Adult pale cotton stainers are often seen in maturing cotton, often as mating pairs. They can damage maturing bolls. (Lewis Wilson, CSIRO)

Selecting an insecticide

As an occasional pest, there are few products registered for their control. The synthetic pyrethroids lambdacyhalothrin (Karate Zeon, Matador) and gamma-cyhalothrin (Trojan) are registered; check the labels of these products for more information. However their status as an occasional pest is influenced by their susceptibility to insecticides used for the control of Helicoverpa and other pests. Cotton stainers may be incidentally controlled when carbamates such as carbaryl or organophosphates such as dimethoate are used.

Survival strategies

Resistance profile

Worldwide there are few records of resistance to insecticides developing in the field, however cotton stainers will react to selection pressure under laboratory conditions. Any decision to use broad spectrum insecticides such as SPs should take into account their impact on beneficial insects and the subsequent risk of flaring whitefly and other secondary pests should also be considered.

Overwintering habit

As there is no resting stage in the cotton stainer's lifecycle, cultural controls between cotton seasons assist greatly in limiting population development (see below).

Alternative hosts

Fuzzy cotton seed used for stockfeed is an important alternative source of food for cotton stainers. Avoid storing fuzzy seed in exposed places where cotton stainers can access this food source over long periods. Controlling ratoon cotton and cotton volunteers is important for limiting cotton stainer's access to alternative food source.

Further Information
DEEDI, Toowoomba
Moazzem Khan: (07) 4688 1310 or 0428 600 705
CSIRO Plant Industry, Narrabri
Lewis Wilson: (02) 6799 1550

Solenopsis mealybug

Phenacoccus solenopsis

The solenopsis mealybug (*Phenacoccus solenopsis*) was first identified from cotton crops in the Emerald and the Burdekin regions during the 2009/10 season.

Damage Symptoms

Nymphs and adults cause damage at all stages of crop development. Infestations can cause crinkled and twisted leaves, reduced flower and boll development, and distorted and stunted plants. Heavy infestations can lead plant death in field patches. Honeydew excreted by the insects onto the leaves and lint can promote the development of black sooty mould.

Sampling

At low densities, mealybugs can be present anywhere on the plant. Crop stress, such as waterlogging, may make cotton more susceptible to mealybug, so it is important to include stressed areas when checking e.g. tail drains. Investigate patches of stunted or dead plants. As solenopsis mealybug has a very wide host range, also monitor surrounding vegetation including gardens.

If mealybugs are found, send samples (as many individuals as possible) to:
Melina Miles or Zara Ludgate (07) 4688 1436
DEEDI PO Box 102, Toowoomba 4350
DEEDI will determine if they are *P. solenopsis*, and keep track of the distribution of the species.

Thresholds

There is no threshold for control of mealybugs. The impact of mealybug on yield and quality has not been evaluated, other than where plant death occurs.

Selecting an insecticide

There are currently no insecticides registered for the control of mealybugs in cotton.

Insecticides are not expected to be the main means of managing solenopsis mealybug in cotton.

There are a number of management options that can reduce the size of infestations, and the overall impact of this pest. In Emerald and Burdekin, natural enemies have proven to be very effective at reducing high mealybug populations, and minimising the build up of populations in crops.

- Avoid early season use of broad spectrum insecticides – these kill natural enemies that may otherwise control mealybug.
- Minimise on-farm sources of mealybug survival and build up e.g. weeds, ratoon and seedling cotton.

Mealybug being eaten by ladybird larvae.

- Monitor for presence of mealybug along with other pest monitoring. Include areas that are under stress where populations may develop first.
- Monitor abundance of adults, nymphs and natural enemies over time, this will provide a picture of whether the mealybug population is building up.
- Consider release of Cryptolaemus and/or lacewings in hotspots.
- Consider treatment of hotspots only – be mindful of spreading infestations with machinery and passage of people through hotspots.
- If insecticide control is warranted, select the softest option – suppression may be sufficient if natural enemies are present.
- Put into practice the industry Come-Clean-Go-Clean protocols to minimise the spread of mealybug.

Key beneficial insects

Predators - Three banded ladybird beetles, lacewings, cryptolaemus, smudge bugs, earwigs and native cockroaches.

To date no solenopsis mealybug parasitoids have been recorded in Australia.

Survival strategies

Key factors that contribute to solenopsis mealybug being a pest:

- They have a high reproductive rate. One female can produce hundreds of offspring.
- They shelter in protected positions on the cotton plant; in squares, bracts and under surfaces of leaves. The waxy coating on mealybugs is water repellent, making them a more difficult target for insecticide contact.
- They can be spread in the field by wind, surface water runoff, rain splash, birds, people and farm equipment. Mealybugs are generally disseminated as first instar 'crawlers'.
- They can survive for long periods without host. QLD DEEDI research found that the crawler stage can live for up to 6 days, and the 3rd instar stage for up to 50 days without food or water.

Over-wintering

Mealybugs can overwinter, but it is unknown to what extent they may overwinter in Australian conditions. However, they have a broad host range and this provides the potential to survive for significant periods on a series of crop and non-crop hosts.

Solenopsis mealybug. (Zara Ludgate, DEEDI)

Alternative hosts

The solenopsis mealybug has a wide host range, and in Pakistan it has been recorded on 154 plant species including field crops, vegetables, ornamentals, weeds, and trees. In Emerald and the Burdekin, solenopsis mealybug has been recorded from a range of common weed species on farm such as pigweed, sow thistle, bladder ketmia, native rosella, vines (cow, bell and potato), crownbeard, and volunteer cotton.

Further information
DEEDI, Toowoomba
Melina Miles 07 4688 1369
Zara Ludgate (07) 4688 1436

Other pests

TABLE 9: Control of armyworm, cutworm and tipworm

Active ingredient	Concentration and formulation	Application rate of product	Comments
Armyworm (Lesser) *Spodoptera exigua*			
Chlorpyrifos	500 g/L EC	0.7 or 0.9 L/ha	When 'army' is moving treat broad strip over and in advance of the infestation. Use higher rate for larvae > 3 cm.
Cutworm *Agrotis* spp.			
Chlorpyrifos	500 g/L EC	0.9 L/ha	Apply immediately infestation is observed. Apply in a minimum of 100 L of water.
Endosulfan	350 g/L EC	2.1 L/ha	Apply at first sign of infestation. Ensure pesticide application management plan (PAMP) is completed.
Tipworm *Crocidosema plebejana*			
Endosulfan	350 g/L EC	2.1 L/ha	Apply at first sign of infestation. Ensure pesticide application management plan (PAMP) is completed.

Other pests

TABLE 10: Control of wireworm

Active ingredient	Concentration and formulation	Application rate of product	Comments
Wireworm *Apryprius variabilis* and False wireworm *Pterohelaeus* spp.			
Aldicarb	150 g/kg G	3.0–7.0 kg/ha	Apply into the seed furrow at sowing.
Bifenthrin	100 g/L EC 250 g/L EC	0.375 L/ha 0.15L/ha	Apply as spray into the furrow at planting. Use a spray nozzle which will deliver a coarse spray in a total volume of 60–100 L/ha.
Chlorpyrifos	300 g/L EC, EC/ULV 500 g/L EC	0.8–2.5 L/ha 0.5–1.5 L/ha	Use higher rate with extreme population numbers. Use rates for row spacing of 1 m. Apply as band spray at least 10 cm wide into open furrow at sowing. Use minimum spray volume of 20 L per sown ha.
Phorate	200 g/kg G	3.0 kg/ha	Apply into the seed furrow at sowing.
Azadirachta indica	50g/L	0.8 L/ha	Apply product in the planting furrow to enable see/soil contact. Apply minimum of 150L water/ha

TABLE 11: Control of cotton leafhopper

Active ingredient	Concentration and formulation	Application rate of product	Comments
Cotton leafhopper (jassids) *Amrasca terraereginae*			
Aldicarb	150 g/kg G	3.0–7.0 kg/ha	Planting into moist soil will allow greater and faster uptake. Use higher rate for longer residual control.
Dimethoate	400 g/L EC	0.35–0.375 L/ha	Use the higher rate for heavy infestations. Lower rate in NSW
Endosulfan (jassids only)	350 g/L EC	2.1 L./ha	Apply at first sign of infestation. Ensure pesticide application management plan (PAMP) is completed.
Gamma-cyhalothrin	150 g/L CS	0.05 L/ha	Apply at recommended threshold levels as indicated by field checks.
Omethoate	800 g/L SL	0.28 L/ha	Apply by ground or air.
Phorate	100 g/kg G	6.0 kg/ha	For short residual control.
		11.0–17.0 kg/ha	For extended period of control. Only use the highest rate on heavy soils when conditions favour good emergence.
	200 g/kg G	3.0 kg/ha	For short residual control
		5.5–8.5 kg/ha	NSW registration only.
Lambda-cyhalothrin	250g/L	0.06 L/ha	

TABLE 12: Control of rough bollworm

Active ingredient	Concentration and formulation	Application rate of product	Comments
Rough bollworm (*Earias huegeli*) (This pest is not normally a problem where a Helicoverpa species control program is adopted.)			
Alpha-cypermethrin	16 g/L ULV 100 g/L EC	2.0–2.5 L/ha 0.3–0.4 L/ha	It is essential to detect and treat infestations before larvae are established or concealed in bolls deep in the canopy. Use high rate for large larvae.
Beta-cyfluthrin	25 g/L EC	0.6 or 0.8 L/ha	Application should be timed to coincide with egg hatching.
Carbaryl	500 g/L SC	2.2 L/ha	NSW only. Apply when pest appears. DO NOT use on cotton after 25% of bolls have opened.
Cypermethrin	40 g/L ULV 200 g/L EC 250 g/L EC 260 g/L EC	1.9–2.5 L/ha 0.375–0.5 L/ha 0.3–0.4 L/ha 0.29–0.385 L/ha	Rates vary. See product label for specific rates. Use highest rate when canopy is dense. Effectiveness is lower for established and concealed infestations.
Endosulfan	350 g/L EC	2.1 L/ha	Apply at or just prior to egg hatching. Ensure pesticide application management plan (PAMP) is completed.
Methoxyfenozide	240 g/L SC	1.7 L/ha or 2.5 L/ha	Apply with recommended adjuvant. Use high rate on rapidly growing crops.
Rynaxypyr (chlorantraniliprole)	350 g/kg	150 g/ha +non ionic surfactant @ 125 gai/100 L	Target brown eggs or hatchling to 2nd instar larvae before they become entrenched in terminals or bolls.

TABLE 13: Control of pink spotted bollworm

Active ingredient	Concentration and formulation	Application rate of products	Comments
Pink spotted bollworm (*Pectinophora scutigera*)			
Chlorpyrifos	300 g/L EC 500 g/L EC	1.75 L/ha 1.0 L/ha	QLD only. Apply when 10–15 moths are trapped on two consecutive nights to prevent infestation of bolls by larvae.
Deltamethrin	5.5 g/L ULV 27.5 g/L EC	2.5–3.0 L/ha 0.5–0.6 L/ha	QLD only. Apply at first sign of activity before larvae enter boll.
Esfenvalerate	50 g/L EC	0.4 L/ha	Central QLD only. Apply at this rate when pink spotted bollworm is only pest present.
Gamma-cyhalothrin	150 g/L CS	0.06 L/ha	QLD only. If Helicoverpa spp. are not present apply when more than 10 adults moths are caught in pheromone traps on 2 consecutive nights.
Lambda-cyhalothrin	250 g/L ME	0.07 L/ha	As above