

## BiOWiSH<sup>®</sup> Crop Liquid

### Evaluation of BiOWiSH<sup>®</sup> Crop Liquid on Corn Production in Texas



#### Executive Summary

BiOWiSH Technologies engaged Precision Study Management as a third-party Contract Research Organization (CRO) to conduct a study to determine the effects of BiOWiSH<sup>®</sup> Crop Liquid coated onto urea as an Enhanced Efficiency Fertilizer (EEF), on corn production in Northern Texas, USA.

The trial compared three treatments:

- Control, Standard Urea Fertility Program
- Control + BiOWiSH<sup>®</sup> Crop Liquid
- N Optimized Fertility Program + BiOWiSH<sup>®</sup> Crop Liquid

The study determined that the addition of BiOWiSH<sup>®</sup> Crop Liquid optimized yield potential by improved nutrient uptake in corn. In this trial, a 6.7 bu/acre (5.5%) increase was observed for the Control + BiOWiSH Fertility Program and a 2.7 bu/acre (2.2%) increase for the N Optimized + BiOWiSH 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<sup>®</sup> 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<sup>®</sup> 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](http://biowishtech.com).

### BiOWiSH<sup>®</sup> 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 Sizes

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

## About Precision Study Management

Precision Study Management LLC (PSM) is a privately held company focused on assisting the Ag Chem industry in the design and execution of field research programs to support regulatory and marketing objectives. The staff at PSM supports clients with their field and laboratory research needs and assists them with product registration requirements. PSM focuses on achieving regulatory objectives through the design and management of field research throughout the field phase, analytical phase, and report phase of the study.

## Objectives

The purpose of this trial was to evaluate the performance of BiOWiSH® Crop Liquid coated onto urea as an Enhanced Efficiency Fertilizer (EEF) for corn, as a full standard fertility program and an optimized fertility program, compared to the Control.

## Implementation Program

PSM conducted the trial consisting of three treatments with four replicates in a randomized complete block design (RCBD) study. The addition of BiOWiSH® Crop Liquid (coated onto the urea) was applied at the manufacturer's recommended rate to both the Control and the N Optimized Fertility Program. The Control program is the most commonly used fertilizing practice in the region for corn and consisted of urea (46-0-0) applied pre-plant, at a rate of 435 lbs/acre (488 kg/ha). For the N Optimized Fertility Program, the urea was applied at 391 lbs/acre (438 kg/ha).

The corn was planted in accordance with local dry-land practices (without irrigation). At the trial site, the urea application occurred pre-plant, and the corn was planted seven days following application. Corn emerged seven days post-planting and fourteen days post-application. There was no significant disease or pest pressure at the trial location.

Yield was collected at harvest for each plot and analyzed comparing the two BiOWiSH® treatments to the Control. The corn crop treatments were assessed for plant health using plant vigor scores and Normalized Difference Vegetative Index (NDVI). Soil sample cores were taken pre-fertilizer application and post-harvest. For each treatment, replicates were individually sampled, mixed together, and chemically analyzed.

Table 1. Fertilizer, Treatments, and Application Timing

Treatment	Application Rate lbs/acre [kg/ha]	Application Phase
Control	435 [488]	Pre-plant
Control + BiOWiSH® Crop Liquid	435 [488]	Pre-plant
N Optimized Fertility Program + BiOWiSH® Crop Liquid	391 [438]	Pre-plant

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

\*\*Urea kg/ha are rounded to the nearest kilogram.

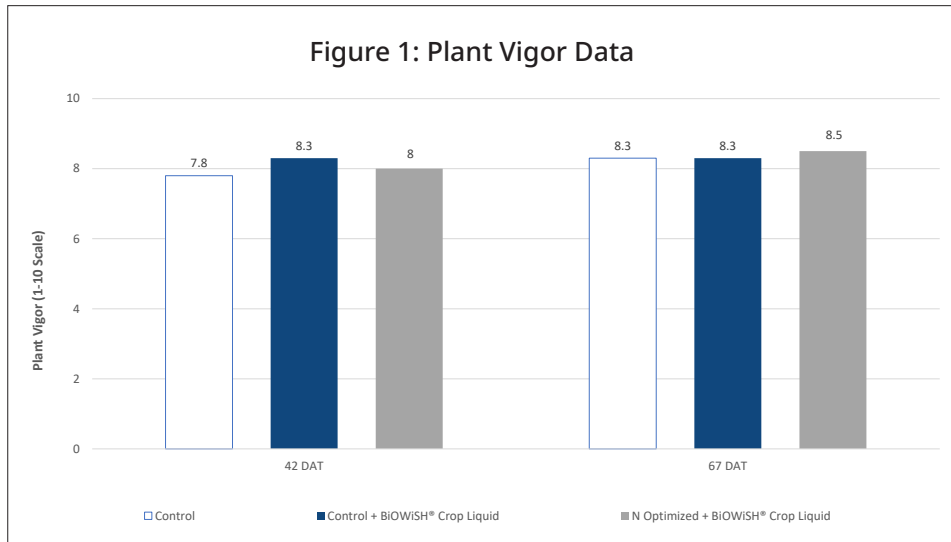
## Results

The assessments for plant vigor and NDVI showed slight advantages for the BiOWiSH® treatments compared to the Control. This suggests improved soil conditions for increased plant vigor present for the BiOWiSH® treatments.

### Plant Vigor

Analysis of plant vigor was conducted twice. The evaluations took place in April (42 days after treatment) and May (67 days after treatment). The data indicates that both BiOWiSH® treatments improved soil conditions for increased plant vigor, even despite a 10% reduction in fertilizer for the N Optimized Fertility Program.

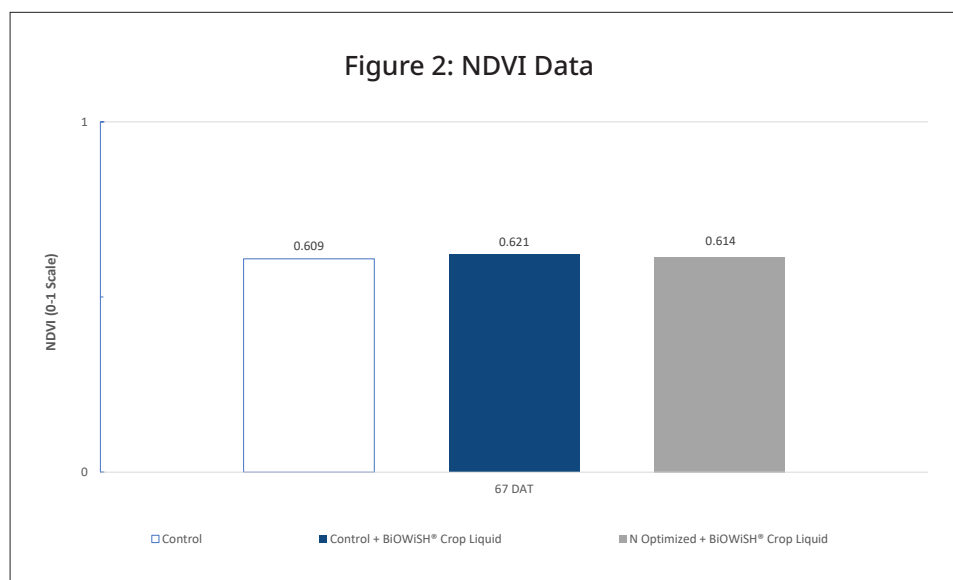
Figure 1: Plant Vigor Data



### Normalized Difference Vegetative Index (NDVI)

Analysis of NDVI values was conducted in May (67 days after treatment). While no significant differences were observed between treatments, a slight increase in NDVI values for the Control + BiOWiSH® Crop Liquid Fertility Program and the N Optimized Fertility Program + BiOWiSH® Crop Liquid was observed over the Control. This again suggests improved soil conditions for increased plant vigor present in both BiOWiSH® treatments.

Figure 2: NDVI Data



## Soil Analysis

Compared to the Control, the soil analysis for the BiOWiSH® treatments demonstrated the same or higher nutrient levels post-harvest as a percentage of pre-treatment values.

Table 2. Soil Analysis Table

Treatment	Sample Timing	Nitrate -N ppm	Phosphorus ppm	Potassium ppm	OM %	pH
Control	Pre-Treatment	21	46	115	1.8	7.0
	Post-Harvest	6.0	48.0	137	1.7	7.9
Post-Harvest Percentage of Pre-Treatment Value		29%	104%	119%	94%	113%
Control + BiOWiSH® Crop Liquid	Pre-Treatment	21	46	115	1.8	7.0
	Post-Harvest	6.0	74.0	141	1.7	7.8
Post-Harvest Percentage of Pre-Treatment Value		29%	161%	123%	94%	111%
N Optimized Fertility Program + BiOWiSH® Crop Liquid	Pre-Treatment	21	46	115	1.8	7.0
	Post-Harvest	7.0	94.0	140	1.9	7.8
Post-Harvest Percentage of Pre-Treatment Value		33%	204%	122%	106%	111%

## Yield Parameters

Figure 3: Yield Data

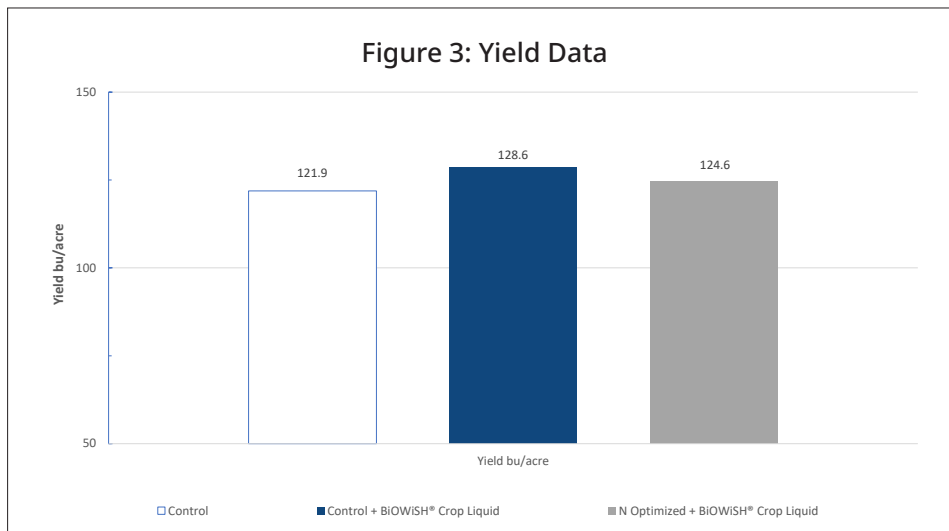


Table 3. Yield and Net Income Table

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]
Control	121.9 [7.65]	-	-	670 [1656]	-
Control + BiOWiSH® Crop Liquid	128.6 [8.07]	6.7 [0.42]	5.5	708 [1748]	37 [92]
N Optimized Fertility Program + BiOWiSH® Crop Liquid	124.6 [7.82]	2.7 [0.17]	2.2	694 [1714]	23 [58]

\*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.

BiOWiSH® Crop Liquid, when added to a regional standard fertility program as a fertility enhancement coated onto urea by the fertilizer supplier for corn grown in Northern Texas, increased yield by 6.7 bu/acre (0.42 MT/ha) over the Control, which is a 5.5% yield increase. In addition, even with a 10% reduction in fertilizer for the N Optimized Fertility Program, the BiOWiSH® treatment out-performed the Control by 2.7 bu/acre (0.17 MT/ha), a 2.2% increase. Both BiOWiSH® treatments had increased profit resulting from the yield increases over the Control program based on input costs and grain values at the time of the study.

## 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 profit changes of \$37 USD/acre (\$92 USD/ha) and \$23 USD/acre (\$58 USD/ha) for the full and N Optimized BiOWiSH® treatments in this study.

Relative to the Control, the BiOWiSH® Crop Liquid treatments maintained similar or greater percent changes to soil nutrient levels and properties between pre-treatment and post-harvest soil sampling time points. This indicates that the BiOWiSH® treatments increased nutrient use efficiency and supported nutrient uptake. The results showed that corn treated with BiOWiSH® coated urea optimized yield potential by improved nutrient uptake, even in the case of the N Optimized Fertility Program.



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