



Ministry of Forestry
Forest Department
Forest Research Institute



**Preliminary Survey on the Infestation of Insect Pests on the
Nursery and Plantation of Tung Oil Tree (*Aleurites montana*
(Lour.) E.H.Wils) in Northern Shan State**



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တန်းဆီပျိုးပင်နှင့်စိုက်ခင်းများတွင် အင်းဆက်ပိုးမွှားများ ကျရောက်မှု
အခြေအနေများကို လေ့လာခြင်း

ခင်မာမြင့်
သုတေသနလက်ထောက်-၂
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်း

တန်းဆီပျိုးပင်များတွင် ပိုးကျရောက်မှုနှင့် ဇီဝဗေဒလေ့လာမှုများကို အမှတ်(၄)ပျိုးဥယျာဉ် သစ်တော
သုတေသနဌာန၊ ရေဆင်းနှင့် မူဆယ်ခရိုင် သစ်တောရုံး အတွင်းရှိ တန်းဆီပျိုးဥယျာဉ်တို့တွင် ဆောင်ရွက်ခဲ့
ပါသည်။ ဤလေ့လာမှုတွင် အမှတ်(၄)ပျိုးဥယျာဉ် ရေဆင်းရှိ တန်းဆီပျိုးပင်များမှ လိပ်ပြာဖလံ မျိုးစဉ်ဝင်
များဖြစ်သည့် *Dasychira mendosa* Huebner (Lymantriidae) နှင့် *Orgyia mixta* Snellen
(Lymantriidae) အင်းဆက်ပိုး(၂)မျိုး မှတ်တမ်းတင်တွေ့ရှိခဲ့ပါသည်။ အင်းဆက်ပိုး ကျရောက်မှုမှာ
အလွန်နည်းပါးသည်ကို တွေ့ရှိရပါသည်။ စိုက်ခင်းများတွင် လေ့လာမှုကို ရှမ်းပြည်မြောက်ပိုင်း၊
သီပေါမြို့နယ်၊ နမ်းမကြိုပိုင်း ၂၀၀၅ခုနှစ် ဧက(၂၀၀) တန်းဆီစိုက်ခင်း၊ သိန္နီမြို့နယ် မိုင်းလီကြီးပြင်တော
၂၀၀၅ခုနှစ်ဧက(၁၀၀) တန်းဆီစိုက်ခင်း၊ မူဆယ်မြို့နယ် မိုင်းယုစက်မှုကုန်ကြမ်းစိုက်ခင်း ၂၀၀၅ခုနှစ်
ဧက(၄၀၀)တန်းဆီစိုက်ခင်းများတွင်၂၀၀၈ခုနှစ်ဧပြီ၊ မေလများနှင့်၂၀၀၉ခုနှစ်၊ ဧပြီလနှင့် ဇူလိုင်လ များတွင်
ဆောင်ရွက်ခဲ့ပါသည်။ စိုက်ခင်း(၃)ခုတွင် ကွင်းဆင်းလေ့လာဆောင်ရွက်စဉ် မူဆယ်မြို့နယ်၊ မိုင်းယု
စက်မှုကုန်ကြမ်းစိုက်ခင်းမှ ရွက်စားပိုးမျိုး *Anomala cupreipes* (Coleoptera: Scarabaeidae) နှင့်
Lepropes lateralis (Coleoptera: Curculionidae) များကျရောက်သည်ကို တွေ့ရှိရသော်လည်း
ကျန်စိုက်ခင်းများတွင် ပိုးကျရောက်ခြင်းမတွေ့ရှိရပါ။ သို့ရာတွင်၂၀၀၉ခုနှစ်၊ ဧပြီလတွင် ကွင်းဆင်းလေ့လာရာ
သီပေါမြို့နယ်၊ နမ်းမကြီးပိုင်း၌ တောမီးဝင်၍ တန်းဆီပင်အချို့ သေကြေပျက်ဆီးပြီး ဒုတိယဖျက်ပိုး
(Secondary pests) ဖြစ်သည့် မှိုနှင့် အင်းဆက်ကျရောက်မှုများကို ဆွေးနွေးတင်ပြထားပါသည်။

**Preliminary Survey on the Infestation of Insect Pests on the Nursery and Plantation of
Tung Oil Tree (*Aleurites montana* (Lour.) E.H.Wils) in Northern Shan State**

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Abstract

The natural incidence and biological study of some insect pests was observed in tung oil, *Aleurites montana* (Lour.) E.H.Wils (Euphorbiaceae) nurseries at the Forest Research Institute, Yezin from May to October, 2007 and 2008. In this study, two species of insect pests, *Dasychira mendosa* Huebner and *Orgyia mixta* Snellen (Lepidoptera: Lymantriidae) were recorded. However, the infestation was found to be very small. On the other hand, a survey was conducted in 2008 and 2009 at different plantations of Northern Shan State, i.e. Namma Reserved Forest (Thipaw Township), Mingli Unclassed Forest (Theinni Township) and Mingyu Industrial Raw Material Plantation (Muse Township), which were planted in 2005. In this study, a Randomized Complete Block Design (RCBD) was used with five replications. In each plantation, five sample plots measuring 20×20 feet with 75 tung trees were inspected for the pest infestation in April, May 2008 and April and July 2009. The insect pest infestations of tung oil plantations were very small except in Mingyu Industrial Raw Material Plantation surveyed in April, May 2008 and April, July 2009. Data were subjected to analysis of variance using SAT/STAT and mean separation was done with least significant difference at 5% level (SAS Institute 1989). Only two species of beetles *Anomala cupripes* (Coleoptera: Scarabaeidae) and *Lepropes laterialis* (Coleoptera: Curculionidae) were recorded from Mingyu Industrial Raw Material Plantation. However, forest fire that occurred in Namma Reserved Forest in April, 2009 killed trees from some blocks of study area and consequently led to the infestation of secondary pests (i.e. Fungus and Insect) in those plantations.

Key words: *Aleurites montana*, Tung oil tree, Infestation, Insect, Pests, Nursery, Plantation, Northern Shan State

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1. Introduction

Tung oil tree, *Aleurites montana* (Euphobiaceae) is a small tree about 5 meters tall, much branched, partially deciduous, deciduous. It is native to China and Shan State of Myanmar.

The oil content of the seed is calcium 50-60 percent. Oil consist chiefly glycerides of beta-elaosteric and oleic acids, and probably a little linoleum acid. Oil cake residue is poisonous and is only fit for manure. Kernels yield valuable drying oil, largely used in paints, varnishes and linoleums. The oil is applied to furuncles and ulcers.

Trees yield about 45-68 kg nuts per year, these yielding about 35-40 % oil. With tung cake an ammonium sulphate, air dry tung seed yields of 12-17 year old trees was 2013 to 2367 Kg/ha, of 6-9 year olds 766-1546 Kg/ha (Spurling and Spurling 1974).

Ministry of Forestry was growing tung tree plantations under the Forest Department of Shan States about more than 3000 acres in 2000 to 2005.

Tung trees are relatively free of insects. However, leaf feeding insects *Buzura suppressaria* Guenee (Lepidoptera:Geometridae), *Euproctis fraternal*, *Orgyia mixta* (Lepidoptera : Lymantriidae) *Cheromettia apicata* More, *Dasychira mendosa* Huebner (Lepidoptera: Lymantriidae), *Attacus atlas* Linn (Lepidoptera : Geometridae), *Lepropes lateralis* Fabricius (Coleoptera: Curculionidae) (Beeson 1941). Shoot, branches and stem borers *Sthenias cylindrator* and *Hypomeces squamosus* (Coleoptera: Cerambycidae), *Icerya aegyptiaca* (Hemiptera: Margarodidae), *Coptotermes ceylonicus* Holmgren (Isoptera: Rhinotermetidae) and *Glyptotermes cilatatus* Bugnion and Popoff (Isoptera: Katermetidae) were reported (Brown.1968).

So far, there was no record with the infestation of insect pests and diseases on tung trees in Myanmar. If there is a heavy infestation with insects, the growth of tree may be severely affected and seed production will be markedly reduced. Therefore, surveys were conducted in the nurseries and plantations to record the infestation of insect pests.

2. Literature review

Tung oil tree grows at specific climatic and soil conditions. It thrives between the temperatures of 18.7°- 26.2° C (Duke, 1978, 1979). They require long, hot summer with abundant moisture, with usually at least 112 cm of rainfall rather evenly distributed throughout the year. Trees require 350-400 hours in winter with temperatures 7.2°C or lower; without this cold requirement, trees tend to produce suckers from the main branches. Vigorous but not succulent growth is the most cold resistant; trees are susceptible to cold injury when in active growth. Production of tung is the best where day and night temperatures are uniformly warm. Trees grow best if planted on hilltops or slopes, as good air-drainage reduces losses from spring forests (Spurling and Spurling 1974).

Tung trees usually begin bearing fruit the third year after planting, and are usually in commercial production by the fourth or fifth year, attaining maximum production in 10-12 years. Average life of trees in the United States is 30 years (Spurling 1974).

Although insect pest infestation is not serious, infestation may cause the retarded growth of the tree. The biology of some insect pests is briefly outlined.

***Dasychira mendosa* Huebner (Lymantriidae: Lepidoptera).** Synonym: *Dasychira fusiformis* Walker. It is widely distributed in southern and eastern Asia, and eastwards to Australia; in the Commonwealth recorded in the warmer parts of Australia, Ceylon, India, Malaya, Pakistan, and Singapore. The larva of this moth feeds on the foliage of many plants, and in various parts of its range has sometimes occurred as a pest of castor, coffee, maize, and tea ; recorded tree hosts include *Acacia catechu*, *Aleurites fordii*, *A.montana*, *Butea monosperma*, *Cassia fistula*, *Ceiba pentandra*, *Cinnamomum zeylanicum*, *Dalbergia sissoo*, *Ficus spp*; *Lagerstroemia speciosa*, *Mangifera indica*, *Palaquium gutta*, *Schleichera trijuga*, *Shorea robusta*, *Tectona grandis*, *Terminalia bellerica*, *T. catappa*, *T. tomatosa* and *Zizyphus mauritiana*. In at least most parts of its range breeding continues throughout the year, during which there are probably 5 or 6 generations (Beeson 1941). The moth, which has pale hindwings and the forewings irregularly patterned with various shades of brown, lays masses of yellow eggs. The larvae feed on the leaves of the host, sometimes causing severe defoliation, and pupate in loose cocoons made of silk and hairs. The larva, which has been described by Gardner (1938), is about 4 cm long when fully grown, with a reddish head, the body grayish or yellowish, spotted and striped with red and with tufts of whitish hair.

***Orgyia mixta* Snellen (Lepidoptera: Lymantriidae).** Common African tussock moth widely distributed in tropical Africa. The larva of this month is polyphagous on the foliage of both broadleaved plants and conifers. It has been recorded on cacao in Ghana (Forsyth 1966) and on various agricultural crop in Malawi (Sweeney 1962b), and injury to forest trees is reported in Kenya, Malawi, and Rhodesia. Recorded hosts include *Acacia mearnsii*, *Aleurites spp.*, *Cupressus lusitanica*, *Eucalyptus paniculata*, *Pinus radiata*, and *Schinus molle*. The species is very common in Kenya, where it is a frequent defoliator in forest nurseries and plantations, and small outbreaks have occurred but have been quickly controlled by parasites (Gardner 1957). It is also of some importance as a pest of *Aleurites* in Malawi.

***Anomala cupripes* Hope (Scarabaeidae: Coleoptera).** June beetle Hong Kong, widely distributed in South-East Asia. A greenish metallic, the adults of which sometimes occurs in swarms and feed on the foliage of various trees, both dicotyledons and conifers. The generation is believed to be annual, with the immature stages living in the soil. The larva feeds on fine roots and decaying vegetable matter, but has not been reported as injurious to forest crops. In Hong Kong swarms of beetles sometimes occur in nurseries and plantations during the summer, occasionally causing serious injury to seedlings of *Pinus massoniana* and to the foliage of young stands of *Eucalyptus citriodora*, *E. grandis*, and *E. maculate*. The species is also very common in Malaya, where slight defoliation of *Aleurites montana* has been reported by Corbett and Gater (1926).

***Lepropus lateralis* Fabricius (Curculionidae: Coleoptera).** Synonym *Astycus laterali* widely distributed in Northern India, Myanmar and Thailand. The adult is polygamous on the foliage of dicotyledonous trees and shrubs; it is known as a minor pest of tea, and other recorded hosts include *Aleurites fordii*, *A.montana*, *Bonbax malabaricum*, and *Tectona grandis* (Beeson 1941, Mathur and Singh 1954-61).

***Coptotermes ceylonicus* Holmgren (Isoptera: Rhinotermetidae)** were distributed in damp wood termite of Ceylon, India, and Indo-China. The species is destructive to buildings and is even able to penetrate brick walls through the mortar joints. The cavities that it forms in wood are characteristically filled with a spongy mass of wood- carton, somewhat resembling the fungus gardens makes a central nest with ramifying foraging galleries, by means of which it attacks and hollows out living trees of many species, usually penetrating the stems at any points where it can gain access through wounds (Beeson,1941). It is known as an occasional pest of *Aleurites* spp and *Hevea brasiliensis*, and also of *tea bushes* and coconut palms, in Ceylon and Southern India.

***Glyptotermes dilatatus* Bugnion and Popoff (Isoptera: Katermetidae).**A dry wood termite, which commonly nests in the dead wood of living trees. It is known as an occasional pest of *Tea bushes* (W.V.Harris 1961), and other recorded hosts include *Aleurites* spp, *Casuarina equisetifolia*, *Hevea brasiliensis* and *Toona ciliate*. The mating pairs enter trees at dead snags, knots,or wounds,and establish themselves in small cavities which are gradually enlarged. The nest has no definite design, and its cavities are partly filled with earth. A fully developed colony includes soldiers and winged and wingless late, but development is slow, and at least 4 years elapse before the late are present (Beeson, 1941). The excavations are restricted to the heartwood, and living sapwood is not attacked. The host shows little outward sign of infestation and its vigor is not impaired for many years.

3. Materials and Methods

(i). Inspection for insect pests in nurseries

A survey was carried out to investigate the number of insect species in *Aleurites montana* (Lour.) E.H.Wils nursery at the Forest Research Institute, Yezin (Latitude 19 ° 07' E) in 2007 and 2008 monsoon seasons. Inspection was made at monthly intervals starting from May through September in each year (Fig.1) and Campus of Forest Office of Muse District in April and May 2008 and April and July 2009. Insect especially lepidopterous larvae were collected from the nursery of Forest Research Institute and brought to the laboratory in plastic cages and reared in the glass jar until the adult emerged (Plate.1.). It was done just for the identification purpose to confirm the species.

Insect rearing was done under the laboratory conditions (temperature about $25 \pm 1^{\circ}$ C and R.H. 65 ± 5 %) at the Entomology Section of FRI. Collected insect larvae were separately placed in individual glass jar with tung-oil leaves as food (Plate.1.). Fresh leaves were provided everyday until the larvae to pupate. All the developmental stages were noted.

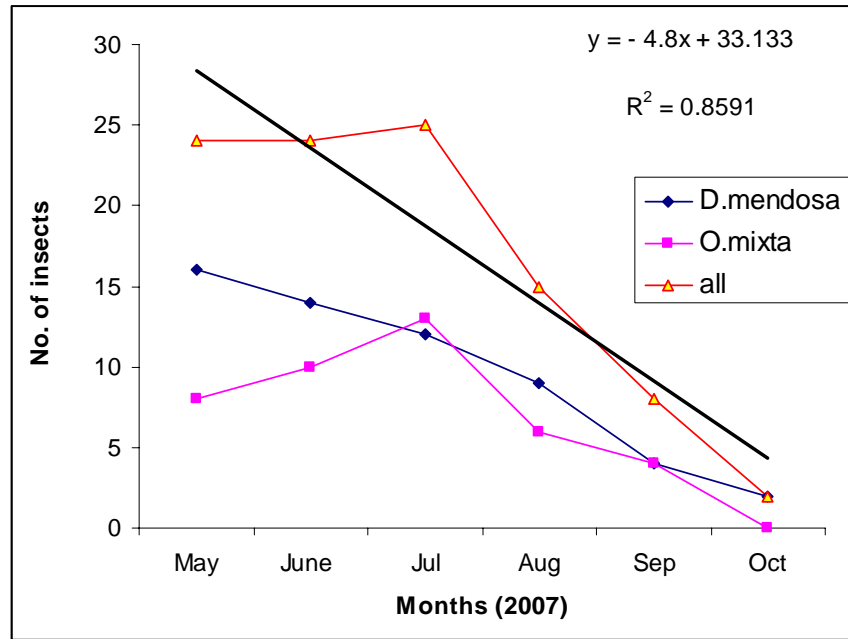


Fig. 1. Natural incidence of insect pests in *Aleurites montana* (Lour.) E.H.Wils at nursery of FRI.

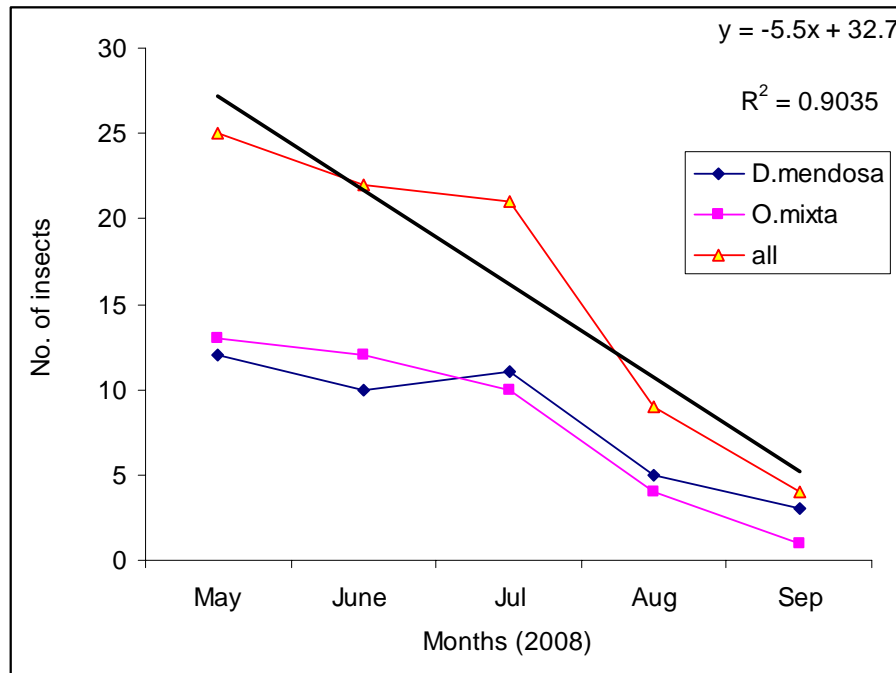


Fig. 2. Natural incidence of insect pests in *Aleurites montana* (Lour.) E.H.Wils at nursery of FRI.



(ii). Exploration for insect pests from different plantations at the Northern Shan State

Three Tung plantations were selected at the Northern Shan State, i.e. 200 acres of Namma Reserved Forest in Thipaw Township, 100 acres of Mingli Unclassed Forest in Theinni Township and 400 acres of Mingyu Industrial Raw Material Plantation in Muse Township which were planted in 2005. In this study, a Randomized Complete Block Design (RCBD) was used with five replications. In each plantation, five sample plots measuring 20×20 feet with 75 tung trees were inspected for the pest infestation in April, May 2008 and April and July 2009.

Data were subjected to analyze of variance using SAT/STAT and mean separation was done with Least Significant Difference (LSD) at 5% level (SAS Institute 1989).

4. Results and Discussions

(i) Inspection for insect pests in nurseries

In this study, two species of insect pests- *Dasychira mendosa* Huebner, *Orgyia mixta* Snellen (Lepidoptera: Lymantriidae) were recorded from the nursery of Forest Research Institute, Yezin.

Sanchez and Laigo (1968) described the biology of tussock moth as follow: the eggs hatch after about 5-6 days, and the resulting male larvae take 15-26 days to become fully

grown; the larger, female take 15-28 days. Pupation takes place in a flimsy cocoon on either leaves or stems. The female and male pupal stages last 4-5 and 6-7 days, respectively.

In a laboratory study, the eggs, larval, pupal, and adult periods of *Dasychira mendosa* were 44.95 days on *Terminalia belerica*, 42.93 days on *T. arjuna* and 40.99 days on *T. tomentosa* (Reddy et al., 1988).

In this study, eggs of *Dasychira mendosa* Huebner hatched in 8 days, the larval period last about 26.17 days and pupal period about 10.89 days. The total life cycle from egg to adult took about 45.06 days. The female moth lived for about 7 days (Table 1).

And also eggs of *Orgyia mixta* Snellen hatched in 9 days and larval period last about 26.7 days and pupal period about 9.8 days. The total life cycle from egg to adult took about 45.55 days. The female moth lived for about 6 days (Table 1).

However, insect pest infestation was not found in the nursery of forest office of Muse District.

Recorded Insects from this study, and host plants were described in (Table 2.)

Table 1. Biological data of *D.mendosa* and *O.mixta* observed in the laboratory at the nursery of Forest Research Institute.

Life stage	<i>D. mendosa</i> (mean ± SD in days)	<i>O .mixta</i> (mean ±SD in days)
Egg (n = 100)	8	9
first instars (n = 12,10)	2.75 ±0.6215	2.90 ±0.7378
second instars	5.18 ±0.7537	5.70 ±0.8232
third instars	5.83 ±0.7177	5.90 ±0.8755
fourth instars	6.08 ±0.6685	6.20 ±0.6685
fifth instars	6.33 ±0.7784	6.00 ±0.6666
Larvae stage	26.175 ±1.881	26.70 ±2.0366
Pupal stage (n = 9, 7)	10.89 ±0.7881	9.85 ± 0.899
All stage	45.06	45.55
Adult stage	7	6

Table 2. Recorded insect pests of *Aleurites montana* (Lour.) E.H.Wils at nursery and plantation.

No	Insect Pests	Part of Damage	Main target trees
1	<i>Dasychira mendosa</i> Huebner (Lepidoptera: Lymantriidae)	Leave	<i>Acacia catechu</i> , <i>Aleurites fordii</i> , <i>A. montana</i> , <i>Dalbergia sissoo</i> , <i>Shorea robusta</i> , <i>Terminalia belerica</i> , <i>T. tomatosa</i>
2	<i>Orgyia mixta</i> Snellen (Lepidoptera: Lymantriidae)	Leave	<i>Acacia mearnsii</i> , <i>Aleurites</i> spp, <i>Eucalyptus paniculata</i> , <i>Pinus radiata</i>
3	<i>Anomala cupripes</i> (Coleoptera: Scarabaeidae)	Leave	<i>Pinus radiata</i> , <i>Pinus massoniana</i> , <i>Aleurites Montana</i> , <i>Eucalyptus citriodora</i> , <i>E. grandis</i> , <i>E. maculata</i>
4	<i>Lepropes lateralis</i> (Coleoptera Curculionidae)	Leave	<i>Aleurites fordii</i> , <i>A. montana</i> , <i>Bombax malabaricum</i>
5	<i>Ips</i> sp (Coleoptera Curculionidae)	Stem borer	<i>Pinus</i> sp
6	<i>Platypus</i> spp (Coleoptera: Platypodidae)	Stem borer	<i>Pinus</i> sp
7	<i>Coptotermes ceylonicus</i> (Isoptera : Rhinotermitidae)	Penetrating the stem at any points where it can gain access through wounds	Attack and hollow out living trees of many species
8	<i>Glyptotermes dilatatus</i> Bugnion and Popoff (Isoptera : Katermetidae)	Dead wood of living trees	<i>Aleurites</i> sp and <i>Hevea brasiliensis</i> and <i>Tea bushes</i> and <i>Casuarina equisetifolia</i> .

(ii) Insect pests in plantations

In this study, only two species of beetles, *Anomala cupries* (Coleoptera: Scarabaeidae) and *Lepropes lateralis* (Coleoptera: Curculionidae) were recorded from Mingyu Industrial Raw Material Plantation, Muse Township (Table 3 & 4). The population of *Anomala cupries* was significantly higher than that of *Lepropes lateralis*. These two species were leaf feeders and *Anomala cupries* feeds on potato, clover, cowpea, maize and soybean. *Lepropes lateralis* was mainly found on pigeon pea, cotton and mango. Since maize and soybean were widely grown as cash crop in the plantations, this may encourage the heavy infestation of *Anomala* on tung trees.

Pest infestation varied with time of survey. Infestation was much higher in May than in April. At the start of the rainy season, the plant growth became better and availability of more food may enhance the population growth of insect pests in the plantation. However, heavy rain may interrupt the normal function of insect, for example: feeding and this may be at least partially responsible for the lower population of insect as observed in July. When two records were compared, the infestation in 2008 was much higher than that of 2009. That may be due to the less infestation of *Anomala* species as it was abundant species.

In May, 2008, and again in April, 2009 severe defoliation by a coleopterous insect was observed in wide areas covering hundreds of hectares of 4 year-old tung oil trees at Mingyu Industrial Raw Material Plantation. However, at the same time, tung trees were healthy or no insect pests were observed in other study areas.

Table 3. Comparison of insect pests recorded from Mingyu Industrial Raw Material Plantation, Muse Township

Insect pest	n	Mean	
<i>Anomala cupries</i>	300	2.8733	a
<i>Lepropes lateralis</i>	300	1.9933	b
CV%		68.946	

Table 4. Comparison of insect pests recorded from Mingyu Industrial Raw Material Plantation, Muse Township in different months

Month	n	Mean	
April 2008	150	2.1667	b
May 2008	150	4.8933	a
April 2009	150	1.8867	b
July 2009	150	0.7867	c
CV%		68.946	

Means with the same letter are not significantly different.

Two species of moth- *Orgyia mixta* Snellen and *Dasychira mendosa* Huebner (Lepidoptera: Lymantriidae) were recorded from nursery at Forest Research Institute and Namma Reserved Forest, Thipaw Township (Table 5).

Orgyia mixta Snellen (Lepidoptera: Lymantriidae) was recorded from Mingli Unclassed Forest, Theinni Township in May, 2008.

In general, the infestation of insect pest in tung oil plantation was very small except in Mingyu Industrial Raw Material Plantation, Muse Township. There was no difference in the population of two insect species in May 2008. However, *Lepropes lateralis* (Curculionidae) was found to be more abundant than *Anomala cupripes* (Scarabaeidae) in April, 2009.

In April 2009, at the same time when some places of Namma Reserved Forest Plantation were affected by fire (Plate 9&10). Therefore, beneath the bark of fire attacking trees were found fungus and secondary pests. Closer examination showed that secondary fungus and insect pests which have a less importance and usually attacks were already beginning to set in on the dead and drying trees, cerambycid borers were found in dead trees. However, normal healthy trees were observed where no fire occurred in the plantation.

Although the design for the survey was the same with Mingyu, there were 15 trees in each plot and five plots in all plantations; infestation was found only in one or two trees.

It was aimed to find out the effective insecticides for the control of insect pests on tung trees. However, the infestation was not serious and the number of insect collected was not large enough to carry out a bioassay. It will be done when the conditions are favorable in the near future.

Conclusions

As tung oil tree is a promising and potential tree for raw material, it is necessary to survey the infestation of insect pests that may hinder the growth of plantation. Based on the finding of the present study, there is not much problem with the insect pests. Only one or two species of leaf feeders were observed in Mingyu Industrial Raw Material plantation intercropped with soybean and maize. The population was not high enough to cause severe damage to the plantation.

Recommendations

In Mingyu Industrial Raw Material Plantation, if the infection is serious enough, the intercrop like soybean and maize should not be grown in the plantation in every year. However, the justification should be based on the economic return from the cash crop and the damage caused to the plantation. Fire in the forest may destroy the plantations by causing the infestation of secondary pests leading to death of some trees that may affect the yield of raw materials. During this study period, some specimens were sent to our section by the Inspectors of tung oil plantations. They were collected from Mingli Unclassed Forest (Theini Township) which was planted in 2000 and they were identified as stem borers *Ips* sp. (Coleoptera: Curculionidae) and *Platypus* sp. (Coleoptera: Platypodidae). Their potential as pest of tung tree should be investigated. In general, regular inspection is needed to check the infestation not only in the plantation but also in the nursery to take necessary action in time in

case of heavy infestation. Further study is needed to get more information for the chemical control of the insect pest in the plantations in the future.

Table 5. Records of Insect Pest in Nannma and Mingli Reserved Forest Plantations in 2008.

Nannma RF				May 2008		Thipaw Township	
Orgyia mixta (Lymantriidae)						Dasychira mendosa	
Tree	P1	P2	P3	P4	P5		
1	2	1	1	1	1		
2	1	1	2	1	2		
Mingli RF				May 2008		Theinni Township	
Orgyia mixta (Lymantriidae)							
Tree	P1	P2					
1	2	1					
2	2	2					



Plate 2, Larval , pupal and adult stages of *Dasychira mendosa* Huebner leaf feeding insects.



Plate 3, Larval and adult stage of *Orgyia mixta* Snellen leaf feeding insects.



Plate 4, Leaf feeder *Anomala cupreipes* (Coleoptera: Scarabaeidae) in Mingyu Industrial Raw Material Tung Plantation.



Plate 5, Leaf feeder *Lepropes lateralis* (Coleoptera:Curculionidae) was found in Mingyu Industrial Raw Material tung plantation.

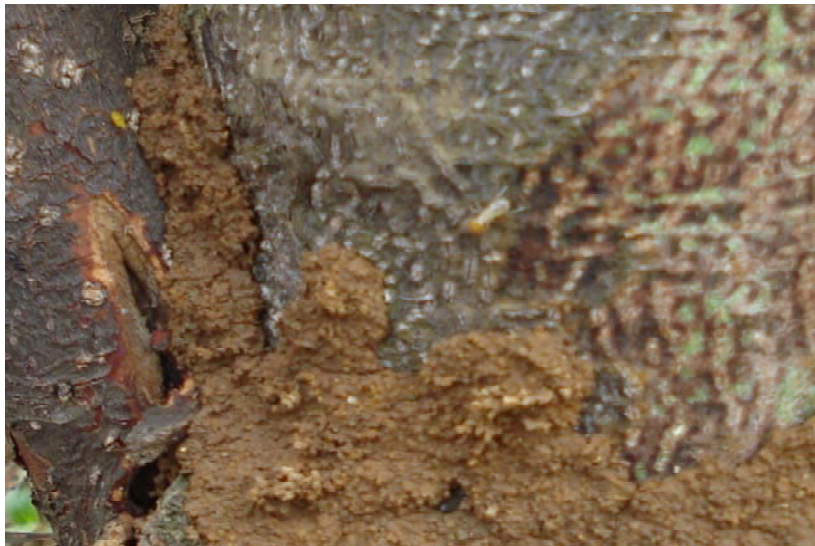


Plate 6, Termite attacking tree in Mingyu Industrial Raw Material Plantation



Plate 7, Stem borer (Coleoptera: Platyporidae) was found in Mingli Unclassed Forest (Theinni Township)



Plate 8, Secondary bark borer (Coleoptera: Cerambycidae) was found from fire attacked tree at Namm Reserved Forest (Thipaw Township)



Plate 9, Fire attacked trees in Namma Reserved Forest (Thipaw Township) in April, 2009



Plate 10, Secondary pests in fire attacked tree at Namma Reserved Forest in April, 2009

Appendix (j)

Raw Data for Number of Insect Pests Recorded from the *Aleurites montana* at the Nursery of Forest Research Institute, Yezin.

	2007						2008						Mean	%
	May	Jun	Jul	Aug	Sep	Oct	May	Jun	Jul	Aug	Sep			
<i>D.mendosa</i>	16	14	12	9	4	2	12	10	11	5	3	8.909	54.757	
<i>O.mixta</i>	8	10	13	6	4	0	13	12	10	4	1	7.36	45.234	
All	24	24	25	15	8	2	25	22	21	9	4	16.27		

Appendix (jj)

Raw Data for Natural Incidence of Insect Pests in Mingyu Industrial Raw Material Plantation (Muse Township)

Mingyu Industrial Raw Material Plantation Muse Township in April,2008

Tree	<i>Anomala cupripes</i> (Scarabaeidae)					<i>Lepropes lateralis</i> (Curculionidae)				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
1	0	1	1	2	2	0	2	2	0	0
2	2	2	2	4	2	3	1	0	1	1
3	0	0	0	0	3	3	2	5	7	7
4	3	1	1	5	0	2	0	4	4	4
5	1	2	3	3	0	2	2	3	2	3
6	3	3	2	5	1	1	3	6	6	6
7	0	3	5	5	0	0	5	2	7	5
8	0	3	0	3	1	4	1	4	4	4
9	2	0	3	3	3	2	2	1	2	1
10	3	2	0	3	3	0	3	0	5	5
11	2	4	4	1	3	6	2	2	2	2
12	1	1	2	1	5	5	1	0	2	2
13	0	0	0	0	2	4	0	1	1	0
14	0	1	0	4	2	2	0	3	3	3
15	0	2	3	1	1	1	4	0	0	4

Mingyu Industrial Raw Material Plantation (Muse Township) in May,2008

Tree	<i>Anomala cupripes</i> (Scarabaeidae)					<i>Lepropes lateralis</i> (Curculionidae)					
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
1		5	6	6	6	6	4	4	9	0	0
2		7	3	8	8	8	3	4	4	0	0
3		9	4	7	0	3	12	5	5	7	7
4		3	5	5	5	3	6	6	4	4	4
5		3	2	3	3	3	5	8	7	7	7
6		7	6	5	5	5	6	8	6	6	6
7		6	3	5	5	0	9	9	7	7	5
8		12	3	8	8	8	4	4	4	4	4
9		4	4	3	3	3	8	7	6	6	6
10		3	5	3	3	3	0	8	5	5	5
11		3	4	4	4	4	6	5	2	2	2
12		8	8	5	5	5	12	7	0	7	7
13		7	5	0	0	5	9	8	5	5	0
14		5	3	4	4	4	10	3	3	3	3
15		3	2	4	4	4	5	3	5	5	5

Mingyu Industrial Raw Material Plantation (Muse Township) in April, 2009

Tree	<i>Anomala cupripes</i> (Scarabaeidae)					<i>Lepropes lateralis</i> (Curculionidae)					
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
1	0	0	0	0	0	0	6	6	6	5	5
2	0	0	0	0	0	0	5	5	8	8	8
3	0	0	0	0	0	0	7	8	7	7	7
4	0	0	0	0	0	0	0	5	3	5	5
5	0	0	0	0	3	3	0	0	5	7	7
6	0	0	0	0	5	5	0	0	0	6	6
7	0	0	0	0	0	0	0	0	0	5	0
8	0	0	0	0	8	0	0	0	0	4	0
9	2	1	2	2	6	2	3	2	1	2	4
10	1	3	0	0	2	0	0	4	0	2	3
11	0	0	1	0	0	4	2	3	2	1	2
12	3	0	5	1	2	1	5	3	0	0	2
13	0	2	0	3	0	0	1	1	1	1	0
14	2	1	2	0	1	3	2	0	0	0	1
15	1	0	1	0	1	1	0	2	0	0	0

Mingyu Industrial Raw Material Plantation (Muse Township) in July, 2009

<i>Anomala cupripes</i> (Scarabaeidae)						<i>Lepropes lateralis</i> (Curculionidae)					
Tree	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
1	0	0	0	0	0	1	1	0	0	1	
2	0	0	0	0	0	5	1	2	1	0	
3	0	0	0	0	0	0	0	1	2	2	
4	0	0	1	0	0	0	2	3	0	1	
5	0	1	0	3	3	0	0	5	2	2	
6	0	0	0	1	0	0	0	0	1	1	
7	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	1	0	0	0	0	4	0	
9	2	1	2	1	2	3	2	1	2	1	
10	1	3	0	2	0	0	0	0	2	3	
11	0	0	1	0	1	2	3	2	1	2	
12	3	0	0	1	2	1	1	1	0	2	
13	0	2	0	3	0	0	1	1	1	0	
14	2	1	2	0	0	0	0	0	0	1	
15	1	0	1	0	0	1	0	2	0	0	

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