In Vitro Degradation of Malathion by the Small Brown Planthopper, *Laodelphax striatellus* (FALLÉN), and the Brown Rice Planthopper, *Nilaparvata lugens* (STÅL) (Hemiptera: Delphacidae)[1]

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The phenomenon of insecticide resistance has become a worldwide problem, apparent in many pest control situations. At least 14 species of insect pests of rice show resistance to insecticides. Among them, the small brown planthopper, *Laodelphax striatellus* (FALLÉN), and the brown rice planthopper, *Nilaparvata lugens* (STÅL), showed high resistance to malathion (MIYATA and SAITO, 1984). OZAKI (1983) and OZAKI and KASSAI (1984) reported that pyrethroids exhibited higher toxicity in the organophosphate and carbamate resistant green rice leafhopper, *Nephotettix cincticeps* (UHLER), than in the susceptible ones.

When malathion resistant (Rm) populations of the small brown planthopper (SBPH) and the brown rice planthopper (BRPH) were selected with fenvalerate (fenvalerate selected (Rm-fen)), their susceptibilities against fenvalerate were reduced. At the same time, the susceptibilities of the Rm-fen strains to malathion were increased (KASSAI and OZAKI, 1984). This kind of phenomena had been reported in the green rice leafhopper between propoxur and propaphos (IWATA and HAMA, 1981), and between carbaryl and propaphos (HOSODA and FUJIWARA, 1977; TSUBOI et al., 1981). TAKAHASHI et al. (1977) and CHAPMAN and PENMAN (1979) also reported the reverse effect of insecticidal activity in the green rice leafhopper and the two-spotted spider mite, *Tetranychus urticae* KOCH, respectively. In this experiment *in vitro* degradation activity of ^{14}C-methyl malathion was assessed and compared with that of susceptible (S), Rm and Rm-fen strains.

The S, Rm and Rm-fen strains of SBPH and BRPH were described by KASSAI and OZAKI (1984). Adult females of insects were homogenized in an ice-cold 0.05 M tris-HCl buffer (pH 7.4) by means of a POTTER-ELVEHJIEM glass homogenizer. The homogenate was centrifuged at $900 \times g$ for ten min at 4°C, and the resultant supernatant was used as an enzyme source (i.e. 900 g supernatant). *In vitro* degradation activity of ^{14}C-methyl malathion was assessed by incubating 900 g supernatant with ^{14}C-methyl malathion (0.23 m Ci/m mole). The reaction mixture contained 1 ml of 900 g supernatant and 10 μl of ^{14}C-methyl malathion (10–3 M) in absolute ethyl alcohol was incubated at 37°C for 30 min with shaking. The reaction mixture was extracted with an equal volume of chloroform twice (MIYATA et al., 1983). Radioactivity in the aqueous fraction was determined for its degradation products with BRAY's scintillator (BRAY, 1960).

Rm strains of SBPH and BRPH showed significantly higher *in vitro* malathion degrading activity than S strains. This malathion degradation was mediated by carboxylesterase (MIYATA et al., 1976; 1983). The results obtained in this study confirmed previous reports. *In vitro* degradation activity of ^{14}C-methyl malathion by the Rm-fen strains showed lower activity than those by the Rm strains. Good correlationship was observed between *in vitro* degradation activity of ^{14}C-methyl malathion and malathion resistance levels in both species (Table 1). Fenvalerate, which also has a carboxylic ester linkage in its molecule, easily degrades in mammals. In mice and rats, about 70–80% of an applied dose of fenvalerate was metabolized through ester bond cleavage (OHKAWA et al., 1979; KANEKO et al., 1981). Therefore, it is worth clarifying whether the role of carboxylesterase of SBPH and BRPH in fenvalerate metabolism, and if the same enzyme also degrades malathion.

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Table 1. *In vitro* degradation of ^{14}C-methyl malathion and toxicity of malathion and fenvalerate in SBPH and BRPH strains

Strain		Degradation activity (μmol/g/hr)	LD_{50} (μg/g)[a]	
			malathion	fenvalerate
SBPH[b]	S	0.20	1.7	1.22
	Rm	6.70	653	0.14
	Rm-fen	4.74	169	0.74
BRPH[c]	S	0.17	4.4	20
	Rm	3.59	1,588	3.5
	Rm-fen	1.43	369	39.6

[a] After KASSAI and OZAKI (1984).
[b] Final enzyme concentrations for S, Rm and Rm-fen strains were 0.4, 0.08 and 0.08%, respectively.
[c] Final enzyme concentrations for S, Rm and Rm-fen strains were 2.0, 0.25 and 0.25%, respectively.

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