seems to be the specific character of a rodent species.

For the last 10 years, the grassland in the study area has been cultivated for field and pasture. Because of this environmental change, changes in the fauna especially the disappearance of *R. norvegicus*, were observed (OHGUSHI, 1985). This resulted in some changes in trapped species as shown in Fig. 2. Individuals of *Rattus* trapped by cage and snap traps decreased remarkably, while individuals of *Mus* trapped by sherman and *Microtus* by snap trap increased. This seems a result of the disappearance of *R. norvegicus* after 1980 (OHGUSHI and SANO, 1982; OHGUSHI, 1985). The trap types effective in catching the various rodent and insectivore species, however, were basically the same before and after the environmental change.

CONCLUSION

The results show that there are differences in the efficiency of trap types for the three species of rodents and one insectivore caught. Types of traps successful in the catching of each species are summarized in Table 2 and will be helpful in the field census methods for small mammals.

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REFERENCES

GROMADZKI, M. and P. TROJAN (1971) *Ann. Zool. Fennici.* **8**: 54–59.

MAEDA, M. and T. OTSUKA (1983) *For. Prot.* No. 137: 18–19.

MAEDA, M. and K. TANIGUCHI (1977) *Nonezumi* No. 137: 4–16.

NAKATA, K. (1979) *Nonezumi* **163**: 20–21.

OHGUSHI, R. (1985) *Appl. Ent. Zool.* **20**: 450–457.

OHGUSHI, R. and A. SANO (1982) *Bull. Jpn. Sea Res. Inst. Kanazawa Univ.* **14**: 37–52.

OTA, K. and M. HASEGAWA (1950) *Zool. Mag.* **59**: 284–288.

Differences of Susceptibility in Rice Varieties to the Whitebacked Planthopper, *Sogatella furcifera* HORVÁTH (Homoptera: Delphacidae)[1]

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The whitebacked planthopper, *Sogatella furcifera* HORVÁTH, (WBPH) is known as one of the most injurious pest insects of rice in South and Southeast Asia. However, in Japan it has been regarded not so injurious an insect as the brown planthopper, *Nilaparvata lugens* STÅL. After immigrating into a paddy rice field, *N. lugens* produces brachypterous females and the population density increases exponentially, resulting in "hopper burn" (KISIMOTO, 1965). WBPH in Japan had been believed to cause damage only in young rice plant. Recently, there have been several reports on damage by WBPH near the heading time of rice plant (HARA and SAITO, 1984; MURAKAMI and KANDA, 1984). Damage has been observed on such varieties as "Musashikogane" which is a variety resistant to rice stripe disease, "Suweon 258" a high-yielding variety, and "British Honduras" (HARA and SAITO, 1984; OKADA, personal observation), all varieties recently cultivated in Japan. Since the damage caused by WBPH will vary with fertilization,

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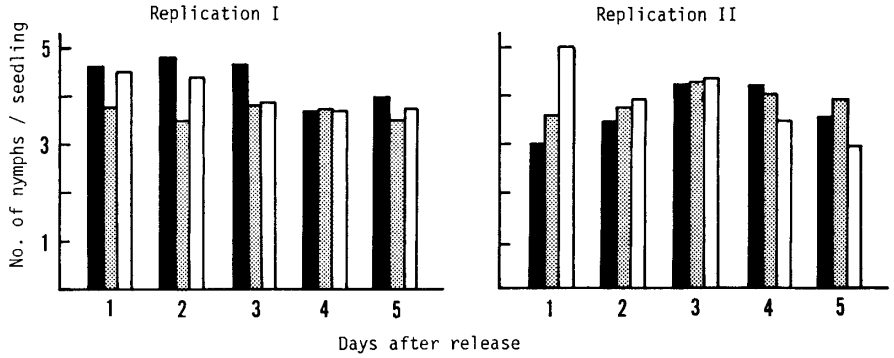

Fig. 1. Daily changes of the number of WBPH nymphs on each seedling.
■:Musashikogane, ▨:Suweon 258, □:Nipponbare.

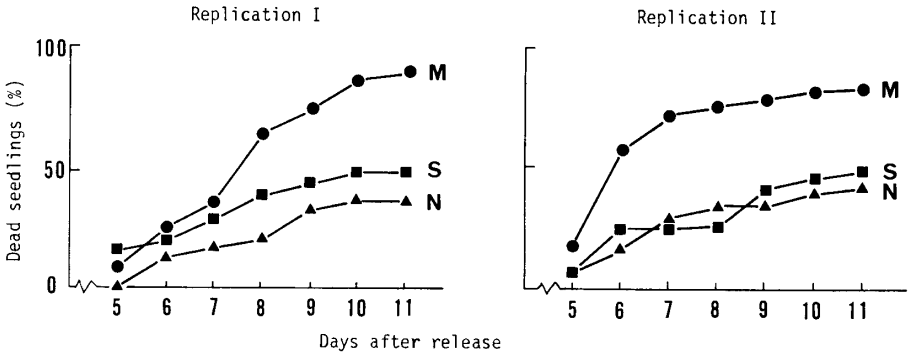

Fig. 2. Daily changes of the percentage of dead seedlings attacked by WBPH nymphs.
M: Musashikogane, S: Suweon 258, N: Nipponbare.

weather condition or amount of chemical control, it is unclear whether the damage really is relevant to the variety itself. Although there have been many papers on varietal resistance to WBPH, papers on susceptibility are scarce (see KHAN and SAXENA, 1985).

The present study was therefore undertaken to know the difference of susceptibility to WBPH among the three varieties: "Musashikogane", "Suweon 258", and "Nipponbare", the latter a variety widely cultivated in Japan.

First, we examined sucking preference of WBPH on seedlings of the three varieties and the resultant damage. Based on the free-choice test described by ITO and KISIMOTO (1981), 24 seedlings of each variety (total of 72 seedlings) were planted in a testing cage ($10 \times 15 \times 15$ cm). About 300 nymphs (3–4 instar) of WBPH were released in the cage when the seedlings grew to 3–5 cm in height. The number of nymphs on each seedling was counted daily until 5 days after release. The number of dead seedlings was counted from the 5th day till the 11th day after release. Tests were carried out in an air-conditioned room at 25°C under 16L-8D regime with two replications.

The results are shown in Figs. 1 and 2. Figure 1 shows there is no difference in sucking preference of WBPH nymphs among the three varieties. However, the damage was different among these varieties and "Musashikogane" was the weakest (Fig. 2). These facts indicate that "Musashikogane" has lower tolerance against the sucking of WBPH.

Next, we examined reproductive power of WBPH on the three varieties using potted rice plants 10, 35, and 50 days after transplanting (10 DAT, 35 DAT, 50 DAT), grown in a greenhouse controlled at 17–32°C. Each plant was covered with a transparent plastic cage, and varying numbers of gravid females were released in the cage. After 5 days, females were removed and the nymphs hatched were counted 15 days after the

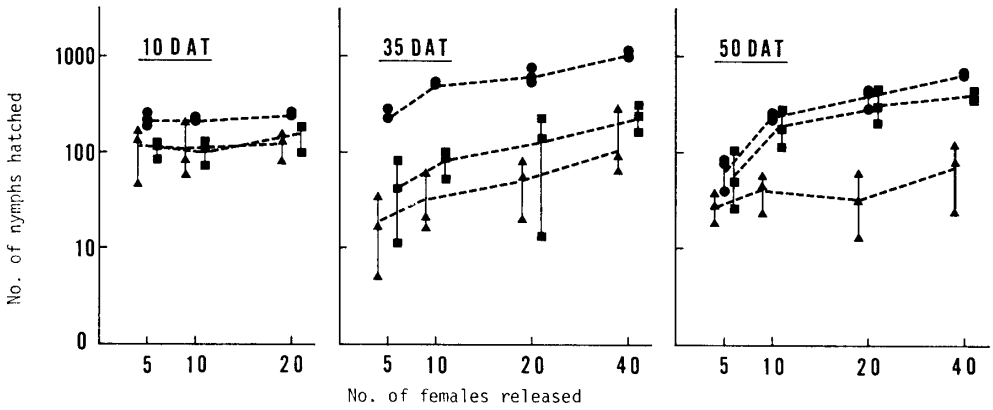

Fig. 3. Reproductive power of WBPH in relation to plant age and female density. ●: Musashikogane. ■: Suweon 258, ▲: Nipponbare. Broken lines connect the mean values of three replications.

release. Tests were carried out with three replications.

The results are arranged in Fig. 3. In rice plants of 50 DAT, many more nymphs were observed on "Musashikogane" and "Suweon 258" than on "Nipponbare" in each female density. In plants of 35 DAT, the number of nymphs on "Musashikogane" was the largest, followed by "Suweon 258", and "Nipponbare" had the fewest. But no difference among the three varieties was found in 10 DAT plants. These facts indicate that WBPH has a higher reproductive rate on aged "Musashikogane" and "Suweon 258" than on "Nipponbare".

KHAN and SAXENA (1985) reported that both nymphs and adults of WBPH in Southeast Asia suck the phloem sap of rice plants which causes stunting, yellowing leaves or wilting, and the plants eventually die when they are attacked severely. They stated that gravid females cause additional damage by making punctures for egg-laying in leaf sheaths which predisposes the plants to bacterial and fungal infections. In the present study, we observed, particularly in "Suweon 258", a hypersensitive response to egg-laying, in other words, yellowing of the parts of the leaf sheaths around the egg-laying punctures. But this response was not remarkable in "Nipponbare".

The results of the present study indicate that, in susceptible varieties there exist differences of susceptibility and some varieties have much lower tolerance against sucking or oviposition of WBPH, or permit higher reproduction of WBPH. Consequently, these varieties are easily damaged by WBPH.

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REFERENCES

HARA, E. and M. SAITO (1984) *Proc. Kanto Plant Prot. Soc.* **31**: 109 (in Japanese).

ITO, K. and R. KISIMOTO (1981) *J. Cent. Agric. Exp. Stn.* **35**: 139–154 (in Japanese with an English summary).

KHAN, Z. R. and R. C. SAXENA (1985) *Insect Sci. Appl.* **6**: 115–134.

KISIMOTO, R. (1965) *Bull. Shikoku Agric. Exp. Stn.* **13**: 1–106 (in Japanese with an English summary).

MURAKAMI, M. and T. KANDA (1984) *Proc. Kanto Plant Prot. Soc.* **31**: 110–111 (in Japanese).