A SEQUENTIAL SAMPLING PLAN FOR LARVAE OF WISEANA SPECIES

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Summary

An example of a technique for sampling areas of porina (*Wiseana* spp.) infestation is detailed, together with a brief outline of the sampling methods involved. The disadvantages and advantages of such a technique are discussed and some idea given of possible future applications. It was concluded that the plan has limited application at present but could be extended with further study.

INTRODUCTION

ACCURATE SAMPLING of porina (*Wiseana* spp.) larvae is usually a time-consuming, laborious process. This is due to the particular type of larval distribution involved. This paper is a research report dealing briefly with work carried out in developing a sampling system for porina larvae.

A sequential sampling system (which reduced the sampling effort involved) was developed by Morris (1954) for spruce budworm. It was thought that the application of such a system could form a base for the development of a standardized sequential sampling plan for porina larvae.

SAMPLING METHODS

SAMPLING INSTRUMENT

Previous work has shown that, for practical and reasonably accurate sampling, a 5½ in. width spade cutting a 6 in. square hole (quarter of a square foot) to the spade's depth (8 to 10 in.) is sufficient for most work. Care must be taken, however, to extract all the larvae present in the soil. Essentially this means careful hand-sifting of the sample, preferably on a sack, with the soil being systematically crumbled to particles not greater than ½ in. diameter.

SAMPLE AREA AND SAMPLE NUMBER

It is known that porina larval populations are not randomly distributed over a paddock, so extreme care must be exercised when actually sampling. Thus it is vitally important to cover the whole paddock as randomly as possible, and not concentrate on areas of known porina infestations. This means using some form of stratification, namely, dividing the paddock into blocks and sampling each block in the manner described below. With a paddock size of, say, 25 acres, five 5 acre blocks should be individually sampled. The number of samples taken in each block should be a minimum of two and preferably more, with a minimum of 10 samples per paddock.

SAMPLING POINT

In a sampling system for an aggregated subterranean insect such as porina larvae, the method used to obtain the actual sampling point is of paramount importance.

Using the stratified layout mentioned above, the actual sample point can be found by using random numbers to obtain different pairs of figures, forming co-ordinates for each sampling point.

Starting from a previously selected corner of a block, the distance given by the first figure of the pair is paced along one side of the block. The operator then turns at right-angles and paces the distance as given by the other number. When the latter distance is reached, the point of the operator's shoe on the final step should be the actual sampling point. It is stressed that this system be rigidly adhered to and no account taken of signs of damage which may appear either side of the actual sampling point.

SAMPLING TIME

This sampling plan should only be used over the February-April period and, until further data are available, only in the Canterbury region. It is possible, however, that with the accumulation of more basic data the plan could be extended to give good results over a longer period and over a larger area.

INFESTATION CLASSES

It is desirable that infestation classes set up for larval populations assessed in the February-March period conform approximately to levels capable of causing enough damage to warrant possible later control (say, by chemicals). There are obvious difficulties in trying to obtain infestation classes of this nature owing to such variations as soil conditions, plant cover and grazing pressure. It was felt that, as there are very few biologically significant, quantitative data on damaging populations, no attempt has been made to define at this stage infestation classes based on economic standards.

For this article three classes of larval infestation will be assumed:

- (1) Greater than 4 per spade square (> 4 sp. sq.).
- (2) Greater than 2 per spade square but less than 3 per spade square ($> 2 < 3$ sp. sq.).
- (3) Less than 1 per spade square (< 1 sp. sq.).

This does not mean that four larvae per spade square or one larva per spade square constitutes a population capable of causing economic damage. These classes have merely been selected for ease of calculation.

THE SEQUENTIAL PLAN

Work carried out at Lincoln has shown that porina larval populations conform to a negative binomial distribution. This was determined by establishing a relationship between mean and variance for many sets of sampling data, covering a wide range of population means. Using a method described by Anscombe (1949) the factor k of the function $m + (m^2/k)$ was obtained (m equals the mean of the population). The function $m + (m^2/k)$ describes the variance of the distribution for negative

FIG. 1: Acceptance and rejection lines used for sampling porina larval populations.

binomial frequency data. The estimated k , calculated to be 1.19, compared most favourably with the actual theoretical value for a negative binomial series (Bliss and Owen, 1958).

Using the k value of 1.19 and the layout as detailed by Morris (1954), it was possible to calculate and plot the acceptance and rejection lines for the infestation classes already mentioned (Fig. 1). For ease of operation in the field, it is best to use a table which can be read from the graph (Table 1).

APPLICATION OF THE PLAN

The operator, when sampling, records the number of samples and the cumulative number of larvae obtained. It is the writer's opinion that at least 10 samples per paddock be taken before the table is consulted. When using the table, it is helpful to visualize each line of the zones shown in Fig. 1 and Table 1 as enclosing a band from which the point (cumulative number of larvae per spade square) must escape before the infestation class is satisfactorily defined. For example, if after sampling ten points the cumulative number of larvae equals three, then the infestation can be classified without further sampling as < 1 per sp. sq. On the other hand, if the number equals 15, then the point is enclosed in Zone A and more sampling must be carried out until the point escapes either into the $> 2 < 3$ per sp. sq. infestation class, or the < 1 per sp. sq. class. If it is found that, after continued sampling, the point has not escaped, then an estimate can be used based on the class toward which the point is drifting towards either the < 1 class or $> 2 < 3$ class if it was "trapped" in Zone A.

TABLE 1: CUMULATIVE NO. OF LARVAE PER SPADE SQUARE

Sample No.	Zone A		Zone B	
	Line 1	Line 2	Line 3	Line 4
10	7	↔ 20	6	↔ 65
11	9	↔ 22	9	↔ 68
12	11	↔ 24	12	↔ 71
13	12	↔ 25	15	↔ 75
14	13	↔ 26	18	↔ 78
15	15	↔ 28	22	↔ 82
16	16	↔ 29	25	↔ 86
17	17	↔ 31	29	↔ 89
18	18	↔ 32	32	↔ 92
19	20	↔ 33	36	↔ 96
20	21	↔ 35	39	↔ 100
21	23	↔ 36	42	↔ 103
22	24	↔ 38	46	↔ 106
23	25	↔ 39	50	↔ 110
24	26	↔ 40	54	↔ 114
25	28	↔ 42	56	↔ 117

Infestation Class < 1

Infestation Class > 2 < 3

Infestation Class > 4

DISCUSSION

One advantage of the plan is that no time is wasted in superfluous sampling of areas where the infestations fall distinctly into one of the three classes. In light (< 1 per sp. sq.) or very severe (> 4 per sp. sq.) infestations, the minimum 10 samples would be sufficient to define precisely the infestation class. Moreover, by using previously defined classes, standardization is achieved allowing different levels of porina infestation to be intelligently discussed by various operators or easily correlated if necessary.

The plan is ideally suited to extensive surveys of large areas. It could enable a small team of men to cover large areas in an effort to determine the degree and extent of potential porina damage.

The plan could also be very useful for forecasting porina outbreaks in a manner similar to that for spruce budworm (Morris, 1954). By devising a sequential sampling system for the porina egg stage and correlating the information obtained with accumulated weather data and amount of plant cover, it should be possible to assess mortality during the egg/1st instar stages. Using this information, the severity of potential infestations could be forecast in time to decide whether or not control measures are required.

One disadvantage of the plan is the relatively greater amount of sampling required under intermediate conditions. However, unless it is particularly important to reduce intermediate populations to the nearest infestation class, an upper limit can be placed on the number of samples taken in any one paddock and an estimate made. Another disadvantage is the relative insensitivity of the class definition. Ideally, it should be possible to classify porina populations precisely, on a unit basis (or less) for

values between one and five larvae per spade square. This would be possible with more intensive sampling per paddock, which would, however, defeat one of the purposes of the sequential plan, namely, reduced sampling.

CONCLUSION

The possible applications of a sampling system such as the one described, although limited at present, could be extended. Carrying out extensive surveys in relation to forecasting infestations has been mentioned. It should also be possible with more data and a more sophisticated plan to determine economic threshold rejection and acceptance lines and extend the plan to classifying large areas directly into those requiring some control measures and those not. The plan could also be extended to certain types of ecological work such as provincial distribution studies, especially in relation to forecasting porina outbreaks.

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