The Tasmanian *Eucalyptus* Leaf Beetle, *Chrysophtharta bimaculata* : An Overview of the Problem and Current Control Methods

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Abstract

Chrysophtharta bimaculata *is a leaf eating beetle capable of causing extensive damage to the eucalypts grown commercially in Tasmania. Although it has been tolerated in the past, the increasing number of plantations in Tasmania have elevated the status of this pest to one capable of causing unacceptably high economic damage. Research is being carried out to develop an effective and environmentally safe means of control.*

Biology and Life History of *Chrysophtharta bimaculata*

C.bimaculata is a dome-shaped beetle approximately 9 x 7mm in size. It is easily recognisable by the two black markings on the pronotum (Figure 1). Live adults are variable in colour, changing from pale green (summer coloration) to a dark red brown in winter. The life history of this insect has been decribed by Greaves (1966) and deLittle (1983). The beetle is not commonly seen during the winter months, as this time is spent in hibernation under bark or in the cracks of dead wood. In spring the adults leave their overwintering sites and congregate on young foliage. On warm sunny days large numbers can be seen flying and feeding, but when the weather is cool or windy they seek shelter.

Egg-laying usually occurs in two peaks, the first in late spring (late Nov/Dec) the second in late summer (late Jan/Feb), although the intensity and timing varies according to location and seasonal factors. Eggs are laid in rafts on young foliage and hatch in eight to eleven days. The larvae (Figure 2) are dark green to black and are grub like in appearance. There are four larval instars, each lasting four to six days under average field conditions. The larvae are highly gregarious and form large feeding groups.

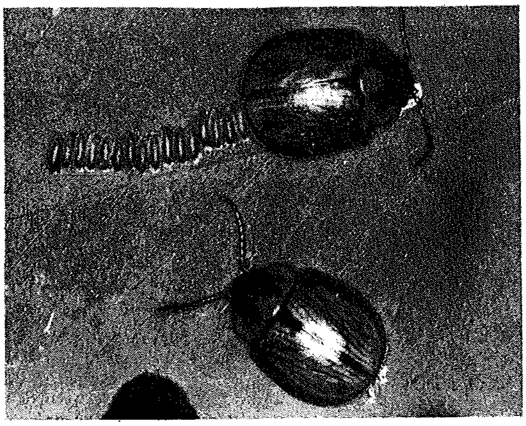

FIGURE 1:
Adult *Chrysophtharta bimaculata* with an egg batch

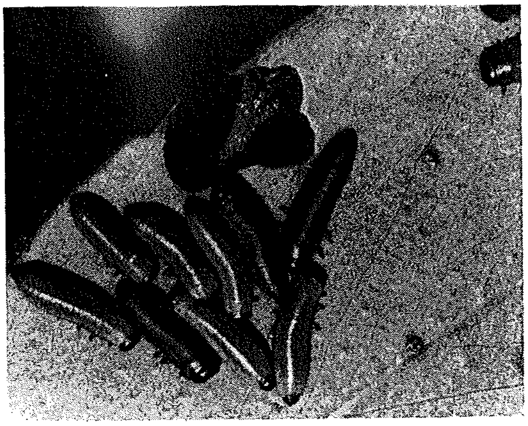

FIGURE 2:
Larvae of *C.bimaculata*

Larval feeding damage is distinctive as whole young leaves are consumed, causing the top of badly affected trees to develop a twiggy, broom-topped appearance. All four larval instars feed, but the majority of damage is due to the older larvae. It has been estimated that approximately 90 per cent of an individual larva's food intake occurs during the third and fourth instars (Greaves 1966).

At the completion of larval growth (approximately one month after egg laying) the larvae fall to the ground and form prepupal cells in leaf litter. Pupation occurs after five to nine days, and new adults emerge 12 to 15 days later. By April, all larval activity has been completed, and the majority of adults have found overwintering sites, although in some areas adults may be seen as late as May.

Effects of *C.bimaculata* on Tree Growth

The tree species preferred by *C.bimaculata* belong to the ash group of eucalypts (e.g. *E.regnans*, *E.obliqua*, and *E.delegatensis*) of Tasmania's wet sclerophyll forests, but the adult foliage of *E.nitens* is also susceptible to attack.

FIGURE 3
A young *E.regnans* tree following moderate defoliation by *C.bimaculata* larvae. Note the preference for new season's foliage, which results in a twiggy, broom-top appearance at the top of the tree and ends of lower branches.

Extensive regeneration and plantation establishment practices provide large, relatively uniform stands of young trees of the insects' preferred food source, not unlike the natural regeneration stands that *C.bimaculata* commonly exploits. Although mature trees are attacked by this species (Kile 1974), young trees are particularly vulnerable to defoliation damage, as they have neither the resources (i.e. a large leaf area) or reserves to easily recover. In addition, as *C.bimaculata* has a preference for young foliage, damage to the buds and leaders results in poor form development.

As illustrated in Figure 3, larval feeding by *C.bimaculata* can result in the loss of a large proportion of a tree's new season growth. This loss of foliage not only represents the amount of growth physically lost, but as growth rate is proportional to a tree's photosynthetic capacity (i.e. leaf area) it brings about a reduction in the rate at which the tree can recover and grow. Initial studies in which trees protected with insecticide were compared to trees subjected to natural chrysomelid attack showed that even low larval population levels resulted in a substantial reduction in tree growth over one season (Figure 4).

In cases where chrysomelid defoliation is repeated over several seasons, the damaging effects are more obvious. The repeated removal of apical buds promotes lateral growth and results in poor tree form. Dieback, and even tree death can occur in severe cases. Quantitative data on these effects are currently being accumulated.

The significance of the chrysomelid problem becomes apparent when it is considered in economic terms. The loss of tree form results in timber being downgraded and slow growth rates lead to a longer rotation time than may otherwise be necessary. When plantations are involved, the economic loss

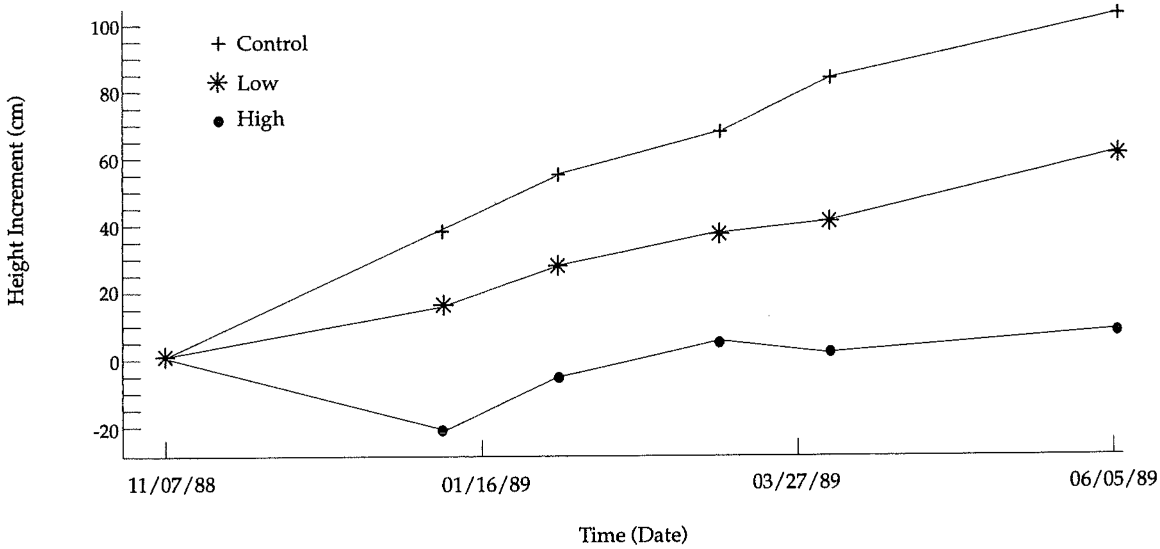

Figure 4
Effect of *C.bimaculata* browsing on height growth of *E.regnans*.
(•HIGH and * LOW represent the average height increment of trees browsed by high and low larval population levels in mid-December. + CONTROL represents the average height increment of trees protected against chrysomelid attack).

Table 1: Stage Specific Mortality of *C.bimaculata* *

Stage	**Average number/shoot**	**Cumulative percentage reduction of *C.bimaculata* population**
eggs	62.5	84 %
1st instar larvae	10.1	85 %
2nd instar larvae	9.1	94 %
3rd instar larvae	3.9	97 %
4th instar larvae	1.7	

* data from deLittle, D.W., Elliott, H.J., Madden, J.L. and Bashford, R. *J. Aust. ent. Soc.* (in press)

can become unacceptable, considering the high establishment costs involved. As the number of plantations in Tasmania is increasing, it has become necessary to develop a means of controlling *C.bimaculata.*

Developing a Control Strategy

C.bimaculata has a number of natural enemies. Eggs and young larvae are predated by ladybirds (Greaves 1966, Elliott and deLittle 1980), soldier beetles and other insects. Larvae are parasitized by tachinid flies (deLittle 1982) and can be dislodged by bad weather (Greaves 1966). Although these agents are not always capable of maintaining *C.bimaculata* populations at non-damaging levels, they do cause very significant mortality. Those larvae parasitized by tachinids do not die until after fourth instar feeding has occurred, but the majority of natural mortality (mainly due to predation) occurs during the egg and early larval stages. This is illustrated in Table 1.

This substantial natural reduction is utilised in the theoretical strategy of integrated control. This strategy makes use of the natural biological control, which in some cases may be large enough to make artificial control measures unnecessary. If after this has occurred, the population is observed to still be large enough to cause economic damage, artificial control measures are introduced. This strategy aims to restrict artificial control to those situations where it is necessary. The majority of feeding damage is due to the third and fourth instars, thus spraying is not necessary until just before this point, allowing time for natural population reduction to take place.

At present, aerial application of chemical insecticides is the most effective means available for large scale *C.bimaculata* control. However, many such agents are non selective in their action, having the potential to kill animals other than the target insect (e.g. other insects, fish) and even being dangerous to humans unless caution is exercised. Current research is aimed at finding an effective control agent which is as 'environmentally safe' as possible. A commercial preparation of *Bacillus thuringiensis* var san diego is being trialled. This is a naturally occurring bacterium that is harmful only to beetle larvae feeding on material contaminated with the bacterial spores. It is most effective against beetles of the chrysomelid family. Because of this specificity, *C.bimaculata* predators and other non-target organisms should not be affected. It is also safe to humans, and can be aerially applied as a conventional insecticide. It is not yet clear whether or not *B.thuringiensis* will be an effective control agent for *C.bimaculata,* so it and other agents are being evaluated.

Population Monitoring

Integrated control is effective only when the given population is closely monitored. This monitoring will enable forest managers to determine:-

a) whether or not the population requires artificial control measures, and

b) the optimum time to apply these measures (i.e., when the majority of larvae are of the second instar; after the majority of predation has occurred and before the majority of feeding damage has commenced).

Fortunately, *C.bimaculata* populations usually but not always develop synchronously; this enables the easier prediction of a population's development, provided monitoring is carried out. In synchronously developing populations, the majority of larvae are of the second instar two to two and a half weeks after egg-laying.

It is important that field staff are aware that the optimum spraying time occurs before the problem becomes apparent, i.e. before defoliation occurs. It is essential that susceptible stands are closely monitored in Nov/Dec and Jan/Feb. Close inspection of foliage in stands with a developing *C.bimaculata* problem will reveal eggs and/or young larvae, and thus indicate that control measures may be necessary.

A sampling system is currently being developed to enable field staff to easily assess whether or not a given population is large enough to warrant control.

Conclusions

C.bimaculata can have severe effects on tree growth if large populations are allowed to develop unchecked.

The key to successful *C.bimaculata* control is awareness and monitoring. Outbreaks must be detected and controlled before damage takes place. In November each year susceptible stands should be monitored for egg populations; a decision can then be made regarding the necessity for control. Silviculture staff with experience of *C.bimaculata* can be contacted if general *C.bimaculata* information is required, or to advise if control is warranted for a given population.

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