Synergists turn back the clock on insecticide resistance

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Helicoverpa armigera and B-Biotype *Bemisia tabaci* (the silverleaf whitefly), are serious pests on cotton, grain legume and horticultural pests in Australia. Insecticide resistance in *H. armigera* and the silverleaf whitefly are major threats to the economic production of cotton in Australia. Pyrethroid resistance is a particular problem as these insecticides are used against *H. armigera* and adult whiteflies late in the season.

Pyrethroid resistance in both *H. armigera* and silverleaf whitefly is largely due to overproduced esterase isoenzymes which hydrolyse and sequester pyrethroids. Esterase inhibitors such as organophosphates and piperonyl butoxide are commercially used on cotton, in tank mixes with pyrethroids, but are only moderately effective in overcoming pyrethroid resistance.

Laboratory studies in both pests with piperonyl butoxide, showed that esterase inhibition did not occur immediately after synergist application and some hours were needed for maximum inhibitory effect (Figure 1). At maximum esterase inhibition, highly resistant *H. armigera* and silverleaf whitefly are completely susceptible to pyrethroids.

Field trials on cotton, pre-treating with PBO, followed by an appropriately timed pyrethroid spray, produced excellent control compared to a pyrethroid alone or a pyrethroid plus PBO tank mix. While this "two spray" technique was very effective, spraying twice (especially by air) is not economic.

against resistant insects.

We therefore explored the use of microencapsulated pyrethroids and PBO, in a tank mix, to produce a suitable time delay between PBO application and pyrethroid release onto the insect pests. Insecticide release needed to be delayed long enough for piperonyl butoxide to penetrate into the insect and do its job.

An available, microencapsulated pyrethroid (lambdacyhalothrin — Karate Zeon), has a short (30 minute) delay in

FIGURE 1: Piperonyl butoxide inhibits esterase, but not immediately in live resistant *H. armigera* and silverleaf whitefly

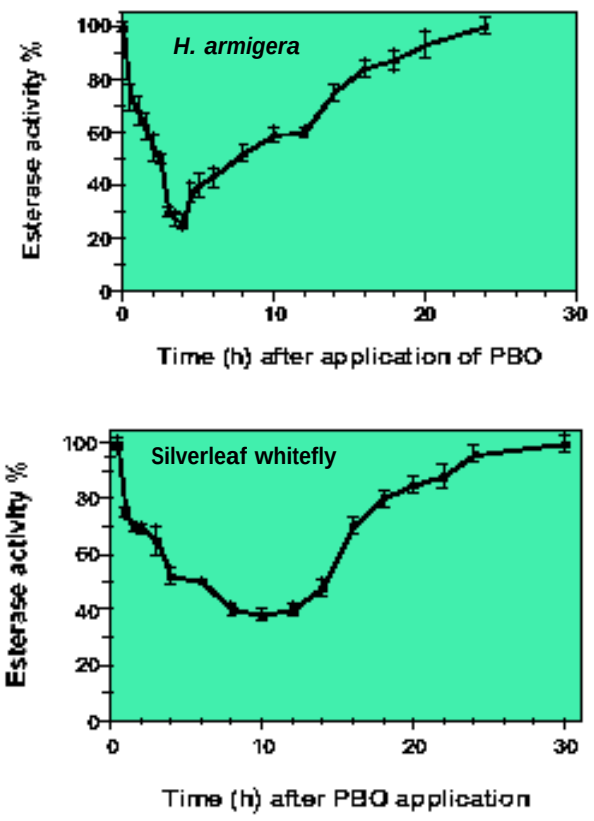
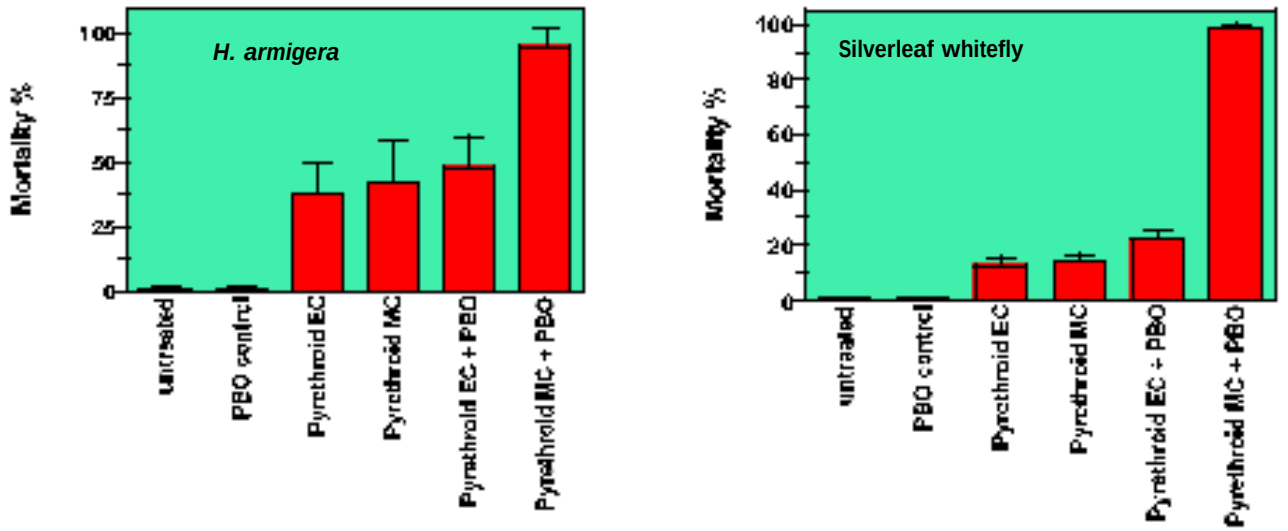


FIGURE 2: Delayed release, microencapsulated pyrethroid plus PBO gives outstanding field kill of resistant *H. armigera* and silverleaf whitefly



pyrethroid release, in water. Field trials on *H. armigera* and the silverleaf whiteflies showed some improved control compared to a tank mix of PBO and EC formulated Karate and this proved that the microencapsulation concept was worth pursuing. But a 30 minute release time is not long enough for effective enzyme inhibition.

With the collaboration of Endura SPA, Italy, we have had novel, microencapsulated, longer release-time pyrethroids synthesised. Laboratory and field trials of these microencapsulated pyrethroids mixed with PBO, have given excellent control of highly resistant insects (Figure 2).

The use of microencapsulation to delay insecticide release, until the inhibitor has effectively suppressed the factors causing pesticide resistance, is an exciting innovation in resistant pest control that can turn back the clock on insecticide resistance (these concepts have been patented*). Particularly as are there are many other esterase mediated resistances in *H. armigera*, silverleaf whitefly and other insect pests.

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(*UK Patent No. 0309773.0, International patent PCT/GB2003/001861)