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Insect Pests of *Mangifera indica* Plantation in Chuping, Perlis, Malaysia

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Abstract: A survey of insect pests of *Mangifera indica* plantation was conducted between July 2006 and March 2007 in Chuping, Perlis, Malaysia. Day sampling and night observations (with light traps) was carried out to observe the presence of insects on leaves, flowers, fruits and branches of the mango tree. Nine orders of insects belonging to 45 families were observed and this includes Coleoptera, Demaptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Odonata and Orthoptera. Coleoptera was the most abundant (Margalef index: 4.446) of which 680 belonging to 30 species and 12 families were collected throughout the period of study. Diptera was the most specious (Simpson Diversity index, 0.89). The result of field study showed that during the non-fruiting season 165 individuals of *Monolepta bifasciata* was recorded probably due to the presence of many young mango shoots during the season. Six adults of *R. simulans* were also observed in fruiting season including a mating pair. The implications of these results are discussed in relation to the management of insect pests of mango plantation in Malaysia.

Key words: *Mangifera indica*, insect pests, abundance, diversity, Malaysia

INTRODUCTION

Mangifera indica (Mango) belongs to the family Anacardiaceae is one of the seasonal fruits widely planted in tropical and subtropical countries of the world. The family Anacardiaceae contains at least 60 genera of which 15 genera were reported in Malaysia (Abidin and Malik, 1996). *Mangifera* is a common genus in Malaysia and 15 species of the genus are found in Peninsular Malaysia. The commonly planted species are *Mangifera indica*, *M. caesia*, *M. foetida*, *M. lagenifera*, *M. longipetiolata*, *M. microphylla*, *M. odorata*, *M. pentandra* and *M. quadrifida* (Abidin and Malik, 1996).

Singh (1989a) reported that major pollinating insects of mango are from the order Diptera, such as *Meliopona* species and *Syrphus* species, *Musca domestica*, House fly were not much prevalent. However, the presence of beetle especially *Coccinella septumpunctata* was quite important whereas that of Hymenoptera and honey bee was negligible.

Mango has many pests of which two groups, the homopterans and coleopterans have been implicated as causative agents of many debilities demanding urgent control. About 260 insects have been reported as pests of mango and this include mango hoppers, mango mealy bugs, scale insects, stem and shoot borers, leaf feeders and gall formers (Veeresh, 1989; Pena *et al*., 1998).

Singh (1989b) and Pena *et al*. (1998) also reported that *Amritodus atkinsoni* (Leth), *Erosomyia indica* Grover and *Rhynhaenus mangiferae* Marsh were the three major insects affecting flowering and fruiting in *Mangifera* species.

In Florida, USA, the blossom pests, *Frankliniella bispinosa*, *F. kelliae*, *Daghbertus* species and a complex of microlepidoptera larvae, such as *Pococera atramentalis*, *Platinota rostrana*, *Pleuroprucha*

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insulsaria, *Tallula* species and *Racheospila gerularia* have been found to be the most important pests of mango flowers. The scales, *Radionaspis indica* and *Morganella longispina* are common pests of the trunk, branches and buds and severe infestations are manifested by cracking of the bark, exudation of sap and decline of upper branches (Pena, 1993; Pena *et al*., 1998).

Ithnin and Shamsudin (1996) reported that beetle pest also include Chrysomelidae and Scarabaeidae.

The successful management of these pests become pertinent so as to improve the quality and increase quantity of mango production in Malaysia. Malaysia mango production is very low compared to Indonesia which in year 2000 has 564 metric tones exported (Pitz *et al*., 2001). However, up till now no information exists on the insect pests of *M. indica* in Malaysia, thus stalling a better understanding of the management needs of the plantation. The study is therefore aimed at assessing the abundance and diversity of insect pests of mango and to determine the dominant pest of the plantation in Malaysia.

MATERIALS AND METHODS

Study Area

Four field studies were conducted between July 2006 and March 2007 at a 70 ha mango *Mangifera indica* (Variety: Sala) farm in Chuping, Perlis, Malaysia (06.5E N 100.3E E). The trees are of average age between 7 and 9 years except for a farm which is more than 17 years of age and average height of 20 feet.

Trees Grading and Damage Assessment

The trees in the 70 ha farm were observed in order to determine any damage on leaves, flowers, stem and trunk Each tree was assessed and its degree of damage rated as 3 for heavy damage (i.e., >40 damaged branches), 2 for moderate damage (i.e., 30-40 damaged branches), 1 for light damage (i.e., 10-20 damaged branches) and 0 for no damaged branches. The respective trees were then banded with masking tape and marked with different colours on all experimental plots.

Diurnal and Nocturnal Sampling

Day and night observations were made to observe the presence of any insects on leaves, flowers, fruits or branches.

Night observation was done by setting up 20 light traps from 7.00 to 11.00 pm using a 3×3 m white cloth vertically placed half meter from the ground with a 160 Watt mercury lamp placed on the top of the cloth at the middle. A Honda E10i generator was used as a power source. The insects were then collected manually or by net sweeping.

Investigation of Pest Borer from Cut Damaged Trunk of *Mangifera indica*

During each visit to the plantation, three damaged trees were chosen each from four heavily damaged areas in the plantation. Every damaged branch was cut off from the trees and each branch was cut opened to observe the presence of insect borer.

Collection of Damaged Fruits

During the fruiting season, all fallen, rotten fruits were collected and cut opened to observe the presence of any stage of pest of mango seed and the pests were taken to be identified. The insects collected from the fruits/seeds were preserved in 70% alcohol.

Insect Identification and Calculation of Diversity Index

All the insects sampled were identified either to order, family of species level using the identification keys provided by Triplehorn and Johnson (2005). Identification of samples was also authenticated using the specimens preserved in the Malaysian Department of Agriculture, Kuala Lumpur. Unidentified species were given a code. Margalef index and Simpson index were used to calculate the abundance and diversity.

$$\text{Margalef index, } H = S\text{-}1/\ln (N)$$

S = No. of species
N = Total number of individuals in the family

The higher value of Margalef index, the more abundant the species.

$$\text{Simpson index, } D = \Sigma \text{ ni (ni B 1)/N (N B 1)}$$

$$\text{Simpson diversity index, } D' = 1\text{-Simpson index}$$

ni = No. of individuals of species observed
N = Total number of individuals in the family

Value of Simpson index is between 0 to 1. Thus for Simpson Diversity index, the nearer the value is to 1, the more diverse is the species.

RESULTS

Tree Grading

There are 14,156 trees in the 70 ha mango farm and all of them were found with different category of damage. The grading shows that 345 (2.44%) trees were heavily damaged, 788 (5.57%) trees were moderately damaged while 13,023 (91.99%) trees were of light damage.

Insect Abundance and Diversity

Table 1 shows that there were 256 individual insects belonging to 21 species and 15 families observed during the non fruiting season (July to November 2006) while Table 2 shows that 731 individuals belonging to 69 species and 39 families were recorded during the fruiting season (December 2006 to March 2007).

In non fruiting season, the most abundant insect was Odonata with Margalef index of 1.8205, followed by Coleoptera (Margalef index, 1.7276) and Hemiptera (Margalef index, 0.2583). While the most diverse insect was Lepidoptera with Simpson Diversity index of 0.7333 followed by Coleoptera (Simpson Diversity index, 0.18646). The least diverse were Dermaptera, Homoptera, Hymenoptera and Odonata each with Simpson Diversity index of 0 (Table 1).

During the fruiting season, Coleoptera was the most abundant insect with Margalef index of 4.4464 and this was closely followed by Lepidoptera (Margalef index, 3.8343) while the least abundant was Hemiptera with Margalef index of 1.2740 (Table 2). The Table 2 also revealed that the most diverse insect was Lepidoptera with Simpson Diversity index of 0.8898 followed by Diptera (Simpson Diversity index, 0.8897), while the least diverse was Hemiptera with Simpson Diversity index of 0.20399.

Table 1: Diurnal and nocturnal abundance and diversity of insects in *M. indica* plantation during non fruiting season (July to November 2006)

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
Coleoptera					
Chrysomelidae	*Monolepta bifasciata*	165	Light trap		
	Podagrica gemella	2	Light trap	0.19538906	0.023807806
Carabidae	*Pheropsophus occipitalis*	2	Light trap	0	0
Tenebrionidae	*Ganocephalum aequatoriales*	1	Light trap and leaves	0.558110627	0.33333333
	Tene A*	5	Light trap		
Scarabaeidae	*Anomala cupripes*	1	Light trap		
	Anomala pallida	4	Flowers and Light trap		
	Apogonia expeditionis	1	Flowers		
	Leucopholis rorida	1	Light trap	1.541695027	0.714285714
Cicindelidae	*Cicindella* species	1	Light trap	0	0
Total 5	10	183		1.727617607	0.186452891
Dermaptera					
Forficulidae	For A*	4	Light trap	0	0
Total 1	1	4			
Hemiptera					
Coreidae	*Vilius melanopterus*	1	Stem and leaves	0	0
Cydnidae	*Geotamus pygmaeus*	47	Light trap	0	0
Total 2	2	48		0.258317767	0.0416667
Homoptera					
Cicadellidae	Cicadel A*	5	Light trap	0	0
Total 1	1	5			
Hymenoptera					
Formicidae	Formi A*	7	Stem and branches	0	0
Total 1	1	7			
Lepidoptera					
Pyralidae	Pyra A*	1	Light trap	0.910239227	0.66666667
	Pyra C*	2	Leaves	0	0
Nymphalidae	Nymp A*	3	Stem		
Total 2	3	6		1.116221253	0.73333333
Odonata					
Odonata A#	*Crocothemis servilia*	1	Stem	0	0
Gomphidae	Gom A*	1	Stem	0	0
Calopterigidae	Calop A*	1	Light trap	0	0
Total 3	3	3		1.820478453	0

#: Unidentified family, *: Unidentified species

Table 2: Diurnal and nocturnal abundance and diversity of insects in *M. indica* plantation during the fruiting season (December 2006 to March 2007)

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
Coleoptera					
Buprestidae	*Chrysobothris delanifica*	1	On branch	0	0
Chrysomelidae	*Cheorane modesta*	76	Light trap		
	Podagrica gemella	3	Light trap	0.228861869	0.074001995
Curculionidae	*Sternochetus mangiferae*	1	Light trap		
	Deiradolcus corbetti	2	Light trap		
	Hypomeces squamosus	61	On flowers	0.480898347	0.091765873
Carabidae	*Abacetus marginicolis*	56	Light trap		
	Planetes ruficeps	6	Light trap		
	Acupalpus vestigiala	67	Light trap and on ground		
	Pheropsophus occipitalis	10	Light trap		
	Stenolophus quinquepustulatus	6	Light trap	0.803740004	0.633524904
Elateridae	*Adelocera* species	2	On branch	0	0
Tenebrionidae	*Tenebrio molifar*	2	Leaves		

Table 2: Continued

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
	Ganocephalum aequatoriales	31	Light trap and leaves		
	Tene A*	9	Rotten fruits		
	Scotobaenus parallelus	3	Ground and light trap	0.788091933	0.48989899
Scarabaeidae	*Brahmina* species	62	Leaves		
	Anomala crupripes	6	Flowers and leaves		
	Onthophagus orientalis	3	Leaves		
	Anomala pallida	2	Flowers		
	Apogonia expeditionis	65	Flower, light trap and leaves		
	Aserica species	2	Light trap		
	Leucopholis rorida	2	Light trap	1.210696001	0.601238637
Cerambycidae	*Rhytidodera simulans*	6	Light trap and on ground	0	0
Coccinellidae	*Coccinella* species	2	Light trap		
	Verania dicscolor	4	Light trap and leaves	0.558110627	0.53333333
Scolytidae	*Campsomeris quadriguttulata*	1	Branch	0	0
Nitidulidae	*Carpophilus lugubris*	6	Rotten fruit	0	0
Total 11	28	497		4.34881348	0.105836633
Diptera					
Tabanidae	Taba A*	4	Leaves and flowers		
	Tabanus species	2	Leaves and flowers		
	Taba C*	2	Leaves and flowers	0.961796694	0.285714286
Stingidae	Sting A*	1	Leaves	0	0
Chironomidae	Chiro B*	3	Light trap	0	0
Muscidae	Musc A*	2	Light trap	0	0
Tepthritidae	Tept A*	3	Light trap	0	0
Total 5	7	17		2.117736743	0.889705882
Hemiptera					
Coreidae	*Vilius melanopterus*	4	Stem and leaves	0	0
Cydnidae	*Geotamus pygmaeus*	99	Light trap	0	0
Pentatomidae	Penta A*	1	Stem and ground	1.442695041	0
	Vezara viridula	1	Ground		
Reduvidae	*Sirthenea flavipes*	2	Light trap	0.72134752	0.6666667
	Ectomocoris atrox	2	Light trap		
Pyrrhocoridae	*Dysdercus cingulatus*	2	Light trap	0	
Total 5	7	111		1.274012427	0.203931204
Hymenoptera					
Vespidae	*Vespa affinis*	4	Flying around trees	0	0
Apidae	*Koptorthosoma confusa*	1	Flying around trees	0	0
Scollidae	Scoll A*	1	Leaves	0	0
Chrysididae	Chrysi A*	1	Leaves	0	0
Formicidae	Formi A*	35	Stem and branches	0.276937893	0.10510505
	Formi B*	2	Stem and branches		
Total 5	6	44		1.32128685	0.363636364
Lepidoptera					
Arctiidae	*Cretonotus gangis*	1	Flying around trees	1.820478453	0
	Rhodogastria astreus	1	Flying around trees		

Table 2: Continued

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
	Asota producta	1	Flowers		
Lepidoptera A#	*Amata hueberi*	1	Flowers	0	0
Pyralidae	Pyra A*	8	Leaves	0.629315961	0.69208986
	Pyra B*	9	Stem		
	Pyra C*	7	Leaves		
Nymphalidae	Nymp A*	10	Stem	1.107808119	0.542857143
	Nymp B*	1	Stem		
	Nymp C*	1	Flying around trees		
	Nymp D*	3	Flying around trees		
Lycaniedae	Lyca A*	1	Leaves	0	0
Geometridae	Geom A*	1	Bark	0	0
Lasiocampidae	Lasio A*	1	Stem	0	0
Ctenuichidae	Ctenu A*	2	Flying around trees		
Hesperidae	Hesp B*	2	Flying around trees	0	0
Total 9	16	50		3.83433328	0.889795918
Orthoptera					
Acrididae	*Valanga nigricornis*	1	Leaves	0	0
Gryllidae	*Tridactylus thoracicus*	2	Leaves	0	0
Gryllotalpidae	*Gryllotalpa longipennis*	1	Stem	0	0
Blattidae	*Pycnoscenis striatus*	5	Light trap	0.480898347	0.535714286
	Blattella germonica	3	Light trap		
Total 4	5	12		1.609718418	0.787878788

#: Unidentified family, *: Unidentified species

Table 3: Diurnal and nocturnal abundance and diversity of insects in *M. indica* plantation during the non fruiting season and fruiting season (July 2006 to March 2007)

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
Coleoptera					
Buprestidae	*Chrysobothris delanifica*	1	On branches	0	0
Chrysomelidae	*Monolepta bifasciata*	165	Light trap		
	Cheorane modesta	76	Light trap		
	Podagrica gemella	5	Light trap	0.363284207	0.456114153
Curculionidae	*Sternochetus mangiferae*	1	Light trap		
	Deiradolcus corbetti	2	Light trap		
	Hypomeces squamosus	61	On flowers	0.480898347	0.091765873
Carabidae	*Abacetus marginicolis*	56	Light trap		
	Planetes ruficeps	6	Light trap		
	Acupalpus vestigiala	67	Light trap and on ground		
	Pheropsophus occipitalis	12	Light trap		
	Stenolophus quinquepustulatus	6	Light trap	0.801533721	0.641505917
Elateridae	*Adelocera* species	2	On branches	0	0
Tenebrionidae	*Tenebrio molifar*	2	Leaves		
	Ganocephalum aequatoriales	32	Light trap and leaves		
	Tene A*	14	Rotten fruits		
	Scotobaenus parallelus	3	Ground and light trap	0.763004334	0.536470588
Scarabaeidae	*Brahmina* species	62	Leaves		
	Anomala crupripes	7	Flowers and leaves		
	Onthophagus orientalis	3	Leaves		
	Anomala pallida	6	Flowers		
	Apogonia expeditionis	66	Flower, light trap and leaves		

Table 3: Continued

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
	Aserica species	2	Light trap		
	Leucopholis rorida	3	Light trap	1.199053634	0.630056231
Cerambycidae	*Rhytidodera simulans*	6	Light trap and on ground	0	0
Cicindelidae	*Cicindella* species	1	Light trap	0	0
Coccinellidae	*Coccinella* species	2	Light trap		
	Verania dicscolor	4	Light trap and leaves	0.558110627	0.533333333
Scolytidae	*Campsomeris quadriguttulata*	1	Branch	0	0
Nitidulidae	*Carpophilus lugubris*	6	Rotten fruit	0	0
Total 12	30	680		4.446425541	0.884016287
Dermaptera					
Forficulidae	For A*	4	Light trap	0	0
Total 1	1	4			
Diptera					
Tabanidae	Taba A*	4	Leaves and flowers		
	Tabanus species	2	Leaves and flowers		
	*Taba C**	2	Leaves and flowers	0.961796694	0.714285714
Stingidae	*Sting A**	1	Leaves	0	0
Chironomidae	*Chiro B**	3	Light trap	0	0
Muscidae	*Musc A**	2	Light trap	0	0
Tepthritidae	*Tept A**	3	Light trap	0	0
Total 5	7	17		2.117736743	0.889705882
Hemiptera					
Coreidae	*Vilius melanopterus*	5	Stem and leaves	0	0
Cydnidae	*Geotamus pygmaeus*	146	Light trap	0	0
Pentatomidae	*Penta A**	1	Stem and ground		
	Vezara viridula	1	Ground	1.442695041	0
Reduvidae	*Sirthenea flavipes*	2	Light trap		
	Ectomocoris atrox	2	Light trap	0.72134752	0.666666667
Pyrrhocoridae	*Dysdercus cingulatus*	2	Light trap	0	0
Total 5	7	159		1.183687787	0.156277366
Homoptera					
Cicadellidae	*Cicadel A**	5	Light trap	0	0
Total 1	1	5			
Hymenoptera					
Vespidae	*Vespa affinis*	4	Flying around trees	0	0
Apidae	*Koptorthosoma confusa*	1	Flying around trees	0	0
Scollidae	*Scoll A**	1	Leaves	0	0
Chrysididae	*Chrysi A**	1	Leaves	0	0
Formicidae	*Formi A**	42	Stem and branches	0.26425737	0.088794926
	*Formi B**	2	Stem and branches		
5	6	51		1.271673891	0.319215686
Lepidoptera					
Arctiidae	*Cretonotus gangis*	1	Flying around trees	1.820478453	0
	Rhodogastria astreus	1	Flying around trees		
	Asota producta	1	Flowers		
Lepidoptera A#	*Amata hueberi*	1	Flowers	0	0
Pyralidae	*Pyra A**	9	Leaves		
	*Pyra B**	9	Stem		
	*Pyra C**	9	Leaves	0.606826151	0.692307692

Table 3: Continued

Family	Species	No. of individual	Remarks/ finding	Margalef index	Simpson diversity index
Nymphalidae	*Nymp A**	10	Stem		
	*Nymp B**	1	Stem		
	*Nymp C**	1	Flying around trees		
	*Nymp D**	3	Flying around trees	1.107808119	0.542857143
Lycaniedae	*Lyca A**	1	Leaves	0	0
Geometridae	*Geom A**	1	Bark	0	0
Lasiocampidae	*Lasio A**	1	Stem	0	0
Ctenuichidae	*Ctenu A**	2	Flying around trees	0	0
Hesperidae	*Hesp B**	2	Flying around trees	0	0
Total 9	16	53		3.778059731	0.885341074
Odonata					
Odonata A#	*Crocothemis servilia*	1	Stem	0	0
Gomphidae	*Gom A**	1	Stem	0	0
Calopterigidae	*Calop A**	1	Light trap	0	0
Total 3	3	3		1.820478453	0
Orthoptera					
Acrididae	*Valanga nigricornis*	1	Leaves	0	0
Gryllidae	*Tridactylus thoracicus*	2	Leaves	0	0
Gryllotalpidae	*Gryllotalpa longipennis*	1	Stem	0	0
Blattidae	*Pycnoscenis striatus*	5	Light trap		
	Blattella germonica	3	Light trap	0.480898347	0.535714286
Total 4	5	12		1.609718418	0.787878788

#: Unidentified family, *: Unidentified specie

Table 4: Type and number of insect borer (larvae) found in the damaged branches of *M. indica* in Chuping, Perlis, Malaysia

		Type and number of larva			
Date	No. of branch	Diptera	Coleoptera	Lepidoptera	Total
July 2006	12	1	5	0	6
Dec 2006	12	0	3	1	4
Feb 2007	12	0	6	0	6
March 2007	12	0	2	0	2

However, Table 3 shows that throughout the period of study, Coleoptera (Margalef index, 4.446) was the most abundant insect in the *M. indica* plantation. This was closely followed by Lepidoptera with Margalef index of 3.7780. The most diverse insect was Diptera with Simpson Diversity index of 0.89.

Branch Borer Observation

The type and number of insect larva (borer) found in the damaged branches of *M. indica* is shown in Table 4. Throughout the study, *Rhytidodera simulans* larvae, a coleopteran belonging to the family Cerambycidae were found and considered as the most common borer in the plantation. Figure 1 to 3 show the larva of dipteran, coleopteran and lepidopteran found inside the damaged branches of *M. indica*.

Pests in Damaged Fruits

Fourteen individuals of *Lasiodactylus pictus* (Coleoptera: Nitidulidae) and six individuals of *Carpophilus lugubris* (Coleoptera: Nitidulidae) were collected from the rotten fruits.

Fig. 1: Dipteran larva

Fig. 2: Larva of *Rhytidodera simulans* (Coleoptera: Cerambycidae)

Fig. 3: Lepidopteran larva

DISCUSSION

Insect Abundance and Diversity in *Mangifera Indica* Farm

This study confirms that Coleoptera was the major pest in mango plantation as reported by Veeresh (1989). Beetles have the ability to adapt to different microhabitats even harsh ones. The mango trees at Chuping are 91.99% of light damage (N = 13,023) thus the healthy mango leaves, young shoots, bark, healthy fruits, rotten fruits and rotten seeds all provide various niche explaining the abundance of beetles in the mango plantation. Coleoptera was found abundant during fruiting season when the fruits are big and the farmers does not apply pesticide during fruiting season. Other than having a hard elytra, physiologically, beetles have the ability to build resistance against insecticide as compared to other orders of insects.

Lepidoptera was the second most abundant since there were many mango inflorescenes during the study. Lepidoptera are flower feeders and also penetrate the fruit pulp. Being herbivore, Lepidoptera is important in regulating plant production and plays an important role in pollination for the mango plantation.

Dipterans are among the most common insects that visit flowers. At least 71 dipteran families contain anthophilous species. Flies have been mentioned as pollinators or regular visitors of at least 555 species of flowering plant (Larson *et al*., 2001) and pollinators of over 100 cultivated plants. This explains why Diptera was the most diverse insects in mango plantation.

Hemiptera was the least abundant. This is not surprising because being sap feeders with sucking mouthparts, the hard tree trunk and branches of the mango trees do not provide niche for Hemiptera to survive. The big mango fruits with thick skin do not also help the sap feeders.

Tritrophic Level and Natural Enemy

In this study, the scarab beetles, *Anomala pallida* and *Apogonia expeditionis* and the snout beetles *Hypomeces squamosus* were found biting on the flowers at night. No natural enemy was seen attacking any of these beetles at any time.

Rhytidodera simulans the major beetle pest of mango (Ithnin and Shamsudin, 1996; Kondo and Razak, 1993) usually attacks the fruiting trees. Adults laid eggs on young branches. In this field study it was observed that the Formicidae often attack larvae of *R. simulans*. Thus it is considered as the natural enemy of the larvae. It is most probable that tritrophic level of: mango branch → *R. simulans* → larvae → Formicidae existed here.

The larvae made some holes along the branches to discharge all their faeces. These holes gave an opportunity for Formicids to attack the larvae. From the field studies, mango trees with Formicid ants on their branches, had no larvae inside them. This was confirmed after cutting the branches opened. Formicid was likely to be the natural enemy of the larvae and served to prevent damages naturally caused by *R. simulans*. Eigenbrode *et al*. (1995) reported that predators mediate host plant resistance to pests by secreting glossy wax. Formicid ants secrete a liquid which was observed to likely cause damages to mango fruits (Personal communication).

Whitwell (1993) reported that large number of the thrip, *Frankliniella* species in Dominican mango plantation was preyed upon by the *Orius* species (Homoptera: Anthocoridae). However in this study no pest/predator/parasitoid complex was found on the mango inflorescences.

Pest of Mango Seed

The presence of *Lasiodactylus pictus* in the spoilt fruits suggests that the family Nitidulidae is also a pest of mango fruits (Fig. 4).

Balock and Kozuma (1964) reported that the attack on fruits by *Sternochetus mangiferae* is only at 1%. Hence, the negligible number of *S. mangiferae* individuals found attacking *M. indica* in this

Fig. 4: *Lasiodactylus pictus* (Coleptera: Nitidulidae) in spoilt fruit of mango

Fig. 5: *Monolepta bifasciata* caught by light trapping

study is not strange. The mango leaf cutter beetle, *Deporaus marginatus* reported by Ithnin and Shamsudin (1996) was however not observed in this study.

Mass Attack of *Monolepta bifacsciata* on Young Shoots

The difference noted in the number and type of species encountered between the non-fruiting (July 2006 B November 2006) and fruiting season (December 2006 B March 2007) may be due to the spraying of insecticide to avoid the attack of pests on the young mango shoots during the non-fruiting season. However, during the fruiting season, spraying of insecticide was stopped to avoid contamination of the fruits, thus explaining the mass attack of *M. indica* by *Monolepta bifasciata* during this period (Fig. 5). This is similar to the observation of Ithnin and Shamsudin (1996). Kalberer *et al.* (2001) reported that plants are generally more attractive to leaf beetle when damaged. Kendrick and Raffa (2006) also reported that beetles were attracted to volatiles released from conspecifics feeding on foliage.

Duration of Life Cycle of *Rhytidodera simulans*

Kondo and Razak (1993) reported that the life cycle of *Rhytidodera simulans* is about 1 year but the adults have not been seen for 17 years by farmers in Chuping Mango Farms (Personal

Fig. 6: *Rhytidodera simulans* in mating position. The eggs, yellow in colour are seen in the background

communication). Although many larvae of the insect were found when the damaged tree trunks were examined, adult individuals encountered in February poses a question about the actual duration of its life cycle in mango plantation in Malaysia. It is however probable that with abundant food supply, the larvae may not need to develop to adult stage. It was very rare to observe *R. simulans*. However in this study, one pair was found in mating position in February 2007 (Fig. 6).

CONCLUSION

This study found that Coleoptera was the dominant pest in *Mangifera indica* plantation at Chuping, Perlis, Malaysia as reflected in the high value of Margalef index from July 2006 to March 2007. However, a year-round study is necessary to elucidate the life cycle of all the insect pests observed in the plantation, so as to formulate appropriate strategies for their control. This would in no doubt increase the aesthetic value and quantity of *M. indica* in Malaysia..

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