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EVALUATING LONG TERM CONTROL OF AMNEMUS SUPERCILIARIS (PASCOE) WITH PRE-SOWING INSECTICIDAL TREATMENTS IN DESMODIUM PASTURES

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SUMMARY

Dieldrin and heptachlor pre-sowing soil treatments were evaluated for long term control of *Amnemus superciliaris* (Pascoe) in *Desmodium* spp. in a trial in south-eastern Queensland during 1969–1975. Treatments significantly reduced infestations of the weevil and root damage for 3 to 6 years. However, injury by the weevil in untreated areas did not produce a serious enough decline in legume density to justify treatment. The maintenance of favourable growing conditions enabled the pasture to compensate for loss of damaged plants.

I. INTRODUCTION

The weevils *Amnemus superciliaris* (Pascoe) and *Amnemus quadrituberculatus* (Boheman) are recorded from northern New South Wales and south-eastern Queensland. In northern New South Wales, they infest clovers and tropical legumes. In south-eastern Queensland, *A. superciliaris,* and to a much lesser extent *A. quadrituberculatus* are pests of greenleaf desmodium (*Desmodium intortum*) and silverleaf desmodium (*Desmodium uncinatum*).

Adult weevils feed on the foliage of *Desmodium* spp. from November until the end of summer but the main injury is caused by larvae feeding on roots from April until pupation in early spring. The roots are destroyed or cinctured, causing wilting and death of the plant.

Braithwaite and Jane (1963) investigated chemical control of *A. superciliaris* and *A. quadrituberculatus* in northern New South Wales and found that surface applications of dieldrin during January controlled both species in white clover (*Trifolium repens*), red clover (*T. pratense*) or subterranean clover (*T. subterraneum*) for one year. As residues from surface applications of dieldrin were unacceptable in grazing pastures, Braithwaite, Gilbert and Jane (1965) investigated the possibility of sub-surface granule applications. Rand and Braithwaite (1975) showed that pre-sowing soil treatments with dieldrin and heptachlor gave control of *A. quadrituberculatus* for 2 years with a decline in control in the third and subsequent years.

In 1969 an experiment was established at Cooroy to assess the control given of *Amnemus* spp. in desmodium pastures by pre-sowing soil treatments (using dieldrin dust or heptachlor granules) and the influence on the pasture of weevil control. *A. superciliaris* was the only species occurring in significant numbers.

II. METHODS

The experimental layout was a 5 x 4 randomized block with plots 6 m wide by 83 m long. The datum area of each plot was a 2·4 m x 75 m median strip. Plots were separated by untreated areas 2 m wide and blocks by untreated areas 4·5 m wide.

The soil, a shallow clayey loam on a north-east slope, was worked up on 30 October 1969. Heptachlor as a granule containing 10% w/w active constituent and dieldrin as a dust containing 1% w/w active constituent were pre-mixed with superphosphate and applied to the soil surface from the fertilizer box of a sod seeder. Heptachlor was used at 0·56, 1·12 and 2·24 kg ha^{-1} and dieldrin at 1·12 kg ha^{-1}. Superphosphate was applied to the untreated plots and guard strips. The trial area was then disced to a depth of 10 to 15 cm to work the insecticides into the soil. On 31 October 1969 the trial area was seeded with *D. uncinatum* at 5·6 kg ha^{-1} and a mixture of *D. intortum,* Nandi setaria (*Setaria anceps*) and white clover (*T. repens*) each at approximately 2·2 kg ha^{-1}. During the course of the experiment, 1969–1975, the trial area received 41·2 kg ha^{-1} of superphosphate at pre-sowing, 103 kg ha^{-1} in 1971, and 61·8 kg ha^{-1} in 1973 and again in 1974. The stocking rate during this period was approximately two cattle per hectare.

Rooted plants (not connected to a stolon) were counted in 20 random 1 m^2 quadrats per plot for a plant density assessment. This assessment was made on *D. uncinatum* on 16 April 1970 and in the winters of subsequent years up to 1975. Plant density assessments were made on *D. intortum* in the winters of 1973 to 1975.

Twenty-five random soil samples, 0·1 m^2 in area and 25 cm deep, each including one to four plants were taken per plot. Assessment was made of root damage by examining the roots of all of the plants in the soil samples and the percentage of root damage was calculated. Larvae in the soil samples were hand-sorted and the number recorded. Root damage assessments and larval counts were made on *D. uncinatum* in the winters of 1971 to 1975 and *D. intortum* in the winter of 1975.

III. RESULTS AND DISCUSSION

Root damage levels

Adult weevils were first observed on the trial area during December 1970 to February 1971, and in July 1971, 56% of roots examined in the untreated plots had sustained some damage. Subsequent root damage in the untreated plots did not greatly vary, peaking at 68·5% in 1972. By comparison, Rand and Braithwaite (1975) reported peak root damage levels of 42·4%, 22·0% and 82·0% in three trials on *A. quadrituberculatus.*

A significantly lower level of root damage than in the untreated plots was maintained by the heptachlor 0·56 kg ha^{-1} treatment in *D. uncinatum* up to 1972 ($P < 0{\cdot}01$), by the heptachlor 1·12 kg ha^{-1} and dieldrin 1·12 kg ha^{-1} treatments up to 1974 ($P < 0{\cdot}07$ except 1974 where $P < 0{\cdot}05$), and by the heptachlor 2·24 kg ha^{-1} treatment up to 1975 ($P < 0{\cdot}01$) (figure 1). The root damage levels of *D. intortum* in 1975 were significantly lower in the heptachlor 1·12 kg ha^{-1} and 2·24 kg ha^{-1} treatments ($P < 0{\cdot}05$ and $P < 0{\cdot}01$ respectively) than in the untreated plots.

This assessment did not distinguish between roots slightly and seriously damaged and some damaged plants undoubtedly survived the attack.

Larval numbers

An average of 0·8 larvae were recorded per sample during the trial in the untreated plots. Larval numbers remained low in the heptachlor 1·12 kg ha^{-1} and 2·24 kg ha^{-1} and dieldrin 1·12 kg ha^{-1} treatments but built up to a level similar to the untreated in the heptachlor 0·56 kg ha^{-1} treatment as early as 1972 (figure 1).

Legume density

The density of *D. uncinatum* was even over the trial area in April 1970. In untreated plots the density of *D. uncinatum* remained relatively unchanged from the 1970 level except in 1971 when density increased over the whole trial, and in 1974 when it fell over the whole trial (figure 2). An exceptionally high rainfall (5 299 mm) was received in the 12 month inter-sampling period July 1973 to July 1974 (figure 2) and although there was no apparent water-logging, wetness and disease may have contributed to the 1974 reduction in density. Similarly the density of *D. intortum* in untreated plots did not vary in 1973 and 1975 but fell over the whole trial in 1974.

The density of *D. uncinatum* was significantly higher ($P < 0·01$) in treated, than in untreated plots first in 1973. In 1975 significant differences from the untreated ($P < 0·05$) occurred again with the heptachlor 1·12 kg ha^{-1} and 2·24 kg ha^{-1} treatments in *D. uncinatum* and the heptachlor 2·24 kg ha^{-1} treatment in *D. intortum*. No significant difference occurred in the plant density of *D. uncinatum* in 1970–72 and 1974. (figure 2).

From the data on *D. uncinatum*, correlations were tested between root damage for one year and legume density for the following year and between root damage and legume density for the same year. However, the plant density changes could not be confidently related to root damage. Statistically significant, but not strong correlations were recorded between root damage in 1972 and plant density in 1973 ($r = -0·7413$ ($P < 0·01$)) and similarly in 1974–75 ($r = -0·4970$ ($P < 0·05$)). A significant correlation ($P < 0·01$) also occurred between root damage and legume density in the same year, 1973 ($r = -0·6964$).

Heavy infestations of the weevil during 1971–1975 failed to permanently affect the desmodium pasture in untreated areas possibly because of the legumes' capacity for recovery and re-establishment. Favourable growing conditions experienced during the trial encouraged the recovery of less severely damaged plants and the establishment of fresh plants and volunteer seedlings. Above average rainfall occurred in 4 of the 6 years of the trial (figure 2), fertilizer was applied approximately every 2 years and over-grazing was avoided. No serious competition from grasses or weeds occurred.

IV. CONCLUSION

A significant reduction in weevil infestation and root damage was given by the heptachlor 0·56 kg ha^{-1} for 3 years, by the heptachlor 1·12 and dieldrin 1·12 kg ha^{-1} treatments for 5 years and by the heptachlor 2·24 kg ha^{-1} treatment for 6 years. Weevil injury in untreated areas, although as high as 68·5%, did not produce sufficient drop in legume density in the mixed pasture to warrant treatment. The maintenance of favourable growing conditions (facilitated by availability of moisture and fertilizer and freedom from disease, excessive competition and grazing pressure) enabled the pasture to compensate for loss of damaged plants.

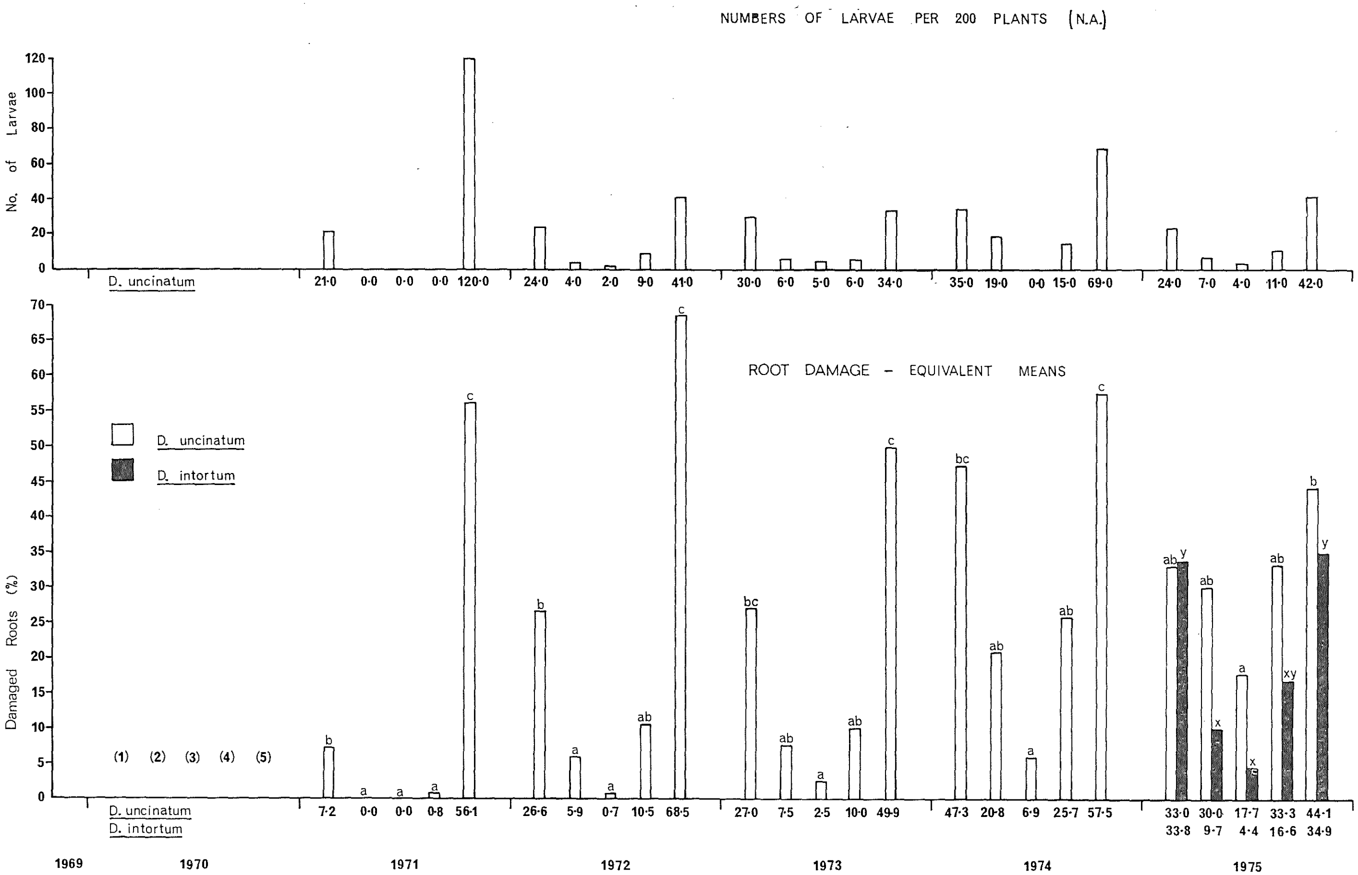

Figure 1. Root damage levels by A. superciliaris *in* D. uncinatum *1970–1975 and* D. intortum *1975, and larval numbers 1971–1975. Treatments—(1) Heptachlor 0·56 kg ha^{-1}, (2) Heptachlor 1·12 kg ha^{-1}, (3) Heptachlor 2·24 kg ha^{-1}, (4) Dieldrin 1·12 kg ha^{-1}, (5) Untreated. Treatments followed by the same small letter (a, b, c—*D. uncinatum*; x, y—*D. intortum*) are not significantly different at the 5% level. N.A. = not analysed. Equivalent means obtained from arc sine transformation.*

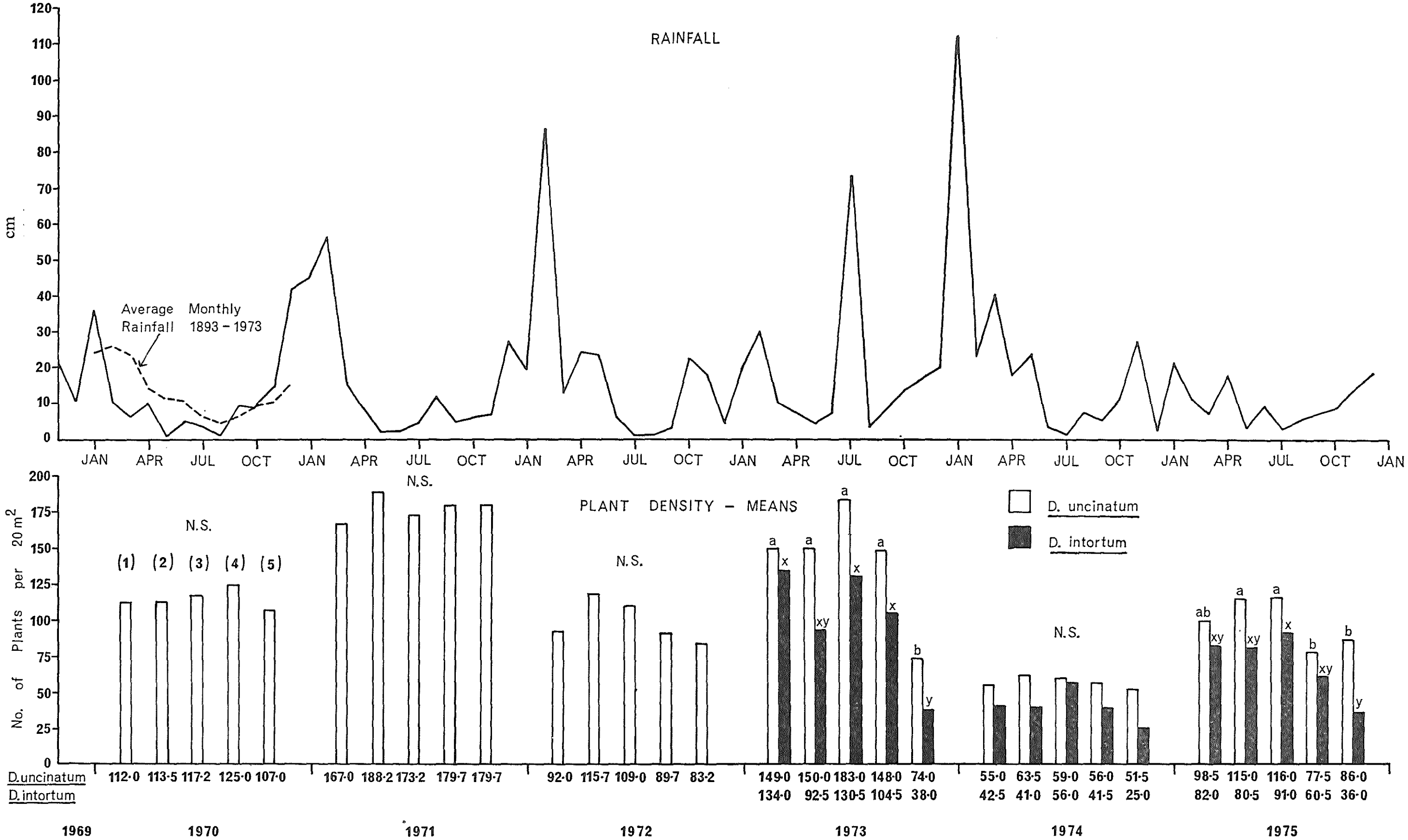

Figure 2. Density of D. uncinatum *1970–1975 and* D. intortum *1974–1975, and the mean monthly rainfall at Cooroy 1970–1975. Treatments—(1) Heptachlor 0·56 kg ha^{-1}, (2) Heptachlor 1·12 kg ha^{-1}, (3) Heptachlor 2·24 kg ha^{-1}, (4) Dieldrin 1·12 kg ha^{-1}, (5) Untreated. Treatments followed by the same small letter (a, b—*D. uncinatum*; x, y—*D. intortum*) are not significantly different at the 5% level. N.S. = no significant differences.*

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