THE EFFECT OF TILLAGE TECHNIQUE ON INSECT PESTS OF SEEDLING MAIZE

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Summary

Insect damage to maize (*Zea mays*) seedlings sown following different methods of tillage was investigated. The main pests found were Argentine stem weevil (*Hyperodes bonariensis*) and greasy cutworm (*Agrotis ypsilon*). In the first year the tillage techniques most prone to insect attack were one pass with plough and disc, followed by minimum tillage, and direct drilling. Conventional tillage methods and rotary hoeing suffered only minor damage in the first year and benefited little from insecticide treatment. Although insecticide applications reduced the amount of damage in the direct drilled and one pass plots, appreciable losses still occurred. In the second year of the trial the one pass treatment suffered most insect damage, the conventional cultivation treatment suffered least insect damage while all other treatments were intermediate.

INTRODUCTION

The insects that commonly attack maize are well known (Given 1973; Watson 1977), two of the most common being Argentine stem weevil (Kain and Barker 1966) and greasy cutworm. Watson (1977) observed that late sown maize appeared to be more at risk to greasy cutworm attack than earlier sowings. The risk of insect attack on seedling maize is known to be high where old ryegrass pastures are cultivated quickly prior to sowing (Kain and Barker 1966; Given 1973; Watson 1977). Kain and Barker showed that Argentine stem weevil larvae moved from undecomposed turf into the germinating seedlings, killing or severely damaging them. Over recent years there has been a continuing trend to quick methods of crop establishment with minimum or no tillage techniques. These methods leave the turf mat of the previous sward intact or as clumps of undecomposed pasture and hence create conditions conducive to insect attack on the sown crop.

This paper reports on insect damage in seedling maize in the first 2 years of a trial designed to investigate the effects of different tillage techniques on dry matter production and soil structure over a 5 year period of continuous cropping.

METHODS

Trial design

The trial was a randomised block design with four replicates, sited on an experimental area at Massey University. The trial area was cropped with maize over the summer and oats during the winter. Five cultivation methods for establishing both crops were compared, traditional cultivation

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with a six week fallow, direct drilling using paraquat as an overall spray, one pass with mould board plough and vibrating tines, minimum tillage with a chisel plough and three passes with a rotary hoe. Plots were 20 x 10m. A precision maize planter was used to seed the plots.

In the first year of the trial (1976/77) when the area was cultivated out of pasture one third of each plot was undersown with 1kg/ha of carbofuran to protect the maize seedlings from insect attack. No insecticide was used in the second year. The direct drilled plots were treated with 2% metaldehyde slug pellets as slugs were known to be a specific problem of this method. The trial was sampled when the majority of plants were at the 1-2 true leaf stage.

Rows were selected randomly from the middle of each plot. In the first year the number of plants in six 1.5m lengths of each row were counted, three lengths in the insecticidally treated sub-plot and three in the untreated sub-plot. In the second year the number of plants in four 3m lengths of row were counted. Where obvious gaps appeared in rows the area was dug up and the number of seeds which had not emerged counted and the cause of death noted. Sample rows were checked a month later to see if any further plants had died from earlier damage.

The spatial distribution of most insect populations is highly aggregated, hence damage to a crop is often patchy, with large areas suffering little or no damage and other areas suffering severe damage. This was the case in this study; the amount of damage was highly variable within and between replicates.

The dependence of the variance on the mean found in the data from this study invalidates the basic assumptions of the *t* and *F* tests. The frequent occurrence of zero presents problems in transforming data to stabilise the variance. To overcome these problems the percentage of damaged plants in each sample unit (i.e. length of row) were pooled as required to minimise zeros and treatment effects were tested using Fishers exact probability test on the proportions falling above and below the combined mean of the treatments being compared.

RESULTS

The percentage of plants damaged (killed and defoliated) in each treatment are presented in Table 1. The main insect pests found were Argentine stem weevil and greasy cutworm. An unidentified species of slug did considerable damage to the first two true leaves, especially in the direct drilled plots, but did not destroy any plants and is not included in the data presented.

TABLE 1: Percentage of maize plants damaged by insects and number of plants sown in parenthesis.

Treatments	Conventional tillage	Direct drilled	One pass	Minimum tillage	Rotary hoeing	Total
1976/77						
No insecticide	2.1 ± 1.2 (138)	14.5 ± 3.0 (137)	39.0 ± 4.0 (146)	19.1 ± 4.0 (136)	2.1 ± 1.2 (141)	16.0 ± 1.4 (698)
Insecticide	1.4 ± 1.0 (143)	5.9 ± 2.0 (136)	6.2 ± 2.0 (145)	1.6 ± 1.1 (127)	2.0 ± 1.4 (148)	3.4 ± 7.0 (699)
1977/78						
	1.1 ± 0.65 (266)	9.9 ± 1.8 (273)	23.2 ± 2.5 (285)	10.0 ± 1.8 (260)	10.7 ± 1.8 (299)	11.1 ± 1.0 (1383)

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DISCUSSION

The trial site was sown out of old pasture and this is reflected in the higher overall amount of insect damage experienced in the first than the second year ($P < 0.05$).

The extent of insect damage was greatest in the one pass treatment ($P < 0.05$), least in the conventional tillage and rotary hoeing treatments ($P < 0.05$) with the minimum tillage and direct drilled treatments being intermediate. With the exception of the rotary hoeing treatment which suffered significantly ($P < 0.05$) more damage in the second than first year and hence joined the intermediate group of treatments, similar results were obtained in both years.

Even with insecticidal protection the direct drilled and one pass cultivation treatments suffered more insect damage than the untreated rotary hoeing and conventional cultivation methods.

Best results with insecticide were recorded on the one pass ($P < 0.01$) and direct drilled treatments ($P < 0.05$). In the conventional tillage, rotary hoeing and minimum tillage, the differences between insecticide and no insecticide are not significant. There is no obvious explanation of the lack of significance for the minimum tillage treatment but for the rotary hoe and conventional tillage treatments it can be explained as a result of the high level of insect control obtained with thorough cultivation. This may also be the case with the minimum tillage treatment but inspection of the means indicates rather that the lack of significance is a result of inadequate data.

CONCLUSION

Insect damage was so low under conventional cultivation that insecticidal protection of maize seedlings seems unwarranted. From these results it appears that maize planted in a seed bed prepared using the one pass technique requires insecticidal protection but the cost benefit of insecticide usage for other treatments requires a closer and more detailed evaluation.

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