

# SHOT-HOLE BORER CONTROL

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## Introduction

The appearance of the Twig Caterpillar (*Ectropis bhurmitra* Warr.) and the Looper Caterpillar (*Buzura strigaria* Moore = *Biston suppressaria* Green) on a large number of estates (so far 39 estates have reported these outbreaks to the TRI), and the persistence and recurrence of Tortrix attacks in areas where dieldrin has been sprayed have made it necessary to reconsider our recommendations for the control of Shot-hole Borer (*Xyleborus fornicatus* Eichh.).

The spraying of dieldrin against the borer in 1961 (Cranham 1961) was the culmination of about ten years of research. The Tortrix side-effect following the use of dieldrin was known from the time dieldrin was first used experimentally (see Baptist 1956a ; 1956b). A large number of field experiments involving hundreds of acres of tea (Cranham 1962 ; Cranham, Danthararayana and Ranaweera 1962) demonstrated that the Tortrix side-effect could be avoided by DDT application at tipping time. The finding that Tortrix could be controlled, coupled with the fact that Shot-hole Borer is a very serious pest (against which no other control measures were known) prompted the Institute to make provisional recommendations to control the borer by dieldrin application. It must be pointed out that during the experimentation period the Twig and the Looper Caterpillars did not appear to any extent as side-effects, but the possibility of any complication other than Tortrix, and Tortrix itself becoming a serious problem was recognized (see The Editorial, *Tea Quarterly* December 1961). The use of dieldrin was considered to be a calculated risk (Cranham 1961). It must be recalled that for these reasons, the recommendation to spray dieldrin was made **provisionally**, subject to alteration or withdrawal depending on its performance once widely accepted.

Since 1962 many estates in Shot-hole Borer affected areas began routine applications of dieldrin as a post-pruning spray. It is estimated that from 1962 to 1965, altogether about 88,000 acres were sprayed with dieldrin. The control of Shot-hole Borer continued to show substantial yield increases. Although the direct benefits from dieldrin spraying was found to be worthwhile, with increase in the acreage under treatment, the Tortrix side-effect proved to be increasingly troublesome. Today it has to be recognized that the Tortrix Caterpillar is not the only limiting factor in using dieldrin. Twig and the Looper Caterpillars have become prominent after three years of wide use of dieldrin and these two pests are known to be potentially more dangerous than either the Tortrix or the Shot-hole Borer.

*After considering all these factors carefully, a decision has been taken to withdraw all previous recommendations for Shot-hole Borer control using dieldrin and aldrin. Although a large number of estates have so far used dieldrin with no serious trouble resulting from side-effects, the suspension of its further use has to be a general one covering all districts. Now that the outcome of mass spraying with dieldrin is known to some extent, it is not difficult to foresee the extent of loss of crop and increase in expenses that might be involved if the Twig, Looper and Tortrix Caterpillars become recurring problems. It is for these reasons that the original recommendations are withdrawn before the problems of side-effects get out of hand.*

## New recommendations for Shot-hole Borer control

**It must be noted that all previous recommendations for Shot-hole Borer control are cancelled with the publication of this paper.**

For the present, the control of Shot-hole Borer with dieldrin must be restricted **only to newly planted tea**. The necessity to control the borer in new clearings is thought to be important as it is considered that the first four to six years from the time of planting is a very vital period during which the stems need some protection from borer attack.

Earlier it was suggested that 6 pints of aldrin could be used in new clearings to control the beetle upto 1 or 1½ years because it caused less Tortrix damage compared to dieldrin (Cranham 1964a). It is now known that under field conditions most of the aldrin applied disappears within the first three to four weeks and about 30 per cent of it is converted to dieldrin. It appears that it is the dieldrin thus formed and not the aldrin that is applied, that actually keeps the borer under control for just over a year. It is, therefore, appropriate to use lower doses of dieldrin rather than use six pints of aldrin. This should bring down the cost of controlling Shot-hole Borer in new clearings by about two-thirds. **It must be emphasized that aldrin is, therefore, no longer recommended for use in new clearings.**

On estates where Shot-hole Borer is considered a serious pest, the following spraying programme applicable only to newly planted tea is suggested :

- 1 - A solution of 2 pints of dieldrin (20% EC) in 100 gallons of water to be sprayed at the end of the first year from planting, and repeated every year until the first prune,
- 2 - A solution of 4 pints of dieldrin (20 % EC) in 100 gallons of water to be sprayed immediately after the first prune,
- 3 - No further dieldrin spraying.

It is important to spray on dry frames to cover most of the stems, avoiding the leaves. Spraying should be done only with knapsack sprayers fitted with nozzles having a disc size of approximately 8 mm. *Mist-blowing is not recommended because of possible spray drifts.*

If plucking is done at all, when 2 pints of dieldrin are used, *there should be a safety period of four weeks between spraying and the next round of plucking by discarding the plucked leaf or by resting the tea.* It is important to bulk the tea from sprayed areas with ten times as much tea made from unsprayed areas. The Tortrix side-effect following low doses of dieldrin should be less, but every round of dieldrin spraying must be followed by prompt DDT application for control of Tortrix if necessary. At the first signs of the appearance of Tortrix, spraying should be done.

This spraying programme should enable estates to obtain Shot-hole Borer control in new clearings until good bush frames are well established. Control of Shot-hole Borer in newly planted tea should minimize the problems of sunscorch, wood-rot, subsequent termite damage and poor recovery from pruning. Later attacks of Shot-hole Borer will be mostly restricted to a higher level in the tea bush and these are periodically removed anyway during pruning.

Mid-cycle spraying with aldrin was provisionally recommended on an experimental basis (Cranham 1966) as an alternative to post-pruning sprays of dieldrin because it carries less risk of Tortrix outbreaks. Under the present circumstances it appears that mid-cycle sprays with aldrin is not an answer to the problems created by dieldrin spraying because a part of the aldrin is converted to dieldrin. The results of experiments with aldrin have not been consistent and the method is impracticable on many estates. Further, there may be serious problems with residues

of either aldrin and/or dieldrin in made tea if aldrin is widely used on tea in plucking. **In view of this, it must be clearly emphasized that the Institute does not now recommend the use of aldrin either as a mid-cycle spray or as a post-pruning spray.**

### **Other lines of research**

Since the present recommendations for Shot-hole Borer control involve only newly planted tea, it becomes clear that the beetle is not controlled in the greater part of the infested acreage which is composed of mature tea. The Institute is aware of this situation and attempts are being made to find a satisfactory method of control that is widely applicable. Listed below are other methods of control available to us; and their applicability to the present problem is discussed. The accent will be on the development of a method of integrated control. The desirability of integrating chemical and biological control is an idea that is widely accepted and practised all over the world because of the manifold secondary problems associated with the extensive use of certain organic insecticides. Now that it is known that most of our tea harbours many insects and mites that could turn into pests with the use of certain types of insecticides (as in the case of dieldrin and DDT), the attempts to control the primary pest must be made with this fact in mind. It is very likely that the final answer to the Shot-hole Borer problem may lie in finding an insecticide that will eliminate the borer without adverse effects on rest of the fauna associated with tea, particularly the hymenopterous parasites of Lepidoptera (which includes the leaf-eating caterpillars of tea).

#### *Alternative insecticides*

Heptachlor is being tested as a possible alternative to dieldrin because it showed some promise in preliminary trials. So far it has induced less Tortrix, but again, this is a chlorinated hydrocarbon which in the long run might bring about problems of side-effects. A series of randomized block type and large scale experiments have been started with heptachlor in new clearings as well as in old tea ; it will take about two or more years before the results are fully known.

Most of the well known organo-phosphorus and carbamate insecticides have been tested for Shot-hole Borer control but have been found to be unsuccessful. The disadvantage of these compounds is that they are not persistent enough to give a lasting control of the borer. However, we continue to screen all new compounds sent to us by manufacturers. There is evidence that fenitrothion and also fenthion give a certain amount of control of short duration when applied at 2½ lb active ingredient per acre (Cranham 1964b). It is intended to carry out further experiments with frequent sprays of these products.

*It must be clearly understood that we do not recommend spraying heptachlor, fenthion or fenitrothion as a measure to control Shot-hole Borer.*

#### *Fungicides and the Ambrosia Fungus*

The possibility of controlling the borer by destroying the Ambrosia Fungus is being investigated. If there were systemic fungicides that were practicable to use, these might give control, but it is possible that even non-systemic fungicides in combination with surfactants may have an effect if they penetrate the galleries.

The Division of Plant Pathology is already conducting preliminary experiments to study the movement of certain antibiotics in the tea plant. The object of this work is to determine whether these antibiotics, many of which have some systemic activity, can be used to control the growth of the Ambrosia Fungus in tea stems, by foliar application. Several isolates of the Ambrosia Fungus have been already obtained and the necessary techniques are now being perfected.

### *Sterile male technique using an atomic radiation*

One of the approaches to insect control is the eradication of the pest by the release of male insects made sexually sterile by irradiation (Knipling 1955). The principles involved are the breeding of large numbers of male insects and making them sexually sterile by exposing them (during the pupal stage) to irradiation without causing serious adverse effects on their mating behaviour. These sterile males are subsequently released in a natural population. The females if mated with the sexually sterile males would have their reproductive potential completely destroyed. This method is found to be applicable only to certain insects which satisfy a number of prerequisites. One of these is that the females should preferably mate only once in their life-time. Another, which is even more important is that the insect must be of a type that can be readily dispersed so that the sterile males will be equally accessible to the virgin females in nature as are the competing fertile males. The method, therefore, does not seem to be feasible in the case of Shot-hole Borer because the males have atrophied wings and are incapable of flight.

### *Use of chemosterilants*

This is an extension of the sterile male technique. Instead of irradiation, chemicals capable of causing sexual sterility are used. These chemical compounds are called chemosterilants. The use of chemosterilants in insect pest control is a new concept which has not been tested extensively but its potential usefulness in controlling some species has been demonstrated abroad (Smith *et al* 1964 ; La-Brecque 1965).

Insect chemosterilants may act in one of three ways. First, they may cause the insects to fail to produce ova or sperm. Secondly they may cause the death of sperm and ova after they have been produced. Thirdly, some of these compounds apparently produce multiple dominant lethal mutations, or severely injure the genetic material in the sperm and ova leading to the death of the zygote (fertilized egg). Steps will be taken in the near future to experiment with these compounds.

### *Insect attractants*

Two types of insect attractants are known. One is produced by the insect itself either to attract the opposite sex, to assemble for mating (assembling scents) or for the purpose of foraging, as in the case of 'trail substances' produced by ants. Of these, it is mainly the sex attractants (also known as 'pheromones') that have been found to be applicable in insect pest control (Jacobson 1966). Sex attractants are chemical substances (or messengers), produced by one sex to lure or sexually excite the opposite sex for the purpose of mating. These substances could be employed to lure large numbers of one sex to their deaths in baited traps or to a chemical sterilant. The major advances in the use of sex attractants in pest control have been predominantly made with the Lepidoptera (Butterflies and Moths).

Although this new technique is known to have great potential in insect pest eradication, the applicability of the method would depend on the type of insect and its mating behaviour. It is very unlikely that sex attractants are involved in the mating habits of Shot-hole Borer because it is known that females of *Xyleborus* sp. are fertilized by the males of the same brood, within the gallery in which they are born.

The second type of insect attractants are those substances found in the host plants (or host animals) which act as feeding stimuli or as ovipositional (egg-laying) lures. Such substances are known to take the form of chemical odours (Thorsteinson

1960), but whether these substances are useful in solving problems of insect pests is not yet fully established. It is undoubtedly important to know the chemical nature of the substances likely to be found on tea stems that attract the borer. Isolation of such substances may lead to possibilities of controlling the beetle.

#### *Insect repellents*

Though insect repellents are used in public health, there are no records of successful instances of repellents being used to protect plants from injurious insects (see Smith 1965).

#### *Biological control*

The possibilities of using parasites and predators for Shot-hole Borer control has not been thoroughly investigated. A probable reason for this is that insect parasites of scolytid beetles are not common. It is known that these beetles are frequently parasitized by nematodes (Graham 1963). Nematodes associated with insects are known as 'entomophilic nematodes' and are distinct from those species which parasitize plants. It may be worthwhile to investigate the possibilities of using nematodes in Shot-hole Borer control. Use of nematodes in bark beetle control is receiving attention in several other countries (Welch 1965). It is intended to begin investigations on control with nematodes.

#### *Resistant varieties of tea*

A possible way of controlling Shot-hole Borer in the long run will be selection and planting of resistant clones of tea. Investigations on these lines are being carried out and some clones offer promise already.

#### **Conclusions**

It is our view that for the present, it is desirable for Shot-hole Borer to be controlled by dieldrin spraying, only in new clearings. If only new clearings are treated, the area sprayed with dieldrin will be extremely small and it is unlikely that problems of side-effects will give cause for serious concern.

#### **Summary**

- 1 - All previous recommendations for Shot-hole Borer control, including mid-cycle sprays with aldrin are withdrawn.
- 2 - For the present, estates are advised that chemical control of Shot-hole Borer in mature tea must be abandoned, whether they have experienced side-effects or not.
- 3 - Shot-hole Borer control with dieldrin should be restricted only to newly planted tea on estates known to be severely infested.
- 4 - To control the borer in newly planted tea,
  - (a) spray 2 pints of dieldrin (20% EC) in 100 gallons of water once a year until the first prune,
  - (b) spray 4 pints of dieldrin in 100 gallons of water immediately after the first prune and stop further spraying.

- 5 - The use of aldrin as a mid-cycle spray is impractical, dangerous and is, therefore, not recommended.
- 6 - The use of aldrin in new clearings or as a post-pruning spray is uneconomical and is, therefore, not recommended.
- 7 - Steps are being taken to develop alternative, and more satisfactory methods of controlling Shot-hole Borer.
- 8 - It is strongly advised that estates adhere to the present recommendations in order to prevent further spread of the Twig and Looper Caterpillars.

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