BiOWiSH® TECHNOLOGIES

Research Study

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Yield in Winter Wheat — Year 3


Winter Wheat

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 BiOWiSH® Crop Liquid when added to a liquid fertilizer program for winter wheat production in Oregon. The results reported in this study are from the third year of wheat trials in the area.

The trial compared two treatments:

• Control, Standard Regional Fertility Program
• Control + BiOWiSH® Crop Liquid

The study determined that the addition of BiOWiSH® Crop Liquid optimized yield potential by improved nutrient uptake in winter wheat. In this study, a 10.7% yield increase (14.1 bu/acre, 0.94 MT/ha) was observed for the Control + BiOWiSH® Crop Liquid Fertility Program, which led to higher profit.

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 their contract research services over the last decade. As an independent 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 when added to a standard regional fertility program to create an Enhanced Efficiency Fertilizer (EEF) for winter wheat production, grown under irrigation, Central Oregon.

Implementation Program

Helena R&D conducted this trial at a research site located near Culver, OR. The trial design was a completely Randomized Complete Block Design (RCBD) with four replicates per treatment. Each replicate plot measured 5 ft wide by 25 ft long (1.5 m by 7.6 m). 'WB528' winter wheat was planted using a precision Great Plains planter and planted at the rate of 120 lb/acre (134.5 kg/ha).

BiOWiSH® Crop Liquid was added to the fertilizer program at the manufacturer's recommended rate and mixed with water for application. Pre-plant fertilizer was broadcast over the trial area at a rate of 450 lb/acre (504.4 kg/ha) with a 40-0-0 plus 5.5% Sulfur composite fertilizer and incorporated into the soil within 72 hours after application. Starter fertilizer applications were applied to each individual plot using a CO_2 backpack sprayer, calibrated to deliver the liquid fertilizer blends in-furrow at the appropriate rates for each treatment. Starter fertilizer treatments, application rates, and timings are shown below in Table 1. Pest and disease management techniques were implemented on site when required.

Table 1. Treatments, fertilizers, and application timings

Treatment	Fertilizer	Application Rate gal/acre [L/ha]	Application Phase
Control	UAN 32% N	9.0 [84.2]	In furrow
	Nucleus®*0-0-21	2.0 [18.7]	In furrow
	Nucleus® O-Phos 8-24-0	5.0 [46.8]	In furrow
	Kickstand®* 0-0-0-7 Zn	0.25 [2.3]	In furrow
	Water	5.0 [46.8]	In furrow
Control + BiOWiSH®	UAN 32% N	9.0 [84.2]	In furrow
	Nucleus®*0-0-21	2.0 [18.7]	In furrow
	Nucleus® O-Phos 8-24-0	5.0 [46.8]	In furrow
	Kickstand®* 0-0-0-7 Zn	0.25 [2.3]	In furrow
	Water	5.0 [46.8]	In furrow

**Nucleus®, and Kickstand® are registered trademarks of Helena Holding Company.*
***BiOWiSH® Crop Liquid used at manufacturer's recommended rate.*

Results

Plant Vigor
In season evaluations of crop vigor, color, plant height, and chlorophyll assessments were similar between treatments. Table 2 represents the data point nearest to the harvest.

Table 2. Plant Vigor

Treatment	Crop Vigor Rating	Color Rating	Plant Height in [cm]	SPAD (%)
Control	5	5	36.3 [92.2]	53.58
Control + BiOWiSH®	5	5	36.0 [91.4]	54.65

Leaf Tissue
In season leaf tissue analysis showed similar nutrient levels between treatments which were at acceptable levels (Table 3).

Table 3. Leaf Tissue Nutrient Levels

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Control	4.07	0.47	3.25
Control + BiOWiSH®	4.37	0.43	2.54

Yield Parameters
Analysis of wheat yield showed that the BiOWiSH® treatment optimized yield potential by improved nutrient uptake by 14.1 bu/acre (0.94 MT/ha), which equates to a 10.7% increase over the standard grower practice. Percent grain protein and grain test weight had similar levels across treatments (Table 4).

Table 4. Yield Parameters

Treatment	Yield bu/acre [MT/ha]	Test Weight	Protein (%)
Control	131.3 [8.77]	59.15	11.1
Control + BiOWiSH®	145.4 [9.71]	59.98	10.8

**An average test weight was used for conversion from bu/ac to MT/ha*
***Notes 1lb = 1.12 kg*

Economics
Economic analysis data is shown in Table 5. Based upon the average yield increase of 10.7% in the Control + BiOWiSH® Crop Liquid, net income increased by 12%, resulting in an increased profit of $69 USD/acre ($171 USD/ha).

Table 5. Farmer Economics on Winter Wheat Yield

Treatment	**Grain Yield** bu/acre [MT/ha]	**Yield Increase** bu/acre [MT/ha]	**Yield Increase** (%)	**Net Income** USD/acre [USD/ha]	**Profit Change** USD/acre [USD/ha]
Control	131.3 [8.77]	-	-	580 [1433]	-
Control + BiOWiSH®	145.4 [9.71]	14.1 [0.94]	10.7	649 [1604]	69 [171]

**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. This enables optimized yield potential by improved nutrient uptake, which led to a 10.7% higher yield and a profit change of $69 USD/acre ($171 USD/ha) for the BiOWiSH® treatment in this study.

Furthermore, BiOWiSH® Crop Liquid, as part of a regional fertilizer program, improved soil conditions for increased plant vigor and supported nutrient uptake.

Contact us:
agronomy@biowishtech.com
+1 312 572 6700
biowishtech.com