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ECONOMIC PERFORMANCE BY USING BIO-INSECTICIDES AND CHEMICAL INSECTICIDES TO CONTROL RICE INSECT PESTS

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ABSTRACT

Entomophagous fungi Metarhizium anisopliae and Beauveria bassiana were worldwide used to manage insect pests. In Vietnam, two registered bioinsecticides namely OMetar and Biovip have been produced from M. anisopliae and B. bassiana, respectively to control insect pests of rice crop. Studies were carried out in the experimental fields of Cuu Long Delta Rice Research Institute during 2004 dry and wet seasons to analyze and compare the economic performance between two treatments as bioinsecticides and chemical insecticides to control rice pests. These two bioinsecticides could suppress population of some major rice insect pests such as brown plant hopper, rice leaf folder at acceptable level. OMetar and Biovip were safe to natural enemies such as spiders, plant bugs and other predators of rice insect pests. Application of OMetar and Biovip to control rice insect pests could reduce production costs as VND 320,000 and VND 60,000 / ha, respectively in dry season and as VND 452,000 / ha in both Ometar and Biovip treatments in wet season.

Key words: Bioinsecticide, Biovip, Brown plant hopper, Natural enemy, Leaf folder, OMetar, Production cost

INTRODUCTION

In the past, immediate solution to pest problems has been dealt with chemical pesticides. Development of resistance to chemical insecticides and concerns over the deleterious effects of chemicals on environmental and human safety have provided a strong impetus for the development of microbial control agents in integrated pest management. A diverse assemblage of microorganisms is currently under consideration as control agents of insects, including viruses, bacteria, protozoa and fungi. Of the fungi, considerable effort has focused on development and utilization of entomopathogenic Hyphomycetes (Inglis et al. 2001). The conidia of these fungi strongly adhere to insect cuticles, germinate and penetrate the cuticles. Insect death may result from a combination of actions, including depletion of nutrients, physical obstruction or invasion of organs and toxicosis.

Many bioproducts from *Metarhizium* and *Beauveria* fungus genera have been applied worldwide to control insect pests as Biogreen, Bio-Path, BioBlast, Cobican, Boverin, Boverol, Ostrinil, etc... (Burges 1998; Butt and Copping 2000). OMetar and Biovip are bioinsecticides from *Metarhizium anisopliae* and *Beauveria bassiana* fungi produced by Insect Ecology and Biological Control Department to control brown plant hopper (BPH), rice bug and lepidopterans. However, beside the efficacy of these bioinsecticides, the economic efficiency should be estimated to bring optimum profit when they were used. So our field experiments were carried out in 2004 dry and wet seasons to understand the technical and economic performance of bioinsecticides and chemical pesticides to control rice insect pests.

Objectives:

- To compare fluctuation of insect pests and natural enemies populations
- To compare production cost of the two treatments and grain yield.

MATERIALS AND METHODS

1. Materials:

Jasmine 85 was used as a susceptible check to BPH and other insect pests. Fertilizers were applied 80-40-30 kg NPK/ha. OMetar and

Biovip products were formulated at 1.2×10^9 spores / gram. Chemical pesticides as Bassa, Applaud, Actara were used to control BPH; Hopsan and Peran were used to control rice bug and leaf folder, respectively.

2. Methods:

The experiment included treatments as OMetar, Biovip and chemicals. The plot size was 1000 m^2. Cultivation and production costs except for insect management were uniformed in all the treatments.

OMetar and Biovip were applied when more than 3 BPHs / tiller or about 1000 BPHs / m^2 were observed, number of rice bug or leaf folder was more than 10 individuals / m^2. Concentration of OMetar and Biovip were applied at 6×10^{12} spores / ha (about 4kg / ha). Chemical pesticides were applied when BPH, rice bug or leaffolder were present. The number of BPH, rice bug and leaf folder and their natural enemies were observed at 10-day interval from 30 days after sowing (DAS). Sampling was carried out at 10 points on 2 crisscross lines of each plot. Data analysis was done by MS Excel program.

RESULTS AND DISCUSSIONS

1. Fluctuation of insect pests between two bioinsecticide and chemical treatments

In 2004 dry season, BPH early occurred at 30 DAS and its population reached high peak at 50 DAS. Biovip was applied at 40 DAS because BPH population was higher than 1,000 individual / m^2 and was repeated at 50 DAS to control second generation of BPH. In OMetar plot, product was only applied at 50 DAS when BPH population per m^2 was over 1,000. After treating bioinsecticides, the BPH population reduced at acceptable level at 60 and 70 DAS. Chemicals was applied in chemical treatment such at 30 DAS, 40 DAS, 50 DAS and 60 DAS because BPHs were present in the field (Figure 1).

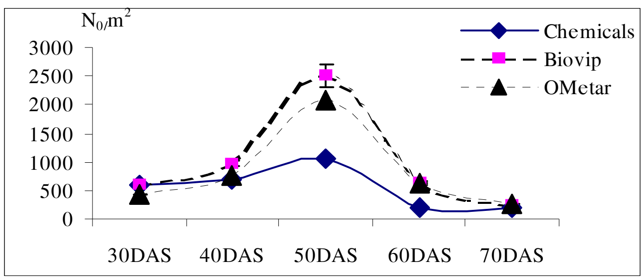

Figure 1: Population dynamics of BPH in 2004 dry season (No/m^2)

In 2004 wet season, BPH population was noticed to be high at 30 DAS in three treatments and all were applied bio- or chemical-insecticides. Then, number of BPH reduced and became equal at 50 DAS among all 3 treatments. At 60 DAS, BPH peak occurred and chemical insecticide was applied in chemical treatment plots. This made BPH population reduced in chemical treatments but still higher than that in Biovip or OMetar treatments especially at 70 DAS. This can be explained by the role of conserved natural enemies in Biovip or OMetar treatments (Figure 2).

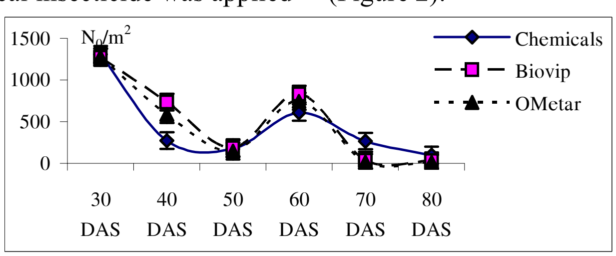

Figure 2: Population dynamics of BPH in 2004 wet season (No/m^2)

Figure 3 showed that leaf folder population in chemical treatment was very high at 70 day after sowing (about 65 larvae per m^2) which was significantly higher than that in OMetar and Biovip treatments (about 4-9 larvae per m^2). This result indicated that due to regularly use of chemical insecticides in the chemical treatment to control BPH that could kill the natural enemies, therefore, leaf folder population of this treatment was very high. Ometar and Biovip could give the effective control to leaf folder and they could not affect to natural enemies. Therefore, leaf folder population in these two treatments was very low.

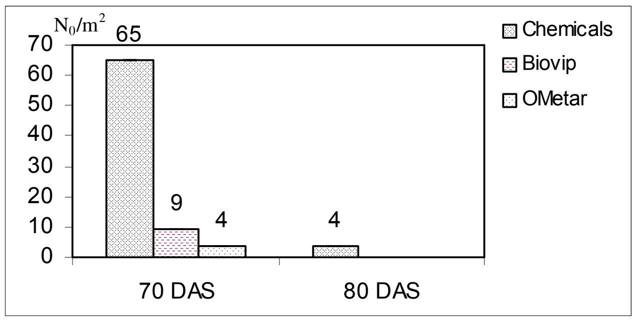

Figure 3: Population density of leaf folder (No/m^2) in 2004 wet season.

2. Fluctuation of natural enemy populations between two bioinsecticide and chemical treatments

Natural enemies play a very important role in rice fields because they control insect pest population levels below the Economic Injury Levels (EILs). The fluctuation of natural enemy populations between two bioinsecticide and chemical treatments was expressed in following results.

The population of predatory spider in Biovip and OMetar treatments was usually higher than that in chemical treatment, even though the significant difference in the population of predatory spider in bioinsecticide and chemical treatments was observed only at 40 DAS and 70 DAS (Figure 4).

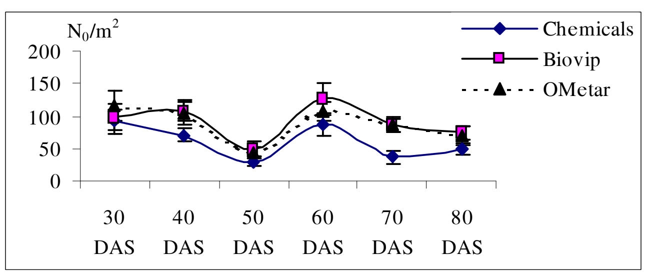

Figure 4: Population dynamics of predatory spiders (No/m^2).

Plant bug, *Cyrtorhinus* is also a natural enemy in the rice field as it could eat eggs and larvae of insect pests. Plant bug population in OMetar and Biovip treatments usually occurred in the field higher than that in chemical treatment in during the time of observation (Figure 5). That could be explained that OMetar and Biovip did not affect to the plant bugs, but the chemical insecticide adversely created effects to this natural enemy.

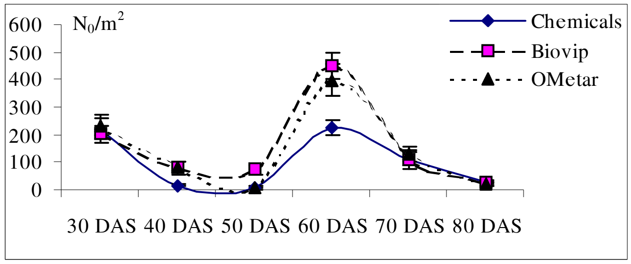

Figure 5: Population dynamics of predatory plant bug (No/m^2).

Water bug, *Microvelia* is the best useful natural enemies as they attack pests in each group. Their population in the rice field depends upon water level and the presence of insect pests as food source.

Figure 6 showed that water bug population were very high in OMetar and Biovip treatments (about 300 per m^2) at 60 DAS and had the same trend with BPH population. Besides, water bug population in chemical treatment was lower than that in OMetar and Biovip treatments because they are susceptible to chemical pesticides.

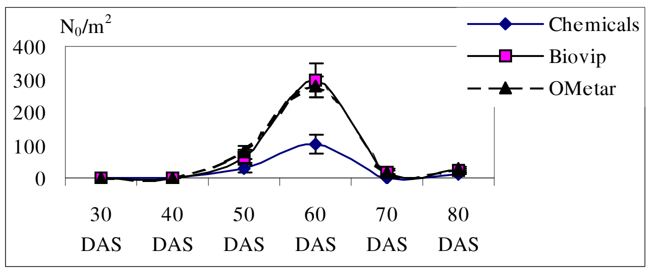

Figure 6: Population dynamics of predatory water bug (No/m^2).

3. Rice yield between two bioinsecticide and chemical treatments

Average yield in the treatments were roughly noticed 6 ton/ha in dry season and 3 ton/ha in wet season. However, no significant difference among the treatments was recorded (Figure 7).

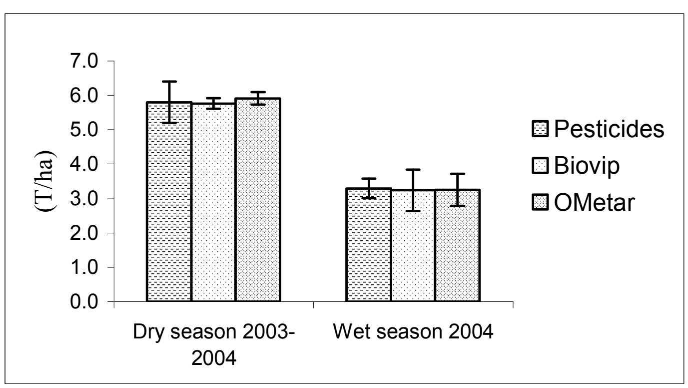

Figure 7: The rice yield of two bioinsecticide and chemical treatments in 2004 dry and wet seasons (Ton/ha).

4. Economic efficiency between two bioinsecticide and chemical treatments

We can compare the difference of economic efficiency among 3 plots based on calculating production costs and income from rice products (Table 1 and 2).

Table 1. The economic efficiency of two bioinsecticide and chemical insecticide treatments in 2004 dry season (VND / 1000 m^2)

	Insecticide	**OMetar**	**Biovip**
	(VND)	(VND)	(VND)
* Pesticides	58,000	0	0
* Bioinsecticides	0	26,000	52,000
* Other Costs	903,000	903,000	903,000
Total Costs	961,000	929,000	955,000
Difference from insecticide	**-**	**32,000**	**6,000**
Grain yield (Kg)	580	591	577
Price: (VND/Kg)	1,900	1,900	1,900
Income:	1,102,000	1,122,900	1,096,300
Net profit:	141,000	193,900	141,300
Income difference from insecticide	**-**	**52,900**	**300**

Table 1 indicated that Ometar and Biovip treatments to control rice insect pests could reduce production costs as VND 320,000 and 60,000 / ha, respectively as compared to chemical insecticide application. Particularly, Ometar application to control rice insect pests could increase the income as VND 529,000 / ha as compared to chemical application in 2004 dry season.

Table 2. The economic efficiency of two bioinsecticide and chemical insecticide treatments in 2004 wet season (VND / 1000 m^2)

	Insecticide	**OMetar**	**Biovip**
	(VND)	(VND)	(VND)
* Pesticides	71,200	0	0
* Bioinsecticides	0	26,000	26,000
* Other Costs	700,000	700,000	700,000
Total Costs	771,200	726,000	726,000
Difference from insecticide	**-**	**45,200**	**45,200**
Grain yield (Kg)	329	325	324
Price: (VND/Kg)	2,500	2,500	2,500
Income	822,500	812,500	810,000
Net profit	63,300	86,500	84,000
Income difference from insecticide	**-**	**35,200**	**32,700**

In 2004 wet season, we spray the bioinsecticide only once to manage rice insects for the whole season of rice. In the chemical treatment plots, we had to spray many times to control the BPH and rice leaf folder. Therefore, the production costs of Ometar as well as Biovip was reduced as VND 452,200 / ha as compared to chemical insecticide treatment. Ometar and Biovip application to control rice insect pests could increase income as VND 352,000 and 327,000 / ha, respectively as compared to chemical insecticide in 2004 wet season (table 2)

CONCLUTIONS:

The use of two entomogenous fungal bioinsecticides, OMetar and Biovip to control rice insect pests could reduce production costs as VND 320,000 and 60,000 / ha, respectively in the 2004 dry season; as VND 452,000 / ha in both two bioinsecticides in 2004 wet season. OMetar and Biovip were safe to natural enemies such as spiders, plant bug and other predators of rice insect pests. Recommendation should be addressed as combination of bio-pesticides with other cultural practices into IPM, INM to bring further economic performance and reduce environmental pollution.

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So sánh hiệu quả kinh tế giữa sử dụng thuốc trừ sâu sinh học Ometar / Biovip và thuốc hóa học trong phòng trừ sâu hại lúa

Thí nghiệm về so sánh hiệu quả kinh tế của việc áp dụng hai loại thuốc sinh học và thuốc hóa học trừ sâu hại lúa đã được thực hiện ở Viện lúa ĐBSCL trong hai vụ Đông xuân 2003-2004 và Hè thu 2004. Kết quả thí nghiệm đã cho thấy rằng việc sử dụng hai loại thuốc sinh học OMetar và Biovip có tác dụng quản lý sâu rầy hại lúa tốt, đồng thời giúp bảo tồn hệ thiên địch trên ruộng lúa và an toàn đối với người và môi trường. Áp dụng thuốc sinh học có thể giảm chi phí sản xuất lúa so với thuốc hóa học, cụ thể là 320.000 đ và 60.000 đ/ha khi sử dụng OMetar và Biovip trong vụ Đông xuân 2003-2004; giảm chi phí sản xuất lúa là 452.000 đ/ha trong vụ Hè thu 2004 với cả hai loại thuốc trên. Nên kết hợp sử dụng thuốc sinh học OMetar và Biovip với các biện pháp canh tác trong quản lý dịch hại tổng hợp, quản lý dinh dưỡng tổng hợp nhằm tăng cao hiệu quả kinh tế và giảm ô nhiễm môi trường.