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Two Insects Doing Serious Damage To Planted Yemane (*Gmelina arborea*) In Yezin And Moswe Areas

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Abstracts

In Yezin and Moswe areas in Pyinmana Division planted yemane was attacked by *Tingis beesoni* (Hemiptera; tingidae) and Alcides gmelinae (Coleoptera; curculionidae) respectively.Methods of attack by these two inseots, effect of injuries and duration of the epidemic period have been studied. Life oyole of *A. gmelinae* has also been studied, and field control of the two insects have been discussed.

Contents

1. Introduction

Gmelina arborea,commonly called by the Burmese name yemane, is on trial in many lowland tropical countries because of the good quality of its wood, its fast growth, uts variety of use and its relative ease of establishment. Yemane plantations have been developed in Burma in the past but these have failed, and the failure has been generally attributed to *Loranthus*. Presently, yemane has been put on trial by the Silviculture Section of the Forest Research. Division, Forest Research Institute (FRI) in the Yezin and Moswe areas, and the early results appear to be extremely promising.

However, two species of insects were found to cause serious damage to the young plantations. These insects were identified as *Alcides gmelinae*,belonging to the order Coleoptera and family curculionidae, which cause the tree to become extremely bushy by attacking the leading shoots and *Tingis beesoni*, belonging to the order Hemiptera and family tingidae, which stop the growth of the above –ground parts of trees with heights of up to 20 ft. and girths of up to 18 inches by sucking the sapthrough leaves and succulent parts rendering plantations of these trees unsuitable for industrial use.

Beeson and bhatia (1939), Garthwaite (1939) ,Beeson (1941), Brown (1968)and Lamb (1968) give the following list of list of insects as being enemies of yemane:

Coleoptera

Alcides gmelinae
Alcides (Alcidodes) ludificator
Apion angulicolle
Apion armipes
Apophylla chloroptera
Calopepla leayana
Dihammus cervinus
Empecamenta calabarica
Glenea galathea
Glenea Indiana
Lagria villosa
Lixus camerunus
Lixus spinimanus
Macrocoma candens
Plocaederus obesus
Podogrica dilecta
Prioptera punctipennis
Pothyne moringae
Sinoxylon anale
Xyleborus fornicatus
Xylotrechus buqueti
Xylotrechus smei

Hemiptera

Agaeus pavimentatus
Anoplocnemis, tristator
Chunrocerus, niveosparsus
Dysderus superstitiosus
Tingis, beesoni
Triozar, fletcheri

Isoptera

Coptotermes curvignathus
Coptotermes niger
Macrotermes goliath

Lepidoptera

Acrocercops telestis
Endoclita undulifer
Eupterote geminata
Eupterote undata
Gonodontis clelia
Indarbela quadrinotata
Metanastria hyrtaca
Phostria caniusalis
Piones aureolalis
Psilogramma menephron
Sahyadrassus malabaricus
Selepa celtis
Xyleutes ceramica

PLATE I

Fig. 1. *yemane* plantation in Moswe.

Fig. 2. 18 month old *yemane* tree in Yezin.

Orthoptera

Heteropternis thoracica *Phaneroptera nana*
Kraussaria angulifera *Phymateus viridipes)*
Zonocercus elegans

Beeson (1941) gives the general description, habit and life cycle of adult *A. gmelinae*; the description of the larva is given by Gardner (1934). General description of the adult, habit and life cycle of *T. beesoni* are given also by Beeson (1941).

This paper is part of a research objective to identify and evaluate control alternatives for insects damaging yemane and other economically important tree species in large monocultures.

2. Materials and Methods

All observation and collection of material for rearing were made in the FRI Silviculture Section Yemane plantations in Yezin and Moswe areas (pl.I, figs. 1,2) situated on the East Pegu Yoma at about latitude 19°55'E and longitude 95°55'E about latitude 20°50'N and longitude 96°20'E respectively.

The average annual rainfall in Yezin during 1970-80 period was 57.16 in. (145.20 cm.) with the heaviest average monthly rainfall of 12.55 in. (31.88 cm.) occurring in August. The lowest average monthly rainfall of 0.023 in. (0.58 cm.) occurred in February. The average monthly temperature during the same period ranged from a minimum of 89.37°F (32°C) to a maximum of 103.96°F (40°C).

In Moswe, the average annual rainfall for the same period was 42.89 in. (108.94 cm.) with the heaviest average monthly rainfall of 8.95 in. (22.73 cm.) occurring in September; the lowest average monthly rainfall of 0.035 in. (0.089 cm). occurred in February. The average monthly temperatures ranged from a minimum of 70.50°F (21.50 cm.) occurring in January to a maximum of 87.98°F (31°C) occurring in May.

The type of forest in Yezin in which the yamane plantations are being developed may be classified as scrub indaing forest with *Dipterocarpus tuberculatus* (in), *Pentacme siamensis* (ingyin), *Shorea oblongifolia* (thitya), *Melanorrhoe usitata* (thitsi) as dorminant species occurring together with *Premna maorophylla* (nipase), *Buchanania lanzan* syn. *Latifolia (lumbo)* and a few *Delbergia cultrata (yindik).* The type of forest in Moswe may be termed as Moist Upper Mixed Deciduous forest with *Tectona grandis* (teak) , *Xylia dolabriformis* (pyinkado) and *Pterocarpus macorcarpus* (padauk) as dorminant species occurring together with other species of lesser economic value such as *Terminalia tomentosa* (taukkyan), *Adina cordifolia* (hnaw) and *Millettia pendula* (Thinwin). *Bamboosa polymorpha* (kyathaung wa) and *Dendrocalamus strictus (myin wa)* both of vigorous growth were also observed.

2.1. Development of Plantations

Development of the pure yemane plantations for experimental purposes began in 1978-79 planting season and season and continued in 1979-80 and 1980-81 planting seasons. Land preparation for plantation development included clear felling of all trees remaining after extraction of high value timber, burning and site clearing. The plantations were developed by transplanting 45 day-old saplings raised in plastic bags containing a mixture of forest top soil, sand and compost in the ratio of 2:1:1; the saplings were transplanted into plastic bags from nursery beds after they reached the two or four-leaf stage; planting was done in June with a spacing of 6 ft. by 6 ft. Weeding was done three times each year between rainy seasons.

2.2. Collection of Material and Laboratory Rearing

a) A. gmelinae

i) Eggs

Presence of A. gmelinae eggs in the pith of shoots and soft stems can be detected by the presence of fresh fissures, neat pin-holes and frayed-out woody fibres (Pl.II, fig. 3,4). Lengths of the shoots or stems bearing these makes were cut with a pair of secateurs and put in plastic bags together with some fresh leaves; the bag was tied securely with a rubber band for carriage and transport. The material containing the eggs were either split in two for examination of the eggs or put in petri dishes containing a moist circular filter paper for larval period study.

Incubation period study was carried out in the laboratory by first confining pairs of newly emerged adults in small petri dishes each lined with a moist circular filter paper and containing a fresh succulent shoot; the shoot served as food as well as receptacle for egg-laying (Pl. II, fig.5). Males could be distinguished from females by their considerably smaller size. Mating normally took place within 24 hr. after emergence; oviposition could be detected from slits and frayed-out woody fibres on the shoots.

ii) *Larvae*

presence of *A. gmelinae* larvae could be detected by the wilting or dry shoots; it could also be detected by the fissured of canker-like wounds on soft stems (Pl. III, fig.6). Lengths of parts bearing these symptoms about 1 mm. deep and 10 mm. apart were first made on one side of the stem with a sharp knife and the wood between the cuts removed so that the pith was exposed and a cylindrical space was formed. (Pl. III, fig. 7). The pith within the space was then hollowed out. The larva from the exausted stem was then removed and transferred into the hollow inside the newly prepared length of stem using a pair of fine forceps. The piece of wood removed earlier from the stem was then replaced and secured lightly with a piece of string. (PL. III, fig. 8).

iii) *Pupae*

A. gmelinae pupae were obtained by rearing the newly hatched larvae through to pupation as described in a) and) b).

iv) *Adults*

A. gmelinae adults were obtained by field collection or by rearing the larvae through to adulthood in the laboratory. When touched, the insects mimic death by dropping off the tree and lying still among the debris on the forest floor. In the laboratory, they feign death by coiling up and by lying still for long periods among the rearing material in the petri dish.

b) *T. bessoni*

T. bessoni was collected only in the field for observation and recording. The life cycle was not studied in the laboratory for lack of rearing facilities.

PLATE II

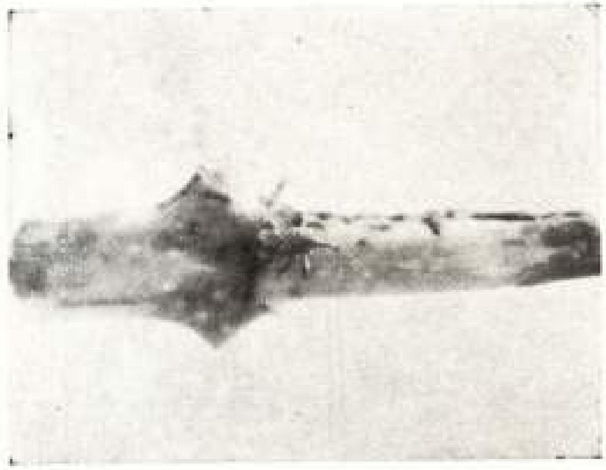


Fig. 3 Oviposition of *A. gmelinae* female showing fissures and frayed-out woody timber on soft *yemane* stem.

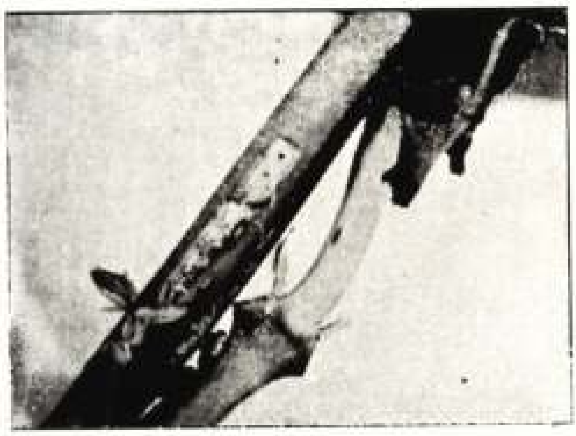


Fig. 4 Soft *yemane* stem showing stripped off bark, and pin-holes for egg-laying.

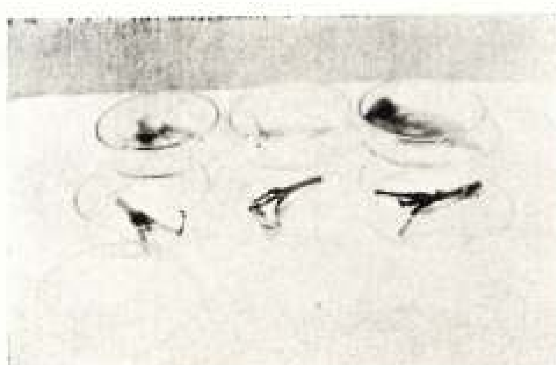


Fig. 5. Method of obtaining eggs in the laboratory.

PLATE III

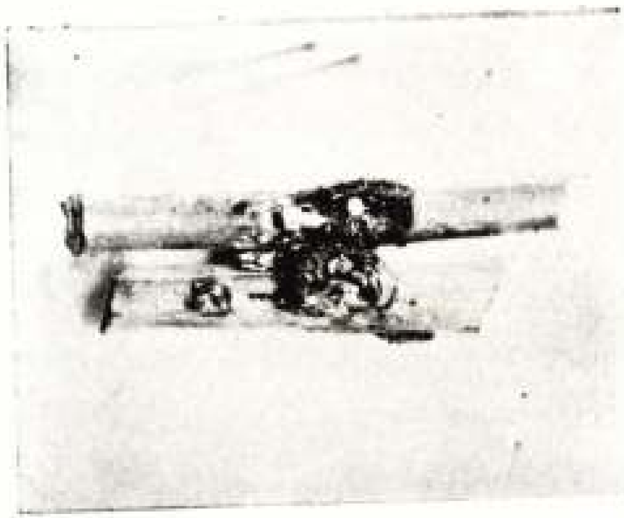


Fig. 6. Canker-like wounds on soft *yemane* stem resulting from *A. gmelinae* activity.
Note posterior end of larva in back ground.

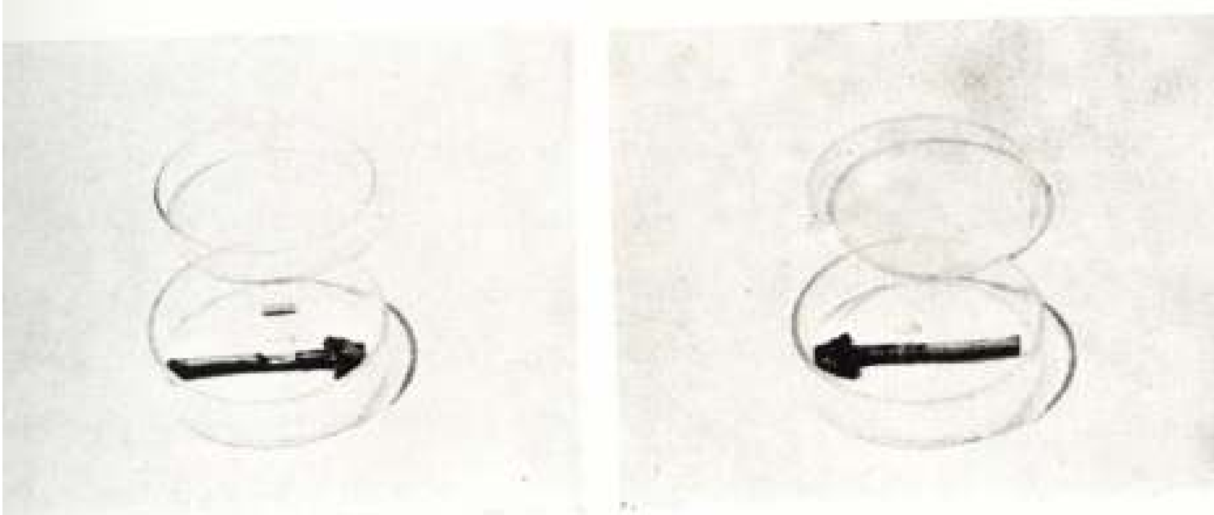


Fig. 7, 8. Method used for rearing *A. gmelinae* larva.

2.3. Control

a) Chemicals and methods used

i. **Malathion** 1/

Commonly known as Malathion. Deodorised, premium grade malathion with a trade name of "Cythion" is manufactured by American Cyanamid Co...

Chemically known as:

S-1, 2-bis (ethoxy carbonyl) ethyl 0, 0-dimethyl phosphorodithiomate

or

diethyl (dimethoxyphosphinothioylthic) succinate

or

diethyl (dimethoxyphosphinothioyl) thiobutanedioate.

Malathion is a non-systemic insecticideand acaricide of low mammalian toxicity and brief to moderate persistence. It is generally nonphytotoxic, but may damage cucumber, string beans etc.

Acute oral LD_{50} for rats is 280 m_g./kg.. Highly toxic to honey bees.

A concentration of 8 ml. per gallon (4.5 litres) of water was used to control *A. gmelinae* on yemane in succession to Dimecron (see Dimecron).

ii) Nogos [1/]

Commonly known as diehlorvos or ddvp. Chemically known as 0,0- dimethyl-2, 2-dichlorovinyl phosphate.

Nogos is a contact and stomach insecticide with fumigant and penetrant action. Non-phytotoxic and non-persistant but highly toxic to honey bees and toxic to birds.

90-day feeding trials of rate at 1000mg./kg. Showed "no effect".

A concentration of 2.25 ml. of Nogos 50Ec per gallon (4.5 litress water which is equivalent to about 0.05% active ingredient in water was used to control *T beesoni* on yemane.

iii. **Dimecron** [1/]

Commonly called phosphamidon. Chemically known as 0-[2-chloro-2- (diethyl-carbamoyl) –1-, methyl-1-methyl-vinyl] –0, 0-dimethyl phosphate.

or

0, 0-dimethyl-0-(1-methyl-2-diethyl-carbamoyl-vinyl) phoaphate.

or

0, 0-dimethyl-0-(diethylamido-1-chlora-crotonyl-1) phosphate etc.

A systemic insecticide rapidly absorbed by the plant; very little contact action; effective against sap-feeding insects at 300-600 g./ha.; non-phytotoxic except to some cherry varieties and sorghum varieties. In plants 50% loss occurs in c. 2 days.

Acute oral LD_{50} for rats is 374-530 mg./kg.; "no-effect" level for rats 1.25 mg./kg. Daily and for dogs 0.1 mg./kg. Daily. Highly toxic to birds and toxic to honey bees.

0.5% of Dimecron 50 equivalent to roughly 22.5 ml. per gallon of water was used to control *A. gmelinae* on yemane is followed by Malathion (see Malathion).

One ounce of soap detegent was used in every 11 litre-sprayerful of insecticide mixture.

Another method was also put on trial by painting 2 ft. length lower portions of the trunks of 20 ft. high yemane with 25% Dimecron using a soft brush.

b) Equipment

Cylindrical, chrome-plated steel Kubota knapsack sprayers of 11 litre capacity were used.

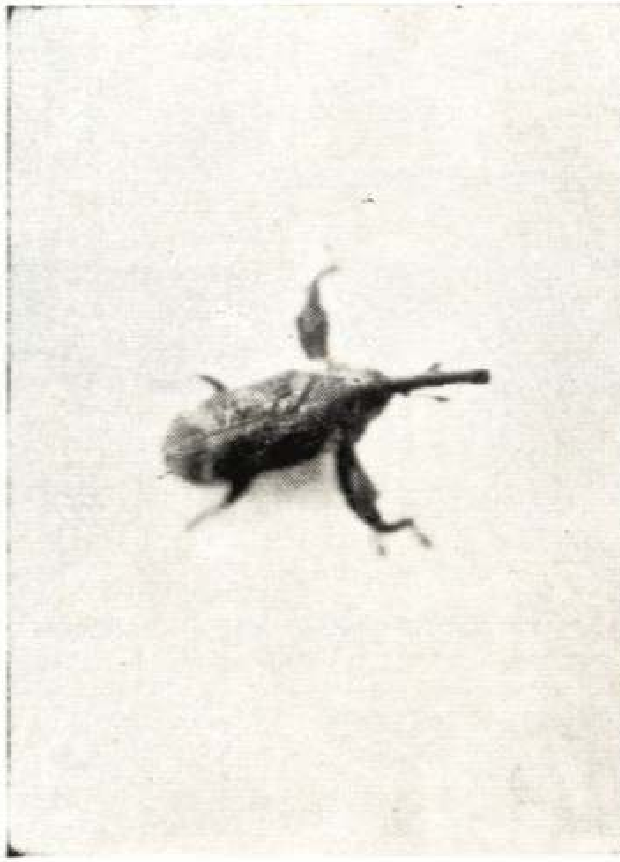


Fig. 9. *A. gmelinae* adult.

Fig. 10. *A. gmelinae* adult (with measuring tape).

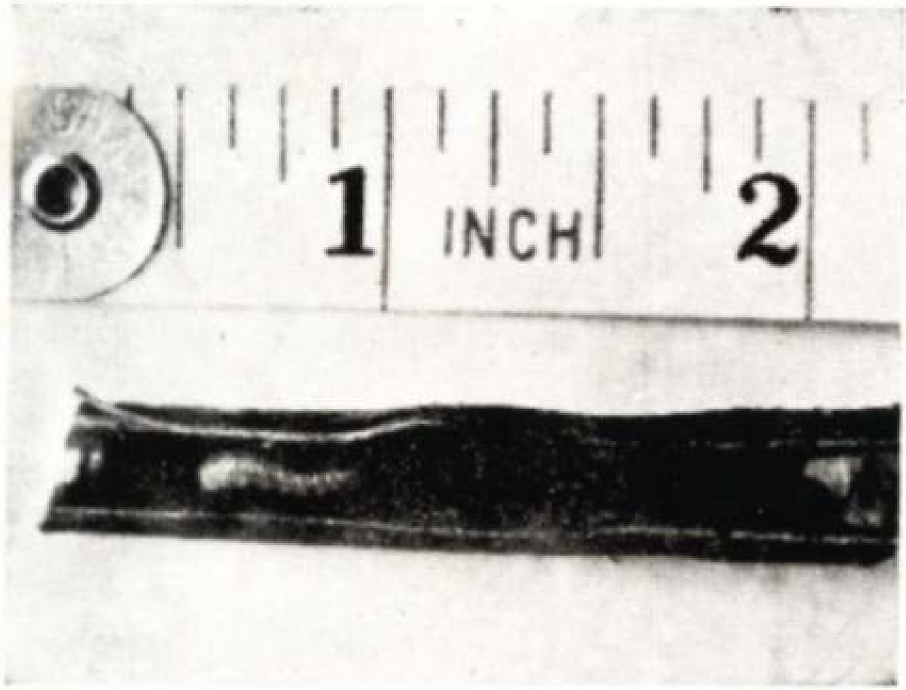


Fig. 11. *A. gmelinae* larva inside tunnel in *yemane* stem.

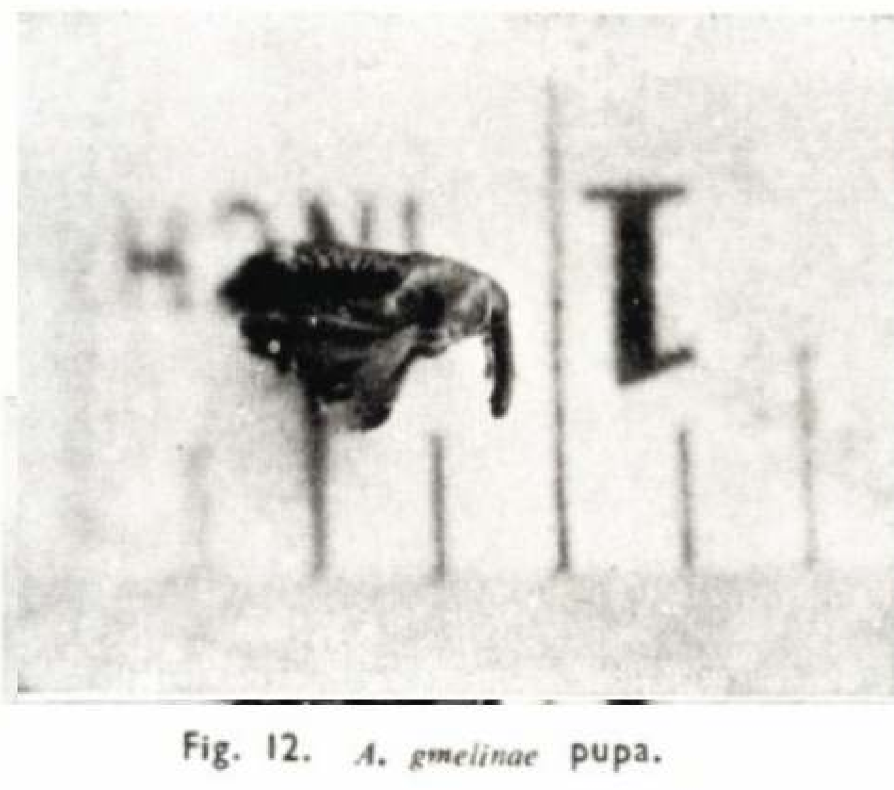


Fig. 12. *A. gmelinae* pupa.

3. Results

3.1. *A.Gmelinae*

Description Of Various Metamorphic Stages

A) Adult

Black, cylindrical beetle about 6-10 mm. long (PL.IV, fig. 9,10). The adult is ordinarily recognizable on yemane by the rostrum which is a snout-like prolongation of the head in front of the eyes at the end of which are the mouth-parts (a characteristic peculiar to insects belonging to the family curculionidae or weevils). The insect has a habit of dropping down to the forest floor mimicking death by lying coiled and still when touched. Longevity of adults was about 3 – 4 weeks with males dying earlier than females.

b) Larva

White, cylindrical, about 7-8 mm. long and about 2-3 mm. in diameter when mature (Pl. V, fig.11). Feeds on the piths and inner walls of the stem. Presence of larvae inside young stems can be detected by cankerous open wounds at intervals along the side of young stems through which excrement is extruded. The laval period was about 18-21 days.

c) Pupa

White when newly pupated, but turned brown and then black after 24 hr. and 48 hr. respectively; about 0.2-025 in. (about 4-5 mm.) long, bent at an angle (Pl. V, fig. 12). The pupal period was about 8-9 days.

d) Egg

The egg is yellowish white, round, transluscent and about 0.5 mm. across.

e) Oviposition

The female gnawed vertical series of holes with her snout (Pl. II, fig.3,4) or peeled off the soft bark and bored a series of holes in the soft pith (Pl. II, fig. 4) so that small cells were formed in the pith. A single egg was laid in each cell. The cells were then covered over with wood fibres. The oviposition period was usually about one week.

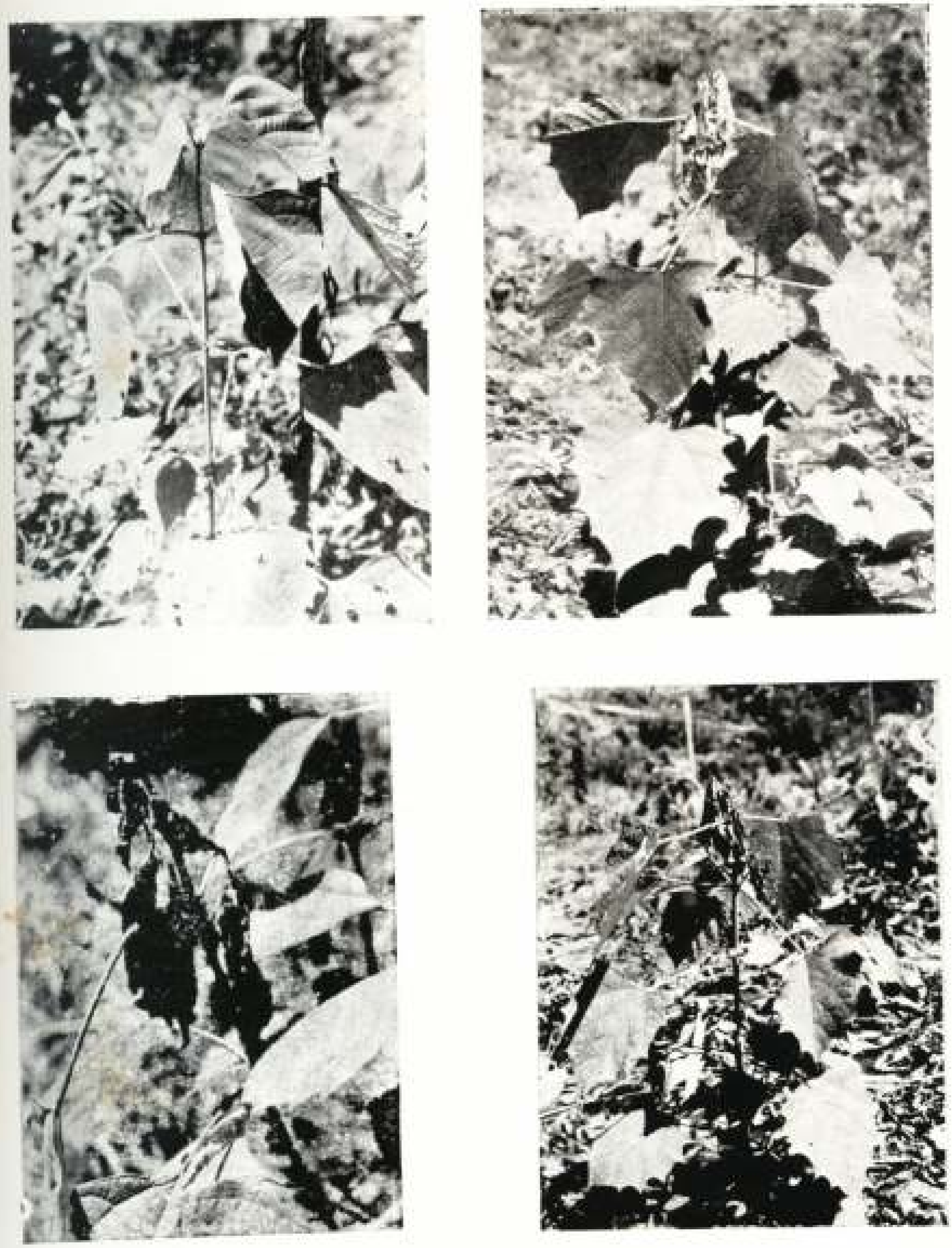
f) Incubation period

The incubation period was found to be from 8-10 days.

g) Life cycle

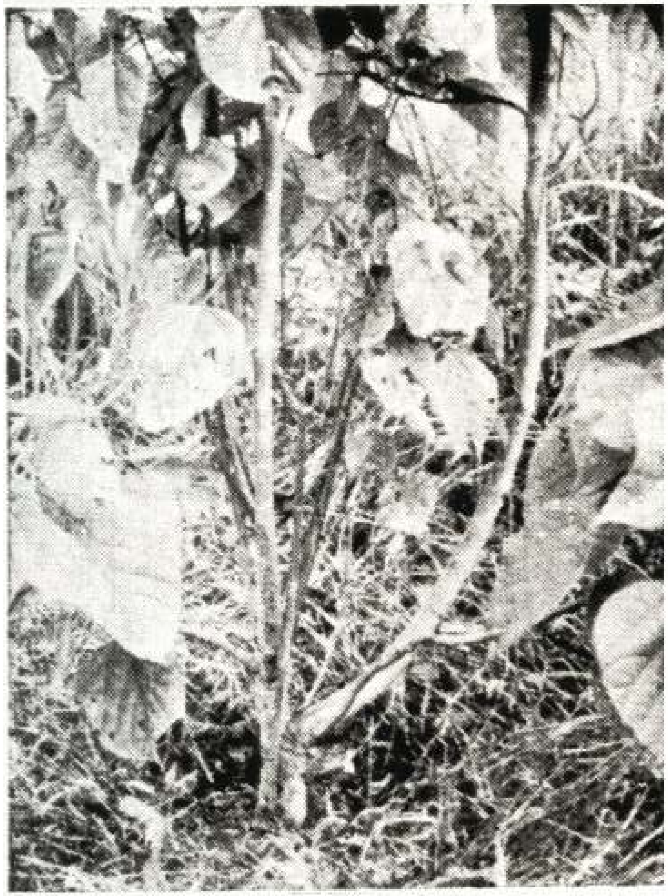
The life cycle lasted for about 41-54 days in the laboratory at a fluctuating temperature of 77˚-102˚ F (25-39˚ C) and a relative humidity of about 80% -90%. There appeared to be more than one generation during the rainy season. Studies on hibernation during the dry season and on ecology is still in progress.

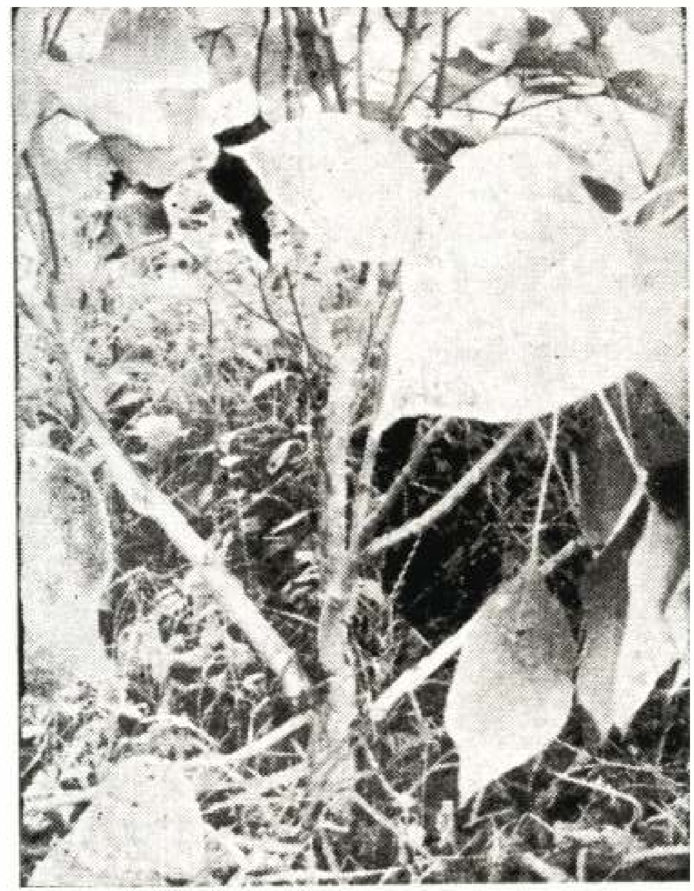
PLATE VI



Figs. 13–16. Clockwise from top left, (13) A vigorously growing *yemane* tree (14), (15), (16) dead leading shoots on young *yemane* caused by *A. gmelinae*.

PLATE VII





Figs. 17-18. Two 3-year-old *vemane* trees that have become branchy due to attack by *A. gmelinae*.

h) Incidence

Incidence of this insect was noticed in September each year in 1978, 1979, and 1980 in Moswe. However, the incidence in 1980 could be termed as slight because only a few attacked shoots on a small number of trees were observed. The plantation developed in 1978 in Moswe was rendered almost totally useless for industrial use due to trees becoming bushy as a result of *A. gmelinae* attack (Pl. VII, fig. 17,18).

i) Method of attack

The attack began by the gnawing of the females on the soft shoots to feed and to lay eggs. Vertical series of slits were made with their snouts or the soft bark was peeled off and a series of holes were bored; an egg was laid in each of the cells formed in the pith beneath each slit or hole.
The eggs hatch, and the larvae began feeding on the pith. As the larvae grew, feeding became more intense and the cambium layer became affected resulting in the death of the shoot (pl. v, fig. 11;fig. 14-16).

j) Effect of incidence

The initial attack caused the leading shoots to die back for a few inches to a foot (Pl. VI, figs. 14-16), and new shoots emerge from the nearest living buds. These new shoots in turn were quickly attacked forcing vertical growth to cease. The tree is thus turned into a bush (Pl. VII, fig. 17,18).

k) Epidemic period

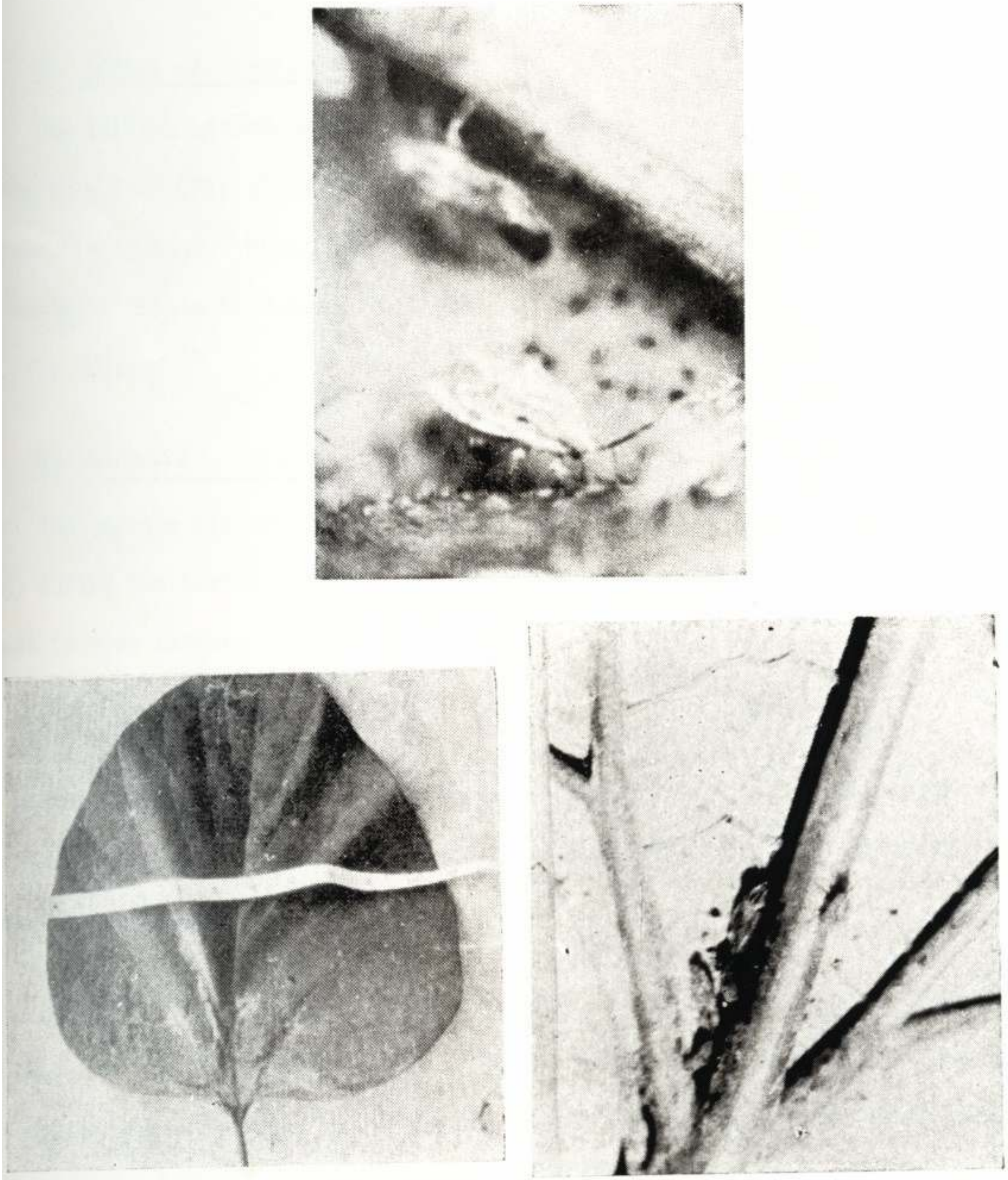
The insects appeared to go through several generations (rediscussion) during the period between August and February, but activity of the insect is most intense between September and October.

3.2. *T. beesoni*

The insects and its life history was not studied, but it appeared to be active from May to November with the most intense activity occurring between late July and October.

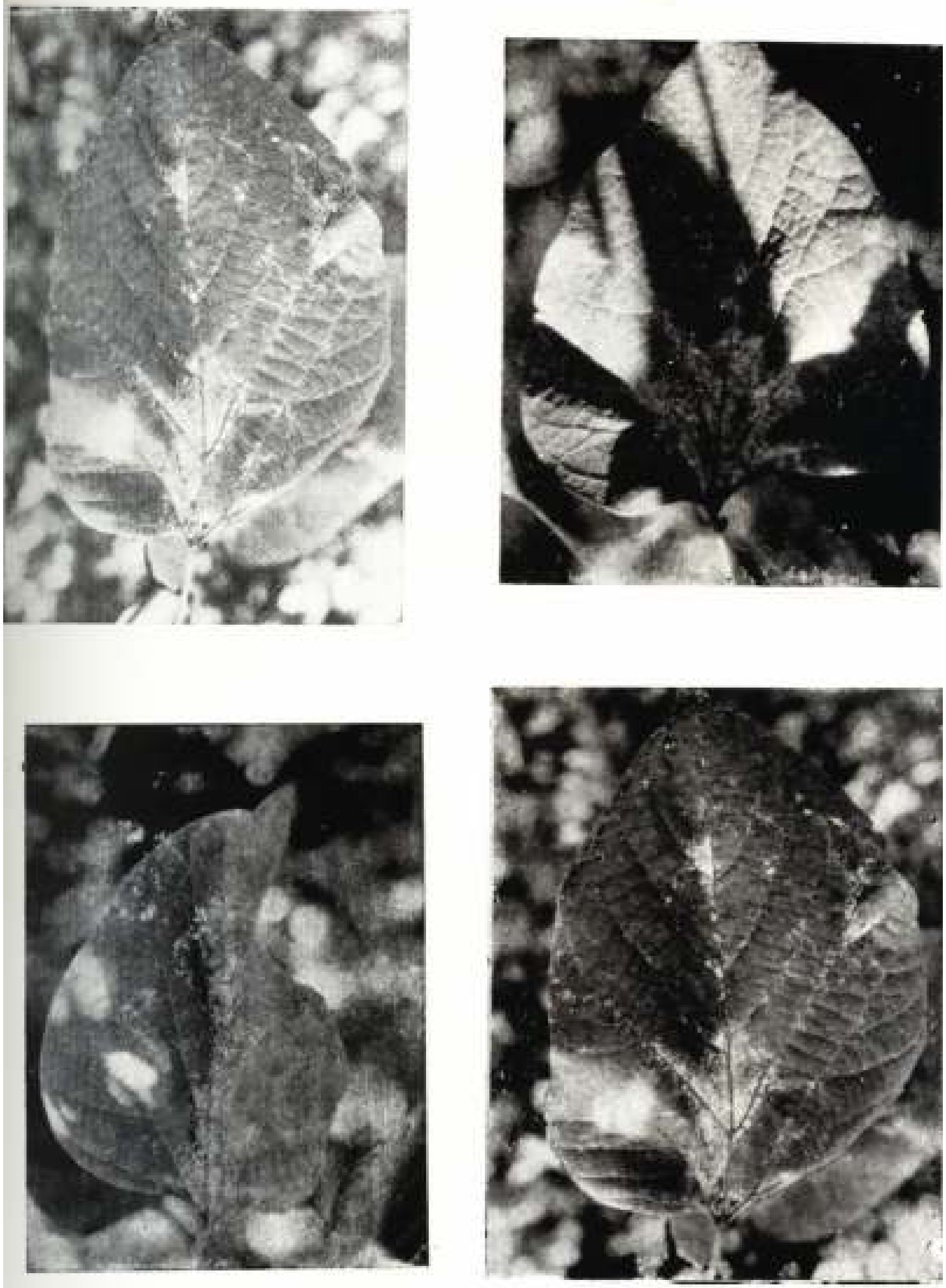
The insect is brown to black, about 0.15-0.2 x 0.1-0.15 in. (3-4mm x 2-3 mm.) in size (Pl. VIII fig. 19). Adults and nymphs in various stages of development (not identical in appearance) were observed at the same time feeding at the bases of leaves on the under surface (Pl. VIII, fig.20). At times of severe epidemics, usually occurring in late July, all the lateral branches of the tree were observed to be covered densely with these insects; even the upper parts of trees with 18 in. (about 46 cm.) circumference were observed to come under severe attack. Leaves become necrotic beginning from about three weeks after the initial attack if the attack was not checked early; necrosis was observed to begin from the base of the leaf and progressed upwards until the whole leaf dries up and falls (Pl. VIII, fig. 21: Pl.IX, fig. 22-25). Complete defoliation occurred 3-4 weeks after the intial attack (Pl. X, fig. 26,27). Coppices soon issued from the base of the defoliated tree (Pl.XI, fig. 29), but the tree never recovered from the effect of the insect attack resulting in the death of the above-ground part (Pl.XI, fig. 28,29) (see discussion).

PLATE VIII



Figs. 19-21. Clockwise from top
(19) Adult *T. beesoni*.
(20) *T. beesoni* feeding gregariously at base of leaf.
(21) *yemane* leaf in early stage of necrosis.

PLATE IX



Figs. 22-25. *yemane* leaves at various stages of necrosis.

PLATE X

Fig. 26. A healthy *yemane* tree.

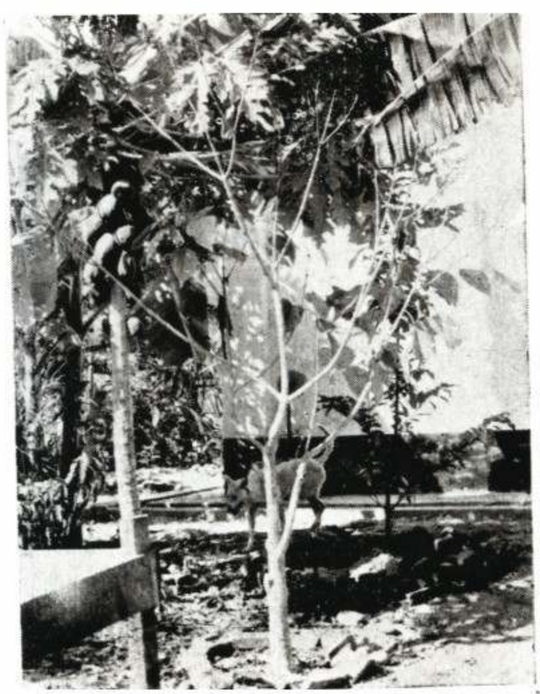


Fig. 27. The same *yemane* tree completely defoliated due to *T. beesoni*.

PLATE XI

Fig. 28. 18in. girth *yemane* tree completely defoliated due to *T. beesoni*.

Fig. 29. Coppices issuing forth from base of *yemane* after complete defoliation due to *T. beesoni*.

3.3. Control

a) *A. gmelinae*

Experiment plots in compartment no. 72, Ngalaik Reserve developed in June, 1979 was treated firest with Dimecron at 2% concentration equivalent to about 9 ml. Demecron 50 per gallon of water, followed by Malathion with a concentration of 8 ml. Malathion 50 per gallon of water; one ounce of soap detergent was used in each 11 litre sprayerful (a little less than 2 gallons) of insecticide mixture for proper wetting. This experimental plot was suffering from early stages of a severe *A. gmelinae* epidemics and the incidence rate was almost 100%.

Some *Gmelina* trees in this 1.6 acre plot were nearly 5 ft. tall in September of the second rain (Pl. I, fig. 1). Stems, branches and leaves of each of the trees were sprayed individually with extreme thoroughness.

Complete control was obtained in this plot. Examination of the plot in Septmeber of 1980 and January of 1981 only showed slight activity of the insect.

b) *T. beesoni*

The insecticides were put on trial separately to control this insect.

i. In the first trial a mixture of 2.25 ml. of Nogos 50 EC per gallon of water and one ounce of soap detergent was used to control *T.bessoni* on 20 ft. tall *Gmelina* trees having 18 in. girths as described in the materials and methods section; the trees were under severe attack with the insect covering all appendages of the tree except the lower parts of the main stems.

The insect was controlled but the leaves nevertheless became necrotic, and complete defoliation occurred 3-4 weeks after the initial attack. Coppices were observed to issue forth from the bases of the trees soon after complete defoliation. These coppices, when kept untreated were again attacked by the insects causing complete defoliation; new growth was again produced at base of the coppices.

ii. In another trial, a mixture of Malathion at 8 ml. per gallon of water and an ounce of soap detergent was used on trees about 2 ft. in height which were under severe attack. Complete control of the insect was obtained but the above-ground parts nevertheless died. Coppices were still produced from the bases of the dried up trees but they succumbed later to another attack by the insect and the severe drought that occurred during that year. (Pl. XIII, fig. 33).

iii. In still another trial, 2 ft. length lower portions of the trunks of 20 ft. high trees which were under early stages *T. beesoni* attack were painted with 25% active ingredient Dimecron using a soft brush. 24 hours after this treatment, insects feeding on the lower surfaces were found to have died with their proboscis still penetrating the epidermis. Although some of the leaves of the larger affected trees in advanced stage of insect-caused necrosis dried and fell the tees were saved. But the portions of the bark of trees thus treated became necrotic due to the high concentration of the insecticide used (Pl. XIII, fig. 34). In the case of smaller trees treated in the same manner, the leaves turned yellow and fell in addition to the treated portions becoming necrotic (Pl. XIV, figs. 35,37; Pl. XV, figs. 39,40). These smaller trees were left untreated during the following rain to observe the effect of the insecticide caused wounds. The trees were found to recover from the effect of the insecticides

PLATE XII

Figs. 30-32. Clockwise from top leff, (Fig. 30) 18in. girth *yemane* tree completely defoliated due to *T. beesoni.* (Fig. 31) Coppices issuing forth from the base 3 weeks after defoliation. (Fig. 32) Coppices grown to about 5ft. after 4 months.

PLATE XIII

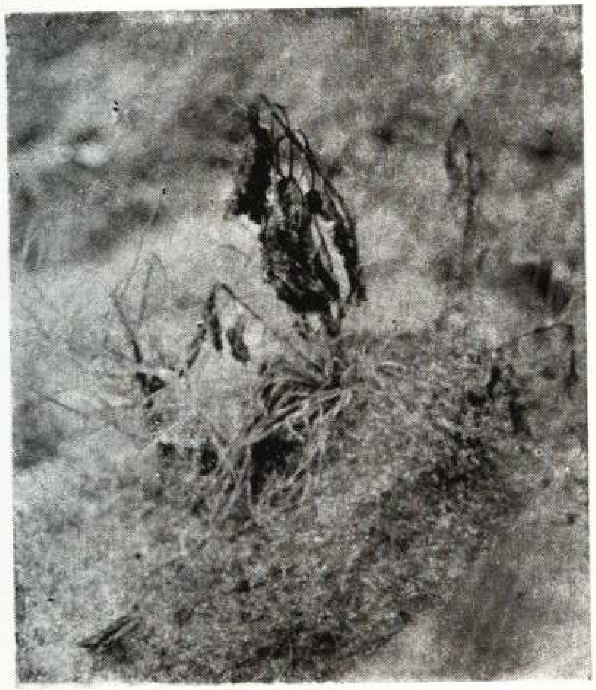
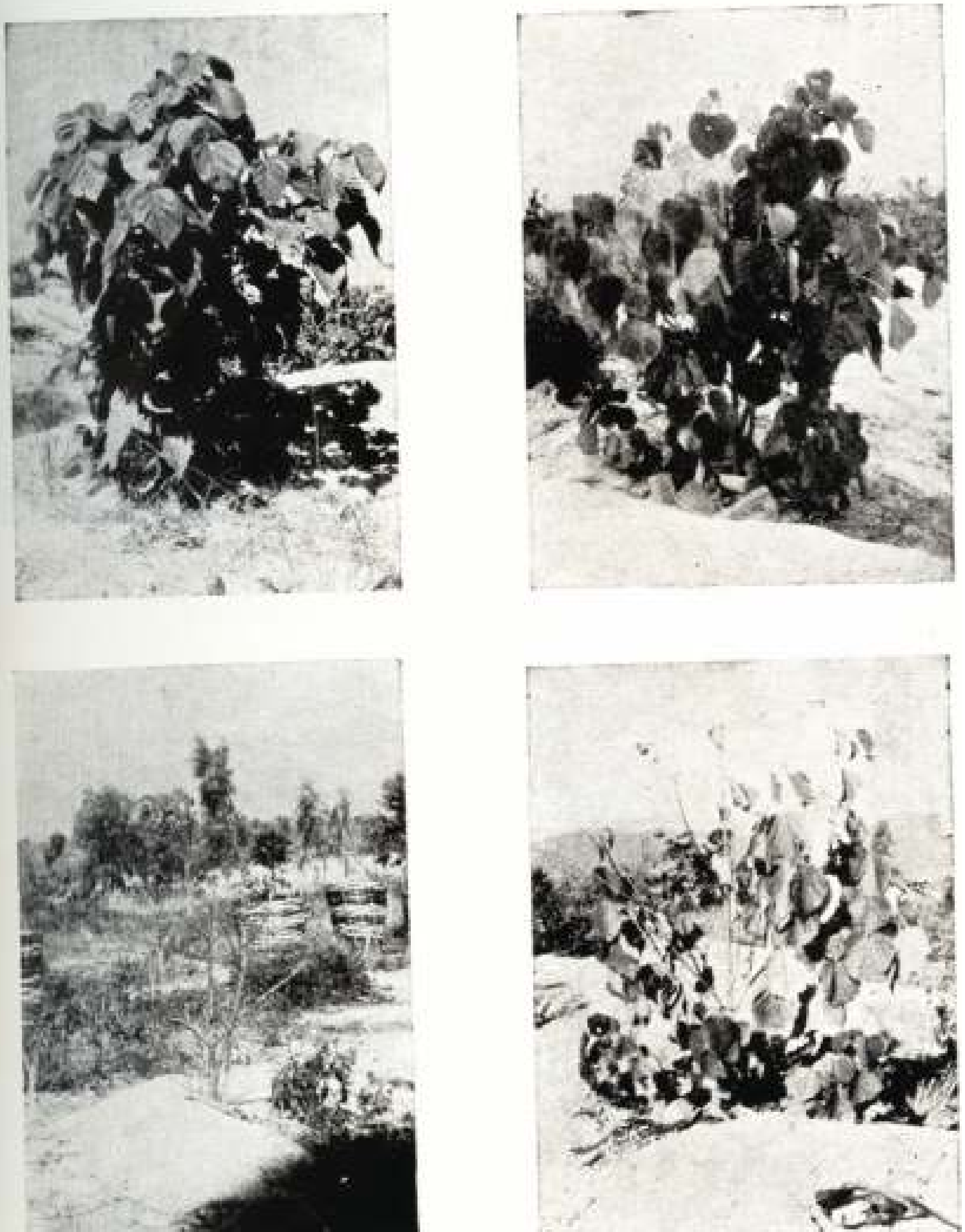


Fig. 33-34. (33) Young *yemane* tree that has recovered but later died due to drought.
(34) *yemane* stem showing necrosis caused by systemic insecticide at high concentrations.

PLATE XIV



Figs. 35-38. Clockwise from top left.
(35) Untreated healthy *yemane* tree.
(36) Same tree after treatment with 25% Dimecron.
(37) Same tree after falling of yellowed leaves.
(38) Same tree defoliated after a successive attack.

PLATE XV

Figs. 39-41. Clockwise from top left
(39) Unattacked tree.
(40) Same tree with some of the leaves fallen due to attack by *T. beesoni*. but saved by insecticidal treatment (systemic)
(41) Same tree defoliated following another attack by *T. beesoni*

but they came under another severe attack by *T. beesoni* and were again completely defoliated (Pl. XIV, fig. 38; Pl. XV, fig. 41).

4. Discussion and Conclusions

4.1. *A. gmelinae*

a) The insect and its life cycle

Beeson (1941) gives a general account of the external morphology of the adult and larval stages, and Gardner (1934) gives a description of the larva; the present findings on the external morphology of the adult and larval stages, were almost similar to the accounts by both the authors. Beeson (tit. Cit.) states that "…….. . The life cycle is apparently annual, the beetles appearing in August, September and remaining alive throughout the winter and spring", but did not mention a period of hibernation. The present results showed that both field-collected and laboratory reared adults did not live beyond a maximum of 3-4 weeks, and the period from egg-laying to pupation was not more than 33-35 days. Furthermore, both field-collected and laboratory-reared pupae emerged readily in 8-9 days at a fluctuating temperature of 77°-102°F (25°-39°C) and relative humidity of about 80%-90%.

Conclusions

The insect may go through several generations during the wet season of the year, but the possibility of a period of hibernation cannot be ruled out since yemane is deciduous, and it goes through a period of dormancy after leaf-shedding which, according to Troup (1921) lasts from January-February to March-April. A more detailed study of the pupal period in the field is therefore necessary.

b) Control

The results showed that insecticidal control of this insect is possible, but the use of a combination of insecticides having different modes of action, namely contact-stomach and systemic, is called for.

At times of epidermics, the insect breeds in large numbers with all metamorphic stages occurring at the same time. Although adults are surface-feeders, eggs are laid deep inside soft stems producing larvae which remain throughout their lives in tunnels made in the center of stems where they pupate. A contact-stomach insecticide alone may eliminate most of the surface feeding adults, but the effect on deep-lying eggs and larvae would be extremely slight. Therefore, the simultaneous use of a rapid-absorbing systemic insecticide becomes necessary to control the insect in the present case. (see results on control on *A. gmelinae*).

4.2. *T. beesoni*

a) The insect and its life cycle

Although general descriptions of the adult have been given by Drake (1929), Drake and Poor (1936) and Beeson (1941), the detailed description of the various metamorphic stages were unavailable. The present study on the general external morphological characters of the adult gave similar results to those given by the above authors. The external morphology of the other metamorphic stages of the insect has not yet been studied.

The life cycle has not been studied due to lack of facilities but according to Beeson (loc. Cit.) “there are 3 generations each lasting about 6 weeks. In the autumn adults continue to frequent the plants. It is not known at what stage hibernation occurs”. Present observations showed the absence of the insect during the dry period between January and March which coincided with the dormant ‘leafless’ period of *yemane*. But the insect reappears soon after the re-emergence of the leaves at the beginning of the wet season as stated in the results section. The insect, therefore, must either go through a period of hibernation at some stage in its life cycle or migrate to another host for survival or propergation. At any case, further research on the ecology of the insect is needed for effective control.

b) Control

Again, the results of the present studies appear to indicate that insecticidal control of this insect is possible, and that , as in the case of *A. gmelinae,* a combination of differently acting insecticides is needed.

However, the need for better knowledge of the available insecticides is very much apparent as is shown by the results of *T. beesoni* control using Dimecron. Therefore, more trials using a wider variety of insecticides and a wider range of concentrations are needed to be carried out.

In conclusion, the results so far have been qualitative, but they all indicated feasibility of the use of insecticides on yemane, and consequently on forest trees, for control of its pests.

But a wider variety of insecticides must be put on both qualitative and quantitative trials before putting them to field use so that optimum results and maximum economy may be obtained.

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