

CONTENTS	Page No.
List of figures	xiv
List of tables	xviii
List of abbreviations	xx
List of appendices	xxii
1. Introduction	1
1.1 Tea	1
1.2 Agro-climate for Tea plantation	2
1.3 Tea ecosystem and its pest diversity and management practices	4
1.4 Looper: caterpillar stage of geometrid moths	5
1.5 Loopers as potential tea pest: damage symptoms and control	7
1.6 Rearing of insects	11
1.6.1 Types of rearing	11
1.6.2 Importance of rearing	11
1.7 Synthetic/Artificial diets for insect rearing	12
1.8 Synthetic diet versus Natural diet	13
1.9 About the contemplated work	14
2. Review of Literature	18
2.1 Tea crop and its pest	18
2.2 Folivores of tea in Darjeeling Terai-Dooars Plantations of North Bengal	19
2.3 Tea loopers	20
2.4 Food utilization efficiencies	22
2.5 Developmental traits	25
2.5.1 Post-embryonic Developmental Parameters	26
2.5.2 Survivorship	26
2.6 Enzymes profile of Lepidoptera on different food regimes	28
2.7 Studies on species of geometrids (loopers) reared on natural diet	31
2.8 Synthetic (=artificial) diets of insects: their formulation and utility in rearing	32
3. Objectives and scope of study	39
4. Materials and Methods	40
4.1 Collection of loopers and moths	40
4.2 Rearing of the loopers and maintenance of continuous culture	40
4.2.1 Natural hosts	42
4.2.1.1 Processing of leaves	42
4.2.1.2 Sterilization of the insect culture equipment and set up	42
4.2.1.3 Maintenance of culture	43
4.2.2 Synthetic diets	44
4.2.2.1 Preparation of synthetic diet	44

4.2.2.2	Dispensing of diet in culture container	45
4.2.2.3	Maintenance of culture	45
4.3	Developmental traits	46
4.3.1	Developmental period	46
4.3.2	Survival	46
4.3.3	Morphometrics	47
4.4	Key preparation	47
4.5	Food utilization study	47
4.6	Mid-gut Enzyme analyses	48
4.6.1	Enzyme isolation	49
4.6.2	Enzyme quantification	49
4.6.2.1	Amylase	49
4.6.2.2	Invertase	49
4.6.2.3	Protease	49
4.6.2.4	Lipase	50
4.6.2.5	Esterase	50
4.6.2.6	Glutathione S-transferase	50
4.6.2.7	Cytochrome P450	51
4.6.3	Protein Estimation	51
4.7	Statistical Analyses	51
5.	Results and Discussion	53
5.1	Preparation of stage-specific identification keys for the common looper species of tea with description of stages	53
5.1.1	<i>Biston (=Buzura) suppressaria</i>	53
5.1.2	<i>Hyposidra talaca</i>	55
5.1.3	<i>Hyposidra infixaria</i>	56
5.1.4	Field identification key to immature stages and adults of geometrid pests of tea	59
5.1.5	Discussion	61
5.2	Designing and development of synthetic (artificial) diet for rearing the geometrid (looper) species	63
5.2.1	<i>Biston (=Buzura) suppressaria</i>	63
5.2.2	<i>Hyposidra talaca</i>	64
5.2.3	<i>Hyposidra infixaria</i>	64
5.2.4	Discussion	72
5.3	Developmental Traits and Food utilization efficiencies on Natural host plants (Tea and Needlewood)	77
5.3.1	<i>Biston (=Buzura) suppressaria</i>	77
5.3.2	<i>Hyposidra talaca</i>	80
5.3.3	<i>Hyposidra infixaria</i>	83
5.3.4	Discussion	86
5.4	Developmental Traits and Food utilization efficiencies on Synthetic diet and Natural host (Tea)	91

5.4.1	<i>Biston (=Buzura) suppressaria</i>	91
5.4.2	<i>Hyposidra talaca</i>	95
5.4.3	<i>Hyposidra infixaria</i>	97
5.4.4	Discussion	100
5.5	Principal Hydrolases and Defense enzymes of loopers reared on Tea, Needlewood and Synthetic diet	103
5.5.1	<i>Biston (=Buzura) suppressaria</i>	103
5.5.2	<i>Hyposidra talaca</i>	108
5.5.3	<i>Hyposidra infixaria</i>	113
5.5.4	Discussion	118
5.6	Standardization of laboratory culture technique for the geometrid (looper) species on synthetic diets	121
5.6.1	Sterilization of rearing equipment and facility	121
5.6.2	Maintenance of rearing system	121
5.6.3	Sexing and mating	122
5.6.4	Collection and sterilization of eggs	122
5.6.5	Hatching of neonates	122
5.6.6	Improvisation of rearing technique	124
5.6.7	Modifications done for normal pupation	126
5.6.8	Cost-benefit analysis of Synthetic diet and Natural diet (Tea)	126
5.6.9	Discussion	128
6.	Conclusion and Deliverables	131
7.	Summary	133
8.	References	138
9.	Index	173
	Appendix 1	
	Appendix 2	
	Appendix 3	