

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Yield in Late Rice



Executive Summary

BiOWiSH Technologies engaged China Agricultural University and Hunan Agricultural University to evaluate the effects of BiOWiSH® Crop Liquid coated onto urea 46-0-0 in late rice production.

The trial compared treatments:

- Urea 46-0-0 (Control)
- Control + Urease inhibitor coated onto urea 46-0-0
- Control + Nitrification inhibitor coated onto urea 46-0-0
- Control + BiOWiSH® Crop Liquid coated onto urea 46-0-0

Rice is the second largest crop after maize in China. Over-fertilization in rice paddy fields is a universal issue in southern China, which causes agricultural non-point pollution in air, water, and soil. Enhanced efficiency fertilizers are good solutions to reduce the fertilizer application rate and increase nutrient efficiency.

The study determined that BiOWiSH® Crop Liquid enhanced fertilizer resulted in the highest yield and Nitrogen Use Efficiency among the treatments, which positively affected net income and enhanced profitability. It also potentially reduced the agricultural non-point pollution of overuse of nitrogen fertilizers.

BiOWiSH® Crop Liquid



- Optimizes yield potential
- Increases nutrient availability
- Enhances root development
- Improves plant vigor
- Enhances native microbial activity in the soil
- Improves soil productivity

Available Sizes

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

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 can be coated onto dry fertilizer or mixed with liquid fertilizer to create an enhanced efficiency fertilizer that optimizes yield potential, expresses plant vigor and improves soil productivity 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.

About China Agricultural University and Hunan Agricultural University

China Agricultural University and Hunan Agricultural University are public research universities in China, specializing in advanced agricultural education. China is a large agricultural country with a vast number of distinct soil types and production environments. Agriculture plays a strategic role in the development of the national economy.

Objectives

BiOWiSH Technologies has conducted numerous trials on many different crops in China to illustrate the commercial effectiveness of BiOWiSH® Crop Liquid coated fertilizers. The objective of this trial was to evaluate BiOWiSH® Crop Liquid coated urea 46-0-0 performance to improve rice yield and Nitrogen Use Efficiency compared to inhibitor products in a standard fertility program recommended by local experts.

Implementation Program

The study was conducted on late rice (variety name: Xiang Wan Xian12) in Heshan District, Yiyang City, Hunan Province, China. The trial had four treatments. Each treatment had three replicates arranged in a randomized complete block design in a plot size of 30m² (322.92 sq ft). Each plot was isolated with plastic film and drainage ditches were built between the replications. Rice seedlings were transplanted 30 days after seeding, with a planting population of 250,000 holes/ha (101,174 holes/acre) and two seedlings per hole. There were two applications of fertilizer at planting and tillering stages. Pest, disease, and weed control were implemented on site when required.

Data collected included agronomic traits, nutrient content in whole plant (N, P₂O₅ and K₂O), biomass yield, grain yield, and 1000-grain weight. These data points were then used to calculate nutrient use efficiency, plot yield, net income gain, and profit change.

Table 1. Treatments, fertilizers, and application timings

Treatment	Fertilizer	Application Rate kg/ha [lbs/acre]	Application Phase
Control	Urea	95 [85]	Base application
	Urea	63 [56]	Sidedress
Control + Urease Inhibitor	Urea	95 [85]	Base application
	Urea	63 [56]	Sidedress
Control + Nitrification Inhibitor	Urea	95 [85]	Base application
	Urea	63 [56]	Sidedress
Control + BiOWiSH®	Urea	95 [85]	Base Application
	Urea	63 [56]	Sidedress

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

Results

Plant Agronomic Trait Data

Table 2 illustrates plant agronomic trait parameters that contribute to yield performance. Ten plants per replicate were collected for a total of thirty plants per treatment to evaluate the agronomic trait data. The BiOWiSH® Crop Liquid coated urea treatment scored at the top of the list in almost all plant agronomic trait data including plant height, panicle length, effective panicle per plant, seed setting rate, and 1000-grain weight.

Table 2. Plant Agronomic Trait Data for Late Rice

Treatment	Plant Height cm [in]	Panicle Length cm [in]	Effective Panicle per Plant	Grain Number per Panicle	Seed Setting Rate %	1000-Grain Weight g [oz]
Control	90 [35.4]	23 [9.1]	15.5	113.7	79.3	25.9 [0.91]
Control + Urease Inhibitor	87 [34.3]	25 [9.8]	15.8	115.3	79.3	26.1 [0.92]
Control + Nitrification Inhibitor	82 [32.3]	24 [9.5]	16.3	113.5	79.2	26.2 [0.92]
Control + BiOWiSH®	90 [35.4]	25 [9.8]	16.9	112.5	81.6	27.1 [0.96]

*Calculations for conversions between imperial and metric units are based on the original source data; slight rounding differences may occur within reported publication values.

**1 US ton/ac = 2.24 MT/ha

Grain and Biomass Yield

Each replicate was fully harvested and combined for each treatment to determine per treatment yields. The study showed that the BiOWiSH® Crop Liquid treatment obtained higher grain yield than the uncoated Control and inhibitor competitors. The BiOWiSH® Crop Liquid treatment also achieved significantly higher biomass yield compared with other treatments.

Table 3. Grain and Biomass Yield

Treatment	Grain Yield MT/ha [tons/acre]	Grain Yield Increase MT/ha [tons/acre]	Grain Yield Increase (%)	Biomass Yield MT/ha [tons/acre]	Biomass Yield over Control (%)
Control	8.06 [3.60]	-	-	14.79 [6.60]	-
Control + Urease Inhibitor	8.11 [3.62]	0.05 [0.02]	0.6	15.16 [6.76]	2.5
Control + Nitrification Inhibitor	8.50 [3.79]	0.44 [0.20]	5.5	15.77 [7.03]	6.6
Control + BiOWiSH®	8.91 [3.97]	0.85 [0.38]	10.6	18.60 [8.30]	25.8

Nitrogen Uptake

Harvest samples were collected from each plot to test the nitrogen (N) content in plant. The plant samples were treated with H₂SO₄-H₂O₂, then tested with the Kjeldahl method. The study showed that the BiOWiSH® Crop Liquid treatment accumulated the highest N content in plant. The high N content in the rice panicle indicated that BiOWiSH® Crop Liquid treatment could enhance the N transportation to panicles and result in a higher yield.

Table 4. Nitrogen Accumulation in Rice Path

Treatment	Total N Plant Accumulation kg/ha [lbs/acre]	N Content over Control in Stalk %	N Content over Control in Leaf %	N Content over Control in Panicle %
Control	153.28 [136.75]	-	-	-
Control + Urease Inhibitor	156.08 [139.25]	-4.4	1.8	3.9
Control + Nitrification Inhibitor	163.33 [145.72]	-6.7	10.1	8.9
Control + BiOWiSH®	171.86 [153.33]	-0.5	7.9	18.8

Nitrogen Use Efficiency

The formula for calculating the utilization efficiency of N fertilizer is as follows:

- N recovery efficiency (NRE) (%) = (N accumulation in the shoot - N accumulation in the shoot from no urea application plot) / N application rate x 100%
- N agronomic efficiency (NAE) = (yield in the N application plot - yield in no N application plot)/applied nitrogen rate
- N physiological efficiency (NPE) = (yield in the N application plot - yield in no N application control plot)/(N accumulation in the shoot - N accumulation in the shoot from no urea)
- N partial factor productivity (NPFP) = plot yield/N application rate

The study showed BiOWiSH® Crop Liquid treatment achieved higher Nitrogen Use Efficiency than other treatments in all nutrient use efficiency calculation methods.

Table 5. Nitrogen Use Efficiency

Treatment	NRE %	NAE %	NPE %	NPFP %
Control	27.2	9.3	34.9	51.2
Control + Urease Inhibitor	29.0	9.6	35.5	51.5
Control + Nitrification Inhibitor	33.6	12.1	35.6	54.0
Control + BiOWiSH®	39.0	14.7	38.8	56.6

Economics

When added to the Control, BiOWiSH® Crop Liquid enhanced fertilizer showed a yield increase of 10.6%, resulting in an increased profit of \$289 USD/ha (\$117 USD/acre) over the Control.

Table 6. Yield and Economics

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	8.06 [3.60]	-	-	2557 [1035]	-
Control + Urease Inhibitor	8.11 [3.62]	0.05 [0.02]	0.6	2555 [1034]	-2 [-1]
Control + Nitrification Inhibitor	8.50 [3.79]	0.44 [0.20]	5.5	2697 [1091]	140 [56]
Control + BiOWiSH®	8.91 [3.97]	0.85 [0.38]	10.6	2846 [1152]	289 [117]

*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

In this trial, the BiOWiSH® Crop Liquid coated urea 46-0-0 treatment increased late rice grain yield in Hunan Province, China, resulting in an increased profit of \$289 USD/ha (\$117 USD/acre) over the Control. BiOWiSH® Crop Liquid also effectively improved many plant agronomic traits and increased biomass and nitrogen accumulation in the panicle. Furthermore, it had higher Nitrogen Use Efficiency compared to the uncoated Control and the tested urease/nitrification inhibitor products.



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