

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Winter Wheat in Kansas



Winter Wheat

Executive Summary

BiOWiSH Technologies, Inc. engaged Kansas State University 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) as part of a winter wheat fertility program in Manhattan, Kansas. The trial compared 4 treatments:

- Standard Fertility Control (Most Common Practice)
- Standard Fertility Control + BiOWiSH® Crop Liquid
- N Optimized Fertility Program
- N Optimized Fertility Program + BiOWiSH® Crop Liquid

In this study, the Standard Fertility Control + BiOWiSH® Crop Liquid treatment was observed to have a marketable yield of 5.6 bu/acre (0.4 MT/ha) higher than the Standard Fertility Control treatment. The N Optimized Fertility Program + BiOWiSH® Crop Liquid increased yield by 10.0 bu/acre (0.7 MT/ha) when compared to the N Optimized Fertility Program and maintained yield compared to the Standard Fertility Control.

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 Kansas State University

Founded in 1863 as the nation's first operational land-grant university, Kansas State University (K-State) is a leading public research institution dedicated to advancing education, discovery, and outreach. With its main campus in Manhattan, Kansas, and additional campuses in Salina and Olathe, K-State serves as a hub for innovation in agriculture, engineering, business, and the sciences. The university is internationally recognized for its pioneering research in food systems, biosecurity, and sustainable practices that strengthen communities locally and globally. Guided by its land-grant mission, K-State integrates teaching, research, and extension to prepare students for impactful careers while delivering practical solutions to farmers, industries, and policymakers. By bridging knowledge and application, Kansas State University empowers future leaders and drives progress worldwide. For more information, visit k-state.edu.

Objectives

The primary objective of this trial was to evaluate the performance of BiOWiSH® Crop Liquid coated onto urea as an Enhanced Efficiency Fertilizer (EEF) at two different rates for winter wheat production in Kansas. The evaluation focused on soil and plant nutrients, yield, and economic benefits for the farmer. The combination of the data is intended to determine whether the addition of BiOWiSH® Crop Liquid can economically and sustainably increase wheat production in standard and reduced nitrogen fertility programs.

Implementation Program

In this trial, the standard regional fertility program for winter wheat served as the Control, consisting of a pre-plant application of 70 lbs/acre of granular MAP and two split applications of urea at 135 lbs/acre each, applied after planting and again before jointing. This program was compared against three variations: the Standard Fertility Control with BiOWiSH® Crop Liquid coated onto the urea, an N Optimized Fertility Program without BiOWiSH®, and an N Optimized Fertility Program with BiOWiSH® coating. The trial was established as a randomized complete block design (RCBD) with four treatments and three replications. Wheat was planted under local practices, grown under non-irrigated conditions, and no significant disease or pest pressure was observed during the season. Soil samples were collected before planting at the flag leaf stage and following harvest. Likewise, plant tissue was sampled at the flag leaf stage, while grain samples were collected at harvest.

Table 1. Treatments, Fertilizers, and Application Timings

Treatment	Fertilizer	Application Rate lbs/acre [kg/ha]	Application Phase
Standard Fertility Control	Uncoated MAP	70.0 [78.5]	Pre-Plant
	Uncoated Urea	136.5 [153.0]	After Planting
	Uncoated Urea	136.5 [153.0]	Before Jointing
Standard Fertility Control + BiOWiSH® Crop Liquid*	Uncoated MAP	70.0 [78.5]	Pre-Plant
	Coated Urea	136.5 [153.0]	After Planting
	Coated Urea	136.5 [153.0]	Before Jointing

Treatment	Fertilizer	Application Rate lbs/acre [kg/ha]	Application Phase
N Optimized Fertility Program	Uncoated MAP	70.0 [78.5]	Pre-Plant
	Uncoated Urea	116.0 [130.0]	After Planting
	Uncoated Urea	116.0 [130.0]	Before Jointing
N Optimized Fertility Program + BiOWiSH® Crop Liquid*	Uncoated MAP	70.0 [78.5]	Pre-Plant
	Coated Urea	116.0 [130.0]	After Planting
	Coated Urea	116.0 [130.0]	Before Jointing

*BiOWiSH® Crop Liquid used at manufacturer's recommended rate.

Results

Soil Analysis

Compared to the Standard Fertility Control, the soil nutrient analysis for the BiOWiSH® treatments demonstrated comparable post-harvest nutrient levels as a percentage of pre-treatment values, indicating that nutrient availability was effectively maintained throughout the season. Notably, the BiOWiSH® treated plots exhibited higher residual nitrate-N concentrations at harvest relative to their pre-treatment levels, suggesting improved nitrogen retention in the soil profile. This trend may reflect enhanced nitrogen use efficiency and reduced N losses during the growing season.

Table 2. Pre-plant and Post-harvest Soil Analysis

Treatment	Sample Timing	Nitrate-N ppm	Ammonium-N ppm	Phosphorus ppm	Potassium ppm
Standard Fertility Control	Pre-treatment	19.3	5.0	28.0	263.0
	Post-harvest	9.0	4.7	22.3	315.3
Post-Harvest Percentage of Pre-Treatment Value		50.1%	95.9%	81.3%	120.1%
Standard Fertility Control + BiOWiSH® Crop Liquid	Pre-treatment	16.7	5.3	27.7	247.0
	Post-harvest	12.3	5.0	26.0	324.3
Post-Harvest Percentage of Pre-Treatment Value		79.5%	97.2%	94.7%	132.0%
N Optimized Fertility Program	Pre-treatment	21.3	5.0	27.7	258.0
	Post-harvest	11.0	4.3	23.7	316.0
Post-Harvest Percentage of Pre-Treatment Value		53.5%	86.7%	90.9 %	122.5%
N Optimized Fertility Program + BiOWiSH® Crop Liquid	Pre-treatment	10.0	4.3	28.0	273.3
	Post-harvest	8.3	4.3	18.3	325.3
Post-Harvest Percentage of Pre-Treatment Value		83.3%	101.1%	67.6%	120.8%

Leaf Tissue and Grain Nitrogen Concentrations per Treatment

Although BiOWiSH® treated plants exhibited slightly lower nitrogen concentrations in leaf tissue compared to the Standard Fertility Control, grain nitrogen levels were essentially equivalent across treatments. However, when total nitrogen uptake is considered—calculated as grain yield (bu/acre) multiplied by grain nitrogen concentration—the BiOWiSH® treatments demonstrated greater overall nitrogen uptake from the field. This indicates that despite similar tissue N levels, the higher yields achieved under BiOWiSH® treatments resulted in greater total nitrogen uptake and utilization efficiency.

Table 3. Leaf Tissue and Grain Nitrogen Content

Treatment	Tissue N (%)	Grain N (%)	Total Grain N (lbs/acre)
Standard Fertility Control	2.05	2.07	118.8
Standard Fertility Control + BiOWiSH® Crop Liquid	1.89	2.09	127.0
N Optimized Fertility Program	2.02	2.02	104.3
N Optimized Fertility Program + BiOWiSH® Crop Liquid	1.76	1.96	112.9

Yield and Economic Analysis

The yield distribution of harvested wheat is presented below. The Standard Fertility Control + BiOWiSH® Crop Liquid treatment was observed to have a yield increase of 5.6 bu/acre (0.4 MT/ha) over the Standard Fertility Control.

The N Optimized Fertility Program + BiOWiSH® Crop Liquid essentially maintained yield with a slight increase of 0.4 bu/acre (0.02 MT/ha) over the Standard Fertility Control. Additionally, the N Optimized Fertility Program + BiOWiSH® Crop Liquid had a yield increase of 10.0 bu/acre (0.7 MT/ha) over the N Optimized Fertility Program.

Economic data on wheat yield from the study is also presented in the table below. The Standard Fertility Control + BiOWiSH® Crop Liquid treatment had a profit change of \$28 USD/acre (\$69 USD/ha) greater than the Standard Fertility Control. The N Optimized Fertility Program + BiOWiSH® Crop Liquid had a profit change of \$7 USD/acre (\$16 USD/ha) greater than the Standard Fertility Control, illustrating profitability in low nitrogen common practice fertility programs.

Table 4. Yield and Net Income Table

Treatment	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]
Standard Fertility Control	95.7 [6.4]	-	-	501 [1238]	-
Standard Fertility Control + BiOWiSH® Crop Liquid	101.3 [6.8]	5.6 [0.4]	5.9	529 [1307]	28 [69]

Treatment	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]
N Optimized Fertility Program	86.0 [5.8]	-9.6 [-0.7]	-10.1	454 [1121]	-48 [-117]
N Optimized Fertility Program + BiOWiSH® Crop Liquid	96.0 [6.5]	0.4 [0.02]	0.4	508 [1255]	7 [16]

*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 Standard Fertility Control. All treatments in Table 4 were compared to the Standard Fertility Program.

Conclusion

BiOWiSH® endophytic *Bacillus* deliver soil nutrients to crops through the rhizophagy cycle creating a symbiotic relationship between the plant and soil microbes. BiOWiSH® Crop Liquid, when incorporated into a regional standard fertility program, increased wheat yields in Manhattan, Kansas.

The Standard Fertility Control + BiOWiSH® Crop Liquid treatment resulted in a 5.9% yield increase of 5.6 bu/acre (0.4 MT/ha) over the Standard Fertility Control, while the N Optimized Fertility Program + BiOWiSH® Crop Liquid achieved a 0.4% yield increase of 0.4 bu/acre (0.02 MT/ha) over the Standard Fertility Control. These yield gains translated to increased grower profits of \$28 USD/acre (\$69 USD/ha) and \$7 USD/acre (\$16 USD/ha), respectively.

In light of the soil results presented in Table 2, the higher productivity and plant vigor observed in the BiOWiSH® treatments indicate that nutrient levels in the soil were effectively maintained relative to the Standard Fertility Control. This suggests a more efficient nutrient conversion process when using BiOWiSH® Enhanced Fertilizer. As a result, wheat treated with BiOWiSH® coated urea outperformed uncoated urea under standard farming practices, maintained yield under reduced nitrogen applications, and achieved yield increases compared to untreated reduced urea rates, all while preserving soil fertility for future cropping seasons. Furthermore, the tissue and grain nitrogen analyses showed that although nutrient concentrations were similar among treatments, BiOWiSH® applications led to greater total nitrogen uptake and improved utilization efficiency.



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