SPRAY TIMING FOR CONTROL OF FROGGATT'S APPLE LEAFHOPPER IN CANTERBURY

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SUMMARY

Adult and nymphal stages of Froggatt's apple leafhopper (*Typhlocyba froggatti*) were sampled in an abandoned Canterbury apple orchard. Summation of day-degrees were made between certain stages of the insect's life cycle. From these data a simple phenological control strategy is proposed for this insect in Canterbury.

INTRODUCTION

Froggatt's apple leafhopper (FALH) was noted as a pest of apple in New Zealand about 1918 (Dumbleton 1934). First reports suggested it was a sizeable problem (Anon 1920; Hyde 1920) and Miller (1922) listed it as one of the more outstanding injurious insects in the 1921-22 season. Its abundance was described as 'alarming' by Cockayne (1924) and it was not until the advent of DDT to orchard spray programmes that this insect was relegated to minor pest status (Cottier 1956). More recently FALH has been controlled in apple orchards by insecticides applied for the 'key pests' although specific measures against it may occasionally be needed (Collyer and van Geldermalsen 1975).

Preliminary observations of the FALH life cycle in Nelson by Dumbleton (1934) on apple indicated two generations. FALH overwinters in the egg stage in the fleshy tissues of the bark of twigs. First generation eggs hatch in spring and proceed through five nymphal instars to first generation adults. The FALH adults feed for about a week before mating and then lay second generation (summer) eggs which are deposited in the midribs and veins of leaves. After hatching, the second generation nymphs again proceed through five nymphal instars until they mature into second generation adults. These adults deposit their eggs underneath the bark of twigs to overwinter.

With the increasing introduction of integrated pest management (IPM) to apple orchards, the routine application of insecticides may be reduced (Thomas, pers. comm.) and this could result in the need for specially timed sprays for sporadic minor pests. Pest phenology rather than crop phenology has proved more reliable for the timing of chemical control and day-degree (D°) summation has been widely used in predictive phenology models. Predicting pest development may obviate the need for intensive sampling programmes to determine optimum dates for insecticide applications.

This paper reports the use of thermal summation to predict the development of FALH and indicate the correct timing for insecticide sprays in Canterbury.

METHODS

FALH populations were studied over two seasons in an abandoned Canterbury apple orchard of approximately 400 mature trees of mixed cultivars which had received no insecticide applications for at least five years. This investigation was part of a more comprehensive sampling programme which is described in Teulon (1983), including a more detailed description of the orchard. Only the two rows on each outer side of the orchard were considered for sampling as other trees were overgrown and unlike those found in managed orchards. All trees sampled were either 'Sturmer' or 'Statesman'. In the second season, half the orchard was not sampled as it was in the process of being cut down.

Leafhopper adults were trapped continuously by yellow sticky boards (250 x 200 x 5 mm) hung on apple trees halfway between the trunk and outside of the canopy, approximately 1.75 m (1980-81) and 1.9 m (1981-82) from the ground. A total of eight boards, four on each side in the 1980-81 season and six boards, three on each side, in the 1981-82 season were placed along the length of the orchard in the two outside rows. Sticky boards were changed weekly in both seasons.

Proc. 37th N.Z. Weed and Pest Control Conf.

Leaf samples were taken to determine nymphal numbers. In the 1980-81 season, one tree was randomly selected from each row of each block in two 'Sturmer' rows on the northern side of the orchard, eight trees in total. Forty leaves were collected weekly from all parts of each tree. In the 1981-82 season four apple trees were randomly selected from the northern 'Sturmer' row. Sixty leaves were collected fortnightly from all parts of each tree.

Maximum and minimum daily temperatures were recorded by a thermohygrograph placed in a Stevenson's screen within the orchard. These field data, and the lower (10.5 °C) and upper (30 °C) threshold temperatures for development derived in the laboratory by Teulon (1983), were used to establish day-degree summations between certain stages of the FALH life cycle (see Table 1). The first adult of the second generation could not be accurately determined from the sampling data so the date of lowest FALH adult catch between generations was used.

TABLE 1: Thermal summation of day-degrees for development of FALH between selected stages in the life cycle in Canterbury. (after Teulon, 1983).

	Season 1.		Season 2.		Mean $\pm$ S.E.
	Date	D °	Date	D °	
First adult (1st generation)	12/11/80	0	17/11/81	0	
First adult (2nd generation)	28/01/81	492.4	1/02/82	529.8	511.1 $\pm$ 18.7
Complete summer egg hatch	4/03/81	737.9	9/03/82	742.7	740.3 $\pm$ 2.4

RESULTS AND DISCUSSION

The thermal summations from first adult in the first generation (November) to the first adult in the second generation (January) (Table 1) had a standard error of the mean that represents less than four calendar days at the time of the beginning of the second adult flight. Considering that samples were taken weekly and in only two seasons this error is small and suitably defines a time when control measures could be taken. The thermal summations between the first adult of the first generation and the time of complete hatch of summer eggs were also suitably defined for use in spray timing.

Day-degree summations for the development of the overwintering eggs were not possible because the time when egg diapause is broken is unknown and development at low temperatures by the egg may not fit the model. In addition, the range of temperatures early in the season may be outside the straight line temperature/development relationship upon which the model is based. Determining the appearance of first nymphs in the orchard is difficult as they are within the tightly bound developing leaves.

A simplified summary of the temporal occurrence of first instar and adult FALH in Canterbury, based on extensive sampling by Teulon (1983), is given in Figure 1. In the past when more importance was placed on the control of this insect, chemical applications were recommended just before the winged adults began to appear in both generations and/or after all eggs had hatched (Dumbleton 1934; Cottier 1956). The most appropriate time to initialise thermal summation would be with the appearance of the first FALH adult on a sticky board within the orchard. This kind of simple presence/absence measurement is much easier than estimating proportions of the life stages in the population. At this time all nymphs have hatched from the overwintered eggs and are present on the foliage so that a single insecticide application should be sufficient control for the first generation. Moreover, most of the adults of the parasite *Anagrus armatus* (Ashmead) would not yet have emerged from the protection of the FALH egg embedded in the bark (Teulon 1983) and therefore parasites of the first generation would largely be conserved. The optimum location and density of the boards within the orchard and position on the tree was not ascertained.

Fig. 1: Insecticide application times for FALH based on pest phenology in Canterbury. (after Teulon, 1983).

Approximately 511 D° after the first appearance of adults of the first generation, the adults of the second generation would be expected to appear and most summer eggs would have hatched. An insecticide application should be applied at this time if leafhoppers are present. Many parasites would again be protected within FALH eggs (Teulon 1983). If no adults were trapped in the first generation it is probable that no control measures would be needed throughout the whole season. However, if infestations continued to build up, a third insecticide application could be made 740 D° after the first adult of the first generation had been caught in the sticky traps. This would ensure that all summer eggs would have hatched and that the nymphs would be exposed to the spray (see Figure 1).

CONCLUSION

Results of monitoring FALH in Canterbury for two seasons indicates that predicting the phenology of FALH in the region can be based on yellow sticky board catches, to indicate the first appearance of adults of the first generation, and thereafter on thermal summation. Sprays should be timed to coincide with the emergence of adults in each generation, the first by trapping and the second after 511 D°. A further insecticide spray could be applied on completion of summer egg hatch (740 D°).

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