POST-EMERGENT CONTROL OF BLACK BEETLE ADULTS IN FIELD CROPS

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Summary

Insecticides were applied in mid-late spring on sweetcorn *(Zea mays),* barley *(Hordeum sativum)* and asparagus *(Asparagus officinalis)* for control of black beetle *(Heteronychus arator)* adults. Isazophos (2.0 kg/ha) gave consistently good results in comparison with the other treatments used. Relatively low numbers of adults (◄2/m^2) were shown to produce significant damage in susceptible wide-row crops. Treatments should be applied against black beetle adults in early spring to minimise damage.

INTRODUCTION

In New Zealand, black beetle has largely been associated with economic damage in pasture and maize. The insect has, however, been associated with damage in a wide range of horticultural and agricultural crops overseas, including vegetables (Wallace 1945), grape and orchard plantings (Wright 1958), small grain cereals, potatoes and other field crops (Harrington 1964; Drinkwater 1977). An increasing diversity of cropping in the Waikato/Bay of Plenty region in recent years has given rise to the risk of susceptible crops being attacked by black beetle.

Damage in crops is usually associated with attack by the adult at the base of the plant, or to underground storage tissue, where adult feeding is largely confined. Woody plants may become ringbarked, usually in the first year after planting before the bark hardens. In herbaceous and graminaceous plants, the stem is weakened or severed, leading to lodging, or disease attack, and ultimately death of the stem.

The best currently acceptable insecticides for adult black beetle control are phorate and isazophos, which provide limited protection when used in maize at planting (Watson *et al* 1978a). In the absence of spring flight, the potential for damage in spring sown crops can be established by ground inspection before planting (Watson *et al* 1978b). In susceptible crops which are autumn sown (e.g. some cereals) or perennial (e.g. asparagus), a buildup of beetle numbers may occur after planting, particularly as a result of autumn flight. It is possible for beetles to invade small areas of cultivation by surface movement from surrounding areas. When they become concentrated under plants in cultivated ground, especially when stem density is low, damage can result from comparatively small numbers.

In spring 1979, opportunities arose for testing ways of reducing black beetle adults in three different crops: early sown sweetcorn, spring sown barley and establishing asparagus. The effect of beetles on the respective crops was determined where possible.

METHOD

Trial 1 - Early sown sweetcorn

In mild, frost free areas such as coastal Bay of Plenty, it is possible to plant sweetcorn from early September to market fresh cobs by Christmas at a considerable price premium. The early plantings at sub-optimal temperatures result in a prolonged seedling stage highly susceptible to black beetle attack. In one planting at Katikati, sweetcorn was planted from early September at 28.6 cm spacing in rows 86.4 cm apart (40,500 plants/ha). Damage from low numbers of black beetle was observed after emergence. In view of the potential crop returns and unknown potential for further damage, it was decided to treat the crop with insecticide. Phorate and isazophos were not commercially available in liquid formulations so the grower applied diazinon which gives some control of black beetle adults (Todd 1969; Watson and Webber 1975).

This treatment, and isazophos spray and granular treatments, all at 2.0 kg/ha, were investigated at Katikati. Plots were four rows by 10 m, with 1 m buffers at each end. Four replicates in randomised blocks were placed on each of adjacent stands planted on 9 September (cv 'Royal Crest') and 24 September (cv 'Miracle'). At treatment on 11 October, the plants were at the 4 - 6 and 2-leaf stages respectively. Sprays were applied in a 20 cm band over the row in 300 litres/ha. Granules were applied in a similar band by hand shaker.

Prior to treatment, beetle numbers were assessed on each block from 10 cm diameter soil cores taken over 10 plants in the outer rows of each plot. Surface counts of dead beetles were made from the whole plot area on several occasions after treatment with dead beetles removed at each assessment. Plant counts on the middle two rows were carried out prior to treatment and after 2 and 4 weeks. Plants were classified as healthy, damaged or dead if all, some or no leaves remained turgid respectively. At a final assessment on 15 December, surviving plant numbers and the number of plants bearing cobs were determined.

Trials 2 and 3 - Spring sown barley

A paddock of barley at Te Rore, near Mount Pirongia, was observed in early November to have large numbers of yellowed tillers which revealed mascerated tissue at the bases characteristic of black beetle feeding. The paddock has been ploughed in early September from formerly paspalum *(Paspalum dilatatum)* dominant pasture which had deteriorated badly from black beetle larval attack in the previous summer. After topworking, the paddock was sown with 146 kg/ha barley cv 'Hassan' on 5 October.

Treatments in Table 1 were applied on 9 November. Granular treatments were broadcast from a hand shaker, and sprays were applied in 500 litres/ha from a portable sprayer. Plots were 5 x 10 m, with five replicates in randomised blocks.

Prior to treatment, beetle numbers were estimated from 10 hand sorted 10 cm diameter samples taken per plot. After treatment, beetle numbers dead on the surface were estimated from two 0.55 x 0.90 m covered areas per plot. Estimates of the barley yield at harvest (28 January) were made from a 1.0 m strip mown down the centre of each plot which was removed for threshing. At this time, black beetle larval numbers were assessed from 25 core samples taken per plot.

Trial 3 was laid down on 14 November, in an area of the paddock containing lower beetle numbers, using the treatments in Table 2. The trial was conducted in a similar manner to Trial 2, but with no untreated control and no estimates of initial black beetle number, larval numbers or barley yield.

RESULTS AND DISCUSSION

Trial 1

On 11 October, there were 30,600 and 36,800 plants/ha on the first and second plantings, of which 4.0 and 2.6% respectively were either damaged or totally wilted from black beetle attack. Pre-treatment sampling gave very low beetle numbers of 0.12 and 0.14/m² on respective plantings, equivalent to about one beetle per 25 plants.

Total counts of dead beetles on the surface showed significantly (P◄0.001) more on treated than untreated plots, with the following number/m²:

isazophos 50 EC	0.18
isazophos 10 G	0.15
diazinon 80 EC	0.09
untreated	0.01

Between 80 and 90% of the dead beetles were recovered from each treatment at the first assessment, 2 days after application. Although soils were moist, rain (probably less than 10 mm) fell on the second day after treatment only. The counts indicated that a large proportion of the number originally sampled had died on the surface, especially in the isazophos treatments.

Plant numbers on the isazophos treatments were significantly higher (P◄0.05) than on the diazinon and untreated plots after one month, with 9% more plants overall. By 15 December, there were 10% more plants (P◄0.05) and 8% more cob bearing plants on the isazophos treatments. Numbers of plants not bearing cobs (16% of total plants) were not significantly different (P►0.05) between treatments. Numbers of visibly damaged plants were highest at the 13 November assessments when they constituted 10% of plants on diazinon and untreated plots compared to 5% on isazophos treated plots.

Assuming one marketable cob per plant, the isazophos treatments, with 2,500 extra cobs/ha, would have repaid the cost of chemicals (assumed to be $30/kg ai) at a return to the grower of 2.4 cents/cob. With prices of 30 to 40 cents/cob expected for the high risk early sweetcorn, costs may have been recouped from an increased yield at only 150 - 200 cobs/ha.

Trials 2 and 3

In trial 2, a significantly greater number of black beetles appeared on the surface of plots treated with decamethrin and isazophos compared with untreated plots (Table 1). Pre-treatment adult numbers were 30.0/m^2 ± 11.2.

TABLE 1: Dead beetle numbers (surface counts), crop yield and larval numbers on barley (Trial 2)

Treatment (kg/ha)	No. dead beetles/m^2	Dry weight seed 1000 kg/ha	Larval No./m^2
untreated	2.2	3.6	66
isazophos 50 EC (1.0)	13.2	4.0	42
isazophos 50 EC (2.0)	17.6	4.6	17
decamethrin 2.5% EC (0.3)	27.5	5.1	14
LSD (P◄0.05)	9.1	0.7	28
(P◄0.01)	12.8	1.0	39

The insecticides resulted in significant yield increases in the two best treatments (Table 1). Regression of numbers of dead beetles on the surface, with yield showed that for every 5/m^2 increase in beetles killed, there was an 8% increase in yield. This occurred after considerable damage was already present at the time of treatment.

Moderately high numbers of second and third instar larvae were present on untreated plots at harvest (Table 1). Since the root feeding larger grub stages were only present during the maturing stages of the crop, it is unlikely that larvae would significantly affect yields. Reports of problems during harvest have occurred, however, when barley has rolled up in front of the harvester due to root severance by black beetle larvae.

In trial 3, decamethrin at rates much lower than that used in Trial 2, and cypermethrin gave comparable mortality to isazophos granules at 2 kg/ha (Table 2). Isazophos EC was slightly more effective than granules.

TABLE 2: Surface mortality of black beetle, Trial 3

Treatment (kg/ha)	No. dead beetles/m^2
decamethrin 2.5 EC (0.01)	2.7
decamethrin 2.5 EC (0.02)	4.3
decamethrin 2.5 EC (0.03)	4.0
decamethrin 2.5 EC (0.04)	6.2
isazophos 50 EC (2.0)	8.0
isazophos 10 G (2.0)	4.8
cypermethrin 25 EC (0.1)	4.1
cypermethrin 20 EC (0.1) (microencapsulated)	3.2
LSD (P◄0.05)	2.3
(P◄0.01)	3.0

Crops

Observations on asparagus

A large increase in export orientated asparagus growing has taken place in the Waikato in recent years, mainly on lighter free draining soils (Riley 1980), which also favour black beetle. The perennial nature of the crop means that damage could result from fresh ingress of beetles each season, with damage in spring affecting both that year's marketable produce and the long term crop vigour.

Observations on a stand of 'Mary Washington' asparagus planted near Hamilton in August 1979 into land formerly used for maize production revealed that black beetle adults had caused severe damage by mid-November, with 34% of the planted crowns destroyed and many of the surviving crowns showing obvious damage, which included lodged or withered fronds with mascerated basal tissue. 'Rutgers Beacon' asparagus crowns planted in the same paddock in late September had suffered a loss of only 0.4% fronds by mid-November, with no crowns destroyed by black beetle. This difference may have resulted from cultivar differences in resistance or tolerance to black beetle or from the different times of planting. Shelter belts were also attacked. In mid-November, many young *Cryptomeria japonica* planted in mid-August were dying after being ringbarked at ground level by black beetle, although *Casurina cunninghamiána, Eucalyptus fastigata* and *Pittosporum eugenioides* were not affected.

On 20 November an insecticide trial was laid down on plots 9 rows (1 m spacings) x 10 m, comparing isazophos 10 G, isazophos 50 EC and phorate 20 G at 2.0 kg/ha and decamethrin 2.5 EC at 0.03 kg/ha, all applied as band treatments along the rows, with two replicates in each cultivar. Surface counts of dead beetles for 5 weeks after treatment revealed total counts six times higher on the isazophos granular treatment than the untreated plots, and 3 to 4 times higher than untreated on the other insecticide treatments. Seventy-five per cent of the dead beetles were found on Mary Washington plots. The highest numbers dead on any plot represented a population of $1.6/m^2$, or 0.3 beetles per crown planted, or 1.3 beetles per surviving crown at treatment of the plot.

Insecticide treatments produced only a slight response (9 - 13%; $P < 0.05$) in the number of new spears produced up to 7 March 1980, reflecting the lateness of the treatment. There was a significant linear relationship ($P < 0.01$) for each cultivar between the numbers of healthy fronds and new spears present on 20 November and on 7 March, showing that the damage which occurred before treatment had a marked effect on subsequent production. This underlines the need for early detection and treatment of black beetle adults.

CONCLUSIONS

In trials in different crops, it was shown that significant reductions in adult black beetle numbers may be obtained using insecticides after crop emergence.

In the three crops, presence of beetles was noticed only after the appearance of damage in the crop. Larger responses could have occurred if ground inspection for the presence of beetles had been undertaken and insecticide applied in early spring. It was likely that infestations in the sweetcorn and asparagus arose from flights of beetles in autumn, whereas beetles in the barley would have largely resulted from the infestation within the paddock.

A low stem density in many susceptible row crops, and resultant concentration of beetles under plants, together with high returns from field crops mean that economic threshold levels may occur at very low numbers compared with pasture (Watson *et al* 1980).

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REFERENCES

Drinkwater, T.W., 1978. Swartmieliekewers : nuwe plaag het ons eers geflons. *Samso 2(5):* 47-52.

Harrington, J.S., 1964. The geographical distribution of the black maize beetle, *Heteronychus sanctae-helenae* Blanchard. *J. ent. Soc. S. Afr. 26:* 438-40.

Riley, A.J., 1980. Asparagus - further diversification in Waikato. *N.Z. Fertiliser Journal No. 55:* 15-6.

Todd, D.H., 1969. Results of field experiments with diazinon and other transient chemicals for control of black beetle adults in pasture. *Proc. 22nd N.Z. Weed and Pest Control Conf.:* 296-300.

Wallace, C.R., 1946. The black beetle *(Heteronychus arator)* as it affects coastal vegetable growers and horticulturalists. *Agric. Gaz., N.S.W. 56:* 339-42, 348.

Watson, R.N., Marsden, R.S. and Townsend, R.J., 1980. Farm surveying of black beetle populations in spring as an indicator of larval populations in sumer. *Proc. 31st N.Z. Weed and Pest Control Conf.:* 103-7.

Watson, R.N., Wrenn, N.R. and Taufa, V.K., 1978a. Investigation on the control of black beetle in seedling maize. *Proc. 31st N.Z. Weed and Pest Control Conf:* 103-7.

Watson, R.N., Wrenn, N.R. and Taufa, V.K., 1978b. Insect pests of maize: detection and control. *Aglink FPP 136:* 3 p.

Watson, R.N. and Webber, K.J., 1975. Insecticide screening trials against black bettle. *Proc. 28th N.Z. Weed and Pest Control Conf.:* 264-7.

Wright, W.E., 1958. The black beetle *(Heteronychus sanctae-helenae* Blanch.). *Agric. Gaz. N.S.W. 69:* 422-7.