FARM SURVEYING OF BLACK BEETLE POPULATIONS IN SPRING AS AN INDICATOR OF LARVAL POPULATIONS IN SUMMER

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Summary

The estimation of black beetle *(Heteronychus arator)* numbers at the adult (September) and egg (early December) stages from spade divots was used to predict larval numbers in February. These estimates were used to determine the general levels of infestation on farms and to categorise paddocks according to the potential for summer larval damage. This system of sampling enabled a high level of correct decisions to be made in spring on the identity of paddocks likely to support economically damaging larval populations in summer. Farm surveying can assist in decisions on management options necessary to alleviate black beetle damage.

INTRODUCTION

Black beetle is a sporadic pest in some pastures in northern areas of the North Island. A rapid population build-up to damaging larval levels can occur in favourable seasons, characterised by abnormally warm springs (King 1979). Investigations in recent seasons have shown that potentially damaging numbers may occur locally, independent of seasonal conditions, on lighter soils where high amounts of paspalum *(Paspalum dilatatum)* are present (Watson and Wrenn 1980). Such areas tend to occur on the fringes of the present black beetle distribution (Watson 1979a).

Black beetle is highly mobile, particularly as a result of dispersal flights in the autumn (Watson 1979a, b), so that a high infestation is not necessarily followed by similar numbers in the next year. High overwintering mortality of black beetle can also occur (King 1979) which makes the estimation of population numbers before spring meaningless as a basis for predicting numbers in the next generation. The prediction of summer larval numbers, and likely pasture damage based on an estimate of numbers in the pre-damaging stages, has been demonstrated by Watson and Wrenn (1980) and King *et al* (1980).

Insecticides, properly applied, can reduce black beetle larval populations (Watson and Webber 1976; Blank and Olson 1978). Their high cost and transient activity must restrict their use to areas where a high probability of economic return can be assured. Best control is obtained from applications between October and early December (Watson *et al* 1978), which means that decisions on the use of insecticide must be made well in advance of pasture damage becoming evident. Assessment of adult numbers in September/October gives the farmer sufficient time to decide and prepare for strategies involving insecticide use or management options such as spring cropping.

The possibilities of farm surveying on a paddock by paddock basis using minimal sampling by spade divots to estimate black beetle numbers in spring and predict damaging summer larval populations were investigated.

METHOD

In September 1979, two farms were selected, at Te Pahu and Te Rore adjacent to Mt Pirongia, on which to conduct farm surveys of black beetle populations. Both farms had suffered pasture damage during the previous one or two summers. In each

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:ase, farmers were contemplating insecticide use to reduce pasture damage in the 1979/80 season. The objectives of the farm surveys were to obtain paddock estimates of black beetle numbers using procedures practical for farmer use and to determine if such assessments could be useful in predicting the risk of pasture damage and so when insecticides or other control measures should be applied.

Black beetle numbers were assessed by taking nine 19 cm square divots, approximately 8 cm deep, in a line at five pace intervals across a representative portion of the paddock. Nine spade squares were equivalent to 1/3 m^2, so that insect numbers from handsorting the divots in each paddock, multiplied by three, gave the approximate numbers/m^2. Sampling was carried out in early spring (for adults), early December (for eggs and small larvae) and February (for large larvae), with resampling taking place in the same general area of each paddock.

Practical success of the predictions is dependent to a large extent on adequately defined economic damage levels. In this study, economic damage levels for larvae were assumed to be between 40/m^2 (when responses to insecticide could be expected in well utilised ryegrass based pasture in normal to dry seasons), and 60/m^2 (when extensive pasture damage and production losses could occur) as noted by King (1979) and Watson (unpublished data). Watson and Wrenn (1980) found larval populations exceeding 40/m^2 were generally derived from adult numbers of at least 10/m^2. Adult numbers of 10/m^2 were, therefore, taken as a threshold, above which treatment of the paddock could be considered economically justifiable. For predictions based on egg estimates, a 1:1 ratio of egg to larval numbers was assumed based on the recovery of eggs by handsorting, so that an egg threshold of 40/m^2 was adopted.

RESULTS AND DISCUSSION

On the Te Pahu farm, 24% of the 25 paddocks surveyed contained adult numbers greater than 10/m^2, with 15/m^2 being the highest recorded in any paddock. At Te Rore, moderate to high numbers were more common with 52% of the 21 paddocks sampled having greater than 10/m^2 adults in September. Overall, numbers appeared to have declined markedly from larval numbers in the previous season at Te Pahu (Watson and Wrenn) 1980). Highest numbers appeared to be present on previously undamaged parts of the farm at Te Rore. Extremely high light trap catches in autumn 1979 in the Te Pahu area indicated extensive dispersal of adults had occurred. In February 1980, 20% and 67% of the paddocks respectively on the Te Pahu and Te Rore farms had larval populations exceeding 40/m^2, and 48% exceeded 60/m^2 at Te Rore, again indicating the generally higher populations on the Te Rore farm.

In view of the low adult numbers generally on the Te Pahu farm and the unfavourable condition of most pastures for black beetle (low paspalum, high clover content), it was suggested that extensive treatment of the farm should not be necessary. At Te Rore, it was suggested that paddocks should be treated on the basis of adult numbers sampled, predicted larval numbers and damage thresholds.

The relationships between adult numbers in September, larval numbers in February and the decision categories reached are shown in Table 1, for the two farms

TABLE 1: Distribution of paddocks in respective larval categories based on estimates of adult numbers using spade divots (46 paddocks)

Adult No/m^2 in September	% paddocks with respective larval No./m^2 in February ◄40	40-60	►60
◄10	50 C	11 M	2 I
10-15	7 I	9 M	4 C
►15	2 I	2 M	13 C

Decision categories based on adult and larval threshold levels of 10/m^2 and 40-60/m^2 respectively. C = correct; M = marginal; I = incorrect.

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together. On the basis of adult numbers and threshold levels previously outlined, 67% of the paddock decisions could have been regarded as correct (Table 1), while in 22%, larval numbers fell within marginal levels. In 11% of the paddocks a wrong decision was made. This may have been due to an incorrect estimate of adult or larval numbers, or a variation in fecundity and/or larval survival affecting actual February larval numbers.

Egg numbers estimated from handsorted spade divots in December provided a useful backup for decisions made on the basis of adult sampling. The relationships between egg numbers in December, larval numbers in February and the decision categories reached are shown in Table 2. Not all paddocks initially sampled in September were resampled in December. From a total of 33 paddocks, 73% of the estimates resulted in "correct decisions" on the threshold levels adopted, seven paddocks (21%) gave marginal larval numbers, and 2 paddocks (6%) resulted in an over-estimate of February numbers. No paddocks with fewer than 40/m² eggs had larval numbers exceeding 60/m².

TABLE 2: Distribution of paddocks in respective larval categories based on estimates of egg numbers using spade divots (33 paddocks)

Egg No/m² in December	% paddocks with respective larval No./m² in February ◄40	40-60	►60
◄40	52 C	12 M	0
40-60	6 I	3 M	12 C
►60	0	6 M	9 C

Decision categories based on egg and larval threshold levels of 40/m² and 40-60/m² respectively. C = correct; M = marginal; I = incorrect.

Egg sampling may be particularly useful to verify decisions on paddocks where adult numbers are close to 10/m². At Te Pahu, between 6 and 15 adults/m² were recorded on 13 paddocks subsequently sampled for eggs. The egg sampling gave a paddock population mean of 12/m² (range 0-30) providing evidence that high larval numbers would not be expected. Numbers in February averaged 31/m² (range 15-60).

The distribution of black beetle infestations within paddocks could influence the accuracy of decisions based on sampling from a small part of the paddock. Black beetle populations in swards of pure species were observed to have an aggregated dispersion in the egg and early instar larval stage but a random dispersion in the larval stage in February and the adult (King 1979). Watson and Wrenn (1980) noted a tendency for all stages, but particularly the adult, to aggregate under paspalum plants in mixed paspalum, grass and legume pasture. This suggests that a potential exists for stratifying sampling on paspalum in this type of pasture, which could improve the chances for a correct decision to be reached.

Approximately 30 person-minutes were required to survey each paddock with 9 spade divots, with a slight reduction in time as experience increased. A farm survey involving up to 30 paddocks could be conducted as a one or two day intensive effort involving all farm staff, or spread through September and early October. Such an investment must be considered against the cost of insecticide, pasture renovation or unnecessary loss of production.

The outcome of the present survey was that no paddocks were treated at Te Pahu and eight were treated at Te Rore. The wet 1979/80 summer conditions resulted in no shortage of pasture for stock, and the damage thresholds for black beetle appeared to be considerably higher than normal. This illustrates the need for accurate long-range weather forecasts to assist the prediction of damage thresholds. Some paddocks with over 75/m² larvae in February 1980 showed visible damage for a brief period in late summer, with stock pulling of ryegrass and other temperate grass species being noted.

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Pulling of grasses also occurred on some of the clover dominant paddocks where larval numbers were usually below 40/m^2. No significant increases in total herbage production occurred during the autumn in mowing trials, after black beetle numbers had been reduced by insecticides.

CONCLUSIONS

Paddock by paddock surveying using spade divots in September to assess black beetle adult numbers is considered a practical means of determining general numbers present on farms, and of identifying paddocks at greater risk from subsequent larval damage to pasture. This gives farmers sufficient time to decide on the need for insecticide control, or to prepare management strategies against potentially damaging infestations. Further sampling of egg numbers in December, though more difficult to assess, may provide useful corroborative information to confirm decisions, especially where adult numbers are close to the threshold level.

It must be recognised that individual paddock estimates of numbers from the spade sampling are highly imprecise in statistical terms. However, the method enables the categorisation of paddocks according to the risk of low to moderate and moderate to high infestation levels being reached, with reasonable accuracy. The reliability of the information is enhanced by sampling a large number of paddocks.

In the normal course of events, black beetles appear to cause most pasture damage over a 1-3 year period in primary infestation areas. Although intensive farm sampling for black beetle may be most relevant during these outbreak periods, regular examination of paddocks is likely to give useful information on the status of other soil dwelling pests in mixed species infestations. This may enable appropriate management strategies to be adopted to reduce the effects of insects in any season.

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