STATUS OF INSECTICIDE RESISTANCE AND RESISTANCE MECHANISMS IN SOME OF THE RICE INSECT PESTS AND FOUR OF THEIR PREDATORS

A THESIS PRESENTED

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ABSTRACT

Insecticide resistance and the underlying resistance mechanisms were studied in five rice insect pests (brown planthopper *Nilaparvata lugens*; green leafhopper *Nephotettix virescens*; paddy bug *Leptocorisa oratorius*; white leafhopper *Cofana spectra* and white-backed planthopper *Sogatella furcifera*), and four of their predators (lady-bird beetle *Micraspis discolor*; ground beetle *Ophionea indica*; mired bug *Cytorhinus lividipennis* and spider *Tetragnatha* sp.). Insects were collected from the rice fields at Batalagoda, Kurunegala district (intermediate zone) and Angunakolapalassa, Hambanthota district (dry zone) of Sri Lanka from August 1999 to January 2002. Insects were subjected to insecticide bioassays with dimethoate and chlorpyrifos (organophosphates), permethrin (a pyrethroid) and carbosulfan and BPMC (carbamates). A fixed dosage of 3500µg/g DDT and 4400µg/g malathion was used to assess the DDT and malathion tolerance. Bioassays were carried out by topical application method. Log-probit mortality lines and LD_{50}/LD_{90} values were obtained for each insecticide except for malathion and DDT, for all the species. For malathion and DDT percentage mortalities were recorded.

N. lugens collected from both sites showed high resistance to permethrin. *L. oratorius* population at Angunakolapalassa was resistant to carbosulfan compared to Batalagoda population. *L. oratorius, M. discolor* and *Tetragnatha* sp. populations at Angunakolapalassa were susceptible to permethrin compared to Batalagoda populations and *Tetragnatha* sp. population was susceptible to chlorpyrifos resistance at Angunakolapalassa. Others showed

similar resistance levels at both study areas. In general, most of the species tested from Batalagoda and Angunakolapalassa had lower tolerance for malathion although some species showed higher tolerance for DDT. To measure the carboxylesterase activity two substrates α/β naphthyl acetate and p-nitrophenyl acetate were used. Highest carboxylesterase activity with the substrate pNPA was present in *S. furcifera* (mean specific activity = 1.91μmol/min/mg). Lowest activity was found in *L. oratorius* (mean specific activity = 0.02μmol/min/mg). Native polyacryalamide gel electrophoresis was used to resolve carboxylesterase isoenzymes. No elevated carboxylesterase bands were found in *O. indica.* The major mechanism of insecticide resistance of rice insect pests and predators was elevated carboxylesterases. Malathion metabolism studies showed the absence of malathion carboxylesterases in all the species. Glutathione S-transferase activities were high in *O. indica* (mean specific activity = 0.55μmol/min/mg) and very low in *Teragnatha* sp. (mean specific activity = 0.11μmol/min/mg). Presence of high oxidase concentrations were detected in *M. discolor* (mean oxidase concentration = 3.82units) and *Tetragnatha* sp. (mean oxidase concentration = 8.75units). Inhibition of the organophosphate and carbamate targetsite acetylcholinesterase (AChE) with propoxur and paraoxon showed that AChEs of *S. furcifera*, *Tetragnatha* sp. and *C. lividipennis* populations are not sensitive to these insecticides. High activity of carboxylesterases and altered acetylcholinesterases were correlated with high resistance to organophophates and carbamates. High levels of glutathione S-transferaes activity had

provided high resistance to organochlorines and high oxidase concentrations were correlated with pyrethroid resistance.