A SIMPLIFIED TECHNIQUE FOR RAPID ESTIMATION OF ADULT ARGENTINE STEM WEEVIL POPULATIONS

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The Argentine stem weevil (*Listronotus bonariensis*) is a major pest of pasture because larvae destroy grasses by mining tillers. Consequently there is considerable interest amongst researchers, product development personnel, consultants and farmers in methods to quantify the intensity of pasture infestation. Data from such methods would provide information for agrochemical and cultivar testing programmes and for diagnosing summer pasture decline.

In this paper a simple technique is described for estimating adult weevil populations in pastures. The technique has been designed to allow sampling and insect counting in the field, with minimal requirement for labour or equipment, yet enable population estimates to be made with an acceptable level of precision. The method uses the adult weevil behaviour of hiding on the soil surface during the day, and of remaining inactive, with legs folded over the body, when disturbed.

The Technique

Steps:

- 1 Cut square turf from pasture with a spade.
- 2 Dislodge weevils by inverting and dropping the turf onto a tray. Rake the soil surface of the grassed side of the turf with fingers or comb, and repeat.
- 3 Replace turf into the pasture
- 4 Repeat steps 1-3 for the number of spade square turves required for the sample (usually 5)
- 5 Pour contents of the tray, through a 5 mm mesh sieve into a bucket of clean water. If there is a large quantity of buoyant material, distribute between several buckets.
- 6 Shake sieve to ensure all small particles, including weevils, drop through to water. Discard sieve contents.
- 7 Agitate the water with a paddle.
- 8 Allow water to settle for several minutes.
- 9 Remove weevils from water surface for counting.
- 10 Calculate weevil density per square metre.

Technique Performance

Population estimates using this simple technique were slight underestimates of the population, compared to fifty 75 mm diameter soil core samples extracted by a laboratory wet sieving and flotation method (Barker and Addison in press) (Fig. 1). Sources of variation in population estimates from the turf sampling technique are the varying rates of recovery of weevils and the lack of size uniformity in spade-cut turves. Tests indicated that 81-96% (mean 87.9%) of weevils were recovered from the spade square turves in the field. Measurements of turves cut from pastures with a 180 mm wide spade resulted in turf sample units of $320 \pm 12 \text{ cm}^2$ and $336 \pm 27 \text{ cm}^2$ when cutting turves with and without the aid of a template respectively. A guide frame reduces the error.

Weevil counts per five 180 mm wide spade square turves can be directly converted to numbers/m² by a conversion factor of 6.17. This underestimates true density. Alternatively the number can be calculated from an equation which incorporates a correction factor (1).

$$\text{No./m}^2 = 2.220 + 34.236 \text{ No./spade square} \quad (1)$$

This estimate was derived from the regression of weevils per spade square against Proc. 41st N.Z. Weed and Pest Control Conf.

numbers/m² estimated from soil coring and laboratory extraction (Fig. 1).

Fig. 1: Regression of adult weevil population estimates from spade squares — field extraction against estimates from soil cores — laboratory extraction.

Taylor (1961, 1971) has shown that the mean ($\bar{x}$) and variance (s^2) calculated from a series of samples from natural populations are related by a power law: $S^2 = a\bar{x}^b$ where $\bar{x}$ is the mean number of insects per core; a is a scaling factor characteristic of the species and related to the environment, sampling procedure, and sample unit employed; b is a measure of aggregation. Randomly distributed populations have $b=1$, aggregated populations have $b>1$, and populations with a tendency toward a regular distribution have $b<1$.

The relationship between mean and variance for the turf samples (Fig. 2) was adequately described by Taylor's power law, estimated by least squares to be:

$$S^2 = 1.269 \bar{x}^{0.931} \quad (2)$$

The number of spade squares (n_s) required to attain a specified level of precision (D), illustrated in Figure 3, was derived from

$$n_s = a/D^2 \bar{x}^{2-b} \quad (3)$$

where a and b are the coefficient and exponent of Taylor's power law respectively, and D is the ratio of the standard error of the mean to the mean.

The speed at which populations were estimated using the technique is dependent on the number of spade squares taken, the amount of debris, and the number of insects in the samples. At insect densities within the range 5-10 per spade square, 12-15 and 15-20 minutes are required, respectively, for samples of 5 and 10 spade squares.

This technique allows quick estimates of Argentine stem weevil adult populations at an acceptable level of accuracy for decision making on control strategies or for monitoring surveys.

Fig. 2: Regression of the mean adult weevil populations estimated from spade squares — field extraction against the associated variance.

Fig. 3: Numbers of spade squares required to achieve a given level of precision for estimating adult weevil populations using the spade square-field extraction technique. D = the ratio of the standard error of the mean to the mean.

REFERENCES

- Barker, G.M. and Addison, P.J. (in press). Sampling Argentine stem weevil (*Listronotus bonariensis*) populations in pasture. Soil-dwelling stages. *N.Z. J. Agric. Res.*
- Taylor, L.R. 1961. Aggregation, variance and the mean. *Nature* 189: 732-735.
- Taylor, L.R. 1971. Aggregation as a species characteristic. pp 357-377. In: G.P. Patil, G.E. Pielou, and W.E. Waters (eds), *Statistical Ecology*, Vol. 1. Pennsylvania State University, Philadelphia.