A GREEN LOCUST CONTROL FOR AUSTRALIAN FARMERS

Louise Lawrence, CSIRO Entomology describes the development of the microbial insecticide, *Metarhizium*, for locust control in Australia

Australia is home to three species of locusts – the spur throated locust, the migratory locust and the Australian plague locust. Of these, the most damaging is the Australian plague locust with outbreaks requiring control occurring about every two years. Locust plagues tend to develop when widespread areas of inland Australia receive good rainfall in successive seasons and subsequent grass growth produces ideal habitats for locusts to breed.

All three species can cause significant damage to pastures and crops in the warmer parts of Australia and outbreaks can occur across large areas from cropping areas to arid zones (western areas of Queensland, New South Wales and Victoria, much of South Australia and southern Western Australia). In addition, there are several species of grasshopper which cause damage to pastoral areas and horticultural crops in the cooler regions of the country.

Now a rare native fungus is set to help Australian and overseas farmers battle locust plagues. Scientists at CSIRO Entomology developed a strain of the naturally occurring fungus, *Metarhizium*, to control locusts and CSIRO has signed a world-wide agreement with the agricultural biotechnology firm, Becker Underwood Ltd, to manufacture, market and distribute the end product, Green Guard®.

Green Guard® has already been used extensively against recent locust and grasshopper outbreaks in Australia, but only under special licence. Now it will be available to all, as it has been granted full registration by the Australian Pesticides and Veterinary Medicines Authority (APVMA). Becker Underwood intends to make it available to farmers through the agricultural reseller network and government bodies involved in locust control such as the Australian Plague Locust Commission and the NSW Rural Lands Protection Boards. They are also involved in discussions with groups around the world such as China where Green Guard® has already been successfully field tested. Becker Underwood have specialised in the development and marketing of biopesticides since 1989.

The Australian plague locust, *Chortoicetes terminifera*

Dr Richard Milner in the lab working on Green Guard® the recently licensed biopesticide for locusts.

Because it is a naturally occurring fungus, Green Guard® can be used in areas where it is not appropriate to use chemical pesticides such as on organic farms, in ecologically sensitive areas and close to water courses. Its use will help minimise the amount of chemical pesticide used for locust and grasshopper control.

There are many strains of *Metarhizium* each of which attacks different insect species. The strain used in Green Guard® is specific to locusts and grasshoppers. When it was first discovered, it did not seem a promising candidate for controlling plague locusts. Locusts like it dry and the fungus likes it moist. But the need for a 'green' alternative to insecticides for locust control made the scientists persevere. It took the research team a decade to produce a commercially viable product.

Initially the infectious spores were mixed with water for spraying, but this was not successful. Not only were the waxy spores difficult to suspend in water, but they quickly dried out and died. The solution was to suspend the spores in oil for spraying. The spores form a suspension in the oil which protects them from the sun and from drying. It also aids the infection process.

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However, before this could be commercialised several major hurdles had to be overcome by detailed research – the spores did not persist well, they settled out quickly and were difficult to resuspend and they clogged spray nozzles. Changes to the manufacturing process, and the formulation has now enabled an effective product to be launched.

The oil suspension can be sprayed under very hot conditions and will not dry out. In fact, the fungus will infect and kill locusts in conditions where it would not normally be expected to be active. The fungus in the oil suspension will survive for several years in storage, but does not persist in the environment for more than about four weeks.

Metarhizium is most effective against locusts and grasshoppers while they are young, known as the hopper stage (see box) and it takes 10-14 days to kill them. It costs a bit more than chemicals, but for those who prefer not to use chemical pesticides, it is the ideal solution. While the fungus is effective against a wide range of grasshoppers and locusts it does not affect even close relatives like crickets. Aquatic life and birds are also safe.

Metarizhium spores literally bore into the locust's cuticle (skin). Once inside they use up water and nutrients and grow little tubes that burrow further eventually killing the insect. There are 40,000 million spores per gram but as few as 500 on one locust is enough to kill it.

The initial research on locusts and grasshoppers was funded by the Rural Industries Research and Development Fund and conducted by Dr Richard Milner from CSIRO Entomology. The subsequent commercial development was by CSIRO Entomology undertaken in collaboration with the Australian Plague Locust Commission, the Queensland Department of Natural Resources, the then NSW Agriculture and industry.

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Australian Plague Locust

Female locusts lay batches (pods) of 30–60 eggs in the soil. Each female lays up to four pods and there are 3-4 generations a year. A collection of egg pods from a number of females is called an egg bed. Egg beds are usually found in bare patches of compact soil. The eggs need warmth and moisture to develop. Eggs in a single egg bed may hatch simultaneously or progressively over several weeks if conditions for hatching are marginal.

Immature locusts are called nymphs or hoppers. These hoppers moult several times before the winged adult emerges. When present in large numbers, hoppers will often concentrate into dense aggregations called bands which vary in size, but can extend over several kilometres. A band can move more than a kilometre from the egg bed before the adults emerge and can consume or damage all vegetation in its path.

If, after the final moult, adult numbers are high enough they may congregate into dense swarms which are usually less than 5 km^2 but can be up to 50 km^2. Migrations of 500–600 km overnight by the winged adults are not uncommon and this behaviour can lead to the sudden appearance of large numbers of locusts in previously uninfested areas. The locusts require green feed to provide fuel for flight and for egg development.

By having a large potential for increase and up to 4 generations a year, locust populations can build up to enormous outbreaks resulting in vast swarms. These locust swarms can cause widespread, severe damage to pasture, cereal crops, such as wheat, rice and oats and summer forage crops, such as sorghum and lucerne, as well as horticultural crops, such as grapes, orchards and vegetables.

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