Thiodicarb /Methomyl Resistance in *Helicoverpa armigera*

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Introduction

At Tamworth, we have been monitoring *H. armigera* for carbamate resistance [thiodicarb (Larvin ®)and methomyl (Lannate®, Nudrin®) resistance since 1982. Thiodicarb resistance was first diagnosed in *H. armigera* in early 1993. The resistant populations were found in intensively sprayed sweet corn in NSW and Queensland and were associated with heavy methomyl and thiodicarb use.

The thiodicarb/methomyl resistance on *H. armigera* remained largely confined to the sweet corn populations, until the 1994/95 summer season, when numbers of resistant individuals were found on cotton, with some control problems. In 1995/96, the problem has been exacerbated with increasing resistance frequencies and a number of resistance associated field failures.

The carbamate resistance situation in *H. armigera* is critical and unless a strong resistance management strategy is adopted, then the cotton industry will loose a yet another valuable class of insecticide to resistance.

Resistance detection

Carbamate resistance was previously detected by slow bioassay procedures and it could take weeks to get the results. However, one of the "spin-offs" of our resistance mechanism studies at Tamworth, is that we have been able to devise rapid biochemical tests to detect

resistance to carbamates. It is a simple squash test. These methods actually test each individual *H. armigera*, for the presence, or absence of the actual enzyme responsible for resistance. The results are instant! The test takes about 20 minutes and can be done on any size larva. It is the ultimate in quick accurate resistance detection, data correlates excellently to results, obtained by conventional bioassay. However, the biochemical tests give us a lot more information.

As well as identifying resistant and susceptible individuals, the biochemical test distinguishes between two types of resistant individuals. The resistant heterozygotes (which have inherited one gene for resistance and one for susceptibility) and the resistant homozygotes (which have two genes for resistance). Resistant heterozygotes, have an intermediate level of resistance compared to homozygotes. (Compared to susceptibles *H. armigera*, it takes about 5 times more carbamate to kill a heterozygote and about 40 times more to kill a homozygote).

Thiodicarb/methomyl resistance - the facts

- The resistance mechanism is due to an insensitive target site in the insect nervous system. *H. armigera* have developed a form of the neurotransmitter *acetylcholine esterase* which is insensitive to attack by thiodicarb and methomyl.
- The resistance mechanism "switches on" when the embryonic nervous system is formed i.e.. approximately the "black egg" stage.
- *H. armigera* can be heterozygous or homozygous for resistance.
- Heterozygotes are a lot more easily killed than homozygotes.

- There is cross resistance between thiodicarb and methomyl (and all other carbamates).
- Selection with thiodicarb or methomyl produces the same result - resistance!

Resistance results

The results of thiodicarb/methomyl resistance testing in *H. armigera* on NSW and Queensland cotton since 1992, are shown in the accompanying. The frequency of all resistant insects (heterozygotes and homozygotes) are plotted, as are the frequencies of resistant homozygotes.

Since early 1995, there has been an inexorable increase in the numbers of resistant *H. armigera* on cotton. Resistance frequencies are high and increasing! The most worrying aspect, however, is that the frequency of resistant homozygotes is also on the increase. This means, in the paddock, that while field rates will normally kill resistant heterozygotes, the very resistant homozygotes are very difficult to kill.

The 1995/96 season

- Many *H armigera* samples were sent to Tamworth for carbamate resistance testing.
- Many samples were sent as a consequence of thiodicarb and methomyl control failures and resistance was often implicated. However, some field control problems were not due to resistance (weather, spray timing etc.).
- The resistance problem is increasing.
- Some samples contained 100% resistant homozygotes!

- Experience from resistance associated field failures, suggests that if there are 40% or more, of resistant homozygotes in a field population, then you are liable to get control problems with methomyl or thiodicarb.

Conclusions

Carbamate insecticides have been one of the few types of insecticides which have remained relatively effective against *H armigera* . However, unless something is done urgently, to manage this increasing resistance problem, then the cotton industry will loose methomyl and thiodicarb to resistance.

An effective carbamate resistance management strategy should include the following points:

- No use of thiodicarb or methomyl in the early season (stage 1).
- Carbamates should only be used in stage 3, when crop growth has slowed.
- No more than 3 sprays per season (including mixtures).
- No consecutive carbamate sprays.
- No ovicidal rates.
- No exceptions.

Thiodicarb/methomyl resistance in *H. armigera*, from Queensland and NSW cotton