

## LIST OF TABLES

		PAGE
Table 1.1	Common pests of tea plantations in Darjeeling hills and Terai-Dooars in northern West Bengal	7
Table 4.1	Standard regression equations for determination of tolerance level (LC <sub>50</sub> ) of <i>Helopeltis theivora</i> based on two defence enzymes	60
Table 5.1	Life cycle parameters of <i>Helopeltis theivora</i> reared on tea in laboratory	74
Table 5.2	Stage specific survivorship in laboratory-reared <i>Helopeltis theivora</i>	76
Table 5.3	Pesticide tolerance levels (LC <sub>50</sub> ) of <i>Helopeltis theivora</i> population from tea plantations of Terai region in northern West Bengal (n=150 for each population)	78
Table 5.4	Relative tolerance levels (LC <sub>50</sub> ) across three generations of <i>Helopeltis theivora</i> when selected by exposure to LC <sub>80</sub> of organophosphate pesticide (monocrotophos, 36% SL)	80
Table 5.5	Relative tolerance level against monocrotophos (36%SL) and the corresponding defence enzyme activity (mean $\pm$ SE, n=180) in <i>Helopeltis theivora</i> populations from tea plantations in Terai of northern West Bengal	88
Table 5.6	Relative tolerance levels and the corresponding defence enzyme activity (mean $\pm$ SE, n=150) in organophosphate pesticide (monocrotophos, 36%SL) selected generations of <i>Helopeltis theivora</i>	91
Table 5.7	Comparison of the isozyme profile of general esterases in organophosphate pesticide selected <i>Helopeltis theivora</i>	100
Table 5.8	Comparison of the isozyme profile of cytochrome P450 in organophosphate pesticide selected <i>Helopeltis theivora</i>	104
Table 5.9	One-way analysis of variance of percent inhibition of general esterases activity and cytochrome P450 by S, S, S – tributylphosphorotrithioate and piperonyl butoxide, respectively in <i>Helopeltis theivora</i> ; n=305	109

## LIST OF TABLES

		PAGE
Table 5.10	Correlation between the concentration of inhibitor and the percent inhibition of the defence enzymes in <i>Helopeltis theivora</i>	109
Table 5.11	Simple regression analysis of inhibitor concentration of percent inhibitions of defence enzymes in <i>Helopeltis theivora</i>	110
Table 5.12	The observed and the expected tolerance level (LC <sub>50</sub> ) of <i>Helopeltis theivora</i> populations based on GE activity	119
Table 5.13	The observed and the expected tolerance levels (LC <sub>50</sub> ) of <i>Helopeltis theivora</i> populations based on CYP450 activity	119
Table 5.14	Life cycle parameters of <i>Oxyopes javanus</i> reared in laboratory	130
Table 5.15	Functional responses of <i>Oxyopes javanus</i> to adult <i>Helopeltis theivora</i> as prey	132
Table 5.16	Regression of <i>Oxyopes javanus</i> density on predation efficiency	132

## LIST OF FIGURES

		<b>PAGE</b>
Figure 4.1A	Map showing position of West Bengal in the Indian union and the two major tea growing districts, Darjeeling and Jalpaiguri therein	40
Figure 4.1B	Map showing sampling sites from the two districts, Darjeeling and Jalpaiguri in northern part of West Bengal	41
Figure 4.2	Curves based on detoxifying enzymes GE (A) and CYP450 (B), for determination of LC <sub>50</sub> values against organophosphate in the field populations of <i>Helopeltis theivora</i>	61
Figure 4.3	Curves based on detoxifying enzymes GE (A) and CYP450 (B), for determination of LC <sub>50</sub> values against synthetic pyrethroid in the field populations of <i>Helopeltis theivora</i>	62
Figure 5.1	Electropherogram showing isozyme pattern of general esterase from the whole body homogenate across organophosphate selected three generations of <i>Helopeltis theivora</i>	93
Figure 5.2	General esterase isozyme profile across organophosphate selected three generations of <i>Helopeltis theivora</i>	95
Figure 5.3	Electropherogram showing isozyme pattern of cytochrome P450 from the whole body homogenate across organophosphate selected three generations of <i>Helopeltis theivora</i>	96
Figure 5.4	Cytochrome P450 isozyme profile across organophosphate selected three generations of <i>Helopeltis theivora</i>	97
Figure 5.5	General esterase isozyme profile of <i>Helopeltis theivora</i> across three generations when inhibited by organophosphate	99
Figure 5.6	Comparison of general esterase isozyme profile across organophosphate-selected generations of <i>Helopeltis theivora</i>	102
Figure 5.7	Cytochrome P450 isozyme profile of <i>Helopeltis theivora</i> across three generations when inhibited by organophosphate	106
Figure 5.8	Comparison of cytochrome P450 isozyme profile across organophosphate-selected generations of <i>Helopeltis theivora</i>	107

## LIST OF FIGURES

		<b>PAGE</b>
Figure 5.9	Inhibition of general esterase by S, S, S – tributylphosphorotrithioate	112
Figure 5.10	Probit transformed curve showing the probability of general esterases activity inhibition in response to S, S, S – tributylphosphorotrithioate in <i>Helopeltis theivora</i>	113
Figure 5.11	Dose response curve showing inhibition of cytochrome P450 by piperonyl butoxide	116
Figure 5.12	Probit transformed curve showing the probability of cytochrome P450 activity inhibition in response to piperonyl butoxide in <i>Helopeltis theivora</i>	117
Figure 5.13	Predatory efficacy of <i>Oxyopes javanus</i> (♂&♀) with variable density of adult <i>Helopeltis theivora</i>	134
Figure 5.14	Predation efficacy of <i>Oxyopes javanus</i> (♀&♂) with increase in its density	134
Figure 5.15	Prey consumption time of <i>Oxyopes javanus</i>	136

## LIST OF PHOTO PLATES

	<b>PAGE</b>	
Plate – 1.1	Tea plantations in northern West Bengal, India	5
Plate – 1.2	Tea mosquito bug, <i>Helopeltis theivora</i> A) Female B) Male	11
Plate – 1.3	Damage symptoms of tea mosquito bug, <i>Helopeltis theivora</i> A) as found in tea plantation B) as observed in laboratory condition	14
Plate – 2.1	A planter applying pesticide in a tea plantation of northern West Bengal	23
Plate – 4.1	Sampling of <i>Helopeltis theivora</i> by vacuum sampler	44
Plate – 4.2	Rearing technique of <i>Helopeltis theivora</i> A) In glass hurricane chimney B) In wooden insect rearing cage C) Tea twig supplying technique for adult D) Tea twig supplying technique for nymph	46
Plate – 4.3	Setup for bioassay and selection of <i>Helopeltis theivora</i> by exposure to pesticide through generations	50
Plate – 4.4	Microplate reader (Opsys MRX <sub>TC</sub> revelation, Dynex technologies, USA)	53
Plate – 4.5	Microplate showing reaction pattern of defence enzymes A) General esterases B) Cytochrome P450 C) Glutathione <i>S</i> -transferase	57
Plate – 5.1	Transverse section of tea twig showing an egg of <i>Helopeltis theivora</i>	69
Plate – 5.2	Nymphal stadia of <i>Helopeltis theivora</i> A) First instar B) Second instar C) Third instar D) Fourth instar E) Fifth instar	72
Plate – 5.3	Schematic representation of the bottleneck effect and artificial selection caused by repeated application of pesticide	83
Plate – 5.4	<i>Oxyopes javanus</i> performing courtship dance	122
Plate – 5.5	Female <i>Oxyopes javanus</i> guarding egg mass/cocoon A) In tea plantations B) In laboratory condition	125

## LIST OF PHOTO PLATES

		PAGE
Plate – 5.6	Spiderlings of <i>Oxyopes javanus</i> A) Newly hatched B) Under binocular microscope (magnification≈40x)	128
Plate – 5.7	Adult <i>Oxyopes javanus</i> A) Female B) Male	128