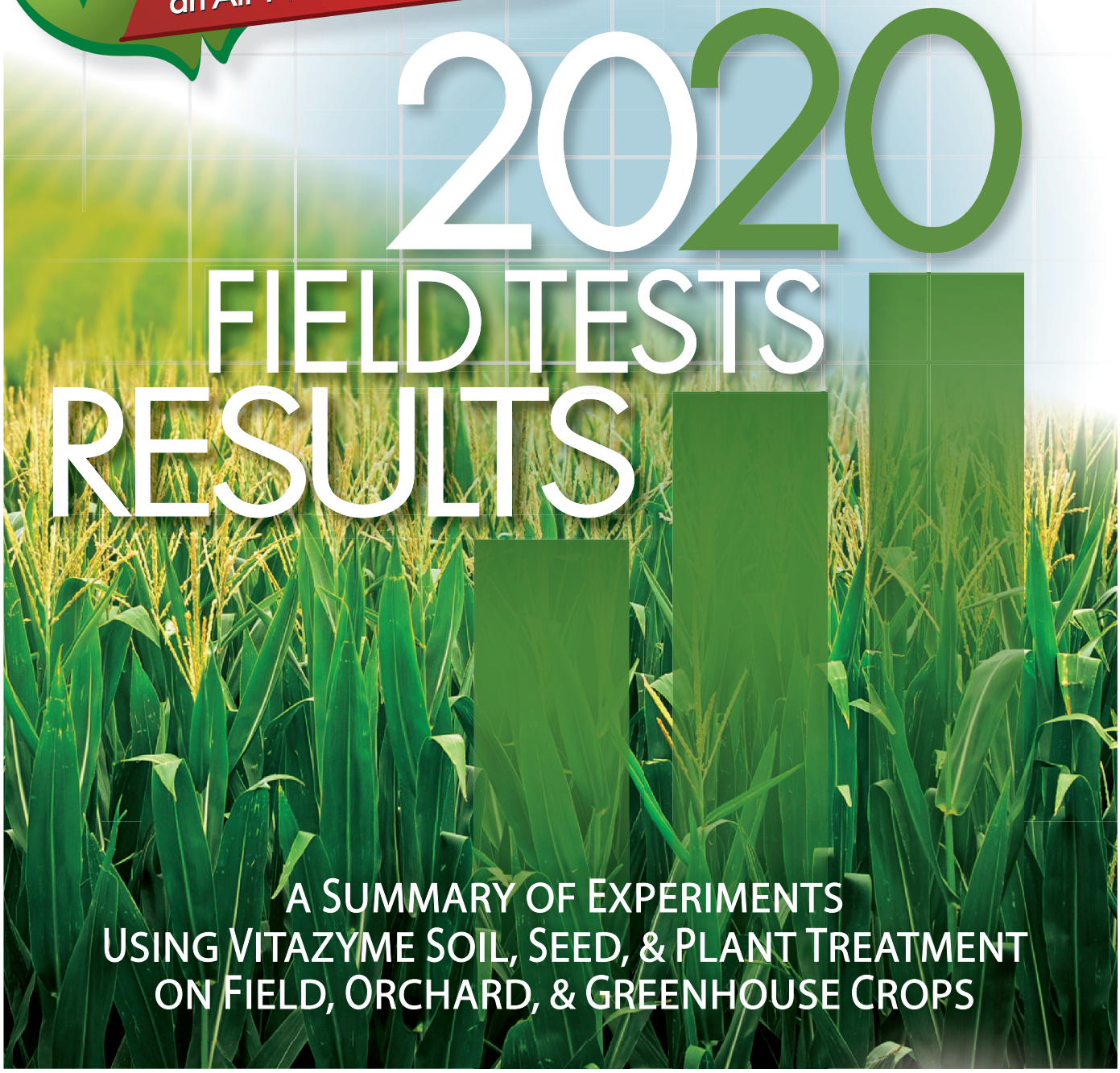
25th Edition

VITAZYME®

an All Natural Concentrate

2020 FIELD TESTS RESULTS



A Summary of Experiments Using Vitazyme Soil, Seed, & Plant Treatment on Field, Orchard, & Greenhouse Crops

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Vital Earth RESOURCES

Introduction

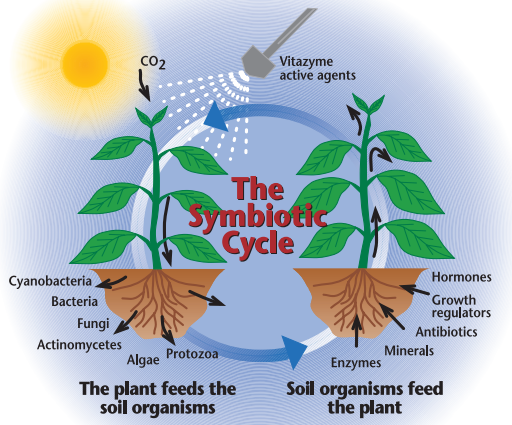
How Vitazyme works within the plant-soil system.

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

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

Improved Symbiosis: The Secret of Vitazyme's Action

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



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

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

Vitazyme contains "metabolic triggers" that stimulate the plant to photosynthesize more efficiently, fixing more sunlight energy in the form of carbon compounds to increase the transfer of carbohydrates, proteins, and other growth substances into the root zone. These active agents may enter the plant through either the leaves or the roots. Root growth and exudation are both enhanced. This enhancement activates the metabolism of the teeming population of rhizosphere organisms to a higher level, triggering a greater synthesis of growth-benefiting compounds and a faster release of minerals for plant uptake. Thus, the plant-microbial symbiosis is stimulated.

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

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

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

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

1. Apply normal levels of organic and commercial fertilizers.
2. Treat the seeds, transplant roots, or seed pieces whenever possible at planting. To treat seeds, typically use 250 ml/ha in the minimum water for good seed coverage. Mixing 1 liter/ton of seeds is also very effective. Dip roots or transplants in a 0.5 to 1% solution, or spray with a 5% solution.
3. Apply Vitazyme to the soil and/or leaves according to recommendations. In most cases use 1 to 1.5 liters/ha per application, from one to three times during the growing season.

Nitrogen Fertilizer Reduction Guide with Vitazyme

Obtain a score for each of these four items

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

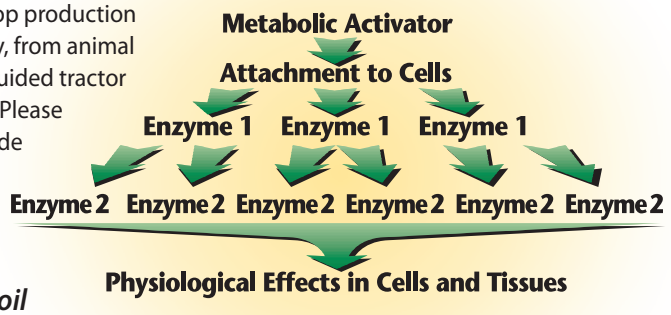
Add the scores above to find the N-reduction

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

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 Highlights *from throughout the world.*

Vitazyme Highlights for 2020

As for the past 25 years, the results with Vitazyme on a large number of crops, both in small plot and on-farm trials, have been uniformly excellent. These results reveal the consistency of the program for farmers in virtually all climatic zones and on all soil types.

1. A trial with Vitazyme on organic bananas in the Dominican Republic revealed an excellent response across all parameters that were evaluated. Leaf number, productive hands, caliper of the hands (both first and last hands for a bunch), and the length of these hands were all improved, leading to an increase in average bunch weight of 10.1%. This increase in yield translated to an excellent added income of $1,730/ha.

2. Twelve studies conducted in farmers' fields in Ukraine, during a very dry year in many parts of the country, revealed once again the utility of utilizing this program in that Eastern European country. In 2020, the yield of winter wheat, spring wheat, winter barley, winter canola, spring canola, sunflowers, sugar beets, soybeans, and corn were improved by 9 to 34%. These yield increases were accompanied by significant improvements in grain gluten and protein contents for wheat. Especially notable were an increase in beet sugar along with the yield increase of sugar beets (a 15% sugar yield increase atop a 9% yield increase), a great yield improvement (34%) with winter barley by using Vitazyme Cold Start in the spring, and an exceptional improvement in yields for grains and canola during drought stress conditions. Also, herbicide damage on corn and sunflowers was dramatically reversed.

3. Vitazyme, together with the microbial product Bio Seed, showed the same excellent responses as in previous years. In Tennessee trials, Vitazyme plus Bio Seed increased wheat yields significantly by about 5% when applied in the spring.

4. A spring canola trial in Alberta, Canada, produced a remarkable 23% increase in yield when the product was applied to the seeds before planting. In-furrow and pre-plant soil treatments also improved yields, by 14% and 5%, respectively. A trial in Manitoba on winter canola, applying Vitazyme along with a herbicide, compared to another biostimulant called "45," produced a 4% greater yield response.

5. A corn trial at South Dakota State University, Brookings, South Dakota, revealed that a foliar treatment at 13 oz/acre (1 liter/ha) increased yield at all nitrogen levels: 19 bu/acre at 40 lb of N/acre, 14 bu/acre at 80 lb of N/acre, and 6 bu/acre at 120 lb of N/acre. The year was unusually dry for part of the season, which likely limited the effect of the seed treatment, which for several years at this research station has shown excellent yield responses.

6. Studies with corn at ACRES Research in Cedar Falls, Iowa, which evaluated the incorporation of Vitazyme into a polymer used to coat urea and stabilize the release of nitrogen, showed some promising results; yield increases of up to 11.6 bu/acre compared to the control were obtained. Further studies will be initiated to determine the proper rates and methods of application for this promising combination.

7. Vitazyme on soybeans continues to be an excellent practice, as shown in a study in northeastern South Dakota, where a 6%, highly profitable yield increase resulted from 13 oz/acre (1 liter/ha) applications in-furrow and at early bloom.

Bananas (Organic) *With Vitazyme application*

Researchers: Damiel Peña and Kelby Contreras
Research organization: DUWEST Dominicana
Location: Guayubin, Monti Crist, Dominican Republic
Farmer: Francisco Javier,
(Inversiones Gonval, farm manager)
Banana variety: Williams
Stage of grove: established
Experimental design: An organic banana grove was selected to evaluate the influence of Vitazyme on banana growth (leaf number), hands per bunch, size of the hands, bunch weight, and yield. One hectare was used for the treated area, and also for the control area. Evaluations were made on five bunches for each treatment in each of three weeks.

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

Fertilization: unknown
Vitazyme application: (1) 1 liter/ha foliar sprayed at flowering in the first week, using a 5 ml/liter solution (0.5%) at 200 liters/ha spray volume; (2) 1 liter/ha foliar sprayed 30 days later.

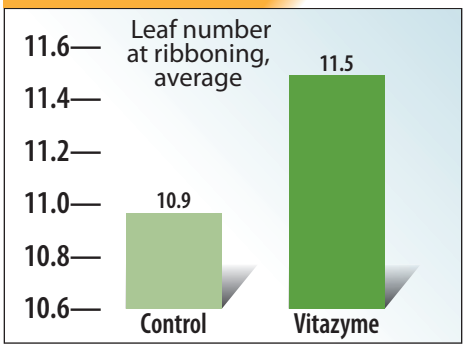
The DUWEST organic banana trial in the Dominican Republic proved that Vitazyme, applied on a monthly basis, increased the yield by 10% while increasing the grade of filling of fingers, length, and number.

Leaves at ribboning: Different colors of ribbons were attached to the polyethylene bags at three different weeks to show the bunch age for harvest scheduling. These dates were established between July 30 and September 17, 2019, at weeks 31, 34, and 38 of the banana calendar. These values were averaged for the three evaluated ribbons.

False hands per bunch: The number of nonproductive (false) hands was counted for each of the five bunches per treatment, and averaged. The number was the same for both the control and the Vitazyme treatment.

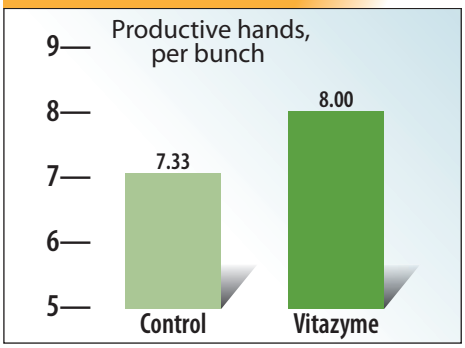
Fruitful hands per bunch: The number of productive hands was counted for each of the five bunches per treatment, and averaged, which resulted in an increase of 0.66 productive hands per bunch.

Leaf Number



Increase in banana leaf number with Vitazyme: 0.6 (+6%)

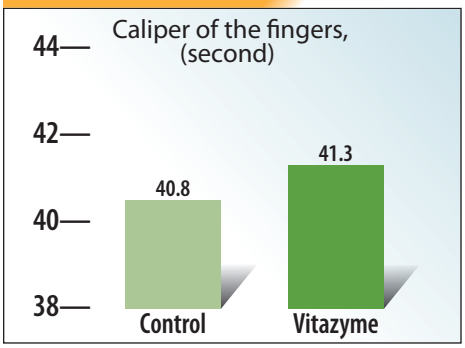
Productive Hands Increase



Increase in the number of productive hands per bunch: 0.66 (+10%)

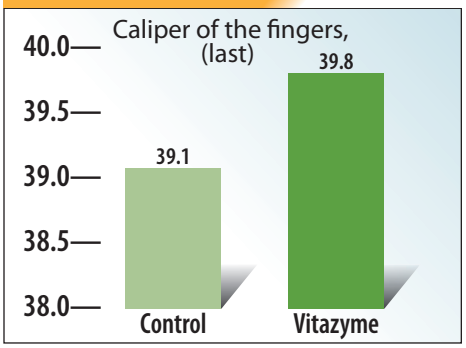
Fruit grade of filling, or caliper of the fingers: Measurements were taken of the caliper of the second and last hands of the five banana bunches from both treatments. These values were averaged for the two treatments.

Second Hand



Increase in grade of the second banana bunch with Vitazyme: 0.5

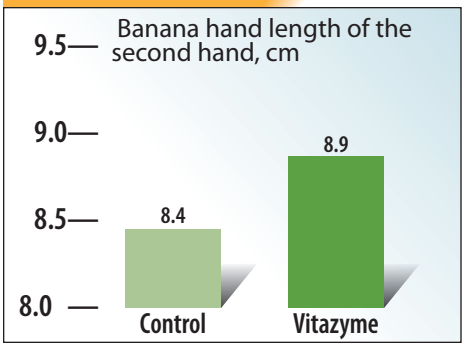
Last Hand



Increase in grade of the last banana bunch with Vitazyme: 0.7

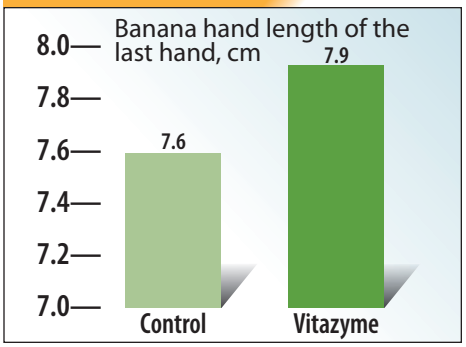
Hand length: These same second and last hands of the five bunches were measured and averaged for the two treatments.

Second Hand



Increase in banana length of the second hand with Vitazyme: 0.5 cm (+6%)

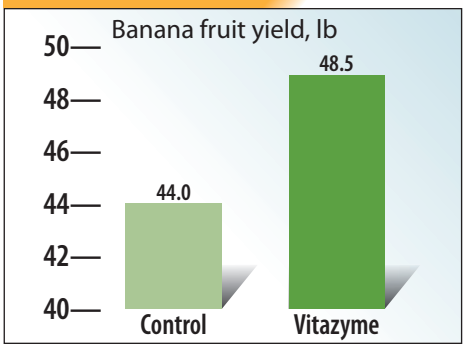
Last Hand



Increase in banana length of the last hand with Vitazyme: 0.3 cm (+4%)

Fruit yield: The weights of the five bunches for each treatment were determined and averaged for both treatments.

Fruit Yield



Increase in bunch weight with Vitazyme: 4.5 lb (+10%)

Profitability: Costs and returns were calculated for both treatments, as shown below.

Parameter	Control	Vitazyme
Bunch weight, lb	44.0	48.5
Yield, lb/ha	91,589	100,880
#Cases/ha	2,180.7	2,401.9
Increase in #cases/ha	—	221.2
Gross income, USD/ha[1]	17,446	19,215
Increase in income vs. Control, USD/ha	—	1,770
Treatment cost vs. Control, USD/ha	—	40
Net income increase, USD/ha	—	1,730

[1]Price for organic bananas = 8 USD/case.

Conclusions: This study has proven the following points.

1. Two 1 liter/ha Vitazyme sprays, at one-month intervals, caused an average increase in weight of 4.5 lb/bunch (+10%) versus the farm control.
2. Vitazyme increased the grade of filling of banana fingers from 0.5 to 0.7 grade versus the control.
3. Banana hand length was increased by Vitazyme from 0.3 to 0.5 cm compared to the untreated control.
4. Vitazyme application cost was 40 USD/ha, which increased yield by 221 cases/ha (10.1%), which gave an increase of 1,730 USD/ha.
5. The area treated with Vitazyme produced excellent plant vigor compared to the untreated control.

Recommendations: It is recommended that Vitazyme be applied at two 1 liter/ha applications, separated by one month, to increase the growth, yield, and income of banana plantations in the Dominican Republic.

Vitazyme Field Tests for 2020

Barley (Spring) *with Vitazyme application*

Researcher: V. V. Plotnikov
Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: LLC "APK Nastashka", Rokytne District, Kyiv Region, Nastashka Village, Ukraine; central Ukraine (440 to 590 mm of rain per year)
Variety: Britni ***Planting date:*** April 8, 2020 ***Planting rate:*** 4 million seeds/ha
Previous crop: corn ***Tillage:*** disking to 10-20 cm, plowing to 20-22 cm, cultivation to 3-4 cm
Soil type: podzolic Chernozem (3.3% organic matter)

Experimental design: A spring barley field was divided into a Vitazyme treated area, and the remainder of the field was left untreated, in order to evaluate the effect of Vitazyme on barley grain yield.

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

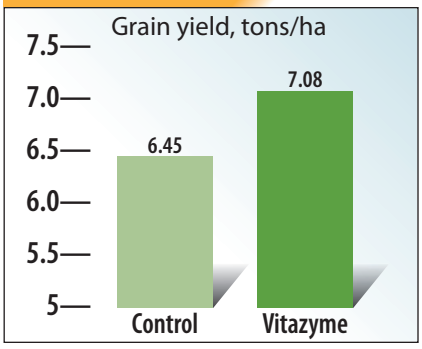
Fertilization: 49 kg/ha of N and 24 kg/ha of S before planting plus 5-16-22 kg/ha of N-P_2O_5-K_2O at planting
Vitazyme application: 1.0 liter/ton of barley seed was applied on April 6, 2020, two days before planting.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	6.45	—
2. Vitazyme	7.08	0.63 (+10%)

Increase in grain yield with Vitazyme: 10 %

Grain Yield



Income results: The extra 0.63 ton/acre produced extra income of $158/ha.
Conclusions: This field-scale barley study in Ukraine, where Vitazyme at 1 liter/ton of seed was planted in a portion of the field, revealed a 10% yield increase with Vitazyme. This increase resulted in a net income increase of $158/ha, showing the great efficacy of this program for barley growers in Ukraine.

Barley (Winter) *With Vitazyme application*

Researcher: V. V. Plotnikov
Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: SE "Servih", Ovidiopol District, Odessa Region, Mykolayivka Village, Ukraine; southern Ukraine (270-350 mm of rain per year)
Variety: Snow Queen ***Planting date:*** October 16, 2019 ***Planting rate:*** 4.5 million seeds/ha ***Previous crop:*** winter canola
Tillage: disking to 6-8 cm, disking again to 20-22 cm, cultivation to 4-5 cm
Soil type: typical Chernozem (4.1% organic matter)
Experimental design: A winter barley field was selected to compare the effects of Vitazyme with an untreated control, to evaluate the effectiveness of this plant growth stimulator to improve the yield of grain. Vitazyme was sprayed after emergence in the fall, and again in the spring.

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

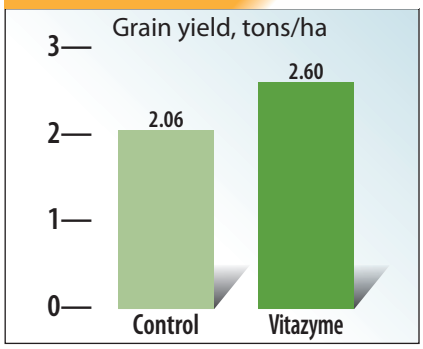
Fertilization: 10-26-26 kg/ha of $N\text{-}P_2O_5\text{-}K_2O$ at planting; 46 kg/ha of N in the spring
Vitazyme application: 0.5 liter/ha sprayed after emergence in the fall, on November 6, 2019; 0.5 liter/ha sprayed on the leaves in the spring, on April 6, 2020
Weather for the growing season: very dry

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	2.06	—
2. Vitazyme	2.60	0.54 (+26%)

Increase in grain yield with Vitazyme : 26 %

Grain Yield



Income results: The grain yield increase of 0.54 ton/ha produced an income increase of $116/ha.
Conclusion: A Ukrainian winter barley trial in 2019-2020, which compared two 0.5 liter/ha foliar/soil applications of Vitazyme (fall and spring) to the untreated control resulted in an excellent grain yield increase of 26%, that brought the farmer an extra $116/ha income. This result proves the great efficacy of using Vitazyme to improve the yield and profits for barley growers in Ukraine.

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

Researcher: V.V. Plotnikov
Research organizations: Plant Designs International,Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: "Valentina" Farm, Ustynivka District, Kirovograd Region, Ustynivka Township, Ukraine; central Ukraine (440 to 590 mm of rain per year)
Variety: 9 Val ***Planting date:*** October 20, 2019 ***Planting rate:*** 4 million seeds/ha ***Previous crop:*** sunflowers
Tillage: disking to 20-22 cm, cultivation to 4-5 cm ***Soil type:*** typical Chernozem (4.0% organic matter)
Experimental design: A winter barley field was divided into an untreated and a Vitazyme Cold Start treated area, to evaluate the effectiveness of this plant growth stimulator to improve the yield of grain.

1 ***Control*** **2** ***Vitazyme Cold Start***

Fertilization: unknown
Vitazyme Cold Start application: 1.0 liter/ha sprayed on the leaves at stem elongation, on April 27, 2020
Weather conditions: During the spring growing season of 2020, the air temperature dropped to -3 to -9°C from April 1 to April 20.

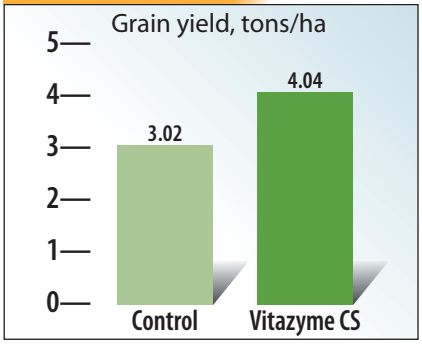
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control*	3.02	—
2. Vitazyme Cold Start**	4.04	1.02 (+34%)

*Without Vitazyme Cold Start for stress relief.
**To help reduce cold stress on the crop.

Increase in grain yield with Vitazyme Cold Start: 34%

Grain Yield



Conclusions: A study on winter barley in central Ukraine, which compared to a single application of Vitazyme Cold Start (1.0 liter/ha at stem elongation) to an untreated control, revealed that the grain yield was improved by a substantial 34% (1.02 tons/ha), this in spite of a dry summer. This result revealed the ability of Vitazyme Cold Start to help overcome cold stress. The efficacy of this product for winter barley production in Ukraine is thus shown to be excellent.

Income results: The extra 1.02 tons/ha yield gave $239/ha more income than the untreated control.

Canola (Spring) *with Vitazyme application*

Researcher: William Hamman, Ph.D., and Donald Scott Walker
Researcher organization: Hamman AG Research, Inc., Lethbridge, Alberta, Canada ***Location:*** Coalhurst, Alberta, Canada
Variety: RRLL ***Planting date:*** May 29, 2020 ***Planting rate:*** 6 kg/ha ***Planting depth:*** 2 cm ***Row spacing:*** 25 cm
Planting method: plot drill ***Soil conditions at planting:*** moist ***Plot size:*** 4 m x 8 m ***Tillage method:*** reduced till
Soil type: dark brown Chernozem; sandy clay loam; organic matter= 1.8%, pH= 8.35, cation exchange capacity = 27.4 meq/100g; fertility level = good, drainage = good
Experimental design: A small-plot replicated canola trial, using four replications arranged in a replicated complete block design, was established using varying application times and methods of Vitazyme, to determine the effect of this biostimulant on the yield of spring canola.

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

Treatment	Vitazyme applicaton[1]				
	Seeds	In-furrow	Pre-plant	Foliar/Soil	Early flower
1. Control	0	0	0	0	0
2. Vitazyme on seeds	1 liter/ton[a]	0	0	0	0
3. Vitazyme in-furrow	0	1 liter/ton[b]	0	0	0
4. Vitazyme on soil pre-plant	0	0	1 liter/ton[c]	0	0
5. Vitazyme foliar/soil early	0	0	0	1 liter/ton[d]	0
6. Vitazyme in-furrow + early flower	1 liter/ton	0	0		1 liter/ton[e]

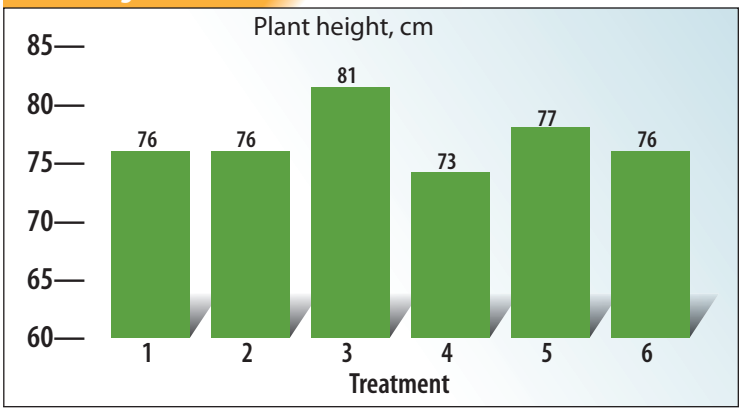
[a]Applied with a seed treater on May 29.
[b]Applied May 29.
[c]Applied May 29 just before planting.
[d]Applied at early heading on June 19, along with Liberty herbicide.
[e]Applied at early flowering on July 15.

Growing season weather: July, August, and September were especially dry.
Fertilization: unknown
Vitazyme application: All rates were 1 liter/ha at the times shown on the table.
Liberty herbicide: Liberty is a BASF non-selective herbicide that controls a broad spectrum of broadleaf and grassy weeds. It is used to control weeds for LibertyLink canola and other LibertyLink crops. The active ingredient is glufosinate ammonium.
Harvest date: September 11, 2020, using a Zurn 150 plot combine, harvesting an area of 1.5 x 8.0 meters for each plot (12.0m^2).

Plant height results: Data was collected August 18.

Treatment	Plant height
	cm
1. Control	76
2. Vitazyme on seeds	76
3. Vitazyme in-furrow	81
4. Vitazyme on soil pre-plant	73
5. Vitazyme foliar/soil early	77
6. Vitazyme in-furrow + early flower	76
CV	6.67
Replicate F	0.21
Treatment F	1.01
Treatment probability (P=0.05)	0.447
LSD (P=0.05)	7.7

Plant Height

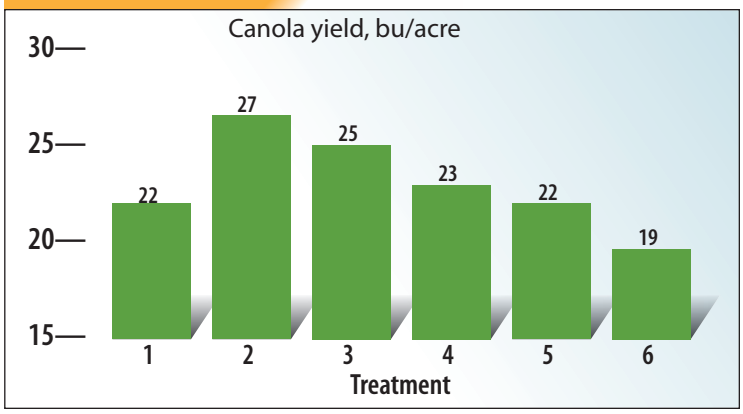


Increase in plant height with Vitazyme applied in-furrow: 5 cm (+7%)

Yield results:

Treatment	Yield	Yield change
	bu/acre	bu/acre
1. Control	22	—
2. Vitazyme on seeds	27	5 (+23%)
3. Vitazyme in-furrow	25	3 (+14%)
4. Vitazyme on soil pre-plant	23	1 (+5%)
5. Vitazyme foliar/soil early	22	0 —
6. Vitazyme in-furrow + early flower	19	(-) 3 (-14%)
CV	18.8	
Replicate F	0.69	
Treatment F	1.43	
Treatment probability (P=0.05)	0.27	
LSD (P=0.05)	6.4	

Canola Yield



Increase in canola yield with Vitazyme

Seeds ..... +23%
In-furrow ..... +14%
Pre-plant..... +5%

Conclusions: This small-plot canola trial in Alberta, Canada, revealed that Vitazyme improved plant height by 7% during an early August evaluation. Yield effects were excellent with the seed treatment, giving a 23% yield increase, although due to plot variability the increase was not significant a P=0.05. The in-furrow and pre-plant soil treatment gave small yield increases, of 14% and 5%, respectively, while the application with Liberty herbicides brought no yield effect. The in-furrow plus early flower applications reduced yield for unknown reasons, possibly due to one unusually low-yielding plot. The Vitazyme seed and in-furrow treatments are shown to be good yield stimulators of canola under Alberta conditions despite a very dry summer.

Vitazyme Field Tests for 2020

Canola (Winter) *with Vitazyme application*

Researcher: Darrel Carlisle ***Research organization:*** Carlisle Liquid Starters, Carroll, Manitoba, Canada
Location: Carrol, Manitoba, Canada ***Variety:*** unknown ***Planting date:*** unknown
Experimental design: A A field of canola was treated in part with Vitazyme, to compare with another biostimulant ("45") applied alongside, to determine the effect of this product on the yield of canola seed.

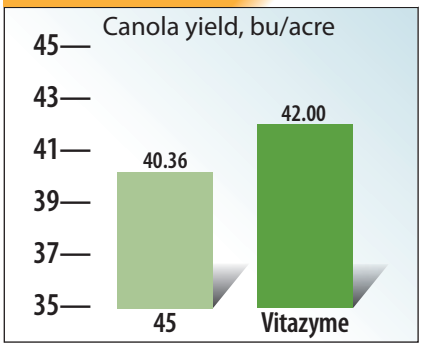
❶ *"45"* ❷ *Vitazyme*

Fertilization: unknown ***Vitazyme application:*** 1.0 liter/ha along with the herbicide
45 application: This product is also called Lignijoule in Western Canada, and is a by-product of the pulp and paper industry.
Yield results: At harvest, two combined samples of canola were collected and weighed for both products.

Treatment	Seed yield	Average yield	Yield change
	bu/acre	bu/acre	bu/acre
45	37.40	—	—
45	43.32	40.36	—
Vitazyme	39.16	—	—
Vitazyme	44.84	42.00	1.64 (+4%)

Increase in seed yield with Vitazyme: 4 %

Canola Yield



Conclusions:
A canola trial in Manitoba, comparing a product called "45" with Vitazyme, showed a 4% better yield with Vitazyme. This increase was 1.64 bu/acre.

Canola (Winter) *with Vitazyme application*

Researcher: V. V. Plotnikov
Research organization: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: PE AF "Dzvony", Peremyshl District, Lviv Region, Bolotnya Village, Ukraine: western Ukraine (550-750 mm of rain per year)
Variety: Seifer ***Planting date:*** August 20, 2018 ***Planting rate:*** 0.5 million seeds/ha ***Previous crop:*** winter wheat
Tillage: disking to 5-6 cm, plowing to 26-28 cm, cultivation to 2-3 cm ***Soil type:*** dark-gray podzolic (2.2% organic matter)
Experimental design: A winter canola field was divided into an untreated control area and a Vitazyme treated area—one application at budding—to evaluate the effect of this biostimulant on canola seed yield.

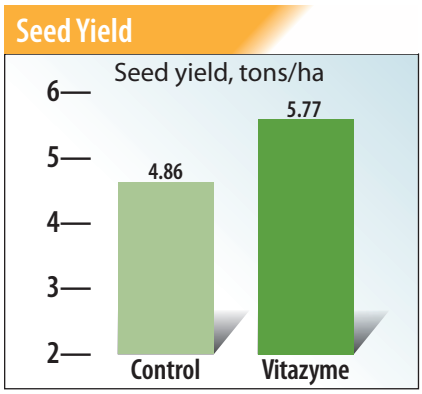
1 ***Control*** 2 ***Vitazyme***

Fertilization: 30-60-90 kg/ha of N-P_2O_5-K_2O during fall plowing; 170-10-13 kg/ha of N-Mg-S in the spring
Vitazyme application: 1.0 liter/ha sprayed on the leaves at budding on May 1, 2019

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	4.86	—
2. Vitazyme	5.77	0.91 (+19%)

Increase in seed yield with Vitazyme: 19%



Income results: As a result of the yield increase of 19%, the net income for this trial was increased by $439/ha

Conclusions: A winter canola trial in western Ukraine in 2018-19, which compared an untreated control portion of a field with a portion sprayed with 0.7 liter/ha of Vitazyme in the spring, resulted in a great 19% yield increase, and a $439/ha net income increase. These results prove the excellent efficacy of Vitazyme for improving the productivity and profits of canola growers in Ukraine.

Corn *with Vitazyme application*

Researcher: Jonathan Jaschen
Research organization: ACRES Research, Cedar Falls, Iowa
Location: Cedar Falls, Iowa ***Variety:*** P0589AMXT
Planting date: May 31, 2020
Plant population: 34,000 plants/acre
Row spacing: 30 inches ***Previous crop:*** corn
Soil type: unknown
Tillage method: conventional

Experimental design: A small plot experiment, using five replications, was initiated using plots that were 15 x 30 ft (450 ft^2), to determine the effects of Vitazyme and PurYield—urea that is encapsulated in a polymer—in different formulations for rate of release, with and without Vitazyme incorporation, to determine the yield enhancement with these formulations versus appropriate untreated controls. The experimental design was a Randomized Complete Block.

Treatment	Normal urea		PurYield[1]		PurYield + Vitazyme[2]		Vitazyme in-furrow	Vitazyme foliar (V6)
	120 lb/acre	180 lb/acre	120 lb/acre	180 lb/acre	120 lb/acre	180 lb/acre		
1	x	o	o	o	o	o	o	o
2	o	x	o	o	o	o	o	o
3	o	o	x	o	o	o	o	o
4	o	o	o	x	o	o	o	o
5	o	o	o	o	x	o	o	o
6	o	o	o	o	o	x	o	o
7	o	o	x	o	o	o	o	x
8	o	o	o	x	o	o	o	x
9	o	o	x	o	o	o	x	o
10	o	o	o	x	o	o	x	o
11	x	o	o	o	o	o	x	o
12	x	o	o	o	o	o	x	x
13	o	x	o	o	o	o	o	x
14	o	o	o	o	o	o	o	o

[1]PurYield was applied as a combination of 10-day release, 30-day release, and 45-day release polymer coated urea in the following fashion: 120 lb/acre N, 425, 425, and 430 g/plot for the three types; 180 lb/acre N, 636, 636, and 643 g/plot for the three types.
[2]PurYield + Vitazyme was a formulation as in footnote 1 above, plus Vitazyme incorporated into the granules at manufacture to give a 13 oz/acre rate.

Fertilization: PurYield was applied by broadcasting at the rates given in the table on May 30, 2020. Urea was likewise broadcast at the rates given in the table on May 30, at 1,220 g/plot for the 120 lb/acre N rate, and at 1,830 g/plot for the 180 lb/acre N rate. PurYield is a polymer-coated urea formulated by Pursell Agri-Tech, Sylacauga, Alabama. Treatment 13 had a side-dress application of urea at V6 (July 1).

Vitazyme application: Vitazyme was applied directly to the urea during the encapsulation process, to give about 13 oz/acre when the granules are applied at normal rates. The in-furrow treatment was at 13 oz/acre applied in the seed row at planting (May 31), and the foliar application was sprayed on at 13 oz/acre at the V6 stage, on July 1, 2020.

Growth results: Excavation of roots on August 28 from Vitazyme treated plants and untreated plants revealed considerably better rooting for the treated plants.

This comparison of corn treated with Vitazyme has the same levels of PurYield nitrogen on both sides. The root growth and ear fill are markedly better with Vitazyme.

Another PurYield nitrogen rate shows the same advantage of ear fill and root enhancement for Vitazyme as with the other nitrogen rate in the other photo.

The Vitazyme treated corn roots on the right show a remarkable enhancement of development compared to the untreated plant on the left.

Ear development is markedly improved in terms of fill and kernel size with the ear from the Vitazyme treated plant on the right.

Yield results: The plots were harvested on October 25, 2020, using a plot combine to harvest the inner two rows of each plot, or an area of 60 in x 30 ft per plot.

Treatment	Yield[1]	Yield change at the same N level					
	bu/acre	Comparison	bu/acre	Comparison	bu/acre	Comparison	bu/acre
1. Urea 120	195.6 a	1 vs. 3	+1.4	1 vs. 5	+4.4	1 vs. 9	+6.8
2. Urea 180	208.4 a	2 vs. 4	+9.9	2 vs. 5	-8.4	2 vs.10	+7.3
3. PurYield 120	197.0 a	3 vs. 5	+3.0	3 vs. 7	-4.1	3 vs.9	+5.4
4. PurYield 180	218.3 a	4 vs. 6	-8.2	4 vs. 8	-5.2	4 vs.10	-2.6
5. PurYield 120 + Vita	200.0 a	5 vs. 7	-6.9	5 vs. 9	+2.4	5 vs.11	-0.4
6. PurYield 180 + Vita	210.1 a	6 vs. 8	+3.0	6 vs.10	+5.6	6 vs.13	+11.6
7. PurYield 120, Vita V6	192.9 a	7 vs. 9	+9.5	7 vs.11	+6.7	7 vs.12	+1.5
8. PurYield 180, Vita V6	213.1 a	8 vs.10	+2.6	8 vs.13	+8.6		
9. PurYield 120, Vita IF	202.4 a	9 vs.11	-2.8	9 vs.12	-8.0		
10. PurYield 180, Vita IF	215.7 a	10 vs.13	+6.0				
11. Urea 120, Vita IF	199.6 a	11 vs.12	-5.2				
12. Urea 120, Vita IF + Vita V6	194.4 a						
13. Urea 180, Vita V6	221.7 a						
14. None	107.0 b						
LSD (P=0.05)	16.9 bu/acre						
CV	6.73						
Replicate F	2.73						
Treatment F	21.84						

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

Conclusions: This small-plot corn study in east-central Iowa, comparing corn yields treated with conventional urea, polymer-coated slow-release urea of 10, 30, and 45 days, these fertilizers incorporated with Vitazyme within the granule, and also with Vitazyme applied in-furrow or foliar at V6, showed a considerable amount of variation among the treatments. As a result, there were no significant differences among the treatment means, except that all of the fertilizer treatments were about double that of the unfertilized control (Treatment 14).

Some increases in yield did appear for the same level of nitrogen when Vitazyme was either added within the polymer granules, or applied in-furrow or foliar.

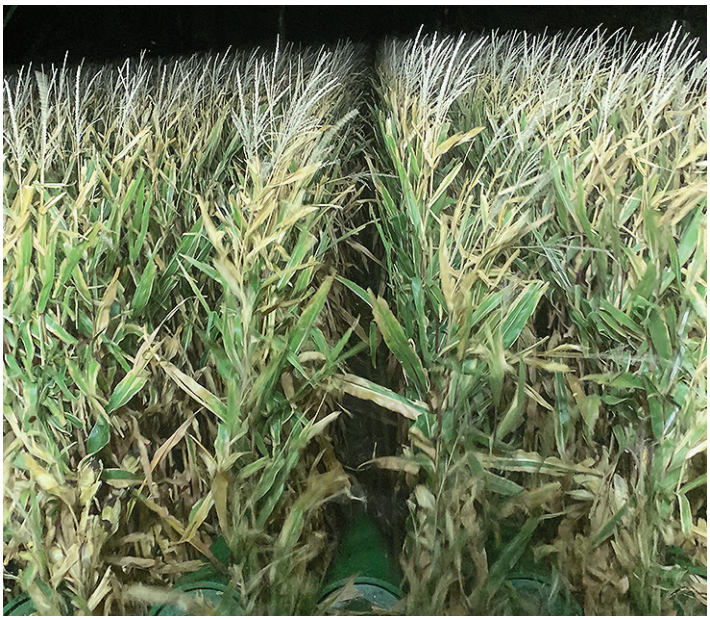
Urea 120 vs. PurYield 120 + Vitazyme.....+4.4 bu/acre
Urea 120 vs. PurYield 120 + Vitazyme in-furrow.....+6.8 bu/acre
Urea 180 vs. PurYield 180, Vitazyme in-furrow.....+7.3 bu/acre
PurYield 120 vs. PurYield 120, Vitazyme in-furrow.....+5.4 bu/acre
PurYield 180 + Vitazyme vs. PurYield 180, Vitazyme in-furrow.....+5.6 bu/acre
PurYield 180 + Vitazyme vs. Urea, Vitazyme V6.....+11.6 bu/acre
PurYield 120, Vitazyme V6 vs. PurYield 120, Viazyme in-furrow....+9.5 bu/acre
PurYield 120, Vitazyme V6 vs. Urea 120, Vitazyme in-furrow.....+6.7 bu/acre
PurYield 180, Vitazyme V6 vs. Urea 180, Vitazyme V6.....+8.6 bu/acre
PurYield 180, Vitazyme in-furrow vs. Urea 180, Vitazyme V6.....+6.0 bu/acre

Because of the high variability of individual plot data, not a lot of confidence can be placed in these data. Of particular note is that the highest yielding treatment was urea applied at 180 lb/acre of N plus Vitazyme sprayed at 13 oz/acre on the leaves at the V6 stage.

There was a significant boost to rooting with Vitazyme treatments that was noted in sampled plots before senescence, which normally would translate to higher yields at harvest.

Corn *with Vitazyme*

Researcher: Mike Williams
Location: Pocahontas County, Iowa
Farmer: Mike Williams
Variety: unknown
Planting date: spring of 2019
Experimental design: A corn field in eastern Iowa was divided into an untreated control area, and an area treated with four products: Vitazyme, Syntose FA (a sugar), Environoc 401 (a microbial array), and WakeUp Spring (a surfactant). These products were applied in-furrow at planting, to determine their combined effect on the yield and maturity of the corn crop.



The Vitazyme treated corn on the Williams farm produced 10 bu/acre more when combined with WakeUp Spring, Environoc 401, and Syntose FA.

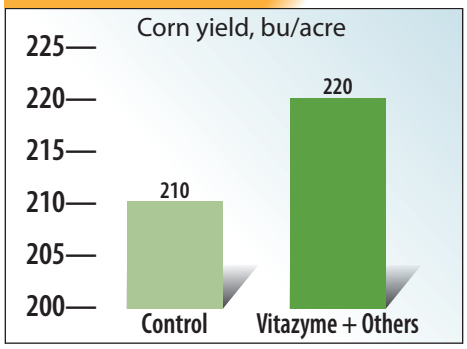
1 ***Control*** **2** ***Vitazyme + Other products***

Fertilization: unknown, the same for both treatments
Syntose FA: a blend of sugars, molasses, and fulvic acid that is recommended for use with starter fertilizers, to enhance soil microorganism activity, made by Conklin Company Inc, Kansas City, Missouri; applied at 1 point/acre (1 lb of sugar)
Environoc 401: an array of beneficial microorganisms that promote rhizosphere function to benefit plant growth, made by Biodyne-USA, Fort Wayne, Indiana; applied at 16 oz/acre in-furrow.
WakeUp Spring: an array of colloidal micelles derived from plant-sourced oils and alcohols, plus chelating agents derived from sugars, designed to enhance the absorption and translocation of plant nutrients, made by Renewable Farming LLC, Cedar Falls, Iowa; applied in-furrow at 3 oz/acre.
Vitazyme application: 13 oz/acre in-furrow at planting
Yield results: At harvest, five 8-row strips each about 0.5 acre, were combined, one strip through the control area and four strips nearby in the treated area. All yields were measured with a combine yield monitor. Grain moisture averaged 16.7%.

Treatment	Yield	Yield change
	bu/acre	bu/acre
Control	210	—
Vitazyme + Others	220[1]	10 (+5%)

[1]Average of strips yielding 215, 221, 221, and 223 bu/acre

Corn Yield



Note the excellent stimulation of germination of corn seedlings on the Williams farm, using Vitazyme and three other products in-furrow at planting.

Increase in corn yield with Vitazyme plus other inputs: 5%

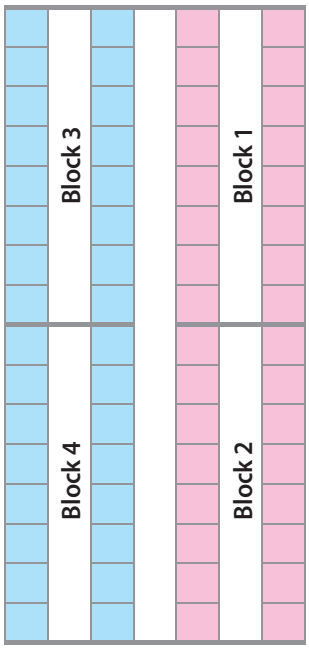
Income results: The price for corn was $3.70/bu. After subtracting product costs, the net return was increased by $30.00/acre
Conclusions: An in-field corn trial in eastern Iowa in 2019, using Vitazyme in-furrow together with a sugar/molasses/fulvic acid product, a microbial array, and a surfactant produced a yield increase of 5%. This increase resulted in a $30.00/acre grain in net income in spite of the very low corn price.

Corn *with Vitazyme application—A Study At South Dakota State University*

Researcher: Graig Reicks and David Clay, PhD.
Research organization: South Dakota State University, Department of Plant Sciences, Brookings, South Dakota
Location: South Dakota State University Experimental Farm, Aurora, South Dakota
Variety: unknown ***Planting date:*** May 2, 2020
Planting rate: 34,750 seeds/acre ***Soil type:*** Brandt silty clay loam
Row spacing: 30 inches ***Planting depth:*** 2 inches
Experimental design: A small-plot corn trial, using four replications with plots that were six rows wide (15 feet) and 20 feet long, was arranged in a randomized complete block design. During harvest a 20-foot x two row section of each plot was hand harvested. Four nitrogen rates were applied to four Vitazyme methods of treatment to determine the effects of these treatments on the yield of corn.

Treatment	Nitrogen rate lb/acre	Vitazyme Treatment	
		Seed	Foliar
1	0	0	0
2	0	X	0
3	0	0	X
4	0	X	X
5	40	0	0
6	40	X	0
7	40	0	X
8	40	X	X
9	80	0	0
10	80	X	0
11	80	0	X
12	80	X	X
13	120	0	0
14	120	X	0
15	120	0	X
16	120	X	0

Fertilization: **Blocks 1 and 2:** appropriate plots received urea coated with N-Fixx urease inhibitor, at 2.11 quarts/ton of urea. **Blocks 3 and 4:** appropriate plots received urea coated with N-Fixx urease inhibitor, at 4.0 quarts/ton of urea.



Note regarding the statistical analysis of this trial: Because there was an error in application of the N-Fixx rates for the plots (half received the high rate and half received the low rate), the arrangement of the replicates was changed, and several plots had to be generated and data values had to be estimated.

Each one of the 16 treatments has been sampled in this South Dakota State University trial, and the plants are laid out for closer inspection.

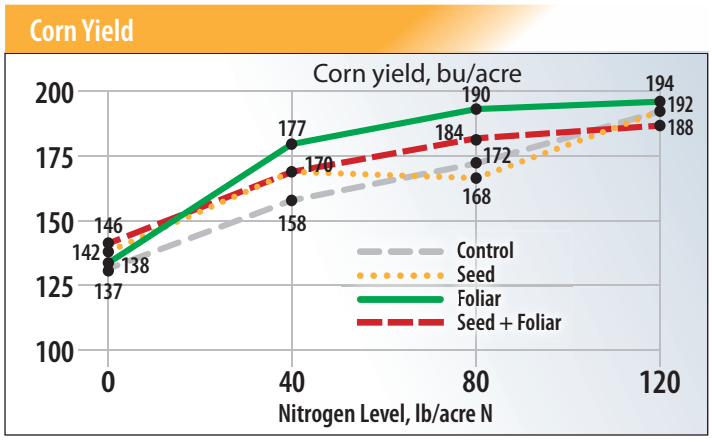
The plants with the various Vitazyme regimes have been laid out to compare the root and plant masses. Note that the Vitazyme treatments give greater and more aggressive root masses than the untreated control roots on the far left.

Vitazyme application: (1) On seeds: the equivalent of 8 oz/acre of Vitazyme was pre-treated on the seeds before planting, using undiluted product. (2) On leaves and soil: 13 oz/acre were applied using a backpack sprayer equipped with 8003 nozzles, at 32 psi; Chemsurf 90 non-ionic surfactant was added at o.25% to maximize droplet adherence to leaves. Application was made at V6 on June 24, 2020.
Harvest date: several days in early November by hand picking of the inner two rows of each plot
Yield results:

Treatment	Vitazyme	Nitrogen	Yield	P-value[1]	Yield change[2]
		lb/acre	bu/acre		bu/acre
1	0	0	137	<0.01	—
2	seed	0	142	<0.01	5 (+4%)
3	foliar	0	138	<0.01	1 (+1%)
4	seed + foliar	0	146	<0.01	9 (+7%)
5	0	40	158	<0.01	—
6	seed	40	170	0.27	12 (+8%)
7	foliar	40	177	0.53	19 (+12%)
8	seed + foliar	40	170	0.18	12 (+8%)
9	0	80	172	0.25	—
10	seed	80	168	0.11	(-) 4 (-2%)
11	foliar	80	190	1.00	18 (+10%)
12	seed + foliar	80	184	0.97	12 (+7%)
13	0	120	192	—	—
14	seed	120	192	1.00	0 (+0%)
15	foliar	120	194	1.00	2 (+1%)
16	seed + foliar	120	188	1.00	(-) 4 (-2%)

[1]Using the two-tailed Dunnett's Test. where the control is 120 lb/acre N with no Vitazyme applied.
[2]Yield changes are computed using the no-Vitazyme treatment as the control for each nitrogen level.

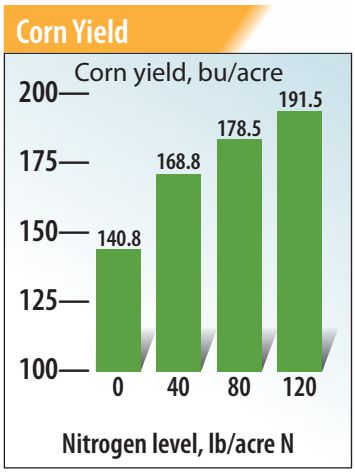
Vitazyme Effects At Each Nitrogen Level



The ears from each of the 16 treatments have been laid out in a grid pattern to reveal how the Vitazyme treatments have improved ear size and fill for all four nitrogen levels.

The ears for the 80 lb/acre nitrogen treatment show how the Vitazyme treatments, in particular the foliar and seed + foliar treatments, have improved ear size and fill, a response to greater root development and plant leaf biomass.

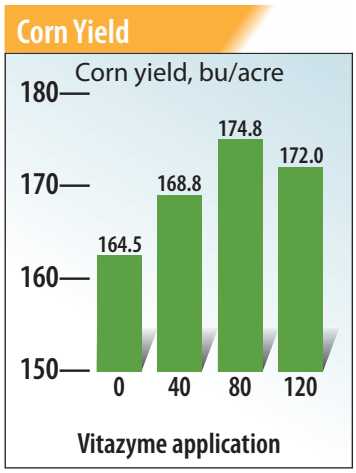
Nitrogen Effects for All Vitazyme Treatments



Increase in corn yield at N levels

40 lb N/acre.... +20%
80 lb N/acre.... +27%
120 lb N/acre.. +36%

Vitazyme Effects for All Nitrogen Levels



Increase in corn yield with Vitazyme applications

Seed..... +2%
Foliar ..... +6%
Seed + Foliar.... +5%

Conclusions: A small-plot corn study at South Dakota State University, using four replications with four equal increments of nitrogen (urea) and variations of Vitazyme application, revealed that the Vitazyme foliar treatment at 13 oz/acre, applied at the V6 stage, significantly boosted yield by 14 bu/acre (8%) above the untreated control. Moreover, all Vitazyme treatments boosted corn yield above the untreated controls by an average of 2, 6, and 5% for the seed, foliar, and seed + foliar treatments respectively. Nitrogen levels boosted yield by 20% to 36% over the no nitrogen treatments. This study was affected by a mistake in applying an N- Fixx coating to the plots at two different rates, but changes in the replication arrangement and estimates for plots made possible a statistical analysis. As stated by Graig Reicks, "Even at the 40 lb N/acre rate, a Vitazyme treatment (either seed or foliar) increased yields to as high as corn grown with 120 lb N/acre." These results show the good efficacy of Vitazyme us to enhance corn yields and improve nitrogen efficiency.

Vitazyme Foliar Pooled Treatment Effect At All Nitrogen Levels

Vitazyme treatment	Nitrogen level	Yield	P-value
	lb/acre	lb/acre	
Foliar	120	195	0.6355
None	120	189	—
Foliar	80	187	0.9937
None	**80**	**173**	**0.0209**
Foliar	40	177	0.1539
None	40	158	<0.0001
Foliar	0	138	<0.0001
None	0	137	<0.0001
Mean, foliar		174.3 (+ 6%)	
Mean, none		164.3	

Using the pooled data, it is apparent that at 80 lb/acre of nitrogen, the Vitazyme foliar treatment produced a significant increase in yield compared the untreated control, at P = 0.02. The mean of all foliar treatments produced 10.0 bu/acre more (6%) yield than the untreated controls.

Increase in corn yield with the Vitazyme foliar treatment at four nitrogen rates

0 N..... 1 bu/acre
40 lb/acre N ..... 19 bu/acre
80 lb/acre N ..... 14 bu/acre
120 lb/acre N ..... 6 bu/acre

Corn, Soybeans *with Vitazyme*

Glyphosate and AMPA Persistence and Distribution in Soils Under Field Conditions in the Midwestern USA

A University of Missouri Multi-Year Study, condensed from a Virtual Annual Meeting of the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America

Note the superior development of the corn ears on the right treated with Vitazyme.

Researchers: Robert Kremer, Division of Plant Sciences, University of Missouri, Columbia, Missouri. Timothy Reinbott, School of Natural Resources, University of Missouri, Columbia, Missouri. Manjula Nathan, Division of Plant Sciences, University of Missouri, Columbia, Missouri. Kelly Nelson, Division of Plant Sciences, University of Missouri, Columbia, Missouri. Paul Syltie, Vital Earth Resources, Inc., Gladewater, Texas. Xiaowei Pan, Agricultural Development Group, Eltopia, Washington. John Fagan, HRI Labs, Fairfield, Iowa.

Background Information

Many recent studies report persistent glyphosate and aminomethylphosphonic acid (AMPA) residues in field soils.

- Soil with >5-year glyphosate application history in Argentina, average concentrations of glyphosate and AMPA were 2300 and 4200 ug/kg, respectively; 25 to 1000 ug/kg soil in various soils.

Very limited information on effects of residual glyphosate/AMPA on soil biological activity or plant growth.

- Germination and early biomass accumulation in oat, faba bean, turnip rape decreased in greenhouse and field plot studies.
- "Low dose glyphosate" (ppb) in the presence of rhizosphere microbiome inhibits seedling growth.

"… the extensive use of glyphosate and the environmental risks associated with it warrant awareness among its user about its judicious utilization, and necessitate further intense investigations to mitigate, avoid, or remove the problems resulting from its use".

Management Considerations

- Residual glyphosate/AMPA effects on soil biology and non-genetically engineered (GE) crops when transitioning from GE with many years of Roundup herbicide applications to non-GE cropping systems with no Roundup.
- Practices for suppressing residual glyphosate/AMPA effects on crop growth.

Research studies performed by the University of Missouri involved the measurement of residual glyphosate/AMPA in soils

1. Use of a biostimulant to improve maize growth, soil health, and tolerance to glyphosate stress (field plots)
2. Mitigation of potential adverse effects of GE crop production for long-term improvement of soil health (farmer fields)

Research Objectives

1. Determine the impacts of residual glyphosate/AMPA on soil health after transition from a GE cropping system to a non-GE cropping system.
2. Determine the effects of a biostimulant (Vitazyme) on rhizosphere biology and crop growth in soils with residual glyphosate contents.

This Pioneer variety responded well to Vitazyme, as can be seen by the ear fill and degree of root development.

Plants treated with Vitazyme typically possess greater leaf area and more chlorophyll, both characteristics which are evident in this comparison. Note also more available nitrogen as evidenced by more leaves on the lower stalk.

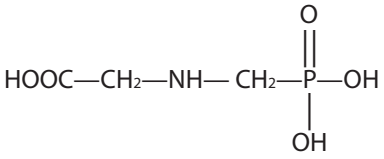
EXPERIMENTAL DESIGN

Sites, Soils, and Management:
Knox County, MO 2016, 2017
Soils: Mexico silt loam (fine, smectitic, mesic, Aeric Vertic Epiaqualfs)
Crops: Maize, soybean
Tillage: minimal, fertilizer based on soil test
Each field had received glyphosate-based herbicides in years prior to the study in 2016 and 2017. Half the plots received no glyphosate. Half the plots received brassinosteroid biostimulant (Vitazyme) at planting and foliar in the vegetative stage

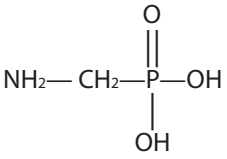
Delaware County, IA-2014-2019
Soils: Bassett-Olin Variant-Bertram-Lilah association- sandy loams
Crops: Maize, soybean
Minimum tillage: fertilizer based on soil test
Fields continuously cropped to GE varieties with annual applications of glyphosate-based herbicides for 19 years prior to transition to non-GE crops and termination of glyphosate use in 2016.

Soil & Rhizosphere Property Measurements
- Root Fusarium colonization
- Rhizosphere pseudomonad rhizobacteria
- Rhizosphere indole-acetic acid producing rhizobacteria
- Rhizosphere Mn transforming bacteria
- Soil glucosidase activity (soil microbial activity)
- Soil microbiome—phospholipid fatty acid (PFLA) profiles
- Soil microbial biomass ("Total PLFA")
- Soil organic C and active C
- Root biomass

Glyphosate Analysis
- Soil samples extracted with ethanol-acetonitrile
- Soil extracts injected into liquid chromatograph—tandem mass spectrometer for detection of glyphosate and AMPA product
- Limit of detection was <1.0 ng/g soil



Glyphosate

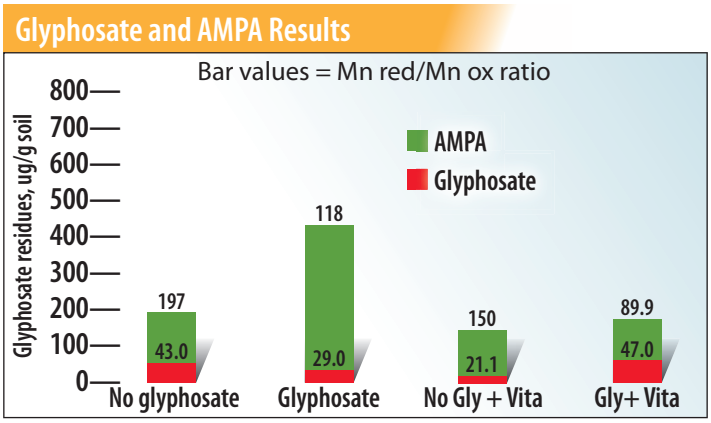


AMPA

The Vitazyme treated soybeans in Missouri have more leaf area and height, plus a higher chlorophyll content, indicative of a greater potential yield

Note the excellent pod formation along the entire stems of these Vitazyme treated soybeans, giving an excellent 60.1 bu/acre yield.

Glyphosate and AMPA results with Vitazyme at a Novelty, Missouri, test site.
Glyphosate and AMPA residues detected in soils of maize plots, averaged over treatments applied in 2017 at Greenley Memorial Research Center, Novelty, MO. Numbers above bars indicate standard deviation. Gly, Glyphosate: Glv+Bs, Glyphosate + Biostimulant

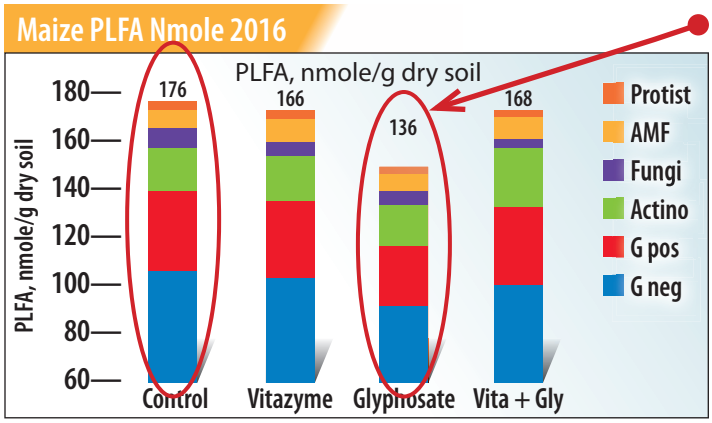


The mean soil glyphosate and AMPA concentrations for each treatment were associated with very high standard deviations, indicating considerable variable distribution within the experimental area regardless of application dosages or times of application.

Considerations from the Novetly, Missouri, field plot study:

- Vitazyme as a treatment to alleviate plant stress caused by glyphosate was confounded by residual herbicide in all plot soils.
- We assumed that glyphosate applied during the growing season interacted with root and rhizosphere microbiomes due to the systemic movement of the herbicide toward the root system, and its release into the rhizosphere.
- However, effects on microbiological activities cannot be correlated to soil glyphosate concentrations due to the unknown quantities of residual glyphosate and AMPA present in the rhizosphere in all plots from previous applications over the years.

Impact of Glyphosate on Rhizosphere Microbial Community (Diversity)



A 32% decrease in microbial biomass due to Roundup

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

Note potential protective effects of Vitazyme on microbiome diversity from the detrimental impact of glyphosate. Reduced microbial abundance = reduced degradation potential or rate.

Conclusion:

- Glyphosate persists in soils as a parent compound, and AMPA as well in fields receiving many applications and for years after termination.
- Distribution of glyphosate residues in soils is very heterogeneous.
- The soil microbiome may mediate only one degradation pathway, resulting in the accumulation of the AMPA metabolite.
- Glyphosate residues may impact soil health and soil biology.
- Many soil factors (pH, SOM, nutrient concentrations, etc.) and management practices may confound overall effects of glyphosate.
- Management to avoid or overcome detrimental effects of persistent glyphosate residues in soils includes:
  - Build up soil organic matter (cover crops, organic amendments)
  - Utilize conservation practices including grass waterways
  - Use Vitazyme to enhance root growth
  - Enhance soil microbial diversity (cover crops, crop rotation)

Vitazyme Field Tests for 2020

Corn *with Vitazyme application*

Researcher: K. Bruce Kirksey, PhD. ***Research organization:*** Agricenter International, Memphis, Tennessee
Location: Memphis, Tennessee ***Variety:*** P7111VT2P (yellow dent corn) ***Planting date:*** May 4, 2020
Planting depth: 1.5 inches ***Plant populations:*** 32, 000 seeds/acre ***Row width:*** 30 inches
Soil: Falaya and Waverly soil types; organic matter = 1.8%, pH = 6.5, cation exchange capacity = 7.8 meq/100 grams of soil
Soil moisture at planting: excellent
Experimental design: A replicated small-plot design (four replications, plots 10 x 30 feet, or four rows per plot; 300 ft^2/plot) was used to evaluate the effect of Vitazyme, alone and in combination with OCC, a plant-based emulsion, to improve the yield of corn grain. Plots were arranged according to a randomized complete block design (RCBD).

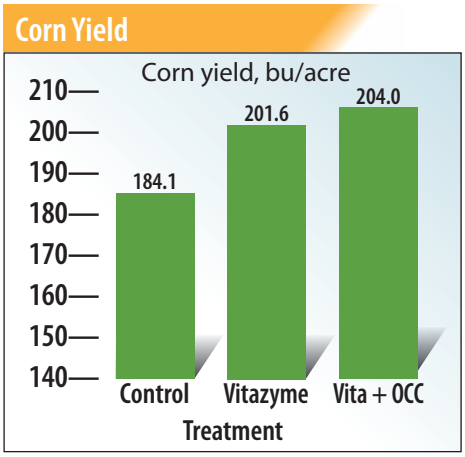
1 ***Control*** **2** ***Vitazyme*** **3** ***Vitazyme =+ OCC***

Fertilization: unknown, but somewhat less than optimum levels for maximum yields
Vitazyme application: (1) 13 oz/acre in-furrow at planting on May 4; (2) 13 oz/acre sprayed on the plants and soil at V6 on June 15
OCC application: 0.0125% v/v of the sprayer capacity sprayed at V6 to the plants and soil on June 15. OCC is a plant-based concentrated emulsion that can be applied alone, or along with nutrients or biostimulants to encourage better growth, higher nutrient efficiency, better crop quality, and reduced pesticide applications.
Growing season conditions: good
Harvest date: October 16, 2020. An Almaco plot combine was used to harvest a 5 x 30 foot section of each plot, or two of the four rows.
Grain moisture results: Grain moisture varied from 15.58 to 15.65%, and there were no significant differences among the three treatments.
Grain weight results: The pounds/bushel weights varied from 55.61 to 56.18, and were not significantly different among the three treatments.

Grain yield results:

Treatment	Yield[1]	Yield change
	bu/acre	bu/acre
1. Control	184.1 b	—
2. Vitazyme	201.6 a	17.5 (+10%)
3. Vitazyme + OCC	204.0 a	19.9 (+11%)
LSD (P = 0.05)	8.2	
CV	2.41	
Replicate F	0.616	
Treatment F	0.002	

[1]Means followed by the same letter are not significantly different at P = 0.05 according to Levene's test.



Increase in corn yield

Vitazyme only..... 10%
Vitazyme + OCC..... 11%

Conclusions: A randomized complete block design study of corn in Memphis, Tennessee, in 2020, comparing Vitazyme alone at 13 oz/acre applied in-furrow and at V6, with an untreated control and the two Vitazyme treatments plus OCC emulsion, produced no differences in grain moisture or grain density at harvest. However, the yield was markedly increased by the two Vitazyme treatments alone (17.5 bu/acre, or 10%), and the two applications plus OCC (19.9 bu/acre, or 11%). These increases were significantly greater than the untreated control at P = 0.002, and reveal the great value of Vitazyme to increase corn yield under somewhat suboptimal fertility conditions. It also appears that OCC emulsion may benefit the activity of Vitazyme.

Vitazyme Field Tests for 2020

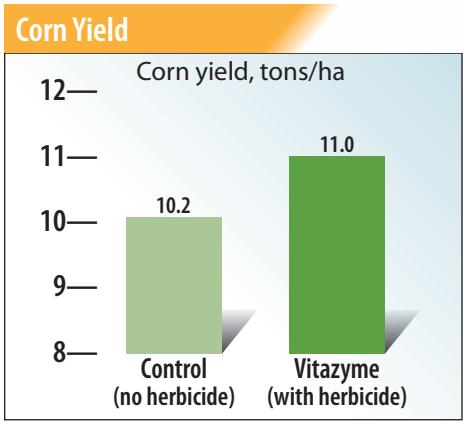
Corn *with Vitazyme—Recovery from Herbicide Damage*

Researcher: V. V. Plotnikov
Research organization: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: LLC "Odemo", Zhmerynka District, Vinnytsya Region, Ryzhivka Village, Ukraine; northern Ukraine (440 to 590 mm of rain per year)
Variety: P9241, FAO 360 ***Planting date:*** April 18, 2020 ***Planting rate:*** 70,000 seeds/ha ***Previous crop:*** winter wheat
Tillage: disking to 6-8 cm, plowing to 22-24 cm, cultivating to 5-6 cm ***Soil type:*** gray podzolic (1.8% organic matter)
Experimental design: A corn field area of 24 ha was mistakenly treated with an anti-slag herbicide at V5, causing severe damage to the plants within two days. To alleviate the damage, Vitazyme was applied as soon as possible (the day after herbicide application) to see if the plant damage could be reversed and corn yields maintained.

1 Control (no herbicide) 2 Vitazyme (with herbicide damage)

Fertilization: 205 kg/ha of nitrogen and 24 kg/ha of sulfur applied before plowing, and 8-24-24 kg of N-P_2O_5-K_2O applied in-furrow at planting
Vitazyme application: 1 liter/ha sprayed on the leaves and soil at V5 on May 20, the day after herbicide application
Herbicide application: Clomazone 480 applied at 100 g/ha at V5 on May 19, causing severe plant damage within hours
Plant observation: The damage caused the inappropriate herbicide application was quickly reversed, and the plants made a complete recovery over the following weeks.
Yield results: Yield measurements were made on the 24-acre herbicide and Vitazyme treated area, as well as an adjoining area that received neither material.

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	10.2	—
2. Vitazyme	11.0	0.8 (+8%)



Increase in corn yield with Vitazyme after herbicide application and damage, versus plants receiving no Vitazyme and herbicide: 8%

Conclusions: A study on herbicide damage of corn in Ukraine, where an untreated control area received neither Vitazyme nor Chomazone 480 herbicide compared to an adjoining area receiving the herbicide, followed by 1 liter/ha of Vitazyme a day later at V5, revealed that the severe damage caused by the herbicide was reversed over the course of several weeks, to produce a crop yield that exceeded the untreated control area by 8% (0.8 ton/ha). This remarkable recovery of the crop following severe herbicide damage reveals the ability of Vitazyme to reactivate the metabolic systems within plants after being severely disrupted by a herbicide.

Soybeans *with Vitazyme application*

Researchers: Graig Reicks and Chris Fischbach
Research organization: South Dakota Soybean Association, Siouz Falls, South Dakota
Location: Fischbach Farms, Mansfield, South Dakota
Variety: unknown ***Planting date:*** unknown
Soil type: Harmony-Beotia silty clay loams, 0-2% slopes, Great Bend-Beotia silt loams, 0-2% slopes, and Harmony-Aberdeen silty clay loams, 0-2% slopes
Experimental design: A soybean field was treated with Vitazyme in 90-foot sprayer strips, and compared with untreated control strips between them to evaluate the effect of the biostimulant on soybean yield. Four replicated strips were used.

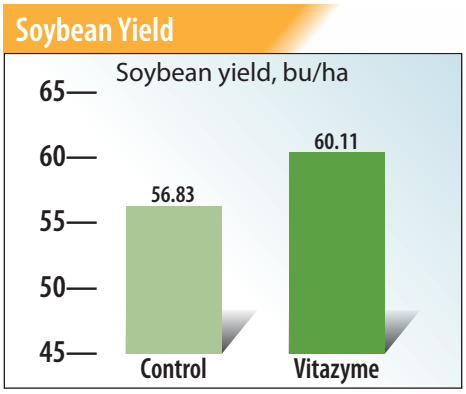
1 ***Control*** **2** ***Vitazyme***

Fertilization: unknown
Vitazyme application: (1) 13 oz/acre in-furrow at planting; (2) 13 oz/acre sprayed on the plants and soil at early bloom
Yield results: Several strips were harvested using a combine-mounted yield monitor, with treated and untreated adjoining strips compared.

These soybeans from northeastern South Dakota show excellent growth and maturity with Vitazyme use.

Replicate	Control	Vitazyme	Yield change
	bu/acre	bu/acre	bu/acre
1	57.50	61.40	3.90
2	57.29	60.71	3.42
3	55.20	58.95	3.75
4	57.34	59.39	2.05
Mean	56.83	60.11*	3.28 (+6%)

*Significantly greater than the control at P = 0.05.



Note the excellent pod formation along the entire stems of these Vitazyme treated soybeans, giving an excellent 60.1 bu/acre yield.

Increase in soybean yield with Vitazyme: 6%

Conclusions: This northeastern South Dakota field scale soybean trial, where Vitazyme applications was compared to an untreated control, revealed that the product significantly increased bean yield by 3.28 bu/acre, or 6%. This increase shows the efficacy of Vitazyme for soybean production in South Dakota.

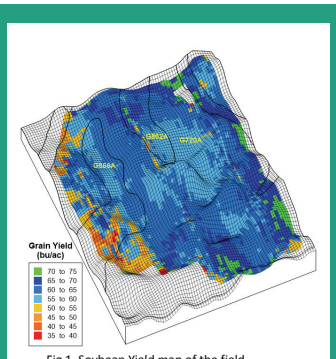


Fig 1. Soybean Yield map of the field

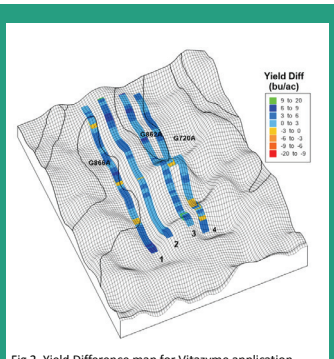


Fig 2. Yield Difference map for Vitazyme application

Compared to the control plants, the Vitazyme treated plants display greater height, leaf area, root growth, stem diameter, pod number, and leaf chlorophyll content.

Soybeans *with Vitazyme application*

Researcher: Dr. Bruce Kirksey ***Research organization:*** Agricenter International, Memphis, Tennessee
Location: Memphis, Tennessee ***Variety:*** GoSoy 4912LL ***Planting date:*** June 17, 2020 ***Planting depth:*** 1 inch
Seeding rate: 140,000 seeds/acre ***Row width:*** 30 inches ***Rows per plot:*** 4
Soil: Falaya and Waverly soil series; silt loam; organic matter = 1.8%, pH = 6.5, cation exchange capacity = 7.8% meq/100g of soil
Fertility level: excellent ***Soil drainage:*** good ***Soil moisture at planting:*** excellent

Experimental design: A small-plot soybean trial, arranged in a randomized complete block design with four replications, the plots being 10 x 30 feet (300 ft^2), was established in order to evaluate the effects of Vitazyme, a silicon product, and OCC emulsion on the yield of soybeans. Vitazyme and silicon were applied alone and in combination, while OCC was applied in combination with Vitazyme.

Treatment	Vitazyme	Silicon	OCC
1	o	o	o
2	x	o	o
3	x	o	x
4	o	x	o
5	x	x	o

Fertilization: unknown

Vitazyme application: (1) 13 oz/acre in-furrow at planting on June 17; (2) 13 oz/acre sprayed on the soil and leaves on July 24 at early bloom. Vitazyme was mixed with silicon for Treatment 5.

Silicon application: (1) 6 oz/acre in-furrow at planting on July 17; (2) 6 oz/acre sprayed on the soil and leaves on July 24 at early bloom. Silicon was mixed with Vitazyme for Treatment 5.

OCC application: OCC is a plant-based emulsion that can be applied alone, or along with nutrients or biostimulants to encourage better growth, higher nutrient efficiency, better crop quality, and reduced pesticide applications. It was applied at 0.0125% v/v of the sprayer capacity at early bloom, over the leaves and soil, on July 24 mixed with Vitayme.

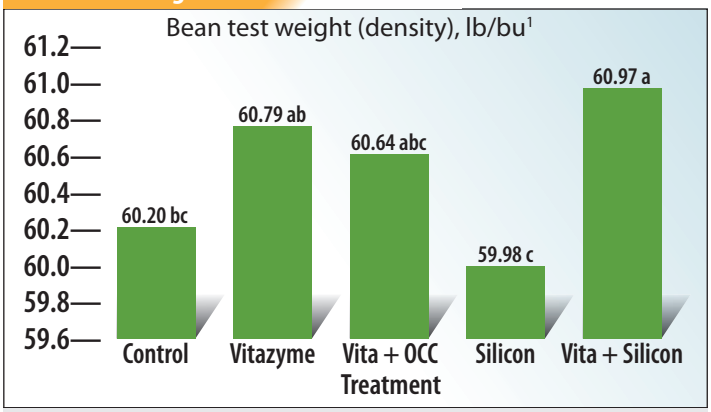
Growing season conditions: good

Harvest date: December 1, 2020. An Almaco plot combine harvested an area of 5 x 30 feet (150 ft^2) from each plot; this area encompassed the middle two rows of each plot.

Bean moisture results: The soybean moisture levels varied from 13.00 to 13.19 % among the five treatments, and were not significantly different.

Bean test weight results: Soybean test weight varied within a narrow range for the five treatment—59.98 to 60.97 lb/bu—and was significant at P = 0.070.

Bean Test Weight



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

LSD (P = 0.05)	0.75
CV	0.81
Replicate F	0.299
Treatment F	0.070

Bean yield results:

Treatment	Yield[1]	Yield change
	bu/acre	bu/acre
1. Control	63.1 b	—
2. Vitazyme	66.9 a	3.8 (+6%)
3. Vitazyme + OCC	66.1 a	3.0 (+5%)
4. Silicon	63.3 b	0.2 (<1%)
5. Vitazyme + Silicon	65.8 a	2.7 (+4%)
LSD (P = 0.05)	2.2	
CV	2.17	
Replicate F	0.657	
Treatment F	0.007	

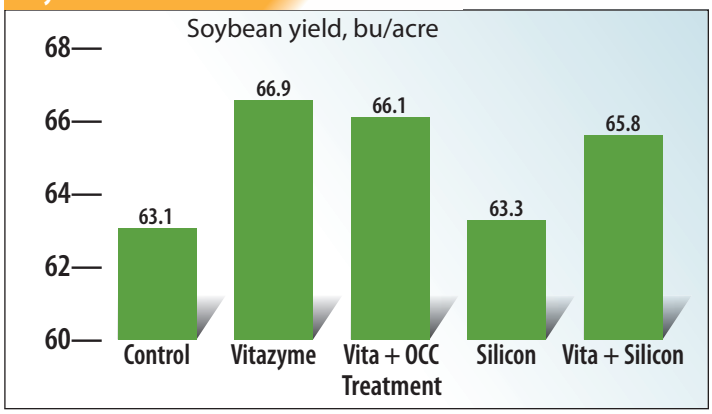
[1]Means followed by the same letter are not significantly different at P = 0.05.

Increase in test weight

Vitazyme alone..... 0.59 lb/bu
Vitazyme + OCC ..... 0.44 lb/bu
Vitazyme+ Silicon... 0.77 lb/bu*

*This increase is significantly greater than the control at P = 0.07.

Soybean Yield



Conclusions: This small-plot soybean trial in western Tennessee revealed a number of conclusions.

- Vitazyme applied in-furrow and at early bloom at 13 oz/acre each application, in all cases significantly increased the soybean yield by from 4 to 6%. The greatest increase was with Vitazyme alone.
- Silicon applied alone did not increase soybean yield, nor did it improve yield when combined with Vitazyme.
- OCC did not improve soybean yield compared to Vitazyme applied by itself.
- Vitazyme, alone or mixed with silicon or OCC, increased the bushel weight of the soybeans, and significantly above the control for Vitazyme plus silicon.

Increase in bean yield

Vitazyme alone	6%
Vitazyme + OCC	5%
Vitazyme+ Silicon	4%

These results indicate that the significant yield increases of this study were obtained with Vitazyme alone, while neither silicon nor OCC caused any yield enhancement. Vitazyme also increased bushel weight, and silicon along with Vitazyme improved that weight significantly above the control. Vitazyme is shown in this study to be an excellent yield and bean density enhancer for soybean growers in the mid-South of the United States.

Vitazyme Field Tests for 2020

Soybeans *with Vitazyme application*

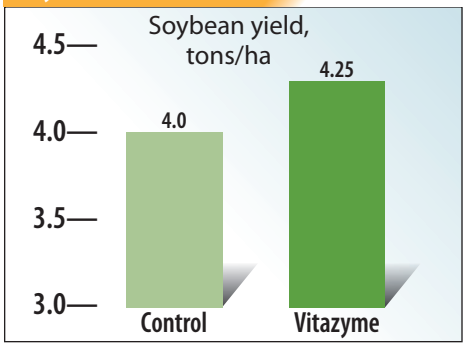
Researcher: V. V. Plotnikov
Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: PE AF "Dzvony", Peremyshl District, Lviv Region, Bolotnya Village, Ukraine; western Ukraine (550-750 mm of rain per year)
Variety: Kuban, F1 ***Planting date:*** May 1, 2019 ***Planting rate:*** 0.8 million seeds/ha ***Previous crop:*** winter wheat
Previous crop: winter wheat ***Tillage:*** disking to 6-8, heavy cultivation to 30 cm, cultivation to 4-5 cm
Soil type: dark-gray podzolic (2.2% organic matter)
Experimental design: A soybean field was partitioned to an untreated control area and a Vitazyme treated area, using a seed treatment, to evaluate the effect of this product on soybean yield.

1 *Control* 2 *Vitazyme*

Fertilization: 100kg/ha of K_20 in the fall of 2018; 16-27-7 kg/ha of N-P_2O_5-K_20 in-furrow at planting
Vitazyme application: 1.0 liter/ton of soybean seeds before planting
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	4.0	—
2. Vitazyme	4.25	0.25 (+6%)

Soybean Yield



Increase in soybean yield with Vitazyme: 6%

Income results: The yield increase of 6 % (0.25 ton/ha) resulted in an income increase of $137/ha.
Conclusions: A soybean trial of field scale was conducted in western Ukraine in 2019, using a Vitazyme seed treatment of 1 liter/ton to compare the yield of soybeans to the adjoining untreated control. The yield increase was 6% (0.25 ton/ha) with Vitazyme, resulting in greater net income of $137/ha, showing this program to be a very good management practice for soybean growers in western Ukraine.

Sugar Beets *with Vitazyme application*

Researcher: V.V. Plotnikov
Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: PE "Zakhidnyy Buh", Zolochiv District, Lviv Region, Rozvoryany Village, Ukraine; central Ukraine (440 to 590 mm of rain per year)
Variety: Pitbull ***Planting date:*** April 26, 2019
Planting rate: 130,000 seeds/ha
Previous crop: winter wheat
Tillage: disking to 10-12 cm, deep tillage to 28-30 cm (Horsch Tiger without reservoir turnover), pre-sowing tillage (Europak combined unit)
Experimental design: A sugar beet field in central Ukraine was divided into an untreated control portion and Vitazyme treated portion of the field, using two foliar spays, to determine the effect of the product on sugar beet yield and sugar content.

There is no question in this photo from Ukraine of the effects of Vitazyme to increase leaf area, and dramatically increase root volume, usually without reducing the sugar content of the beets.

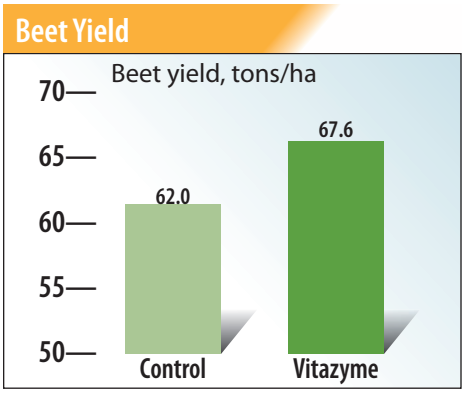
1 ***Control*** **2** ***Vitazyme***

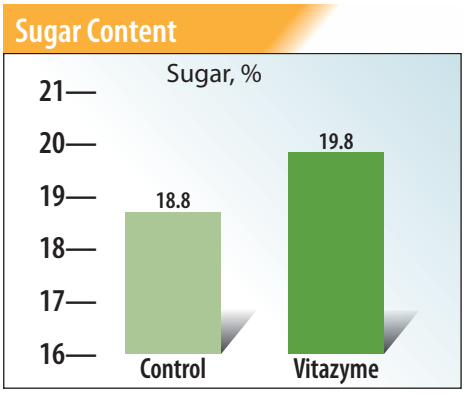
Fertilization: 140-120-160 kg/ha of N-P_2O_5-K_2O in the fall of 2018; 40 kg/ha of N before planting
Vitazyme application: 0.5 liter/ha sprayed on the leaves and soil two times; June 6 and June 26, 2019

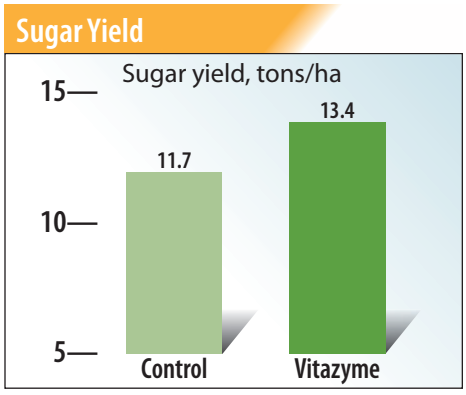
Yield and sugar results:

Treatment	Beet yield	Yield change	Sugar content	Content change	Sugar yield	Yield change
	tons/ha	tons/ha	%	%	tons/ha	tons/ha
1. Control	62.0	—	18.8	—	11.7	—
2. Vitazyme	67.6	5.6 (+9%)	19.8	1.0 (+5%)	13.4	1.7 (+15%)

Increase in beet yield with Vitazyme: 9%
Increase in sugar content with Vitazyme: 5% (1.0 percentage point)
Increase in sugar yield with Vitazyme: 15 %







Income results: The extra beet sugar increase of 1.7 ton/ha produced an extra net income of $194/ha.
Conclusions: This field-scale sugar beet trial in Ukraine, using two 0.5 liter/ha foliar/soil sprays, produced 9% beet weight, 1.0 percentage-point, and 15% sugar yield increases in central Ukraine in 2019. These improvements resulted in a $194/ha increase in net income, illustrating the viability of Vitazyme for sugar beet production.

Sunflowers *with Vitazyme application—Effectiveness in Reducing Herbicide Stress*

Researcher: V. V. Plotnikov
Research organizations:
Plant Designs International, Rochester, New York;
Agro Expert International, Kaharlyk, Ukraine,
and the Cherksy Experimental Station of Bioresources
Location: Drabiv District, Cherkasy Region,
Drabovo-Bariatynske Village, Ukraine; central Ukraine
(440 to 590 mm of rain per-year)
Variety: NK Neoma
Planting date: April 21, 2020
Planting rate: 55,000 seeds/ha
Previous crop: winter wheat
Tillage: disking to 6-8 cm, harrowing to 22-24 cm,
cultivation to 5-6 cm
Soil type: typical Chernozem (3.9% organic matter)
Experimental design: A sunflower field was divided into an untreated and a Vitazyme treated area, to evaluate the effectiveness of this plant growth stimulator to improve the yield of sunflower seeds.

Sunflower responses to Vitazyme in Ukraine continue to be excellent, as for the 2020 trial in central Ukraine, where the yield was improved by 12.

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

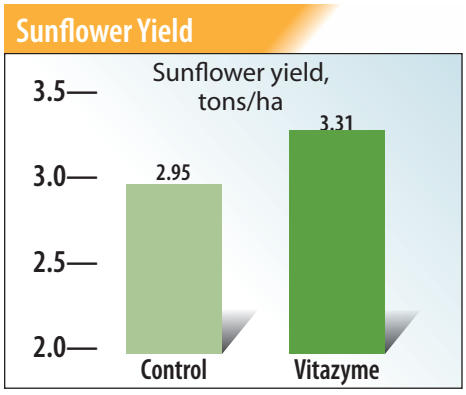
Fertilization: 46 kg/ha of N during pre-plant cultivation, and 4-15-20 kg/ha of N-P_20_5-K_20 per ha at planting
Vitazyme application: 1.0 liter/ha sprayed at the 6-leaf stage on May 24, 2020.
Herbicide application: In 2019, a herbicide with the active compound amidosul Furon 250 had been applied to winter wheat, and the carryover effect seriously affected the sunflower crop. To ameliorate this stress, Vitazyme was applied on May 24 at 1 liter/ha.

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	2.95	—
Vitazyme*	3.31	0.36 (+12%)

*Applied to relieve herbicide stress.

Increase in sunflower yield with Vitazyme: 12%



Income results: This increase in yield of 0.36 ton/ha produced an income increase of $181/ha.

Conclusion: A field-scale trial in Ukraine compared an untreated control with Vitazyme applied at 1.0 liter/ha over the canopy at the six-leaf stage. This application was designed to relieve herbicide stress. This single application produced a marked yield increase of 12% (0.36) tons/ha over the untreated control, showing the great-efficacy of this biostimulant to increase sunflower yields in Ukraine in spite of herbicide damage.

Wheat *with Vitazyme—A Synergism Study with Flobond SC-100 Polymer*

Researcher: Amanda Ver Helst
Research organization: SGS North America, Inc., Brookings, South Dakota
Location: Brookings, South Dakota
Variety: Prevail hard red spring wheat
Planting date: September 10, 2020
Soil: Sungro Propagation Mix
Planting rate: 10 seeds per pot
Experimental design: A growth chamber experiment, using six replications, was designed to evaluate the effect of Vitazyme alone, and Vitazyme plus Flobond SC-100 polymer, as a pretreated seed coating on the germination and early growth, leaf and root growth, and shoot and root mass of hard red spring wheat under varying degrees of water stress.

Treatment	Amount of water			
	100%	75%	50%	25%
1. Vitazyme	x	x	x	x
2. Vitazyme + SC-100	x	x	x	x
3. Control	x	x	x	x

Fertilization: potting mix pre-formulation
Vitazyme application: Seeds for Treatment 1 and 2 were treated with a seed treater at 415 ml/100g of seed, which is the equivalent of about 6 oz/acre as applied by the seeds.
SC-100 application: After the seeds were treated with Vitazyme for Treatment 2, the seeds were coated with 1% Flobond SC-100 polymer.
Watering regime: The following watering schedule was followed.

Watering rate	Soil amount	Initial water added	Weekly water added
	g/pot	g/pot	ml/pot
100%	2032	3736	467
75%	2032	2802	350
50%	2032	1868	234
25%	2032	934	117

Harvest date: October 14, 2020
Plant stand results: Counts for plants were made on September 14, 15, 16, 18, 22, and 28, and October 24.

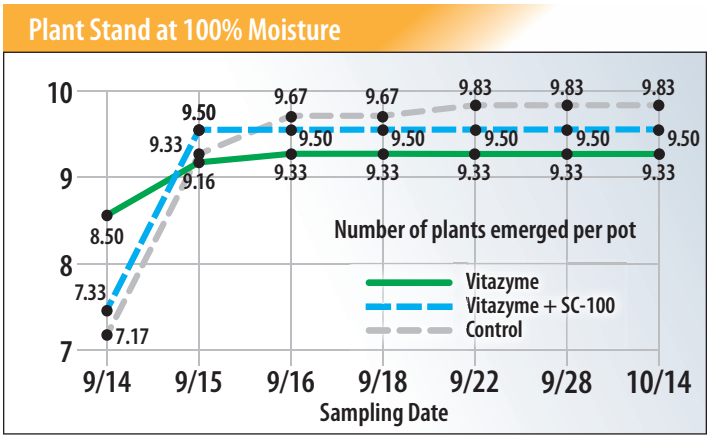
Wheat planted in pots for this SGS early growout study was evaluated for emergence at several times early in the growth cycle, and at harvest the plant heights and weights were determined.

The wheat in these pots was seeded at ten seeds per pot, and counted frequently at the beginning of the study to determine any improvements in emergence, based on the amount of water received and the treatment.

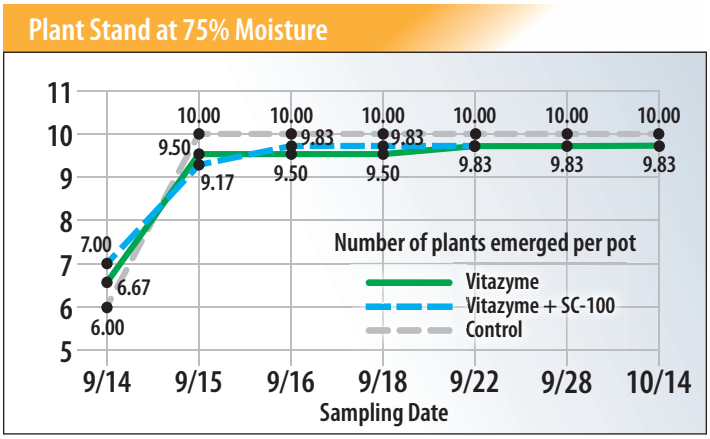
Plant stand results:

PLANT STAND OVER TIME

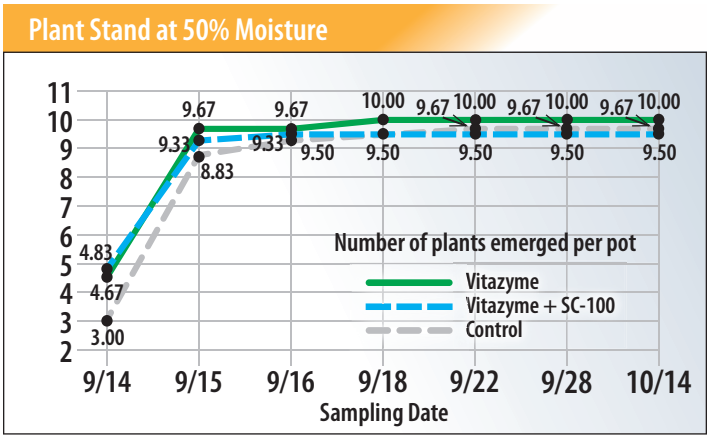
Plant Stand at 100% Moisture



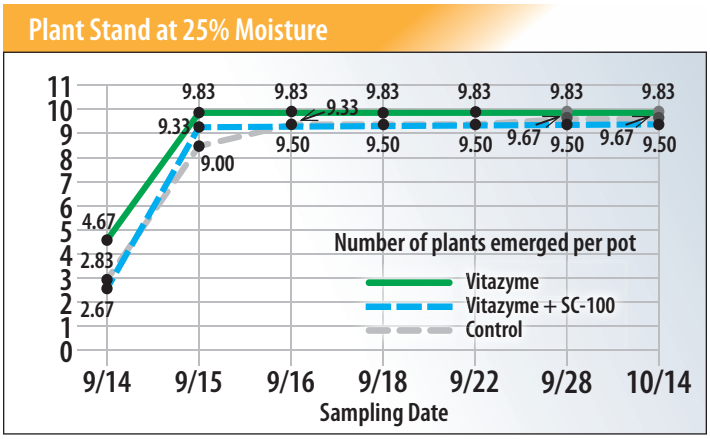
Plant Stand at 75% Moisture:



Plant Stand at 50% Moisture:



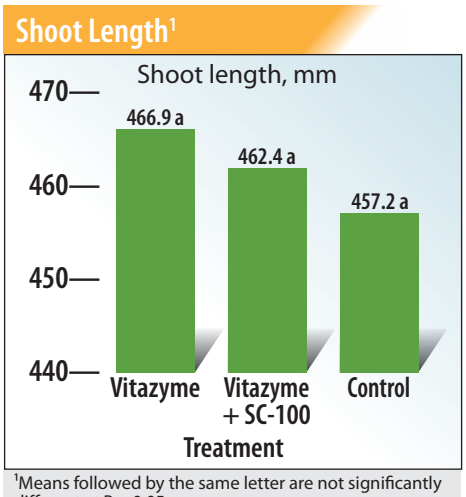
Plant Stand at 25% Moisture:



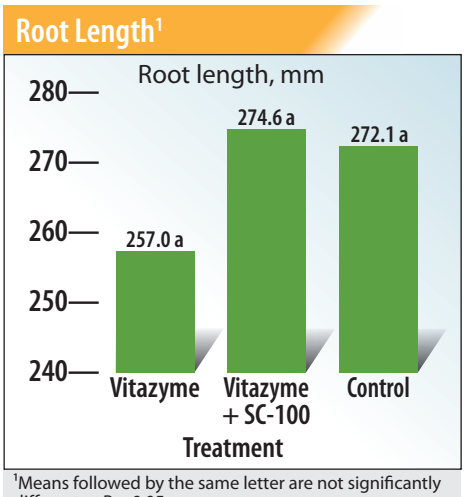
Shoot and root length results:

SHOOT AND ROOT LENGTH

Results for Three Treatments Over All Moisture Levels



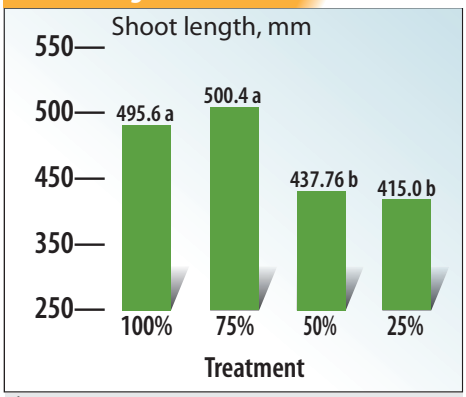
[1]Means followed by the same letter are not significantly different at P = 0.05.



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

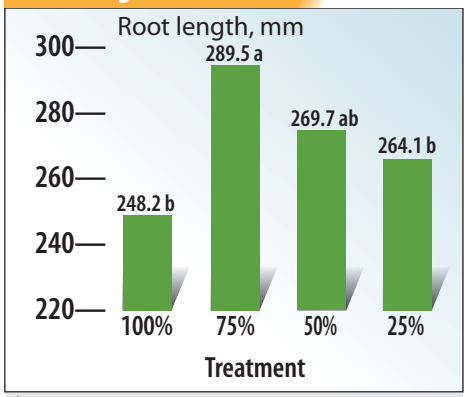
Results for Moisture Levels Over All Three Treatments

Shoot Length[1]



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

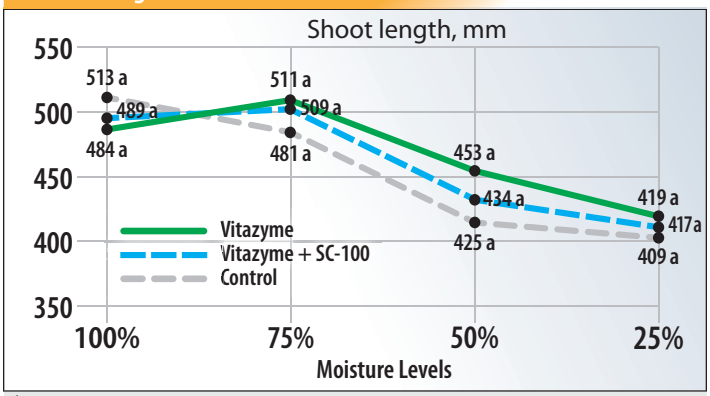
Root Length[1]



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

Shoot Length for Three Treatments at All Four Moisture Levels[1]

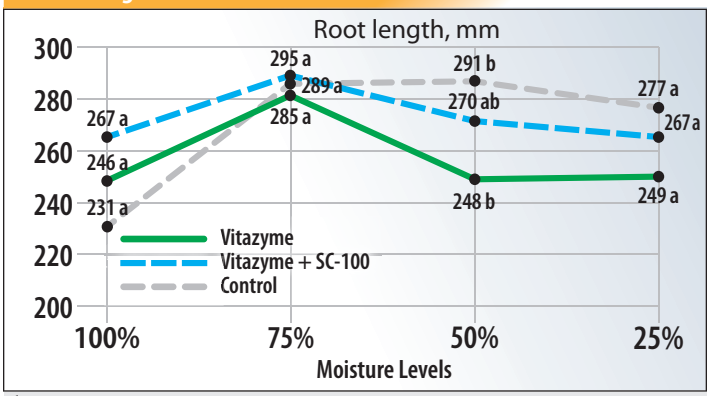
Shoot Length



[1]Means followed by the same letter are not significantly different at P = 0.05 at each moisture level.

Root Length for Three Treatments at All Four Moisture Levels[1]

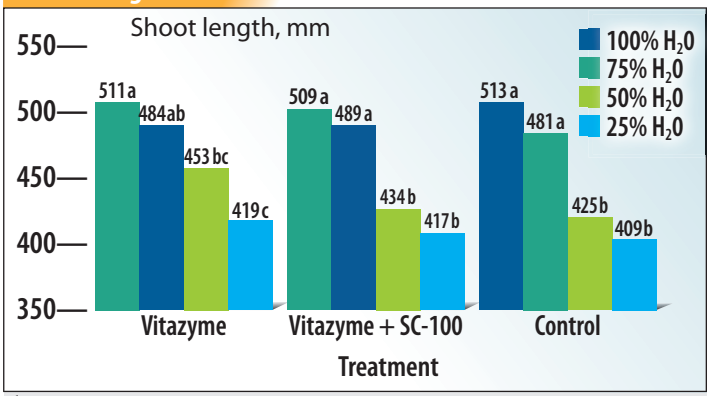
Root Length



[1]Means followed by the same letter are not significantly different at P = 0.05 at each moisture level.

Shoot Length for All Four Moisture Levels for Three Treatments[1]

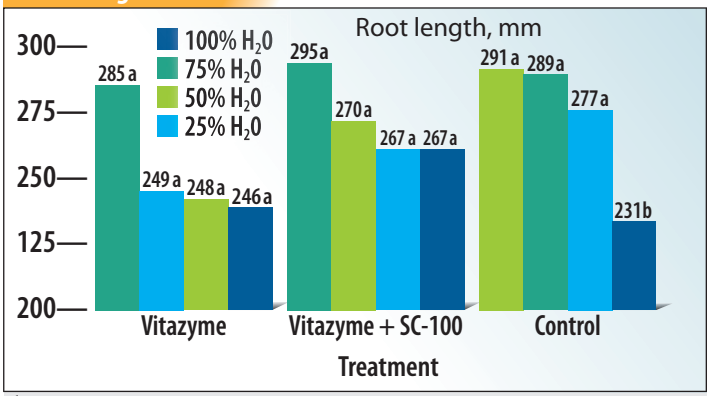
Shoot Length



[1]Means followed by the same letter are not significantly different at P = 0.05 for each treatment.

Root Length for All Four Moisture Levels for Three Treatments[1]

Root Length



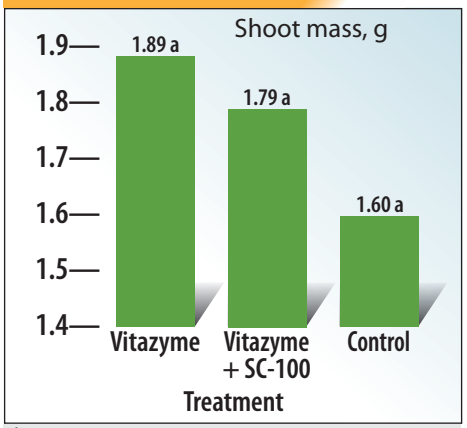
[1]Means followed by the same letter are not significantly different at P = 0.05 for each treatment.

Shoot and root mass results:

SHOOT AND ROOT MASS

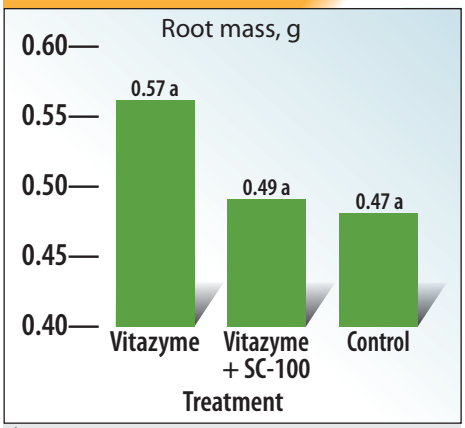
Results for Three Treatments Over All Moisture Levels[1]

Shoot Mass[1]



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

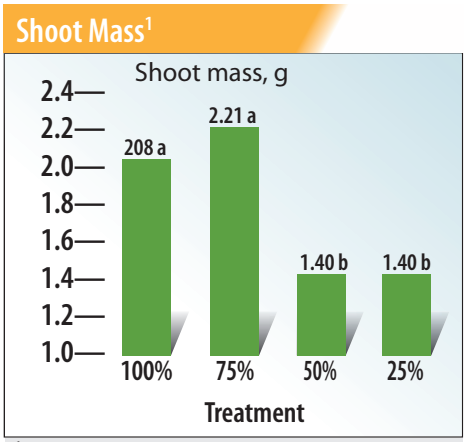
Root Mass[1]



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

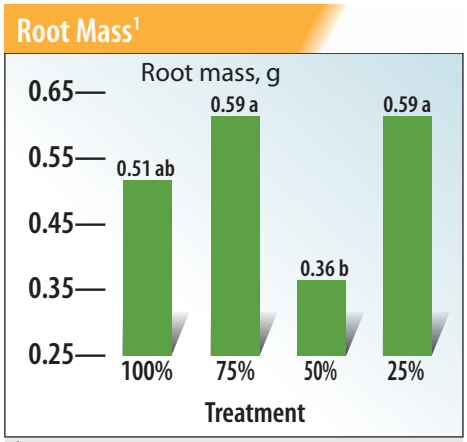
Results for Moisture Levels Over All Three Treatment

Shoot Mass[1]



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

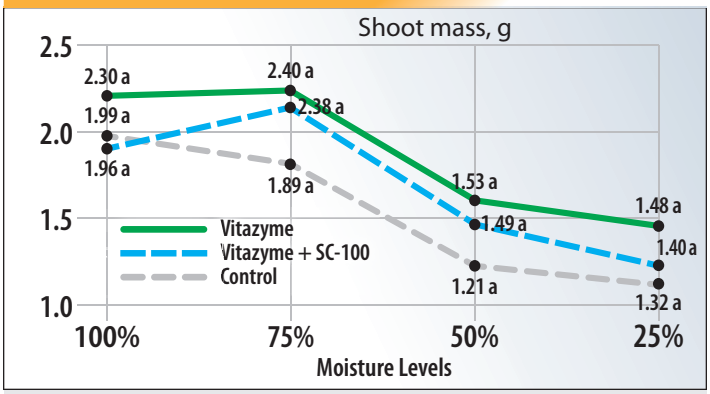
Root Mass[1]



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

Shoot Mass for Three Treatments at All Four Moisture Levels[1]

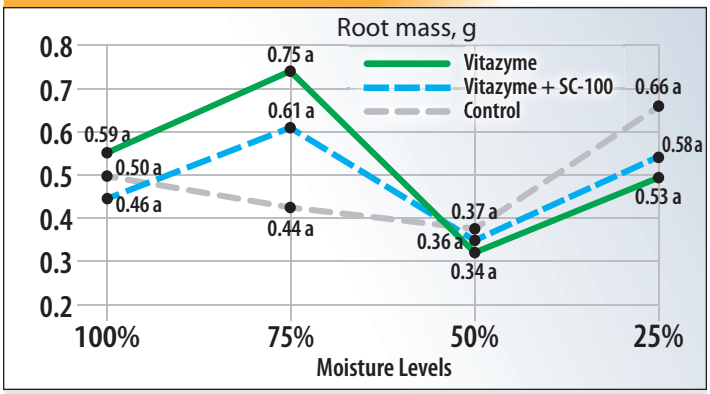
Shoot Mass



[1]Means followed by the same letter are not significantly different at P = 0.05 at each moisture level.

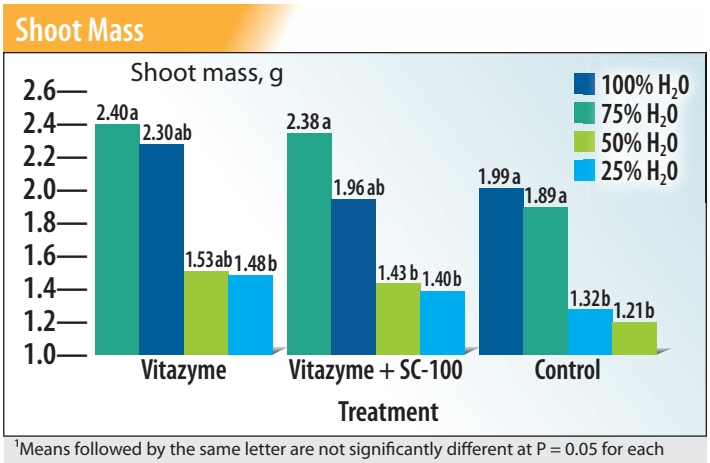
Root Mass for Three Treatments at All Four Moisture Levels[1]

Root Mass



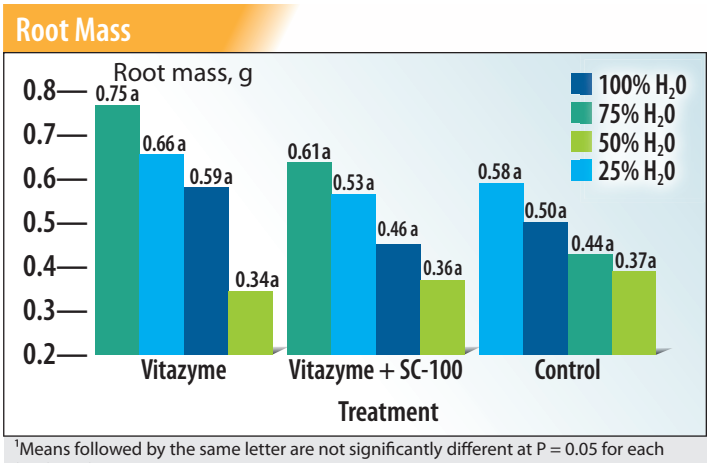
[1]Means followed by the same letter are not significantly different at P = 0.05 at each moisture level.

Shoot Mass for All Four Moisture Levels for Three Treatments[1]



[1]Means followed by the same letter are not significantly different at P = 0.05 for each treatment.

Root Mass for All Four Moisture Levels for Three Treatments[1]



[1]Means followed by the same letter are not significantly different at P = 0.05 for each treatment.

Conclusions:

Seedling emergence: There were no clear patterns of seedling emergence in this study for the three treatments, and no statistics run to determine significant differences. There was a tendency for slightly better emergence of the Vitazyme and Vitazyme + SC-100 treatments at the 50% and 25% moisture levels the first days of the trial.

Shoot and root length: Over all moisture levels, the Vitazyme and Vitazyme + SC-100 treatments gave slightly longer shoots than the control, and Vitazyme + SC-100 gave the longest roots. The differences were not significant, Shoot length was greatest for the Vitazyme and Vitazyme + SC-100 treatments at 75%, 50%, and 25% moisture levels, but root lengths were the reverse, Vitazyme having significantly shorter roots at 50% moisture. The Vitazyme + SC-100, and Vitazyme tended to support greater shoot and root length at the 75% moisture level.

Shoot and root mass: Over all moisture levels, both Vitazyme and Vitazyme + SC-100 produced a greater mass of shoots and roots, though nonsignificantly, than did the control. Both Vitzyme and Vitazyme + SC-100 increased shoot and root mass above the control at 75% moisture; this also held for 50% and 25% moisture for shoot mass. Both Vitazyme and Vitazyme + SC-100 increased shoot mass above the control at all moisture levels except in one instance. Vitazyme improved root mass at all moisture levels except the 50% level.

It is suggested that the potting mix and initial watering, even at the low moisture levels of 25% and 50%, may have reduced potential responses of the corn for both Vitazyme and Vitazyme + SC-100 due to the excessive moisture at the beginning of the study, thus reducing the ability of the SC-100 to fully express its hygroscopic properties.

Wheat (Spring) *with Vitazyme application*

Researcher: V. V. Plotnikov
Research organization: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: PE AF "Dzvony", Peremyshl District, Lviv Region, Bolotnya Village, Ukraine: western Ukraine (550-750 mm of rain per year)
Variety: Quintus, F2 ***Planting date:*** April 1,2019 ***Planting rate:*** 4.5 million seeds/ha ***Previous crop:*** soybeans
Tillage: disking to 6-8 cm, heavy cultivating to 28 cm, cultivation to 3-4 cm ***Soil type:*** dark-gray podzolic (2.2% organic matter)
Experimental design: A spring wheat field in Ukraine was divided into an untreated control area and a Vitazyme treated area using treated seed to determine the effect of this product on the grain yield and quality.

1 ***Control*** **2** ***Vitazyme on seeds***

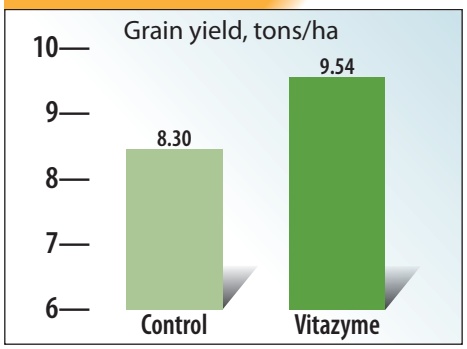
Fertilization: 83 kg/ha of N applied broadcast before planting; 10-26-26 kg/ha of N-P_2O_5-K_2O at planting; 32 kg/ha of N applied later
Vitazyme application: 1.0 liter/ton of seed applied March 26, 2019, 6 days before planting

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	8.30	—
2. Vitazyme	9.54	1.24 (+15%)

Increase in grain yield with Vitazyme: 15%

Grain Yield



Income results: The extra 1.24 tons/ha of grain yield resulted in added net income of $361/ha.

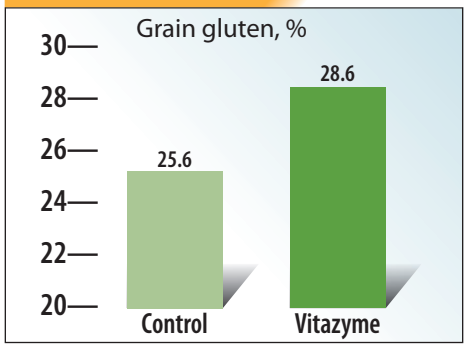
Gluten and protein results:

Treatment	Gluten	Gluten change	Protein	Protein change
	%	%	%	%
1. Control	25.6	—	12.8	—
2. Vitazyme	28.6	3.0 (+12%)	14.5	1.7 (+13%)

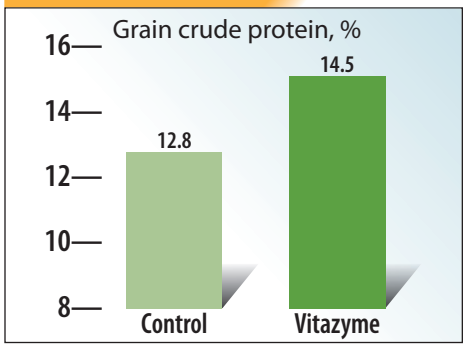
Increase in grain gluten with Vitazyme: 12%

Increase in grain crude protein with Vitazyme: 13%

Grain Gluten



Grain Protein



Conclusions: A spring wheat field-scale trial in western Ukraine, in which an untreated control area was compared with a Vitazyme treated area, revealed that a 1.0 liter/ton of seed treatment increased the grain yield by 1.24 tons ha (15%), grain gluten by 3.0 percentage-points (12%), and grain crude protein by 1.7 percentage points (13%). The overall economic improvement from the application amounted to a significant $361/ha, showing the great utility of using Vitazyme on spring wheat in Ukraine.

Wheat (Winter) *with Vitazyme application*

Researcher: Bruce Kirksey, Ph. D.
Research organization: Agricenter International, Memphis, Tennessee
Location: Memphis, Tennessee
Variety: Turbo (Triticum aestivum)
Planting date: October 18, 2019
Planting depth: 0.75 inch
Row spacing: 7.5 inches
Rows per plot: 9
Population: 1.5 million seeds/acre
Planting method: seed drill
Tillage method: conventional
Planting conditions: friable soil, good moisture
Soil type: Falaya silt loam
Fertility level: good
Soil drainage: good
Soil values: pH = 6.1, organic matter = 1.8%, C.E.C. = 7.8 meq/100 g.
Experimental design: A small-plot randomized complete block experimental design experiment was established for winter wheat, each plot being 30 x 6 feet (180 ft^2). Four treatments with four replications were used (16 plots), to determine the effects of Vitazyme, Bio Seed, and Caramba fungicide on wheat yield.

Treatment	Caramba	Vitazyme	Bio Seed
1.	14 oz/acre	—	—
2.	14 oz/acre	13 oz/acre	100g/acre
3.	—	13 oz/acre	100g/acre
4.	—	—	—

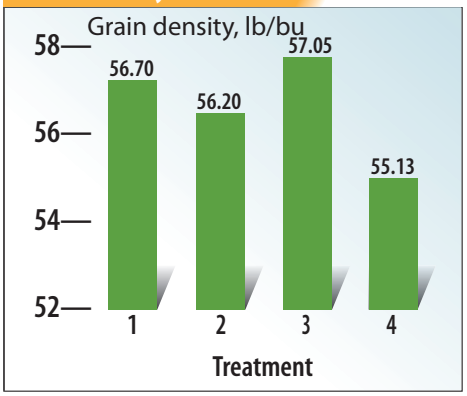
Fertilization: unknown
Caramba application: 14 oz/acre to Treatments 1 and 2 on April 6, 2020. Caramba is a Fusarium head blight suppressor containing metconazole, made by BASF.
Vitazyme application: 13 oz/acre to Treatments 2 and 3 on April 6, 2020
Bio Seed application: 100 g/acre to Treatments 2 and 3 on April 6, 2020. Bio Seed is a mixture of bacteria and fungi that are beneficial to seed germination and plant development.
Harvest date: July 7, 2020, using an Almaco Plot Combine, on a 5 x 30-foot strip for each plot

Test weight results: The density of the grain for each treatment was determined with the plot combine.

Treatment	Grain density[1]	Density change
	lb/bu	lb/bu
1. Caramba	56.70 ab	1.57 (+2.8%)
2. Caramba + Vita + Bio Seed	56.20 b	1.07 (+1.9%)
3. Vitazyme + Bio Seed	57.05 a	1.92 (+3.5%)
4. Control	55.13 c	—

[1]Means followed by the same letter are not significantly different at P = 0.05

Grain Density



Increase in grain density

Caramba 2.8%
Caramba + Vitazyme + Bio Seed 1.9%
Vitazyme + Bio Seed 3.5%

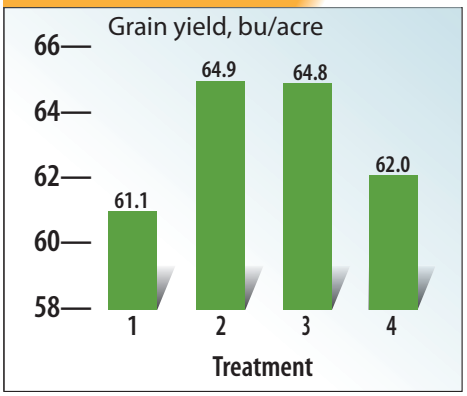
Grain moisture results: There were no significant differences in grain moisture among the four treatments.

Yield results:

Treatment	Grain yield[1]	Yield change
	bu/acre	bu/acre
1. Caramba	61.1 b	(-) 0.9 (-1.5%)
2. Caramba + Vita + Bio Seed	64.9 a	2.9 (+4.7%)
3. Vitazyme + Bio Seed	64.8 a	2.8 (+4.5%)
4. Control	62.0 b	—

[1]Means followed by the same letter are not significantly different at P = 0.05

Grain Yield



Increase in grain yield

Caramba + Vitazyme + Bio Seed 4.7%
Vitazyme + Bio Seed 4.5%

Conclusions: In this small-plot winter wheat study at Memphis, Tennessee, with generally good growing conditions throughout the season, Vitazyme and Bio Seed teamed up to produce consistent and significant yield increases, approaching 3 bu/acre. Caramba fungicide, however, by itself reduced the yield slightly, and did not produce a synergism when combined with Vitazyme and Bio Seed; Caramba added to this combination significantly reduced the test weight. These results show a good benefit for winter wheat production by using Vitazyme and Bio Seed in combination when applied in the spring.

Wheat (Winter) *with Vitazyme application*

Researcher: V. V. Plotnikov
Research organizations: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: PE "AF Dzvony", Peremyshl District, Lviv Region, Bolotnya Village, Ukraine; western Ukraine (550-750 mm of rain per year)
Variety: Arctis, F3
Planting date: October 15, 2019
Planting rate: 6 million seeds/ha
Previous crop: soybeans
Tillage: disking to 6-8 cm, deep cultivation to 28 cm, pre-sowing cultivation to 3-4 cm
Soil type: dark-gray podzolic (2.2% organic matter)
Experimental design: A winter wheat field was selected to apply a springtime Vitazyme spray to a portion of the field, while leaving the rest of the field as an untreated control area, to determine the effect of this product on grain yield and quality.

The rooting of winter wheat in Ukraine is shown here to be excellent and vigorous despite drought conditions. Under stress such as drought, the product enables the crop to be more productive.

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

Fertilization: 10-26-26 kg/ha of N-P_2O_5-K_2O at planting; 220-7-9 kg/ha of N-Mg-S in the spring
Vitazyme application: 0.7 liter/ha sprayed in the leaves at stem elongation, on May 21, 2020

Yield results:

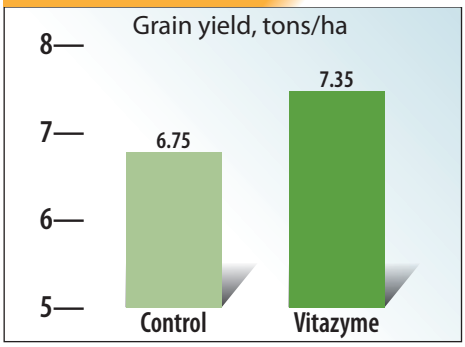
Treatment	Yield	Yield change
	tons/ha	tons/ha
Control	6.75	—
Vitazyme	7.35	0.60 (+9%)

Income results: The single 0.7 liter/ha application resulted in a net income increase of $161/ha.

Gluten and protein results:

Treatment	Gluten	Gluten change	Protein	Protein change
	%	%	%	%
1. Control	21.4	—	11.6	—
2. Vitazyme	23.5	2.1 (+10%)	12.8	1.2 (+10%)

Winter Wheat Yield

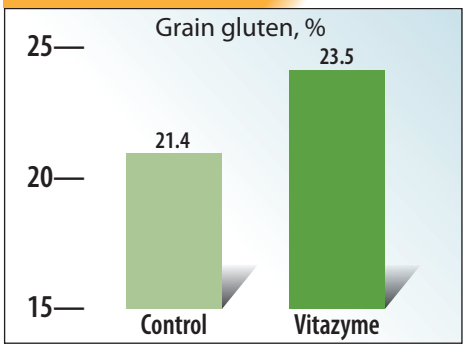


Increase in grain yield with Vitazyme: 9%

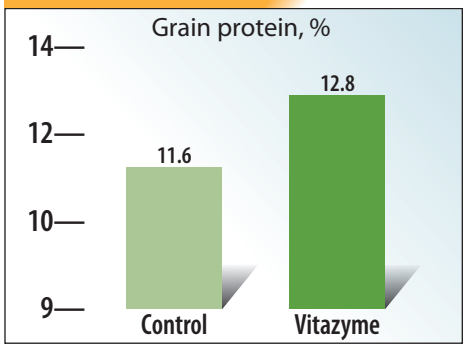
Increase in grain gluten with Vitazyme: 10%

Increase in grain crude protein with Vitazyme: 10%

Grain Gluten



Grain Protein



Conclusion: This field-scale winter wheat trial in western Ukraine compared an untreated control with Vitazyme applied foliar in the spring, at 0.7 liter/ha. This single application resulted in a 9% yield increase, and excellent grain gluten and crude protein increases of 10% each, which resulted in a net income increase of $161/ha. Such positive results show the efficacy of this program to improve the yield, quality, and profitability for wheat growers in western Ukraine.

Wheat (Winter) *with Vitazyme application—Use of the Vitazyme Cold Start Variant*

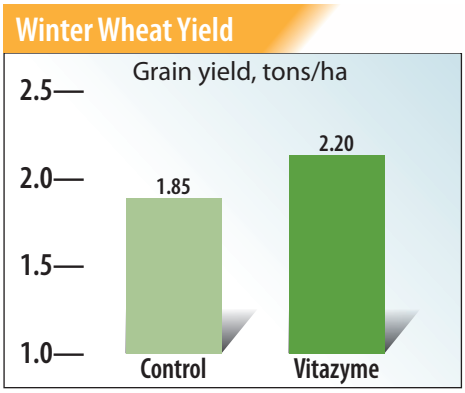
Researcher: V. V. Plotnikov
Research organization: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: LLC "VKAF Maiaky, Biliaiivka District, Odessa Region, Maiaky Village, Ukraine; southern Ukraine (270-350 mm of rain per year)
Variety: SN Kombin
Planting date: September 30, 2019
Planting rate: 3.5 million seeds/ha
Previous crop: chick peas
Tillage: disking to 6-8 cm, plowing to 20-22 cm
Soil type: typical Chernozem (4.1% organic matter)
Experimental design: A winter wheat field was divided into an untreated, and a Vitazyme (on the seeds) and Vitazyme Cold Start treated area to evaluate the effectiveness of this plant growth stimulator to improve the yield of grain.

1 *Control* **2 *Vitazyme on the seeds & Cold Start in the spring***

Fertilization: 21 kg/ha of N and 24 kg/ha of S during pre-plant cultivation in 2019; 10-20-10 kg/ha N-P_2O_5-K_2O at planting; 80 kg/ha of N in the spring (liquid urea +NH3 with Vitazyme Cold Start).
Vitazyme application: 0.5 liter/ton of seed of Vitazyme at planting; 0.3 liter/ha of Vitazyme Cold Start sprayed at early tillering, along with nitrogen, on March 4, 2020
Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	1.85	—
2. Vitazyme on seeds + Vitazyme Cold Start	2.20	0.35 (+19%)

Increase in grain yield with Vitazyme + Vitazyme Cold Start: 19 %

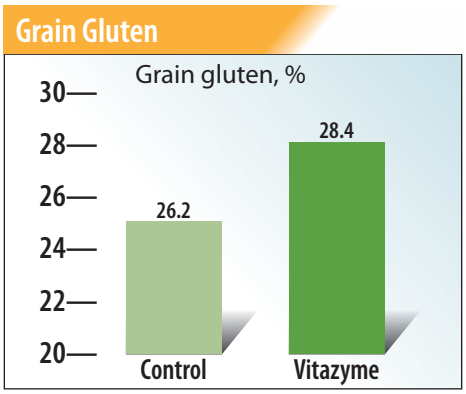


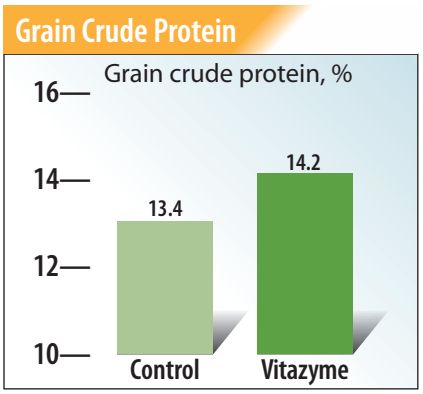
This winter wheat crop shows excellent rooting and overall plant development under very dry southern Ukraine conditions, with Vitazyme applied to the seeds before planting.

Grain gluten and protein results:

Treatment	Gluten	Gluten change	Protein	Protein change
	%	%	%	%
1. Control	26.2	—	13.4	—
2. Vitazyme on seeds + Vitazyme Cold Start	28.4	2.2 (+8%)	14.2	0.8 (+6%)

Increase in grain gluten with Vitazyme: 8%
Increase in grain protein with Vitazyme: 6%





Income results: The extra 1.02 tons/ha of yield, plus improvements in grain quality, boosted net income in this trial by $94/ha.
Conclusions: A winter wheat trial in southern Ukraine during a very dry summer revealed that a Vitazyme seed treatment at 0.5 liter/ton of seed, coupled with a spring foliar spray at 0.3 liter/ha, caused a very respectable yield increase of 0.35 ton/ha, while at the same time increasing the grain gluten and grain crude protein by 8% and 6%, respectively. These results show how this simple biostimulant program will boost wheat yield and quality in spite of very dry growing season conditions.

Wheat (Winter) *with Vitazyme application*

Researcher: V. V. Plotnikov
Research organization: Plant Designs International, Rochester, New York, and Agro Expert International, Kaharlyk, Ukraine
Location: LLC "Agricor Holding", Novgorod-Siversky District, Chernihiv Region, Popivka Village, Ukraine; northern Ukraine (550-670 mm of rain per year)
Variety: Kubus, F2 ***Planting date:*** September 5, 2019 ***Planting rate:*** 4.5 million seeds/ha ***Previous crop:*** winter barley
Tillage: disking to 6-8 cm, plowing to 20-22 cm, cultivation to 4-5 cm ***Soil type:*** gray podzolic (2.0% organic matter)
Experimental design: A winter wheat field was divided into an untreated and a Vitazyme treated area to evaluate the effectiveness of this plant growth stimulator to improve the yield of grain.

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

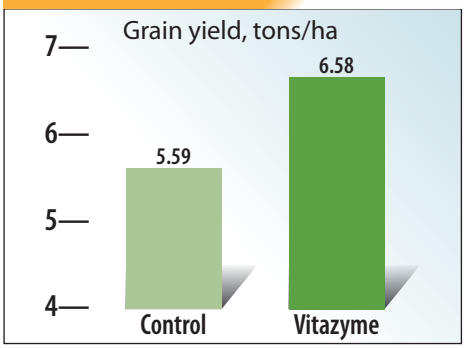
Fertilization: 30-0-40 kg/ha N-P_2O_5-K_2O preplant; 85 kg/ha of N in the spring
Vitazyme application: 1.0 liter/ha sprayed on the leaves on May 3, 2020

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	5.59	—
2. Vitazyme	6.58	0.99 (+18%)

Increase in grain yield with Vitazyme: 18 %

Grain Yield

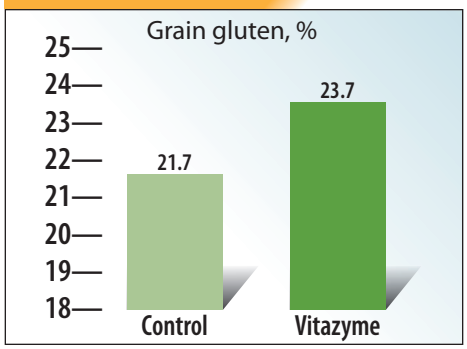


Grain gluten and protein results:

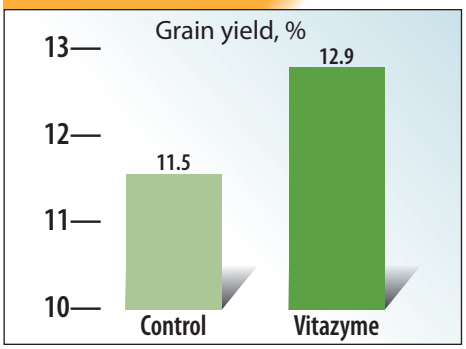
Treatment	Gluten	Gluten change	Protein	Protein change
	%	%	%	%
1. Control	21.7	—	11.5	—
2. Vitazyme	23.7	2.0 (+9%)	12.9	1.4 (+12%)

Increase in grain gluten with Vitazyme: 9%
Increase in grain protein with Vitazyme: 12%

Grain Gluten



Grain Protein



Income results: The 18% improvement in yield, along with increases in grain quality, led to a substantial net income increase of $269/ha.
Conclusions: This field-scale Ukraine trial with winter wheat, comparing a single Vitazyme application with the untreated control, revealed that yield increased by 18%, while both gluten and protein were elevated, by 9 and 12% respectively. Income was likewise increased, by $269/ha. Such a simple and effective, low-cost program for winter wheat makes this product an attractive supplement for farmers in Ukraine.

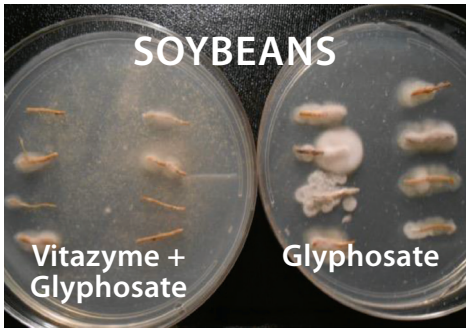
A Brassinosteroid-Based Biostimulant Improves Plant Growth, Soil Health, and Tolerance to Glyphosate Stress

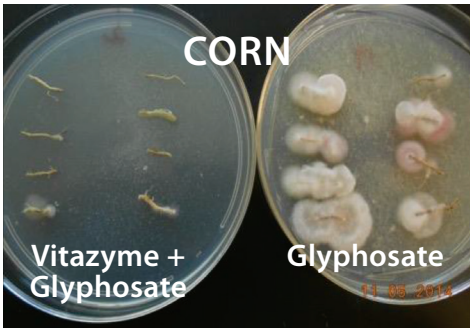
A summary of a paper presented at the Fourth International Biostimulant Conference, Barcelona, Spain, November 18-21, 2019 by Manjula V. Nathan, Robert J. Kremer, Paul W. Syltie, Timothy M. Reinbott, Kelly A. Nelson, and Xiaowei Pan, Division of Plant Sciences, University of Missouri, Columbia, Missouri USA

A multi-year study with Vitazyme biostimulant on corn and soybeans in Missouri proved that the negative effects of glyphosate in soil-plant systems can be remediated. The study examined root growth, Fusarium infection, and the proliferation of beneficial microorganisms in response to **(1)** no products, **(2)** Vitazyme alone, **(3)** glyphosate alone, and **(4)** Vitazyme and glyphosate applied together.

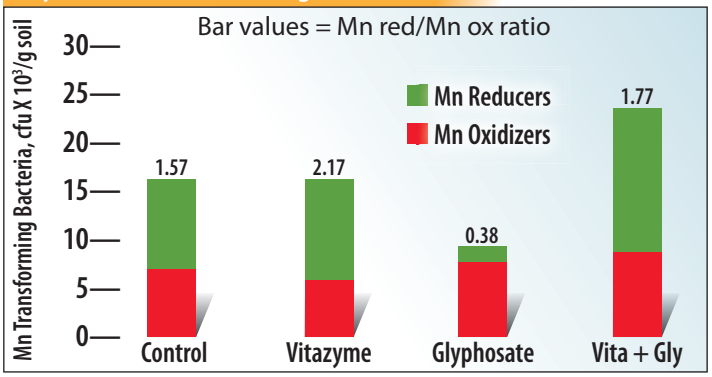
Findings include:

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

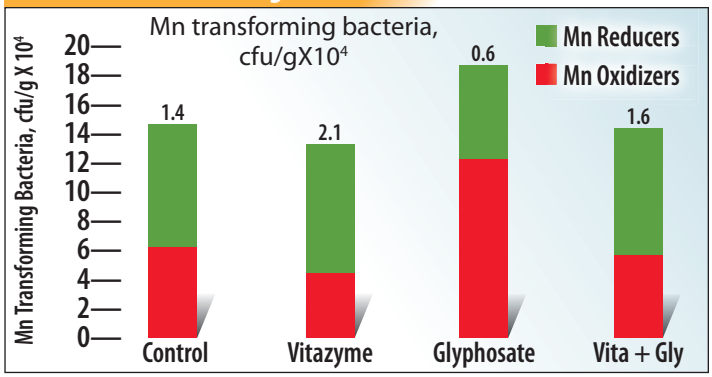




Soybean Mn Transforming Bacteria



Maize Mn Transforming Bacteria



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 *(photo3)*, and expanded the root mass considerably above the non - Vitazyme treated control *(photo 2)*. 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 0.066 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