

## Field Crops

### Rice, Maize & Green Vegetables, Vietnam



#### Background

BiOWiSH Technologies, along with distributor Enzyrna Co. Ltd. and Vietnam's Ministry of Agriculture and Rural Development, Center for Testing of Fertilizer, Southern Region, conducted tests on the efficacy of BiOWiSH™ Crop on rice and maize crops in Vietnam.

Rice is the most important crop in Vietnam, the second largest exporter and seventh-largest consumer of rice in the world. A recent study said it is critical that Vietnamese farmers adjust their farming practices to keep production levels up and their environmental impact down<sup>1</sup>.

The second most important crop in Vietnam is corn. It is used to feed people during rice shortages and also as feed for Vietnam's growing poultry and livestock industries. Some of the challenges facing Vietnamese corn farmers are poor soil fertility and irregular rainfall<sup>2</sup>.

#### Objectives

For the rice crops the objectives were to increase yield components, such as Panicle number/m<sup>2</sup>, filled grains/panicle, and 1000 grains weight, as well as paddy yield. For the maize crops the objectives were to increase plant weight and actual yield.

#### Solution

BiOWiSH™ Crop was chosen for the trial because it has the potential to increase yields and profits of rice and maize farmers, as well as reduce the environmental impact of inorganic fertilizers in Vietnam. BiOWiSH™ Crop stimulates microbial activity in soil, helping to increase micronutrient uptake in plants and improve plant vigor.

#### BiOWiSH™ Crop

- Improves yields
- Improves plant vigor
- Increases total number of crops per annum
- Increases nutrient availability to plants
- Stimulates microbial activity in the soil
- Accelerates crop residue decomposition

#### Available Sizes

- 100g/3.5oz
- 1 kg/2.2lb
- 5kg/11lb



<sup>1</sup> Gillis, Justin. October 23, 2012. Food and Climate: A New Warning. The New York Times. Retrieved from <http://green.blogs.nytimes.com/2012/10/23/food-and-climate-a-new-warning/>

<sup>2</sup> Thanh Ha, D., T. Dinh Thao, N. Tri Khiem, M. Xuan Trieu, R.V. Gerpacio, and P.L. Pingali. 2004. Maize in Vietnam: Production Systems, Constraints, and Research Priorities. Mexico, D.F.: CIMMYT

## Implementation Program

Eight trials were conducted: two small scale and two large scale trials on rice crops, and two small scale and two large scale trials on maize crops.

For the rice trials, testing was conducted over a two month period at Duc Hoa and Chau Thanh in Long An province, Mekong Delta region of Southern Vietnam. Both large and small scale trials were conducted at the same site, using the same parameters on a 10,000 m<sup>2</sup> plot. A seeding density of 120 kg seed/ha was used.

The control treatment used standard inorganic fertilizers per ha: 100 N + 70 P<sub>2</sub>O<sub>5</sub> + 35 K<sub>2</sub>O. Two different concentrations of BiOWiSH™ Crop were studied: 750g per ha and 1.1kg per ha, applied on days 10 and 20.

The BiOWiSH™ treatments also incorporated 90% of the inorganic fertilizer program used in control. The maize trials were also conducted over a two month period in the Cu Chi district of Ho Chi Minh city. Both large and small scale trials were conducted at the same site, using the same parameters on 5,000 m<sup>2</sup> plot. A density of 33 plants/m<sup>2</sup> was used. The control treatment used standard inorganic fertilizers per ha: 120 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O. The maize trials applied the same BiOWiSH™ Crop treatment programs as the rice trials.

In Vietnam, it is common practice by farmers to plant or sow maize intercropped with green vegetables.

## Results

### Test 1: Rice

For the two small scale trials, BiOWiSH™ Crop increased the number of panicles per square meter. The panicle is part of the rice plant that develops into grains, therefore more panicles translates into more rice being grown. Yields in the areas treated with BiOWiSH™ Crop were as much as 13.2% higher than the untreated areas.

Small Scale Trial One - Duc Hoa, Long An						
Treatment	Panicle/ m <sup>2</sup>	Filled grains/ panicle	1000 grains weight (g)	Paddy yield (t/ha)	Increase yield incomparison with control	
					t/ha	%
Control	409.0	59.9 b	24.0	5.88 b	-	-
BiOWiSH™ Treatment 1	440.8	65.2 a	24.1	6.59 a	0.71	12.0
BiOWiSH™ Treatment 2	444.8	65.3 a	24.3	6.61 a	0.73	12.5
CV%	6.23	5.74	4.62	5.38		
LSD 0.05	NS	6.03	NS	0.46		

- Means in a column followed by a common letter are not significantly different at 5% level by DMRT

- NS. Not significant

- Control = 100 N + 70 P<sub>2</sub>O<sub>5</sub> + 35 K<sub>2</sub>O fertilizer per ha

- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program

- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

Small Scale Trial Two - Chau Thanh, Long An						
Treatment	Panicle/ m <sup>2</sup>	Filled grains/ panicle	1000 grains weight (g)	Paddy yield (t/ha)	Increase yield incomparison with control	
					t/ha	%
Control	406.8	59.9 b	23.6	5.80b	-	-
BiOWiSH™ Treatment 1	428.3	64.7 a	24.3	6.54a	0.74	12.7
BiOWiSH™ Treatment 2	431.8	65.1 a	24.4	6.57a	0.77	13.2
CV%	6.08	5.82	5.26	5.84a		
LSD 0.05	NS	4.31	NS	0.56		

- Means in a column followed by a common letter are not significantly different at 5% level by DMRT

- NS. Not significant

- Control = 100 N + 70 P<sub>2</sub>O<sub>5</sub> + 35 K<sub>2</sub>O inorganic fertilizer per ha

- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program

- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

The large scale trials evaluated the economic benefits of using BiOWiSH™ Crop. Researchers used a rice price of \$0.325 USD/kg and a total labor cost of \$50.00 USD per ha. The cost of BiOWiSH™ Crop was partially offset by the savings from reducing the standard inorganic fertilizer program by 10%.

Using the above parameters, BiOWiSH™ Crop has the potential to increase paddy yield by about .8 (ton/ha) when compared to the control, resulting in net profit increases of up to \$199.55 USD / ha / crop.

Economic Benefit of using BiOWiSH™ Crop - Large Scale Trials in Long An					
	Actual yield (tons/ha)	Increase compared to control		Increase compared to control costs (\$ USD/ha)	Net profit (\$ USD/ha)
		Tons/ha	\$ USD/ha		
Control	5.84	-	-	-	-
BiOWiSH™ Treatment 1	6.57	0.73	237.25	54.80	182.45
BiOWiSH™ Treatment 2	6.63	0.79	256.75	57.20	199.55

- Means in a column followed by a common letter are not significantly different at 5% level by DMRT

- NS. Not significant

- Control = 100 N + 70 P<sub>2</sub>O<sub>5</sub> + 35 K<sub>2</sub>O inorganic fertilizer per ha

- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program

- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

## Test 2: Maize & Green Vegetables

With the maize and green vegetable trials, the use of fertilizers with BiOWiSH™ Crop increased the yield by as much as 4.03 ton/ha over the control.

Small Scale Trial One - Ho Chi Minh				
Treatments	Weight of 5 Plants (g)	Vegetable Yield (ton/ha)	Increase yield incomparison with control	
			t/ha	%
Control	406.8	26.72 b	-	-
BiOWiSH™ Treatment 1	528.3 a	30.50 a	3.78	14.1
BiOWiSH™ Treatment 2	529.5 a	30.75 a	4.03	15.1
CV%	5.64	5.76		
LSD 0.05	54.23	4.12		

- Means in a column followed by a common letter are not significantly different at 5% level by DMRT
- NS. Not significant
- Control = 120 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O inorganic fertilizer per ha
- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program
- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

Small Scale Trial One - Ho Chi Minh				
Treatments	Weight of 5 Plants (g)	Vegetable Yield (ton/ha)	Increase yield incomparison with control	
			t/ha	%
Control	441.8 b	26.60 b	-	-
BiOWiSH™ Treatment 1	526.8 a	30.00 a	3.40	12.8
BiOWiSH™ Treatment 2	528.5 a	30.25 a	3.65	13.7
CV%	6.44	7.04		
LSD 0.05	58.83	1.93		

- Means in a column followed by a common letter are not significantly different at 5% level by DMRT
- NS. Not significant
- Control = 120 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O inorganic fertilizer per ha
- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program
- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

The large scale trials examined the economic benefits of using BiOWiSH™ Crop. Researchers used a commodity price of \$0.125 USD/kg and a cost of labor of \$50.00 USD. The cost of BiOWiSH™ Crop was partially offset by the savings from reducing the standard inorganic fertilizer program by 10%.

Using the above parameters, BiOWiSH™ Crop has the potential to increase yield by about 3.5 (ton/ha) when compared to the control, resulting in net profit increases of up to \$394.05 USD / ha / crop.

Economic Benefit of using BiOWiSH™ Crop - Large Scale Trials in Ho Chi Minh					
	Actual yield (tons/ha)	Increase yield incomparison with control		Increase compared to control costs (\$ USD/ha)	Net profit (\$ USD/ha)
		Tons/ha	\$ USD/ha		
<b>Control</b>	26.83	-	-	-	-
<b>BiOWiSH™ Treatment 1</b>	30.24	3.41	426.25	54.80	371.45
<b>BiOWiSH™ Treatment 2</b>	30.44	3.61	451.25	57.20	394.05

- Control = 120 N + 60 P2O5 + 40 K2O inorganic fertilizer per ha
- BiOWiSH Treatment 1 = 750g BiOWiSH™ Crop per ha + 90% of control program
- BiOWiSH Treatment 2 = 1.1kg BiOWiSH™ Crop per ha + 90% of control program

## Conclusion

Plants treated with BiOWiSH™ Crop had higher yields than control plants in both the small and large scale trials.

For the rice trials, the increases were between 12.0 to 13.2% on the small scale trials. The large scale rice trials had increased yield of between 0.73 and 0.79 (ton/ha), which resulted in increases in net profit of between \$182.45USD and \$199.25 USD / ha / crop.

The small scale maize and green vegetable trials had yield increases ranging from 12.8 -15.1%. The large scale trials had yield increases ranging from 3.41 to 3.61 (ton/ha) and increases in net profit of between \$371.45 USD and \$394.05 USD / ha / crop.

As both large and small scale BiOWiSH™ trials showed consistent yield increases, a reasonable assumption could be made in regards to increased profitability for all plot sizes.

After the trials, BiOWiSH Technologies completed research and development to enable coating and blending of BiOWiSH™ Crop with inorganic fertilizers, allowing simultaneous application and eliminating additional labor cost.

## Glossary of Terms

See Appendix 1.

## Contacts

### BiOWiSH Technologies

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## Appendix 1 - Glossary of Terms

**Control** - in experimental designs, a control group is the “untreated” group with which an experimental group (or treatment group) is contrasted. It consists of units of study that did not receive the treatment whose effect is under investigation.

**Yield** - a measurement of the amount of a crop that was harvested per unit of land area. Crop yield is normally measured in tons per unit area (acre, hectare).

**Panicle** - the panicle is part of the rice plant that develops into grains, therefore more panicles translates into more rice being grown.

**Paddy** - a field where rice is grown.

**Maize** –more widely known as corn, a tall annual cereal grass bearing kernels on large ears. The leafy stalk produces ears which contain the grain, which are seeds called kernels. Intercrop - to grow more than one type of crop in the same field, especially in alternating rows or sections.

**NPK** - stands for nitrogen, phosphate and potash, the three nutrients that compose complete fertilizers. You’ll encounter NPK when reading the contents printed on bags of fertilizer. For example, if the bag says 20-10-5, that means 20% nitrogen, 10% phosphate and 5% potash.

**Standard inorganic fertilizer program** - NPK fertilizer combination typically used by the farmers to produce the crop.

**Coefficient of Variation (CV)** - is a normalized measure of dispersion of a probability distribution used for comparison between data sets with different units or widely different means. The higher the CV, the greater the dispersion in the variable. The lower the CV, the smaller the residuals relative to the predicted value.

**Least significant difference (LSD 0.05)** – takes into account the sample sizes of the two groups being compared, it computes a standard error of the difference between those two means. The main idea of the LSD is to compute the smallest significant difference between two means as if these means had been the only means to be compared and to declare significant any difference larger than the LSD.

**Duncan’s multiple range test (DMRT)** - provides significance levels for the difference between any pair of means.

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