SHORT COMMUNICATIONS

Damage to Ears of Rice Plants Caused by the White-Backed Planthopper, *Sogatella furcifera* (Homoptera: Delphacidae)[1]

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Outbreaks of the white-backed planthopper (WBPH) have recently been reported in Southeast Asia (KHAN and SAXENA, 1985). Depressive effects on yield by the attack of WBPH are well known (KATO, 1948; ITOGA and SAKAI 1954; SUENAGA, 1959). WBPH usually sucks the leaves and leaf sheaths, while SUENAGA and NAKATSUKA (1958) noted that it attacked the flag leaf and the panicles after ear emergence. Few studies have been made, however, on the direct damage done by WBPH to the panicles.

In August of 1982 and 1983, brown ears of rice plants were found throughout Shimane Prefecture. The glumes were brown-colored and some of them were empty. Neither cultural nor meteorological causes were found and there was no proven implication of microorganisms. This paper describes symptoms of the damage and concludes through experiments with planthoppers that their intensive sucking causes these symptoms.

Damaged rice plants in the fields were first observed just after ear emergence in the western part of Shimane. Most of the damaged ears were pale brown, while normal ears of the same cultivars were pale green. Heavily pigmented ears were patchily distributed in the fields. The flag-leaf sheath was also sometimes brown. Some ears were black because of the sooty mold that grows on the honeydew of the planthopper. The topmost internode of heavily-colored tillers was sometimes not fully extended. Similar damage was also widely found in 1983 in the eastern part of Shimane.

Grains from severely damaged (SD) and non-damaged (ND) rice plants were compared. Ten hills of rice plants were sampled at harvest from two damaged fields in the western part of Shimane,

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Table 1. Yield comparison between damaged and non-damaged rice plants (average of 10 hills and standard deviation)

Location	No. of grains per hill	No. of sterile grains (%)	No. of rice grains of each grain width			Total weight of brown rice (g)	Weight of 1,000 brown rice (g)
			<1.7	1.7–1.8 (%)	<1.8 mm		
Masuda							
Severely damaged	1,332±283	250±66 (19.2)	70±24 (5.2)	51±20 (3.8)	962±247 (71.8)	20.7±5.3	19.2±0.5*
Non-damaged	1,124±136	55±25 (4.8)	25±14 (2.2)	29±10 (2.5)	1,014±109 (90.4)	21.7±2.1	20.3±0.9
Mito							
Severely damaged	892±101	153±77 (17.1)	77±52 (8.5)	39±13 (4.4)	623±140 (70.0)	13.6±2.8*	18.3±1.3*
Non-damaged	914±173	48±12 (5.2)	13± 8 (1.4)	25±26 (2.5)	829±149 (90.9)	18.3±3.1	21.1±0.8

* Significant difference at 1% level by WILCOXON signed rank test.

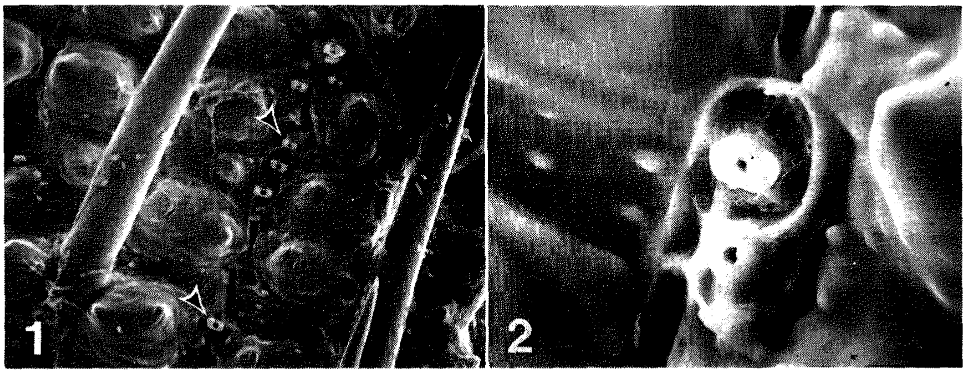

Fig. 1. Scanning electron micrograph of WBPH feeding marks (arrows) on a glume (×360).
Fig. 2. WBPH feeding marks (×860).

Masuda and Mito, in 1982, in addition to 10 hills each of non-damaged rice plants from adjacent fields. SD contained about 18% sterile grains as compared to about 5% in ND (Table 1). Husked rice grains were separated into three groups by grain width: less than 1.7 mm, between 1.7 and 1.8 mm and over 1.8 mm. The rates of the grains of over 1.8 mm in SD and ND were 71.8% and 90.4% respectively in Masuda and 70.0% and 90.9% in Mito. The grain weight significantly decreased in SD. Weight reductions of total yield were 4.6% and 25.7% in the two pairs of fields. In addition to the yield reduction, husked rice of SD was darker brown than that of ND.

As WBPH was assumed to be a plausible causative agent of the damage, it was fed in the laboratory on rice plant in order to observe which part of the plant it attacks. WBPH gathered to suck the flag-leaf sheath at booting stage, then gathered on the ear and sucked the glumes at the heading stage. Following full emergence of the ear, some of the insects tended to suck the neck of the spike or the rachis-branches. Several dozen laboratory-cultured or field-collected nymphs and adults were then confined in each of several paper envelopes containing a newly emerged ear in order to experimentally induce a brown ear. Glumes turned brown in a day or two but those of non-infested plants did not. Another infestation experiment on potted whole rice plants showed that planthoppers gathered on emerging glumes and turned them brown. In some cases the topmost internode did not extend from the flag-leaf sheath and some glumes remained in the sheaths. These observations coincided well with those in the field.

The brown glumes on which the planthopper had been fed experimentally were observed by a scanning electron microscope in order to confirm the feeding of WBPH. Many feeding marks were observed on the glumes (Figs. 1, 2), indicating that the insect inserted its stylet into the tissue. The stylet penetration through tissues seems to trigger coloration of the glumes. Other sucking insects would have potentiality to be the causative agent since many of them attack glumes. The small brown planthopper, *Laodelphax striatellus*, caused similar damage in infestation experiments (unpublished data). *Nilaparvata lugens*, however, did not damage the ear because it mainly attacked the lowest part of the stems throughout the growing stages of the rice plant.

WBPH migrates over the East China Sea into Japan every year (Kisimoto, 1971). In 1982, about 5,400 WBPH adults were caught by a light trap at Masuda on 13–15 July, and the total number trapped in July was the largest in the last 24 years in Masuda (Masuda Plant Protection Office). In 1983, WBPH migration into fields took place primarily on 15–16 July and 21–22 July. The numbers caught by light traps at Izumo were about 3,200 and 23,200 respectively in these two periods, and those are the largest in 35 years. A great number of nymphs of the following generation was observed in paddy fields in the first half of August. In Shimane Prefecture, rice plants are planted in early May and their heading occurs from late July to mid-August. Therefore, the heading of rice plants often coincides with the time when the feeding activity of the progeny of immigrants increases.

REFERENCES

ITOGA, S. and H. SAKAI (1954) *Kyushu Agr. Res.* **14**: 225–227 (in Japanese).

KATO, M. (1948) *Nogyo oyobi Engei* **23**: 431–433 (in Japanese).

KHAN, Z. R. and R. C. SAXENA (1985) *J. Econ. Entomol.* **78**: 1280–1286.

KISIMOTO, R. (1971) *Trop. Agric. Res. Ser.* **5**: 201–216.

SUENAGA, H. (1959) *Proc. 3rd Symp. Jpn. Soc. Appl. Ent. Zool.*, pp. 12–14 (in Japanese).

SUENAGA, H. and K. NAKATSUKA (1958) *1st Special Report for Occurrence Forecast of Diseases and Pests*. The Ministry of Agriculture and Forestry, Tokyo, 468 pp. (in Japanese).

Adult Emergence of *Coccinella septempunctata bruckii* MULSANT (Coleoptera: Coccinellidae) in Winter in Central Japan[1]

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The first generation adults of *Coccinella septempunctata bruckii* MULSANT emerge usually in spring and aestivate at the base of weeds such as *Miscanthus sinensis* (SAKURAI et al., 1981) and *M. sacchariflorus* (SAKURATANI and KUBO, 1985) in central Japan. The second generation adults emerge in autumn and overwinter in the weeds without obligatory diapause (SAKURAI et al., 1981). However, it is suggested that the overwintering stage of *C. septempunctata bruckii* is not always fixed, because we often observed not only active adults but also larvae and pupae of this species in winter fields. This paper reports the adult emergence of *C. septempunctata bruckii* in winter in central Japan.

On 7th December 1983, 5 prepupae and 7 pupae were found on a dumped wood stake, 7×8×110 cm, lying on a sunny and grassy bank (34.9°N, 135.7°E, 10 m above sea level) of the Yodo River in the Osaka Plain. Including some mature larvae which crawled from the surrounding grasses, the total number of pupae attached to the stake amounted to 31. The developmental process of each pupa or prepupa was observed at intervals of 3–5 days till 31st January 1984. We confirmed the emergence of adults by checking the pupal exuvia remaining on the stake.

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Figure 1 shows the processes of pupation and adult emergence of *C. septempunctata bruckii* on the stake. Six (Nos. 26–31) of 31 pupae disappeared from the stake by unknown factors, 3 pupae (Nos. 23–25) did not emerge as adults till 31st January and others (22 pupae) became adults. Two (Nos. 17 and 18) individuals were observed in the course of molting to pupae on 7th December 1983. The emergence of adults reached a peak late in January 1984. The period of pupal stage calculated for 13 individuals for which both pupation and adult emergence could be observed, ranged from 25 to 48 days with a mean of about 33 days.

The cold of that winter was a record among the last several years. The prepupae and pupae were covered with snow several times and probably were exposed to intense cold in the morning (31 days during the observation period were below 0°C in minimum air temperature at the Kyoto Local Meteorological Observatory, 15 km distant from our investigation site (The Japan Meteorological Agency, 1984)). Nevertheless, most pupae were able to become adults (Fig. 1). Some new adults, with pale colored elytra, were observed around the stake and were not malformed but normal. The developmental zero and thermal constant for pupae of *C. septempunctata bruckii* is respectively 12.2°C and 50.4 day-degrees for a Kyoto population (SAKURATANI et al., 1985). The total effective temperature calculated based on maximum air temperature recorded at the Kyoto Local Meteorological Observatory (The Japan Meteorological Agency, 1984) was only 6 day-degrees during the observations. This value was too low for the pupae to develop to adults.

Figure 2 shows the hourly changes of the temperature recorded by a resistance thermometer at the stake on 14th–15th December 1983. In the