

## SURVEY OF HIMALAYAN DWARF MISTLETOE IN THE UPPER KAGAN FORESTS

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**Abstract.** A survey of the Upper Kagan forests revealed the occurrence of Himalayan dwarf mistletoe on blue pine growing in the temperate forests of Bura-wai, Batakundi and Naran. The infested areas lie all along the left bank of Kunhar river from Jaba to Naran; the road distance being about 39 kilometres. The mistletoe infection was also observed across the river. The incidence of the parasite was 56%. It was found to increase, generally, with tree size. The infection rating for the stand was 2.7.

**Introduction.** The dwarf mistletoes (*Arceuthobium* spp.), a specialised group of plants, parasitise conifers growing all over the world. These mistletoes are recognised as biodegrading agents of forest trees which compete with the hosts for water and mineral requirements. They adversely affect growth, vigour and seed development of the infected trees, weakening them to become vulnerable to many other diseases and insect pests ultimately leading to their premature death. A study carried out on juniper dwarf mistletoe (Zakaullah and Badshah, 1977) in the Sasnamana state forest of Baluchistan indicated that the frequency of the parasite was fairly high and the mortality was quite heavy among the sampled trees.

Coniferous forests of Kagan occupy an area of about 56,801 hectares out of which more than 75% is covered by temperate forests including Moist and Dry Temperate Forest Types (Champion, Seth and Khattak, 1965). Four important timber species, i.e., blue pine (*Pinus wallichiana*), deodar (*Cedrus deodara*), silver fir (*Abies pindrow*) and spruce (*Picea smithiana*) are found naturally growing in the area. They frequently occur as mixed crops. However, they may occasionally be found to grow as pure stands. The present study was undertaken in the dry temperate forests of Upper Kagan, Kagan Range, Kagan Forest Division to determine the incidence, abundance of inoculum and infestation limits of the Himalayan dwarf mistletoe.

**Review of Literature.** No information is available on the systematic survey of Himalayan dwarf mistletoe (*Arceuthobium minutissimum*) in the Upper Kagan forests. However, the occurrence of the parasite has been reported on blue pine growing in the Batakundi (Nasir and Ali, 1972) and Naran (Jamal and Beg, 1974) forests.

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**Material and Methods. Survey Procedures.** Information was collected from local forest staff, on all levels, through showing them samples and making them understand the symptoms such as the presence of mistletoe plant, witches' broom and spindle-shaped swelling on the infected branch. Maps of forest divisions and ranges were studied for locating roads and paths, passing through main forest areas and, on ridges.

(a) *Surveys.* Reconnaissance: Observations were recorded by walking along the sides of the forest roads and paths and entering into the interior after every 1.609 kilometres or roughly 20 minutes walk upto 60–80 metres at right angles to the road or path in alternating manner. Similarly, infested trees were spotted from ridges with the help of telescope.

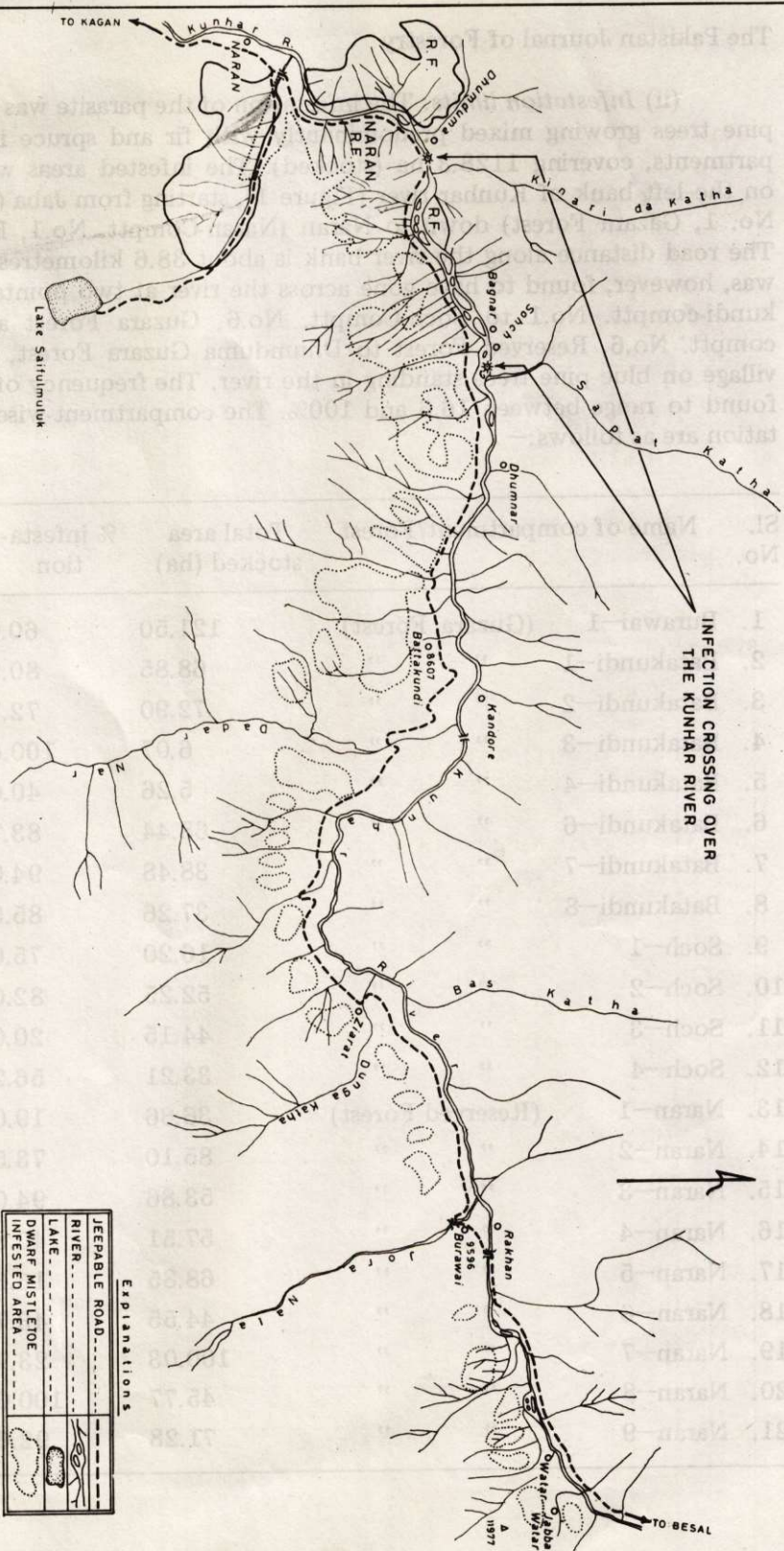
(b) *Intensive:* Infested compartments were surveyed by taking 0.5% area along inspection or bridal paths. In case, where no path was available, the study plots of 60x15 m size were laid along the compartment boundary or along a line-transect running through the centre of the compartment at regular intervals. The data on aspect, elevation, slope, tree species, crown class, dbh, height and vigour were recorded in respect of each sample tree beside noting down important symptoms caused by the parasite.

The 6-class infection rating system described by Hawksworth and Lusher (1956) was used for living trees. For this, the crown was divided into thirds, each third rated as: (0) no visible infection; (1) light infection ( $\frac{1}{2}$  or less of total number of branches in the third infected) and (2) heavy infection (more than  $\frac{1}{2}$  of the total number of branches in the third infected). The ratings for each third were added to obtain rating for the stand.

**Results.** (i) *Occurrence and incidence of attack:* The survey showed that the Himalayan dwarf mistletoe was parasitising blue pine trees in the temperate forests of Burawai, Batakundi and Naran, Kagan Forest Division. Out of 71 sample plots studied, 48(57.7%) were found infested. Of the 624 study trees, 350 (56.1%) had the attack of the parasite. The incidence of attack was found to increase, generally, with increase in the diameter of the tree as follows:—

| Dbh class<br>(cm) | Number of<br>plants studied | Plants infected with mistletoe |      | Infection rating |
|-------------------|-----------------------------|--------------------------------|------|------------------|
|                   |                             | No.                            | %    |                  |
| 0– 20             | 121                         | 39                             | 32.2 | 1.4              |
| 21– 40            | 125                         | 59                             | 47.2 | 2.3              |
| 41– 60            | 84                          | 57                             | 67.8 | 3.6              |
| 61– 80            | 131                         | 85                             | 64.8 | 3.2              |
| 81–100            | 119                         | 84                             | 70.6 | 3.3              |
| 101–120           | 37                          | 23                             | 62.2 | 3.1              |
| 121 and +         | 7                           | 3                              | 42.9 | 1.0              |
| Total:            | 624                         | 350                            | —    | —                |
| Average:          | —                           | —                              | 56.1 | 2.7              |





Map of Upper Kagan forests of Naran, Batakundi and Burawai showing the limits of Himalyan dwarf mistletoe infestation

Fig. 1



(ii) *Infestation limits*: The infestation of the parasite was recorded on blue pine trees growing mixed predominantly with fir and spruce in 21 forest compartments, covering 1128.3 ha (stocked). The infested areas were found to lie on the left bank of Kunhar river (Figure 1), starting from Jaba (Burawai-comptt. No. 1, Gazara Forest) down to Naran (Naran-Comptt. No.1, Reserved Forest). The road distance along the river bank is about 38.6 kilometres. The infestation was, however, found to have gone across the river at two points, i.e., from Batakundi-comptt. No.1 to Soch-Comptt. No.6, Guzara Forest and from Naran-comptt. No.6, Reserved Forest to Dhumduma Guzara Forest, near Dhumduma village on blue pine trees standing in the river. The frequency of the parasite was found to range between 16.6 and 100%. The compartment-wise details of infestation are as follows:—

| Sl. No. | Name of compartment/Forest | Total area stocked (ha) | % infestation | Average infection rating |
|---------|----------------------------|-------------------------|---------------|--------------------------|
| 1.      | Burawai-1 (Guzara Forest)  | 121.50                  | 60.0          | 3.1                      |
| 2.      | Batakundi-1 " "            | 68.85                   | 80.9          | 4.2                      |
| 3.      | Batakundi-2 " "            | 72.90                   | 72.7          | 2.9                      |
| 4.      | Batakundi-3 " "            | 6.07                    | 100.0         | 5.7                      |
| 5.      | Batakundi-4 " "            | 5.26                    | 40.0          | 1.0                      |
| 6.      | Batakundi-6 " "            | 68.44                   | 83.7          | 4.7                      |
| 7.      | Batakundi-7 " "            | 38.48                   | 94.0          | 4.4                      |
| 8.      | Batakundi-8 " "            | 37.26                   | 85.5          | 3.4                      |
| 9.      | Soch-1 " "                 | 16.20                   | 75.0          | 3.0                      |
| 10.     | Soch-2 " "                 | 52.25                   | 82.0          | 3.4                      |
| 11.     | Soch-3 " "                 | 44.15                   | 20.0          | 1.0                      |
| 12.     | Soch-4 " "                 | 33.21                   | 56.2          | 3.1                      |
| 13.     | Naran-1 (Reserved Forest)  | 36.86                   | 19.0          | 0.9                      |
| 14.     | Naran-2 " "                | 85.10                   | 73.5          | 3.6                      |
| 15.     | Naran-3 " "                | 53.86                   | 94.0          | 5.2                      |
| 16.     | Naran-4 " "                | 57.51                   | 40.6          | 1.9                      |
| 17.     | Naran-5 " "                | 68.85                   | 16.6          | 0.5                      |
| 18.     | Naran-6 " "                | 44.55                   | 43.7          | 1.7                      |
| 19.     | Naran-7 " "                | 100.03                  | 23.7          | 1.2                      |
| 20.     | Naran-8 " "                | 45.77                   | 100.0         | 4.4                      |
| 21.     | Naran-9 " "                | 71.28                   | 92.6          | 5.9                      |





Figure 2.— A blue pine tree infected with *Arceuthobium minutissimum*.

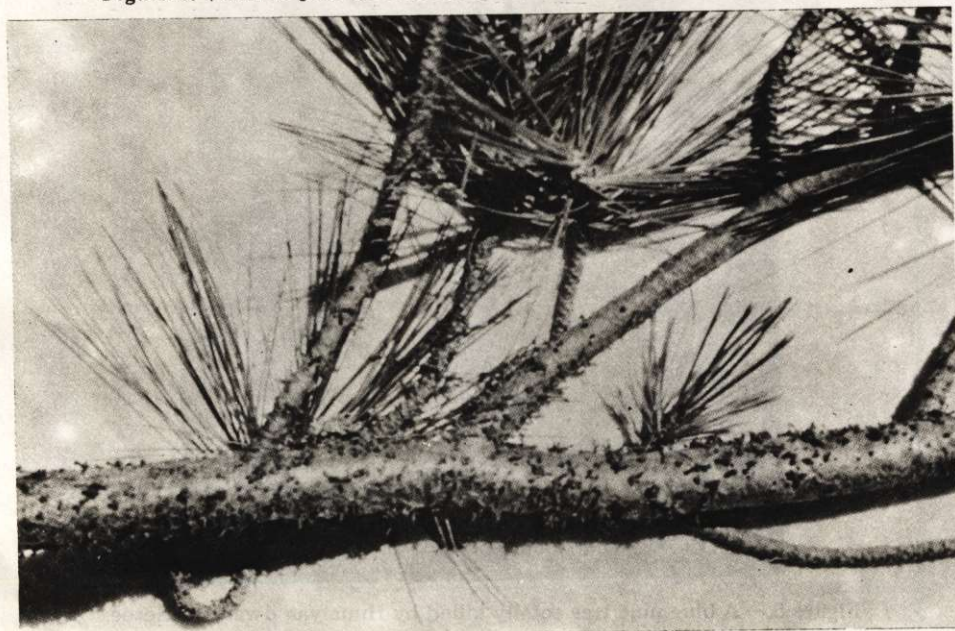


Figure 3.— Pistillate plants of *A. minutissimum* growing on a blue pine branch.





Figure 4.— Heavy dwarf mistletoe infection showing deterioration of the forest stand.



Figure 5.— A blue pine tree totally killed by Himalyan dwarf mistletoe.



(iii) *Symptoms*: The most conspicuous symptom of dwarf mistletoe infection was the witches' broom, the growth of abnormal branching habit often with usually dense foliage (Figure 2). The first sign of infection, however, may be a fusiform swelling and the parasite forming aerial shoots (Figure 3).

(iv) *Effects on host*: The heavy dwarf mistletoe infection was found to deteriorate the host stand. The foliage of the heavily infected trees was lighter green than those of healthy ones (Figure 4). The volume of crown was also found markedly reduced. The mortality of the host, due to mistletoe attack, was found to be uncommon (Figure 5).

**Discussion and Conclusions.** The incidence of Himalayan dwarf mistletoe was only recorded on blue pine occurring in the dry temperate forests of Upper Kagan. The attack of the parasite was observed in the forest areas of Burawai, Batakundi and Naran lying on the left bank of Kunhar river. The mistletoe infection was also found to have crossed over to the right bank, at a couple of points. The delay in the spread to other side may be partly due to the river acting as a natural barrier and partly due to the absence of host plants (Khan, 1970). The frequency of the dwarf mistletoe was 56.1%. It was found associated with size of the tree as also reported by other workers (Hawksworth, 1962; Zakaullah and Badshah, 1977). The average infection rating of 2.7 shows that the mistletoe has great inoculum potential for further spread in the area. The witches' brooms were the diagnostic features indicating the dwarf mistletoe infection from long distances. The rate of mortality of the host was recorded to be very low. This may be because the trees totally killed by the parasite, generally, fall prey to wind throw etc. and are removed.

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