SARDI Entomology – developments in IPM and biological control

Fullers rose weevil.

Kellys citrus thrip.

By Dr Peter Crisp

SARDI (South Australian Research and Development Institute) Entomology is a small but productive unit that is part of SARDI's Sustainable Systems Division. The team, led by Greg Baker, has Biosecurity and research roles covering a wide range of broadacre and horticultural crops. The unit collaborates with other research and private organisations across Australia providing solutions to agricultural pest problems, many of which can be transferred directly into organic management systems. The unit also provides an education service that assists growers with identification of pest and beneficial insect and mite species in their crops, improving their appreciation of the potential benefits of IPM strategies.

The current biosecurity responsibilities include locust control, management of fruit fly outbreaks through mass release of sterile adults and monitoring tramp ant populations in South Australia. Research projects include improving information on the lifecycles of and developing integrated management programs for thrips, Fuller's rose weevil, light brown apple moth, *Brassica* pests, snails and olive scale and biological control of weeds such as salvation Jane and Cape broom.

Kelly's citrus thrip

Kelly's citrus thrips (KCT), which cause cosmetic damage that results in downgrading of fruit, costs the Australian citrus industry millions of dollars every year. KCT was under effective biological control until the increased use of organophosphate insecticides in the early 1990s. KCT has since developed resistance to many of the pesticides used in Australian citrus orchards. Early in SARDI's KCT research program it was noted that they pupate in the soil. In an organic orchard and a low input conventional orchard pupal mortality in the soil was much higher than recorded in high input conventional orchards. This pupal mortality was closely correlated with populations of soil dwelling predatory mites, which was in turn positively related to levels of soil organic carbon. An investigation was conducted using soil amendments such as compost from recycled green waste, composted grape mark and animal manure. The soil amendments have provided suppression of KCT and have had the added benefits of increased yield, increased fruit size and improved water use efficiency.

Onion thrips

Another thrips species that causes significant downgrading of onions and economic losses is onion thrips. In addition to yield losses caused by onion thrips feeding in the field, these thrips cause significant cosmetic damage and market downgrade on stored onions. Two approaches are currently being assessed: the addition of predatory mites to bins of harvested onions and again, as in the case of KCT, the use of soil amendments and predatory mites to suppress the thrips in the field. The addition of the predatory mite *Neoseiulus*

cucumeris to onion bins after harvest has reduced the downgrading of red onions due to cosmetic thrips damage from 60% of bulbs to 5%. Preliminary field trials using soil amendments and release of *Hypoaspis aculifer* last year produced encouraging reductions of thrips densities, and currently large-scale trials are initially showing a range of agronomic benefits where compost has been applied to the soil after sowing.

Erythracarus (predatory mite).

Western flower thrips

The third thrips species that is currently the focus of SARDI's ongoing control efforts is western flower thrips (WFT), which causes cosmetic damage in a wide range of horticultural crops, and in some crops its ability to transmit viruses can result in near-total crop loss. WFT has developed resistance to most common pesticides and is the major insect threat in many greenhouse and field crops. There are a number of biological control options that are currently commercially available and other beneficial organisms that colonise crops where broad-spectrum insecticides are withheld; these include predatory mites (*Microsmaris* species and *Pergamasus* species), *Hippodamia* ladybird, parasitoid wasps and lacewings. However, maintaining populations of these beneficials at levels required to control incoming waves of WFT can be difficult. Management techniques to improve the environment in and around the crop are being assessed to reduce pest populations around crops and greenhouses and to provide a suitable environment for beneficial organisms. Of particular interest in greenhouse crops is the *Microsmaris* sp. mite which appears to be a predator of both WFT and whitefly. It has established naturally in some greenhouses but appears susceptible to pesticides. If this predator can be mass-reared and released in greenhouses before pest numbers reach economic thresholds, the reliance on chemical pesticides is likely to be reduced.

Revegetation by Design

One current project that both reduces pest habitat and promotes populations of beneficial mites and insects is Revegetation by Design. The research is based in the high-density vegetable production area on the Northern Adelaide Plains, where major vegetable crop losses are caused by WFT, largely through transmission of tomato spotted wilt virus. The project aims to replace exotic weed species, which are an ideal haven for pests such as WFT, with native plant species which are less suited to the pests and provide food and protection for beneficial species. The research has shown that pest thrips are abundant on many weeds but not on some native plant species, while the parasitoids and other beneficial insects were the most abundant and diverse invertebrates on the endemic plants. Crops adjoining the strips of native vegetation should benefit from reduced pest pressure and

increased populations of beneficial insects, and if so, reduce the need for toxic sprays to maintain market-quality produce.

For more information on Revegetation by Design, the guidebook from the project can be downloaded free at www.sardi.sa.gov.au/pages/ento/hort_pests/reveg.htm

Microsmaris (predatory mite).

Fullers' rose weevil

Another pest in SARDI's firing line is Fullers's rose weevil (FRW). While FRW does not damage citrus fruit it is a quarantine pest for a number of potential citrus export markets that are of critical importance to the Australian citrus industry. The problem is caused by FRW eggs laid under the calyx of the fruit, which are difficult to detect and survive packing and transport. Currently, if eggs are detected on fruit at import receival, the shipment is either fumigated or, more likely, rejected. While the weevils can be controlled by the application of broad-spectrum insecticides, this is not a preferred approach as there are strict residue limits and the pesticides disrupt other IPM strategies within the orchard.

The IPM approach researched targets two of FRW's weak points: its extended time in the soil as larva and pupa and its inability to fly. Soil-applied fungal and nematode entomopathogens are being trialled for FRW larval and pupal control. The soil amendments used in the KCT control programs may also assist the survival of these pathogenic fungi and nematodes by creating a more balanced soil environment and maintaining higher soil-moisture levels. Because the flightless must climb up tree trunks or foliage to access fruit, SARDI research is developing a spray unit that will target tree trunks, thereby greatly reducing volumes of chemical required and hence avoiding the disruption of beneficial organisms in the citrus canopy.

New detective biosensors

SARDI researchers are also involved in the development of high-tech biosensors that could be used in a number of ways to assist producers control insect pests.

The molecular sensors can be used to detect pheromones at extremely low levels, giving advance warning of the presence of pests at levels that would not normally be detected and thereby allowing early action such as introduction of beneficial organisms. The technology can also be used to find compounds that bind to an insect's chemical receptors, providing the opportunity to disrupt mating with benign short-lived compounds.

For more information on SARDI entomology and its projects, email Greg Baker at baker.greg@saugov.sa.gov.au or Peter Crisp at crisp.peter@saugov.sa.gov.au. For Revegetation by Design information, contact Glenys Wood at wood.glenys@saugov.sa.gov.au