Biology, Ecology and Behavior of Rice Planthoppers and their Parasitoids*

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Introduction

The brown planthopper, *Nilaparvata lugens* has become a serious threat to rice production throughout tropical and sub-tropical Asia. It causes "hopper-burn" and complete wilting and drying of rice plants. The brown planthopper causes severe damage to rice crops not only by intensive sap sucking but also by transmitting virus disease. Large-scale rice crop damage caused by this pest was reported in the 1970s in several South and Southeast Asian countries. Another *N. lugens* population was found to infest a weed grass *Leersia hexandra* that grows abundantly in canals near irrigated rice fields in Southeast Asia. The *Leersia* infesting *N. lugens* population fails to survive on rice plants. Conversely, rice infesting N. *lugens* does not thrive on *Leersia.* There is a controversy among the scientists whether *N. lugens* of *Leersia* represents a biotype or a sibling species or a cryptic species. The studies were undertaken to determine whether any cryptic or sibling species exist in *N. lugens.*

Materials and Methods

A total of 15 experiments including morphological, molecular genetic and host plant relationship studies were conducted to differentiate two sympatric populations of brown planthopper, *N. lugens,* one from rice and the other from *L.hexandra,* a weed grass. Seven morphological characters from males and characters of stridulatory organs were studied. Experiments were conducted on survival and ovipositional response, adult longevity, fecundity and assimilation of food, mate choice and genetic status (Latif *et al.*, 1998b, c) of rice and weed associated populations of *N. lugens.* Isozymes analyses were done using starch gel electrophoresis (Latif *et al.* 1998a). Inheritance studies of isozymes, short and long primers RAPD markers (Latif *et al.*, 2000) in *N. lugens* were also done. Inheritance and association of malathion resistance was studied. For population genetic studies, RAPD and DALP (Latif *et al*, 2000) markers were analysed. Studies on parasitiods of brown planthopper were also done.

Results and Discussion

The scatter plot based on seven morphometric characters indicated that insect with high esterase activities (usually caught off rice) and those with low esterase activities (usually caught off *L. hexandra*) showed 6-8% overlapping between the two populations of *N. lugens.* But scatter plot of the morphological characters of stridulatory organs produced distributions that were almost non-overlapping. Scanning electron micrographs showed some variations in different morphological characters but were not population specific. No heterogametic mating occurred in mate choice experiments. Crosses between the populations showed some barriers for hybrid production. Out of 18 enzymes, six loci were found to be polymorphic at 95% criterion namely, *Mdh, Idh, Pgm, Gpi, 6Pgd* and *Acp.* The genetic distance (average 0.182) and the existence of a diagnostic enzyme marker (GPI) between rice and *Leersia* infesting populations indicated that both populations are closely related but different species. The inheritance of GPI, IDH and MDH isozymes were studied in families generated from mating individuals of two sympatric populations of *N. lugens.* These *loci* were inherited in simple Mendelian fashions. The inheritances of short and long primers RAPD were studied. Thirty-one bands could be tested for segregating ratios in two families of *N. lugens* and they were found to be inherited in simple Mendelian fashions. Two diagnostic bands, one from short primer RAPD (OPD03.7; 0.65kb) and the other from long primer RAPD (pehA#6.3; 1.00kb) were found to be present only in the *Leersia* infesting populations of BPH. The UPGMA cluster analyses based on both enzyme and RAPD markers showed that all the rice infesting populations of *N. lugens* clustered together as a group and *Leersia* infesting populations of the same localities formed another distinct cluster. Rice plants were best suited for the establishment of the rice infesting population, and *L. hexandra* was a favourable host for the *Leersia* infesting population. Another experiment was conducted to investigate the parasitoids of planthoppers. Several species of Trichogrammatidiae (Hymenoptera) and Mymaridae (Hymeoptera) were obtained from the eggs of *Nilaparvata lugens.* A consideration of the evidence from all the studies on *N. lugens* with high esterase activity usually caught off rice and *N. lugens* with low esterase activity usually caught off *L. hexandra,* suggested that both insect populations from Malaysia belong to closely related sibling species.

Conclusions

A consideration of the evidence from studies on host plant relationships, reproductive isolation, hybridization, morphometric variations, levels of esterase activity, existence of diagnostic isozyme and DNA level markers, genetic distance, consensus tree and molecular variance between *N. lugens* with high esterase activity usually caught off rice and *N. lugens* with low esterase activity usually caught off *L. hexandra* suggested that both insect populations from Malaysia belong to closely related sibling species.

Benefits from the study

Identification of a sibling species complex in brown planthopper, *N. lugens* is important for the formulation of

effective control measures for this major pest of rice. Rice farmers of Southeast Asia will benefit greatly from this.

Literature cited in the text

Latif, M.A., Tan, S.G,. Omar, M.Y., Siraj, S.S. and Is mail, A.R. 2000. Inheritance of Long Primer Random Amplified Polymorphic DNA (LP-RAPD) molecular markers in brown planthopper, *Nilaparvata lugens*. Proc. Of the 4th National Congress on Genetics, 26-28 September 2000, Awana Genting Highlands Golf and Country Resort, Pahang, Malaysia, p. 186-193.

Latif, M.A., Tan, S.G., Omar, M.Y., Siraj, S.S. and Ismail, A.R. 1998a. Evidence of cryptic species complex in brown planthopper, *Nilaparvata lugens*. Proc. of the Malaysian Science and Technology Congress, 7-9 November, 1998, Kuala Terengganu, Malaysia, p. 56-63.

Latif, M.A, Omar, M.Y., Tan, S.G., Siraj, S.S. and Ismail, A.R. 1998b. Studies on the adult longevity, fecundity and assimilation of food between rice and weed infesting populations of brown planthopper, *Nilaparvata lugens*. *Malays. Appl. Biol.*, 27: 20-23.

Latif, M.A., Omar, M.Y., Tan, S.G., Siraj, S.S. and Ismail, AR. 1998c. Survival and ovipositional status of rice and weed associated populations of *Nilaparvata lugens*. *Sci.International* 10: 249-250.

Project Publications in Refereed Journals

Latif, M.A., Omar, M.Y, Tan, S.G., Siraj, S.S. and Ismail, A.R. 1998. Studies on the adult longevity, fecundity and assimilation of food between rice and weed infesting populations of brown planthopper, *Nilaparvata lugens*. *Malays. Appl. Biol.* 27: 20-23.

Latif, M.A., Omar, M.Y., Tan, S.G., Siraj, S.S. and Ismail, A.R. 1998. Survival and ovipositional status of rice and weed associated populations of *Nilaparvata lugens*. *Sci.International.* 10: 249-250.

Graduate Research

Mohd. Abdul Latif. 2000. Genetics [PhD]. Universiti Putra Malaysia.

Rohana Ibrahim. 1998. Entomology [MS]. Universiti Putra Malaysia.

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