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Brown Planthopper (*Nilaparvata lugens*) and Pest Management in Thailand

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Introduction

Rice is a major food security crop in Thailand as well as in other countries of the Asian region. Thailand is the world's largest exporter of rice; 9.03 million tons of rice were exported in 2010. The most produced strain of rice in Thailand is jasmine rice, which is a higher quality type of rice. However, jasmine has a significantly lower yield than other types of rice, but it normally fetches more than double the price of other strains on the global market. Insect pests are a serious problem in rice production and decrease rice yields. Outbreaks of pests are due to a number of reasons and is symptomatic for unsustainable agricultural practices. Amongst the unsustainable practices are the excessive and indiscriminate pesticide applications that impact upon beneficial organisms through ecological disruptions and resistance of the target pests to the applied pesticide. Furthermore, global warming may affect crop damage caused by insect pest, by changing the degree of synchronisation between pest occurrence and the susceptible stage of crops. This is the case of the brown planthopper (BPH), *Nilaparvata lugens* Stal is a serious insect pest, especially in tropical Asia on continuously cultivated rice. Both nymphs and adults of BPH damage rice plants through extensive feeding on them. BPH also transmits viruses such as rice ragged stunt (RRSV) and rice grassy stunt (RGSV). Thus, increased levels of BPH occasionally accompany substantial losses of rice crops through virus diseases. There is now clear evidence of resistance development to some of the recently introduced pesticides such as imidacloprid and other groups of chemical use in rice field. Reducing the vulnerability of the rice crop to pest outbreaks entails a holistic management approach and understanding of the key sciences, *viz.* ecology and toxicology. This present study searched for potential biocontrol

candidates of BPH from 2 isolates of *Metarhizium anisopliae* and two isolates *Beauveria bassiana* and pest management practices for control brown planthopper in Thailand.

Material and Methods

Insect

Adult and nymphs of Brown planthoppers (Fig. 1) collected from the rice fields of Sanpatong district, Chiang Mai Province, were maintained on 20-30 days susceptible rice variety TN1 in the fine-mesh nylon cages in a greenhouse (28 $\pm$2°C, 70-80 % RH). Water were provided in pot about 3 cm above ground. Brachypterous adults taken from this population were transferred onto new seedling and allowed to lay eggs for 3 days. The adults were then removed and the eggs laid on the seedling were allowed to develop into third-instar nymphs under the same conditions.

Preparation of conidial suspension

Two *Metarhizium anisopliae* (BCC 4849 and BCC 4810) and two *Beauveria bassiana* (BCC 6241 and BCC 2637) were obtained from Culture Collection, National Center for Genetic Engineering and Biotechnology (BIOTEC, Thailand). All cultures were grown on potato dextrose agar (PDA) (Difco, Becton-Dickson, USA) for 10 days. Conidial suspensions were prepared by lightly scraping the fungal culture surface with a sterile cell spreader. The conidial clumps were suspended in distilled water with 0.1% Tween 80 (ICI Americas, Norwich, NY, USA). The suspensions were vortexed for 2 min to dissociate clumps and then filtered through two layers of cheesecloth to remove conidial clumps and mycelial debris. Concentration of each suspension was diluted to 2 x 10^8 conidia/ml determined by a hemocytometer under a phase-contrast microscope. The suspensions were shaken before use.

Insect bioassays

The pathogenicity tests with different isolates of *B. bassiana* and *M. anisopliae* against third instar nymphs of brown planthopper (BPH) were done in greenhouse. The conidial concentration was 2 **x** 10^8 conidia/ml. Plants used in the bioassays were grown in peat-based compost standing in approximately 3 cm water, under the same conditions, at the start of the bioassays rice were 15-20 cm tall, approximately 3 weeks post germination. The pots were placed in a cage (60 x 60 x 200 cm) and covered with a nylon sheet to prevent BPH contaminate to the rice field. Six treatments consisting of 4 entomopathogenic fungi with an untreated control and a water treated with tween 80 control were performed in three replicates. Ten third-instar BPH nymphs, between

2 mm and 2.5 mm long were released onto each of the pot 1 day before application. Aliqouts of 2 ml of a fungal suspension were sprayed into each pot. Mortality was monitored at 3 and 7 days, and dead nymphs were incubated individually, on sterile filter paper. For confirmation of fungus infestation of the dead BPH, cadavers were dipped in a 10% sodium hypochlorite (NaOCl) solution (Sigma-Aldrich, MO, USA) for 5 min, allowed to dry, placed on PDA amended with chloramphenicol (0.1%) and monitored for possible mycelium germination.

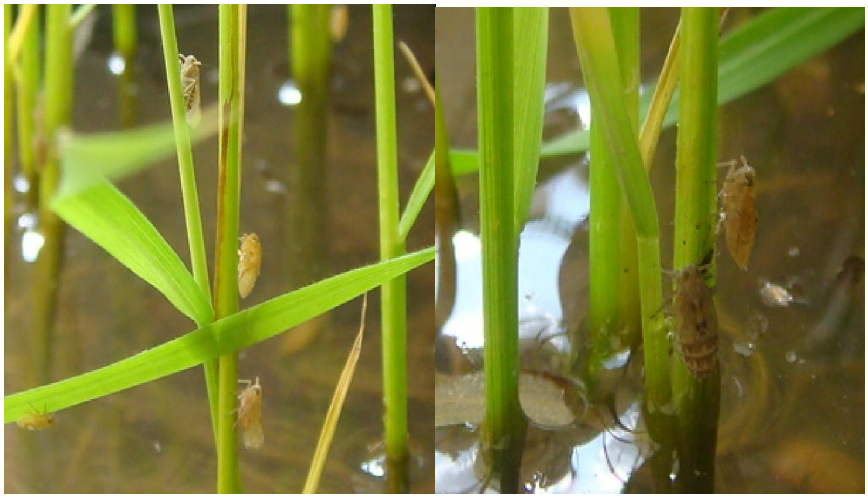

Figure 1. Habitat of Brown plant hopper (*Nilaparvata lugens*)

Results and Discussion

At the recommended dose of 2 **x** 10^8 conidia/ml, bioassay of BPH showed that *M. anisopliae* BCC 4849 was the best in terms of optimum nymphs mortality within 7 days after spraying. Initial mortality was observed at 3 days after treatment. Four entomopathogenic fungi bioassays were summarized in Table 1. Mortality of all isolates quite low ranged from 6 to 20.33 % at 3 days after application and cumulative mortality were increased at 7 days after spray application (53.33- 72%). Mortality was highest by *M. anisopliae* BCC 4849 (72%) and *B. bassiana* BCC 2637 (66.67%). However, *M. anisopliae* BCC 4810 and *B. bassiana* BCC 6241 gave BPH cumulative mortality at 7 days 53.33 and 60 % respectively. Control of conidial deposits on the sprayed nymphs is another important concern. Another source of the variation could arise from the time control of conidial spray and deposition by hand, which was difficult to keep uniform for all the sprays, in spite of being carefully operated. (Jin et al. 2008). None of all isolates test in this work killed more than 80 % BPH nymphs. This is in accordance with the results of unpublished BPH bioassays of many fungal isolates that were undertaken in the early 1980s (Roberts and Leger, 2004; Jin et al, 2008 and Jin et al, 2010). Almost all of the cadavers placed in the moist

chambers were mycotized when examined individually under a microscope. No mortality or fungal was found in control groups.

Table 1. % Mortality of BPH by entomopathogenic fungi at 3 and 7 days after spraying.

No	Treatments	Cumulative mortality (%)	
		3 days	7 days
1	*M. anisopliae* BCC 4849	20.33	72.00 a
2	*M. anisopliae* BCC 4810	10.67	53.33 c
3	*B. bassiana* BCC 6241	6.00	60.00 b
4	*B. bassiana* BCC 2637	10.33	66.67 ab

Conclusions and Outlook

Two entomopathogenic fungi *M. anisopliae* BCC 4849 and *B. bassiana* BCC 2637 were found to be promising fungal candidates for biological control of rice pest such as BPH. Efficacy of BPH control of both fungi were ranging from 66.67 - 72%. The potential of these entomogenous fungi for controlling BPH needs to be continued studying on other rice insect pests. The simple methods to produce fungal biomass has to be demonstrated in small scale areas before developing in large scale areas. However, Integrated pest management (IPM) is the best way to control rice pest such as cultural control methods are needed to help reduce the brown planthopper population. Simultaneous rice cropping, if practiced over a wide area and rotated with secondary crops, would break the life cycle of the insect pest. Water management by raising a field 's water level or draining it for a few days would help destroy the insect population (Oka,1979). However, if high infestation of BPH, selected chemicals have enhanced field control of a numbers of phloem feeding insect pest. Such approaches can be utilized to increase the potential for successful exploitation and integration of fungal pathogens for BPH control. The evidence indicates that the potential for development of a mycoinsecticide for the biological control of BPH warrants further studies.

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