SAMPLING THRIPS ON A *VIBURNUM* HEDGE

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ABSTRACT

Thrips are common pests on ornamental plants, but reliable methods for estimating their density are not available. A leaf-sampling method to estimate the density of greenhouse thrips, *Heliothrips haemorrhoidalis,* on a *Viburnum tinus* hedge was investigated. Random leaf sampling was carried out on seven occasions and data were analysed using optimum sample size formulae to calculate the minimum sample size required to reliably estimate thrips density. Thrips densities were shown to vary widely through space and time and sample sizes required for a fixed level of precision were large. The main implication of these results for monitoring thrips is that more time efficient methods should be explored.

Keywords: greenhouse thrips, ornamental plants, *Viburnum*, sampling, dispersion.

INTRODUCTION

A variety of thrips species is found on ornamental plants and they frequently cause damage that ranges from minor leaf speckling and discolouration that reduces aesthetic appeal to premature leaf senesence and plant death (Dreistadt *et al.* 1994). Some thrips species have also been implicated in the transmission of plant pathogens (Ullman *et al.* 1997). Control of thrips on ornamental plants has commonly relied on the application of insecticides, although biological and cultural methods can sometimes be employed (Lewis 1997).

In many urban areas where ornamental plants are grown to enhance the landscape, the application of insecticides is increasingly being questioned. Their application can now only be made when justified, i.e., when pest numbers or damage exceed a threshold. Unlike some horticultural production systems, reliable methods for sampling and estimating thrips populations on ornamental plants in urban landscapes are not available.

The aim of this study was to investigate a method for sampling thrips to estimate population density on a common ornamental plant.

MATERIAL AND METHODS

The study was carried out on a *Viburnum tinus* L. hedge on the Lincoln University campus. The hedge, bordering lawn and garden, was approximately 90 m long and orientated in a north-south direction. The average height of the hedge was 3.0 m. On the western side of the hedge, eight 5-metre plots were marked out with 5-metre buffers between each plot. In each plot, three strata were defined; lower (below 1.0 m), middle (1.0 to 2.0 m), upper (2.0 to 3.0 m). Using random numbers, 30 sample positions were located along each plot and assigned randomly to one of the three strata. As thrips were mainly found on new season's growth, the first leaf of new season's growth located at each position was removed and placed in a plastic vial which was capped to retain any active thrips. Sampling was done on 7 occasions between 5 October 1998 and 12 February 1999. The numbers of immature and adult thrips on each leaf were recorded and a subsample of 20 leaves from each sampling occasion was measured to determine the average leaf area.

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To investigate variability of sample size requirements, sample data were analysed using optimum sample size formulae that calculate the minimum sample size required to reliably estimate thrips density. Two optimum sample size formulae were compared. The first is a general formula for samples of reasonable size (e.g., 30 sample units) (Karandinos 1976):

$$n = \left(\frac{z_{\alpha/2}}{D}\right)^2 \frac{\sigma^2}{\mu^2}$$

where *n* is the smallest sample size required for a reliable estimate equal to a fixed proportion *D* (in this study 20%) of the mean μ. The parameter σ is the standard deviation of the sample and $z_{\alpha/2}$ is the upper *α/2* point of the standard Normal distribution.

The second formula used assumes that the parent distribution is the Negative Binomial distribution, often used to determine optimum sample sizes for aggregated populations (Karandinos 1976):

$$n = \frac{z^2_{\alpha/2}\left(\frac{1}{\mu} + \frac{1}{k}\right)}{D^2}$$

where k is the parameter of the Negative Binomial distribution (NBD).

To detect changes in population dispersion over time, Lloyd's index of patchiness (*I*) (Pedigo and Buntin 1994) was also calculated for each plot on each sample occasion.

RESULTS

The predominant thrips species found on the hedge was greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché). Low numbers of thrips were sampled from October to January; the mean number of thrips per sample unit did not exceed 0.75/leaf (Fig. 1, sample data pooled over the eight plots). The thrips population rapidly increased between the penultimate (17 January) and final sample date (12 February) when mean thrips/leaf (± s.e.) for the pooled data increased to 5.26 ± 2.65. Mean thrips/cm^2 followed the same trend (not shown) despite the fact that the average leaf area increased 85% (from 10.17 to 18.75 cm^2) over the sample period. Because the areas of individual leaves were not recorded, no further analysis was carried out on this density measure.

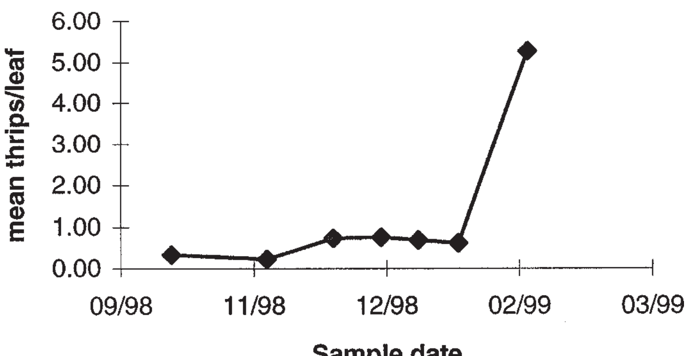

FIGURE 1: Estimates of mean thrips/leaf from 5 October to 12 February on a *Viburnum tinus* hedge at Lincoln University. Data are pooled over the 8 plots (n = 240).

TABLE 1: Variability in density estimates, sample size requirements and index of patchiness within the eight plots over the sample period for greenhouse thrips on a *Viburnum tinus* hedge at Lincoln University.

Sample date	Range of plot estimates of mean thrips/ leaf (± s.e.)	No. of samples size required (General formula)	No. of samples required (NBD)	Index of patchiness (*I*)
5 Oct	0.03[a] (0.03)	2881	-	-
	1.50[b] (0.43)	235	219	2.78
6 Nov	0.0 (-)	-	-	-
	0.97 (0.35)	372	320	3.84
1 Dec	0.0 (-)	-	-	-
	2.37 (0.53)	146	332	2.09
19 Dec	0.60 (0.18)	269	335	3.27
	1.03 (1.27)	146	196	1.55
2 Jan	0.30 (0.14)	600	800	3.91
	1.50 (0.28)	99	187	1.37
17 Jan	0.37 (0.14)	418	485	2.62
	1.07 (0.26)	168	284	1.82
12 Feb	0.30 (0.13)	526	568	3.14
	18.23 (2.75)	66	66	1.63

[a] Smallest estimate
[b] Largest estimate

Considerable variability was found over the eight plots on each sample occasion. Table 1 shows the range of estimates of mean thrips/leaf/plot (± s.e. for the corresponding plot), the minimum sample size (when this could be calculated) required for an estimate of mean thrips/leaf ± 20%, for the general formula and the formula based on the NBD, and Lloyd's index of patchiness (*I*). Clearly, the sample sizes required to obtain reliable estimates of thrips density before February would be costly. The number of leaves that would need to be examined did not fall below 100 until higher densities of thrips were recorded on the last sample date. Furthermore, considerable variability was found over the small spatial distances represented by the plots. For the February sample date, mean thrips/leaf varied from 0.30 ± 0.13 to 18.23 ± 2.75. The sample size formula for the NBD gave higher optimum sample sizes than the general formula and for both formulae, the sample size increased with increasing aggregation (increasing values of *I*).

DISCUSSION

Greenhouse thrips is commonly found on *Viburnum* species, other ornamental plants and crops (Mound and Walker 1982). This study has shown that, for sampling thrips on ornamentals, a simple random sample of fixed size would be costly, especially when thrips numbers are low. In addition, the thrips showed an aggregated dispersion pattern and considerable variability in densities over small spatial distances. Even when the data for the eight plots were pooled (giving a fixed sample size of 240 leaves), the lowest sample size calculated by the general formula for an estimate of mean densities with ± 20% precision, was 242 leaves.

Of particular concern is the observation that symptoms of leaf damage became evident even at low thrips densities. For ornamentals, where the aesthetic appearance of the leaves is important, the levels of damage observed would probably be above the tolerance threshold (e.g., > 5% leaf discolouration). The results of this study suggest that because of variability in estimates of thrips densities over time and space, the determination of an acceptable action or tolerance threshold at low thrips densities would require very large sample sizes.

In addition to obtaining information on optimum sample sizes and thrips dispersion, a secondary objective of this study was to obtain baseline data for an experiment to determine the effect of predator release on thrips populations. The variability detected between plots and over time indicates the value of such data. For example, while plots 2, 4, and 7 consistently had the highest estimates of mean thrips/leaf from October to January, plots 5 and 6 (that previously had low estimates) showed higher mean densities on the February sample date (when plot 5 had the highest estimate). Such variability could confound interpretation of the effect of predators in an experiment with small (but normally acceptable) numbers of replicates.

For monitoring thrips, other sampling methods that are more time efficient and that are easy to implement by the nonexpert, should be explored. Once an action/ tolerance threshold has been established, binomial (presence/absence) sampling linked with such a threshold may provide an effective protocol. Several such sampling protocols have been developed for thrips on crops (e.g., Steiner 1990; Navas *et al*. 1994).

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