Research article

Resource-based Alternative Approach on Rice Bug *(Leptocorisa oratorius* Fabricius*)* Management for Food Security and Bio-safety

MARINA A. LABONITE*
Research and Development Center, Bohol Island State University, Philippines
Email: mtalabonite@yahoo.com.ph

Received 17 December 2012 Accepted 6 May 2013 (*Corresponding Author)

Abstract: In the Philippines, rice bug is a serious menace at reproductive stage of rice causing qualitative as well as quantitative losses resulting in yield reduction by 14% (PGCPP-BPI-MAF, 1986). Thus, chemical pesticides become an instant management strategy in rice culture for many decades until even after users realized its adverse effects on environment and human health. Though effective, various reports are made on pesticide residues in food, soil, water, air and overall environment causing health problems (Magallona, 1985). These problems are more than lessons from the technology. Hence, the need to seek for an effective technology that also reduces input costs while assuring supply of safe and nutritious food for man and all useful organisms, tapping common yet underutilized pest-repellent plant species. The Hindu (2002) reported that companion planting with repellent and trap crops is among the safe but sure ways to manage the insect pests of crops. Repellents are plants with strong natural aroma that can ward-off insect pests away. This experimental research determined the usefulness of resource-based alternative approach on rice bug management using four repellent plant species. A two-factorial randomized complete block design was employed with sites and repellent species as factors. The indigenous repellents tested in three replicates per site were: Bamboo (*Bambusa levis* L.), Erect Shell (ES) Ginger Plant (*Catimbium haenkei* L.), Malubago (*Hibiscus tiliaceus* L.) and Sand Ginger (*Kaempferia galanga* L.) with one control treatment as check. The statistical analysis revealed that the repellents tested were all effective in reducing rice bug population and infestation compared to the control, however, Bamboo and Sand Ginger are the most significantly effective. Findings imply that resource-based approach using repellents is efficient in reducing rice bug population and infestation, thus, it is valuable in preventing its yield loss in producing safe food and in making the rice agro-ecosystem safe for the useful organisms.

Keywords resource-based alternative approach, pest management, food security, bio-safety, chemical approach in pest management, repellents

INTRODUCTION

Rice grain is an important human food in many parts of the world but the plant is a host of various insect pests like rice bugs. Heinrich (1985) observed that rice bugs nymphs are more active feeders than adults but the latter cause more damage as they feed for a longer period of time. Feeding may contaminate grains with pathogens that cause discoloration or pecky rice of impaired quality and susceptibility to breakage during milling. To avoid this, farmers resort to pesticide sprays when rice bugs are in a damaging stage and state.

However, the World Bank (2005) warned that if mismanaged, most pesticides can lead to crop losses and pose a risk to human health and the environment. This includes the cost incurred due to pesticide clean-up, cost related to human health and cost incurred due to increase in pesticide resistance in insects and disease vectors and destruction of natural enemies of pest species, that may result in lost value in agricultural produce. Hence, there is a need for an alternative approach that assures safe and nutritious food for man and all useful organisms.

Mihindo (2002) asserted that humankind has become more conscious on the fragility of the earth in the face of technological development. The conventional farming technology has precipitated many of our problems as people are left with a depleted and abused environment and deepening moral apathy. Success in development is more likely to be achieved when traditional knowledge systems are fused with modern technology.

Among the indigenous, safe but sure ways to manage insect pests of crops is companion planting with repellent crops (Hindu, 2002). Repellents are plants with chemical properties to ward off pests away. However, no data are available that show the effectiveness of these species to rice bugs, hence, this study was done.

The experiment aimed to determine the effects of indigenous repellent species on rice bug population, infestation and yield of rice. Being proven effective, these plant genetic resources shall be conserved and utilized as an alternative approach on rice bug management for food security and bio-safety.

OBJECTIVE

The main idea of this research was to determine the usefulness of a resource-base alternative approach using indigenous repellent plant species on rice bug management. Specifically, the study was aimed for the following objectives:

1. To assess the usefulness of *Bambusa levis* L., *Catimbium haenkei* L., *Hibiscus tiliaceus* L. and *Kaempferia galanga* L. in resolving rice bug infestation
2. To identify the repellent species that is significantly effective in minimizing rice bug population and infestation
3. To evaluate the effect of indigenous repellents on the yield of treated crops and
4. To find out the interaction of factors particularly the site and repellent species on the infestation of rice bugs.

METHODOLOGY

Participatory on-farm experimentation was employed with the cooperation of farmers in four municipalities with natural growth of repellent species: Bilar, Pilar, San Miguel and Tubigon in Bohol, Philippines. A two-factorial randomized complete block design (RCBD) with three replicates was adopted. Sites and the botanicals are the two factors studied. Four indigenous repellent species were tested with one control treatment as check with no repellents used. The repellent Bamboo (*Bambusa levis* L.) locally named Butong; Erect Shell (ES) Ginger Plant (*Catimbium haenkei* L.) or Tagbak; Malubago (*Hibiscus tiliaceus* L.) or Mabago; and Sand Ginger (*Kaempferia galanga* L.) or Kiso were used.

The rice crop host of the rice bug was grown following recommended cultural management practices except on pest management. To confine the rice bug/test pest and facilitate data collection that measure the effectiveness of the repellents, a mesh net enclosure at 1.5 m high was established in all plots in four sites before heading stage of rice started.

Data collection was done weekly in all plots in four sites in four consecutive weeks. The data gathered were rice bug (nymphs and adults) population, number of infested grains per panicle using 10 randomly selected panicles and the yield of rice in kilograms at 14% moisture content per plot per block. To determine the significance between the treatments, all data gathered were analyzed using analysis of variance (ANOVA). The same data were subjected to further test of significance using Tukey's Honest Significant Difference (HSD) Test.

RESULTS AND DISCUSSION

Usefulness of repellent species in reducing rice bug population

The average population of rice bugs is presented in Fig. 1. It reveals a fluctuating trend. The data imply that Bamboo was very effective and useful in reducing the rice bug population, followed by Sand Ginger, ES Ginger Plant and Malubago as the least effective. Though Malubago was less effective, data still indicated that it has much lower rice bug count than the Control.

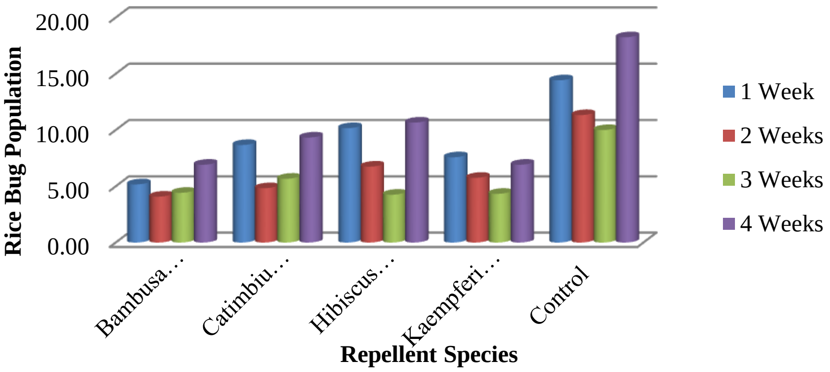

Fig. 1 Average rice bug population per repellent species in all sites

The ANOVA on the rice bug population gives a highly significant difference between repellents, between sites and in its interactions. This means that rice bug population in the experiment was affected by the significant effects of each repellent used and by the varied conditions of the study sites.

Table 1 Tukey's HSD Test on rice bug population as affected by repellent species

Repellents		RICE BUG POPULATION							
		1st Week		2nd Week		3rd Week		4th Week	
		Subset		Subset		Subset		Subset	
		1	2	1	2	1	2	1	2
Bamboo	*B. levis*	5.17		4.08		4.42		6.92	
Sand Ginger	*K. galanga*	7.58	7.58	5.75		4.33		6.92	
ES Ginger	*C. haenkei*	8.67	8.67	4.83		5.66	5.66	9.33	
Malubago	*H.tiliaceus*	10.17	10.17	6.75	6.75	4.25		10.67	
Control			14.42		11.33		10.00		18.25
Significant		0.276	0.083	0.507	0.095	0.905	0.120	0.168	1.000

** Means within the same subset are not significant to each other.*

Table 2 Tukey's HSD Test on rice bug population as influenced by site

Sites	RICE BUG POPULATION								
	1st Week		2nd Week		3rd Week		4th Week		
	Subset *		Subset *		Subset *		Subset *		
	1	2	1	2	1	2	1	2	3
Bilar		11.53		11.33	2.80		7.40		
Pilar	8.47	8.47	5.53			11.39			16.73
San Miguel	3.00		4.13		4.60			11.87	
Tubigon		13.80	5.20		4.13		5.67		
Sig.	0.096	0.107	0.776	1.000	0.620	1.000	0.601	1.000	1.000

** Means within the same subset are not significant to each other.*

Table 1 and Table 2 show the Tukey's HSD Test of significance on the rice bug population. Table 2 shows a similar weekly trend of significantly lower rice bug population for Bamboo-treated crops ranging with only 4.08 to 6.92 bugs over the other repellents and the control which have higher average count ranging 10.00 to 18.25 bugs. The two Ginger species are also showing lower bug population with 4.33 to 7.58 for Sand Ginger; and 4.83 to 9.33 bugs for ES Ginger Plant compared to the control. Table 3 illustrates the significant and constant influence of San Miguel site on the effectiveness of the repellents in reducing rice bug population ranging from 3.00 to 11.87 bugs compared to other sites, though Tubigon and Pilar follow the trend while Bilar's influence on the effectiveness of the repellents came only on the last two weeks.

Effective repellents in minimizing rice bug infestation

The rice bug infestation in terms of average number of rice bug-infested grains per site per repellent is presented in Fig. 2. The data indicate that rice bug infestation was consistently low in the Bamboo-treated plots and consistently high in the Control plots. This implies that Bamboo is a very effective controlling species for rice bug, and thus, can be used in its management while producing a safe food and securing the agro-ecosystem for all life forms. The data also disclosed that in all sites, Bamboo is an effective repellent for rice bug management as it reduced its infestation better than the other species wherever it was. However, the other three repellent species gave better protection than the Control.

Table 3 shows that rice bug infestation in repellent-treated crops is significantly different compared to the Control at 5% level. However, the difference in infestation between sites is highly significant at 1% level, so do with the interactions of the species and sites. This analysis implies that the degree of effectiveness of the repellents is not only governed by the inherent quality of each species itself but also by the site where the repellents are used. Therefore, the efficiency of the species depends on the area where it will be used as also shown in Fig. 2 where *B. levis* has significantly reduced bug infestation in Pilar, San Miguel and Tubigon but not in Bilar while *K. galanga* gave better protection to rice in Tubigon and San Miguel but not as effective as in other sites, thus, one species will not work efficiently in all areas.

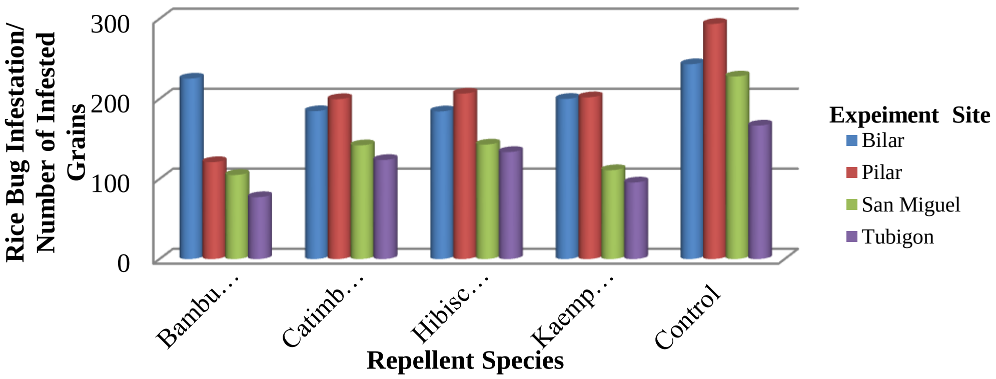

Fig. 2 Average rice bug infestation per repellent species per site

Table 3 The ANOVA on the rice bug infestation per repellent per site

Sources of Variation	F-Value	Significance
Repellent Species	7.669	*.003
Site	12.733	**.000
Repellent Species x Site	761.972	**.000
C. V. = 16.20%		

** significant at 5% level* *** highly significant at 1% level*

The Tukey's HSD Test on rice bug infestation shows that all repellents had significantly lower infestation compared to the control. As to site, Rice bug infestation was significantly lesser in San Miguel and Tubigon than in Pilar and Bilar implying that rice bugs activity is also influenced by rice environments.

Influence of the repellent species on yield of rice

Both nymphs and adult bugs suck the milky white endosperm of rice grains at milking stage. The removal of milky sap usually results in smaller grains causes yield reduction. Figure 3 shows that in every site, rice plants treated by each species produced closely similar yield but untreated plants had lower harvest. Findings impart that the use of repellent species can improve rice yield via the protection against bugs it provided the crop.

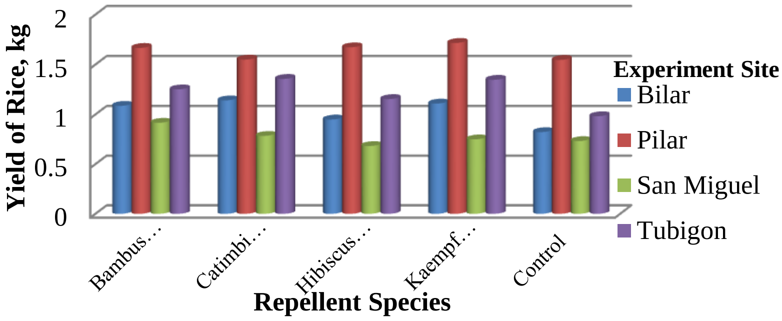

Fig. 3 The average yield of rice, in kilograms, per repellents species per site

The analysis of variance on yield in Table 4 shows a significant degree of difference in yield between repellent species but a highly significant variance between sites, and on the interaction between site and species. This implies that yield was significantly influenced by site factor and by the repellents themselves. It also indicates that rice yield differed depending on the site and on the repellent species.

Table 4 Analysis of variance on rice yield of test crop

Sources of Variation	F-Value	Significance
Repellent Species	4.559	*.018
Site	88.931	**.000
Repellent Species x Site	3659.681	**.000
C. V. = 7.21%		

** significant at 5% level* *** highly significant at 1% level*

The results of the Tukey's HSD Test on yield of test crop revealed that among repellent species, ES Ginger Plant and Malubago are not significantly different to each other and the Control, but these had significantly lower in yield than those with Bamboo and Sand Ginger.

The test also illustrates a highly significant degree of difference in yield between sites. The result also imparted that aside from the effects of the repellents used; the site factor somehow caused a significant difference on the yield of the crop as rice is a site-specific crop.

CONCLUSIONS

Based on the data gathered in this experiment, the following conclusions were made:
1. Bamboo (*Bambusa levis* L.), ES Ginger Plant (*Catimbium haenkei* L.), Malubago (*Hibiscus tiliaceus* L.) and Sand Ginger (*Kaempferia galanga* L.) are useful in resolving rice bug infestation, these can be an alternative approach in rice bug management.
2. All the four repellent species are effective in reducing rice bug population and infestation compared to the control, however, Bamboo and Sand Ginger are the two most valuable species.
3. The effect of the repellent species on the yield of the treated crops was significantly higher especially for Bamboo and Sand Ginger but those with ES Ginger Plant, Malubago and the control had similar lesser harvest.

4. There was a significant interaction of between the repellents and sites on the infestation of rice bugs as evidenced by the effect of Bamboo that significantly reduced bug infestation in Pilar, San Miguel and Tubigon but not in Bilar. It is showing that its repelling performance of Bamboo is not only the function of the species but also of the site.
5. Since Bamboo and Sand Ginger are significantly effective for rice bug management, these repellents should be conserved for food security and bio-safety. To promote conservation, it should be used, protected and domesticated.

ACKNOWLEDGEMENT

The author highly recognizes the active participation and cooperation of the farmer-partners in the four experiment sites and the BISU administration for the permission and financial support.

REFERENCES

Heinrichs, E.A., Reissig, W.H., Litsinger, J.A., Moody, K., Fiedler, L., Mew, T.W. and Barrion, A.T., 1986. Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia. International Rice Research Institute, Laguna, Philippines.

Magallona, E. 1980. Pesticide management. Businessday Corporation, Inc. Makati, Metro, Manila. Philippine. 17-18.

Mihindo, N. 2002. Organic agriculture in Kenya. Fusion of Science and Traditional Knowledge, Kenya Institute of Organic Farming. Nairobi, Kenya.

The Hindu, 2002. Herbal pesticides. (http://www.thehindu.com/todays-paper/tp-features/tp-sci-tech-and-agri/a-farmer-develops-a-herbal-pest-repellent-after-suffering-from-chemical-pesticides/article671747.ece)

The Hindu, 2002. Companion planting to manage crop pests. (http://www.hindu.com/thehindu/seta/2002/08/22/stories/2002082200140300.htm)

PGCPP-BPI-MAF,1986. Malate, Ministry of Agriculture. Manila,Philippine. 62.

World Bank, 2005. Sustainable pest management. Achievements and Challenges. World Bank Publishing Center.Washington D.C., USA.