Research Study

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Maize Production in Brazil

Executive Summary

BiOWiSH Technologies partnered with the Fundação MT as a third-party Contract Research Organization (CRO) to conduct a research trial. The study tested the effects of BiOWiSH® Crop Liquid coated onto urea as an Enhanced Efficiency Fertilizer (EEF) on maize production in Primavera do Leste, Brazil.

The trial compared three treatments:

- Control, Standard Urea Fertility Program
- Control + BiOWiSH® Crop Liquid
- N Optimized Fertility Program + BiOWiSH® Crop Liquid

The study determined that the addition of BiOWiSH® Crop Liquid optimized yield potential by improved nutrient uptake in maize grown under Safrinha conditions in Brazil. In this trial, a 5.8% increase was observed for the Control + BiOWiSH® Fertility Program and a 15.5% 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® 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 the Fundação MT
The Foundation for Support for Agricultural Research of Mato Grosso (Fundação MT) plays a very important role in supporting agricultural research to promote the success and expansion of agriculture in Mato Grosso. The organization was founded in 1993 by 23 seed and soybean producers in the state concerned about the future of agriculture.

The Fundação MT was built on principles and values, such as economic and socio-environmental sustainability. Their agronomic research was developed to promote good land use and increase crop productivity. The Foundation currently assists Mato Grosso farmers in different study areas such as Entomology, Crop Protection, Genetics, Nutrition, and many other aspects for important crops in the region such as soybean, corn, and cotton.

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 in a full standard fertility program and an optimized fertility program, compared to the Control under dryland, Safrinha maize production conditions.

Implementation Program

The study was a randomized complete block design. The site was a no-till dryland field planted with maize following soybean. The P3858 PWY variety was treated with a fungicide/insecticide seed treatment standard for the area. 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 Urea Fertility Programs. The Control treatment consisted of a standard grower program of urea at 200 kg/ha (178 lbs/acre). This was compared to the Control + BiOWiSH® Crop Liquid at 200 kg/ha (178 lbs/acre) and the N Optimized Fertility Program + BiOWiSH® at 180 kg/ha (161 lbs/acre) applied at sidedress. The rate of BiOWiSH® Crop Liquid applied per ton of urea remained the same for all coated treatments.

The application timing was at the V3 crop stage. The urea was applied using a mechanical fertilizer spreader and was not incorporated into the soil. No phosphorous or potassium fertilizer were applied because the maize crop followed a soybean crop. Disease and insect control were performed as needed based upon local recommendations and thresholds. Soil sample cores were taken pre-fertilizer application and post-harvest. For each treatment, replicates were individually sampled, mixed together, and chemically analyzed.

The 2021 crop season presented atypical weather conditions as compared to previous seasons. The rainfall regime started later than usual delaying the soybean sowing and pushing the "Safrinha" window to outside what is considered ideal. Conditions were unusually hotter and drier; therefore, stress on the plant was higher during the season. Consequently, the pollination and formation of the corn ear were impacted, thus affecting the number of grains per ear.

Pre-treatment and post-harvest soil samples were taken for all treatments for comparison. In addition, plant tissue samples were collected at the flowering corn stage. The difference in soil and plant laboratory analysis, and yield data can be used to understand the efficiency of nutrient conversion.

Table 1. Fertilizer, Treatments, and Application Timing

Treatment	Application Rate kg/ha [lbs/acre]	Application Phase
Control	200 [178]	Sidedress
Control + BiOWiSH® Crop Liquid	200 [178]	Sidedress
N Optimized Fertility Program + BiOWiSH® Crop Liquid	180 [161]	Sidedress

**BiOWiSH® Crop Liquid used at manufacturer's recommended rate.*
***Urea kg/ha are rounded to the nearest kilogram.*

Results

The assessments of soil and plant tissue demonstrated advantages for the BiOWiSH® treatments over the Control, as the treatments had similar or greater percent changes to nutrient levels and properties between pre-treatment and post-harvest sampling points. The data below indicates overall optimized yield potential by improved nutrient uptake for the BiOWiSH® treatments over the Control.

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	Phosphorus ppm	Potassium ppm	OM %	pH
Control	Pre-Treatment	23.2	68.4	4.3	6.7
	Post-Harvest	13.4	68.4	3.59	6.8
Post-Harvest Percentage of Pre-Treatment Value		58%	100%	83%	101%
Control + BiOWiSH® Crop Liquid	Pre-Treatment	13.4	68.4	3.59	6.8
	Post-Harvest	37.9	78.2	3.83	6.9
Post-Harvest Percentage of Pre-Treatment Value		283%	114%	107%	101%
N Optimized Fertility Program + BiOWiSH® Crop Liquid	Pre-Treatment	15.9	69.4	3.91	7.2
	Post-Harvest	15.7	70.4	4.12	6.7
Post-Harvest Percentage of Pre-Treatment Value		99%	101%	105%	93%

Plant Tissue Analysis

Compared to the Control, the plant tissue for analysis for the BiOWiSH® treatments demonstrated similar nutrient levels post-harvest as a percentage of pre-treatment values.

Table 3. Plant Tissue Analysis Table

Treatment	**Total Nitrogen** ppm	**Phosphorus** ppm	**Potassium** ppm
Control	27	2	19
Control + BiOWiSH® Crop Liquid	26	2	19
N Optimized Fertility Program + BiOWiSH® Crop Liquid	26	2	19

Yield Parameters

Based on input cost and crop values at the time of the study, The Control + BiOWiSH® Crop Liquid Fertility Program yield increase of 5.8% led to a profit change of $48 USD/ha ($19 USD/acre). The N Optimized Fertility Program + BiOWiSH® Crop Liquid yield increase of 15.5% led to a profit change of $149 USD/ha ($60 USD/acre).

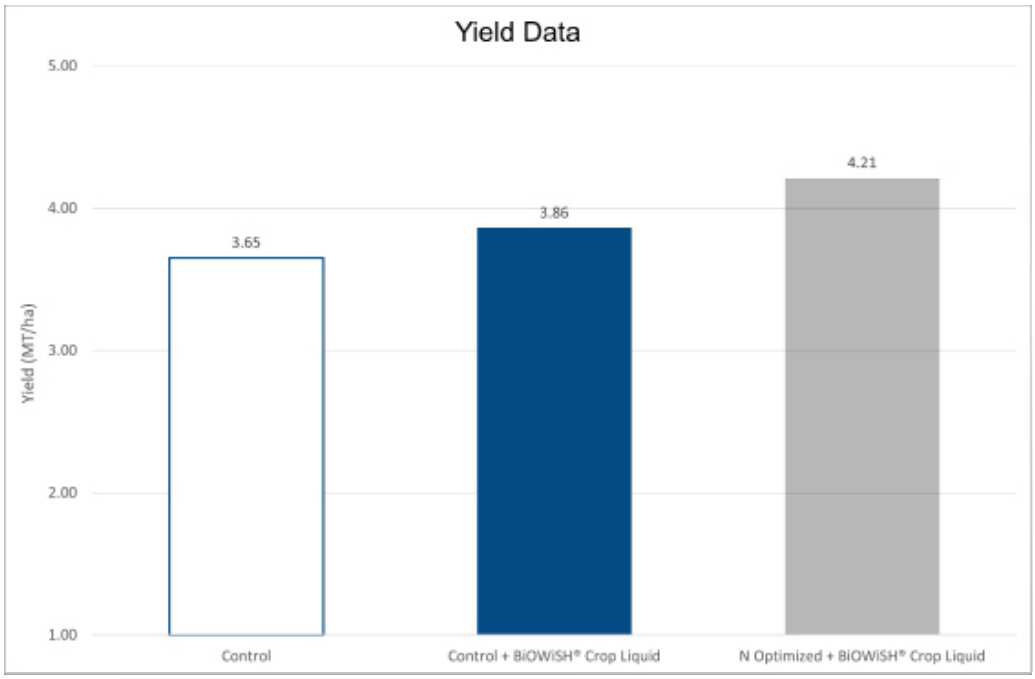

Table 4: Yield and Net Income Table

Treatment	**Yield** MT/ha [tons/acre]	**Yield Increase** MT/ha [tons/acre]	**Yield Increase** (%)	**Net Income** USD/ha [USD/acre]	**Profit Change** USD/ha [USD/acre]
Control	3.65 [1.63]	-	-	820 [332]	-
Control + BiOWiSH® Crop Liquid	3.86 [1.72]	0.21 [0.09]	5.8	868 [351]	48 [19]
N Optimized Fertility Program + BiOWiSH® Crop Liquid	4.21 [1.88]	0.56 [0.25]	15.5	929 [392]	149 [60]

**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. When added to a regional standard fertility program for dryland maize production in Brazil under Safrinha conditions, BiOWiSH® Crop Liquid enabled optimized yield potential by improved nutrient uptake. This led to a profit change of $48 USD/acre ($19 USD/ha) in the Control + BiOWiSH® Crop Liquid treatment over the Control. Even with a 10% reduction in fertilizer for the N Optimized Fertility Program, the BiOWiSH® treatment improved profitability by $149 USD/ha ($60 USD/acre).

Furthermore, as seen in Table 2 and Table 3, the soil and plant tissue results illustrate that the BiOWiSH® treatments increased nutrient use efficiency and supported nutrient uptake.

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