

ABSTRACT

Ecological studies were carried out on four mango varieties (Shmama, Balady, Holman and Alphonso) in Inshas El-Raml district, Sharkia Governorate during the two successive years (2007-2008 and 2008-2009) to survey the important scale insects and mealybugs which attacking mango varieties and their associated natural enemies. Seven species of scale insects and mealybugs belonging to four families, five parasitoids species and one predacious species were recorded. Seasonal abundance, number of generations, effect of climatic factors, preferable level, preferable leaf surface, distribution and susceptibility of the mango varieties to infestation for both *Kilifia acuminata* (Signoret) and *Aulacaspis tubercularis* (Newstead) and its associated natural enemies were studied. The relationship between insects infestation and chemical composition of leaves of mango varieties were also considered.

CONTENTS

	Page
INTRODUCTION.....	1
REVIEW OF LITERATURE	4
1. Survey and ecological studies	4
1.1. Seasonal abundance	4
1.1.1. Family: Coccidae	4
1.1.1.1. Mango shield scale (Acuminate scale), <i>Kilifia acuminata</i> (Signoret) (= <i>Lecanium acuminatum</i>)	4
1.1.1.2. The guava soft scale insect, <i>Pulvinaria psidii</i> Maskell	7
1.1.2. Family: Diaspididae	10
1.1.2.1. White mango scale insect, <i>Aulacaspis tubercularis</i> (Newstead)	10
1.1.2.2. The latania scale insect, <i>Hemiberlesia lataniae</i> (Signoret)	13
1.1.2.3. The circular black scale, <i>Chrysomphalus aonidum</i> (Linnaeus)	17
1.1.2.4. Oyster shell mango scale insect, <i>Insulaspis</i> (= <i>Lepidosaphes</i>) <i>pallidula</i> (Green)	18
1.1.3. Family: Margarodidae	21
1.1.3.1. The ornamental - Palm mealybug, <i>Icerya seychellarum</i> (Westwood)	21
1.2. Natural enemies	27

- II -

1.3. Effects of climatic factors on scale insects, mealybugs and their associated natural enemies ...	36
1.4. Chemical analysis	41
MATERIALS AND METHODS	43
1. Survey, population densities and seasonal abundance	43
2. Estimation number of predator and parasitism ratios	44
3. Effect of climatic factors on the insect population and natural enemies	44
4. The preferable direction for the insect stages and natural enemies	45
5. Chemical analysis	46
5.1. Moisture %	46
5.2. Total soluble protein, fats and carbohydrates analysis	47
5.2.1. Total soluble protein	47
5.2.2. Fats	47
5.2.3. Carbohydrates %	48
RESULTS AND DISCUSSION	50
PART ONE	
1. Survey and ecological studies	50
1.1. Survey	50
1.1.1. Survey of scale insects and mealybugs infesting four mango varieties	50
1.1.2. Survey of natural enemies of scale insects	58
1.1.2.1. Survey of parasitoids of scale insects	58

- III -

1.1.2.1. Survey of predators of scale insects	62
1.2. Ecological studies on some scale insects infesting mango varieties	65
1.2.1. Ecological studies on <i>Kilifia acuminata</i> (Signoret)	65
1.2.1.1. On Shmama variety	65
1.2.1.1.1. Seasonal abundance	65
1.2.1.1.1.1. Females population	65
1.2.1.1.1.2. Nymphs population	70
1.2.1.1.1.3. Total number of alive stages	70
1.2.1.1.1.4. Total number of non alive stages	76
1.2.1.1.1.5. Percentages of total mortality	76
1.2.1.1.1.6. Percentages of parasitism	77
1.2.1.1.2. Effect of climatic factors	78
1.2.1.1.2.1. On females	78
1.2.1.1.2.2. On nymphs	80
1.2.1.1.2.3. On total number of alive stages	80
1.2.1.1.2.4. On total number of non alive stages	81
1.2.1.1.2.5. On percentages of total mortality	81
1.2.1.1.2.6. On percentages of parasitism	82
1.2.1.1.2.7. Combined effect of climatic factors	82
1.2.1.1.3. Preferable level and Preferable leaf surface ..	83
1.2.1.2. On Balady variety	85
1.2.1.2.1. Seasonal abundance	85
1.2.1.2.1.1. Females population	85
1.2.1.2.1.2. Nymphs population	85
1.2.1.2.1.3. Total number of alive stages	92
1.2.1.2.1.4. Total number of non alive stages	93

1.2.1.2.1.5. Percentages of total mortality	96
1.2.1.2.1.6. Percentages of parasitism	97
1.2.1.2.2. Effect of climatic factors	97
1.2.1.2.2.1. On females	97
1.2.1.2.2.2. On nymphs	99
1.2.1.2.2.3. On total number of alive stages	99
1.2.1.2.2.4. On total number of non alive stages	100
1.2.1.2.2.5. On percentages of total mortality	101
1.2.1.2.2.6. On percentages of parasitism	101
1.2.1.2.2.7. Combined effect of climatic factors	101
1.2.1.2.3. Preferable level and Preferable leaf surface ..	102
1.2.1.3. On Holman variety	104
1.2.1.3.1. Seasonal abundance	104
1.2.1.3.1.1. Females population	104
1.2.1.3.1.2. Nymphs population	104
1.2.1.3.1.3. Total number of alive stages	109
1.2.1.3.1.4. Total number of non alive stages	110
1.2.1.3.1.5. Percentages of total mortality	115
1.2.1.3.1.6. Percentages of parasitism	116
1.2.1.3.2. Effect of climatic factors	116
1.2.1.3.2.1. On females	116
1.2.1.3.2.2. On nymphs	117
1.2.1.3.2.3. On the total number of alive stages	118
1.2.1.3.2.4. On total number of non alive stages	120
1.2.1.3.2.5. On percentages of total mortality.....	120
1.2.1.3.2.6. On percentages of parasitism	121
1.2.1.3.2.7. Combined effect of climatic factors	121

1.2.1.3.3. Preferable level and preferable leaf surface ..	122
1.2.1.4. On Alphonso variety	125
1.2.1.4.1. Seasonal abundance	125
1.2.1.4.1.1. Females population	125
1.2.1.4.1.2. Nymphs population	125
1.2.1.4.1.3. Total number of alive stages	126
1.2.1.4.1.4. Total number of non alive stages	127
1.2.1.4.1.5. Percentages of total mortality	136
1.2.1.4.1.6. Percentages of parasitism	137
1.2.1.4.2. Effect of climatic factors	137
1.2.1.4.2.1. On females	137
1.2.1.4.2.2. On nymphs	138
1.2.1.4.2.3. On total number of alive stages	138
1.2.1.4.2.4. On total number of non alive stages	139
1.2.1.4.2.5. On percentages of total mortality	141
1.2.1.4.2.6. On percentages of parasitism	141
1.2.1.4.2.7. Combined effect of climatic factors	141
1.2.1.4.3. Preferable level and preferable leaf surface ..	142
1.2.1.5. Number of generations	144
1.2.1.6. The preferable direction for the insect and its associated parasitoids	144
1.2.1.7. Comparison between population densities and percentages of parasitism of <i>Kilifia acuminata</i> (Signoret) on mango varieties	152
1.2.1.7.1. Population density	152
1.2.1.7.2. The mean percentage of parasitism	153

1.2.2. Ecological studies of <i>Aulacaspis tubercularis</i> (Newstead)	155
1.2.2.1. On Shmama variety	155
1.2.2.1.1. Seasonal abundance	155
1.2.2.1.1.1. Females population	155
1.2.2.1.1.2. Males population	156
1.2.2.1.1.3. Nymphs population	156
1.2.2.1.1.4. Total number of alive stages	161
1.2.2.1.1.5. Total number of non alive stages	162
1.2.2.1.1.6. Percentages of total mortality	162
1.2.2.1.1.7. Predator population	163
1.2.2.1.1.8. Percentages of parasitism	168
1.2.2.1.2. Effect of climatic factors	169
1.2.2.1.2.1. On females	169
1.2.2.1.2.2. On males	171
1.2.2.1.2.3. On nymphs	171
1.2.2.1.2.4. On total number of alive stages	172
1.2.2.1.2.5. On total number of non alive stages	172
1.2.2.1.2.6. On percentages of total mortality	173
1.2.2.1.2.7. On predator population	174
1.2.2.1.2.8. On percentages of parasitism	175
1.2.2.1.2.9. Combined effect of climatic factors	175
1.2.2.1.3. Preferable level and preferable leaf surface ..	176
1.2.2.2. On Balady variety	180
1.2.2.2.1. Seasonal abundance	180
1.2.2.2.1.1. Females population	180
1.2.2.2.1.2. Males population	180
1.2.2.2.1.3. Nymphs population	185

- VII -

1.2.2.2.1.4. Total number of alive stages	186
1.2.2.2.1.5. Total number of non alive stages	191
1.2.2.2.1.6. Percentages of total mortality	191
1.2.2.2.1.7. Predator population	192
1.2.2.2.1.8. Percentages of parasitism	193
1.2.2.2.2. Effect of climatic factors	194
1.2.2.2.2.1. On females	194
1.2.2.2.2.2. On males	194
1.2.2.2.2.3. On nymphs	196
1.2.2.2.2.4. On total number of alive stages	196
1.2.2.2.2.5. On total number of non alive stages	196
1.2.2.2.2.6. On percentages of total mortality	197
1.2.2.2.2.7. On predator population	198
1.2.2.2.2.8. On percentages of parasitism	199
1.2.2.2.2.9. Combined effect of climatic factors	199
1.2.2.2.3. Preferable level and preferable leaf surface ..	200
1.2.2.3. On Holman variety	204
1.2.2.3.1. Seasonal abundance	204
1.2.2.3.1.1. Females population	204
1.2.2.3.1.2. Males population	204
1.2.2.3.1.3. Nymphs population	209
1.2.2.3.1.4. Total number of alive stages	209
1.2.2.3.1.5. Total number of non alive stages	210
1.2.2.3.1.6. Percentages of total mortality	211
1.2.2.3.1.7. Predator population	212
1.2.2.3.1.8. Percentages of parasitism	217
1.2.2.3.2. Effect of climatic factors	218
1.2.2.3.2.1. On females	218

- VIII -

1.2.2.3.2.2. On males	218
1.2.2.3.2.3. On nymphs	220
1.2.2.3.2.4. On total number of alive stages	220
1.2.2.3.2.5. On total number of non alive stages	221
1.2.2.3.2.6. On percentages of total mortality	221
1.2.2.3.2.7. On predator population	222
1.2.2.3.2.8. On percentages of parasitism	223
1.2.2.3.9. Combined effect of climatic factors	224
1.2.2.3.3. Preferable level and preferable leaf surface ..	224
1.2.2.4. On Alphonso variety	228
1.2.2.4.1. Seasonal abundance	228
1.2.2.4.1.1. Females population	228
1.2.2.4.1.2. Males population	228
1.2.2.4.1.3. Nymphs population	233
1.2.2.4.1.4. Total number of alive stages	234
1.2.2.4.1.5. Total number of non alive stages	234
1.2.2.4.1.6. Percentages of total mortality	235
1.2.2.4.1.7. Predator population	240
1.2.2.4.1.8. Percentages of parasitism	241
1.2.2.4.2. Effect of climatic factors	241
1.2.2.4.2.1. On females	241
1.2.2.4.2.2. On males	242
1.2.2.4.2.3. On nymphs	244
1.2.2.4.2.4. On total number of alive stages	244
1.2.2.4.2.5. On total number of non alive stages	245
1.2.2.4.2.6. On percentages of total mortality	246
1.2.2.4.2.7. On predator population	246
1.2.2.4.2.8. On percentages of parasitism	247

- IX -

1.2.2.4.2.9. Combined effect of climatic factors	248
1.2.2.4.3. Preferable level and preferable leaf surface ..	248
1.2.2.5. Number of generations	252
1.2.2.6. The preferable direction for the insect and its associated natural enemies	252
1.2.2.7. Comparison between population densities, predator to prey ratio and percentages of parasitism of <i>Aulacaspis tubercularis</i> (Newstead) on mango varieties	261
1.2.2.7.1 Population density	261
1.2.2.7.2. Predator to prey ratio	261
1.2.2.7.3. Percentage of parasitism	262
PART TWO	
2. Relationship between chemical composition of mango leaves and the infestation	264
SUMMARY	272
REFERENCES	291
ARABIC SUMMARY	