



ADAMA



Trivor[®]

Product Guide

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Introducing Trivor®

Trivor® is a unique insecticide that provides rapid knockdown and extended residual control of many of the sucking insects that attack Citrus crops. Key targets include Californian Red Scale and Pink Wax Scale, Citrus Mealybug, Kelly's Citrus Thrips and Citrus Leaf Miner. Containing two modes of action, Trivor® sets a new benchmark in knockdown control and longer term protection. Trivor® is applied at low use rates and displays minimal impact on beneficial insects.

The Impact of Insect and Mite Pests in citrus crops

Insect and mite pests are responsible for significant production losses throughout Australia's 28,000 hectare citrus fruit growing industry. In all growing regions including the major areas of southern Australia's Riverland, Sunraysia and Riverina and Queensland's Emerald and Central Burnett, citrus trees are attacked by one or more species of a range of hemipteran insects with sucking mouthparts – including scale and mealybugs – and all aerial parts of the tree are susceptible.

Red Scale is possibly the most important scale pest for Australian citrus growers with heavily infested fruit downgraded during packing, and if population levels are high, serious damage can occur to trees including occasionally tree death.

Mealybugs feed on tree sap and produce honeydew, which can result in the growth of sooty mould on foliage and fruit, once again reducing quality and marketability. Additionally, live mealybugs on fruit sent for export can result in expensive fumigation treatment if detected at the overseas port of entry.

Kelly's Citrus Thrips are a significant pest, particularly in the Riverland-Sunraysia regions of South Australia and Victoria, with losses of up to 40 % experienced even with the application of previously available control measures.

To minimise losses from sucking pests, growers must have suitable control measures at their disposal including the timely application of appropriate insecticides.

Extensive efficacy and crop safety trials have been undertaken by Adama to develop Trivor® as an effective new option for growers in Australia and other major global citrus producing countries.



Trivor® is available in 5 L packs from Adama Innovation Centres.





Trivor[®] at a Glance

Trivor [®]	
Registered Crops	Citrus
Pest Spectrum	<p>Black scale (<i>Saissetia oleae</i>)</p> <p>Californian Red Scale (<i>Aonidiella aurantii</i>)</p> <p>Citrus Leaf Miner (<i>Phyllocnistis citrella</i>)</p> <p>Citrus Mealybug (<i>Planococcus citri</i>)</p> <p>Kelly's Citrus Thrips (<i>Pezothrips kellyanus</i>)</p> <p>Pink Wax Scale (<i>Ceroplastes rubens</i>)</p>
Formulation Type	Dispersible Concentrate (DC)
Use Rate	40 mL/100 L of water or 1.6 L/ha
Water Rates	<p>Apply as a dilute (high volume) spray to the point of runoff, ensuring thorough coverage.</p> <p>Select the Trivor[®] application rate based on the spray volume as follows:</p> <ul style="list-style-type: none"> • Up to 4000 L/ha water Apply Trivor[®] at 40 mL/100 L • > 4000 L/ha water Apply Trivor[®] at 1.6 L/ha

Key Features

- Two highly effective and trusted active ingredients combine to provide protection from hard and soft scale species and other key sucking pests of citrus
- Rapid knockdown action combined with long residual protection
- Highly compatible dispersible concentrate formulation allowing one pass insect and disease control when mixed with registered fungicides
- Two modes of action for resistance management.

Mode of Action

GROUP	4A 7C	INSECTICIDE
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Trivor[®] is a combination of Group 4A and Group 7C insecticides and as such incorporates two distinctly different Modes of Action.

Acetamiprid

Acetamiprid is a member of the Neonicotinoid (Group 4A) insecticide family and interferes with neurotransmission in target insects causing feeding to cease within hours or even minutes and achieves mortality within 24–48 hours. Acetamiprid acts through both ingestion and direct contact with insects and displays some translaminar movement within plant tissue.

Pyriproxyfen

Pyriproxyfen is an insect growth regulator (Group 7C) that suppresses embryogenesis (egg development) and mimics juvenile hormone, inhibiting metamorphosis and preventing target insect nymphs developing into adults. Its effects are slow to appear but irreversible. Pyriproxyfen acts primarily through ingestion by the target insect with some contact and ovicidal activity which allows for an extended period of control.

Mode of Action Summary

Parameter	Acetamiprid	Pyriproxyfen
Concentration	186 g/L	124 g/L
IRAC Group	4A	7C
MOA	Nicotinic acetylcholine receptor agonist Nerve action	Juvenile hormone mimic Growth regulation
Uptake pathway	Contact and ingestion	Contact, ingestion and ovicidal
Systemic activity	Non-systemic, translaminar	Translaminar
Speed of action	Rapid knockdown	Slow acting, long term

Use Rates and Target Pests

Citrus

Trivor® will control Californian Red Scale, Pink Wax Scale, Black scale, Citrus Mealybug, Citrus Leafminer and Kelly's Citrus Thrips.

Apply Trivor® as a dilute (high volume) spray to the point of runoff, ensuring thorough coverage. Select the Trivor® application rate based on the spray volume, as follows:

Spray volumes up to 4000 L/ha water apply Trivor® at 40 mL/100 L

Spray volumes > 4000 L/ha water apply Trivor® at 1.6 L/ha

Red Scale, Pink Wax Scale, Black Scale and Citrus Mealybug: 40 mL/100 L of water or 1.6 L/ha

- Trivor® should be applied post flowering, when monitoring indicates the onset of crawler emergence, to control the second generation or later generations of Red Scale
- After application, continue monitoring crops and if required apply a second application after a minimum interval of 21 days
- If monitoring indicates additional applications are required, rotate to an insecticide from a different mode of action group.

Citrus Leaf Miner: 40 mL/100 L of water or 1.6 L/ha

- Apply in late spring after the main flowering has finished and prior to the Summer or Autumn flush at the first signs of infestation and before pest establishment
- Continue to monitor crops after applying Trivor® and if additional sprays are required apply an insecticide from a different mode of action group before applying a second Trivor® application
- Do not apply consecutive applications of Trivor® for control of Citrus Leafminer.

Kelly's Citrus Thrips: 40 mL/100 L of water or 1.6 L/ha

- After flowering has finished, apply Trivor® when local pest thresholds are reached, typically just prior to calyx closure
- Do not target populations that are well-established where mature adult insects dominate the population. Continue to monitor crops and if thrips pressure persists/moderate to high numbers are present, apply a second application after a minimum spray interval of 14 days.



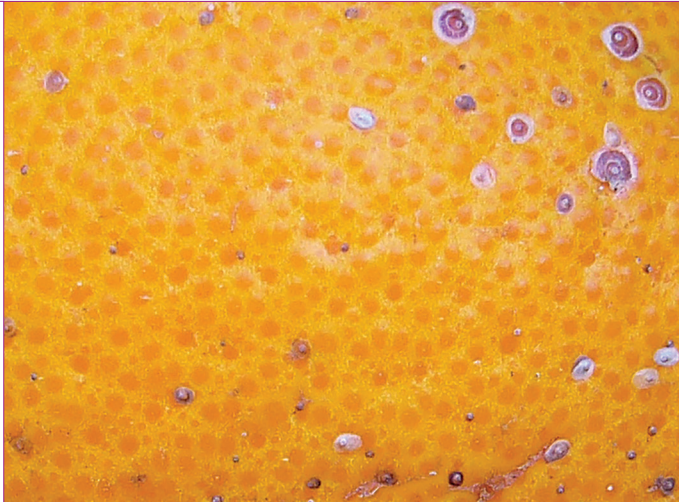


Key Insect Pests Controlled

Scale and mealybugs are members of the Hemipteran superfamily Coccoidea which groups the insects according to the following key attributes:

- Adult females are almost, or in fact completely, sedentary and are anchored to the host plant by their mouthparts

Californian Red Scale (*Aonidiella aurantii*)



- Adult females are typically reddish-brown and up to 2 mm in size. Males are slightly smaller, paler in colour and more elongated
- The mobile immature reddish-yellow 'crawler' stage commonly feed on leaves, shoots and fruit
- Feeding damage is caused by heavy infestations resulting in shoot distortion and leaf drop and fruit may become pitted and unmarketable.
- Red scale is found in all areas where citrus is grown in Australia
- There may be 2-5 generations per year in southern states and 5-6 in Queensland.

Black Scale (*Saissetia oleae*)



- Adult females are typically dark brown to black and up to 2 mm in size
- The 'crawler' stage is typically cream to light brown in colour and feed initially on young leaves before settling on young stems and twigs
- Feeding damage may be minimal but honeydew excretions from high scale numbers can lead to the development of sooty mould which hinders photosynthesis
- Black Scale is commonly found throughout Queensland citrus growing areas.

Citrus Leafminer (*Phyllocnistis citrella*)



- Adult moths are about 2 mm long, silvery white in colour with wings fringed with long hairs
- Young larvae live in silken tubes among leaf blades
- Significant damage can be caused to leaves due to curling and severe infestations can retard growth in young trees
- Citrus Leaf Miner can occur in all Australian citrus growing areas
- Attacks are most severe in late autumn depending on temperature.

- Juveniles emerge as mobile 'crawlers' that become less free-moving as they mature
- Adults develop thick protective layers of wax or other inert substances
- Adult males often resemble winged aphids, lack functional mouthparts, and are very short lived.

Citrus Mealybug (*Planococcus citri*)

- Adult females are typically about 3 mm long and covered in a white mealy wax
- The immature crawler stages are similar in appearance to the adult female, and settle under the fruit calyx in early Nov
- Significant damage is caused by the development of Sooty Mould which can result in End Rot and fruit drop
- Citrus mealybug can occur throughout Australia
- In Queensland there are at least six generations per year, 4-5 in New South Wales and 3-4 in Victoria, Western Australia and South Australia.

Pink Wax Scale (*Ceroplastes rubens*)

- Adult females are typically pink to pale red and up to 3-4 mm in size
- First generation crawlers emerge to settle on shoots and leaves from mid-Sept to early Dec peaking in Oct/ Nov. Crawlers of the 2nd generation emerge in Feb to late April to settle on shoots, leaves and fruit stalks
- Damage is often minor but frequent due to the development of Sooty Mould which reduces photosynthesis in the leaves and spoils the appearance of fruit
- Pink Wax Scale can be found in all citrus growing regions in Queensland and occurs along the east coast as far south as Sydney.

Kelly's Citrus Thrips (*Pezothrips kellyanus*)

- Adults are black, 2-3 mm long, with black legs. The wings are dark with a small clear band at the top
- Nymphs are pale yellow
- Found in flowers, under the calyx and between touching fruit
- Feeding on fruit is recognisable as a ring of damaged tissue or 'halo' at the stem end and fruit scarring or bleaching can reduce pack out
- Can be found in all citrus growing areas in Australia and can be a significant pest, particularly in the Riverland-Sunraysia regions of South Australia and Victoria.





Application

Spray Application Recommendations

Apply Trivor® as a dilute (high volume) spray ensuring thorough coverage of fruit and foliage throughout the crop canopy.

For young trees the water volume will be approximately 1000 L/ha.

Higher volumes are usually required to achieve thorough coverage in mature/bearing trees. DO NOT apply Trivor® to bearing trees in a spray volume of less than 1000 L/ha.

If the spray volume will exceed 4000 L/ha, use the per hectare rate of Trivor® and adjust the dilute concentration accordingly. Do not exceed a water volume of 8000 L/ha.

Restrains

DO NOT apply Trivor® more than twice per growing season.

DO NOT apply Trivor® by air.

DO NOT apply Trivor® if rainfall that is likely to produce runoff is forecast within 48 hours.

DO NOT apply during flowering as bees foraging in the crop will be affected. Residues may remain toxic to bees for several days after application.

Rainfast Period

DO NOT apply if rainfall is expected before spray deposits are dry on the leaf surface.

Withholding Period

DO NOT harvest for the domestic market for 14 days after application.

For fruit destined for an export market: Consult your exporter, www.australiancitrusgrowers.com or Adama Australia.

Tank Mixture Compatibility

Trivor® is physically compatible with a number of insecticides, fungicides and adjuvants.

Trivor® does not require the addition of an adjuvant to achieve maximum efficacy.

A number of oils have been tested for compatibility, but none of them add to the already superior performance of Trivor® so would be deemed an unnecessary extra cost and may be left out unless required according to the label of suitable mixing partner fungicides or miticides.

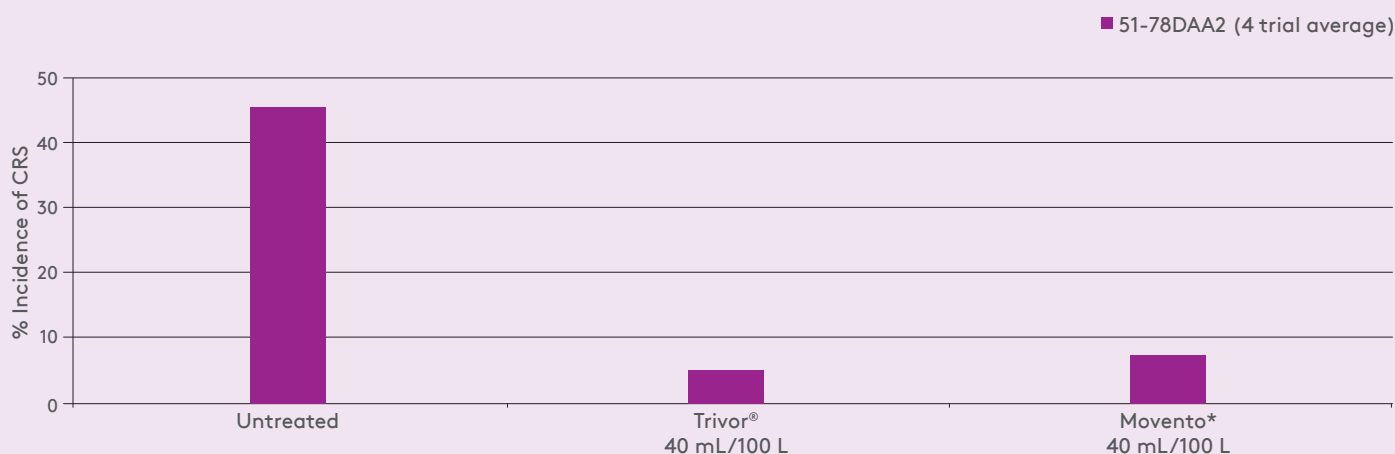
The following products have been tested for both physical and biological compatibility with Trivor® and do not present a phytotoxicity risk or a reduction in target insect control when tank mixed:

Amistar* 250
BioPest* Paraffinic Oil
Chief® Aquafflo
Coppox* WG
Dithane* Rainshield Fungicide
Hasten* Oil
Sorcerer® + BioPest* Paraffinic Oil
Torque* Miticide

As formulations of other manufacturer's products are beyond the control of Adama and water quality varies with location, all mixtures should be tested prior to mixing commercial quantities. Please contact your local Adama representative for further information on compatibility of Trivor® with other products or visit adama.com for the latest information.

Trial Results

Californian Red Scale - Incidence

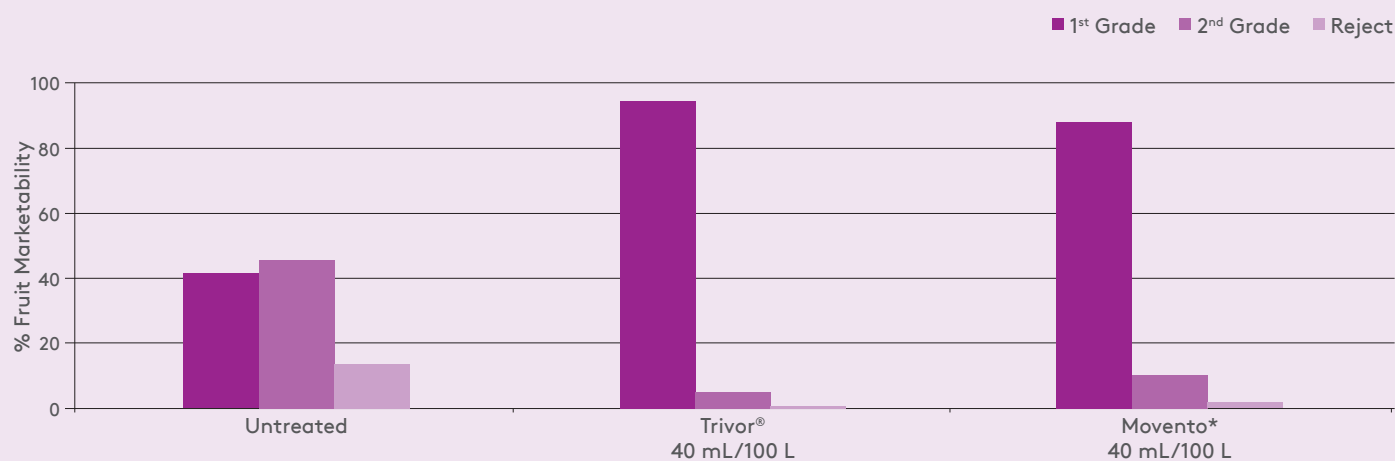


(Averages of 4 trials Conducted by Peracto in Gayndah, Bundaberg and Biggenden, Qld, 2011-2014 Mandarin cv. Hickson, Imperial and Honey Murcott, and Lemon cv. Eureka)

Chart 1.

Application of Trivor® and Movento significantly reduced the incidence of Red Scale in all 4 of these trials when compared to the untreated control. Trivor® consistently displays equivalent or better control of both Red Scale when compared with the highest use rate of Movento (40 mL/100 L) and significantly better in all cases when lower rates of Movento are used.

Californian Red Scale - Fruit Marketability



(Average of 3 trials Conducted by Peracto in Gayndah, Bundaberg and Biggenden, Qld, 2011-2014 Mandarin cv. Hickson and Honey Murcott, Lemon cv. Eureka)

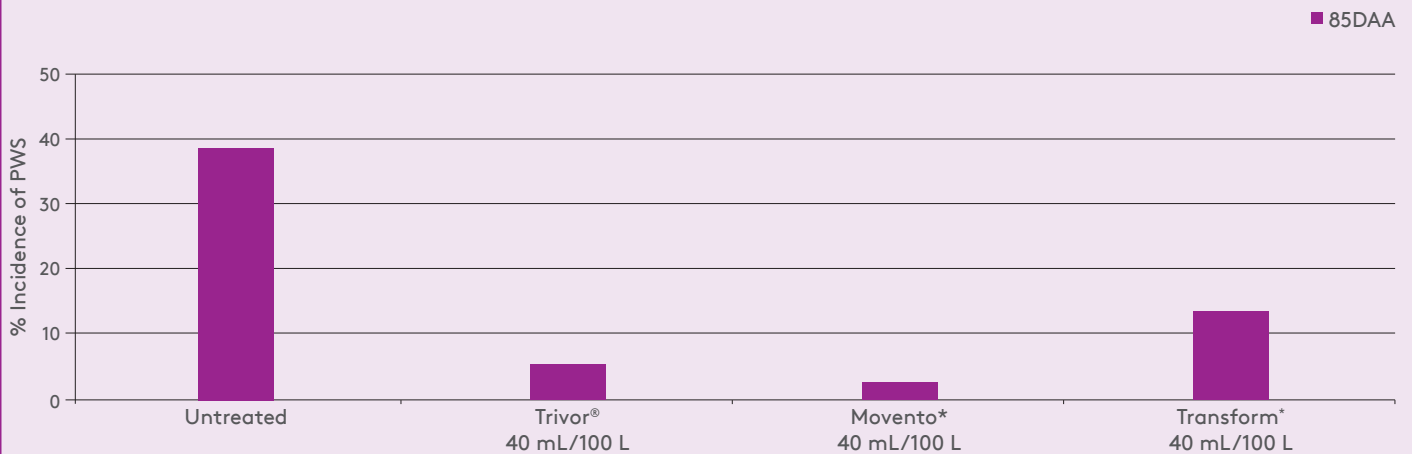
Chart 2.

Application of Trivor® and Movento significantly increased the pack out rates of fruit in all 3 of these trials when compared to the untreated control. Trivor® consistently displays equivalent or better pack out rates of 1st grade fruit when compared with the highest use rate of Movento (40 mL/100 L) and significantly better in all cases when lower rates of Movento are used.



Trial Results

Pink Wax Scale - Incidence

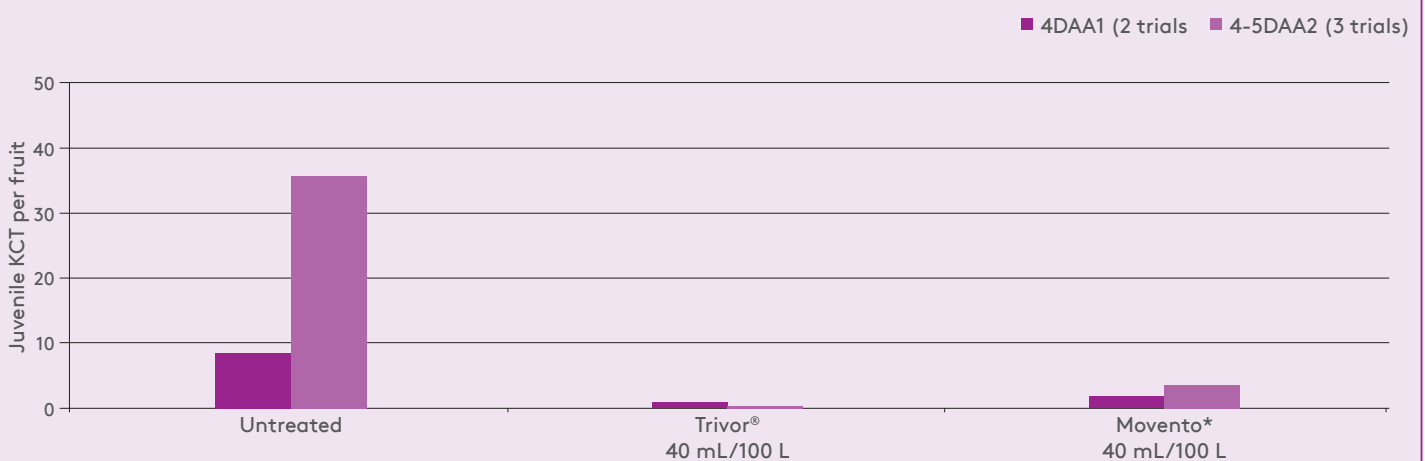


(Average of trials conducted by Peracto on mandarin cv. Imperial and Orchard Services on Mandarin cv. Imperial Gayndah, Qld, 2013/2014)

Chart 3.

Application of Trivor® and Movento significantly reduced the incidence of Pink Wax Scale in this trial when compared to the untreated control and Transform* at 85 days after application. Trivor® consistently displays equivalent or better control of both hard and soft scales when compared with the highest use rate of Movento (40 mL/100 L) and significantly better in all cases when lower rates of Movento (20-30 mL/100 L) are used.

Kelly's Citrus Thrips - Incidence

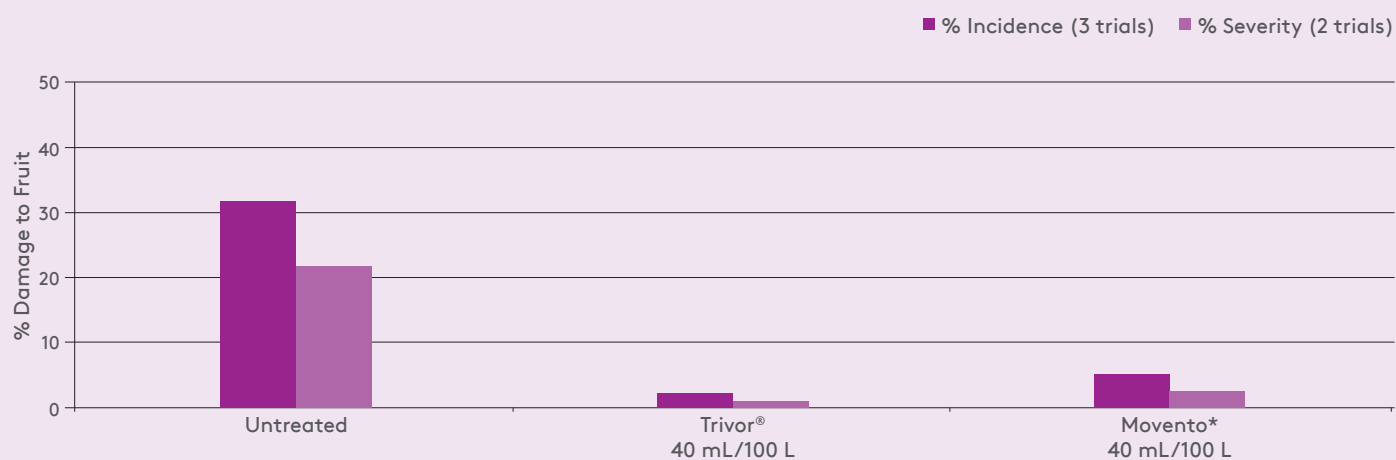


(Average of trials conducted by R&D Solutions on Lemon cv. Lisbon, Buronga and Coomealla, NSW, 2013/2014)

Chart 4.

Application of Trivor® and Movento provided immediate knockdown and significantly reduced the incidence of juvenile Kelly's Citrus Thrips in all 5 of these trials when compared to the untreated control. Trivor® consistently displays equivalent or better control when compared with the highest use rate of Movento (40 mL/100 L) and significantly better in all cases when lower rates of Movento (20-30 mL/100 L) are used.

Kelly's Citrus Thrips - Fruit Damage

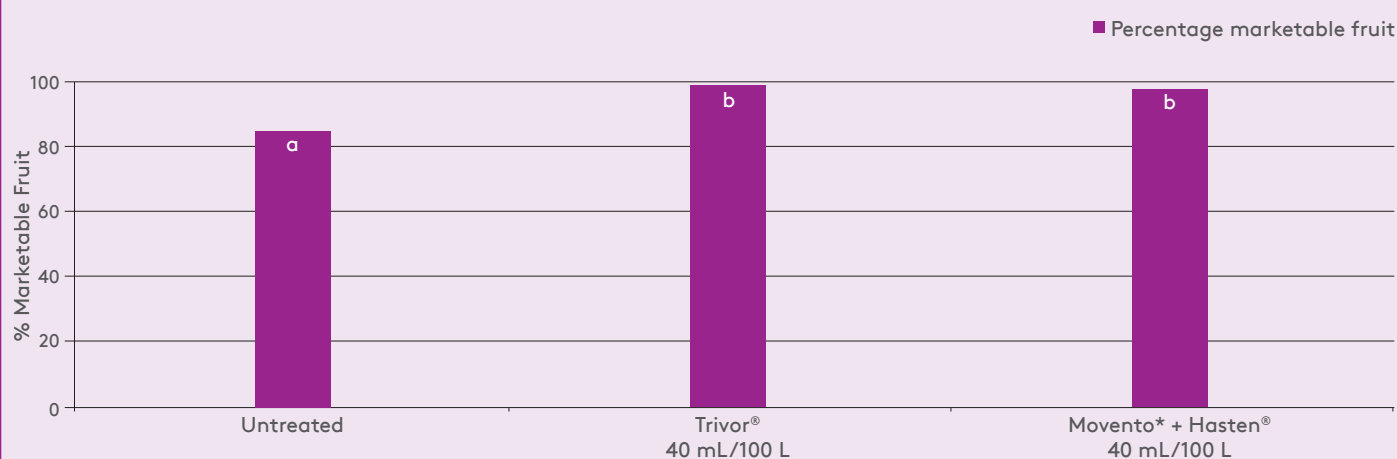


(Average of trials conducted by R&D Solutions on Lemon cv. Lisbon, Buronga and Coomealla, NSW, 2013/2014)

Chart 5.

Application of Trivor® and Movento significantly reduced the incidence and severity of fruit damage in trials when compared to the untreated control. Trivor® consistently displays equivalent or better damage control when compared with the highest use rate of Movento (40 mL/100 L).

Kelly's Citrus Thrips - Marketable Fruit Yield



(Trial conducted by R&D Solutions on Lemon cv. Lisbon, Coomealla, NSW, 2013/2014)

Chart 6.

Application of Trivor® (99.3 %) and Movento (98.7 %) significantly increased the percentage of marketable fruit in trials when compared to the untreated control (86 %) where Kelly's Citrus Thrips were not managed as effectively. Trivor® consistently displays equivalent or better fruit quality when compared with the highest use rate of Movento (40 mL/100 L).



Citrus Mealybug - Incidence

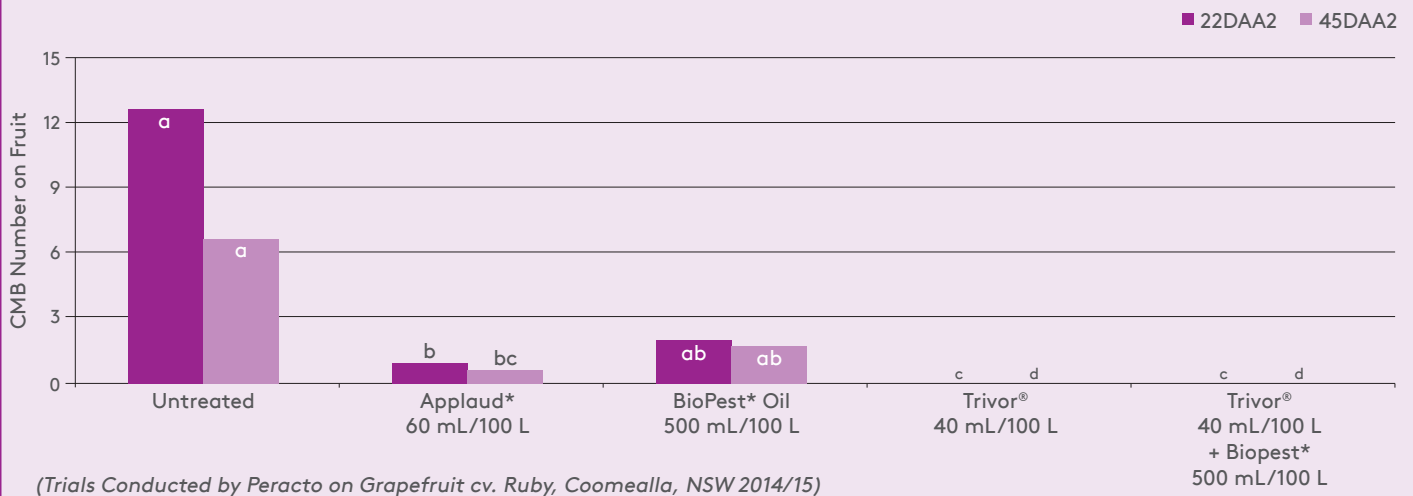


Chart 7.

Trivor® is registered for Citrus Mealybug control - not just suppression. Application of both Trivor® and Applaud* significantly reduced the incidence of Citrus Mealybug in trials when compared to the untreated control or BioPest* Oil alone - even out to 45 days after application.

Citrus Leaf Miner - Incidence 9DAA2 Gayndah

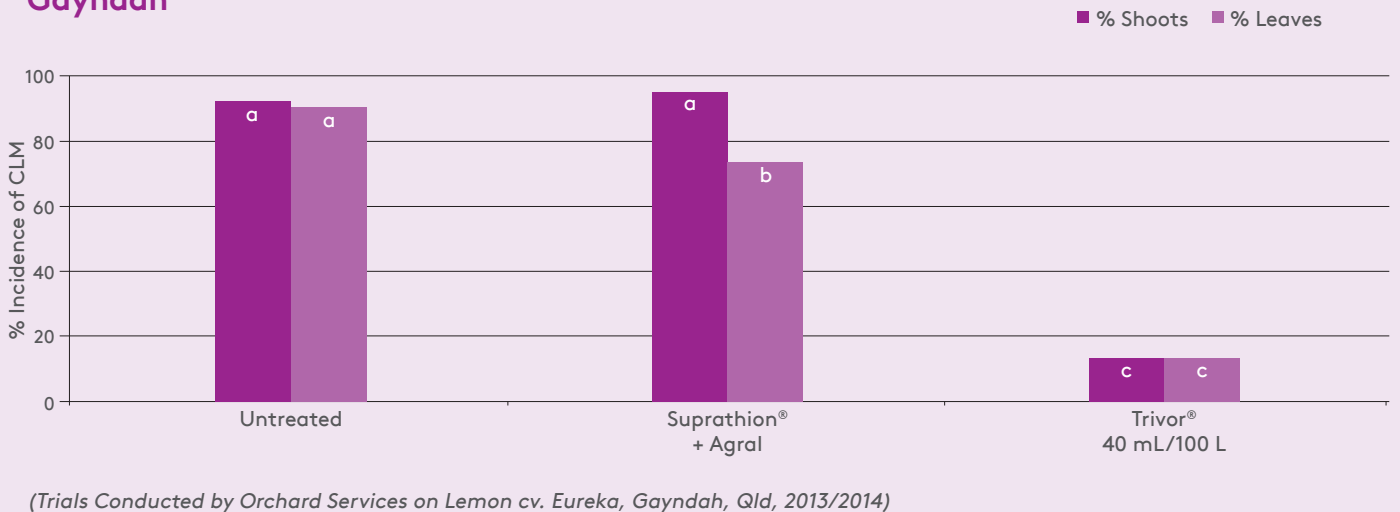


Chart 8.

Trivor® offers significantly improved Leaf Miner control in both shoots and leaves in trials when compared to the untreated control and Suprathion®.

Integrated Pest Management

Integrated pest management (IPM) has been established in Australia for several decades and is successfully used in many growing regions employing a range of options to maintain pests at acceptable levels. As with any commercial operation, the aim in an IPM system is to cost effectively grow high quality, marketable produce by utilising the various control options available. Options incorporated into IPM systems include the use of biological control methods (such as the introduction of predatory and parasitic insects and mites), cultural control methods, sound varietal selection and of course the use of selective chemical crop protection products.

Crop protection chemicals should always be carefully chosen, and not simply used on a scheduled basis but as deemed required by systematic pest monitoring. Selective options that target the pest spectrum that is out of balance should always be considered first rather than more disruptive broad-spectrum options.

Red Scale

Monitor regularly for Red Scale by sampling five leaves per tree on each of 20 randomly selected trees per 1-5 ha block. Examine adult female scale during November-December to determine parasitism by *Aphytis lingnanensis* or *Comperiella bifasciata*. If scale infestation levels are high and *Aphytis* parasitism is less than 20 % (during December) or 50 % (during January) then application of Trivor® may be required.

Pink Wax Scale

Pink Wax Scale management can be assisted by the presence of parasitic wasps such as *Anicetus beneficus*, *Metaphycus varius*, *Scutellista caerulea* and *Coccophagus ceroplastae*. Effective predators include the ladybeetles, *Rhyzobius ventralis*, *Cryptolaemus montrouzieri* and *Harmonia conformis*, the caterpillar *Catoblemma dubia* and lacewings, *Mallada* spp. The fungus, *Verticillium lecanii* may infect and assist to reduce high density populations of Pink Wax Scale under humid conditions.

Black Scale

Black Scale management can be assisted by the predatory ladybeetle, *Cryptolaemus montrouzieri*. It is often naturally present in orchards but care should be taken to apply insecticides so as not to remove the predator population if present in high enough numbers to manage the pest satisfactorily without the aid of an insecticide.

Kelly's Citrus Thrips

Monitor fruit for Kelly's Citrus Thrips using a hand lens - looking under the calyx - every week from petal fall to calyx closure and checking between touching fruit later in the season. The total number of thrips found is not significant, it is the percentage of fruit that is infested with thrips that is important. Action is required if 5 % or more of fruit are infested with Kelly's Citrus Thrips.

Kelly's Citrus Thrips management can be assisted by predatory thrips such as the native *Haplothrips* spp as well as predatory mites, bugs and spiders.





Features and Benefits

What Trivor® does	What this means for growers
Provides equal to or better than market standard control of major pest species giving up to 120 days control	Peace of mind that fruit and trees are protected from key pests for the duration of the growing season
Will control the second or later generations of Red Scale and Citrus Mealybug	Time saving as one application will work for an extended period
Will also control Citrus Leafminer and Kelly's Citrus Thrips	Confidence that one application for the target pest will control several other key pests if present
Maximised marketable fresh fruit potential	Peace of mind that new high quality standards for export and domestic markets will be met
Safe to bees when applied correctly	Peace of mind that pollination is not disrupted
Compatible with IPM programs	Peace of mind that mite flaring will not occur unlike older more disruptive chemistry
Ideal rotation with Movento* (Group 23) either in-season or from one season to the next.	Peace of mind that there can be long term sustainability for the industry.

Resistance Management

Trivor® should be used in conjunction with a season long program for these pests including insecticides with alternative modes of action and integrated pest management practices. All insecticides, including dual mode of action products such as Trivor®, should be rotated with alternative mode of action products and other non-chemical control techniques such as Integrated Pest Management.

Adama recommends using Trivor® in rotation with Movento* as a responsible approach. This can be achieved by using 1-2 applications of Trivor® or Movento* each year and alternating from season to season, or by using Trivor® as the first application in a season, followed by Movento* as the second treatment.

Adama encourage the responsible use of insecticides as outlined in the CropLife Insecticide Resistance Management Guidelines. CropLife guidelines can be found by visiting www.croplifeaustralia.org.au

Frequently Asked Questions

How will I know if Trivor® is the best option for my situation?

A comprehensive insect monitoring and identification programme should form part of any good crop management strategy.

When multiple pest species are present, Trivor® is often an ideal choice for both the primary and secondary target pests. Ensure that timing of application is appropriate whenever choosing insecticide options.

Will I need one application of Trivor® or two per season?

Managing the numbers from the first pest insect generation is the key to sustained control. Depending on the pest insect spectrum and levels present, a single application of Trivor® may be used just after flowering to control Kelly's Citrus Thrips – which will also provide effective control of scale and mealybug populations. However, if scale or mealybug pressure is very high, after the initial application of Trivor®, when monitoring indicates an additional control is timely, a second application of Trivor® may be used.

The back-to-back applications enhance the reservoir of Trivor® in the tree canopy thus controlling the early life-cycle stages of future generations of hard and soft scales, mealybugs & Kelly's Citrus Thrips before they can establish on leaves and fruit.

How will Trivor® help me manage resistance?

Trivor® is a combination of Group 4A and Group 7C insecticides and as such incorporates two distinctly different modes of action, both working effectively to control the key sucking pests of citrus. Trivor® is a significantly more effective and less disruptive replacement for older insecticides whilst providing a perfect partner for Movento* (Group 23) for alternation between seasons so that three different modes of action are being used and ensuring long term sustainability for the citrus industry.

What effect will Trivor® have on beneficial species present at the time of application?

Our development work with Trivor® has shown that application of Trivor® will diminish populations of

parasitoid wasps and ladybeetles. The reason for this is that Trivor® provides such a high level of control of the target pests that the food source remaining is not substantial enough to support large numbers of these species.

The wet residue of Trivor® is toxic to bees, however, applying in the early evening when bees are not foraging will allow spray to dry, reducing the risk to bees the following day.

Does Trivor® have the potential to flare mites?

In all of the development trials for Trivor®, no evidence of pest mite flaring was observed in Trivor® treated trees. Flaring of mites can occur due to a decrease in predatory mite populations, or as a result of an increase in the fecundity of pest mites. The low application rate of Trivor® means that a modest amount of the neonicotinoid component - acetamiprid - is applied. Soil applications of imidacloprid have the potential to exist a lot longer in the tree and to be more disruptive.

When is the best timing to use Trivor®?

The best timing to use Trivor® is post flowering, when monitoring indicates the onset of scale and mealybug crawler emergence. After application, continue monitoring crops and if required apply a second application after a minimum interval of 21 days. If monitoring indicates additional applications are required, rotate to an insecticide from a different mode of action group.

To target Kelly's Citrus Thrips, apply Trivor® after flowering when local pest thresholds are reached, typically just prior to calyx closure. Do not target populations that are well established where mature adult insects dominate the population. Continue to monitor crops and if thrips pressure persists or moderate to high numbers are present, apply a second application after a minimum spray interval of 14 days.

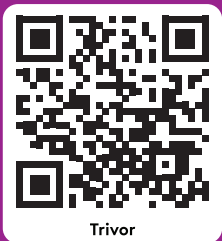
Does Trivor® have a fit in my Integrated Pest Management (IPM) program?

Trivor® displays low to moderate toxicity to predatory insects and mites when used as directed and causes minimal disruption to beneficial insect populations allowing a suitable fit in most IPM systems.



Summary

- Two highly effective active ingredients that work together to provide protection from hard and soft scale species and other key sucking pests of citrus
- Rapid knockdown action combined with extended residual protection
- Highly compatible dispersible concentrate formulation allowing one pass insect and disease control when mixed with fungicides
- Two modes of action for resistance management.



Scan here for all the latest information and resources for Trivor®



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