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Fumigating a farm to control grain insects

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During the past year, two major projects for control of grain insects were organised on Western Australian farms. Both exercises aimed to eradicate grain pests which would have seriously threatened grain exports if they had become established. The fumigation was done jointly by the Entomology Branch of the Department of Agriculture, and the Agriculture Protection Board.

Since the early 1970s, species of grain insects have been developing resistance to the main chemical used for control, malathion. Consequently, the effectiveness of malathion has been declining. Alternatives to malathion are limited — most are in the same chemical group as malathion, the organophosphates. Dichlorvos and fenitrothion are examples. The recently developed synthetic pyrethroids, including bioresmethrin, are effective against grain insects but are much more expensive than the organophosphates. It is therefore necessary to do whatever possible to prolong the effective life of organophosphate insecticides. Resistance in Western Australian grain insects is mainly specific to malathion and these strains can be controlled with an alternative organophosphate. However, in recent years, certain strains of the lesser grain borer, *Rhizopertha dominica*, have been found with multiple OP resistance, and these have been hard to control. The insect occurs worldwide and is one of the most important pests of stored grain in Western Australia. Inspection of farms by the Agriculture Protection Board has so far revealed a low incidence of malathion resistance in *Rhizopertha*, and of the resistant strains collected, only one strain, from a farm near Northam, was found to have multiple organophosphate resistance. To prevent this strain leaving this farm and contaminating the bulk system, all areas of the farm where grain insects could breed were treated to achieve eradication.

**Exotic grain pests**

A number of serious pests of grain, common in other countries, do not occur in Australia. The khapra beetle, *Trogoderma granarium* and the warehouse beetle, *Trogoderma variabile*, are two such pests. The khapra beetle is the most feared grain insect in the world, and the warehouse beetle is second in importance only to the khapra beetle. Establishment in Australia of either the khapra beetle or the warehouse beetle would be disastrous for the export grain industry. Their hairy larvae (see photograph) eat and spoil a large range of stored products, and because of their tolerance of fumigants, they are extremely hard to kill. Several species of *Trogoderma* are native to Australia and are sometimes found on farms. They themselves are no threat to the grain industry, but because they appear so similar to warehouse and khapra beetles, they can easily be mistaken for them.

In March this year, an infestation of the warehouse beetle was identified on a farm at East Morawa. Extensive searching throughout Western Australia failed to find any further infestations, although native *Trogoderma* were found on a number of farms. Eradication of the infestation was therefore warranted.

**Fumigation operations**

To eradicate the strain of *Rhizopertha* with multiple resistance, it was necessary to fumigate two machinery sheds, two haysheds, three metal silos and the farm machinery. To fumigate these buildings, it was necessary to cover them with plastic sheeting. For this exercise, 200 micron black polythene was used to cover the buildings. However, polythene is not ideal as it is difficult to make a good permanent seal with tape. Overnight winds partly unsheeted several structures, and these needed recovering. The use of clips instead of tape would overcome the sealing problem with polythene.

Larvae of the warehouse beetle on clover seed. Actual size is 6 to 7 mm long

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The operation to eradicate the warehouse beetle at Morawa was simpler. This property had been maintained in an orderly condition and was clean of spilt grain. Only two buildings, a shearing shed and poultry shed, needed treatment. The infestation was in bagged seconds wheat in the shearing shed, and the insects had been subsequently carried to a poultry shed.

Because it appeared that such large-scale farm treatments would become increasingly necessary, heavy-duty reinforced tarpaulins were bought at a cost of $5 600. Joining, and the problem of achieving gas-tight seals were overcome by using large bulldog-type paper clips. Although each tarpaulin measured 16 metres by 35 metres and weighed 230 kg, it was relatively easy to cover and seal the two buildings. A front-end loader was used to advantage, and was useful in providing soil to anchor the sheet. On both farms, methyl bromide was used for fumigation. It was convenient for this type of operation, being supplied in cylinders containing 91 kg. The methyl bromide was discharged as a liquid into shallow trays over which electric fans directed air. The exposure period required is no more than 24 hours and the whole job could be done in a short time.

As the warehouse beetle is exceptionally hard to kill with methyl bromide, a dosage of six times that needed for control of the usual grain insects was used. Almost any degree of fumigation would have been possible as the tarpaulin-clip method gave an extremely good seal.

A quantity of seed wheat suspected of being infested was sheeted separately and fumigated with phosphine over a 10 day period. Methyl bromide was not used as it is quite toxic to plant material and the dose used for Trogoderma would have completely killed the seed. Surrounds and buildings which were not fumigated were thoroughly saturated with a residual insecticide.

Carbaryl was used at Northam and permethrin, a synthetic pyrethroid, was used at Morawa.

Efficiency of the operations

When fumigating for control of an insect pest, a level is determined according to the "Concentration-by-time" (CT) factor needed to kill it. This value is obtained by multiplying the fumigant concentration by the hours of exposure, and it varies according to the species of insect.

In both operations the CT values obtained were greatly above those required for complete control. However, the ultimate success of operations of this type can only be assessed by repeated inspection. In the eight months since fumigation at Northam, no Rhizopertha have been found despite close searching. Inspections at Morawa following treatment have disclosed many dead insects but no live insects have been found.