The Solenopsis mealybug outbreak in Emerald

By Kate Charleston (DEEDI), Stewart Addison (Cotton Catchment Communities CRC), Melina Miles (DEEDI) and Susan Maas (DEEDI)

In February 2010, the outbreak of an exotic species of mealybug, known as the Solenopsis mealybug (*Phenacoccus solenopsis*) was confirmed on cotton properties in Emerald. This mealybug has now also been confirmed from cotton in the Burdekin and at two locations on the Darling Downs, as well as on hibiscus plants in Brisbane. To date there have been no confirmed reports of this mealybug on cotton in NSW.

Although the Solenopsis mealybug is an exotic species it is not known how long it has been in Australia. It is possible that the current infestation of cotton is due to a recent introduction or this pest may have been present for some time without an outbreak occurring. Given its wide distribution, it is likely it has been in Australia for some time.

The cotton industry and the Queensland Government have responded quickly to this mealybug outbreak. In the past two months a number of trials and surveys have been conducted in a coordinated approach involving the CRDC, Cotton CRC, Cotton Australia, and DEEDI.

In this article we provide general information about the Solenopsis mealybug, in particular its lifecycle, damage symptoms and methods of spread. We highlight the results of disinfestation and longevity trials, and a survey investigating factors affecting mealybug occurrence in central Queensland. We also report on the amended industry protocols to reduce the spread of mealybug and priorities for future research.

SOLENOPSIS MEALYBUG

The Solenopsis mealybug originates from North America. In 1990 it was found in cotton crops in Texas where it caused widespread damage and in 1992, this pest moved south to Central America, the Caribbean and Ecuador. Much later, in 2004, it was found in India and Pakistan where it caused significant damage and crop loss.

The solenopsis mealybug is polyphagous (like *Helicoverpa armigera* and *punctigera*) which means that it has a wide host range. In Pakistan it has been recorded on 154 plant species including field crops, vegetables, ornamentals, weeds, and trees.

Identification and lifecycle of the Solenopsis mealybug

The female mealybug is wingless with a three to four mm long oval shaped body, covered with white hydrophobic (water repellent) mealy wax. Bare spots on the thorax and abdomen appear as dark longitudinal lines.

The adult male is about 1 mm long, with a pale grey body and a single pair of transparent wings. Two filaments of white wax project from the end of its abdomen. The adult male has no feeding mouthparts and causes no damage.

Mature females lay eggs in waxy pouches called ovisacs, which contain between 150–600 eggs. The eggs hatch after three to nine days into nymphs called 'crawlers', which are very mobile.

The female crawler undergoes four larval instars before turning into an adult (no pupal stage). The total life span of a female mealybug is 30–48 days, which includes 21 days as adult. Male crawlers undergo three larval instars before passing through a pupal stage. The male mealybug lives for 24–30 days including three to five days as an adult. Mealybugs can have 12–15 generations in a year, depending on temperature.

Mealybugs can survive cold conditions, both on the host plant and in the soil. In warm climates, they reproduce all year round.

Mode of damage

Mealybugs have sucking mouth parts at all stages of their life cycle, which they use to extract large amounts of plant sap. They produce honeydew during the feeding process and this forms a sticky deposit on the leaves and stem. Honeydew promotes the growth of sooty mould fungi which inhibit photosynthesis.

Symptoms of plants infested during the vegetative phase include; distorted and bushy shoots, crinkled and/or twisted and bunchy leaves and stunted plants that dry completely in severe cases.

Late season symptoms include; fewer, smaller and deformed bolls, reduced plant vigour and early crop senescence. Mealybugs can also stain cotton lint and reduce quality.

Methods of spread

Mealybugs are generally disseminated as crawlers. Crawlers readily move from infested to 'clean' plants. The waxy coating on the mealybug crawlers also facilitates passive transport of the insect by sticking onto equipment, other insects, birds, animals or people. Crawlers can be transported by wind and rain or in water in irrigation channels. Long-distance movement through the transport of infested plants is also possible.

Ants can play a role in the spread of mealybugs. The name solenopsis refers to a genus of ant with which this mealybug has been associated. To protect their supply of honeydew on which they feed, the ants spread mealybugs, protect them from natural enemies and keep their colonies clean.

MEALYBUG DISTRIBUTION AND FACTORS AFFECTING MEALYBUG OCCURRENCE IN CENTRAL QUEENSLAND

In early February a survey of mealybug affected farms was conducted in the Emerald region. The objective of this survey was:

- To determine the extent of the mealybug infestation; and,
- To identify any farm practices or environmental conditions that may be associated with an outbreak of this pest.

The infested area in Emerald was largely confined to the Western Emerald Irrigation Area (EIA) with only a few reports of mealybug east of Emerald township. The area of fields affected by mealybug was around 2686 hectares out of a total of 16,800 hectares of cotton grown in the EIA. The approximate area of infested plants was 97 hectares with an estimated total area of crop loss of 34 hectares.

The precise factors influencing the severity of mealybug infestation are still unclear given just one season of data. But there are a number of factors common

Cotton stem covered by mealybug. (PHOTO: Zara Ludgate)

Mealybug infested cotton field near Emerald. (PHOTO: Zara Ludgate)

to infested farms, and these broadly correspond with findings in other countries where this pest affects cotton. The key findings of the survey are outlined below:

Volunteer cotton and weeds

The most severe mealybug infestations were on farms with ratoon cotton present in both fallows and in-crop. Similarly, the percentage of highly infested fields increased with the presence of weeds in-crop. Weedy field perimeters and poor channel hygiene was also associated with mealybug infestations. Many of the infested fields had weedy field borders whilst few infested fields had clean surroundings, suggesting that weedy perimeters increased the likelihood of infestation.

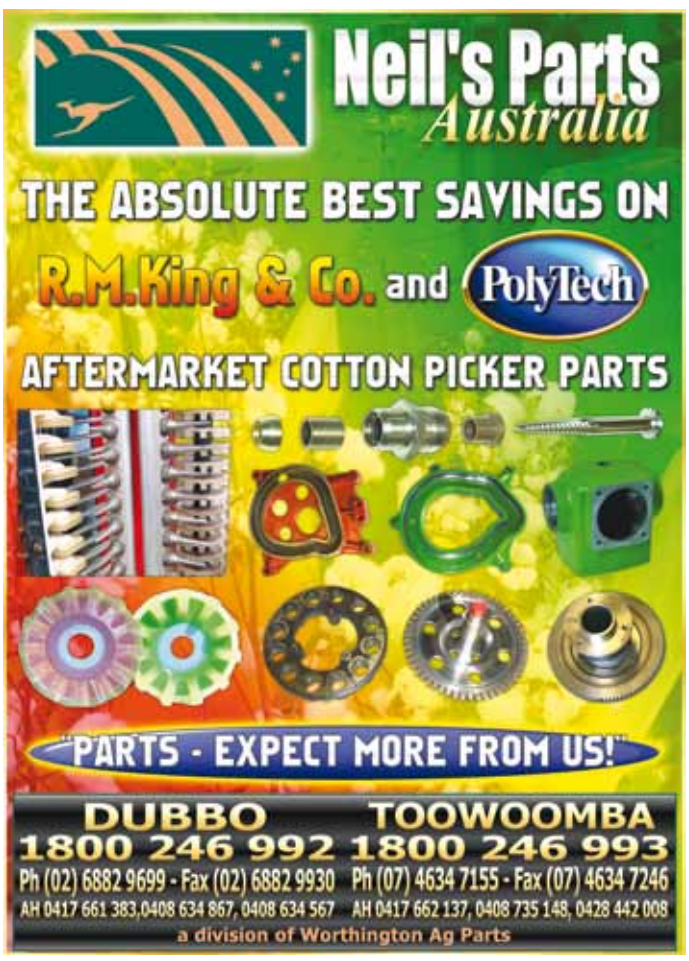
Plant stress

Stress is associated with damaging populations of mealybug in a range of cropping situations worldwide. From the survey it is evident that mealybug establishment was higher in those fields where plants exhibited stress caused by waterlogging, drought or nutrient deficiencies.

Beneficial insects

In some fields where no insecticides were used, beneficial numbers increased and eventually contained the infestations,

...20 ▷



Natural enemies such as lacewings (left) and Cryptolaemus ladybird beetles (right) are very efficient natural enemies of mealybugs. Note: The Cryptoleamus larvae, which resemble large mealybugs, are eating a mealybug. (PHOTO: Zara Ludgate)

◁19...MEALYBUGS

though some crop damage occurred. The most abundant beneficials observed were the green lacewing, and a number of ladybeetle species including Cryptolaemus and the three-banded ladybeetle.

Spread of mealybug infestations on infested farms

A number of cases provided evidence of mealybug moving down irrigation furrows and re-establishing further down the field. Furthermore there was confirmation of mealybug movement by vehicles, with tractors observed with mealybugs on their wheels.

DECONTAMINATION TRIAL

With the mealybug outbreak in Emerald confined to a relatively small number of farms, minimising the spread of this pest is a priority. The cotton industry urgently needed a means of confidently decontaminating machinery that has been used in infested fields before moving to 'clean' fields or other cotton regions.

DEEDI researchers conducted a simple trial to evaluate the efficacy of a number of products to kill all stages of mealybug on farm machinery.

The replicated experiment had seven treatments – each applied to a colony of mealybug on a detached terminal of a mature cotton plant. An assessment of mortality was made at 24 hours after treatment, and again at 84 hours (Table 1).

The application of Pulse Penetrant to farm machinery can potentially control 90–100 per cent of all nymphs and adults, and provides an effective option for minimising the movement of mealybug on machinery. Good coverage of surfaces is important to achieve the high levels of control seen in this trial. The use of Pulse Penetrant is now included in the cotton industry Come Clean Go Clean protocols, and its use is supported by an emergency use permit.

MORTALITY TRIAL

To demonstrate the importance of decontamination, a mortality trial was conducted by DEEDI researchers, to determine how long mealybug can survive without a host plant to simulate survival on farm machinery. In this replicated experiment mealybug crawlers and third instars were placed in ventilated vials without a food source or water.

The number of dead and live mealybugs were recorded at regular intervals. To date results are that crawlers can survive for up to six days without food. The third instars survive much longer with 46 per cent of mealybugs still alive after 21 days. These results highlight the importance of decontamination to minimise spread of mealybugs.

INDUSTRY PROTOCOLS FOR MANAGING MEALYBUG SPREAD

Following the trial work and survey results, the cotton industry has amended its 'Come Clean Go Clean' protocols to include practices to reduce the spread of mealybugs. The protocol builds on the fusarium washdown treatments and includes recommendations for:

- Washdown including use of Pulse Penetrant;
- Inspection;
- Personal hygiene;
- Module movement; and,
- Post harvest management including crop destruction and weed control.

The cornerstone of the protocol is the thorough washdown of equipment followed by a final spray treatment of Pulse Penetrant at a concentration of at least 0.5 per cent or 500 mls per 100 L. Good coverage of all surfaces is important to achieve the high levels of control seen in the decontamination trial. The protocol

TABLE 1: Percentage mortality (1st, 2nd–3rd, and adult) of Solenopsis mealybug at 12 and 84 hours after treatment

Treatment	Percentage mortality at 24 hours	Percentage mortality at 84 hours
Control	0.9 ± 0.3	11.9 a (2672)
Farmcleanse 2%	4.8 ± 0.9	26.9 b (2253)
Canopy 1%	4.2 ± 2.3	28.9 b (1323)
Degreaser 10%	9.6 ± 2.6	31.9 b (2236)
Farmcleanse 10%	65.6 ± 10.4	61.6 c (1740)
Pulse 0.2%	90.1 ± 3.6	92.2 d (1798)
Pulse 0.5%	99.8 ± 0.1	99.7 d (1542)
LSD		12.2

Means followed by the same letter are not significantly different (P > 0.05).
Numbers in brackets is total number of individuals in the treatment.

The decontamination trial. (PHOTO: Richard Lloyd)

Mealybugs (especially early instar nymphs) can be carried on people and clothing.

recommends equipment leaving known mealybug infested areas such as the Central Highlands be inspected by an independent contractor.

Because early instar nymphs are highly mobile and extremely small (1–2 mm), they can be carried on people and clothing. Growers and consultants need to consider this when visiting farms and avoid physical contact with infested plants and follow the protocol for personal decontamination where this is not possible. The protocol outlines that timely crop destruction and control of volunteer/ratoon cotton and weed hosts will reduce the potential for populations to expand and spread over winter.

MEALYBUG RESEARCH PRIORITIES

With much still unknown about this exotic mealybug, entomologists have identified a number of research priorities.

- Monitor the incidence and distribution within and beyond cotton-growing regions.
- Evaluate a range of options for controlling mealybug. Trials will commence in the Burdekin where cotton and mealybug are present through April–May. While growers are encouraged to 'go soft' to maximise beneficial populations, they also need to know that they have

...22▷

an effective control option should the mealybug population approach damaging levels.

- Develop reliable monitoring techniques for mealybugs in cotton at different stages of growth, and at varying densities. Being able to detect and monitor mealybug is critical to making decisions about the need for control, or otherwise, during the season.
- Monitoring mealybug populations in Emerald through winter and prior to the 2010–11 crop. This monitoring, focused on areas where mealybug populations were high in 2010, will provide information on where mealybug reside outside of the cotton season, and possibly what the mealybug pressure will be like during the 2010–11 cotton season.

SUMMARY

The survey of Emerald farms affected by mealybug highlights that plant stress, weediness (in and around cotton fields), the presence of re-growth cotton and the presence of beneficial insects had a significant impact on the likelihood of Solenopsis mealybug becoming of commercial significance. These findings support the importance of good farm hygiene and the continued focus on IPM. These practices, in conjunction with the implementation of the industry Come Clean Go Clean protocols, and research stand the industry in good stead to manage this pest.

For more information about the trial results, Pulse Penetrant permit, 'Go Clean Come Clean' protocols, how to report infestations or where to send mealybug samples, visit the Cotton CRC website at www.cottoncrc.org.au

Predators control the Burdekin's mealybugs

The newly-discovered Solenopsis mealybug may have met its match with early populations being controlled by native Australian predator insects in Burdekin cotton crops.

Speaking on CSD's Web on Wednesday broadcast, DEEDI research scientist, Dr Paul Grundy, said mealybug were present in crops in 2009, and worryingly, were attacking the current crop as it was emerging out of the ground.

"In 2009 it didn't get to the stage where it was uncontrollable, but it was certainly a management difficulty.

"One of the things we found last year was there was very little in the way of natural enemy activity which was associated with those mealybugs, which was a little strange compared with experiences with mealybugs in other countries."

"This season, when we started seeing the pest on seedling cotton, we were expecting to have major problems early in the crop with mealybugs, but we since have seen really good numbers of natural enemies move in and keep pest numbers at bay – so that's a very different experience to last year where we just could not find any natural enemies.

"The predator species that we're seeing that seem to be quite effective are the three banded ladybirds and lacewings in particular."

Paul said the scenario was typical of a new pest being introduced into an environment – a lag time for the natural predator populations to adjust to a level where they can suppress the pest.

"Its very early in the season and it remains to see how things unfold, but now we're seeing these natural enemies getting around we're hoping we can take advantage of that – hopefully rely on biological control as far into the season as we can, and with a bit of luck we might get away with minimal spraying for mealybug," he said.

Controlling the insect with insecticides has proven very difficult as they have a waxy coat which protects them from the sprays.

Further information: Dr Paul Grundy 07 4720 5110.

Early season populations of mealybug in Burdekin cotton crops are being controlled by native predator insects.