Pest Management

On Farm | November 2011 | Produced by Cotton Catchment Communities CRC

Petroleum Spray Oil in cotton:
Facing the season ahead

Using petroleum Spray Oils (PSO's) to manage aphids and mirids

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Meeting IPM Challenges in the 2011/12 Cotton season

Good vegetation covering following good winter rains enhances populations of pest and beneficial insects. As weed and vegetation dry out there is likely to be an influx of beneficials and pests onto attractive irrigated crops

Recently, there have been reports of cotton seedlings have been infested with aphids moving from weeds, shrubs and harvested wheat crops etc. The migrating aphids may not be cotton aphids which means cotton may not be their preferred host and numbers are likely to decline or rarely become a problem in these circumstances. See the Pests and Beneficials in Australian cotton Landscapes booklet or insect ID Guide on the Cotton CRC Web site.

However, growers and consultants may be concerned about the densities of these aphids on their seedling cotton plants and be tempted to control them. (for help see the CottASSIST Aphid yield loss estimator on the Cotton CRC Web site)

The decision to control aphids should consider the potential disruption to beneficial insects starting to establish as a result of the aphid infestations. With this in mind, the use of synthetic insecticide such as organophosphates after seed treatments may not be a good option. Given that the use of petroleum spray oils, Canopy® or Biopest® oils (check label for current registration), can be highly effective in controlling and suppressing pest populations on cotton crops, particularly early in the season when good coverage can be more easily achieved.

Managing aphids and mirids with PSOs

PSOs can be used as either stand alone products or as adjuvants with synthetic insecticides to control aphids and mirids:

- For mirids the standard thresholds for applying PSO or Biological insecticides is 1 mirid/ metre in warm areas or 0.5 mirids/metre in cool areas (based on visual samples).
- At seedling to first open boll, the aphid threshold is 90% plants infested and from first open boll to harvest 10% plants infested (see Cotton Pest Management Guidelines for more details). Note, that PSOs alone are most effective if aphid numbers are not too high (about 60% of plants infested) and plants are smaller so that good coverage is possible. Also, 2 consecutive sprays 14 days apart can be applied to suppress aphid numbers.

Rates for Early season control (Young plants):
Apply 2-5% v/v or 2-5L/ha in 100L of water per hectare using ground rig.

Rates for Mid to Late season control (Big plants):

Apply 1 - 2% v/v or 1 - 2L/ha to 1/2 or 3/4 rates of recommended insecticides (check labels). To reduce impact on beneficial insects selective insecticides will be more appropriate than broad spectrum hard insecticide such as pyrethroids.

Other options:

Mix at least 1-2L/ha PSOs in every spray product (insecticides, growth regulators, foliar fertilizers etc.) applied to cotton crops. By doing this cotton growers can

maintain PSO residues on the cotton leaves suppressing the build up of mirids and other secondary pests such as aphids, whiteflies, mites, apple dimpling bugs, stink bugs, jassids etc. This use pattern can be used in Bollgard II® crops to reduce the use of synthetic insecticides to control minor pests.

Rates for irrigated and dryland crops:

The rates of application of PSOs are similar for both dryland and irrigated cotton crops at similar growth stages.

MODE OF ACTION OF PSOs AGAINST INSECTS SUCH AS APHIDS AND MIRIDS

The mode-of-action of PSOs against aphids and mirids is direct suffocation with most of the mortality occurring within the first 10-60 minutes after spraying. The oil can also penetrate the fatty tissues of the insects when they come into direct contact with the oil resulting in the death of the insect. This suggests that the oils have a physical (contact) mode of action.

Those insects that do not have direct contact with PSO, but that encounter oil treated areas through subsequent movement can also die from the toxic oil residues. Generally, Oils have multiple targets as opposed to synthetic insecticides. Oils can penetrate through the insect cuticle or body to form physical barriers to gaseous exchange or dissolve internal lipids and eventually enter the internal cellular structures causing death of the insect.

Effect of PSOs on airborne volatiles released by cotton plants (solid phase micro-extraction ,SPME) tests.

Plants release airborne volatiles. The quantity of airborne volatiles released by plants (e.g. cotton plants) assist insects, especially cotton pests, to detect and select the plant for oviposition or colonization. Experiments using a solid phase micro-extraction (SPME) tests showed that airborne volatiles released by cotton plants treated with PSO was far less than water treated plants (Figures 1 and 2). Thus the application of PSO onto cotton plants masks the release of plant volatiles, tricking the insects to believe that the plant is not a good host plant resulting in low pest infestations. The more cotton plants are treated with PSO, the higher the oil residues built on the plant leaves reducing the release of airborne volatiles and subsequent pest infestation.

Therefore oil sprays make the cotton plants unattractive for aphids to form colonies and other pests such as *Helicoverpa spp*, Silverleaf whiteflies, green vegetable bugs, green mirids etc to infest the plants in high numbers.

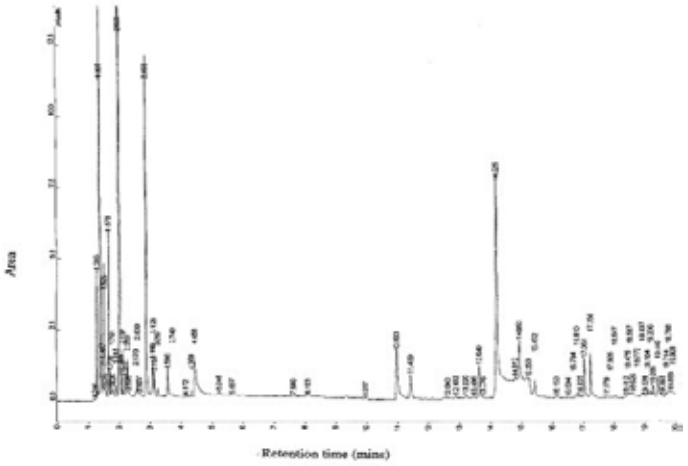

Figure 1: . Airborne volatiles from cotton plants sprayed with water only.

Plant volatiles released by cotton plants and used to target feeding and oviposition are evident in the gas chromatograph of volatiles sprayed with water only (Figure 1 ABOVE). These volatiles are masked by the application of PSO (Figure 2 BELOW)

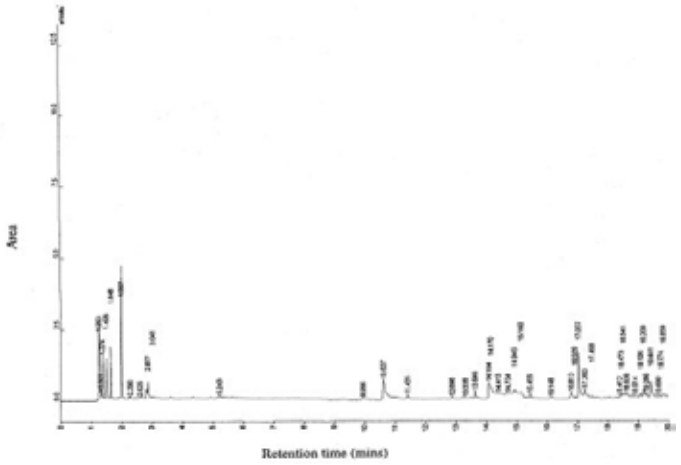

Figure 2: Airborne volatiles from cotton plants sprayed with PSO . From Chromatographic (SPME) analyses of tests of cotton plants treated with PSO in the glasshouse. (R Mensah et al. , International Journal of Pest Management, .

Application of PSOs against pests on cotton crops

The optimum rate of application of PSO is 2% v/v or 2L/ha in 100L of water per hectare. Use higher rates - up to 5% if pest abundance is high. PSOs can be applied using groundrig or aircraft. Growers, are advised not to apply PSOs at temperatures of 40ºC or above to avoid oil burns

to the crop.

Application by ground rig

When used with ground rig, application volume should vary according to the stage of growth of the cotton crop. Application should aim to achieve the best coverage possible both of the upper and lower leaf surfaces and the plant terminal. This is helped by using higher water volumes (80-150 l/ha) and boom droppers where possible. During the early season, there is the opportunity to reduce costs as PSOs can be applied as a band to cotton crops. In dryland cotton crops, where it is possible to use ground rigs late into the season, it is recommended that 100-120L/ha application volumes be used.

Application by aircraft (fixed wing or Helicopter)

The most effective volume of application by air is 30-40L/ha in the mid to late cotton season. These relatively high water volumes will help to ensure effective coverage. All plant terminals, leaves, squares and bolls should receive spray to maintain the oil residues on the crop.

Cotton management

Agronomic management of cotton crops that are treated with PSOs within an IPM program should be similar to management practices used for the whole farm. However, growers should avoid high plant stands and planting late. High plant stands will affect or interfere with spray coverage and hence potentially reduce the efficacy of the PSO.

Insect Management

Insect sampling and thresholds

Insect sampling methods, and thresholds can be sourced from Australian Cotton IPM Guidelines, Cotton Pest Management Guide

Publications are available on line on the Cotton CRC Web site: www.cottoncrc.org.au

An aphid yield loss estimator tool is available as part of the CottASSIST Suite of web tools:

http://cottassist.cottoncrc.org.au/Aphids/Default.aspx

Management of seedling pests

Where pests such as aphids, thrips, jassids, green mirids, apple dimpling bugs, mites and whiteflies require control during early season, the use of PSOs is recommended. PSOs should be applied from 2-5% v/v in a band spray before the pests reach IPM treatment thresholds. The higher oil rates should be used if pest abundance is high. Repeated applications of PSOs early season has been shown to reduce the build up of aphids and other pests while maintaining beneficial insects.

Managing *Helicoverpa spp.* with PSOs

Modes of action

PSOs can kill *Helicoverpa spp*. eggs and neonate larvae by smothering them, particularly early in the season when plants are smaller and effective spray coverage (up to run-off) can be achieved. Research trials show that white eggs are more susceptible to oil than brown eggs. In addition to direct toxicity to the eggs and larvae, PSOs can also deter *Helicoverpa spp*. adult egg lays by suppressing cotton plant volatiles or odours so the pest does not recognise the plant as a good host. Helicoverpa larvae present at the time of PSO application can also suffer from direct feeding toxicity.

PSOs alone

PSOs can be used alone to control Helicoverpa provided issues of coverage and pest pressure are considered. PSOs are generally slower acting than synthetic insecticides and provide only 30 - 50% control of the population. So, when use alone it is critical to ensure good coverage and to apply them at a lower Helicoverpa threshold of 1.0 - 1.5 larvae per metre. PSOs alone are most effective early season.

PSOs as an adjuvant for biological and synthetic insecticides

In the mid - late season when cotton plants are bigger, achieving good coverage can be difficult, especially if application is by aircraft. This may result in inadequate efficacy if PSOs are used alone. Instead, during this period PSOs are better used as adjuvants to enhance the efficacy of biological and synthetic insecticides. Research has shown that addition of 2% v/v of PSO to ½ or 3/4 rates of insecticide achieved (check individual labels). Helicoverpa control equivalent to the full rate of insecticide without the oil. Reducing the rate of insecticide also has less negative effect on beneficial populations as well as reducing costs. Growers should note that the 1/2 or 3/4 rates of the insecticides should be calculated from the maximum label rate. Addition of 1 l/ha PSO to full label rates of synthetic insecticides also provides better control than the insecticides alone. PSOs can be added at 2% v/v to full label rates of biological products to enhance efficacy and persistence.

Using PSOs with beneficials

One of the benefits of PSOs is that they have little negative effect on most beneficial groups, especially adult beneficials. They will however reduce numbers of some beneficials in the larval stage, such as ladybeetle larvae. The decision to control *Helicoverpa spp*. should be based on a combination of pest numbers (thresholds), fruit retention and abundance of beneficials (as indicated by the beneficial insects to pest ratio). Table 1 outlines a strategy to incorporate the effect of beneficials into the pest management decision process. The table refers to the beneficial to pest ratio, which takes into account the effect of predators and egg parasites on *Helicoverpa spp*.

The **Beneficials to Pest ratio** is calculated as:

$$\frac{\textbf{Number of beneficial insects per metre}}{\textbf{(viable Helicoverpa eggs*) +VS\&S larvae}}$$

*Eggs that will survive to hatch. In regions where egg parasitism is active do not include parasitised eggs

Conclusions

PSOs offer a new and valuable tool that can be used to help control pests in IPM systems. Growers should be aware that all oils are not the same and therefore should only use products registered or under permit with APVMA.

Acknowledgement

The Cotton Research and Development Corporation provided funding for the project. Special thanks to Dr Adriana Najar-Rodriguez (PhD) student who studied effect of PSOs on aphids. Adriana was supervised by Dr robert Mensah and Assoc. Prof. Gimme Walter (Univ of Qld).

Disclaimer:

Important Use of Pesticides

Pesticides must only be used for the purpose for which they are registered and must not be used in any other situation or in any manner contrary to the directions on the label.
Some chemical products have more than one retail name. All retail products containing the same chemical may not be registered for use on the same crops. Registration may also vary between States.

Check carefully that the label on the retail product carries information on the crop to be sprayed. This publication is only a guide to the use of pesticides. The correct choice of chemical, selection of rate, and method of application is the responsibility of the user.

Check that permits for use are current.

Pesticides may contaminate the environment. When spraying, care must be taken to avoid spray drift onto adjoining land or waterways. Residues may accumulate in animals fed any crop product, including crop residues, which have been sprayed with pesticides. In the absence of any specified grazing withholding period(s), grazing of any treated crop is at the owner's risk.

Table 1: Making a decision based on the predator or beneficial insects to pest ratio to control *Helicoverpa spp*. larvae.

Predator/Beneficials to Pest Ratio	Helicoverpa Situation	PSO Action
Beneficial to Pest ratio is greater than 0.5	Pest management in your crop is going well Less than 2 helicoverpa larvae/m	None - beneficials should effectively control
Beneficial to Pest ratio between 0.4- 0.5	Predominantly eggs, larvae threshold not exceeded Helicoverpa neonate (VS+S) larvae less than 1.5/m	Apply food sprays to attract beneficials. Apply PSO to deter Helicoverpa egg lay and directly kill neonates
Beneficial to Pest ratio is between 0.4 - 0.5	Predominantly neonate and close to threshold (1.5- 2.0 larvae /m) AND Crop small, adequate coverage can be achieved	Apply 2L/ha PSO with biological insecticides (NPV or Bt) or 2 - 5 L/ha PSO as a stand alone
Beneficials to Pest ratio is between 0.4 - 0.5	Predominantly neonate and close to threshold (1.5- 2.0 larvae /m) AND Crop Larger, reducing coverage	Apply 2 L/ha PSO with reduced rates of recommended selective insecticides
Beneficials to Pest ratio is 0.4 or less indicating beneficial insect numbers are low	2 larvae /metre reached	1L/ha PSO to full rate selective insecticide