Alfalfa *with Vitazyme application*

Researcher: Michael Rethwisch
Research organization: Palo Verde Valley Vegetables, University of California Cooperative Extension, University of California Agriculture and Natural Resources, Riverside, California
Location: Palo Verde, California
Planting date: mid-January 2023
Variety: unknown; newly planted
Soil type: unknown
Experimental design: A newly-planted alfalfa field received a Vitazyme application on part of the acreage, with the rest of the field left untreated. The purpose of the trial was to evaluate the effect of the biostimulant on alfalfa quality.

1 *Control* 2 *Vitazyme*

Fertilization: unknown
Vitazyme application: 20 oz/acre (1.5 liters/ha) on January 14, 2023, shortly after planting
Alfalfa quality results: The sampling was performed in replicated fashion on March 30, and analyzed at a quality testing laboratory.

Treatment	90% dry matter basis						10% dry matter basis	
	Crude protein	ADF[1]	NDF[2]	Fat	Lignin	Energy	TDN[3]	RFV[4]
	%	%	%	%	%	Mcal/Lb		
Control	17.29	29.90	36.31	1.37	6.89	0.583	57.4	145.5
Vitazyme	18.99	27.99	33.70	1.47	6.40	0.605	59.0	161.4
P–value	0.057	0.1448	0.0975	0.0826	0.1144	0.1386	0.1436	0.1249

[1]ADF = Acid Detergent Fiber; [2]NDF = Neutral Detergent Fiber; [3]TDN = Total Digestible nutrients; [4]RFV = Relative Feed Value.
All of these values for Vitazyme are significant at F = 0.15 or less, with crude protein nearly significant at P = 0.05, and NDF and Fat significant at P = 0.10.

Improvement in alfalfa feeding quality with Vitazyme

Crude protein ..... 1.79 percentage-points
*ADF..... 1.91 percentage-points**
*NDF ..... 2.61 percentage-points**
FAT ..... 0.10 percentage-point
*Lignin ..... 0.49 percentage-point**
Energy ..... 0.022 Mcal/Lb
TDN 1.6
RFV..... 15.9

*These are negative values for Vitazyme, which is favorable for feeding because they show feed components that are not digestible.

Conclusions: This alfalfa study in Southern California, using 20 oz/acre (1.5 liters/ha), applied shortly after planting, showed that Vitazyme improved all of the eight feeding parameters examined, especially crude protein, which increased by 1.79 percentage points. All changes with Vitazyme were significant at P = 0.15 or less. Feeding energy was increased as were the digestible nutrients and feed value, at the same time that undigestible contents, such as lignin and cellulose, were reduced. These results show that Vitazyme will improve the feeding value of alfalfa in several ways.

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2010 Crop Results

Vitazyme on Vetch, Spring

Researcher: V. V. Plotnikov *Research organization*: National Academy of Agrarian Sciences
Location: Vinnytsia State Agricultural Research Station, Vinnytsia, Ukraine (Central Forest and Steppe Region)
Variety: Liliana *Soil type*: gray podzolic (organic matter = 2.2%, hydrolyzed N = 8.4 mg/100 g soil, P = 15.8 mg/100 g soil, exchangeable K = 12.4 mg/100 g soil, pH = 5.5)
Previous crop: spring barley *Planting date*: April 17, 2010 *Planting rate*: 1.8 million seeds/ha
Soil preparation: disking to 6 to 8 cm, tillage to 22 cm, cultivation to 4 to 5 cm
Experimental design: A spring vetch plot area was divided into four replicates with a control and two Vitazyme treatments, with the objective of determining the effects of the product on vetch yield.

1. Control **2. Vitazyme on seeds** **3. Vitazyme on seeds and leaves**

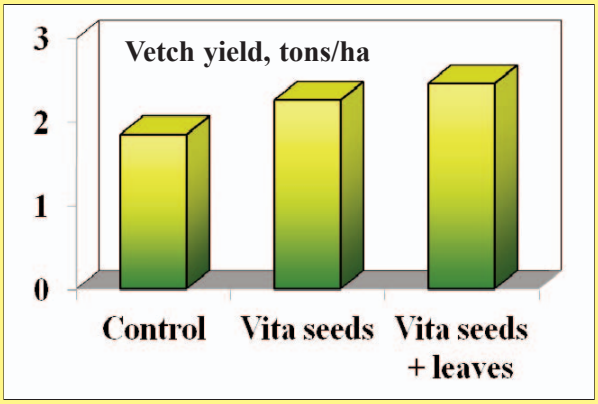
Fertilization: 15-15-15 kg/ha of N-P_2O_5-K_2O, incorporated before planting

Vitazyme application: Treatments 2 and 3, 1 liter/ha on the seeds at planting on April 17; Treatment 3, 1 liter/ha on the leaves and soil at early bloom on June 9

Yield results:

Treatment	Yield	Yield change
	tons/ha	tons/ha
1. Control	1.85	---
2. Vitazyme, seeds	2.26	0.41 (+22%)
3. Vitazyme, seeds + leaves	2.46	0.61 (+33%)

Yield increase with Vitazyme: 22 to 33%



Income results: The single seed treatment produced 1,005 hrn/ha more increase, whereas the seed plus foliar treatment increased yield by 1,305 hrn/ha.

Conclusion: Vitazyme in this replicated Ukranian spring vetch trial produced excellent yield increases using both a seed treatment (22%), and a seed plus foliar treatment (33%). Income increases were commensurate with yield increases: 1,005 and 1,305 hrn/ha, respectively. These results illustrate how effective this biostimulant is to improve the yields and income for vetch in Ukraine.

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2009 Crop Results

Vitazyme on Vetch

Researcher: O.V. Kornijchuk, V.V. Plotnikov, and agronomic scientists
Organization: Vinnytsia State Agricultural Experiment Station, Ukraine Academy of Agrarian Sciences, Vinnytsia, Ukraine *Location*: Ukraine central forest-steppe area near Vinnytsia
Variety: Pribuz'ka super elite *Planting rate*: 1.8 million seeds/ha *Previous crop*: barley
Soil type: gray forest steppe soil; in the 0-30 cm layer, 2.2% organic matter, 8.4 mg/100 g of soil "hydrolyzed nitrogen", 15.8 mg/100g of soil phosphorus, 12.4 mg/100 g of soil exchangeable potassium, and pH=5.5.
Planting date: April 14, 2009 *Tillage*: plowing, harrowing, and cultivation
Experimental design: A uniform field was divided into Vitayme treated and untreated plots of 1.0 ha, replicated four times, to discover the effect of the product on the vetch cover crop. Both Vitazyme treatments had a seed treatment, while one of them received an additional foliar/soil application.

1. Control **2. Vitazyme on the seeds** **3. Vitazyme on the seeds and leaves**

Fertilization: 10 kg/ha N, 10 kg/ha P_2O_5, and 30 kg/ha K_2O.

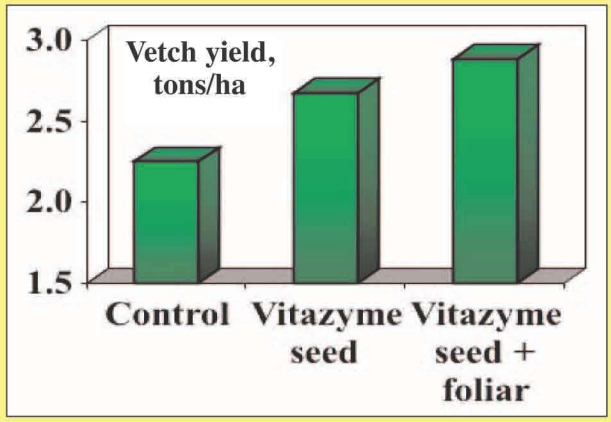
Vitazyme application: Both Treatments 2 and 3 received a 1.0 liter/ton of seed Vitazyme application at planting (April 4, 2009), while Treatment 3 received an additional 1.0 liter/ha sprayed on the leaves and soil on June 6, 2009, at branching.

Yield results:

Treatment	Vetch yield	Yield change
	tons/ha	tons/ha
1. Control	2.25	—
2. Vitazyme, seeds	2.67	0.42 (+19%)
3. Vitazyme, seeds + leaves	2.88	0.63 (+28%)

Increase in vetch yield with Vitazyme

Seed treatment 19%
Seed + foliar treatment 28%



Income results:

- **Income increase with Vitazyme, on seeds: 820 hrn/ha**
- **Income increase with Vitazyme, on seeds + leaves: 1,040 hrn/ha**

Conclusions: This Ukraine study on vetch revealed that the harvested yield was improved considerably with Vitazyme applied to the seeds (+19%), but especially when an additional 1.0 liter/ha was applied to the leaves and soil (+28%). Income also increased substantially with both Vitazyme treatments. Vitazyme is shown to be an excellent material to add to the usual cultural program for more effective use of soil and fertilizer nutrients, to improve yield and profitability.

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2009 Crop Results

Vitazyme on Alfalfa, haylage

Researcher: James Calahan *Location*: Maryland Farms, Reaboro, Ontario, Canada
Variety: Pick Seed *Soil type*: clay loam *Cutting date*: July 15, 2009

Experimental design: A 50-acre silage field in 2008 was divided into two replicates of treated and untreated sections, and silage was made from both sections to determine the feeding value of the forage on the second cutting crop.

1. Control **2. Vitazyme**

Fertilization: 140 lb/acre of 50% potassium magnesium sulfate (18-11-18% N-P_2O_5-S) and 50% KCl (0-0-60% N-P_2O_5-K_2O) the fall of 2008; 100 lb/acre of $(NH_4)_2SO_4$ + boron (8 lb of 15% B) in the spring of 2009
Vitazyme application: Vitazyme (13 oz/acre) + 1 gal/acre of 8-0-0-10% N-P_2O_5-K_2O-Ca after the first cutting
Silage feeding value: Samples from the untreated hay field, as well as the treated field, were sent to Agri-Food Laboratories, Guelph, Ontario, on July 17, 2009. The results below are reported on a dry basis.

Parameter	Unit	Control	Vitazyme	Change
Dry matter, as received	%	69.08	72.33	3.25 (+5%)
Protein (CP), N x 6.25	%	19.05	20.93	1.88 (+10%)
UIP Bypass Est.	% of CP	27.11	30.08	2.97 (+11%)
Fiber				
Acid detergent fiber	%	29.49	27.04	(-) 2.45 (-8%)
Neutral detergent fiber	%	40.38	35.54	(-) 4.84 (-12%)
Lignin	%	4.25	4.44	0.19 (+4%)
Minerals				
Calcium	%	1.48	1.57	0.09 (+6%)
Phosphorus	%	0.27	0.30	0.03 (+11%)
Potassium	%	1.69	1.75	0.06 (+4%)
Magnesium	%	0.17	0.17	0
Sodium	%	0.10	0.03	(-) 0.07 (-70%)
Zinc	ppm	23.80	26.10	2.30 (+10%)
Manganese	ppm	22.62	20.11	(-) 2.51 (-11%)
Copper	ppm	6.90	7.18	0.28 (+4%)
Energy				
TDN (est.)	%	65.34	65.34	0
Non-fiber carbohydrates		30.17	33.13	2.96 (+10%)
Relative feed value		156.27	172.56	16.29 (+10%)
Starch	%	2.85	2.47	(-) 0.38 (-13%)
WTDN		66.48	68.51	2.03 (+3%)
WNEL		1.51	1.58	0.07 (+5%)
WNEG		0.76	0.82	0.06 (+8%)
WNEM		1.48	1.54	0.06 (+4%)
Starch as % of NFC		9.45	7.46	(-) 1.99 (-21%)

Conclusions: In this Canadian haylage trial, comparing Vitazyme to an untreated control, the treated haylage showed a uniformly superior quality across most parameters. The changes were nearly all positive, and the reductions uncovered were generally for parameters that were favorable with a reduction. These changes are summarized below.

Dry matter	**+ 5%**	**Manganese**	**-11%**
Crude protein	**+10%**	**Copper**	**+4%**
UIP bypass	**+11%**	**Non-fiber carbohydrates**	**+10%**
Acid detergent fiber	**-8%**	**Relative feed value**	**+10%**
Neutral detergent fiber	**-12%**	**Starch**	**-13%**
Lignin	**+4%**	**WTDN**	**+3%**
Calcium	**+6%**	**WNEL**	**+5%**
Phosphorus	**+11%**	**WNEG**	**+8%**
Potassium	**+4%**	**WNEM**	**+4%**
Sodium	**-70%**	**Starch, % of NFC**	**-21%**
Zinc	**+10%**		

Of particular interest in this study is a large 10% increase in relative feed value with Vitazyme, and a 10% increase in protein, with a commensurate 13% drop in starch content. Fiber also dropped, allowing for more nutritional components such as protein and minerals. All essential minerals except manganese increased in content of the haylage.

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2006 Crop Results

Vitazyme on *Pennisetum purpureum*, cv. Cuba CT-115

Researchers: R.S. Herrera, M. Garcia, Ana M. Cruz, and A. Romero.
Research organization: Animal Science Institute (ICA), Havana, Cuba
Location: near Havana, Cuba
Variety: Pennisetum purpureum, cv. Cuba CT-115
Planting date: unknown
Soil type: red ferralitic (Eutrustox)
Planting rate: unknown
Experimental design: Various Vitazyme regimes were used to evaluate effects of this forage legume on crop yield and growth at different times; these regimes will be outlined with each section below. No irrigation or fertilization were used except for fertilizer in the last trial mentioned. The tests were conducted during Cuba's dry season, except for one established pasture test that was carried out all year, and the fertilizer trial that was completed during the rainy season. The plot setups were of a completely randomized design with four replications.

Crop Establishment Application

Treatment	Dry matter[a]	Change	Leaves[a]	Change	Dead matter[a]	Change
	tons/ha	tons/ha	%	%	%	%
Control	2.69 b	—	22.12 b	—	15.74 a	—
1.5 liters/ha at planting	3.10 a	0.41 (+15%)	28.32 a	6.20	6.93 b	(-) 8.81

[a]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.

Increase in yield with Vitazyme: 15%

The yield was measured at 135 days after planting (full establishment), with a sizable yield increase (15%) from only one Vitazyme application at planting. Also, there were more leaves in the total yield (6.2% more percentage points), and less dead tissue (8.81% less percentage points).

Different Applications At Planting and Shortly After

Treatment	Dry matter[a]	Change	Height[a]	Change	Leaves[a]	Change
	g/m^2	g/m^2	cm	cm	%	%
1. Control	245.0 ab	—	73.6	—	23.2 a	—
2. 1.5 l/ha in-furrow	303.2 a	58.2 (+24%)	86.2	12.6 (+17%)	26.9 a	3.7
3. 1.5 l/ha after planting	193.2 bc	(-) 51.8 (-21%)	55.2	(-) 18.4 (-25%)	31.6 a	8.4
4. 1.5 l/ha at 7 days	189.2 bc	(-) 55.8 (-23%)	80.0	6.4 (+9%)	28.6 a	5.4
5. 1.5 l/ha at 14 days	134.4 c	(-) 110.6 (-45%)	75.0	1.4 (+2%)	22.1 a	(-) 1.1
6. 1.5 l/ha at 21 days	183.9 bc	(-)61.1 (-25%)	74.6	1.0 (+1%)	24.5 a	1.3

[a]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.
***P=0.001

Increase in yield with Vitazyme (in-furrow): 24%

Only Vitazyme applied at 1.5 liter/ha in-furrow at planting caused a yield increase in this study, but the increase was 24%. Height effects on the plants of the various treatments were variable, and there was no significant effect on leaves as a percentage of the biomass.

Dosage Levels At Planting

Treatment	Dry matter[a]	Change	Height[a]	Change
	g/m^2	g/m^2	cm	cm
1. Control	259.8 a	—	126.7 a	—
2. 0.75 liter/ha	338.8 a	79.0 (+30%)	136.6 a	9.9 (+8%)
3. 1.5 liters/ha	284.6 a	24.8 (+10%)	133.3 a	6.6 (+5%)
4. 2.25 liters/ha	143.9 a	(-) 115.9 (-45%)	98.8 b	(-) 27.9 (-22%)
Standard error	46.4[ns]		7.5*	

[a]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.
***P=0.05.

Increase in yield with 0.75 liter/ha Vitazyme: 30%

Though not significant, the 0.75 and 1.5 liters/ha rates at planting increased grain yield by 30% and 10%, respectively. The high rate of 2.25 liters/ha decreased yield and growth below the control.

Established Pasture Treatments

Treatment	Yield[a], per cutting dry matter						
	1	2	3	4	5	Total	Change
	----------	----------	----------	tons/ha	----------	----------	----------
1. Control	2.96 b	3.40	2.05 b	2.53 b	1.05 b	11.99	—
2. Vitazyme[b]	3.29 a	3.70	2.60 a	3.00 a	2.42 a	15.01	3.02 (+25%)
Standard error	0.03*	0.23[ns]	0.12*	0.10**	0.07***		

[a]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.
[b]1.5 liters/ha sprayed over the soil after each cutting, every 90 days during the dry season and every 60 days during the rainy season.
***P=0.05; **P=0.05; ***P=0.001.

Increase in yield with Vitazyme: 25%

Vitazyme at every cutting increased grass yield, in all cases but one significantly. The total of all cuttings was 25% greater with Vitazyme than for the untreated control.

Application Timing After Cutting

Treatment	Dry matter*	Change	Leaves*	Change
	tons/ha	tons/ha	%	%
1. Control	3.17 b	—	32.96 bc	—
2. Immediate	3.50 ab	0.33 (+10%)	34.91 ab	1.95 (+6%)
3. At 7 days	3.37 b	0.20 (+6%)	36.95 a	3.99 (+12%)
4. At 14 days	3.75 ab	0.58 (+18%)	36.73 a	3.77 (+11%)
5. At 21 days	3.59 ab	0.42 (+13%)	37.27 a	4.31 (+13%)
6. At 28 days	4.25 a	1.08 (+25%)	33.69 bc	0.73 (+2%)
7. At 35 days	3.79 ab	0.62 (+20%)	32.34 c	(-)0.62 (-2%)
Standard error	0.75		2.10	

[a]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.
*P=0.05.

Increase in yield with Vitazyme at 1 to 35 days after cutting: 10 to 25%

Vitazyme applied at any time after cutting caused an increase in yield, up to 25% at 28 days which was a significant increase. Leaf percentages were even more significant, with all but the immediate, 28, and 35 day applications producing a significant leaf increase. This indicates a likely improvement in palatability of the grass with Vitazyme, since a higher percentage of leaves usually indicates greater digestibility.

Effects With Nitrogen Fertilizer

Treatment[a]	Dry matter, per cutting				
	1	2	3	Total	Change
	----------	----------	tons/ha	----------	----------
1. Control	2.05 d	2.50 b	1.05 d	5.60 d	—
2. Vitazyme	2.60 c	3.00 b	2.42 c	8.02 c	2.42 (+43%)
3. N (150 kg/ha)	3.76 b	6.10 a	4.64 a	14.50 a	8.90 (+159%)
4. N (150 kg/ha) + Vita	4.34 a	5.80 a	3.68 b	13.82 a	8.22 (+147%)
5. N (100 kg/ha) + Vita	3.48 b	5.40 a	3.81 b	12.69 b	7.09 (+127%)
6. N (75 kg/ha) + Vita	3.95 ab	5.90 a	3.75 b	13.60 a	8.00 (+143%)
7. N (50 kg/ha) + Vita	3.97 ab	5.20 a	3.26 b	12.43 b	6.83 (+122%)
Standard error	0.14***	0.31***	0.18***	0.21***	

[a]All Vitazyme applications were at 1.5 liters/ha over the soil and leaves when the fertilizer was applied.
[b]Means followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.
***P=0.001.

Increase in yield with Vitazyme alone: 43%

Vitazyme with no fertilizer boosted grass yield greatly — by 43% — but with all levels of fertilizer Vitazyme did not boost the yield above the 150 kg/ha N application. This boost in yield with fertilizer over the untreated control at the same N level is usually observed, but not in this study. It is theorized that excessive N was made available with Vitazyme, suppressing growth and yield.

Conclusions from the authors:

For the establishment period:

- The application of 1.5 L/ha of Vitazyme increased yield and reduced the proportion of dead material.
- The best moment to apply the product was immediately before planting: the product is applied in the furrow bottom immediately after furrow opening, and right away planting and covering is carried out.
- The dosage of Vitazyme did not influence establishment.

For the production period:

- When no fertilizer or irrigation was applied, Vitazyme increased yields.
- The best yield was reached when Vitazyme was applied 28 days after cutting, but did not differ with the application immediately after cutting.
- When 75 kg/ha N/ha + split Vitazyme is applied after each cutting during the rainy season, similar yields are reached as when 150 kg/ha N fertilizer is applied.

Recommendations

1. Apply 1.5 L/ha of Vitazyme at planting.
2. If no fertilizer is available, apply 1.5 L/ha of Vitazyme after each cutting.
3. If nitrogen fertilizer is available, apply 75 kg N/ha and split 1.5 L/ha Vitazyme, after each cutting, during the rainy season.
4. Studies on split application of Vitazyme dosages are recommended.
5. Economic analyses should be implemented.

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2005 Crop Results

Vitazyme on *Pennisetum Purpureum*

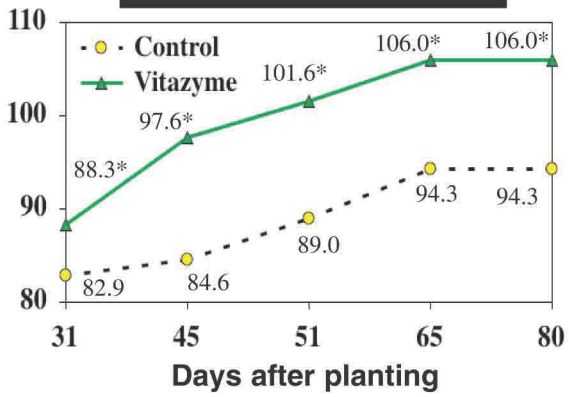
Researcher: Rafael Garcia, Ph.D.
Variety: *Pennisetum purpureum* cv. Cuba CT-115
Planting date: September, 2004
Location: Cuba
Growth stage: new planting
Tillage: unknown

Experimental design: A uniform test area was marked off in 27m^2 plots, upon which two treatments were established in a completely randomized design (four replicates). Evaluations were made of plant growth characteristics as well as leaf pigment content.

1. Control **4. Vitazyme**

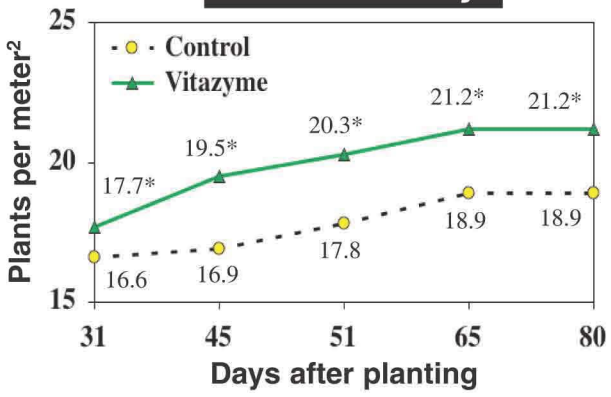
Fertilization: none
Vitazyme applications: 13 oz/acre (1 liter/ha) at planting
Germination and growth results:

Germinated Seeds



*Significantly greater at P=0.001.

Plant Density



*Significantly greater at P=0.001.

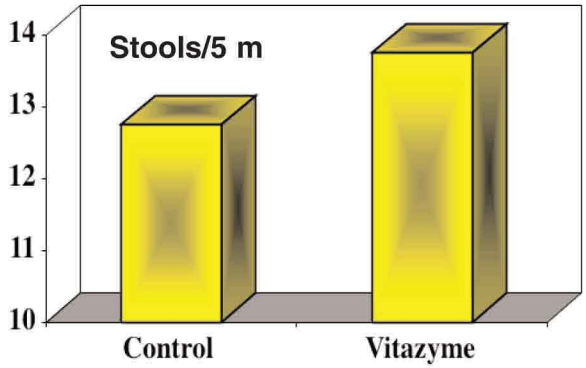
Stool and Stalk Density

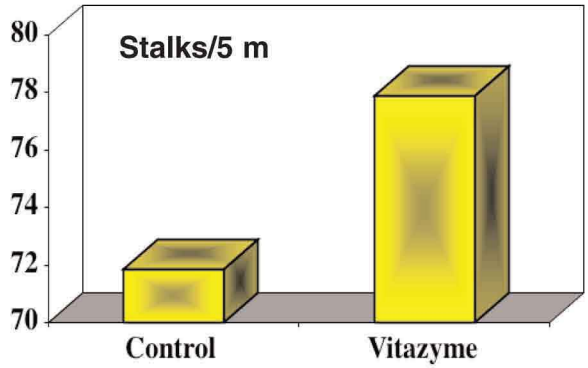
Treatment	Stools	Change	Stalks*	Change
	stools/5 m	stools/5 m	stalks/5 m	stalks/5 m
Control	12.75	—	71.87 b	—
Vitazyme	13.75	1.00 (+8%)	77.88 a	6.01 (+8%)

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

Increase in stools with Vitazyme: +8%

Increase in stalks with Vitazyme: +8%

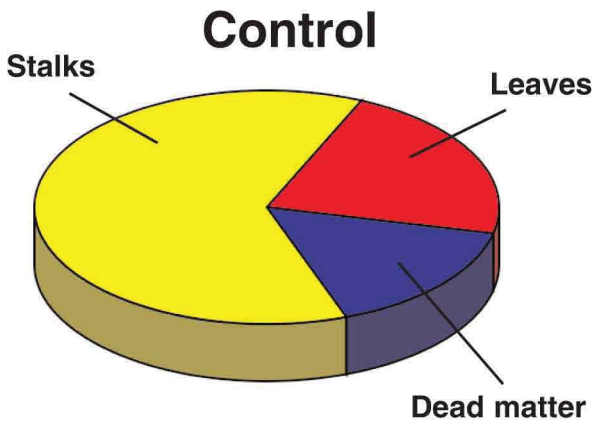


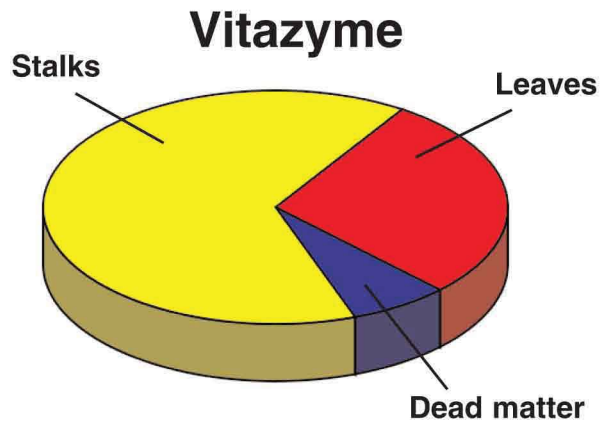


Leaves, Stalks, and Dead Tissue Composition of Total Tissue

Treatment	Leaves*	Change	Stalks	Change	Dead matter*	Change
	percent of total tissue					
Control	22.12 b	—	62.14	—	15.74 a	—
Vitazyme	28.32 a	+6.20	64.75	+2.61	6.93 b	-8.81

*Means followed by the same letter are not significantly different at P=0.01 (for leaves), and P=0.001 (for dead matter).





Dry Matter Content of Leaves, Stalks, and Whole Plants

Treatment	Leaves	Change	Stalks	Change	Whole plant	Change
	% of dry matter					
Control	31.45	—	28.00	—	28.19	—
Vitazyme	32.94	+1.49	28.95	+0.95	29.35	+1.16

Yield results:

Treatment	Fresh matter*	Change	Dry matter*	Change	Leaves**	Change	Dead tissue**	Change
	tons/ha							
Control	9.53 b	—	2.69 b	—	0.59 b	—	0.42 a	—
Vitazyme	10.41 a	0.88 (+16%)	3.10 a	0.41 (+15%)	0.86 a	0.27 (+46%)	0.21 b	0.21 (-100%)

*Means followed by the same letter are not significantly different at P=0.05.
**Means followed by the same letter are not significantly different at P=0.01.

Changes with Vitazyme

Increase in fresh matter yield: +16%
Increase in dry matter yield: +15%
Increase in leaf yield: +46%
Decrease in dead tissue yield: -100%

Leaf pigment effects:

Leaf Photosynthetic Pigment Content

Treatment	Chlorophyll a	Change	Chlorophyll b	Change	Carotenoids*	Change
	---------- mg/dm^2 ----------					
Control	1.73	—	0.71	—	0.44 b	—
Vitazyme	1.93	0.20 (+12%)	0.71	0	0.55 a	0.11 (+25%)

*Means followed by the same letter are not significantly different at P=0.01.

Changes with Vitazyme

Increase in chlorophyll a: +12%
Increase in carotenoids: +25%

Conclusions: In this Cuban trial with the forage grass *Pennisetum purpureum* cv. Cuba CT-115, Vitazyme produced several significant improvements in grass growth and quality.

1. Germination was increased throughout the 80-day test period.
2. Plant density was improved at every stage during the 80-day growth period, with 2.3 more plants per square meter with Vitazyme at 80 days.
3. Stool and stalk density at the end of the test period were both increased with Vitazyme, by 8% in each case.
4. The relative composition of leaves, stalks, and dead tissue was much more favorable for the Vtiazyme treated grass, with a greater percentage of leaves and stalks and a reduction of dead tissue.
5. The dry matter content of the entire plant was higher with Vitazyme.
6. Vitazyme produced a 16% higher fresh yield, a 15% higher dry matter yield, a 46% greater leaf yield, and only half the dead tissue as the control.
7. Both the chlorophyll and carotenoid photosynthetic pigments were increased by the Vitazyme versus the control grass.

Vitazyme has been shown in this study to a powerful adjunct to typical management practices for the production of *Pennisetum purpureum* in Cuba.

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2004 Crop Results

Vitazyme on Hay

Farmer/Researcher: Nelson Gerlach *Location*: Far Hills, New Jersey *Soil type*: silty clay
Variety: orchard grass, timothy, red clover *Age*: mature *Cutting date*: about June 15
Experimental design: A 10-acre hay field was divided into two equal parts. Half of the field was left untreated and the other half was sprayed with Vitazyme to evaluate the product's effects on hay yield. All other practices were the same for both halves.

1. Control **2. Vitazyme**

Fertilization: 200 lb/acre 19-19-19% N-$P_2O_5K_2O$ in late April
Vitazyme application: 13 oz/acre sprayed on the treated half on May 1
Yield results: The hay was cut, dried, and baled as standard rectangular bales. Then the bales for the two five-acre parcls were counted. Each bale weighed approximately 50 pounds.

Treatment	Hayyield	Hay yield	Increase	Value of increase•
	bales/5acres	lb/acre	lb/acre	$/acre
Control	290	2,900	—	—
Vitazyme	315	3,150	250 (+ 9%)	$15.00

*Based upon a value of $3.00/50 lb bale.

Increase in hay yield: + 9%

Increase in hay value" + $15.00/acre

Conclusions: In this New Jersey on-farm hay trail with Vitazyme, the product increasd both the yield (+9%) and income (+ $15.00/acre) of the crop as a result of only one application applied around spring greenup time.

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2004 Crop Results

Vitazyme on Alfalfa

Vitazyme and Rhizobium Bacteria Compatibility

Researcher: Paul W. Syltie, Ph.D.
Gladewater, Texas
Soil type: fine sandy clay loam
Planting rate: thinned to 12 plants/pot
Location: Vital Earth Resources Research Greenhouse,
Variety: common
Pot size: 1 gallon
Planting date: December 30, 2002

Experimental design: A greenhouse study was arranged with four treatments and seven replicates, using 1 gallon commercial plastic pots. The study was designed to evaluate if Vitazyme, premixed with rhizobium bacteria inoculant before planting, will inactivate the bacteria. Analyses of parameters were made using analysis of variance with CoHort software.

Treatment	Vitazyme*	Rhizobium**
1	O	O
2	O	X
3	X	O
4	X	X

* Pure, undiluted product

** "Nitragin" inoculant [*Rhizobium meliloti*] for alfalfa; expiration date December 31, 2004

Vitazyme and Rhizobium treatments: Treatment 2, a slurry was made of the rhizobium and alfalfa seeds, and soaked for 1 hour before planting; Treatment 3, alfalfa seeds were soaked for 1 hour in undiluted Vitazyme before planting; Treatment 4, alfalfa seeds were soaked with undiluted Vitazyme and rhizobium for 1 hour before planting.

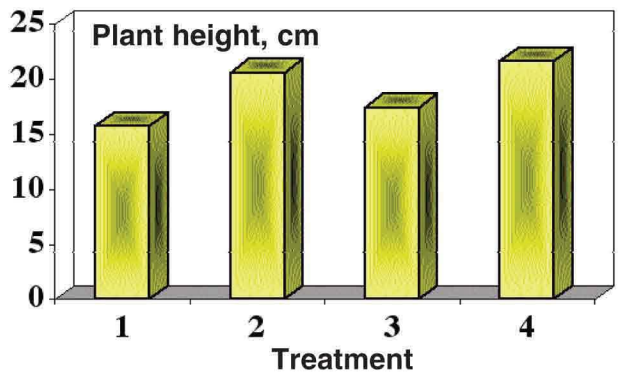
Harvest date: February 24, 2004, 89 days after planting

Harvest results: At harvest all roots were washed free of soil, and the plants were laid out and measured for height, leaf chlorophyll, fresh nodule weight, nodule type, and then dried in a drying oven at 115°F for 20 hours to evaluate dry weight.

Plant Height

Treatment	Plant height*	Change
	cm	cm
4	21.6 a	5.9 (+38%)
2	20.6 a	4.9 (+31%)
3	17.4 b	1.7 (+11%)
1	15.7 b	—

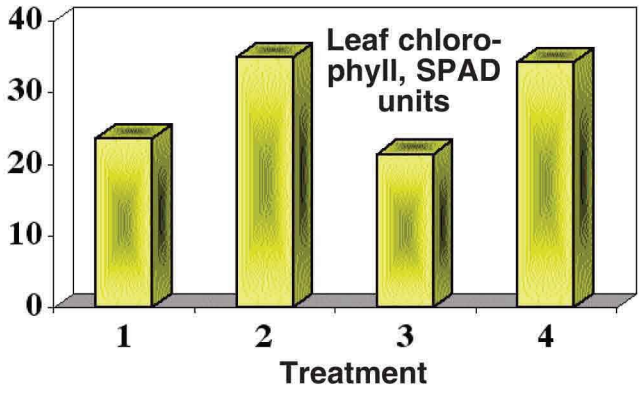
*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test. $LSD_{0.10}$=3.1 cm.



Increase in height (Vitazyme + Rhizobium): 38%

Both Vitazyme + rhizobium (Treatment 4) provided the best growth to giver the tallest plants, followed by rhizobium alone, which was significantly as tall as Treatment 4. Without rhizobium nitrogen fixation to encourage growth, plant growth was significantly less.

Leaf Chlorophyll



Treatment	Chlorophyll*	Change
	SPAD units	
2	34.9 a	11.3 (+48%)
4	34.2 a	10.6 (+45%)
1	23.6 b	—
3	21.4 b	(–)2.2 (–9%)

*An average of seven values per pot, using a Minolta SPAD chlorophyll meter. Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test. $LSD_{0.10}$=3.9 SPAD units.

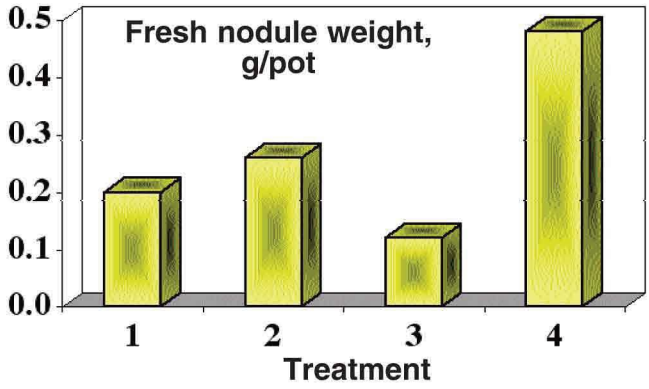
Both treatments receiving rhizobium (2 and 4) had the highest chlorophyll values, since these symbiotic bacteria fixed more nitrogen for chlorophyll synthesis. Lower chlorophyll for Vitazyme alone (Treatment 3) resulted from stimulated plant growth (carbon fixation) without commensurate adequate nitrogen fixation to maintain high-nitrogen chlorophyll levels.

Increase in leaf chlorophyll (Vitazyme + Rhizobium): 45%

Nodule Weight

Treatment	Nodule weight*	Change
	g	g
4	0.48 a	0.28 (+140%)
2	0.26 b	0.06 (+30%)
1	0.20 b	—
3	0.12 b	(–)0.08 (–40%)

*Nodules were carefully removed from the roots for each plant. Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test. $LSD_{0.10}$=0.19 g.



Increase in nodule weight (Vitazyme + Rhizobium): 140%

Total fresh nodule weight was by far the greatest for Treatment 4 (Vitazyme + rhizobium), while Treatment 2 (rhizobium alone) gave the second highest nodule weight. Without added rhizobium bacteria the nodule weights were the least.

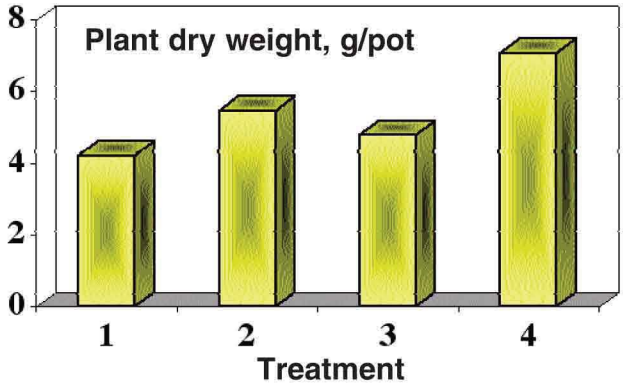
Nodule Type

There were clearly two types of nodules detected during this investigation, one very white colored that was apparently a native, wild type present in the soil. These were seen especially in Treatments 1 and 3 where no rhizobium was applied. Treatments 2 and 4 had quite different rose-colored rhizobium nodules besides the white native species. It was apparent that the rose-colored nodules were derived from the introduced rhizobium bacteria, which fixed abundant nitrogen, since the plants having these nodules in their root zones were uniformly darker green — having more chlorophyll — and contained an abundance of red-colored leghemoglobin, the compound present in rapidly nitrogen-fixing molecules.

The proportions of the two nodule types for the four treatments are given on the next page.

Treatment	Chlorophyll*	Change
	------ % of total nodules ------	
1	100	0
2	28	72
3	100	0
4	33	67

Dry Weight



Treatment	Chlorophyll*	Change
	grams	grams
4	7.08 a	2.86 (+68%)
2	5.47 b	1.25 (+30%)
3	4.79 bc	0.57 (+8%)
1	4.22 c	—

*Means followed by the same letter are not significantly different at P=0.10 according to the Student-Newman-Keuls Test. $LSD_{0.10}$=1.21 g.

Vitazyme plus rhizobium (Treatment 4) caused by far the greatest dry matter increase (+68%), while rhizobium alone gave the second largest increase ... 30% above the control. Vitazyme alone (Treatment 3) was statistically equal to the rhizobium treatment, and was also equal to the control (Treatment 1).

Increase in dry weight (Vitazyme + Rhizobium): 68%

Conclusions: This greenhouse study on alfalfa with Vitazyme and rhizobium bacteria revealed the following points:

1. Vitazyme had a strongly positive synergism with rhizobium bacteria in this alfalfa study, exceeding the control treatment in terms of dry weight (+68%), plant height (+38%), leaf chlorophyll (+45%), and nodule weight (+140%). All of these values, except for leaf chlorophyll, exceeded the other three treatments.
2. Added rhizobium bacteria had a strong positive effect in boosting plant height, leaf chlorophyll, nodule weight, and plant dry weight, especially with Vitazyme.
3. The added *Rhizobium meliloti* inoculant was much more effective at increasing nitrogen fixation for alfalfa plants than was the native rhizobium species.
4. There was no negative interaction between Vitazyme and rhizobium bacteria when they were mixed prior to seeding. Rather, there was a positive interaction between the two products during the course of the experiment.

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2002 Crop Results

Vitazyme on Alfalfa (Regrowth)

Analyzed by the University of Wisconsin Alfalfa/Grass Evaluation System – Milk 2000

Researcher: Ronald Stutzman *Institution*: Stutzman's Research Farm *Location*: Arkport, New York
Variety: Doebler's Phirst *Planting date*: June 10, 2002 *Soil type*: silt loam

Experimental design: A small plot design with five replicates in a randomized complete block design was laid out in an alfalfa field that had been established in the spring. This test utilized regrowth after the first cutting. Forage samples were collected and packed in ice in a cooler, and sent to the laboratory at Marshfield, Wisconsin.

1. Control **2. Vitazyme**

Fertilization: none

Vitazyme application: 13 oz/acre to the leaves and soil at 3 to 4-inch height of regrowth, on August 15

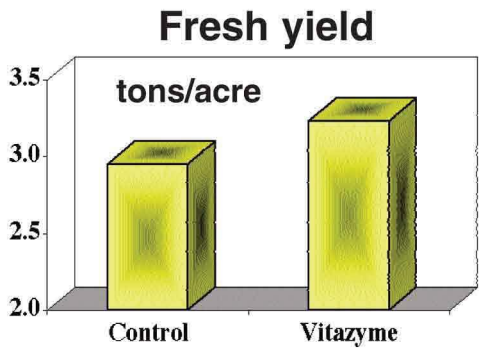
Harvest date: October 1, 2002

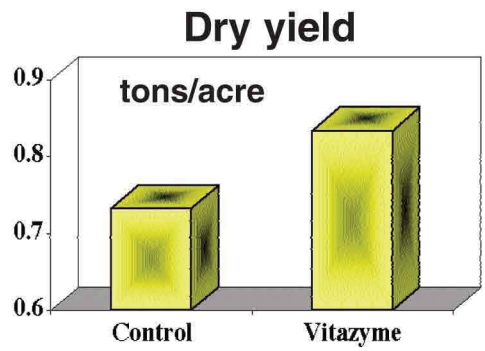
Yield results: The forage was harvested, and sent to Wisconsin for weighing and analysis, and plot values were statistically analyzed for significant differences using COHORT software.

Treatment	Fresh yield[1]	Change	Dry yield[1]	Change
	tons/acre		tons/acre	
Control	2.95 a	—	0.732 a	—
Vitazyme	3.23 a	+0.28 (+9%)	0.834 a	+0.102 (+14%)

[1]Means followed by the same letter are not significantly different at P = 0.10 Tukey Kramer). The dry yield is adjusted to 100% dry matter.

Vitazyme increased the yield of Alfalfa above the control by 9% (fresh weight), or 14% (dry weight). These differences are not significant due to sizable variations in yield among the various plots, thus raising the experimental error.





Increase in fresh yield: 9%

Increase in dry yield: 14%

Forage quality results: Samples of the forage from each plot were sent to the University of Wisconsin Alfalfa/Grass Evaluation Laboratory in Marshfield, Wisconsin. The values determined were then statistically analyzed to determine significant differences of treatment means using COHORT software and the Tukey-Kramer test. Differences in values within each mean were quite large, so no significant differences were detected.

Treatment	Crude protein (CP)	Acid detergent fiber (ADF)	Neutral detergent fiber (NDF)	Digestible NDF	Ash
	% of dry matter	% of dry matter	% of dry matter	% of NDF	% of dry matter
Control	23.2 a	19.6 a	27.08 a	43.1 a	11.3 a
Vitazyme	22.8 a	20.1 a	28.08 a	43.2 a	11.6 a

Treatment	Non-fibrous carbohydrate (NFC)	Total digestible nutrients (TDN)	Net energy of lactation (NEL)	Dry matter intake (DMI)	Forage, % of total DMI
	% of dry matter	% of dry matter	M cal/lb	lb/day	%
Control	39.1 a	66.5 a	0.69 a	43.5 a	0.83 a
Vitazyme	38.2 a	65.5 a	0.67 a	41.5 a	0.79 a

Milk production calculations: Milk 2000 calculations were made based upon the quality and yield parameters shown above.

Treatment	Milk per day from the forage[1]	Milk per ton of forage[1]	Milk per acre[1]	Change
	lb/day	lb/ton	lb/acre	lb/acre
Control	62.2 a	3,103 a	2,513 a	—
Vitazyme	57.7 a	3,031 a	2,245 a	+ 268

[1]Means followed by the same letter are not significant at P = 0.10 according to the Tukey-Kramer test.

Even though the differences were not significant, the Vitazyme treated alfalfa was calculated to produce 268 lb/acre more milk than the untreated control.

Income increase: With milk at $15.00/cwt, the increase in milk value is 2.68 cwt/acre, or $40.20/acre for this second cutting of alfalfa forage.

Increase in milk income: $40.20/acre

Conclusions: Vitazyme increased alfalfa production by 14% in this replicated New York study, while forage quality was not affected significantly in this test. In other tests forage quality has been substantially improved with Vitazyme. This translated to a $40.20/acre increase in milk output as calculated by the University of Wisconsin's Milk 2000 Alfalfa/Grass Evaluation System.

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2002 Crop Results

Vitazyme on Alfalfa (New Seeding)

University of Wisconsin Alfalfa/Grass Evaluations – Milk 2000

Researcher: Ronald Stutzman *Location*: Stutzman's Research Farm, Arkport, New York
Variety: Doebler's EX 468 *Soil type*: silt loam *Planting date*: July 1, 2002

Experimental design: A small plot design with five replicates in a randomized complete block arrangement, with two treatments and five replications.

1. Control **2. Vitazyme**

Samples of the forage were collected at harvest from each plot, packed in ice, and sent to the University of Wisconsin Alfalfa/Grass Evaluation Laboratory in Marshfield, Wisconsin, from which Milk 2000 calculations were made. Data were statistically analyzed using Analysis of Variance and the Tukey-Kramer test.

Fertilization: none

Vitazyme application: 13 oz/acre to the seeds and soil before the seeds were rolled into the soil

Harvest date: October 1, 2002

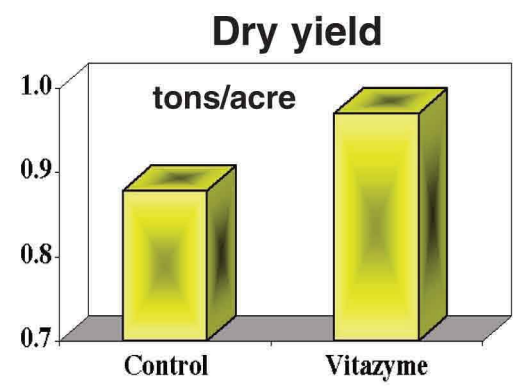
Weather during the growing period: Rain and cold temperatures early in the season required replanting twice before a good stand was established.

	Precipitation	Growing degree days
June	5.3	497
July	2.6	624
August	1.6	511
September	?	484

Yield results: Forage was harvested on October 1, 2002, and sent to the University of Wisconsin Alfalfa/Grass Evaluation Laboratory for weighing and yield determinations.

Treatment	Wet yield[1]	Change	Dry yield[2]	Change
	tons/acre			
Control	3.34 b	—	0.878 b	—
Vitazyme	3.54 a	0.20 (+6%)	0.970 a	0.092 (+10%)

[1]Means followed by different letters are significantly different at P = 0.21 according to the Tukey-Kramer test.
[2]Means followed by different letters are significantly different at P = 0.04 according to the Tukey-Kramer test. Dry yield is adjusted to 100% dry matter.



Increase in dry yield: 10%

Quality results: Several forage quality parameters were measured at the laboratory in Marshfield, Wisconsin, but few of them showed a significant difference between the two treatments.

Treatment	Crude protein (CP)*	Acid detergent fiber (ADF)	Neutral detergent fiber (NDF)	Digestible NDF	Ash
	% of dry matter	% of dry matter	% of dry matter	% of NDF	% of dry matter
Control	21.0 a	27.4 a	36.0 a	40.9 a	11.3 a
Vitazyme	21.6 a	27.7 a	36.0 a	38.4 b	10.7 a
Level of significance	P = 0.32	P = 0.82	P = 0.96	P = 0.03	P = 0.43
$LSD_{0.01}$ (if valid)				LSD = 1.6	

* Means followed by different letters are significantly different as P = 0.10.

Treatment	Nonfibrous carbohydrate (NFC)*	Net energy for lactation (NEL)*	NRC 48-hr digestibility*	Base forage dry matter intake*
	% of dry matter	Mcal/lb		lb/day
Control	31.7 a	0.613 a	30.66 a	32.36 a
Vitazyme	33.0 a	0.613 a	28.99 b	32.27 a
Level of significance	P = 0.16	P = 0.90	P = 0.08	P = 0.95
$LSD_{0.01}$ (if valid)			LSD = 1.52	

* Means followed by different letters are significantly different at P = 0.10.

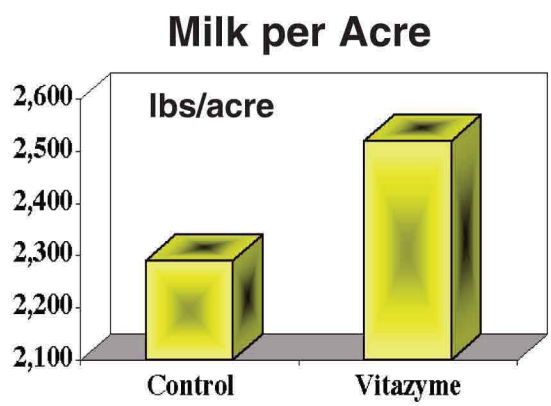
Only digestible neutral detergent fiber and the NRC 48-hour digestible neutral detergent showed significant differences between the two treatments. Thus, there appeared to be little difference in forage quality between the Vitazyme and control treatments, which is contrary to the other forage tests that have shown a superior forage quality when Vitazyme was used.

Milk output results: The yield and quality parameters were used by the Milk 2000 program to calculate estimated milk output for each plot harvested.

Treatment	Milk per day from the forage*	Milk per ton of forage*	Milk per acre*	Change
	lb/day	lb/ton	lb/acre	lb/acre
Control	36.6 a	2,614 a	2, 290 b	—
Vitazyme	35.0 a	2,583 a	2,519 a	+229 (+10%)
Level of significance	P = 0.49	P = 0.45	P = 0.03	
$LSD_{0.1}$ (if valid)			LSD = 155	

* Means followed by different letters are significantly different at P = 0.10.

The milk per day from the forage, and the milk per ton of forage, were not significantly different for the two treatments, but **the milk output per acre was significantly improved (at P = 0.03) by Vitazyme over the control, by 10%, or 229 lb/acre, a reflection of the improved overall alfalfa yield (+10%).**



Increase in milk per acre: 229 lb/acre

Income increase from the milk: At a price of $15.00/cwt for the milk, the increased income for the use of Vitazyme on this alfalfa is $34.35/acre

Increase in milk income: $34.35/acre

Conclusions: In this alfalfa forage study in New York, Vitazyme significantly increased the yield for the first cutting, by 10% over the control. Few quality parameters were significantly changed. however, so that the total milk output per acre was also increased by 10% above the control, which amounted to a $34.35/acre increase in milk income.

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2000 Crop Results

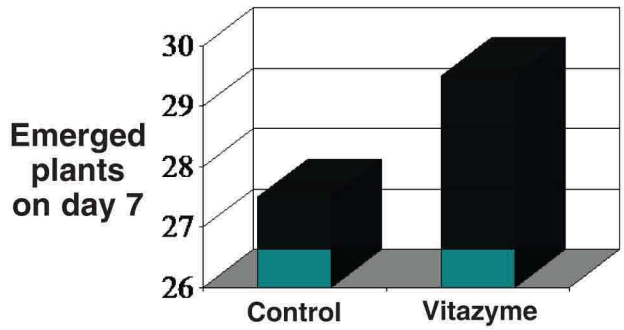
Vitazyme on Alfalfa (Tray Study)

Agricultural Custom Research and Educational Services

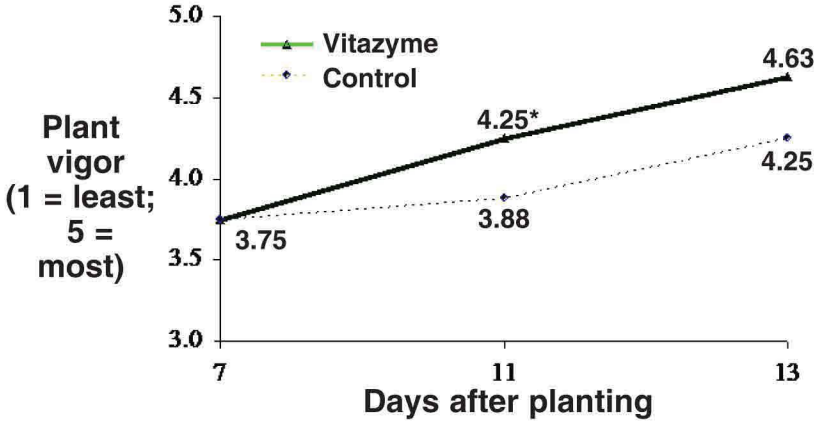
Researcher: Bertel Schou, Ph.D.
Location: Cedar Falls, Iowa
Variety: Unknown
Soil type: Maxfield silt loam, surface soil
Tray size and type: 10 x 21 inches, slotted tray inside a solid tray, and a paper liner below
Experimental design: Trays were placed under full-spectrum grow-lights that shone 14 hours per day, with an air temperature of 65 to 85°F. Each tray had 6,000 grams of the sieved silt loam soil, which formed a two-inch layer in which two furrows were made. Twenty seeds were placed every 2 inches in the two furrows and covered. Then a measured amount of water was added, first to obtain ideal planting conditions, and subsequent waterings were accounted for as well to give a net water usage. Typical field water loss is 0.25 to 0.35 in/day. Four replicates were used in the study. Measurements were taken 7, 11, and 13 days after planting.
Vitazyme application: The equivalent of 13 oz/acre Vitazyme was applied to the soil surface at planting.
Growth parameters measured: Most differences in growth parameters for the two treatments were not significant, though differences did appear and are shown here. A significant difference in plant vigor did occur.

Plants Emerged

	Control	Vitazyme	Change
	plant number		
Plants emerged on day 7	27.5	29.5	+2.0 (+7%)



Plant Vigor



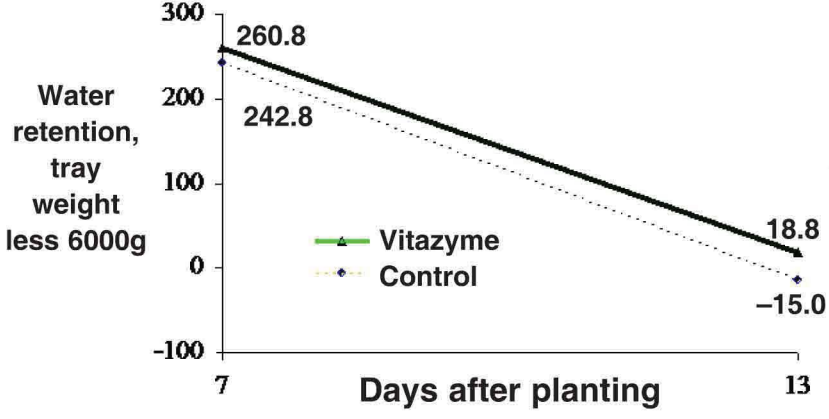
Vitazyme substantially improved alfalfa seedling plant vigor after seven days following planting. The improvement at day 11 was significantly different at P = 0.06.

Plant vigor increase: 10%

* Significantly greater than the control at P = 0.06 according to Duncan's New Multiple Range Test. $LSD_{0.10} = 0.29$.

Soil and Plant Water Retention

The amount of water remaining in the trays, after additions were subtracted, was highest for the Vitazyme trays. This shows that Vitazyme reduced water loss from the soil and plants, and thus improved water use efficiency.



Conclusions: Vitazyme applied to alfalfa in this study showed that the product can significantly improve plant vigor, enhance early plant emergence, and reduce plant and soil water loss, thereby increasing water use efficiency.

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1999 Crop Results

Vitazyme on Alfalfa

Farmer: John Periera *Location*: Tracy, California *Variety*: Yolo *Cutting*: fourth

Experimental design: An alfalfa field was divided into two portions, one part treated with Vitazyme and the other part left untreated.

1. Control **2. Vitazyme**

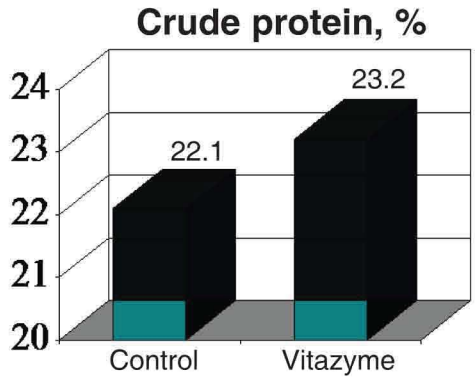
Fertilizer treatments: none

Vitazyme application: 13 oz/acre by air to the new growth, shortly after the third cutting had been harvested.

Yield results: None were collected on the fourth cutting.

Quality results: Samples of the two treatments were sent to J.L. Analytical Services, Inc., at Modesto, California, for various quality determinations. All determinations are expressed on a 100% dry basis.

Parameter	Control	Vitazyme
Acid detergent fiber, %	30.6	30.5
Crude protein, %	22.1	23.2
Total digestible nutrients, %	59.4	59.5
Net energy of lactation, Mcal/lb	0.605	0.606



Increase in crude protein: 1.1 percentage point

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1998 Crop Results

Vitazyme on Ryegrass (silage and grain)

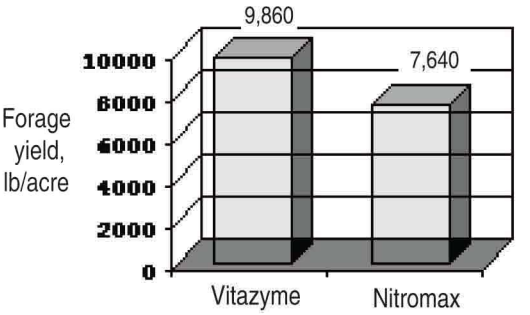
Researcher: Karl Hallen *Location*: Clyde, New York
Planting date: fall of 1997, broadcast into standing sorghum/sudangrass ("sudax")
Variety: bin run, variety unknown *Soil type*: Alton gravel (gravely with little silt and clay)
Experimental design: A field of 3.4 acres was divided into two equal parts, 1.7 acres receiving Vitazyme and the other 1.7 acres receiving another biostimulant called Nitromax.

1. **Vitazyme**
2. **Nitromax**

Fertility treatments: about 15 tons/acre of manure in 1997
Vitazyme and Nitromax applications: 13 oz/acre sprayed on the plants and soil at spring greenup
Harvest date: mid-May for forage, when the crop was just coming out of the boot stage; August for grain
Harvest method: the cut ryegrass was baled at 60% moisture, and wrapped in plastic; the grain was combined
Yield results: Bales from both treatments were weighed.

Silage

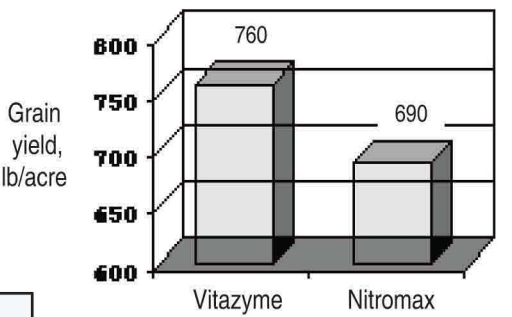
	Vitazyme	Nitromax	Increase
Total yield, lb	16,762	12,988	3,774
Plot area	1.7 acres	1.7 acres	
Yield, lb/acre	9,860	7,640	2,220



Forage increase: 29%

Grain

	Vitazyme	Nitromax	Increase
Total yield, lb	1,292	1,173	119
Plot area	1.7 acres	1.7 acres	
Yield, lb/acre	760	690	70



Grain increase: 10%

Conclusions: Vitazyme, compared to Nirtomax, provided a superior yield increase for both forage (29%) and grain (10%) with ryegrass.