# AN ECOLOGICAL STUDY OF WHITE-BACK PLANTHOPPER, *SOGATELLA FURCIFERA* HORVATH IN VIETNAM, 1968

By

Chia-hwa Tao and Ngo-Dinh Ngoan

## Introduction

Although the *sogatella furcifera* is found throughout the rice-producing areas of the world, its outbreak is not as important as the brown plant hopper, *Nilaparvata lugens*, whose damaging infestation is usually connected with climatic conditions and agricultural practices throughout the year. Severe injury is frequently found on the heading stage of rice plants on this period due to the favorable weather. Population level of either the nymphs or the adults reaches a peak. Since successful eradication of rice stem borers was obtained with new certain synthetic insecticide, the pest frequently causes heavy damage to rice plants, particularly in Taiwan, Japan, Korea and the Philippines. In South Vietnam, however, the *S. furcifera* is a major pest of rice plants, since climatic condition is favorable for its multiplication throughout the year. The ecological studies of this pest were carried out at Japan and Taiwan, while no available datum is obtained from Indo-China, especially from Vietnam. Therefore, Ngo-Van-Quyen, Chief, Plant Protection Service, encouraged us to make the ecological studies of this pest is purpose to contribute to the establishment of the economic control measures in the future. Results are presented in this paper.

## Distribution

Japan, Okinawa, Korea, Taiwan, Micronesia, Siberia, Manchuria, China, Indo-China, India, Ceylon, North Africa, the Philippines, Sumatra, although widely distributed, the pest is found more or less only along the equator, and is considered to be tropicopolitan. (see 4)

## Host Plants

*Oryza sativa* L., *Saccharum officinarum* L., *Zizania latiforia* Turcz., *Hordeum vulgare* L., *Setaria italica* Beauv., *Panicum crusgalli* L., *Zea mays* L., *Poa anua* L., *Phalaris arundinacea* L., *Alopecurus aequallis* Schol., *Sporobolus elongatus* R., *Digitaria adscendens* Henr., and *Eleusine indica* Gaertner. The most preferred host plants of this pest is the rice plant. The pest passes several generations in the weedy areas, if no rice plant is offered. (see 4)

Observation on the Infestation of rice plant

Vietnam is situated in the tropical zone. Its ecological dimension is particularly suitable for rapid multiplication of *Sogatella*. With regards to the climatic conditions, the multiplication is more favorable in the Mekong Delta area than in the coastal region of central Vietnam. In contrast, the brown plant hopper does not mutiply readily under the Mekong delta coastal region this year. This pest generally attacks the rice plants during the tillering, differential, booting and heading stages, causing losses of vegetation, reduction of tillers leaf withering, burning of stems, and production of empty rice panicles. Usually the differential stage is the most susceptible stages, during this stage of the rice plants are often entirely destroyed by overlapping generations of the plant hoppers. The population of the nymphs is generally prevailing that of the adults. During the growing season of the rice plants, the plants are usually attacked by 3 or 4 overlapped generations especially in rice areas where multiple rice crops are practiced. Sometimes sporadic outbreaks of this pest are found in the old seedling beds. The degree of infestation depends upon microclimatic conditions and cultural practices.

## Materials and Methods

The study was consisted of the bionomics, survival of adults, the rate of population of wing-form, seasonal fluctuation of egg population, percentage of parasitism of egg parasites, and the rate of population of newly-hathced nymphs. All the works were carried out in the green house of Plant Protection Service from January to December in 1968.

1. Bionomics: The life history of this pest is quite variable with the ecological conditions. The number of generations per year varies from two to three in the northern part of Japan to as many as five or more in the southern part of Japan, four in Korea and seven or eight in Taiwan. In the present observation, this hopper has sixteen generations in a year due to the favorable temperature, it developed and multiplicates throughout the year. The results showed that the duration of various stages of each generation was not significantly different. In each generation egg stage last 5.2 to 10.5 days with exception of the lst generation being the longest and was not significantly different. Nymphal stages of each generation last from 9.6 to 15.4 days excepted with 10th generation being shortest. This was also insignificant. The entire cycle from egg to adults requires 15.3 to 21.9 days, excepted with 10th generation being shortest. This was not significantly different while the variance of both the temperature and the humidity is not notable all year round. As shown in table 1:

Table 1: Duration of various growing stages in each generation

| Giner-ation | Duration of egg stage (days) | Duration of nymph-al stage (days) | Duration of entire cycle (days) |
|---|---|---|---|
| 1st | 10.5 | 14.0 | 24.5 |
| 2nd | — | — | 21.0 |

| | | | |
|---|---|---|---|
| 3rd | 7.5 | 10.5 | 18.0 |
| 4th | 5.6 | 12.5 | 18.1 |
| 5th | 5.4 | 11.5 | 16.9 |
| 6th | 5.6 | 11.4 | 17.0 |
| 7th | 5.2 | 11.2 | 16.4 |
| 8th | 5.3 | 13.6 | 18.9 |
| 9th | 5.2 | 12.6 | 17.8 |
| 10th | 5.7 | 9.6 | 15.3 |
| 11th | 5.8 | 11.0 | 16.8 |
| 12th | 6.4 | 11.4 | 17.8 |
| 13th | 6.7 | 10.1 | 16.8 |
| 14th | 6.2 | 12.6 | 18.8 |
| 15th | 6.5 | 15.4 | 21.9 |
| 16th | 6.0 | 14.0 | 20.2 |

2. Behavior: Most of the adults emerge in the morning. The male adults usually emerge 1 to 2 days earlier than the females. The brachysterous emerge later than macropterous females; both individuals lay eggs 3 or 4 days after the copulation. while laying, the female inserts are ovipositors into the tissues of the leaf sheath. Eggs are laid massly, and each mass consists of 5 to 20 eggs arranged side by side. Newly-laid eggs are milky in color become yellowish before hatching. Part of the tissues around the eggs-mass is harmed by oviposition and turns dark brown color. Newly hatched nymphs which are grey in color stay on their egg shells for 3 to 5 minutes. They are gregarious during the early instars and suck the sap of rice stems. After the first moult they begin to dispers each other and crawl to the other part of the rice plant to suck the sap of rice stems particulary in its mature stage. The outbreak of this hopper depends on the population density of both the nymphs and the adults under favorable conditions, while the nymphs cause serious damage to rice plants, as they are moke important than adults.

3. Adult longevity: The observation was begun from the 3rd generation to the 16th generation on 20 pairs of macropterous forms of each generation. All adults emerged from nymphs which were reared in the green-house. Each pair of adults was reared in a glass cylinder (5 cm in diameter and 15 cm in height) with one freshly-rooted rice stem inside. Six glass cylinders were placed in a petri dish, (17 cm in diameter and 3 cm in height). The water was supplied in each petri dish in the case of necessary. Each top of the glass cylinder was covered with fine muslin and fastened with rubber bands to prevent adults from escape. Freshly-rooted rice stems were changed every five days throughout the observation, and records were taken every morning. The results showed that the macropterous females generally lived longer than macropterous males and the longevity of both the females and males were variable in each generation. The relative longevity of adults was probablly affected by the temperature and the humidity throughout the observation. The average of longevity of the females ranged from 2.3 to 16.0 days and that of males from 1.9 to 10.7 days, as shown in table 2:

Table 2: Duration of adult longevity in each generation

| Generation | Day of emergence | Day of death | | Logevity | |
|---|---|---|---|---|---|
| | | Female | Male | Female | Male |
| | | | | (days) | |
| 3rd | 22–25/II | 3–18/III | 25/II–15/III | 15.6 | 10.7 |
| 4th | 13–19/III | 18/III–9/IV | 17–21/III | 8.7 | 4.8 |
| 5th | 4/IV | 18/IV=1/V | 5–9/IV | 16.0 | 3.5 |
| 6th | 23–28/IV | 24/IV–9/V | 24–29/IV | 6.2 | 1.9 |
| 7th | 19–21/V | 13/V–12/VI | 23/27/V | 9.6 | 6.1 |
| 8th | 9/VI | 11/VI–2/VII | 11/15/VI | | |
| 9th | 30/VI–1/VII | 8–14/VII | 2/8VII | 8.7 | 5.4 |
| 10th | 18/VII | 20–22/VII | 19–21/VII | 2.3 | 2.1 |
| 11th | 9/VIII | 12–15/VIII | 14–17/VIII | 4.3 | 3.1 |
| 12th | 2/IX | 9–12/IX | 9–10/IX | 7.4 | 6.9 |
| 13th | 25/IX | 27/IX–10X | 16–30/X | 8.7 | 4.8 |
| 14th | 14–15/X | 16–30/X | 11–16/XI | 9.7 | 7.2 |
| 15th | 9/XI | 11–17/XI | 5–24/XII | 5.2 | 4.3 |
| 16th | 4–5/XII | 9–25/XII | | 11.5 | 5.7 |

4. Population level of wing-form: The observation was made on the 12 to 19 pairs of adults of each generation. They were individually reared in a glass cylinder with freshly-rooted rice stems inside, and were placed in the petri dishes of water which was filled every morning. The top of the glass cylinders was individually covered with a fine muslin and fastened with rubber bands to prevent adults from escape. The change of the freshly-rooted rice stems in each glass cylinder was made at five day intervals and individually transferred into other one until the eggs hatched to emerge from adults through the observation. Newly-emerged adults were counted after being killed by a poison bottle every morning. The period of adult emergence varied in each gendration, it was closely counted with survival of former adults for laying their eggs under climatic conditions. The period of adult emergence of each generation lasted from 3 to 20 days, with the 6th generation being longest and the 12th generation being shortest. The percentage of wing-form of the females and the males varied in each generation. However, the percentage of macropterous males usually was highest in each generation, which was not significantly different. For the females, however, it varied from generation to generation, indicating that the females, particularly, brachypterous ones, were more sensitive to temperature, humidity and other factors. According to the data. the rate of macropterous females ranged from 7.6 to 49.1 per cent; brachypterous females, from O.O to 47.9 per cent; and macropterous males from 40.1 to 63.6 per cent. The severe out-break of the pest was also associated with population density of both the macroptorous females and the brachypterous females. Sometimes, the brachypterous females were as important as the macropterous females, causing injury of the rice plants under favorable conditions. The results obtained showed that

the weather with exception of the environmental conditions, was considerably more suitable to its multiplication in South Vietnam throughout the year, as shown in table 3:

Table 3: Population dynamics of wing-form in each generation

| Genera-tion | Date of emergence | Emerging period | No. of emerged adults | Percentage of wing-form | | |
|---|---|---|---|---|---|---|
| | | | | Female | | Male |
| | | | | Marco. | Brach. | Macrc. |
| 1st | 15–25/I | 8 | 52 | 11.5 | 46.2 | 42.3 |
| 3rd | 24/II–10/III | 14 | 599 | 34.5 | 9.6 | 55.9 |
| 4th | 12–26/III | 14 | 621 | 37.6 | 9.3 | 54.0 |
| 5th | 3/18/IV | 15 | 261 | 12.5 | 17.2 | 63.1 |
| 6th | 21/IV–12/V | 20 | 359 | 12.0 | 47.9 | 40.1 |
| 7th | 15–24/V | 9 | 116 | 28.4 | 8.6 | 63.5 |
| 8th | 12–1 /VI | 7 | 122 | 30.3 | 18.0 | 51.6 |
| 9th | 25/VI–15/VII | 19 | 195 | 35.9 | 12.3 | 51.8 |
| 10th | 14–19/VII | 5 | 144 | 7.6 | 36.8 | 55.6 |
| 11th | 8–12/VIII | 4 | 45 | 24.4 | 22.2 | 53.4 |
| 12th | 26–29–VIII | 3 | 81 | 40.7 | 7.4 | 52.0 |
| 13th | 26/IX–8/X | 13 | 263 | 28.5 | 21.3 | 50.2 |
| 14th | 14–22/X | 8 | 426 | 37.1 | 9.9 | 53.0 |
| 15th | 6–24/XI | 8 | 658 | 49.1 | 0.0 | 50.9 |
| 16th | 6–9/XI | 5 | 311 | 39.2 | 6.4 | 54.3 |

The 2nd generation was not completed because of V. C. offensive in Saigon in February, 1968.

5. Investigation on the seasonal fluctuation of egg population: This was a study on the occurrence of the hopper under climatic conditions. It will be used as a basic reference for outbreak prediction in the furture. Samples of egg Laying rice stems brought in from outside were individually examined under the dissecting microscope and the number of eggs were counted at 5–6 day intervals from April 16 through December 7, 1968. It was usually done six times in each month, except for April, November and December. The average of oviparious rice stems sampled, ranged from 31.5 to 40.8 in each time. According to the data, the number of egg-masses per rice stem, eggs per egg-mass and per rice stem were highest in July and lowest in April and May. With exception of April, May and July, there was no significant difference in each month. The number of eggs laid into the tissues of the rice stems was closely correlated with the number of adults emerged under favorable conditions. It was shown that the climatic conditions were the most important factors concering the outbreak of this pest. Throughout the investigation, the increment of population is especially significant in wet season. Results are given in table 4:

Table 4: Seasonal fluctuation of egg population from April to December

| Date survey | Times of survey (total) | No. of rice stems/ survey | No. of egg clusters /survey | No. of eggs/ survey | No. of egg-masses /riee stem (av.) | No. of eggs/ egg-cluster(av.) | No. of eggs/ rice stem (av.) |
|---|---|---|---|---|---|---|---|
| 16-26/IV | 3 | 38.0 | 114.3 | 1,028.0 | 2.9 | 9.0 | 26.3 |
| 1-27/V | 6 | 31.5 | 75.2 | 734.8 | 2.9 | 8.0 | 23.6 |
| 1-27/VI | 6 | 36.5 | 189.5 | 2,702.8 | 4.4 | 13.0 | 59.8 |
| 2-29/VII | 6 | 39.5 | 341.0 | 4.876.8 | 8.7 | 14.1 | 124.3 |
| 5-28/VIII | 6 | 40.8 | 255.2 | 2,510.5 | 6.2 | 9.9 | 61.4 |
| 2-28/IX | 6 | 39.3 | 270.7 | 2,539.2 | 6.8 | 9.7 | 62.2 |
| 5-30/X | 6 | 35.5 | 254.2 | 2,312.7 | 6.9 | 8.7 | 61.4 |
| 2-25/XI | 5 | 38.8 | 293.6 | 2,529.2 | 7.6 | 8.5 | 63.3 |
| 2-7/XII | 2 | 38.0 | 247.5 | 2,518.0 | 6.6 | 10.1 | 66.9 |

6. Investigation on the seasonal occurrence of newly-hatched nymphs: This study was carried out on the oviparious rice stems which were brought from outside. Rice variety IR 8 was used as a standard one and was transplanted on the pots on June 25. The number of newly-hatched nymphs were counted 34 days after transplanting, when the initial symptom of rice stem infested by the hoppers was discovered under natural conditions. A samplo of one hill of rice plants was selected at random in each plot and was transferred in each glass cylinder after washing the roots of soft mud. It was placed in the large petri dishes in which the water supplied in the case of necessary. Survey was made at 7 to 12 day intervals from July 28 to September 26. The newly-hatched nymphs were counted after killing them in the poison bottle every morning until all eggs were completely hatched in each time. Popultation density of newly-hatched nymphs generally increased from July 29 to August 26 and decreased in August 30 to September 5, while its population increased again in early mid-September and decreased in late September and early October when the rice plants were entirely destroyed by the hoppers during favorable weather. Results are given in table 5:

Table 5: Seasonal occurrence of newly-hatched nymphs

| Date surveyed | Period hatching nymphs | No. of hills surveyed | No. of rice stems/ hills | No. of newly-hatched nymphs (Total) | No. of hewly-hatched nymphs/ rice stem (av.) | No. of newly-hatched nymphs/ hill (av.) |
|---|---|---|---|---|---|---|
| 28/VII | 29/VII-7/VIII | 3 | 13.3 | 766 | 19.2 | 255.3 |
| 8/VIII | 9-18/VIII | 5 | - | 2,166 | - | 433.2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19/VIII | 20–28/VIII | 5 | 25.8 | 5,044 | 39.1 | 1,008.8 |
| 29/VIII | 30/VIII–5/IX | 5 | 19.4 | 2,033 | 21.0 | 407.0 |
| 5/IX | 5–16/IX | 5 | 13.4 | 7,745 | 115.6 | 1,549.0 |
| 17/IX | 18–26/IX | 5 | 12.8 | 5,748 | 85.8 | 1,149.6 |
| 26/IX | 27/IX–2/X | 5 | 14.4 | 1,354 | 26.6 | 270.8 |

7. Egg parasites: Two species of egg parasites have been found from the eggs of *Sogatella*. According to the morphology of the parasites, they are minute hymenopterous wasps. The larger bluish-black one is supposed as to a *Eulophid* parasite (unidentified). The yellowish-brown one is identified as *Anagrus* sp. Family mymaridae. The parasitism of these species was examined in the egg-masses of *Sogatella* under the dissecting microscope in the laboratory. More than to 72.5% of eggs was parasitized. It seemed that *Eulophid* parasite was more important than the *Anagrus* sp. in reducing hatching rate of *Sogatella* eggs, as shown in table 6:

Table 6: Parasitism of egg parasites of s. furcifera in 1968

| Date of survey | No. of oviparous rice stems | No. of eggs | No. of egg per sited | percent of parasitism |
|---|---|---|---|---|
| 25/V I | 36 | 748 | 605 | 72.5 |
| 15/VIII | 14 | 307 | 222 | 72.3 |

Environmental factors concerning the outbreak

Climatic conditions, cultivating methods, natural enemies and other plants or animals are known as the factors concerning the outbreak of the hopper, among them climatic conditions are the most prominent factors.

According to the observation, length of daytimes temperature and humidity are the climatic factors which seem to have close connection with rice in population density. In the case of many generations, there appeared a constant rice in population density when the daytimes sborten, and the temperature was constant between the day and the night during rainy season namely from June to November. In contrast, the decrease of population ecology was closely connected with a long daytimes and high temperature during dry season namely November through May, particularly significant in April and May. Although the climatic conditions are the most prominent factors for an outbreak of this pest. the environmental factors are also considerably important. Therefore, the serious outbreak of this pest would be closely correlated with climatic and environmental factors.

## Results

According to the present study ecological study of this pest, the climatic conditions are the most effective indicator to determine the outbreak of the hopper. Macroptertus and brachypterous adults are usually abundant in the wet season when the temperature does not

change very much between day and night. The length of daytimes may decrease, while the humidity may be constant at about 85%. The population of S. furcifera is gradually built up from June and begins to decrease in December. The increment of population is particularly significant in April and May, in this season the weather becomes hotter and drier in South Vietnam Although climatic conditions are main factors concerning the outbreak of this pest, heavy infestation of rice plant presumably depends upon the cultural practices and microhabitat.

## Summary

The White-back plant hopper, *Sogatella furcifera* Horvath is a major pest of rice plants in favorable weather in South Vietnam. It produces more than sixteen generations a year. The degree of infestation varies from year to year and is usually associated with climatic conditions and multiple rice practices. The hopper population is high in wet season and low in dry hot season. The pest attacks rice plants causing more serious injury on differential stage than that of the tillering stage. Because at latter stage, the multiplication of this pest is easily influenced by some external factors such as wind velocity, length of daytimes, number of cloudy days, water level and hill spacing. The damage to rice plants in irrigated fields is more serious than that in the ordinary fields where water level is usually high. Therefore, the outbreak of the pest in Central Vietnam is more serious than in South Vietnam, as the environmental condition would be suitable for it multiplication throughout the rice growing season.

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# 中 文 摘 要

## 越南白背飛蝨生態之研究

陶 家 驊* 吳 定 秀*

白背飛蝨（*Sogatella furcifera* (Horvath)）爲越南水稻區重要害蟲之一，在越南自然環境之下，適其繁衍滋生，一年發生16世代，其蔓延成災，往往受氣候和水稻栽培制度相互密切之關係。故其爲害水稻程度，隨歷年氣候和環境而異，就其發生環境而言，中越水稻區較湄公河三角洲水稻區有利條件，蔓延猖獗季節恒在高溫多濕時期，構成水稻爲害時期，尤以分化時期最爲嚴重，但品種間亦有顯著差異IR5 及IR8 兩個品種受其爲害較當地品種爲熾烈，一旦適其氣候和環境，常導致嚴重災害發生。通常在水稻分蘗時期，鮮有其構成災害發生，惟時受外界因子干擾而影響所致，諸如風之速力、日照和陰日時間，禾田間水位之高低，以及水稻行距離較大等，足可抑制其發生。故禾田灌溉區，常以灌溉水量限制，遇其繁衍滋生其爲害程度則較普通禾田自然灌溉區爲嚴重，蓋因其水位常高之灌溉區所致也。

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* 中華民國駐越南農業技術團技正， ** 越南植物保護所昆蟲組主任