**PHENOLOGY OF WHITEFRINGED WEEVIL
(*GRAPHOGNATHUS LEUCOLOMA*) IN PASTURE
IN NORTHERN NEW ZEALAND**

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SUMMARY

Whitefringed weevil (*Graphognathus leucoloma* (Boheman)) populations were monitored over a 12 month period at two sites in dairy pasture in the Waikato and Bay of Plenty regions of northern New Zealand. Population density declined from 130 and 250/m² in April 1993 to 50/m² at both sites in December by which time most of the population were eighth to eleventh instar larvae. When first instar larvae appeared in February and March population density increased to about 350/m². Adult whitefringed weevil were present from November to March with peak numbers occurring in January and February. The presence of late instar larvae year round indicated that some individuals did not complete development in one year.

Keywords: whitefringed weevil, population ecology, pasture pests

INTRODUCTION

Whitefringed weevil (*Graphognathus leucoloma*) (Coleoptera : Curculionidae) (WFW) is a parthenogenetic insect of South American origin, which occurs in lowland pastures of the North Island, and in Nelson, Marlborough and Canterbury in New Zealand. The fecundity and longevity of adults is greatly affected by diet. East (1977) found that WFW adults reared on a leguminous diet lived for up to 3 months and could lay 1000 eggs, whereas on a grass diet longevity fell to approximately 2-3 weeks and less than 10 eggs were laid. The eggs of WFW are laid in batches in a gelatinous mass which hardens and adheres to soil and litter (Young *et al.* 1972). WFW has 11 larval instars in populations reared in laboratory and insectary conditions (Gough and Brown 1991). The first instar WFW is non-feeding but can survive in the soil for up to 10 weeks (Gough and Brown 1991).

The foliar feeding adult WFW is not considered to be economically important, but East (1981, 1983) has shown that root feeding larvae can reduce dry matter production in pure swards of white clover (*Trifolium repens*) by up to 28%, and ryegrass (*Lolium perenne*) and white clover pasture by up to 10%. Whitefringed weevil is also an important pest of vegetable crops such as potatoes (Matthiessen 1991), peas and beans (Todd 1964).

Control of WFW in pastures has proven to be very difficult. High rates of organochlorine insecticides were effective in controlling WFW larval populations (Todd 1964), but these are now banned from use in agriculture. Cultural control options, such as three intensive rotary cultivations at 7 day intervals, are effective at reducing larval populations in vegetables and crops (East and Parr 1977), but are unlikely to be used widely in pastoral farming. Insecticides applied against the adult WFW may be useful in some situations (Learmonth and Matthiessen 1993). However, little information about the life history and phenology of this pest, necessary for effective timing and placement of insecticide treatments against teneral adults, is available in New Zealand.

This paper reports on the population phenology of WFW in the northern North Island of New Zealand. The study is part of a larger research programme to determine the pest status and population dynamics of WFW in pasture which may lead to new control measures.

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METHODS

Two study sites on dairy farms were selected in the summer of 1992-93. One site was located in the Waikato at the Ruakura Agricultural Research Centre, Hamilton and the other site was situated in the Pongakawa area, approximately 15-20 km south east of Te Puke, in the Bay of Plenty. At each site, five paddocks of perennial ryegrass and white clover were selected. All paddocks had high initial populations of WFW larvae in the soil and were part of the normal farm operation.

On each sampling date from April 1993, 100 randomly located soil cores (10 cm diam) were taken monthly from each paddock to a depth of 20 cm (Kain and Atkinson 1975). Each core was placed separately into a polythene bag and returned to the laboratory for extraction. The extraction process used was similar to that used for other pasture pests (Kain and Atkinson 1976) except that only three stainless steel sieves with mesh aperture sizes of 3.2, 1, and 0.4 mm were used. The largest sieve separated out the largest larvae, pupae and the adults while the smallest aperture size captured the small first to fourth instar larvae. To estimate the efficiency of the extraction technique, 25 mixed instar larvae, 25 adults or 25 pupae were placed into each of ten WFW-free soil cores. These cores were subsequently extracted and the number of larvae retrieved was compared to the original numbers in the cores. All larvae were counted, and placed into a preservative solution. Head capsule widths of larvae were measured using a graduated eyepiece at 50x magnification and larvae were assigned to instars based on the criteria of Gough and Brown (1991).

RESULTS AND DISCUSSION

The efficiency of extraction was 100% for adults, pupae and larval instars 8-11, 95-98% for instars 5-7 and 85% for instars 1-4. The results in Figs. 1 and 2 have not been corrected for extraction efficiency.

Figure 1: Average density (No./m²) of whitefringed weevil (WFW) at two sites in the Waikato and Bay of Plenty. (Bars represent SEM).

The population trends at both sites were similar. Densities of WFW slowly declined from an initial high population in April, of approximately 250/m² in the Waikato and 130/m² in the Bay of Plenty, to a minimum of approximately 50/m² at both sites in January 1994 (Fig. 1). The slope of the population decline was steeper at the Waikato site particularly between April and July, and September to November, than at the Bay of Plenty site, indicating that different mortality factors may be operating during these periods. Whitefringed weevil density had increased to approximately 350/m² at the final sampling in March 1994. Pupae and adult WFW were present at low levels from November to March. Peak adult numbers occurred in January and February.

For convenience of presentation the 11 larval instars have been grouped into four categories (Figs. 2a,b) depending on head capsule widths. At the initial sampling in April 1993 the majority of larvae had reached the seventh instar. In contrast, in a dry summer climate of Western Australia, the majority of the WFW population overwinter as first instar larvae (Matthiessen 1991). Whitefringed weevil larvae continued to develop during the winter at both sites (Figs. 2a,b). By early summer (December) more than 80% of all larvae in the current study were in instars 8-11. The presence of large larvae (8-11 instar) throughout the year indicated that not all larvae were able to complete their life cycle within 1 year. Only a small number of pupae (peak at 5/m²) and adults (peak 3/m²) were found when compared to the population of large instar larvae. This indicates that there may be a factor causing high mortality amongst late instar WFW.

Figure 2: Instar groupings as a percentage of the total whitefringed weevil larval population in the Waikato (a) and Bay of Plenty (b).

The rapid increase in density that occurred in February 1994 was due to recruitment of first instar WFW. Weevils contained mature eggs in their ovaries within 2 weeks of emergence and females laid eggs in pots in the laboratory from December to March, although eggs did not hatch in the field until February (Hardwick, unpubl. data). The most likely factor controlling the egg hatch is summer rainfall. WFW eggs require saturation with water before hatching (Gross *et al.* 1972) and Matthiessen (1991) found that first instar larvae of WFW only appeared after the winter rains had started. The contrast in rainfall patterns between New Zealand and Australia may explain the different composition of overwintering populations. The data gathered in this study are a useful preliminary insight into the population dynamics of WFW and as the trial continues, a more complete picture of its pest status will be developed.

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