HONEY DISEASE, AN INDICATOR OF POPULATION DECLINE IN GRASS GRUB

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SUMMARY

Populations of grass grub (*Costelytra zealandica*) were surveyed in Canterbury each year between 1981 and 1984. Where high levels (> 30% incidence) of honey disease (*Serratia* sp) were recorded in any one year the grass grub populations had declined by the following season. Population growth was recorded only where disease levels were low (< 30%). The use of honey disease as an indicator of population decline is discussed.

INTRODUCTION

Long term studies of grass grub populations have often shown dramatic collapses or declines between seasons. These collapses have been caused by density independent factors such as drought (East 1972) or combat mortality and starvation following the complete destruction of pastures (Kain 1975). Populations, however, have also been shown to collapse when there is both adequate moisture and pasture growth, possibly as a result of pathogens (East and Willoughby 1983). The identification of such factors would make prediction of grass grub decline possible and would be a useful basis for determining whether pesticide applications were warranted.

Honey disease is caused by bacteria of the genera *Serratia* sp (previously tentatively identified as *Hafnia alvei*). The disease has been identified as an important cause of mortality in grass grub populations in Canterbury (Trought *et al* 1982). In this paper the relationship between occurrence of honey disease and population growth is examined and its use as an indicator of population decline discussed.

METHODS

Grass grub populations were surveyed for population density and disease in Canterbury in May/June each year between 1981 and 1984. At each time of sampling, ten to thirty 15 cm³ spade samples were taken in a diagonal strip across each paddock. The samples were broken apart, the larvae were extracted and counted, and a visual diagnosis made for honey disease (See below).

The proportion of honey diseased larvae in any one year was compared with both the population in the subsequent year and the index of population trend (I) (Southwood 1966), calculated as:

$$I = \frac{P_{n+1}}{P_n}$$

Where P is the total larval population and n is the year of collection. The index supplies an indicator of population growth between seasons.

Sixteen paddocks were sampled each year as part of a regular grass grub survey. Additional paddocks were added for analysis when information on populations and disease for two or more years became available. Only paddocks with over 50 grass grubs/m² in year n were used in the calculation of I in order to reduce distortions caused by a high variance in samples of low populations.

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TABLE 1: Grass grub populations and honey disease incidence in Canterbury, 1981-1984.

	Year			
	1981	1982	1983	1984
Mean grass grub population/m ² .	217	152	204	246
Mean % honey disease	36	15	17	24
No. of sites	16	20	25	18

Fig. 1: Grass grub larva infected with honey disease on the right. A healthy prepupal larva is shown on the left.**Honey disease**

Larvae infected with honey disease have a clear honey colouration. This is caused by a bacterial infection (*Serratia* sp) in the insect gut which causes the insect to cease feeding and void the gut of the normal contents of soil and organic matter. On initial infection the larvae remain active, but over a period of 4-6 weeks become withered and

die. During this period fat bodies are broken down causing an intensification of the honey colouration. The disease is commonly found in second and third instar larvae in the early winter. The condition should not be confused with the creamy prepupal stage caused by opaque fat bodies laid down towards the end of the larval stage (Fig. 1). The disease is frequently found in Canterbury and other parts of New Zealand (Stucki *et al* 1984) and, with its relatively short mortality time, may recycle through the infected population.

Fig. 2. Grass grub index of population trend (I) in relation to percentage honey disease in the previous season. Histograms show the mean I for each disease class.

RESULTS

Mean grass grub populations and honey disease incidence in each year are shown in Table 1. Peak populations and highest disease incidence occurred in 1981. This was followed by lower population levels in 1982 and a drop in disease. Mean population rose over the next two seasons and disease climbed to a mean of 24% in 1984.

Examination of individual paddocks showed that populations with a high level of disease (>30%) in any one year had a low population (<200/m²) in the subsequent year. High populations (>300/m²) only occurred following a low disease incidence (<30%) in the previous year.

The comparison between disease and the index of population is presented in Fig 2 indicating that only those paddocks exhibiting low levels of disease in year n showed a positive population growth in the subsequent year. When divided into four disease levels, 0-10%, 11-30%, 31-60%, 61 + %, it can be seen that the mean population growth declines with increasing disease level. The decrease in population was not directly related to pasture age as several paddocks over 10 years of age showed a population increase.

DISCUSSION

Population decline in grass grub may be caused by a variety of factors and, as Fig. 2 shows, populations will decline both in the presence and absence of honey disease, particularly when affected by severe drought as in 1982. However, the only populations to increase in number occurred where there had been low disease levels in the previous season while all populations following high disease levels declined substantially with one exception.

Many tactics for the control of grass grub populations, such as mob stocking and pasture renovation, rely on the assumption that older pastures develop an immunity to grass grub attack (French *et al* 1983). However, as this study shows older pastures can experience population growth and grass grub outbreaks, but only in the absence of disease.

While, on the basis of the data available, it is not possible to set a firm threshold for population decline it seems that disease levels of greater than 30% will lead to a decline in population in the subsequent year. While this level may seem insufficient to cause such dramatic decreases as have been recorded it is important to remember that the disease can recycle through the population producing a much greater cumulative effect. Neither does it prove that honey disease is the causative agent in population decline. Such conclusions could only be reached after a thorough study of the the population dynamics of the insect in relation to disease.

It appears, however, that the presence of honey disease, an easily diagnosed pathogen, in grass grub populations can indicate a decline in numbers in the subsequent season. Such information can be used in decisions as to the value of insecticide application and could be a vital component in the search for long term, rational strategies for grass grub control.

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REFERENCES

- East, R., 1972. Starling (*Sturnus vulgaris* L.) predation on grass grub (*Costelytra zealandica* (White) Melolonthinae) populations in Canterbury. *Ph. D. Thesis, Lincoln College*.
- East, R. and Willoughby, B.E., 1983. Grass grub (*Costelytra zealandica*) population collapse in the northern North Island. *N.Z. J. Agric. Res.* 26: 381-390.
- French, R.A., Pearson, J.F., Vartha, E.W. and Fraser, T.J., 1983. Grass grub: coping without chemical control. *Proc. N.Z. Grassld. Ass.*, 44: 217-221.
- Kain, W.M., 1975. Population dynamics and pest assessment studies of grass grub (*Costelytra zealandica* (White), Melolonthinae) in the North Island of New Zealand. *Ph. D. Thesis, Lincoln College*.
- Stucki, G., Jackson, T.A., and Noonan, M.J., 1984. Isolation and characterization of *Serratia* strains pathogenic for larvae of the New Zealand grass grub *Costelytra zealandica*. *N.Z. J. Sci.* (in press).
- Southwood, T.R.E., 1966. *Ecological Methods*. Methuen, London.
- Trought, T.E.T., Jackson, T.A. and French, R.A., 1982. The incidence and transmission of a disease of grass grub (*Costelytra zealandica*) in Canterbury. *N.Z. J. Exp. Agric.* 10: 79-82.