage: disking to 8-10 cm, plowing to 20-22 cm, pre-planting cultivation to 3-4 cm
Soil type: podzolized chernozem (3.9% organic matter)
Experimental design: A winter wheat field was divided into a Vitazym Cold Start treated portion, while the remainder of the field was left untreated. The purpose of the trial was to evaluate the effect of Vitazyme Cold Start on winter wheat yield and quality, as well as added income, when used to all alleviate weakened plants in the spring due to fertility and water stress.

❶ *Control* ❷ *Vitazyme Cold Start in the spring*

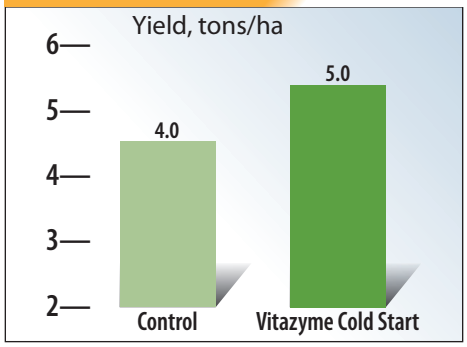
Fertilization: 8-8-8 kg/ha of N-P_2O_5-K_20) in-furrow at planting; 50 kg/ha of N broadcast foliar in the spring
Vitazyme Cold Start application: 1 liter/ha sprayed on the leaves at the BBCH 31 (boot) stage on May 16, 2022. Vitazyme Cold Start is a version of Vitazyme that performs better than the standard Vitazyme under cold and wet springtime conditions.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	4.0	—
2. Vitazyme Cold Start	5.0	1.0 (+25%)

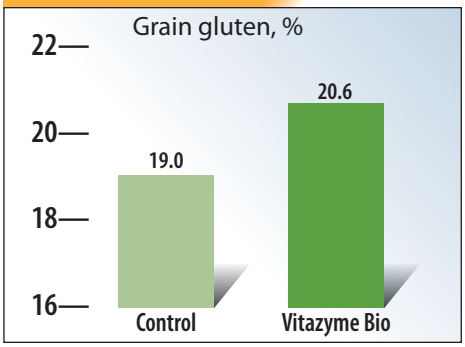
Yield increase with Vitazyme Cold Start: 25%

Grain Yield



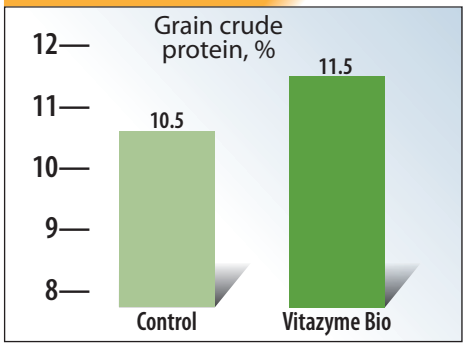
Grain quality results:

Grain Gluten



Increase in grain gluten with Cold Start:1.6 percentage-points

Grain Crude Protein



Increase in grain crude protein with Vitazyme Cold Start: 1.0 percentage-point

Income results: The additional 1.0 ton/ha yield and improved grain quality increased the net income for the crop by $160/ha.
Conclusions: A split-field winter wheat field trial in Ukraine, utilizing 1 liter/ha of Vitazyme Cold Start sprayed on the leaves in the spring to help overcome fertilizer and drought stress, produced a very fine yield increase of 25%, while at the same time increasing grain gluten (+1.6% percentage points) and grain crude protein (+1.0 percentage point). These improvements in winter wheat production help confirm the results of Vitazyme Cold Start on winter wheat for several years, that it is an excellent, very profitable addition to farmers' management programs in Ukraine.

Winter Wheat *with Vitazyme Bio (Organic Vitazyme) application*

Researchers: Vadim V. Plotnikov
Research organization: Agro Expert International, Kaharlyk, Ukraine, and Plant Designs International, Rochester, New York
Location: LLC "Svitanok-SM," Berezivsky District, Odessa Region, Stari Mayaki Village, Ukraine; southern Ukraine (270-350 mm of rain per year)
Variety: Skarbnytsya F3
Planting date: October 5, 2021
Planting rate: 4.3 million seeds/ha
Previous crop: sunflowers
Tillage: disking to 10-12 cm, direct seeding to 3 cm with a Potinger planter
Soil type: typical chernozem (3.5% organic matter)
Experimental design: A winter wheat field was divided into a Vitazyme Bio seed-treated portion, while the remainder of the field was treated with another product, Raikat Start. The purpose of the trial was to compare the effect of Vitazyme Bio and Raikat Start on the seeds on winter wheat yield.

Immature heads obtained from the plants later in the season show much improved and more mature head and seed development with Vitazyme Bio than for the untreated heads on the left.

Note the much better leaf and root development with the Vitazyme Bio treatment on the right.

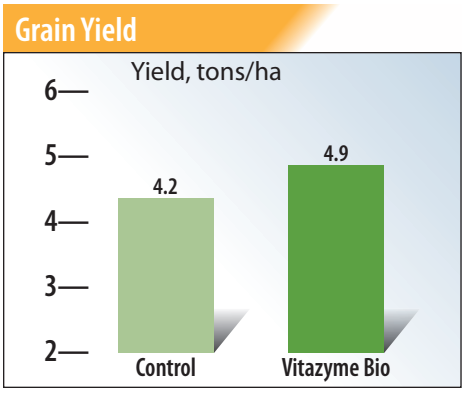
1 ***Raikat Start*** **2** ***Vitazyme Bio***

Fertilization: 6-30-0% N -P_2O_5-K_2O in-furrow at planting, and 63 kg/ha of N and 24 kg/ha of S broadcast later after planting
Vitazyme Bio application: 1.0. liter/ton of seed treated on September 9, 2021, 6 days before planting
Raikat Start application: 0.75 liter/ton of seed. This product is a combination of macro and micro-elements, amino acids, polysaccharides, and cytokinins designed to aid in seed germination, plant growth and stress tolerance, and disease resistance.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Reikat Start	4.2	—
2. Vitazyme Bio	4.9	0.7 (+17%)

Yield increase with Vitazyme Bio: 17%

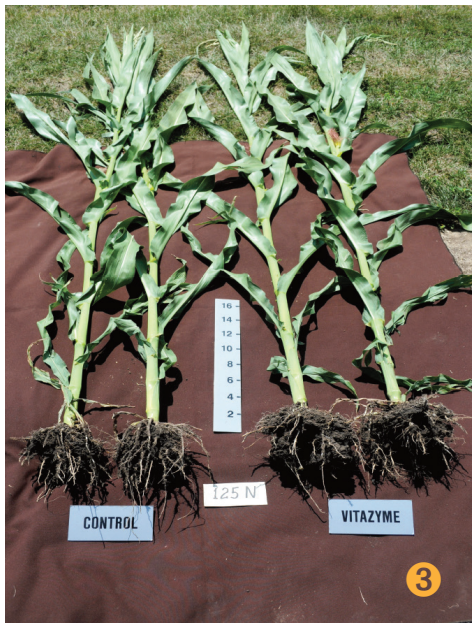


Income results: The seed application of Vitazyme Bio produced 0.7 ton/ha more yield than Raikat Start, which is valued at $125/ha.

Conclusions: A field-scale comparative study in Ukraine was performed with Vitazyme Bio and Raikat Start as seed treatments. Rates of application were 1.0 and 0.75 liter/ha for the two products, respectively. Yield results showed that Vitazyme Bio outyielded the Raikat Start by 0.7 ton/ha, that netted the farmer $125/ha more income. In this study, Vitazyme Bio has been shown to be the superior seed treatment of the two for winter wheat in Ukraine.

Vitazyme *Improves Nitrogen and Water Efficiency.*

A study conducted by Dr. David Clay and Graig Reicks at South Dakota State University, at the Aurora Research Farm in 2014 *(photo 1)*, revealed that



Vitazyme improves corn yield, while significantly increasing the efficiency of nitrogen and water utilization. The season was wet and yields in general in the area were high, but even so a typical high nitrogen rate of 125lb/acre produced superior leaf and stalk growth *(photo2)*, and expanded the root mass considerably above the non - Vitazyme treated control *(photo 3)*. Ear size was noticeably increased in representative ears sampled at harvest time *(photos 4 and 5)*. Note the longer and wider ears with Vitazyme treatment. The yield of grain was increased significantly by about 9 bu/acre, and nitrogen efficiency was improved by 0.66 bu/lb of N. Moreover, the yield loss due to water stress was reduced from 14.2 bu/acre in the control to only 5,0 bu/acre with Vitazyme. These results show how a simple addition of this product to the grower's program can improve the yield of grain through improved fertilizer and water utilization. It is a program designed for corn growers everywhere whose intent is to maximize yields with a minimum of nitrogen use.

Corn yield at 125 lb N/acre

Control..... 161.0 bu/acre
Vitazyme ..... 170.1 bu/acre

Nitrogen efficiency at 125 lb/acre

Control..... 0.400 bu/lb of N
Vitazyme ..... 0.466 bu/lb of N

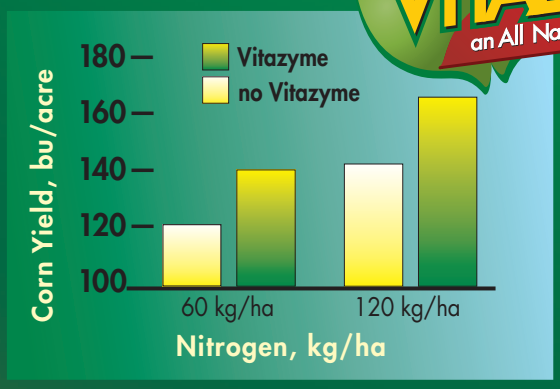
Yield loss from water stress at 125 lb N/acre

Control..... 14.2 bu/acre
Vitazyme ..... 5.0 bu/acre

SOME DRAMATIC EFFECTS OF VITAZYME ON FERTILIZER EFFICIENCY

See What VitaZyme® Did in Canada to Improve Nitrogen Utilization!

VitaZyme®
an All Natural Concentrate



At Branchton, Ontario, VITAZYME produced significant yield increases of 16% at both 60 and 120 kg/ha of nitrogen.

- Increase with Vitazyme at 60 kg/ha: $74.40/acre!
- Increase with Vitazyme at 120 kg/ha: $90.00/acre!

THE YIELD WITH VITAZYME AT 60 KG/HA OF NITROGEN WAS STATISTICALLY THE SAME AS THE YIELD AT 120 KG/HA OF NITROGEN WITHOUT VITAZYME!

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