INFLUENCE OF CULTIVATION, SOWING DATES AND THE LIFE CYCLE OF ARGENTINE STEM WEEVIL RELATIVE TO SEEDLING SURVIVAL IN MAIZE

G.M. BARKER, R.P. POTTINGER AND P.J. ADDISON

Ruakura Soil and Plant Research Station, MAF, Hamilton

SUMMARY

Damage to seedling maize *(Zea mays)* by larvae of Argentine stem weevil *(Listronotus bonariensis) was* affected by cultivation period, sowing dates and the insects life history. There was a close relationship between egg and larval numbers in the pasture before cultivation and subsequent seedling damage, with crops sown in October and early November at greatest risk. Control (< 10% damage) was obtained from a cultivation period prior to sowing (15 days or more for mid-November to mid-December sowings).

INTRODUCTION

The Argentine stem weevil, is a major pest of graminaceous crops in New Zealand due to the stem-boring habit of the larvae. The bionomics of the weevil in pasture has been studied by Kelsey (1958), Pottinger (1961a,b), May (1961), Barker and Pottinger (1982), and Barker *et al* (1981). Goldson (1981) has studied the reproductive seasonality of the weevil. There are regional variations in the timing of the life cycle events and the dynamics of the populations.

Kain and Barker (1966), Given (1973), Watson (1977) and Watson and Wrenn (1978) have described Argentine stem weevil damage in maize seedlings. The source of infestation is by transference of larvae from decomposing grass tillers into the emerging maize plants. Larvae can successfully hatch from eggs on dead and dying pasture plants. Total crop loss may result at the seedling stage if cultivation is inadequate or the maize is not protected by insecticide. Kain and Barker (1966) and Watson and Wrenn (1978) noted that infestation was greatest in crops grown on land newly cultivated out-of pasture, and the longer the period between cultivation and sowing, the less severe the damage. Watson and Wrenn (1978) suggested that prevention of larval damage can be obtained from a cultivation period of at least 4 weeks prior to sowing or by application of insecticide. In a comparison of tillage techniques, Carpenter *et al* (1978) and Carpenter (1981) found that direct drill, one pass minimum tillage, and rotary hoeing methods suffered greater larval damage than the conventional tillage method. Damage was highest for the first year following pasture; crops sown in the same ground in subsequent years suffered variable but generally lower levels of insect damage. The damage in the latter was dependent on the presence of Argentie stem weevil infested grass weeds prior to sowing maize.

In all previous studies of Argentine stem weevil in maize, there has been little consideration given to the overall life cycle of the pest. The aim of the trial reported here was to relate the period between cultivation and sowing to the life history of stem weevil and ultimately to seedling mortality.

MATERIALS AND METHODS

The trial site was a second year ryegrass-white clover pasture at the Ruakura Agricultural Research Centre, on a Te Kowhai clay loam soil.

Plots were cultivated out of pasture at 10 day intervals from 25 August 1980 until 25 December 1980. The plots were cultivated by hand to simulate rotary hoeing. From 10 October to 30 December 1980, subplots were sown at intervals between 0 and 45 days after cultivation. As an additional treatment, at each sowing, maize was direct drilled into desiccated pasture. Each sub-plot consisted of a single row of maize seeded longitudinally in an area 1.0 x 3.0 m. All treatments were replicated four times. Adjacent plots and replicate blocks were separated by 1.0 m wide buffers of pasture.

Rotary hoeing was simulated by spade dicing and digging. On the day of sowing, these plots were reworked with the spade to produce a satisfactory seed bed. For the direct-drilled plots, the pasture was desiccate by paraquat immediately prior to sowing. Maize seed (hybrid Pioneer 3709) was sown by hand at 10 cm spacings (equivalent to 100 000 seeds/ha) in spade formed furrows to 5 cm depth, without insecticide.

Plant counts were made at 5 day intervals from emergence of seedlings to assess the numbers attacked by stem boring larvae. Cumulative totals were used to calculate the percentage losses presented in this paper. Causes of emergence failure were checked by digging up and examination of the seed. Sampling was confined to the central 25 plants of each row.

During the period 25 August 1980 to 2 April 1981 Argentine stem weevil populations were monitored by sampling the pasture buffer zones between plots. Four replicate tiller samples were collected at 10-15 day intervals by shearing at ground level. In the laboratory 200 representative tillers from each sample were searched for eggs before extraction of the larvae by Goldson's (1978) procedure. Tiller densities were estimated from 50 turf plugs (4.8 cm dia.) on 3 September 1980, 2 December 1980, 15 January 1981, and 2 April 1981. Populations of adult weevils were estimated at 10-15 day intervals from fifty 7.5 cm dia. cores. Weevils were recovered by wet sieving and flotation.

Air temperature at 10 cm height and soil temperature at 5 cm depth in cultivated soil were monitored on a continuously recording hygrothermograph on site.

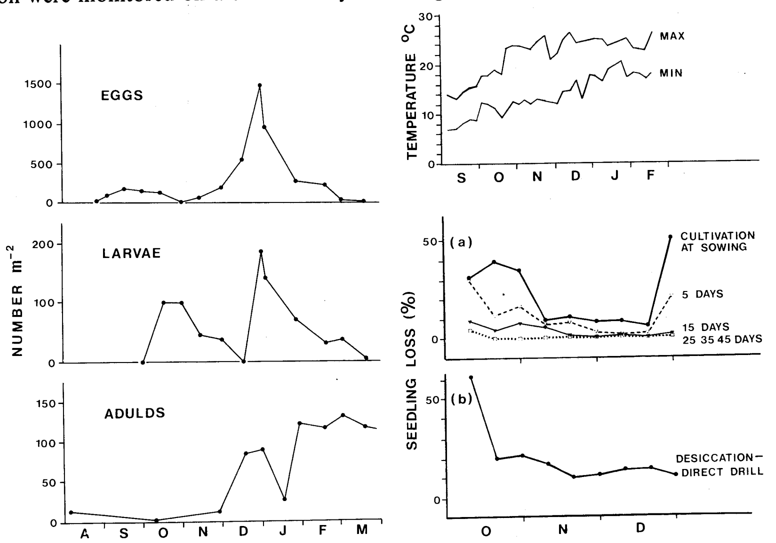

Fig. 1. (Left) Argentine stem weevil egg, larval and adult populations in pasture.

2. (Top right) Five daily mean maximum and mean minimum temperatures for cultivated soil (5 cm depth).

3. (Bottom right) Maize seedling losses due to stem weevil at sowing dates for various cultivation intervals.
(a) Cultivated plots.
(b) Direct drilled plots.

RESULTS AND DISCUSSION

Argentine stem weevil egg, larval and adult populations from the pasture are presented in Fig. 1. As is typical of Waikato pasture (Barker and Pottinger 1982; Barker *et al* 1981) the low number of overwintered adults produced a small spring generation which in turn produced a significantly larger summer generation.

Throughout the trial period there was a steady rise in air and soil temperature (Fig. 2). Temperature was monitored as it has a four fold effect. Temperature may affect the rate of turf breakdown, rate of larval transfer to maize seedlings, the rate of seedling growth, and rate of plant damage.

Seedling mortalities for all treatments are shown in Fig. 3. Only those seedlings killed by stem boring larvae are included. In the cultivated plots seedling mortalities were directly related to egg and larval abundance at cultivation and inversely related to the number of degree days between cultivation and sowing calculated from the soil temperature measurements ($R^2 = 0.82$; $P < 0.01$) : % mortality = 0.36 + 0.015 (No. eggs + larvae/m^2) + 4415 (No. degree days)$^{-2}$. It is proposed to investigate the general applicability of this relationship in future field trials. Seedling lossed in cultivated plots were greater in October and late December when first and second generation larvae respectively were present in high numbers, than in November and early December sowings ($P < 0.05$). Throughout the trial period seedling losses were minimal if 25 days or more elapsed between initial cultivation and sowing (Fig. 3a).

Sowing of grain maize and sweetcorn in the South Auckland province extends from early October to mid December. Most maize is sown between 10 October and 15 November as there are agronomic advantages in early sowing (McCormick 1974; Farrell 1975). Crops sown at this time are particularly at risk unless sowing is preceded by an adequate cultivation period or crops are protected by insecticide. The results of the present trial confirm earlier findings (eg. Watson and Wrenn 1978) that a period of 4 weeks fallow is required to reduce stem weevil damage to safe levels ($\angle$10% seedlings damaged). The damage potential was lower for the period 15 November to 15 December because of the lower numbers of Argentine stem weevil pre-adult stages in pasture grass tillers, during this period a minimum of 15 days cultivation was adequate (Fig. 3a).

Over the 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 or stubble in an an undecomposed state and create conditions conducive to stem weevil larval transference (Watson and Wrenn 1978, Carpenter *et al* 1978, Carpenter 1981). In the present trial the direct drilled plots were sown immediately following application of the desiccant, paraquat. Seedling losses during October early-November related well to insect abundance but for subsequent sowing dates larval survival and damage were lower ($P < 0.001$). At the later sowings, the rapid desiccation of the grass tillers and the higher temperatures probably contributed to lower insect survival but seedling losses with direct drilling were never less than 10% (Fig. 3b).

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