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A Preliminary Report on the Mortality of *Pinus khasya* Royle in Kalaw Area

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ကလောတဝိုက်ရှိနှစ်ခွထင်းချူးများသေကြေခြင်းနှင့်ပတ်သက်၍အစီရင်ခံချက်

အောင်ဇေယျ
သစ်တောသုတေသနဌာန၊ရေဆင်း။

စာတမ်းအကျဉ်းချုပ်

သဘာဝတောနှင့် လူတို့ဖန်တီးမှု၏ အကျိုးဆက်များကြောင့် ရှမ်းပြည်တောင်ပိုင်း ကလောတဝိုက်ရှိ သဘာဝ နှစ်ခွ ထင်းချူးတောများနှင့် ၎င်းစိုက်ခင်းများတွင် ပိုးမွှားများ ကျရောက်ဖျက်ဆီးခံရပုံကို အစီရင်ခံဆွေးနွေးလျက် အဆိုပြုချက်များဖြင့် တင်ပြထားပါသည်။

A Preliminary Report on the Mortality of *Pinus khasya* Royle in Kalaw Area

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Abstract

A Sequence of events which led to the insect epidemic in natural stands and plantations of *Pinus khasya* Royle in the Kalaw area listed in this report. Possible causes of these events are discussed and further statements are made for consideration by agencies concerned.

PLATE I

Fig. 1. 15-year-old *P. khasya* plantation near Kalaw along Kalaw-Taungyi Road photographed in December, 1980.

Fig. 2 Needles on some *P. khasia* trees in 15-year-old plantation near Kalaw turning yellow abnormally in December, 1980.

Preliminary Report on the Mortality of *Pinus khasya* Royle in Kalaw Area

In early September, 1980, a report was made by the Shan State Forest Department Officials on yellowing of pine needles in natural pine forests and plantains around Kalaw which was though to be caused by insects. At the suggestion of the Director, Forest Research Institute 1/, examinations were made by the Entomology Section of the Institute in the Kalaw area in late September, 1980. Findings during this examination and those during the three subsequent ones made in December, 1980, October, 1981 and July, 1982, are listed in this report which is essentially a general report to stimulate interest and promote discussion among agencies concerned in finding ways and means for systematically developing and maintaining healthy pine forests in the Shan State.

1. Needle yellowing

In September, 1980, a number of *P. khasya* trees both in natural stands and in 15-years-old plantations were found affected randomly. Needles began turning yellow at the tip of the branch and the yellowing progressed toward the base resulting in the tree turning yellow totally. The affected trees were found scattered individually among healthy ones (P1. I, fig.2). Closer examination showed no sign of fungal or insect attack either on the tree as a whole or on the needles, nor were there any sign of scorching by undergrowth fires.

Examination of the topsoil overlying the limestone substratum on which the affected and healthy trees stood in four different places showed that the red-clay topsoil layer under affected trees were very much shallower than that under healthy ones.

According to the local residents, a drought occurred in the previous year (1979), and although rainfall was normal at the beginning of the rainy season in early May, it suddenly broke off after about one week to resume again intermittently in late August. Meteorological data of Kalaw area (Table 1) shows that rainfall was indeed low in Kalaw area in 1979 and the average monthly temperature during the year was found to be well above those of the previous three years. Local residents also reported a similar climatic condition in the following year (1980) without a drought condition; a slight rise in temperature was recorded in Kalaw area in the same year (Table 1).

1/ Presently Director- General, Department of Forest, Burma

Discussion

Factors such as rainfall, both annual total and monthly distribution, temperature and soil characteristics among others affect tree vigour. When these factors are unfavorable trees become stressed and physiologically weakened resulting in these trees exhibiting abnormal characteristics.

Copper deficiency has been known to cause needle yellowing in some pines such as *P. caribaea* in Australia resulting in the affected trees becoming susceptible to insect attack and eventual death (personal communications); but this may be ruled out in the present case since needle yellowing and mortality occurred in individual trees randomly distributed among healthy ones rather than in large patches or area.

Table 1. Annual rainfall and average monthly temperature in Kalaw area during 1930, 1955 and the period 1974 -82 1/.

Year	Annual rainfall in inches	Average monthly temperature in °F
1930	50.77	65.1 1/
1955	51.00	66. 2 2/
1974	46.01	59.2
1975	82.01	62.2
1976	45.01	63.3
1977	54.05	78.8
1978	54.02	82.7 3/
1979	37.08	89.6
1980	55.00	91.1
1981	45.52	90.8
1982	52.52	89.8

1/ Working Plans for Kalaw Reserve and Kalaw Extension Reserve for the period 1929-30 to 1938-39 Vol . I.

2/ Working Plans for Southern Shan State Forest Division for the period 1955-56 to 1968-69 Vol . I.

3/ Data from Range Officer, Forest Department, Kalaw.

2 . Pine mortality

In September, 1980, at the same time when pine trees in the same area were affected by yellowing of needles, a large number of trees were found dead in natural stands (P1. II., fig. 3) as well as in 15 year old plantations (P1. II., fig. 4). A larger number of dead trees were found in natural stands, and mortality occurred randomly among individual trees rather than in large patches or area, and was not confined to either hilltops, slopes, or valleys. The dead trees were sooty black in appearance. Examination of the soil on which the affected trees stood in four different places showed the shallowness of the red clay topsoil layer under dead trees; the top soil layer under healthy trees was found to be considerably deeper. Closer examination showed that secondary fungal and insect attacks were already beginning to set in on the dead and dying trees, and larvae of a Cerambicid borer was found in some dead trees which were in turn found to be preyed upon by Cicindelid larvae.

PLATE II

Fig. 3. 25–30 year-old dead *P. khasya* trees among healthy ones in a natural stand near Kaliw in September, 1980.

Fig. 4. Dead *P. khasya* trees among healthy ones in 15-year-old plantation near Kaaw in December, 1980.

Table 2. Yields of *P. khasya* in the Southern Shan State Forest Division during the period 1970-83 1/.

No.	Year	Tons extracted
1.	1970-71	3040
2.	1971-72	3007
3.	1972-73	6962
4.	1973-74	1679
5.	1974-75	2176
6.	1975-76	2026
7.	1976-77	3025
8.	1977-78	3026
9.	1978-79	7769
10.	1979-80	14483
11.	1980-81	16719
12.	1981-82	9107
13.	1982-83	4932

1/ Data from Extraction Department, Timber Corporation.

Pine regeneration, however, appeared normal at the time in places in this forest where no fires occurred, but this may have been due to low moisture requirement of the wildlings in their still very early stages of development.

Discussion

These findings appear to indicate as in the case pine needle yellowing that natural factors such as unfavorable patterns in rainfall, temperature and soil characteristics among others which occurred during the period possibly produced stress in the trees weakening them physiologically; this may have led the trees to exhibit abnormal characteristics and probably to death in extreme cases.

3. Resin tapping

In September, 1980, both authorised and unauthorised resin tapping from healthy trees were observed in natural *P. khasya* stands the Kalaw area where dead trees were also present. Several trees of about 30 in. girth with two, in one case even three, blazes on them were observed growing healthily about 20 ft. away from dead trees with no apparent injury at the time . Normally, only one blaze of about a foot across is allowed on a tree with 36 in. minimum girth in authorised resin tapping limit, however, had been changed from time to time.

Examination of the topsoil layers under dead and healthy trees showed a similar condition as in cases 1 and 2, and since the examinations were made at the same time and in the same general area, the similar combination of unfavorable natural factors as in cases 1 and 2 also prevailed in this case.

PLATE III

Fig. 5. Needle browning due to burning of debris for heat to stimulate rapid collection of resin at chipping site. Note fire scorching and large scar at chipping site.

Fig. 6. Pine mortality due to "lightwood" chipping. Note closeness of living and dead tree.

4. "Lightwood "chipping

In some areas of the natural forests around Kalaw, dead trees with girths of about 14-18 in. and apparently dying tress with similar girths bearing brown needles on the basal parts were observed alongside luxuriantly growing trees with similar girths (P1.III, fig 6). Closer Examination of the dead trees showed large scars and scorching by fire at about 1-4 ft. from ground level (P1.III, fig 5). The scars were found to be caused by extremely heavy chipping for " lightwood" which is used in starting kitchen fires. The scorched basal parts of the trees. (P1.III, fig 5). were found cased by burning of twigs and debris at the base of the trees for heat to stimulate rapid collection of resin at chipping sites. Browning of needles (P1.III, fig 5).on the apparently dying trees were found to be caused by the rising heat from these fires.

PLATE-IV

Fig. 7. 17-year-old *P. khasya* plantation being heavily attacked by Lepidopterous insects in July, 1982.

Fig. 8. *P. khasya* trees in 17-year-old plantation recovering from heavy defoliation by Lepidopterous insects.

Discussion

So far, no insect has been found to be directly connected with either needle yellowing or mortality in *P. khasya* during the series of observations made in September and December, 1980. Although the evidences were circumstantial, they appear to indicate that insects or diseases were not primarily responsible for the occurrence of abnormal characteristics and moralities in *P. khasya* in the area during 1979 and 1980.

5. Defoliation by insects

In October, 1981, and again in July, 1982, severe defoliation by alepidopterous insect was observed in wide areas covering hundreds of hectares of 16 and 17 year old *P. khasya* plantation. The brown-haried larvae were identified as early and late stages of *Metanastria letipennis* (Lepidoptera; Lasiocampidea). In some areas, newly attacked trees were observed to be browning off beginning from the bases of the branches (P1.IV, fig 7) with the browning advancing towards the tips as the attack went on. But at the same time in other areas, new leaves were issuing from trees that were totally devoid of mature leaves (P1.V, fig 8); closer examination indicated that these trees were recovering from total defoliation due to severe insect attack.

Discussion

The presence of both early and late larval stages of the month in the same general area during the same period of time indicated that natural conditions such as distribution of rainfall , and temperature that prevailed all along the epidemic period were highly favorable for rapid insect multiplication; conditions such as heavy rainfall for a very short duration coupled with abnormally high temperatures produce high humidities that are known to be favorable for rapid insect multiplication. These coupled with weakness in the trees caused by factors indicated in cases 1, 2, 3 and 4 could possibility have helped develop what began as a limited insect attack into a severe epidemic. Investigations showed that although mortalities occurred among affected trees, the percentage was small, and a large proportion recovered to resume apparently normal growth.

6. Factors influencing tree health and insect multiplication.

Health and growth of trees are influenced by natural factors such as rainfall, temperature and soil characteristics. Multiplication of insects is also affected by rainfall or humidity and temperature, though in a reverse manner. This implies that while abnormal patterns in rainfall and temperature such as long rainless intervals between heavy showers and high temperature as well as poor soil characteristics adversely affect vigour and growth of trees sometimes leading top death in extreme cases, the former two factors hasten the metabolic activity of insects, shorten the life cycle enable more generations of insects to attack already weakened trees. Long term studies to gain knowledge on tree vigour, growth characteristics, bud and leaf structure 1/ , resin canals 2/ , starch content, and pore diameter 3/ of wood should be made since all these factors are related to tree health, and therefore, to the susceptibility to attack by insects. Similarly, research on tree physiology, soil structure, soil composition, and climatic influences should be conducted as facilities warrant since these factors are also related to tree health and influence susceptibility of trees to insect attack. On the other hand, various forestry practices may be the cause of problems involving insects, and therefore, experimentation in forestry science and practices may provide the explanations of, or the remedies for insect problems. Therefore, it is obvious that intricate relations exist between forest entomology and different aspects of forestry besides other natural as well as artificial factors, and these relations should be studied as circumstance permits.

1/ Bennet, W.H. (1959). The effect of needle structure upon the susceptibility of hosts to the pine needle miner (*Exoteleia pinifoliella* (Chamb)) (Lepidoptera: Gelechiidae Can. Ent. 86 (2) : 46-54.

2/ Harris, P (1960). " Production of pine resin and its effect on survival of *Rhyacionia buoliana* (Shiff.) (Lepidoptera : Olethrentidae)" . Can. J.Zool. 38 : 121-130.

3/ Snyder, T.E. (1916). "Egg and manner of oviposition of *Lystus planicollis."* J. Agric. Res. 6 (7) : 273-276 + pl:

7. Recording of Meteorological data

Precise recording and monitoring of meteorological data should be carried out by local Forest Department personnel in each jurisdiction. The data should be relayed to all State and Divisional Forest Department offices, to the office of the Director-General, Forests Department and to the Forest Research Institute to compute and forecast any adverse events such as insect outbreaks and drought conditions in plantations and natural forests alike. These forecasts should be relayed to Forest Department offices in States and Divisions concerned so that adequate precautionary measures can be taken in advance.

8. Insecticidal control

Although insecticides are readily available, there is a lack of specialised application equipment. To apply insecticides in a situation like the present one in which plantations of 17 year old pines are involved, ground equipment capable of reaching 60-70 ft. in height become necessary. Both chemicals and equipment must be imported at great cost. But as plantation acreages increase, means of direct pest control become increasingly necessary to enable immediate action before environmentally acceptable long term preventive and control alternatives can be developed. Insecticides provide one of the most effective and versatile means of obtaining quick protection from insects. But they are not appropriate to be used in certain situations, and they must be correctly tested and chosen, properly handled and applied to obtain maximum benefit. There may also be undesired effects such as damage to beneficial parasitic and predaceous insects and mites, bees, birds, fish and other aquatic animals. Furthermore, insecticides do not strike at the underlying causes of insect outbreaks (tree vigour, soil characteristics, rainfall, temperature and factors influencing them) and do not guarantee to prevent a recurrence of similar outbreaks later.

9. Salvaging of dead and drying trees

In severe insect attacks where no direct control can be undertaken, rapid salvage operations may be called for before deterioration becomes advanced resulting in total loss. But the amount and distribution of material to be salvaged must be known before the size of salvage requirements, ease of access, and length of salvage programme can be judged. Salvage may be impractical when damage is dispersed.

10. Fire protection

Resin tapping and lightwood chipping among other factors appear to be the direct causes of fires in natural pine forests, and these fires almost certainly are the main causes for poor pine regeneration in this area. Absence of a dense ground cover of young plants and a thick layer of fallen needles cause rapid soil leaching and erosion leading to undesirable ecological disturbances. Therefore, research on fire protection in pine forests of the area appears to be very mush needed to enable formulation and enforcement of strict fire protection regulations.

11. Timber extraction and reforestation

Burma traditionally practices a conservation - oriented timber extraction policy, but this has not prevented a decline in yields and consequently has caused overcutting in the country's most accessible areas to meet extraction targets. Therefore, projects are being

implemented which aims at building up timber resources through reforestation and better silvicultural practices while increasing timber extraction..

Table 3. *P. khasya* stock in Kalaw Reserve and Kalaw Extension reserve taken in 1929 1/.

8"-12"	12"-16"	16"-20"	20"-24"	24"-28"	28"-32"	32"& over
38,295	31,813	31,025	19,025	6,071	1,255	234

Table 4. Yields of *P. khasya* from Kalaw reserve and Kalaw Extension Reserve during the period 1912-1925 2/.

No.	Period	Yield (tons)
1.	1912-13 to 1913 -14 (1 yr.)	1,063
2.	1914-15 to 1918 -19 (5 yr.s)	596
3.	1919- 20 to 1923 -24 (5 yrs.)	342
4.	1924 - 25 to 1925 -26 (2 yrs.)	775

1/-, 2/ Data from " Working Plans for Kalaw Reserve and Kalaw Extension Reserve for the period 1929- 30 to 1938-39 " Vols. I and II.

P.khasya extraction has been observed to have greatly increased in the past few years beginning from 1978-79 extraction year (Table 2) (very low annual rainfall and high average monthly temperature also occurred in Kalaw area during this year), but recent data on stockings of this species is unavailable. Acreage of pine plantations established in the Southern Shan State during the period between 1921 and 1976 totaled 605 1/; data on pine plantations in the year following 1976 was unavailable. Stockings of *P. khasya* in the Kalaw area in 1930 2/, and yields for the same area during the year 1912 -1926 3/ are given in tables 3 and 4 for comparison.

Pine reforestation projects, however, are being implemented in Kalaw area with a 1983-84 target of 100 acres increasing progressively to 2000 acres per year to total 6,500 acres in 1987-88.

1/- Data from Working Plans Office Forest Department, Burma

2/, 3/ Edwards, F.G and Nixon. N.B. (1930). Working Plans of Kalaw Reserve and Kalaw Extension Reserve for the period 1929- 30 to 1938-39 " Vols. I and II.