CONSIDERATIONS FOR THE DESIGN OF FIELD TRIALS WITH INSECTICIDES FOR THE CONTROL OF PORINA CATERPILLAR

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Summary

The cost-benefit equation which indicates the profitability of insecticide use is best stated with least assumptions. Assumptions about the percentage mortality suffered by a population of porina caterpillar (*Wiseana* spp.) from a given treatment cannot be made with assurance because the conditions for maximum vulnerability have not been defined. Vulnerability is defined as a measure of the probability that a given treatment will not result in more than a stated percentage of survivors. The published results of sixty field trials for the chemical control of porina caterpillars are suggested to be largely deficient in the gathering of data which bear on vulnerability and profitability and a plea is made for more attention to behavioural, physical and climatic factors which affect the properties of the insecticides such trials are intended to evaluate.

IN their paper "An economic study of the use of insecticides for the control of porina caterpillar" McLaren and Crump (1969) made certain assumptions in the construction of their economic model. One of these was that "one application of insecticide gives complete control of all larvae". Complete mortality of a pest population is generally reckoned to be unattainable (except in a few special situations such as fumigation) and although it may remain as a target to be strived for it would be more realistic to accept a lower figure and more useful to be able to predict with confidence the lowest mortality that will follow a particular treatment. Over the years from 1964 onwards, several field trials have examined the effects of insecticides on porina caterpillar (*Wiseana* spp.) populations and these trials have tended to change in character from the early comparisons of a large number of chemicals to the later trials in which there is greater emphasis on profitability. The extent of this experimentation is shown in Table 1.

From this work three insecticides have become accepted in commercial control of porina caterpillar; overall, however, the yield of information is disappointingly small in that the conditions which are most conducive to their successful and profitable use are not well established and the variety of presentations of data from all these trials make it virtually impossible to arrive at a common basis for comparison.

It seems timely, then, to outline the more important considerations which affect the chemical control of porina caterpillars so that the most favourable conditions for securing maximum mortality can be discerned.

TABLE 1: INSECTICIDE USE IN FIELD TRIALS AGAINST PORINA CATERPILLAR

<i>No. of Trials</i>	<i>Insecticide</i>	<i>No. of Insecticides</i>
> 30	diazinon	2
	fenitrothion	
> 20	trichlorfon	1
> 10	methidathion	1
> 5	fensulfothion	2
	trichloronate	
< 5	7 materials	7
once only	26 materials	26
		39

Factors affecting the efficacy of an insecticide under field conditions are listed under the headings which follow, together with an indication of the present state of knowledge and of ways in which field trials might supplement this.

1. THE INSECTICIDE

(a) INTRINSIC TOXICITY

Laboratory methods now exist for estimating the toxicity of insecticides to porina caterpillars. Susceptibility to diazinon, fenitrothion and trichlorfon has been determined and resistance to these three materials could be detected (Perrott, 1970). For no other materials has toxicity to porina caterpillar been estimated.

(b) PERSISTENCE

Even for the commonly used insecticides, the order of persistence is known in only a very general way and for other materials the position is worse. Persistence is probably extremely important in porina control. While persistence may best be measured using bio-assay techniques, cumulative mortality recorded by sampling field treatments on several consecutive days immediately following treatment will give indications both of persistence and larval emergence.

2. THE INSECT

(a) SUSCEPTIBILITY TO INSECTICIDES AND CHANGES IN SUSCEPTIBILITY WHICH MAY OCCUR WITH GROWTH

Expressed as μg toxicant/g body-weight of insect, there are no changes in susceptibility of porina caterpillar to diazinon, fenitrothion or trichlorfon. However, this might not be true for other insecticides which have been used or which become of interest. The size range of target populations should therefore be measured and any selective effects of treatments noted when post-treatment counts are made of survivors. The size range of (preferably) up to 100 survivors of any treatment should be measured to the nearest five millimetres.

(b) EMERGENCE AND FEEDING BEHAVIOUR

All the indications (Esson, 1970; R. A. French, pers. comm.; Perrott, unpubl. data) are that emergence and feeding of porina caterpillar are very erratic. This will have a profound effect on the exposure of larvae to insecticide deposits. Repeated sampling as suggested under 1(b) would add to the present rather scanty knowledge of emergence and help to reveal its significance in relation to control and show its dependence on weather conditions.

3. CLIMATIC FACTORS WHICH MAY AFFECT

(a) THE PERSISTENCE OF THE INSECTICIDE

This would best be determined by chemical analysis or bio-assay but once again, in trials in which application was followed by changeable weather, repeated sampling could be revealing.

(b) THE BEHAVIOUR OF THE INSECT

There are indications that emergence is inhibited by frost (Lowe, 1966), by rainfall and by drought (Esson, 1970), but there is still a great need for published quantified data showing what weather and soil conditions are most conducive to larval emergence.

4. THE STATE OF THE PASTURE

While insecticide deposits per unit area will be greatest on short pasture, and therefore supposedly the most effective, it may not always be possible to achieve this state by grazing at a time when control measures are indicated. Pasture length and sward thickness and composition should be recorded to reveal their influence on the success of chemical treatments. Better still, trials could be specifically designed in which these features are the variables.

Taken together, these factors contribute to the concept of vulnerability, of which a convenient definition might be "a measure of the probability that a given treatment will not result in more than a stated percentage of survivors". Some of the factors listed can be properly measured only in the laboratory; others may need some degree of change in the environment to allow measurement to be made, while others though capable of laboratory simulation must ultimately be the subject of field work. However, much of the work with insecticides against porina caterpillar has taken the form of field trials and it is reasonable to assume that field trials will continue to be laid down as new materials demand evaluation. It is therefore worth summarizing the frequency of those measurements which have been made of the factors which contribute to vulnerability. This information forms Table 2.

Now that the urgency of finding substitutes for DDT in porina caterpillar control is long past, the most informative trials will be those which attempt to define the conditions which governed the performance of the material or materials under test. Given the transient nature of the insecticides now used and the erratic behaviour of larvae, improvements in control are likely to come from applications under the best combination of climatic and pasture conditions for survival of the chemical with those which have the least inhibiting effect on caterpillar emergence and feeding.

TABLE 2: ANALYSIS OF DATA FROM 60 FIELD TRIALS WITH INSECTICIDES AGAINST PORINA CATERPILLARS

Physical data at time of treatment:									
Soil	....	....	....	....	....	....	....	....	5
Weather	....	....	....	....	....	....	....	....	13
Pasture	....	....	....	....	....	....	....	....	14
Data on larvae:									
Pre-treatment — size	range	....	....	....	....	....	....	....	39
— no./area	....	....	....	....	....	....	....	....	14
Post-treatment — size	range	....	....	....	....	....	....	....	1
— no./area	....	....	....	....	....	....	....	....	42
Effects on pasture:									
Arbitrary visual estimate	....	....	....	....	....	....	....	....	26
Quantified data	....	....	....	....	....	....	....	....	5

(Recorded in the *Proceedings of the Weed and Pest Control Conference* during the years 1964-8 inclusive)

While this combination may best be deduced from specifically designed experiments, much more information would be available if, in regular insecticide field trials, fuller records were both taken and published so that correlations between results could be attempted.

It is suggested that, in future field trials with candidate insecticides,

- (1) Data to fill all the categories in Table 2 be gathered (except the arbitrary estimate of pasture response).
- (2) The pattern of rainfall and temperature should be recorded.
- (3) Plots be sampled and not only numbers but the sizes of larvae recorded on the first five days following treatment, or until stability is reached.
- (4) Herbage yield be recorded for all treatments.
- (5) In addition to transformed data in tabular presentations, actual numbers also be given, or the transformation stated.

However, while it is clear that field trials can contribute more than they have in the past, it is equally clear that some of the questions to which answers are required are purely ecological or are best resolved in the laboratory and that, unless the present standard of porina caterpillar control is thought satisfactory, it will be unrealistic to rely on field trials alone to provide the information which will allow a closer approach to the target of "complete control from one application of insecticide".

REFERENCES

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