UNIVERSITI PUTRA MALAYSIA

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DOCTOR OF PHILOSOPHY
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By

SAN SAN WIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

June 2010

DEDICATION

I dedicate this thesis to my husband U Kyaw Htin Oo and daughter Myintzu Khin for their patience and support during my study in Malaysia

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

POPULATION ECOLOGY OF BROWN PLANTHOPPER (*Nilaparvata* lugens Stal) AND WHITE BACKED PLANTHOPPER (*Sogatella furcifera* Horvath) IN MYANMAR

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June 2010

Chairperson: Professor Rita Muhamad Awang, PhD

Faculty : Agriculture

The ecological studies on the brown planthopper (BPH) *Nilaparvata lugens* (Stal) (Hemiptera: Homoptera) and the white backed plant hopper (WBPH) *Sogatella furcifera* (Horvath) (Hemiptera: Homoptera) were carried out in Myanmar. BPH is one of the major pests of rice and damage by this pest could cause hopper burns due to intensive sucking of the plant. This suggested an urgent need for alternative control measures besides using chemical insecticides. This study was conducted with the objectives to establish the biological life tables of BPH and WBPH, investigate their feeding and movement behaviours and examine the relationships between population fluctuations, host plant, rainfall and humidity in the field. The studies were conducted in an unsprayed rice field at Hmawbe Research Area, Myanmar from July 2007 to May 2008. Age specific survival and fecundity rates of BPH and WBPH were measured under field conditions. A life table was constructed using single sex methods. The population parameters of BPH fed on rice showed that the intrinsic rate of natural increase (r_m) of BPH was 0.0677 per female per day. The daily finite rate

of increase (λ) was 1.07 females per female per day with mean generation time (T) of 34.64 days. The net reproduction rates (Ro) of the population was 10.02. The population doubling in time (DT) was within 10.42 days. The population parameter of WBPH fed on rice showed that the intrinsic rate of natural increase (r_m) of WBPH were 0.0699 per female per day. The daily finite rate of increase (λ) was 1.0255 females per female per day with mean generation time (T) of 34.97. The net reproduction rates (Ro) of the population was 9.2732. The population doubling time (DT) was within 10.88 days. Feeding behaviour studies suggested that in both choice and no choice experiments, the patterns of feeding lesions between BPH and WBPH were quite similar. Higher numbers of feeding lesions were observed on 30 day old plants than 45 day and 60 days old plants. More feeding on leaf sheath than on leaf blade was observed for both planthoppers. In the movement behaviour study, it was revealed that BPH adults were found to be more active than the nymphal instars. In older rice plants, the highest movement (4.7 cm per two hours) was observed on 60-day-old plants and lowest (2.7 cm per two hours) on 30-day-old plants. Increased movements of planthoppers were observed at 13:00hrs. Population fluctuation study revealed that BPH population was high at 64 and 74 DAT (in mid September 2007) associated with heavy rainfall, high temperature and high humidity. The population was lowest at 138 DAT (in the mid week of October 2007) suggesting that low rainfall and low humidity were, at least partially responsible for the decrease population of the BPH. During the dry season, the population was low at 8 DAT (early week of January 2008) and then increased at 31 DAT (first week of February 2008). However, the population declined at 56 DAT and increased to moderate numbers at 86 DAT. The population development trend of WBPH was almost similar to those observed for BPH. During the dry season, the highest WBPH population was

recorded at 90 DAT and the lowest at 33 DAT. During the first cropping coinciding with the rainy season, the fluctuation of planthoppers was correlated with temperature and rainfall. During the second cropping coinciding with the dry season, there was no rainfall and planthoppers population was observed to be correlated to temperature and relative humidity. Therefore, temperature, rainfall and relative humidity influenced planthopper populations during two different rice growing seasons.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ljazah Doktor Falsafah

**POPULASI EKOLOGI BENAH PERANG (*Nilaparvata lugens* Stal) DAN BENAH PUTIH
(Sogatella furcifera Horvath) DI MYANMAR**

Oleh

SAN SAN WIN

June 2010

Pengerusi : Profesor Rita Muhamad Awang ,PhD

Fakulti : Pertanian

Suatu kajian dari aspek ekologi benah perang (BPH) *Nilaparvata lugens* (Stal) (Hemiptera: Homoptera) dan benah putih (WBPH) *Sogatella furcifera* (Horvath) (Hemiptera: Homoptera) telah dijalankan di Myanmar. BPH merupakan salah satu perosak utama tanaman padi dan tindakan menghisap pokok mengakibatkan kesan terbakar pada pokok. Oleh itu, teknik kawalan alternatif yang segera adalah perlu untuk diaplikasikan selain penggunaan racun serangga kimia. Kajian ini telah dijalankan dengan objektif untuk menghasilkan jadual hayat biologi BPH dan WBPH, menyelidik perilaku pemakanan serta pergerakan dan mengkaji perhubungan di antara turun naik populasi, tumbuhan perumah, taburan hujan dan kelembapan di sawah padi. Kajian ini telah dijalankan di sawah padi yang tidak disembur di Hmawbe Kawasan Penyelidikan, Myanmar dari Julai 2007 sehingga Mei 2008. Kebolehan hidup umur-spesiflk berdasarkan usia dan tahap kesuburan BPH dan WBPH diukur dalam persekitaran makmal dan lapangan. jadual hidup dihasilkan dengan menggunakan kaedah satu seks.Parameter populasi BPH menunjukkan pertambahan semulajadi kadar intrisik (r_m) BPH adalah 0.0677 /betina/hari. Tahap

dan pertambahan kadar finate (λ) adalah 1.07 betina /hari, dengan purata tempoh generasi (T) adalah 34.64 hari. Kadar penghasilan bersih (R_O) populasi adalah 10.02. waktu penggandaan populasi (DT) adalah 10.42 hari. Parameter populasi WBPH menunjukkan bahawa pertambahan semulajadi kadar intrisik (r_m) WBPH adalah (0.0699) betina/hari. Tahap dan pertambahan kadar finate (λ) adalah 1.0255 betia/ hari, dan min tempoh generasi (T) adalah 34.97. Kadar penghasilan bersih (R_O) populasi ialah 9.2732. Waktu penggandaan populasi (DT) adalah 10.88 hari.Kajian perilaku pemakanan menunjukkan bahawa dalam kedua dua kaijian dengan pilihan dan tanpa pilihan, pola makan antara BPH dan WBPH adaloh hampir sama. Kesan pemakanan an yang lebih tinggi didapati pada tanaman berumur 30 hari. Kesan pemakan an yang lebih banyak dijumpai pada kelopak daun dibandingkan dengan helai daun bagi kedua-dua jenis benah. Dalam kajian pergerakan,didapati benah perang dewasa adalah lebih aktif dibandingkan dengan nimfa dan instar. Bagi padi dewasa, pergerakan tertinggi (4.7 sm/ dua jam) direkodkan pada tanaman berusia 60 hari dan pergerakan terendah (2.7 sm/ dua jam) pada tanaman berusia 30 hari.Peningkatan dalam pergerakan direkodkan pada jam 13:00. Kajian turun naik populasi mendedahkan bahawa populasi BPH adalah tinggi pada hari ke 64 dan 74 selepas penanaman (pada pertengahan September 2007). Ini adalah berhubungan dengan taburan hujan tinggi, suhu tinggi dan kelembapan yang tinggi. Populasi adalah terendah di 138 HSM (di minggu pertengahan Oktober 2007) mungkin disebabkan oleh taburan hujan yang kurang dan kelembapan rendah dan ini setidak-tidaknya bertanggungjawab atas penurunan populasi BPH. Semasa musim kering, populasi adalah rendah pada 8 HSM (minggu awal Januari 2008) dan kemudian meningkat kepada 31 HSM (minggu pertama bulan Februari 2008). Walaubagaimanapun, populasi menurun pada 56 HSM dan meningkat ke 86

HSM. Cara perkembangan populasi WBPH hampir serupa dengan yang diamati pada BPH. Pada musim kering, populasi WBPH adalah tertinggi pada 90 HSM dan terendah pada 33 HSM. Sewaktu tanaman pertama pada musim hujan, turun naik benah populasi adalah berkorelasi dengan suhu dan taburan hujan. Sewaktu tanaman kedua yang sama dengan musim kemarau, tidak ada hujan dan populasi benah didapati berkorelasi dengan suhu dan kelembapan relatif. Oleh kerana itu, suhu, taburan hujan dan kelembapan relative didapati mempengaruhi populasi benah pada dua musim penanaman.

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Finally, I wish to express my deepest appreciation to my husband U Kyaw Htin Oo and my daughter Myintzu Khin for their patience, understanding, support and inspiration given to me during the period of my study in Malaysia.

I certify that a Thesis Examination Committee has met on 10 June 2010 to conduct the final examination of San San Win on her thesis entitled "The ecology of rice brown planthopper *Nilaparvata lugens* (Stal) and white backed planthopper *Sogatella furcifera* (Horvath) on rice 'in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the degree of Doctor of Philosophy.

Members of the Thesis Examination Committee were as follows:

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Date: 9 July 2010

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Date: 12 August 2010

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or any other institutions.

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San San Win

Date: 9 July 2010

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LIST OF ABBREVIATIONS

%	Percent
^{o}C	Degree Celcius
ANOVA	Analysis of Variance
cm	Centimeter
cm^2	Centimeter Square
cohort	an initial number or unit of individual insects used in the study on life table in which its development is recorded from birth until the last member is dead
distribution	the position, arrangement, or frequency of occurrence (as of the members of a group) over an area or through a space or unit of time
DAT	days after transplanting
DT	doubling time
efficiency	effectiveness of the predator in affecting coexistence of the prey
ETL	Economic Threshold Level
fecundity	a measure of the total egg production by a female (Southwood, 1979)
fertility	the number of viable eggs laid by a female (Southwood, 1978)
functional response	the form of an increasing number of prey eaten per predator as prey density increases, at least up to some limiting value representing maximum prey consumption within a prescribed time.
life cycle	total number of days of immature stadia, egg, larva and pupa (for MS) or nymphal instar (for AG)
life table	tabulation presenting complete data on the mortality and fecundity schedule of a cohort

G	Gram
h	Hour
ha	Hectare
HSM	Hari Selepas Menyemai/Menanam
IPM	Integrated Pest Management
IRRI	International Rice Research Institite
Kg/ha	Kilogram per Hectare
LSD	Least Significant Difference
m	Meter
mm	Millimeter
ns	Not Significant
RH	Relative Humidity
SAS	Statistical Analysis System
sp.	Species
TN-1	Taichung Native 1
UPM	Univeristi Putra Malaysia
WAT	Week After Transplanting