fed normally on Reihou, 47% could feed on IR26, and 1% could feed on IR26, IR42, and Reihou. Average honeydew excreted daily was about 46±23 mg on Reihou and 33±18 mg on IR26, respectively. Only one female excreted 49 mg on IR42. Five females excreted more than 10 mg on IR26, but less than 10 mg on Reihou and IR42 (see figure).

We conclude that about half of the recent BPH immigrants to Japan were biotype 2, and the rest were still biotype 1. ■

Detoxifying enzymes of the brown planthopper (BPH)

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Among the major detoxifying enzymes, hydrolases are the most studied group because of their involvement in the resistance of *Nilaparvata lugens* Stål to both organophosphorus and pyrethroid insecticides. Activity of carboxylesterase toward 1-naphthyl acetate in BPH is at least 20-fold higher than in some lepidoptera. More than a dozen carboxylesterase isozymes have been resolved using isoelectric-focusing electrophoresis, and substrate specificity has been observed in some isozymes.

Considerable conjugation of 1 -chloro-2,4-dinitrobenzene mediated by glutathione transferase has been observed in BPH. This enzyme in the pest, however, does not show any detectable activity toward another model substrate, 1,2-dichloro-4-nitrobenzene, or insecticides (parathion, paraoxon, and methyl parathion) known to be substrates for glutathione transferase in other insects.

Activity of microsomal P450-dependent monooxygenases toward several model substrates in BPH is very low-only about 1/50 to 1/100 of that in some lepidopterous insects. It has been hypothesized that this low mono-oxygenase activity may be due to its contact with only water-soluble materials in plant saps (see table).

The metabolic mechanisms of insecticide resistance observed in BPH may reflect the fundamental makeup of detoxifying enzymes. A lack of cross-resistance in BPH from existing organophosphorus/pyrethroid resistance (conferred by enhanced carboxylesterase hydrolysis) to buprofezin might be because the carboxylesterases do not hydrolyze this chitin synthesis inhibitor. Further, there may not be active microsomal monooxygenases with which to hydroxylate buprofezin, a known detoxifying reaction observed in soils. If resistance to buprofezin should occur in BPH, it might be the result of target site alterations. ■

Activities of detoxifying enzymes of *Nilaparvata lugens* Stal.

Enzyme and substrate	Specific activity
Carboxylesterase	
1-naphthyl acetate	40.2 µmol/min per mg protein
2-naphthyl acetate	36.9 µmol/min per mg protein
Glutathione transferase	
1-chloro-2,4-dinitrobenzene	192 µmol/min per mg protein
1,2-dichloro-4-nitrobenzene	ND[a]
Parathion	ND
Paraoxon	ND
Methyl parathion	ND
Microsomal P450-monooxygenases	
Aldrin	3.75 pmol/min per mg protein
Methoxyresorufin	2.90 pmol/min per mg protein
Ethoxyresorufin	ND
Ethoxycoumarin	ND

[a]ND = not detected.

Integrated pest management—other pests

Efficacy of benomyl in controlling the ufra nematode in Vietnam

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We conducted two experiments to test the effect of benomyl on the ufra nematode, Ditylenchus angustus, in deepwater rice in farmers' fields.

The first experiment was conducted in the village of Long Thanh My, Thu Duc district, Ho Chi Minh City. The farmer transplanted 45-d-old seedlings of variety Tieu doi in an ufra-prone area. Eight benomyl treatments were evaluated.

The second experiment was conducted, in Dong Phu, Chau Thanh district, Can Tho Province, in a field dry seeded with variety 1960. Rice showed ufra symptoms 40 d after sowing. Two benomyl and water solutions were tested: 0.1 and 0.2% ai sprayed at a rate of 500 liters/ha. An untreated control was the third treatment.

Fields were cultivated following farmers' practices. Experiments were laid out in a randomized complete block design with four replications using 7- × 7-m plots for the first experiment and 10- × 10-m plots for the second experiment. In the first experiment, 10 hills/plot were collected at rice crop maturity for nematode analysis. In the second experiment, five crop cuts of 20- × 20-cm were collected at random from each plot 1 d before, and 10 and 20 d after benomyl treatments. In both experiments, nematodes were extracted from all of the stems collected. Results were analyzed using ANOVA. Means were separated using DMRT.

D. angustus infestation was low in the first experiment, most probably because of late flooding and low water level during the flood. Results indicate,