SHORT NOTE

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Feeding of the adults of the large pine weevil, *Hylobius abietis* (Coleoptera: Curculionidae)

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Abstract. The adult feeding of *Hylobius abietis* on five tree species, *Pinus sylvestris*, *Picea abies*, *Betula pendula*, *Fraxinus excelsior* and *Acer pseudoplatanus* was compared in no-choice tests. *P. sylvestris* was consumed in significantly greater quantities than any of the other species, the order of preference being *P. sylvestris*>>*B. pendula*>>*P. abies*>>*F. excelsior*>*A. pseudoplatanus*. In spite of being a broad-leaved tree, *Betula pendula* was consumed more than the coniferous *P. abies*, although a high proportion of insects did not feed on *B. pendula*.

Introduction

The large pine weevil, *Hylobius abietis* (L.) (Coleoptera: Curculionidae) is the most serious pest of establishment forestry in the UK, causing over £ 500,000 damage to coniferous forests each year (Heritage et al., 1989).

Adult weevils have been observed to feed on some broad-leaved tree species (Scott & King, 1974), although its larval (Munro, 1928) and adult feeding preferences appear to be for coniferous trees (Leather et al., 1994). It appears that some conifer trees are more suitable as hosts for *H. abietis* (e.g. *Pinus sylvestris*) than others (e.g. *Picea abies*), (Bejer-Petersen et al., 1962). Volatile compounds from host coniferous trees, particularly from freshly cut timber or sawdust piles attract adult weevils (Selander et al., 1973).

Control of *H. abietis* is difficult as the adult weevil is capable of long distance migration to colonise new areas (Solbreck & Gyldberg, 1979; Solbreck, 1980). This type of migration occurs when the weevils emerge from the pupal stage to seek fresh habitats (Solbreck, 1980). This difficulty in control is compounded as the larval stage lives inside the wood of the tree stump (Scott & King, 1974), where it is difficult for insecticides to penetrate.

At present, broad-leaved trees are planted around blocks of coniferous crop stand. These blocks of conifers present the weevil with a large attractive site for feeding and could attract migrating weevils. If a more mixed forest design was approached, it is likely that some of the damage caused by *H. abietis* could be reduced (Leather et al., 1994). Before such a strategy is implemented it is important to investigate further the feeding behaviour of *H. abietis* on deciduous and coniferous trees. This paper investigates feeding of *H. abietis* adults on three species of deciduous trees and two coniferous tree species.

Material and Methods

The adult weevils used in the following experiment were trapped using billet traps (Nordenhem, 1989) on a Forestry Commission clear-fell site in Crowthorne Woods, near Bracknell, Berkshire, UK.

Freshly cut twigs (3 cm long, 1 cm diameter) of the conifers *Pinus sylvestris*, *Picea abies* and the deciduous *Betula pendula*, *Acer pseudoplatanus* and *Fraxinus excelsior* were cut and twenty five twigs of each species placed singly into plastic chambers (5.5 cm × 4.5 cm × 2.8 cm) with one adult weevil. These

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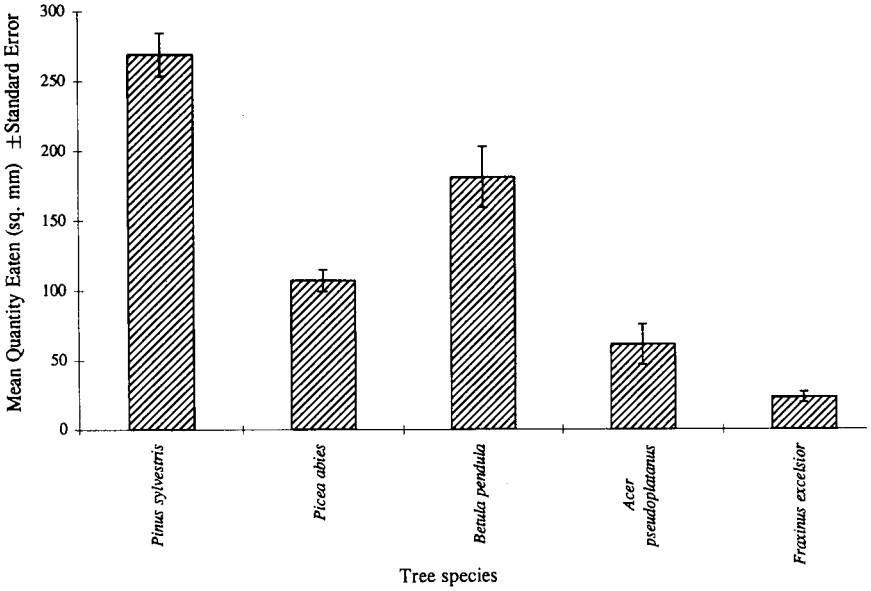

Fig. 1. Mean quantity of each tree species eaten throughout the experimental period.

tree species were chosen as they are common in the UK. The chambers were then incubated at 20°C with a light : dark regime of 16L : 8D. The weevils were allowed to feed on the twigs for five weeks.

At the end of each week, a record was made of the feeding damage on each twig. All twigs were removed and replaced with fresh twigs of the same species of tree. The amount eaten by each weevil was calculated by measuring the area of bark of each piece of wood consumed. This was performed by wrapping a piece of acetate, onto which a millimetre square grid had been photocopied, around the wood and counting the number of square millimetres of bark that were absent from the twig surface.

The data were analysed using ANOVA to establish whether there were any significant differences among feeding activity on any of the tree species.

Results

Analysis of the amounts eaten over the five week experimental period shows that the weevils consumed significantly more of the *Pinus sylvestris* twigs than they did of twigs from *Picea abies*, *Betula pendula*, *Acer pseudoplatanus* or *Fraxinus excelsior* (Fig. 1, $p < 0.001$, ANOVA). They ate significantly more of the *Betula pendula* twigs than those from *Picea abies*, *Acer pseudoplatanus* or *Fraxinus excelsior* (Fig. 1, $p < 0.001$, ANOVA). Significantly more *Picea abies* was eaten than *Acer pseudoplatanus* or *Fraxinus excelsior* (Fig. 1, $p < 0.01$, ANOVA).

In addition to the amount eaten, note was taken of the number of twigs where no feeding occurred. The numbers of undamaged twigs recorded at the end of the last week of the experimental period are presented in Fig. 2 and can be used as a measure of overall adult weevil mortality as all those weevils not feeding were dead by the end of the experiment. The data for the last week of feeding is displayed with respect to the numbers of adult weevils which were alive at the end of the five weeks (Fig. 2).

Discussion

The results from this experiment show that adult *H. abietis* consumed significantly more *Pinus sylvestris* twigs than any of the other four tree species. Leather et al. (1994) has shown in choice tests that *H. abietis* adults prefer *P. sylvestris* and *P. abies* to *F. excelsior*. From these tests it might have been

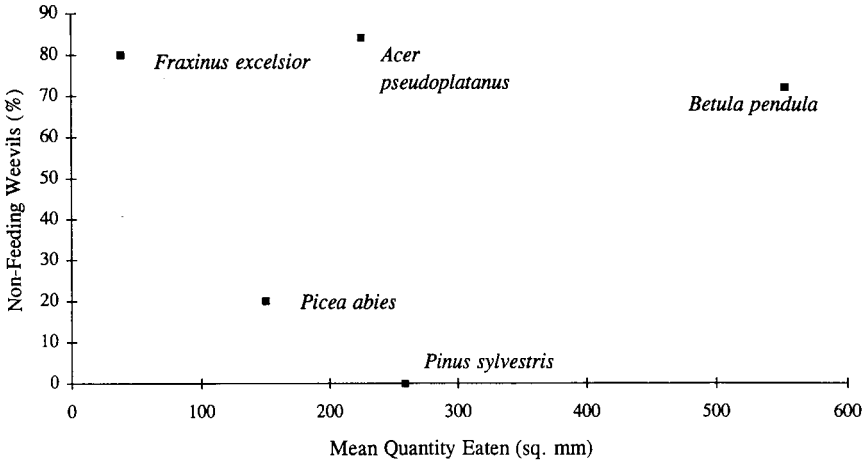

Fig. 2. Mean quantity (sq. mm) of each tree species eaten in the fifth week by remaining weevils and percentage of non-feeding weevils after completion of experiment.

expected that this species would eat more of a conifer than broad-leaved tree. Therefore, the fact that in the present no-choice test *H. abietis* adults consumed a mean of 69% more of the twigs of the broad-leaved *Betula pendula* than of the conifer *Picea abies* was unexpected. Whether these results relate to differences in the levels of attractant versus deterrent compounds between the conifers and among the broad-leaved trees needs further study.

Adult weevils have been shown to be attracted to conifers by several volatile compounds (Selander et al., 1973; Tilles et al., 1986a, b). It is not known whether the poor consumption level of *P. abies* results from the absence of these attractants or the presence of deterrent compounds. It is possible that *B. pendula* contains compounds that attract *H. abietis*, further work being required to substantiate this idea.

Leather et al. (1994) have suggested that broad-leaved trees could emit repellent compounds to deter insects or the bark of these trees could contain compounds that could kill the weevils if consumed. In the present experiment, non-feeding of *H. abietis* was greater on all three broad-leaved species than on either conifer. The low quantity eaten by each adult and high mortality of weevils exposed to *A. pseudoplatanus* and *F. excelsior* suggests that the twigs of these species contain compounds that deter feeding and the insects starved to death. The large amount consumed and high mortality of adult weevils exposed to twigs of *B. pendula* suggest that either they were poisoned by compounds in the twigs consumed or that some essential nutrients were absent.

The low level of adult beetle mortality occurring on the conifers suggests these could be the natural host of *H. abietis*, no mortality occurring with those fed *P. sylvestris*, and very little occurring with those fed *P. abies*. It has been noted, however, that *P. abies* has been found (e.g. by Guslits, 1970) to be a less suitable host for *H. abietis* attack than *P. sylvestris*. Therefore *P. abies* would make a better candidate for cropping in areas with a weevil problem as weevil development is slower and fecundity lower.

Further work is required to establish the role of plant chemistry in selection behaviour of weevils. As several broad-leaved tree species (e.g. *B. pendula*) are easy to cultivate these species could be a useful intercrop with a conifer species if repellents or poisons were found. If it is true that *B. pendula* has attractant compounds to weevils together with poisons in the feeding substrate, this tree species could be an excellent intercrop, attracting weevils away from conifers such as *P. abies*, death following feeding. This would reduce the incidence of adult weevil damage to the softwood trees as well as providing a valuable hardwood crop.

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