A REVIEW OF CHEMICAL CONTROL MEASURES FOR PORINA

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Summary

This paper reviews measures recommended for control of porina (*Wiseana* spp.) with insecticides from use of carbon disulphide emulsion by Cockayne in 1915 up to trials with ultra-low volume (ULV) spraying with organophosphate insecticides in 1968. The main problems outstanding in chemical control of porina are discussed.

THE first comprehensive report on porina (*Wiseana* spp.) was that of Cockayne (1915). His observations were confined to the Wellington district and the recommended control measure for small areas was carbon disulphide emulsion. In 1936, Miller mentioned the extensive damage caused by this pest but stated, as did Cockayne, that little could be done to control porina in pasture. Lead arsenate was recommended for the control of porina in lawns. In 1940, Greenall stated that "Direct control by means of insecticides is out of the question because of cost." He suggested that the use of a mixture of cocksfoot (*Dactylis glomerata*), red clover (*Trifolium pratense*) and crested dogstail (*Cynosurus cristatus*) as pasture species because of their comparative immunity to porina attack (this was under South Otago conditions). There is nothing in the later literature to indicate the efficacy of this suggestion.

The first mention of chemical control for porina in pasture is to be found in the D.S.I.R. files (1938) where Dr Miller suggests that a poison bait consisting of calcium arsenate, molasses and bran might be tried. However, it was not until 1940 that anything like a scientific approach to porina control by chemical means was made, when Dumbleton and Dick (1941) conducted their experiments with baits, sprays and dusts using arsenical compounds and derris. They concluded that Paris green baits offered the most promise. Further work (Dumbleton and Dick, 1942) led them to conclude that February-April is the critical period for pasture damage and that a population of 10 to 12 larvae per square foot is capable of baring the ground by May. For the next few years poisoned bran baits were effectively used to control porina in pasture. It was not until 1947 (Dumbleton *et al.*, 1950) that DDT was first tested against porina. This work showed that both DDT and lindane applied as sprays were as good as the Paris green bait methods, but these new compounds were a little more expensive. In 1951, Kelsey published a paper on grass grub (*Costelytra zealandica*) and porina control endorsing the earlier results with the then new organic insecticides and also mentioning the long-term control given by these compounds.

Kelsey *et al.* (1949) reported that the incorporation of γ -BHC or DDT into superphosphate topdressing was more effective and cheaper than Paris green bait treatments and topdressing done separately. In the following year another report by the same authors appeared (Kelsey *et al.*, 1950). Here it was shown that porina populations were increasing in density and that the amounts of Paris green bait previously recommended were not adequate to deal with these heavier populations. Kelsey *et al.* (1949) stated that γ -BHC 0.85 lb (all rates in active ingredient per acre) was four times as effective as the equivalent dosage of DDT, but thought it would be too costly for general farm use.

In 1951, Doull stated that, if the new control methods (DDT and γ -BHC) were correctly applied, complete destruction of the pasture should be a thing of the past.

However, the problem of residues was to upset this apparently ideal state of affairs. In 1955, Kelsey published control recommendations based on eight years' experimental work. These were 1 lb γ -BHC for high return crops and $\frac{1}{2}$ lb BHC or 2 lb DDT for general grazing land. These recommendations in general have proved to be effective.

In about 1956, DDT prills were first used and, although some claims of effective porina control have been made, it is unlikely, in view of the feeding habits of this insect, that satisfactory control with pelleted DDT can be obtained. Although the organophosphate compounds were introduced as early as 1953, the first reports on their use against porina were not published until eleven years later (Helson *et al.*, 1964). Since that report there has been a steady flow of publications concerning the control of porina with organophosphate insecticides (Arthur and Cassels, 1965; Cassels, 1966; Kelsey, 1965; Christie, 1965; Perrott, 1966; Kelsey and Read, 1966; Lowe, 1966; Patterson, 1966; Taylor, 1966). All these authors are in agreement that, in general, organophosphates as spray formulations give better control than do granular or pelleted formulations. This same observation was made by Kelsey (1965) for DDT.

In 1964, the Agricultural Chemicals Board drafted regulations restricting the use of organochlorine insecticides to pelleted or granular formulations. Since then, therefore, the farmer has been obliged to consider his grass grub and porina problems separately. If both pests are present in one area, then two treatments are necessary. Satisfactory control of the porina infestation is given by the organophosphate insecticides in current use and, as yet, there is no evidence of this insect becoming resistant.

Besides the cost of the insecticide itself, major costs in treating porina are those of application and formulation of the pesticide to make it suitable for spraying or spreading. A new technique which could considerably reduce these costs is that of ultra low volume (ULV) spraying. This technique utilizes the fact that many organophosphate compounds are liquids in the pure or technical state and are sprayed as such, thereby obviating formulation costs. The actual quantity of insecticide applied is the same as in high volume (HV) sprays — *i.e.*, $\frac{1}{2}$ or 1 lb. In volume, this represents as little as 6 to 8 fl. oz (hence the name ULV) compared with 20 to 50 gal/acre using HV techniques. The ULV technique is independent of water supply and the application equipment does not have to be filled frequently to cover a given area. This represents a considerable saving in time and therefore money.

Field trials, conducted earlier this year, using ground equipment showed that the ULV technique gave as good control as did the HV technique (Waller and Howitt, 1968).

These trials were put down during a prolonged hot dry spell when the caterpillars were about 1in. long. Although these conditions were not conducive to long residual life of the organophosphates used, the population of caterpillars was reduced from 15/sq. ft to 1 to 2/sq. ft.

Although the experimental work in New Zealand is still in its early stages, the great success of ULV techniques in the U.S.A. against a wide variety of pests suggests that it may provide a significant advance in control of porina.

There are still problems associated with the chemical control of porina. One of the most important is the transient nature of the chemicals currently used, particularly when considered in relation to the behaviour of the larvae. If all the larvae in a given area were to emerge and feed on the same night, or even within two or three nights, transient insecticides should give complete control. However, laboratory observations, backed up by some field observations, indicate that often a proportion of the population may not emerge for a week or more. Therefore one application of a transient chemical may allow survival of an appreciable proportion of the population.

The effect of climatic factors on the emergence of the larvae is largely unknown. It is usually assumed that cold or frosty conditions inhibit emergence. If this is the case then the practice of not treating until pasture damage is evident may well be faulty since this does not usually occur until the colder part of the year when larvae may not emerge for several days. The correlation of emergence and feeding behaviour with climatic factors is being studied in the Nelson district using the technique of time-lapse photography.

Another problem is that of the occurrence in some areas of two or even three species of porina. If the transient chemical is applied too early, the larvae originating from the later moth flights will not be killed. If this same chemical is applied later in the season, the larvae from the first moth flight may have grown too large to be killed readily, and may have caused considerable pasture loss.

Arising from this is the problem of variation of susceptibility with size of larvae. It is obvious that the amount of insecticide required to kill a large larva is greater than that required to kill a small larva. However, in some insects there is a definite change in susceptibility to insecticides with increasing size — *i.e.*, in relation to body weight the earlier stages are much easier to kill than the later stages. Information on this point has not yet been established for porina. The only way to obtain this is by use of dose/effect experiments on laboratory-reared larvae, since larvae in the field are not uniform enough in size to give reliable results. Unfortunately, rearing porina larvae beyond about third or fourth instar has so far met with little success.

As yet no reports of resistance of porina to any of the chemicals currently used for its control have been received. At this stage, therefore, it would be advisable to establish base line toxicological data for porina. Then, if resistance were to occur, comparisons with these base line data could be made, thereby detecting immunity to chemicals at an early stage. The use of first instar larvae for these dose/effect experiments is suggested in view of their uniform size and the ease with which they can be hatched from eggs kept in the laboratory. Also there are well established techniques for dosing and handling small lepidopterous larvae. A drawback is the sensitivity of first instar porina larvae to changes in humidity. However, this should present no difficulty if good controlled environment rooms are available.

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