Problems of Pest Assessment: Forestry Pests

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The problems of assessment of forest pests fall clearly into two categories: (1) The assessment of the insect population; (2) The assessment of the effect of that population on the tree's growth.

The insect's effect is usually channelled through an intermediary stage, for example defoliation or root damage, which then subsequently causes increment loss. In this case it is necessary to define an insect population, its effect on, say, foliage loss, and then relate defoliation to timber loss. Few studies reported in the literature have looked at all these levels of assessment. Usually forest pests are either studied from the insects' or entomologist's point of view, in which case the insect will be adequately studied, or the problem is looked at from the trees' or forester's point of view and timber increment is quantified, but not the insect population causing the initial damage. From the point of view of the forest industry the initial work must be concerned with crop loss assessment, otherwise it is impossible to justify the level of control measures or research investment for a particular problem.

In forestry, compared with agriculture or horticulture for example, rotation periods are long and it is convenient to consider the problems of pest and impact assessment in four phases: (1) Growth of the seedlings in the nursery; (2) Establishment of crops in the forest; (3) Growth and maturation of the forest; (4) Harvesting of produce and land preparation for replanting.

High investment levels and the vulnerability of the trees to low populations of insect pests in nurseries dictates the regular use of insecticides and hence the lack of problems of assessment for the entomologist.

Insects can affect establishment success in two ways: by causing seedling mortality or by reducing height growth. Mortality is readily assessed, but the causes of death not always easily seen. Factors such as seedling health, which can be measured by root growth and resin response to insect attack, must also be taken into account. Reduction in height growth may mean suppression, lengthening of rotation period or costly releasing. With defoliation damage that is caused by Heliothis armigera in February and March on young seedlings, for example, it is possible to predict the growth of seedlings by estimating defoliation levels and terminal bud damage (Alma 1973). Height growth is most affected by terminal bud damage and the incidence of bud damage increases with defoliation. Generally seedlings a year old can withstand a foliage loss of over 50% without bud damage and up to 50% with bud damage before they are likely to be suppressed.

In the growth and maturation phase New Zealand is fortunate in having few pests that require assessment. Two basic pieces of information are required to assess insect impact on foliage. These are the distribution of foliage on the tree and the distribution of the insects on the branches and within the canopy of the tree. If this information is available it is possible to put forward stratified sampling techniques to sample accurately the foliage and the insects on it (Morris, 1954). Some of the difficulties that may appear are: changes in foliage distribution caused by the insect population, changes in the population due to variation in nutrient levels in the foliage or due to the interaction between individuals at different densities, and changes in the distribution of the insects in the canopy as their populations fluctuate. There is also the physical problem of tree size to overcome — it may be necessary to sample up to 60m above ground level.
Actual timber losses caused by debilitating insects (e.g. scale insects, aphids, defoliators) are notoriously difficult to estimate. Many of the effects may not show up immediately; subtle changes in tree taper are often apparent, and variation in increment at breast height or even within the actively growing canopy may not show up until 2, 3 or 4 years after an insect outbreak (for example see Dixon 1971; Blais 1958). To adequately demonstrate the effect of insects on tree growth it is necessary, as in all forms of scientific research, that insect free controls be used. It is surprising how infrequently this type of evidence has been provided in the literature, when it could give unequivocal evidence of the amount of damage and timber loss being sustained.

The harvesting phase of forestry, and the subsequent preparation for planting the next crop, also has its problems. Insects may degrade stockpiled logs or render export produce liable for fumigation (forest produce containing or carrying living insects is a prohibited export). Most of the problem insects (e.g. Prionoplus reticularis, Hylastes ater, termites, etc.) breed in stumps and logging waste. Attempts are being made to assess the insect populations that emerge from waste after different clearfelling methods and land preparation techniques (such as burning, windrowing, total utilization of large diameter material, etc.) have been carried out. Populations of emerging adults may be monitored by interception traps. These will indicate the treatment method which will lead to the lowest numbers of pests and will also serve as an early warning system so that operations can be modified during critical mass flight periods. Attack on stockpiles can also be reduced from knowledge of the behaviour of the insects. Material in ground contact is most susceptible to attack. Contact can be readily avoided, and attack greatly reduced, simply by piling logs on skids.

It is the forest entomologist’s job to draw together the entomologist’s studies on the insect pest and the forester’s studies on timber production losses to demonstrate to forest management where the problems lie and how much productivity is being lost. With this type of information it is then possible to justify further research investment and decide whether it is economically feasible or necessary to apply control measures. The information gathered will also be useful in assessing the success of any control measures that are applied.

A satisfactory introduction to the subject of forest pest assessment and its literature may be found in Funke (1971), Knight (1967), Kozlowski (1969), Kulman (1971), and Rafes (1971).

REFERENCES