

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Rice Production in California



Executive Summary

BiOWiSH Technologies, Inc. engaged Helena Agri-Enterprises, LLC as a third-party Contract Research Organization (CRO) to conduct a study to determine the effects of BiOWiSH® Crop Liquid coated onto urea to create an Enhanced Efficiency Fertilizer (EEF) for rice production grown in a continuous flood system in California.

The trial compared four treatments:

- Control, Standard Regional Fertility Program
- N Optimized Fertility Program + BiOWiSH® Crop Liquid
- Control + Stabilized Nitrogen Technology
- Control + Controlled Release Polymer Coated

The study determined that the N Optimized Fertility Program + BiOWiSH® Crop Liquid program optimized yield potential in rice by improved nutrient uptake, which led to an increased return on investment in this study.

Background

About BiOWiSH Technologies

Headquartered in Cincinnati, Ohio, BiOWiSH Technologies, Inc. is a global provider of biotechnology solutions. As a leader in the agricultural market, we help farmers increase crop production sustainably, safely, and cost effectively. Our revolutionary BiOWiSH® Crop Liquid is a blend of proprietary microbial cultures that can be coated onto dry fertilizer or mixed with liquid fertilizers to create an enhanced efficiency fertilizer. BiOWiSH® endophytic *Bacillus* deliver soil nutrients to crops through the rhizophagy cycle creating a symbiotic relationship between the plant and soil microbes. This helps farmers achieve consistent results across a broad range of operating conditions, climates, and environments. By unifying nature and science, BiOWiSH reinvents the way food is grown. For more information, visit biowishtech.com.

BiOWiSH® Crop Liquid



- Optimizes yield potential by improved nutrient uptake
- Increases nutrient use efficiency and supports nutrient uptake
- Optimizes soil conditions for greater root mass
- Improves soil conditions for increased plant vigor
- Enhances beneficial microbes in the rhizosphere

Available Size

- 264 gal/1000 L

About Helena Agri-Enterprises, LLC

Helena Agri-Enterprises, LLC is a leading provider of crop production and crop protection products in the United States and worldwide. Headquartered in the USA, the company has been in the agronomic products supply business for more than fifty years and has expanded its contract research services over the last decade. As an independent Contract Research Organization (CRO), Helena R&D is a team of highly trained and experienced study directors, field researchers, and support staff. They are one of several independent CROs that BiOWiSH Technologies, Inc. works with to independently evaluate our agronomy products.

Objectives

The objective of this research study was to determine the efficacy of BiOWiSH® Crop Liquid, manufactured in the USA by BiOWiSH Technologies, Inc., on rice production when added to a fertility program common to the production area in California. The focus was on BiOWiSH® Crop Liquid's impact in an N Optimized Fertility Program compared to the Control.

In addition, the Control and N Optimized + BiOWiSH® programs were compared to a stabilized nitrogen technology and a controlled release polymer technology.

Implementation Program

The study was conducted on a grower field near Marysville, California, USA. The treatments were organized as a Randomized Complete Block Design (RCBD) with four replications. The field was prepared normally, beginning with soil tillage, leveling, and rolling. Plots were delineated and a 6-foot-wide levee plot was established to create a contiguous soil border between plots to maintain the integrity of the treatments.

Two fertilizer application schemes were used in the study: a single pre-flood soil surface application with the fertilizer incorporated; and, a sequential program with base fertilizer as previously described, followed by a sequential fertilizer application into the flood water at panicle initiation.

Table 1. Treatments, fertilizers, and application timings

Treatment	Fertilizer	Application Rate lb/acre [kg/ha]	Application Phase
Control	Urea (46-0-0)	303 [340]	At planting
	MAP (11-52-0)	96.2 [108]	At planting
	MOP (0-0-60)	100 [112]	At planting
	Urea (46-0-0)	65.2 [73]	Panicle initiation
N Optimized Fertility Program (95%) + BiOWiSH® Crop Liquid	BiOWiSH® Coated Urea (46-0-0)	287 [322]	At planting
	MAP (11-52-0)	96.2 [108]	At planting
	MOP (0-0-60)	100 [112]	At planting
	BiOWiSH® Coated Urea (46-0-0)	61.9 [69]	Panicle initiation
Control + Nitrogen Stabilizer Technology	Stabilized Nitrogen Coated Urea	303 [340]	At planting
	MAP (11-52-0)	96.2 [108]	At planting
	MOP (0-0-60)	100 [112]	At planting
Control + Controlled Release Polymer Coated	Polymer Coated Urea	131 [147]	At planting
	Urea	172 [193]	At planting
	MAP (11-52-0)	96.2 [108]	At planting
	MOP (0-0-60)	100 [112]	At planting

*Calculations for conversions between imperial and metric units are based on the original source data. Slight rounding differences may occur within reported publication values.

**BiOWiSH® Coated Urea (46-0-0) is urea coated with BiOWiSH® Crop Liquid according to the manufacturer's recommended rate.

The Control treatment is the most common, best management practice used by growers in the region as defined by the independent CRO. Observations of the following characteristics were made to represent the effect of the various nitrogen technologies on rice performance including:

- Plant Height
- Plant Vigor
- Grain Yield

Plant tissue samples were collected for plant nutrient composition analysis. An economic evaluation of the different fertilizer programs was performed based on cost data at the time of study for farmers in California.

Results

Crop Performance

BiOWiSH® Crop Liquid improved soil conditions for increased plant vigor in this study. Even when part of an N Optimized Fertility Program, the BiOWiSH® Crop Liquid treatment had higher average vigor scores than the Control.

Table 2. Crop Performance

Treatment	Plant Stand pl/f ² [pl/m ²]	Plant Height in [cm]	Vigor (0-5)
Control	14.3 [153.9]	32.5 [82.6]	3.5
N Optimized Fertility Program + BiOWiSH® Crop Liquid	17.0 [183.0]	34.3 [87.1]	3.8
Control + Nitrogen Stabilizer Technology	17.3 [186.2]	34.4 [87.4]	3.5
Control + Controlled Release Polymer Coated	16.0 [172.2]	32.9 [83.6]	3.5

*Calculations for conversions between imperial and metric units are based on the original source data, slight rounding differences may occur within reported publication values.

Plant Analysis

BiOWiSH® Crop Liquid increased nutrient use efficiency and supported nutrient uptake. This is evidenced in the case of the N Optimized Fertility Program, where nutrient levels were within the range of the other treatments that received full levels of fertilization.

Table 3. Plant Analysis

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Control	4.64	0.49	2.62
N Optimized Fertility Program + BiOWiSH® Crop Liquid	4.05	0.47	3.06
Control + Nitrogen Stabilizer Technology	4.32	0.39	2.85
Control + Controlled Release Polymer Coated	3.77	0.43	2.93

Economics

Economic data on rice yield using input cost and crop values from the time of the study are presented in the table below. The N Optimized + BiOWiSH® Crop Liquid treatment gave the best economic result: an additional \$744/acre (\$1837/ha) over the recommended most common fertilizer program.

Table 4. Yield and Economics

Treatment	Yield tons/acre [MT/ha]	Yield Increase tons/acre [MT/ha]	Yield Increase (%)	Net Income USD/acre [USD/ha]	Profit Change USD/acre [USD/ha]
Control	4.64 [10.40]	-	-	2042 [5048]	-
N Optimized Fertility Program + BiOWiSH® Crop Liquid	6.33 [14.19]	1.69 [3.79]	36.4	2786 [6885]	744 [1837]
Control + Nitrogen Stabilizer Technology	6.07 [13.61]	1.43 [3.21]	30.8	2667 [6591]	625 [1543]
Control + Controlled Release Polymer Coated	5.85 [13.11]	1.21 [2.71]	26.1	2575 [6363]	533 [1315]

*Calculations for conversions between imperial and metric units are based on the original source data; slight rounding differences may occur within reported publication values.

**Net income is the crop value minus the fertility program cost. It does not account for non-fertility expenses.

***Profit change is the difference between net income of the respective program and the Control.

Conclusion

BiOWiSH® endophytic *Bacillus* deliver soil nutrients to crops through the rhizophagy cycle creating a symbiotic relationship between the plant and soil microbes. Together, the cycle improved soil conditions for increased plant vigor in this study. This enabled optimized yield potential by improved nutrient uptake, which led to a profit change of \$744 USD/acre (\$1837 USD/ha) for the N Optimized + BiOWiSH® treatment in this study.



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