



**Government of the Union of Myanmar
Ministry of Forestry
Forest Department**



**Shoot Borers of *Pinus Khasya* Royle Ex Gord. in Forest
Plantations in Myanmar
Part I Distribution and Biology**

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မြန်မာပြည်သစ်တောထင်းရှူးစိုက်ခင်းများရှိ
သုံးခွထင်းရှူး (*Pinus khasya* Royle ex Gordon) တွင်ကျရောက်
ဖျက်ဆီးသောပိုးများ အပိုင်း(၁) ပျံ့နှံ့ပုံနှင့်ဇီဝဗေဒ

ဦးအောင်ဇေယျ (B.Sc. [Rgn.] Dip. For. [Oxon.], M.Sc. [Oxon.])
လက်ထောက်ညွှန်ကြားရေးမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

မြန်မာပြည်သစ်တော ထင်းရှူးစိုက်ခင်းများရှိ သုံးခွထင်းရှူးတွင် ကျရောက်ဖျက်ဆီးသော အညွန့်ဖောက်ပိုး(၂)မျိုး ပျံ့နှံ့ပုံ၊ ဘဝနှင့်လေ့များကို လေ့လာထားပါသည်။ ၎င်းပိုး(၂)မျိုးမှာ *Petrova salweenensis* Miller (*Ryacionia criatata* Wals.) (Lepidoptera : Tortricidae, Olethreutinae) ၊ *Siph Dioryctria sylvestrella* Rats. (Lepidoptera: Pyralidae) တို့ဖြစ်ကြပါသည်။ ၎င်းတို့၏ အမည်နာမ ကိုးကားသေချာစွာခွဲခြားရန် လိုအပ်ပါသည်။ အဘယ်ကြောင့်ဆိုသော် ထင်းရှူးအညွန့်ဖောက်ပိုးများ ပါဝင်သော *Ryacionia* (= *petrova*) မျိုးစုဝင်ပိုးများသည် ထင်းရှူးသီးဖောက်ပိုးများပါဝင်သော *Dioryctria* မျိုးစုဝင်အချို့သောပိုးများနှင့် များစွာတူသဖြင့် ဖြစ်ပါသည်။ မည်သည့်အကြောင်းကြောင့် ယခင်က သုံးခွ ထင်းရှူးတွင် ကျရောက်ခဲ့ခြင်းမရှိသော ပိုးမွှားများ လျင်မြန်စွာ ပြန့်ပွားလာခဲ့ခြင်းနှင့် အစဉ်အလာအားဖြင့် အသီးဖောက်ပိုးများဖြစ်သော *Dioryctria* မျိုးစုဝင်ပိုးများ အညွန့်များကို ဖောက်ဝင်ဖျက်ဆီးခြင်း ကိုလည်း ဆွေးနွေးထားပါသည်။

Shoot Borers of *Pinus Khasya* Royle Ex Gord. in Forest Plantations in Myanmar

Part I. Distribution and Biology

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Abstracts

The distribution, life histories and methods of attack of two shoot borers of *Pinus Khasya* Royle ex Gord. were studied. The insects were identified as *Petrova salweenensis* Miller (= *Rhyacionia cristata* Wals.) (Lepidoptera: Tortricidae, Olethreutinae) and *Dioryctria sylvestrella* Rats. (Lepidoptera: Pyralidae), but detailed taxonomic study is needed since pests belonging to the genus *Dioryctria* which usually attack the cones of pines and those to *Rhyacionia* (= *Petrova*) which bore into the shoots are very similar. The sudden appearance of these previously unreported pests in the *P. khasya* plantations in Myanmar and the probable cause of *Dioryctria* species attacking fresh shoots instead of cones which usually is the case with this pest is also discussed.






1/ The name of this species of pine has now been widely accepted as *Pinus kesiya* Royle ex Gordon

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FOREST REGIONS of BURMA

0 50 100 200 300 400 Km

-  TROPICAL RAIN FOREST
-  TROPICAL SWAMP FOREST
-  SUBTROPICAL MOUNTAIN FOREST
-  CENTRAL DRY ZONE
-  SHAN STATES TROPICAL MIXED FOREST
-  TROPICAL DRY DECIDUOUS FOREST
-  SUBTROPICAL LOWLAND FOREST
-  TEMPERATE MOUNTAIN FOREST
-  TROPICAL MOIST FOREST

AFTER DAVIS (1964)



1. Introduction

Development of native and exotic pine plantations is in great progress in the South East Asian region where long fiber pulp, which these pines provide, is the high demand for paper and allied industries that have been established in this region. Following these increases in the area of pine monocultures, the number of pests, both pathogen and insect, have also increased using these plantation as food.

1.1 The Tree

Pinus khasya Royel ex Gordon has been known to grow in the Union of Myanmar since time immemorial. Troup (1921) gave the names of *P. khasya* as Khasi pine, Dingsa (vernacular name in Khasi hills where this pine was found by Hooker) and Tinyu (Burmese): distribution is given as Khasi and Naga hills, Manipur, hills of upper Myanmar, the Shan State and the hills between the Sittoung and the Thanlwin rivers. Largest areas of *p. khasya* in Myanmar, however, are found in the Southern Shan State and cover approximately 1830 sq. miles (Troup, 1921). *P. khasya* also occurs in the Chin hills, the Pakokku hill tracts, Mongtung in the Northern Shan State, Mainglon to the South of Mogok, the ridges of the Chindwin drainage in Myitkyina, and in the hills between the Sittoung and the Thanlwin rivers on the ridges from 2,500 ft. upwards near the Chinese border (Troup, 1921; Armitage and Burley, 1980). Another species of pine, namely *Pinus merkussi* Jungh., also grows in the Union of Myanmar, but in very much smaller numbers in southern part of the Southern Shan State southward through the Kaya State and the hills of the Thanlwin and Thoungyin drainages (Fig. 1).

Acreage of pine plantations, mainly of *P. khasya*, established between 1895 and 1983 was 8195 1/, but 1989 figures showed the total acreage to have increased to over 25,000 2/. This sudden rise in the pine plantation acreage is due to the fact that the total annual

1/ Data from the Department of Meteorology and Hydrology, 1984.

acreage of pines sown, predominantly of indigenous *P. khasya*, and small trial plots of introduced *P. khasya*, *P. petual*, *p. caribaea*, *P. oocarpa*, *P. elliottii*, *P. maximinoi* and *P. petula* Var. *tecunumanii*, increased dramatically in the 1983-84 planting season when the Forestry II project came into being with Asian Development Bank assistance. The introduced species of pines were brought in from various world pine sources including Setropa of Holland which supplied the exotic variety of *P. khasya* which was put on growth trails in this country for the first time.

1.2 The pests

A number of pests of *P. khasya*, both pathogen and insect, has been reported. *Armillaria mellea*, *Cronartium quecuum*, *Dothistroma pini*, *Fomes pinicolor*, *Lactiporus sulphurens*, *Pythium debaryanum*, *Thanatiphorus cucumeris* have been listed by Prowne (1968) as pathogens of *P. khasya*. Beeson's 1941 account of the "Ecology and Control of the Forest Insects of India and the Neighbouring Countries" included *Metanastria grisea*, *M. ampla*, *Lebeda nobilis* and *Heliothes armigera* as Lepidopterous insect defoliators of *P. khasya* in the Union of Myanmar.

M. ampla, *M. grisea*, *L. nobilis* belonging to the family Lasiocampidae are large moths which have been the only insects reported to have caused sporadic damage to the foliage of *P. khasya* in Myanmar (Beeson, 1941). Serious damage done by insects to other parts of the living tree of *P. khasya* has not been reported in the available literature on forestry in Myanmar. However, with recent large and rapid increases in monocultural pine plantations, reports of damage to *P. khasya* in Myanmar due to previously unreported shoot borers become increasingly frequent beginning in 1986; development of these plantations began as mentioned above in 1984. This paper describes the findings of investigations initiated by a report in 1986 from the Deputy Director of Plantation Area 3-6 based in Tounggyi in the Southern Shan State where *P. khasya* is grown as large, monocultural plantations.



//// - areas of native &/or exotic pine (*Pinus* spp.)

X - pine areas in which shoot moth attacks have been recorded before 1985

• - pine areas in which shoot moth attacks have been recorded after 1985

Fig. 2. Present extent (natural and plantation) of *Pinus* species with records of attacks by pine shoot moth (*Rhyacionia* and *Dioryctria*) (After Speight and Speechly, 1982).

2. Materials And Methods

This study was conducted in the monocultural plantations of *P. khasya* begun in 1984 in Kalaw area, Southern Shan State. at about latitude 25° 43' N and longitude 96° 50' E at an altitude of approximately 1160 m. (3800 ft.), and in Pyin Oo Lwin in Mandalay Division at about latitude 22° 01' N and longitude 96° 28' E at an altitude of approximately 1100 m (3500 ft.) (fig 2 & 3). The average annual rainfall for both the areas for the period 1971-80 were 1543 mm; the highest maximum temperature for the same period was 32.9° C and the lowest 0.3° C ^{1/}. The types of forest in the Southern Shan State are Oak, Oak mixed with pine, and Pine Forests; approximately the same types of forests occur in the Pyin Oo Lwin area. Present studies were made in *P. khasya* plantations established in clear-felled areas of Pine Forests. Spacing of trees in all plantations studies was 8½ ft. Small trial plots of various species of pines are planted with 9 ft. x 9 ft x 9 ft. spacing.

For sampling of insect attack, three replicates of 100 trees each were taken randomly in each plantation, and each replicate was examined for shoot borer injuries. This was done by sweeps along ten adjacent rows of ten trees each from north to south if the trees were planted in the east-west direction. This system was followed throughout the study. Sampling was carried out monthly during the fourth week.

The life cycles of the moths were studied both in the field and in the laboratory; studies in the laboratory were conducted under simulated conditions using lighted refrigerated incubators.

3. Results

3.1 Life cycle and method of attack

The adult *P. salweenensis* (Figs. 4a, 4b) has brownish-orange forewings broadly banded with silver, and dull grey hind wings. The adult *D. sylvestrella* (Figs. 5a 5b) is coloured grey-brown with a

^{1/} Data from the Department of Meteorology and Hydrology, 1984.

silvery sheen banded with darker brown across the forewings; the hind wings are orange-grey. The hind wings of the moths have a distinct line along the margin. The wing expanse of *P. salweenensis* is 15-20 mm and that of *D. sylvestrella* is 25 mm.

The life cycles of both *P. salweenensis* and *P. sylvestrella* appeared to be similar. The moths are active in the evening, remaining quiescent during the day, but slight activity is usually observed about midday. They fly in the evening in slow hovering movements beating their wings rapidly. Mating usually takes place in the evening following emergence; it appeared to take place only once for both sexes. The number of eggs laid per female is about 80-150; they are usually laid singly on the bark of the young shoots while they are still green on or at the bases of the needles. The average duration of the egg stage is about 7-14 days. The hatching larva exudes a silken thread and moves away from the egg shell into cracks or narrow spaces between the buds and spins a roof of silken thread; the larva bites through the bud scales and bore into the soft tissue at the base of the needle (Fig. 6). As the larva continues to feed and grow, the hold enlarges in the bud and the frass and masticated resin are stuck bit by bit on the web of silk (Fig. 7). After a few days, it bores into the centre of the shoot itself (Fig. 8) boring upwards at first, and then returning downwards

towards the basal part later. No death was observed in trees attacked by both the insects; however, deformation of parts of the tree results from the injury (Fig. 9a & 9b). The larva of *P. salweenensis* during the young stage is yellowish in colour and gradually darkens to brown as it grows older and is about 11 mm. in length when fully grown (Fig. 10). The larva of *D. sylvestrella* on the other hand is light grey with blackish spots along the dorsolateral lines, and is about 15-20 mm. long when it reaches the last stage (Fig. 11). The larval stage lasts for about 21-45 days; the duration's of pupil stage last about 7-14 days.

Table 1. Incidence of shoot-borers in *P. khasya* plantations.

Sr. No.	Place of sampling	year of establishment	year of sampling	% average incidence	plantation area
1.	Kalaw (Forestry II Project)	1984	1986	round to nearest decimal place	400 ac.
	Pyin Oo Lwin (Forestry II Project)	----- not sampled -----			
2.	Kalaw (Forestry II Project)	1984	1987	38	400 asc.
	Pyin Oo Lwin (Forestry II Project)	1984	1987	30	500 ac.
3.	kalaw (Forestry II Project)	1984	1988	53	400 ac.
	Pyin Oo Lwin (Forestry II Project)	1984	1988	25	500 ac.
4.	Kalaw (Forestry II Project)	1984	1989	49	400 ac.
	Pyin Oo Lwin (Forestry II Project)	1984	1989	18	500 ac.
	Aung Ban (Forest Dept. Plantation)	1981	1989	0	8 ac.
	Thigoun Taung (Forest Dept. Plantation)	1982	1989	0	32 ac.
5.	Kalaw (Forestry II project)	1984	1990	39	400 ac.
	Pyin Oo Lwin (Forestry II Project)	1984	1990	33	500 ac.
6.	Kalaw (forestry II Project)	1984	1991	41	400 ac.
	Pyin Oo Lwin (Forestry II Project)	1984	1991	18	500 ac.

4. Discussion and Conclusion

Of the two previously unreported shoot meths that were found in the *P. khasya* plantations in Myanmar, *D. sylvestrella* first appeared in 1986 in Kalaw in the Southern Shan State followed by *P. salweenensis* in 1989. A year later, both the species were collected in Pyin Oo Lwin 90 miles away separated by lowland terrain grossly different in topography, vegetation and climate from the two locations.

The absence of reports of shoot borers on naturally occurring *P. khasya* Myanmar has been mentioned earlier. Plantations of *P.khasya* have been developed and established, though in much smaller acreages, with seeds from indigenous sources in the same general areas since the early sixties especially in the Southern Shan State and no report of shoot borer damage in these plantations had either been made except

for reports of sporadic damage done by large defoliators belonging to the family Lasiocampidae. An example of this absence of shoot borers in *P. khasya* plantations can be seen in table 1 where examination of 8-acre and 32-acre *P. khasya* plantations in Aung Ban and Thigoun Toung established in 1981 and 1982 respectively from indigenous *P. khasya* seeds.

Cooling (1968) observed *D. sylvestrella* and *R. crystata* attacking shoots of natural *P. khasya* stands in Baw Laung region in north western Thailand. The presence of plantations of *P. khasya* established in this area were also reported to be attacked by the same species of shoot borers (Hutacharearn, 1977,1978; Chaiglom, 1977). The seeds used for the establishment of these plantations are likely to be of Thai provenance, much as the *P. khasya* plantations were established with seeds of Myanmar provenance, but plantations in Thailand were established somewhat below its natural range at about 700 m. above sea level. It has been suggested that the establishment of large monocultural *P. khasya* plantations below its natural range, or below 1000 m. on fairly poor sites might be expected to become susceptible to shoot borer attack (Gibson and Jones, 1976). However, plantations in the present study have been established in the clear-felled areas of the natural pine forests at about 1100-1200 m above sea level.

Cooling (loc. cit) did not observe attack by shoot borers in pure *P. merkusii* plantations and in mixtures of it with *P. khasya*, and Speight and Speechly (loc. cit.) considered *P. khasya* to be most susceptible to shoot borer attack followed by *P. merkusii* and *P. caribaea* with *P. oocarpa* the most resistant in Thailand; Lepis in 1982 reported that *P. crystata*, which now occurs in Myanmar, has a host range that includes *P. merkusii* and *P. caribaea* in the Philippines; shoot borer attack on *P. merkusii* is also reported from Indonesia (Ruswandy and Wiriaadianta, 1980).

It appears from the above that of the pine species that are prone to shoot borer attack, *P. khasya* stands out to be the most susceptible in the S. E. Asian Region, and this species of pine is considered to be most suited for plantation development in Myanmar and other countries of S. E. Asia such as china, Taiwan, Thailand, Malaysia, Indonesia, Vietnam, Laos, Cambodia and the Philippines, where large plantations have already been established (fig. 2). However, the fact that the absence of shoot borers in the plantations established with the indigenous variety of *P. khasya* in Myanmar prior to the introduction of its exotic variety and the exotic species of *P. patula*, *P. caribaea*, *P. oocarpa*, *P. elliotii* and *P. maximinoi*, and the sudden appearance of shoot borers afterwards bore out the fact that introduction of exotic species or provenances should be made by getting them through proper quarantine procedures and putting them on manageable trials with ample safeguards for emergencies before going through larger trials; presence of shoot borers have already come to light in the Philippines, Vietnam and Thailand.

Browne (loc. cit) reports *Dioryctria* spp. to be largely cone and seed borers, and certain species tunnel into the bark of small trees, buds and flowers. *D. armatella* Hulst, *D. clarioralis* Walker, *D. disclusa* Heinrich, *D. ebeli* Mutuura and Munroe, *D. yatesi* Mutuura and Munroe and *D. merkelii* Mutuura and Munroe are all reported to be cone borers in North America but shoot attacks prior to cone infestation are common (Ebel et al.). Presence of cone borers have not been reported in S. E. Asia but the presence of *D. sylvestrella* attacking shoots in plantations of *P. khasya* in Myanmar where no trees have reached cone bearing age could well be a prelude to attack on cones as well when these plantations come of age.

Further, since *P. khasya* is the most widely planted of the pine species the probability of it being located by rapidly dispersing adult moths is greater than for the

other exotic pine species, and therefore, constant care should be taken to detect and examine the damage to the trees of the plantations and the presence of any unusual insect activity, however slight they may be, so that measures could be taken to control any untoward situation in the quickest possible time.

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