Research Study

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Sorghum in the State of Texas

Sorghum

Executive Summary

BiOWiSH Technologies, Inc. engaged Precision Study Management as a third-party Contract Research Organization (CRO) to conduct a study to determine the effects of BiOWiSH® Crop Liquid coated urea on grain sorghum production in Markham, Texas, USA.

The trial compared two treatments:

- Urea (Control)
- Control (Control + BiOWiSH® Crop Liquid)

In this study, the BiOWiSH® treatment resulted in an increase in yield of 4.8 bu/acre (0.30 MT/ha) when compared to the standard fertility program.

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 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.

Objectives

The purpose of this study was to evaluate soil nutrients and plant vigor, collect yield and define the farmers' economic benefit on grain sorghum production using urea coated with BiOWiSH® Crop Liquid. The combination of the data is intended to determine whether the addition of BiOWiSH® Crop Liquid as a fertilizer enhancement can economically increase crop production by improving soil conditions for increased plant vigor and preserving post-harvest soil nutrients when the same input fertilizer is applied.

Implementation Program

BiOWiSH® Crop Liquid was added to the regional standard fertility program for sorghum, which is the most commonly used fertilizing practice in the region for field sorghum planting and consisted of urea applied pre-plant at a rate of 272 lbs/acre (305 kg/ha).

This trial was conducted in the state of Texas as a replicated strip trial design. At the trial site, the field sorghum cultivar BDC4501 was planted in accordance with local practices. The crop was not irrigated. The application occurred pre-plant and the sorghum was planted two days following the broadcast application. Emergence was eight days post planting and six days post application. There was no significant disease or pest pressure at the trial location.

Treatment	Application Rate lbs/acre [kg/ha]	Application Phase
Urea (Control)	272 [305]	Pre-plant
Urea (Control) + BiOWiSH® Crop Liquid	272 [305]	Pre-plant

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

Results

For the Normalized Difference Vegetation Index (NDVI) rating, the BiOWiSH® treatment showed a slightly higher NDVI value (3.3 %) over the control. This suggests improved soil conditions for increased plant vigor present for the BiOWiSH® treatment.

Table 1. NDVI Table

Treatment	NDVI
Control	0.60
Urea (Control) + BiOWiSH® Crop Liquid	0.62

Table 2. Soil Table

Treatment	Sample Timing	Nitrate-N ppm	Phosphorous ppm	Potassium ppm	OM (%)	pH
Control	Pre-treatment	23	48	119	2.0	6.8
	Post-harvest	5	49	73	1.4	7.4
Post-Harvest Percentage	of Pre-Harvest Value	22%	102%	61%	70%	109%

Treatment	Sample Timing	Nitrate-N ppm	Phosphorous ppm	Potassium ppm	OM (%)	pH
Control + BiOWiSH® Crop Liquid	Pre-treatment	22	42	105	1.7	6.8
	Post-harvest	4	42	67	1.2	7.4
Post-Harvest Percentage	of Pre-Harvest Value	18%	100%	64%	71%	109%

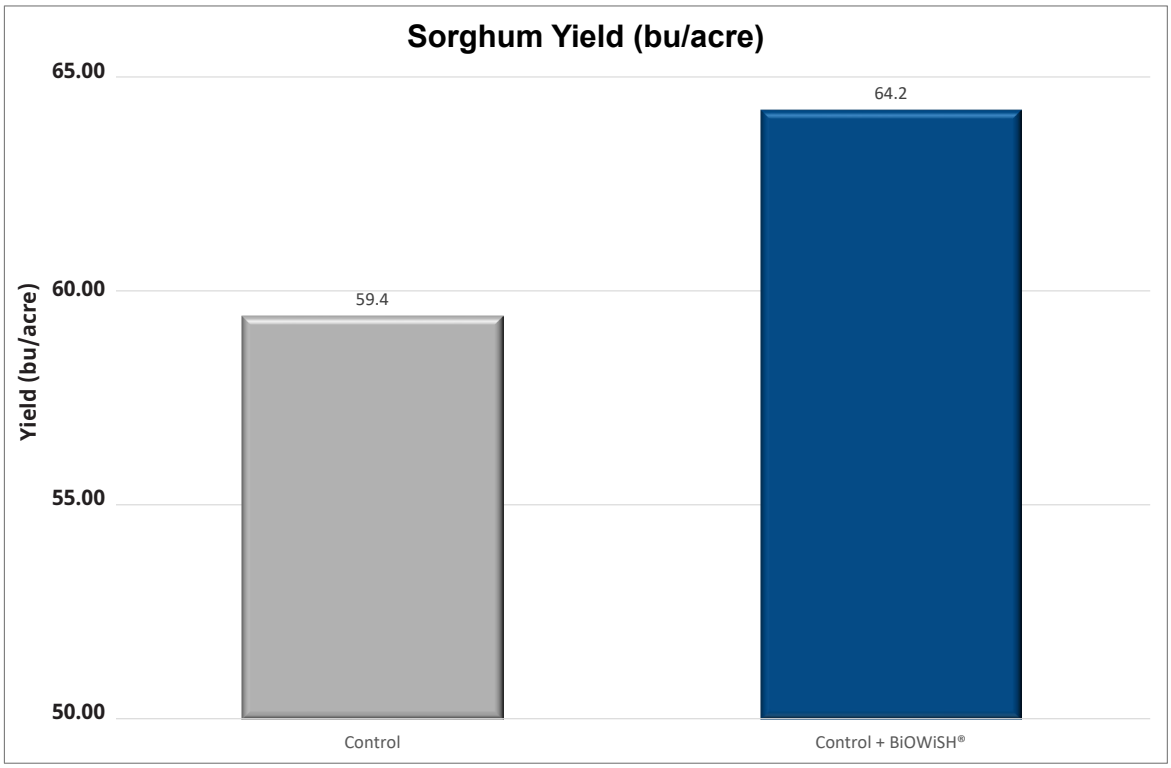

Table 3. Yield and Net Income Table

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]
Urea (Control)	59.4 [3.7]	-	-	283 [699]	-
Urea (Control) + BiOWiSH® Crop Liquid	64.2 [4.0]	4.8 [0.3]	8.1	308 [761]	25 [62]

**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.*

A significant yield response was measured between the Control and the Control + BiOWiSH® Crop Liquid treatments. The BiOWiSH® coated urea had a yield of 64.2 bu/acre (4.0 MT/ha) compared to the 59.4 bu/acre (3.7 MT/ha).

Relative to the Control, the BiOWiSH® Crop Liquid treatment has similar percent changes to soil nutrient levels and properties between pre-treatment and post-harvest soil sampling time points.

Conclusion

BiOWiSH® Crop Liquid, when added to a regional standard fertility program, increased yields of grain sorghum grown in Texas from 59.4 bu/acre (3.7 MT/ha) with the Control to 64.2 bu/acre (4.0 MT/ha). The 8.1% overall yield increase of 4.8 bu/acre (0.3 MT/ha) over the Control increased profit to the grower by $25 USD/acre ($62 USD/ha).

In addition to the yield increase, the NDVI rating, which is commonly used as a yield indicator, showed a slightly higher NDVI value for the BiOWiSH® over the control treatment. This suggests improved soil conditions for increased plant vigor present for the BiOWiSH® treatment.

Based upon the soil results in Table 2, the BiOWiSH® treatment maintained similar nutrient levels in the soil relative to the control. This indicates that the BiOWiSH® treatment increased nutrient use efficiency and supported nutrient uptake. The results showed that sorghum treated with BiOWiSH® coated urea optimized yield potential by improved nutrient uptake under standard farming practices while, improving soil conditions for increased plant vigor for future cropping seasons.

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