

## BiOWiSH® Crop Liquid

### BiOWiSH® Crop Liquid Optimizes Yield in Wheat Helena Research Tests BiOWiSH® Coated Urea Fertilizer

#### Executive Summary

BiOWiSH Technologies, Inc. engaged Helena R&D as a third-party Contract Research Organization (CRO) to conduct a study to determine the effects of BiOWiSH® Crop Liquid on wheat production. The trial compared three treatments:

- A regional fertilizer program as the control (Control)
- The same fertilizer program with BiOWiSH® Crop Liquid added (Control + BiOWiSH® Crop Liquid)
- Reduced Control + BiOWiSH® Crop Liquid

The study determined that the BiOWiSH® treatments increased root biomass, yield, and grower economics while maintaining grain quality.

#### Background

##### About BiOWiSH® Crop Liquid

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 with industry leading shelf-life and consistent results across a broad range of operating conditions and environments, all at a low cost to farmers. BiOWiSH® Crop Liquid enhances native microbial activity in the soil and root development, optimizing nutrient use efficiency and improving plant vigor. BiOWiSH® Crop Liquid is proven to enhance the effects of applied fertilizers by increasing yield and improving soil productivity.

##### About Helena Agri-Enterprises

Helena Agri-Enterprises 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 50 years and has expanded its 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, manufactured in the USA by BiOWiSH Technologies, Inc, on wheat production when added to a fertility program common to the production area in Central Oregon. The focus was on BiOWiSH® Crop Liquid's impact on soil health, root biomass, yield of spring wheat, grain quality, and the grower economics.

In this trial, the common regional wheat fertility program was compared to the same programs with BiOWiSH® Crop Liquid.

### BiOWiSH® Crop Liquid



- Optimizes yield potential
- Optimizes nutrient use efficiency
- Enhances root development
- Improves plant vigor
- Stimulates native microbial activity in the soil
- Improves soil productivity

#### Available Sizes

- 190 L/50 gal
- 1000 L/264 gal

## Implementation Program

The study was a Randomized Complete Block Design with four replications. The control plots were treated with the standard grower program of 280 lb/a of urea. Alturas spring wheat cultivar was planted on Day 0. Urea treatments (see Table 1) were applied on a research site in Madras, Oregon on Day 1, and irrigation began on Day 3. The trial began on April 21<sup>st</sup> and the crop was harvested at maturity in August.

Treatment Name	Post-Plant Fertilization Program	Rate [kg/ha] lb/acre	Application Phase
Control (no BiOWiSH®)	Urea (46-0-0)	[314] 280	Post-plant
Control + BiOWiSH®	BiOWiSH® Crop Liquid Coated Urea (46-0-0)	[314] 280	Post-plant
Reduced Control + BiOWiSH®	BiOWiSH® Crop Liquid Coated Urea (46-0-0)	[269] 240	Post-Plant

Table 1: Treatment regimens

## Results

- Both BiOWiSH® treatments resulted in significantly increased revenue
- Both BiOWiSH® treatments resulted in higher yield
- BiOWiSH® treated plants had larger root biomass
- BiOWiSH® treated plants had higher foliar biomass
- All 3 treatments had statistically similar grain protein
- Soil nutrients were maintained across all treatments

## Economics

The revenue increased for the Control + BiOWiSH® Crop Liquid and Reduced Control + BiOWiSH® Crop Liquid by \$24.15 and \$11.25 per acre, respectively, over the control treatment.

Treatment	Revenue increase over control [US\$/Ha] US\$/acre	Return On Investment
Control	-	-
Control + BiOWiSH®	[\$59.68] \$24.15	4.6%
Reduced Control + BiOWiSH®	[\$27.80] \$11.25	8.5%

Table 2: Return On Investment Over Control

The Reduced Control + BiOWiSH® allowed for the same input cost as the most common practice, yet increased yield resulting in more profit. While the Control + BiOWiSH® added some cost to the current practice program, the resulting higher yield increase provided even more profit. Additionally, because the soil nutrients were maintained, the increased yield did not result in future potential losses.

## Yield:

The Control + BiOWiSH® and Reduced Control + BiOWiSH® showed increased yield over the standard grower practice by 7% and 2%, respectively.

Table 3 shows Yield (bushels/acre and kilograms/hectare) for all 3 treatments:

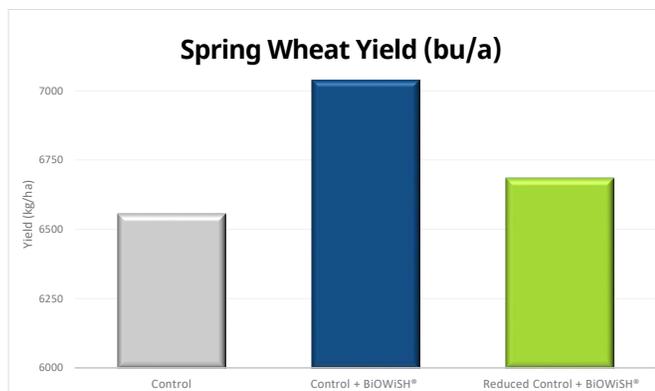
Treatment	Yield [mT/ha] Ton/acre
Control	[6.57] 2.93
Control + BiOWiSH®	[6.68] 2.98
Reduced Control + BiOWiSH®	[7.04] 3.14

**Table 3:** Yield Totals

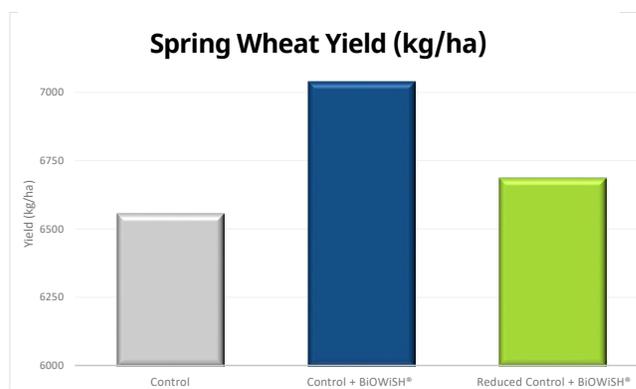
Yield results are shown visually in Image 1 and graphically in Figure 1.



Control (left) and Control + BiOWiSH® (right)



**Figure 1a:** Yield (bu/a) Results



**Figure 1b:** Yield (kg/ha) Results

## Soil Health:

Figure 2 shows the post-harvest Soil Health Calculation for the control and the two BiOWiSH®. The Soil Health Calculation looks at the balance of soil carbon, nitrogen, and their relationship to microbial activity. This number represents the overall health of the soil.

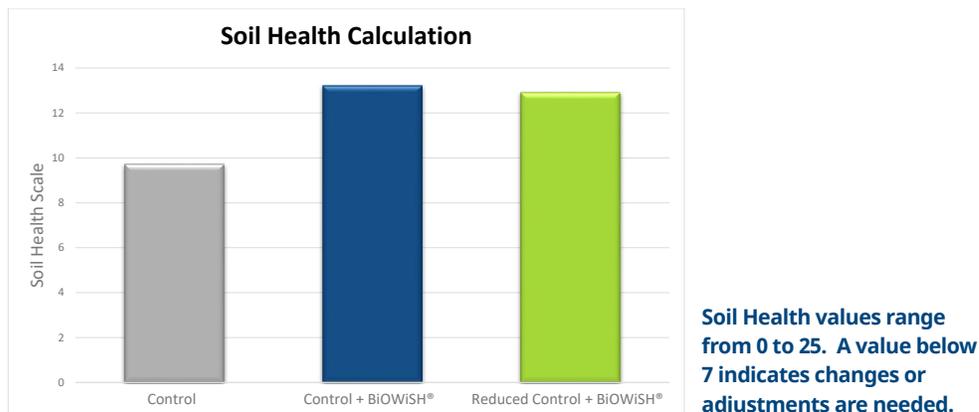


Figure 2: Soil Health Calculation

The soil health calculation for the Control legs (Standard Grower Practice) was 9.7. The Control + BiOWiSH® Crop Liquid and Reduced Control + BiOWiSH® Crop Liquid legs had soil health ratings of 13.2, and 12.6, respectively.

In general, higher yield removes a greater amount of soil nutrients from the soil. When this happens, the growers need to bump up their fertilizer application in the following year. In this study (see Table 4), it was observed that **the yield increase in the BiOWiSH® Treatments did not deplete soil nitrogen or other nutrients.**

Treatment	Nitrate Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)
Control	7	16	349
Control + BiOWiSH®	10	18	394
Reduced Control + BiOWiSH®	11	21	405

Table 4: Post-harvest available soil macro-nutrients

## Plant Health:

The Control + BiOWiSH® treatment resulted in 86% higher root biomass. The Reduced Control + BiOWiSH® showed a 24% increase in root biomass. In both cases the spring wheat BiOWiSH® Treatments developed larger roots, indicating overall mass flow of nutrients to the plant and benefits for low rainfall crops.

Table 5 shows average Root Mass (grams) for all three tested treatments:

Treatment	Root Biomass [g] oz	Increase (%)
Control	[15.8] 0.56	-
Control + BiOWiSH®	[29.4] 1.04	86%
Reduced Control + BiOWiSH®	[19.6] 0.70	24%

**Table 5: Root Biomass**

Table 6 shows average Foliar Biomass (grams) for all 3 treatments:

Treatment	Foliar Biomass (g) OZ
Control	[60.6] 2.14
Control + BiOWiSH®	[63.6] 2.24
Reduced Control + BiOWiSH®	[62.8] 2.21

**Table 6: Foliar Biomass**

Table 7 shows Grain Protein percent for all 3 treatments:

Treatment	Grain Protein (%)
Control	10.0
Control + BiOWiSH®	10.0
Reduced Control + BiOWiSH®	10.0

**Table 7: Grain Protein %**

## Conclusion

Helena's research trial showed that, when added to urea fertilizer, BiOWiSH® Crop Liquid improves soil health, root biomass, and yield. At the same time, the BiOWiSH® treatment was able to maintain protein content in the wheat. The highest revenue increase came from adding BiOWiSH® to the standard practice of 280 lb/a urea, resulting in a \$24.15 increase in profit per acre (\$59.68 USD/hectare) compared to the standard practice without BiOWiSH®.

Reducing the grower standard nitrogen fertility allowed for a fertility program cost equal to the Control. With the equal cost, the Reduced Control + BiOWiSH® treatment resulted in equal grain protein content, enhanced root biomass, improved soil health, maintained soil macro-nutrients and increased yield. The spring wheat revenue was \$15.27 higher per acre (\$37.73 USD/hectare) than the standard practice, meaning that the \$15.27 increase was profit.

BiOWiSH® Crop Liquid can help wheat farmers achieve greater profits and sustain them by increasing the yield without depleting soil nutrients.



BiOWiSH™ is a registered trademark of BiOWiSH Technologies International, Inc.

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