Update on redlegged earth mite resistance in Western Australia: Now showing resistance to chlorpyrifos

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Key messages

- In WA there are now 56 properties identified with populations of redlegged earth mites (RLEM) that are resistant to synthetic pyrethroids such as bifenthrin,
  And 3 properties with RLEM resistant to omethoate and synthetic pyrethroids.
- And 4 properties with RLEM resistant to omethoate only
- This year 2 properties for the first time were detected with RLEM resistant to chlorpyrifos.
- Resistance to synthetic pyrethroids has been confirmed to be heritable and persistent over many years. The omethoate resistance is also heritable but its persistence is yet to be determined, it is unknown if chlorpyrifos resistance is heritable.
- Most growers with resistance were spraying for pests other than RLEM, if possible use alternatives to the synthetic pyrethroids and organophosphate groups when spraying crop pests.

Aims

To determine the extent of RLEM insecticide resistance in the Western Australia grain belt.

Method

Mite collection

Growers, consultants and agronomists were contacted to participate in a survey to determine the extent of RLEM resistance. Paddocks that were previously known or suspected of having a chemical failure or farms with high levels of pesticide usage were selected to participate in the survey.

RLEM were collected either by using a suction sampler or by collecting weeds with mites on them from along fence lines. At least 100 mites were collected and placed into air tight containers with moistened paper towel and plant material.

At each collection site the following was recorded:

1. GPS reading
2. Location of paddock and farmer's name
3. Property name

Mites were stored below 15^{o}C until testing for resistance could commence.

Treatments for RLEM resistance screenings

The inside of 5 mL vials were coated with either:

- Bifenthrin at 0.1 g a.i./L (10 g ai/ha) (equivalent to field rate)

- Bifenthrin at 0.00006 g a.i./L (equivalent to twice the LD_{90})

- Omethoate at 0.0018 g a.i./L (equivalent to twice the LD_{90})

- Control (water)

Mites from a known susceptible source were also used to compare results with the test populations of mites.

Treatments for RLEM resistance to omethoate and chlorpyrifos

The inside of 5 mL vials were coated with either:

- Chlorpyrifos at 0.7, 0.07, 0.007, 0.0007, 0.00007, 0.000007 g a.i. /L

- Omethoate at 0.29, 0.029, 0.0029, 0.00029, 0.000029, 0.0000029 g

a.i./L

-Methidathion at 0.8, 0.08, 0.008, 0.0008, 0.00008, 0.000008 g a.i./L

- Control (water)

Testing for resistance

Vials were coated with the required insecticide concentration then left upside down at room temperature until all inner surfaces were completely dry. Once dry, a vetch leaf was placed at the bottom of each vial.

Then for each collection site, 8 healthy RLEM were placed on top of the vetch in the vial. For each treatment there were 6 replicates.

Scoring for resistance

After 24 hours mites were assessed. Mites that were alive received a score of 1, mites that were incapacitated or dead received a score of 0.

Results

Synthetic pyrethroid resistance

Resistant RLEM have been found to occur from Esperance to the South Stirlings and north to Dandaragan. There are now 56 properties in Western Australia with RLEM resistant to synthetic pyrethroids. All of these properties have a history of repeated applications of synthetic pyrethroids for pests other than RLEM.

Omethoate resistance

In 2014 , two properties near Capel were discovered with RLEM resistant to both synthetic pyrethroid and highly tolerant to the organophosphate chemical omethoate. In 2015 these properties were re-tested and RLEM were found to still be highly tolerant of omethoate and resistant to synthetic pyrethroids.

In 2015, one property in Boyup Brook with synthetic pyrethroid resistance and omethoate tolerance was found and a further four properties with RLEM showing tolerance to omethoate only.

To date, growers with RLEM resistant to synthetic pyrethroids have been able to control these mites using other insecticides from the organophosphate (OP) group (Group 1B), e.g. dimethoate and omethoate. The combined omethoate and SP resistance found at Capel and Boyup Brook is indicating that the current insecticide dependence is commencing to break down. Growers with omethoate tolerant RLEM have been able to control these mites using other insecticides in the OP group such as chlorpyrifos.

Chlorpyrifos resistance

In 2015, two properties in the Capel region reported RLEM surviving spray applications of chlorpyrifos. Resistance testing revealed these mites were not resistant to omethoate, synthetic pyrethroids or methidathion. Comparing a single population of RLEM at Capel with a RLEM population at South Perth that has never been exposed to chlorpyrifos suggests that the Capel population is >114 times more tolerant to chlorpyrifos at the LD_{50}. However, more rates need to be tested as the South Perth population had 100% mortality at the lowest rate of chlorpyrifos tested.

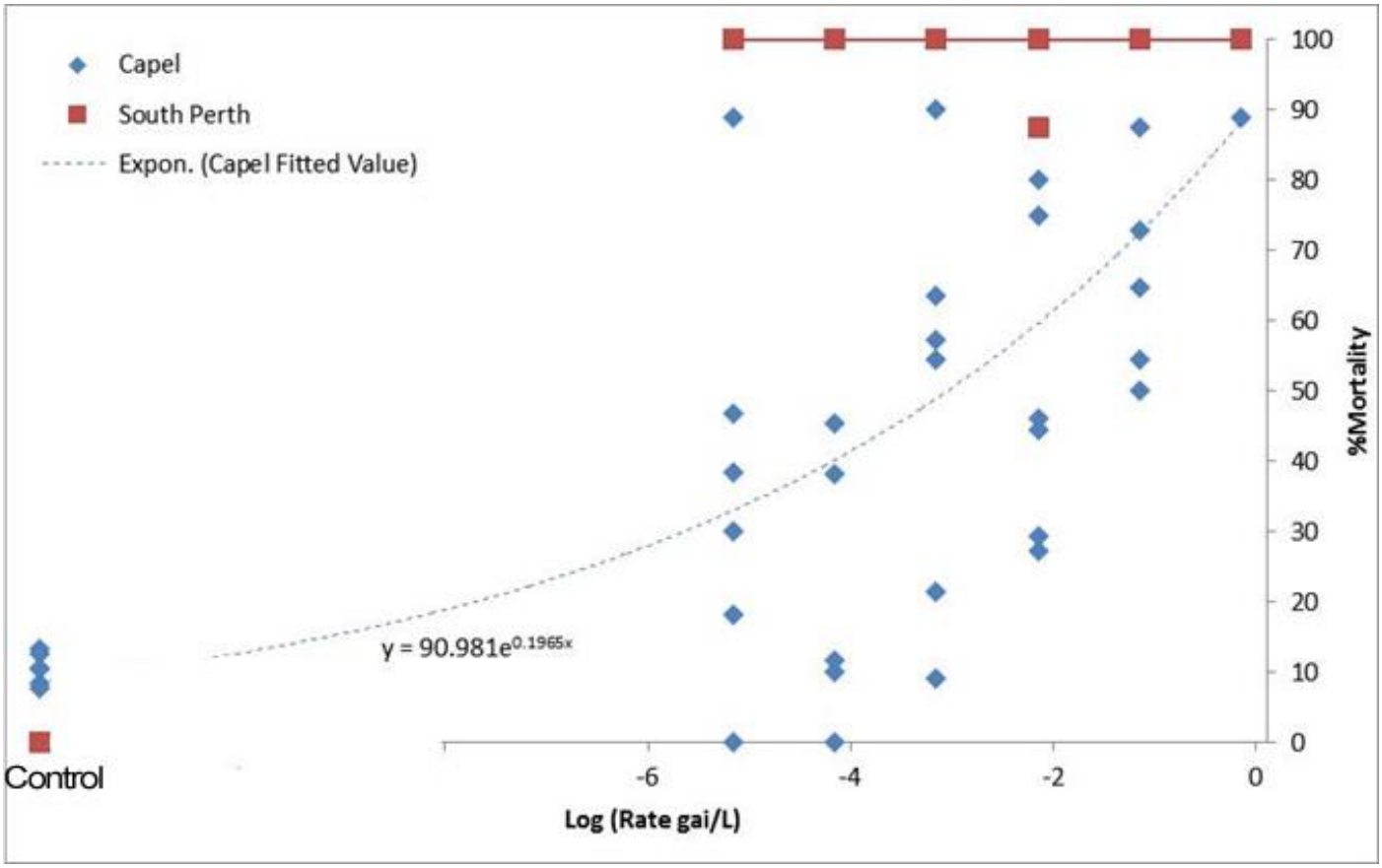

Figure 1 Mortality of redlegged earth mites from two sites exposed to chlorpyrifos at various rates

Managing resistance in RLEM

- Crop rotations that fit with the farming system e.g. growing crops susceptible to RLEM e.g. canola following crops that do not support large RLEM populations , e.g. cereals.
- Heavily grazing pasture paddocks through spring in the year prior to sowing crops susceptible to RLEM e.g. canola.
- Decreasing weeds that will hosts mite populations within the crop phase and around fence lines
- Use insecticidal seed dressings.
- If sprays need to be applied for the control of any pest, rotate chemical groups within the season and between years and consider using insecticides not in the SP or OP group.

Conclusion

A total of 56 properties have been identified from 2006-2015 with RLEM resistant to frequently used synthetic pyrethroid insecticides such as bifenthrin.

A total of 3 properties were found with cross resistance to omethoate and synthetic pyrethroid insecticides. RLEM highly tolerant to omethoate showed susceptibilities to other insecticides in the OP Group.

Two properties were found with RLEM that were tolerant to chlorpyrifos. These mites were susceptible to synthetic pyrethroids and other insecticides in the OP group.

The only way to stop resistance from developing is to rotate chemical groups. We need to look at better ways as an industry to control pests that do not solely rely on insecticide applications.

Key words

Bifenthrin, chlorpyrifos, dimethoate, dose response, omethoate, Redlegged earth mite, resistance, synthetic pyrethroids

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