



For control of
leaf feeding insects
in forests



SHIELD SYSTEMIC INSECTICIDE™ FORESTRY TECHNICAL MANUAL



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Introduction

Sumitomo Chemical Australia has developed Shield Systemic Insecticide as a soil application for control of leaf feeding insects in Eucalypt trees. This method of application allows systemic uptake into the tree. Shield Systemic Insecticide is very active at low concentrations in the leaf and a single application can give control of insect pests for up to 2 years, with minimal effect on the environment and beneficial insects.

Timely application during the first 3 years of establishment will provide protection from leaf feeding insects that can kill young trees. **This can prevent the complete loss of new plantings.**

It also promotes unrestricted growth in young trees; in height and diameter – to produce greater wood volume. **This may reduce time to harvest by 1 to 3 years.**

Currently the registered label only applies to Eucalypt trees, but work is being continued on other tree species.



*Paropsisterna
agricola*



*Gonipterus
scutellatus*



Insects controlled

Leaf feeding beetles and weevils including:

Paropsisterna agricola and other *Paropsisterna* species

Cadmus australis

Liparetrus jenkinsi

Heteronyx dimidiata and other *Heteronyx* species

Gonipterus scutellatus

Psyllids including:

Creiis lituratus

NOTE: While not yet extensively tested, Shield has not demonstrated good results in controlling lepidopteran (caterpillar) pests.



Application methods

Many different application methods have been considered and tested; including pre-plant application, dipping of seedlings, seedling injection, trunk sprays, trunk injection and drenches for large trees. After consideration of insect control, work-place health and safety issues and application efficiency, the following two application methods were found to be the best.

For seedlings and transplants

Apply the chemical with an injection spear about 2 cm below and to the side of the seedling root ball – at or soon after planting. Application direct to the root ball may affect plant growth. To benefit from the treatment, seedlings need to be actively growing. Speed of control will depend on how fast Shield Systemic Insecticide is taken up by the seedling. This will be assisted by post-planting rainfall or watering of at least 10 mm. It is recommended that application be done before, or during, the main seasonal rainfall period.

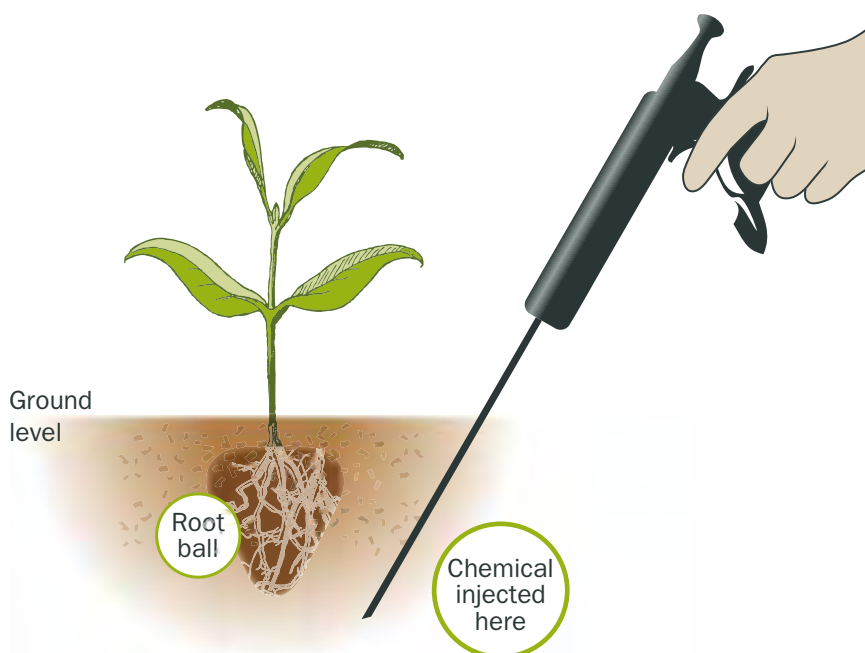


FIGURE 1: Injection of Shield/water mixture near base of seedling root ball.



FIGURE 3: Dead “spring” beetles and wingless grasshoppers at the base of a seedling treated with Shield Systemic Insecticide (Western Australia).

For general protection from sporadic attack across large areas, 1.25 mL of Shield Systemic Insecticide per seedling is sufficient. Where severe pressure over a short period is expected, as is common for “spring beetles”, then 5 mL of Shield Systemic Insecticide per seedling is recommended. If the source or direction from which the attack is coming from is known, an application at this higher rate to create a barrier about 10 seedling rows wide from the edge of the block can be effective (Figure 2). Some damage to the outermost seedlings may still occur, but most beetles will die within 4 days and so the attack can be stopped before it spreads across the whole block.

NOTE: Some forestry companies have developed automated injectors. If water or a gel are added to the planting hole, then Shield Systemic Insecticide can also be added to these.

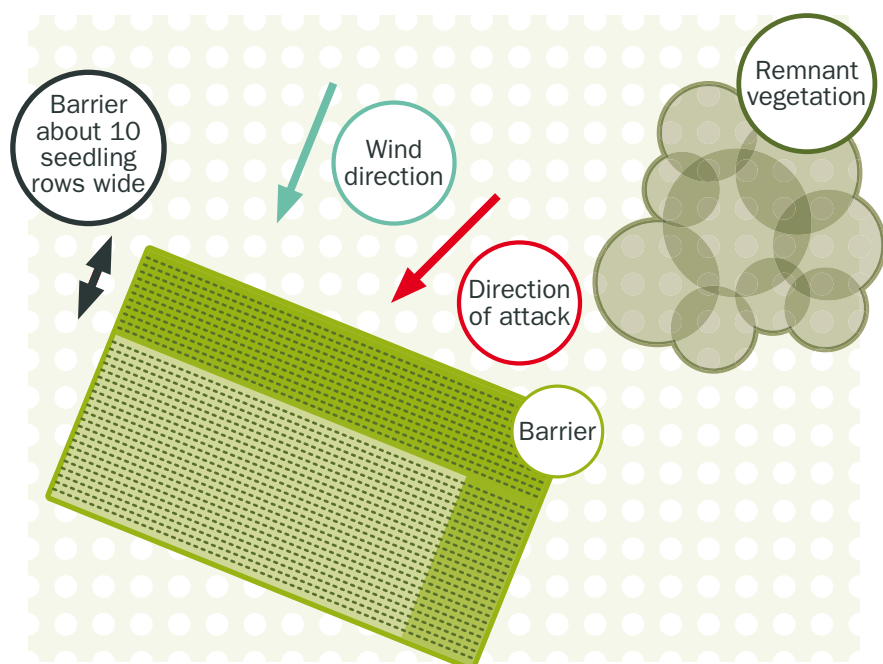


FIGURE 2: Using a higher rate of Shield Systemic Insecticide to create a barrier of treated seedlings on the edges of a block against “spring” beetles.

Application methods (continued)

For large trees

Apply Shield Systemic Insecticide when flight monitoring for adults and/or field populations of eggs, larvae or nymphs indicate that an economically damaging population will occur. Because it may take several weeks for the insecticide to be taken up and become effective, it is recommended that application is done by looking at pest pressure on an area-wide basis and treating high risk sites (e.g. close to known or expected sources of the pest) prior to the main infestation commencing.

Application should be by subsoil injection; 10 - 15 cm deep and in a continuous line 20 - 40 cm from the tree trunks parallel to the centre of the row (Figure 4). This is normally on the outer edge of the mounded area. All weeds out to 65 cm from the tree trunk should be controlled by knockdown and residual herbicide application to prevent them taking up the chemical.

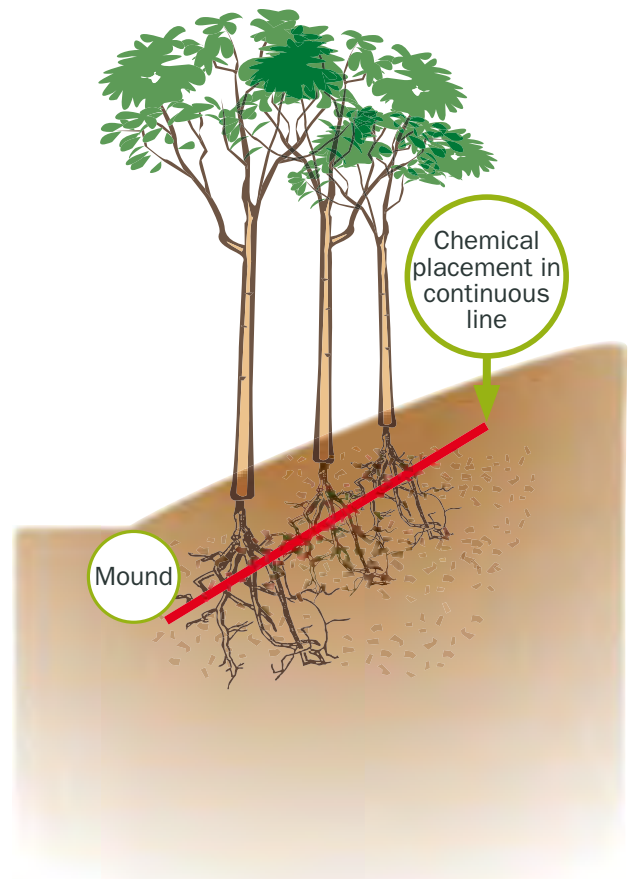


FIGURE 4: Insecticide placement by coulter in large trees.

FIGURE 5: Single row coulter applicator cutting a furrow down a row of trees. The Shield/water mixture is injected at about 20 psi through a 1 - 2 mm nozzle, down the back of the tine into the ground.





FIGURE 6: Single row coulters applicator working on a slope with long grass – which should be sprayed out prior to application of Shield Systemic Insecticide.

The speed at which Shield Systemic Insecticide becomes effective depends on how fast the product is taken up by the tree, which needs to be actively growing. Uptake will be assisted by post-treatment rainfall soaking down into the root zone. Generally this requires at least 25 mm of rain in a single event. It is recommended that application occurs before, or at the start of the main annual rainfall period. Long term water logging may also inhibit chemical uptake and tree growth. If severe pest attack takes place prior to the chemical becoming effective in the plant, a knock-down insecticide may be required to give short term protection.

It is recommended to treat the trees when they are one to two years old. Treatment at this age reduces the rate of Shield Systemic Insecticide required and protects the trees at the time when they are most vulnerable to insect damage. The larger the tree, and the higher the insect pressure – the higher the rate of Shield Systemic Insecticide required.

For trees 1 - 2 m tall, use at least 3.75 mL/tree

For trees 2 - 4 m tall use at least 5 mL/tree

For trees 4 - 8 m tall use 5 - 10 mL/tree

These amounts of Shield Systemic Insecticide should be applied with water in a total volume of at least 40 mL/tree.

FIGURE 7: A two row hydraulically adjustable coulters applicator with a second mixing tank and nozzles set up to apply herbicide to the base of tree rows at the same time as Shield Systemic Insecticide is applied sub-surface. This machinery is patented. Contact your Sumitomo Chemical representative for more information.



FIGURE 8: Protection against severe *Creils psyllid* attack in four year old *E. dunnii* trees – seven months after application. Shield Systemic Insecticide was applied at 5 mL per tree (New South Wales).

NOTE:

1. Sampling of leaves in larger trees indicated that the concentration of Shield Systemic Insecticide in the tree peaks 1 to 4 months after application, and then slowly declines over the next 18 months. It also indicated that distribution of insecticide through the tree canopy is fairly uniform.
2. Grass/weed cover should be sprayed out with a knock-down herbicide at application to prevent it from taking up the Shield Systemic Insecticide.
3. An adjustable 2 row applicator that applies herbicide at the same time is also available.



Features and benefits

Features	Benefits
Easy flowable liquid formulation (a 20% soluble concentrate)	Suitable for a variety of application methods to suit the operation; such as injection with planting water and gel or coulters application for big trees
Rapid penetration of roots and translocation within the plant	With good wetting of the soil after application, control will start in 2 to 3 weeks
Systemic mode of action through root uptake	Suitable for application to the soil, which has less effect on the environment and beneficial organisms than spraying of the foliage
Long half-life in soil	Control lasts 1 to 2 years
Controls a wide pest spectrum	Reduced need for different insecticide products to control different pests
Effective long term insect control	Improves plantation establishment by preventing loss of new planted trees
Economical	Treatment with Shield Systemic Insecticide can shorten the harvest cycle by 2 to 3 years

Activity and mode of action



The active ingredient in Shield Systemic Insecticide is clothianidin. It is taken up by ingestion when insects suck or chew on the trees, after which it interferes with the transmission of nerve impulses. This causes the insects to stop feeding, followed soon after by death.

Trial results

For seedlings

Eucalypt seedlings were treated with Shield Systemic Insecticide at planting. 151 Days later, adult beetles were placed on the leaves and monitored over a week. After four days, nearly 90% of the beetle population in the Shield treatment had died.



FIGURE 9: *Paropsisterna* is a wide-spread beetle pest of eucalypts that feeds over long periods of time. Beetles show many colour variations.

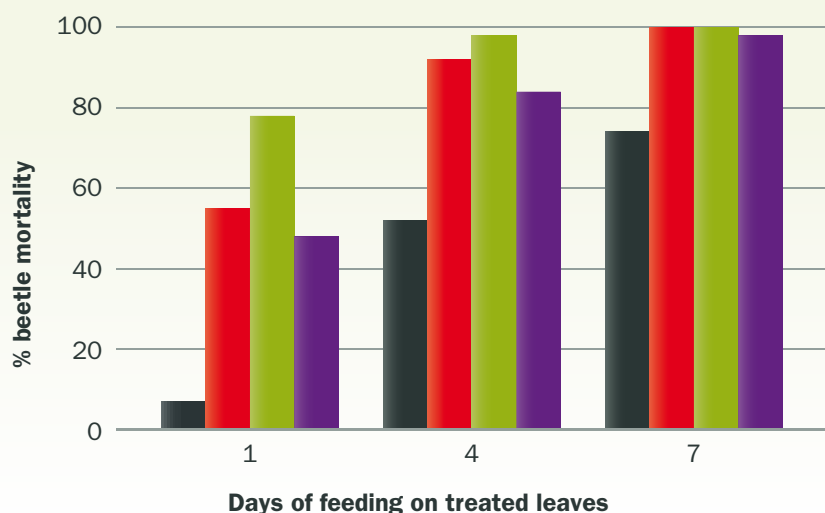
FIGURE 10: Control time for *Paropsisterna agricola* beetles feeding on *E. nitens* seedlings (Tasmania).

■ Untreated
■ Shield 1.25 mL (0.25 gai)/tree
■ Shield 2.5 mL (0.5 gai)/tree
■ Imidacloprid 0.5 gai/tree



FIGURE 11: Control time for *Cadmus australis* beetles feeding on *E. nitens* seedlings (Tasmania).

■ Untreated
■ Shield 1.25 mL (0.25 gai)/tree
■ Shield 2.5 mL (0.5 gai)/tree
■ Imidacloprid 0.5 gai/tree



Trial results (continued)

In this trial “Spring” beetles – *Liparetrus jenkinsi* (early) and *Heteronyx elongates* (late) swarmed and attacked the trees on several occasions. Application occurred at planting; in a mixture with 5 mL of water adjacent to the root ball.

FIGURE 12: Shield Systemic Insecticide applied as a soil injection (barrier application) against “spring” beetles on *E. globulus* seedlings. Comparison with a tablet containing imidacloprid and fertiliser (Albany, WA).

- Untreated
- Shield 1.25 mL (0.25 gai)/tree
- Shield 2.5 mL (0.5 gai)/tree
- Imidacloprid 0.5 gai + fertiliser/tree

* Crown Damage Index

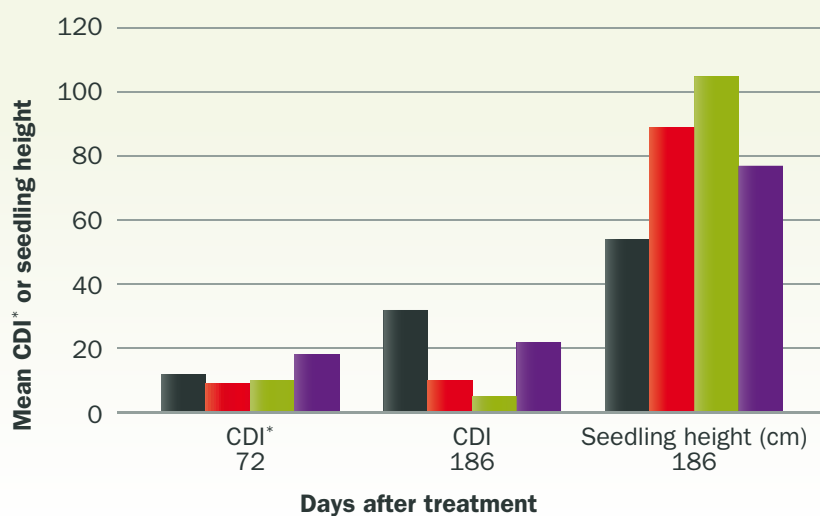


FIGURE 13: Leaf blister saw fly (*Phylacteophaga* sp.) damage on *E. grandis* x *camaldulensis* (New South Wales).



FIGURE 14: Protection after months of attack by leaf blister saw fly, from soil-applied Shield Systemic Insecticide in two year old *E. grandis* x *camaldulensis* (New South Wales).

For large trees

Untreated

Treated

FIGURE 15: The symptoms of *Creilis lituratus* psyllid attack on *E. dunnii* (New South Wales).

FIGURE 16: Shield Systemic Insecticide at 5 mL/tree protecting three year old *E. dunnii* from *Creilis psyllid* attack. Photograph taken six months after treatment (New South Wales).

FIGURE 17: The efficacy of Shield Systemic Insecticide for reducing colonization by psyllid nymphs in three year old *E. dunnii*, when applied by soil coulters to one or both sides of the row (New South Wales).

- Untreated
- Untreated both sides of tree coulters
- Shield 2.5 mL/tree one side coulters
- Shield 5 mL/tree one side coulters
- Shield 5 mL/tree both sides coulters
- Shield 7.5 mL/tree one side coulters

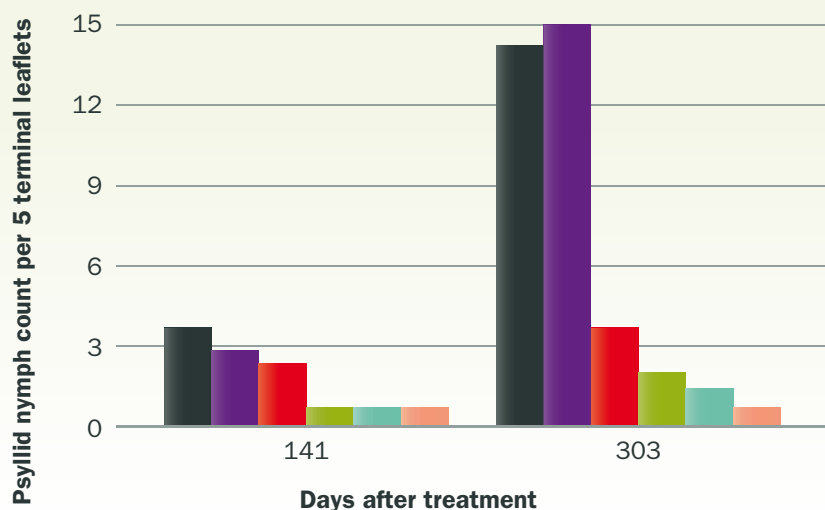
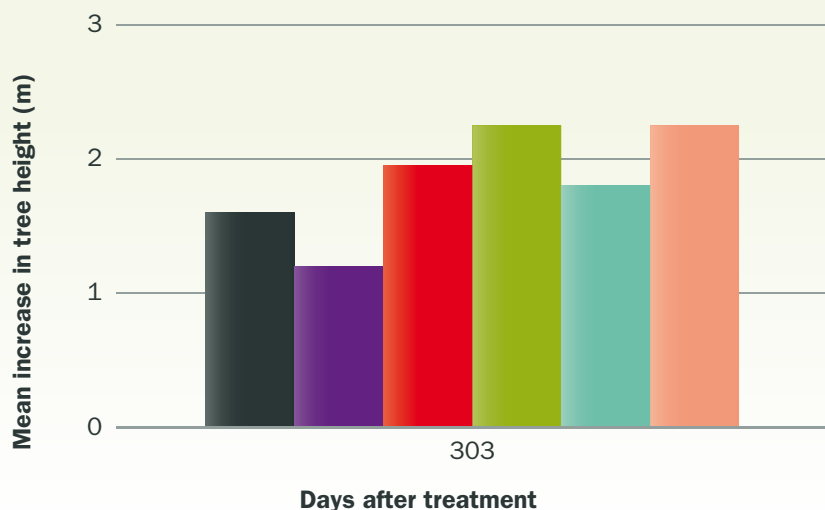


FIGURE 18: Trial data to demonstrate how Shield Systemic Insecticide, applied by coulters to one side of the tree at 5 - 7.5 mL per tree, gave a significant increase in growth (height) by protecting *E. dunnii* from *Creilis psyllid*.

- Untreated
- Untreated both sides of tree coulters
- Shield 2.5 mL/tree one side coulters
- Shield 5 mL/tree one side coulters
- Shield 5 mL/tree both sides coulters
- Shield 7.5 mL/tree one side coulters





Trial results (continued)

FIGURE 19: Trial data to demonstrate how Shield Systemic Insecticide, applied by coulter to one side of the tree at 5 - 7.5 mL per tree, gave a significant increase in growth (stem diameter) by protecting *E. dunnii* from *Creilis psyllid*.

- Untreated
- Untreated both sides of tree coulter
- Shield 2.5 mL/tree one side coulter
- Shield 5 mL/tree one side coulter
- Shield 5 mL/tree both sides coulter
- Shield 7.5 mL/tree one side coulter

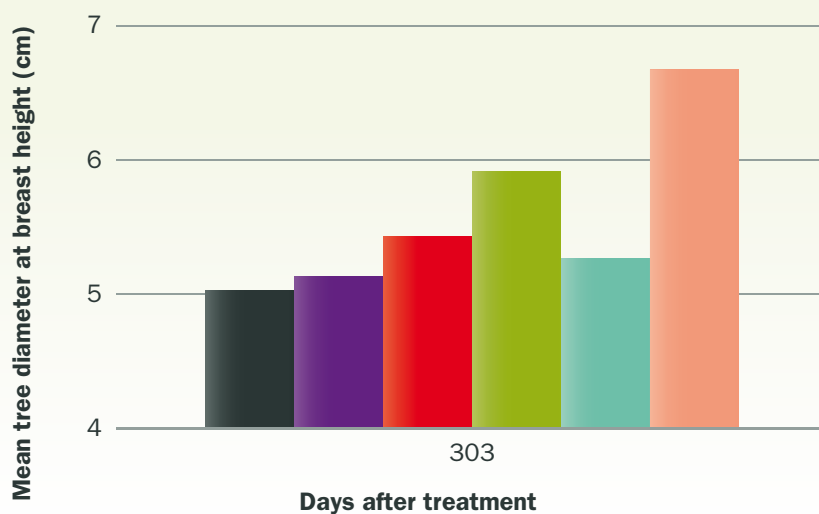
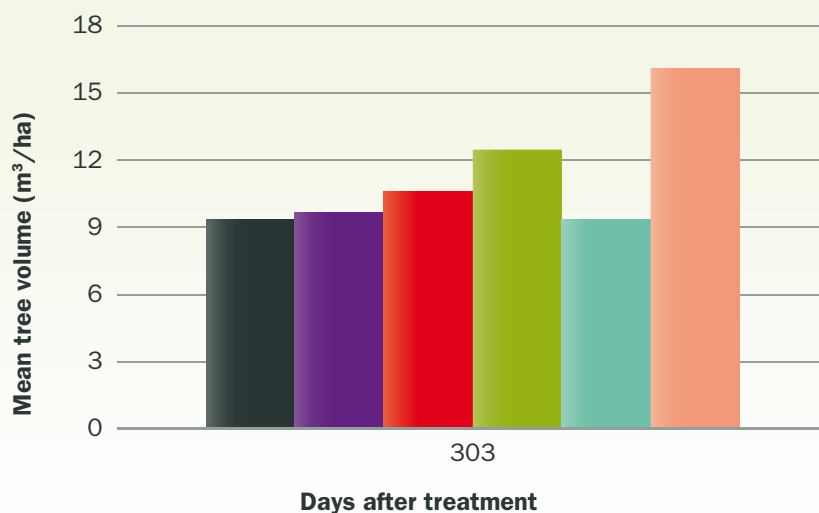


FIGURE 20: Trial data to demonstrate how Shield Systemic Insecticide, applied by coulter to one side of the tree at 5 - 7.5 mL per tree, gave a significant increase in yield (tree volume) by protecting *E. dunnii* from *Creilis psyllid*.

- Untreated
- Untreated both sides of tree coulter
- Shield 2.5 mL/tree one side coulter
- Shield 5 mL/tree one side coulter
- Shield 5 mL/tree both sides coulter
- Shield 7.5 mL/tree one side coulter



NOTE: Application with soil coulter to both sides of the tree causes root pruning and loss of growth, and is not recommended.

FIGURE 21: *Eucalyptus grandis* x *camaldulensis* under attack from leaf blister saw fly beetles and fungal disease. Shield Systemic Insecticide at 3.75 mL/tree applied by single side coulter significantly reduced damage and improved growth.



FIGURE 22: Ten meter tall *Eucalyptus globulus* trees in Western Australia were attacked by leaf feeding *Gonipterus scutellatus* weevils and other beetles. Shield Systemic Insecticide was applied to one side of the trees by coulter at 5 mL per tree gave very good protection.



Untreated



Treated

FIGURE 23: *Gonipterus scutellatus* weevils – a major cause of large tree damage in Western Australia.



Trial results (continued)

FIGURE 24: Shield Systemic Insecticide applied to two year old *E. globulus* for weevil and beetle control in Western Australia. Soil application by coulter injection down one side of the tree row at 30 cm out from the trunk and 10 cm deep. Tree height at the time of application averaged 10 m.

■ Untreated
■ Shield 5 mL/tree one side coulter
■ Shield 20 mL/tree one side coulter

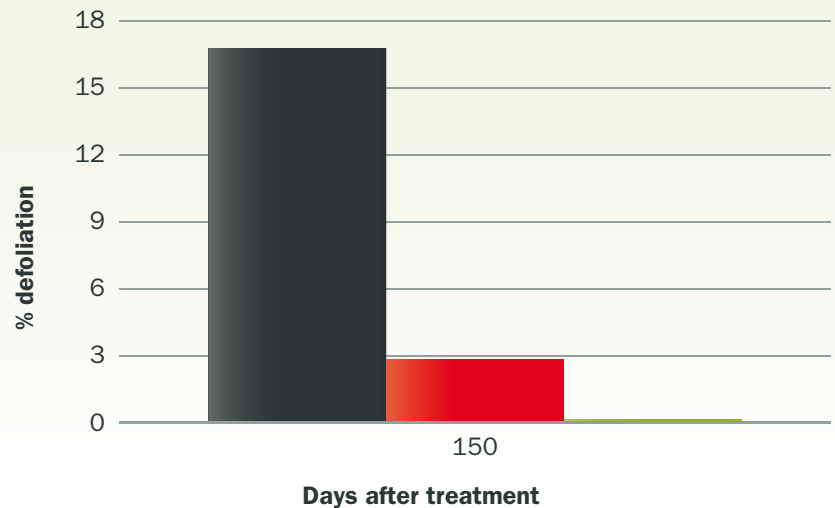
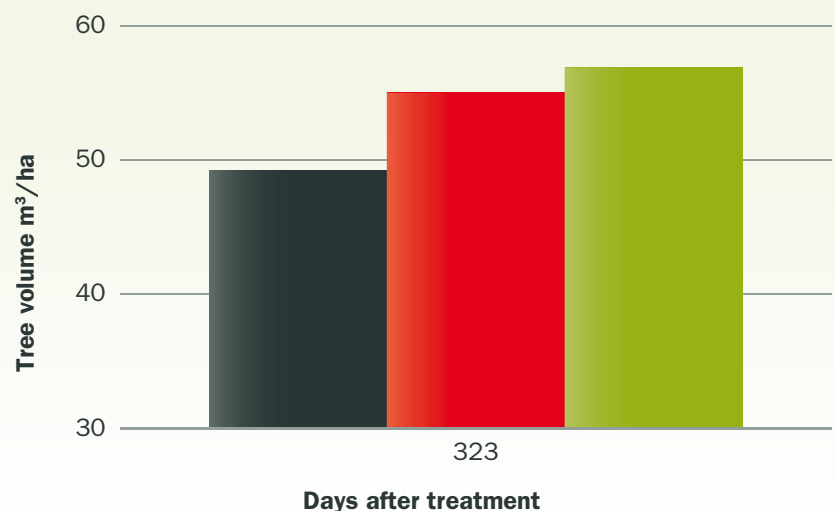


FIGURE 25: Effect of Shield Systemic Insecticide applied to two-year old *E. globulus* for weevil and beetle control, on the volume of wood per hectare after one year.

■ Untreated
■ Shield 5 mL/tree one side coulter
■ Shield 20 mL/tree one side coulter



This clearly demonstrates the negative effect of defoliation on tree growth and production of wood. Unfortunately, due to the limited number of treatments one can include in a large scale forestry trial, this trial did not include a 10 mL/tree treatment. Although 5 mL/tree gave good protection, our experience from other trials indicate that in this situation 10 mL/tree would have been close to the optimum rate.

How to get the most out of Shield Systemic Insecticide sub-soil application

1 Shield Systemic Insecticide is best placed below ground in the top root feeding zone 10 - 15 cm deep. This prevents loss of the active ingredient due to breakdown from sunlight and wash-off in rain storms. It also positions the chemical in close proximity to the feeder roots and is safer to workers and non-target organisms.

2 Trial work over several years showed that a significant wetting of the soil from rainfall within 1 to 2 months after application is important to get good uptake and control of pests. Shield Systemic Insecticide is not very water soluble and does not readily leach – even in sandy soil. Water moving down into the top 20 cm of soil will help the chemical to dissipate into a bigger volume of soil and move closer to the small feeding roots. This, in turn, will accelerate uptake of the product and promote growth in the tree. It is for this reason that application before or during the main seasonal rainfall period is recommended. In WA, SA, VIC, ACT and S/NSW this is typically in the months May to August. In N/NSW, QLD and NT it is typically in the months of October to January. In the northern areas it is important to complete application before the heavy summer wet season limits tractor access.

3 Timing of application should be based on a careful analysis and monitoring of insect pest life cycles, as well as likely location and periods of attack. Timing should preferably occur at least 2 months before the first serious attacks to allow Shield Systemic Insecticide to translocate right through the plant.

4 Area-wide management of insect pests and treatment of likely “hot spots” is recommended as most pests are mobile and can move readily from one block to another. This will require co-operation between different forestry operators.

5 Grass and weeds growing at the base of treated trees will take up some chemical and also inhibit growth in smaller trees. It is therefore important that they are sprayed with herbicide prior to, or during application of Shield Systemic Insecticide.

6 It is important to correctly identify the pests to be controlled. Several excellent publications are available to identify forestry pests. Generally these can be found by contacting your state forestry service.

Is sub-soil application of Shield Systemic Insecticide safe for grazing livestock?

A detailed evaluation of clothianidin residues in grass growing in proximity to the soil location where Shield Systemic Insecticide was applied sub-soil showed that while there was some initial uptake in situations where the grass was not sprayed out on the mound, this chemical level declines rapidly. If proper grass/weed control is practiced, then chemical uptake by grass and weeds will not occur.

However, to be safe and because weather conditions do not always permit weed control practice as planned, it is recommended that livestock is excluded from treated areas for a period of eight weeks after application.

After a period of eight weeks it is safe to graze livestock in treated areas. This has been approved by the residue evaluators of the APVMA, and is now on the label.



Directions for use

Crop	Pest	Rate	Critical comments			
Eucalypt seedlings from planting to one year old	Leaf feeding beetles including: <i>Paropsisterna agricola</i> , <i>Cadmus australis</i> , <i>Liparetrus jenkinsi</i> , <i>Heteronyx dimidiata</i> and other <i>Heteronyx</i> species	Subsoil seedling injection adjacent to root ball. 1.25 mL per seedling at or soon after planting – mixed with water to a total volume of 5 mL. Where severe pest pressure is expected: 2.5 mL per seedling at or soon after planting – mixed with water to a total volume of 5 mL.	Apply by injection about 2 cm below or to the side the seedling root ball at or soon after planting. DO NOT apply Shield directly to the root ball area as this may affect plant growth. The speed of control from this application depends on how fast the product is taken up by the seedling, which needs to be actively growing. This will be assisted by post-planting rainfall or watering of at least 10 mm. It is recommended that application is before or during the main annual rainfall period. If severe attack takes place prior to the chemical becoming effective in the plant, a knockdown insecticide may be required to give short term protection.			
Eucalypt trees from 1 to 5 years old in the height range 0.5 to 8 m	Psyllids including: <i>Creiis lituratus</i>	Subsoil side dress application: 2.5 - 10 mL per tree mixed with water for a total volume of at least 40 mL/tree. Suggested rates based on tree height. In general the larger the tree and the higher the insect pressure the higher the rate required.	Apply when monitoring of adult flights and field populations of eggs, larvae or nymphs indicate that an economically damaging population is expected. Because it may take several weeks for the chemical to be taken up and become effective it is recommended that application is done by looking at the pest pressure on an area wide basis and treating high risk sites prior to infestation. Application should be by subsoil injection 10 - 15 cm deep and in a continuous line 20 - 40 cm from the tree trunks parallel to the row. This is normally on the outer edge of the mounded area. All weeds out to 65 cm from the tree trunk should be controlled by knockdown and residual herbicide application to avoid them taking up the chemical.			
		<table><tr><th>Tree height (m)</th><th>mL/tree</th></tr><tr><td>0.5 - 4</td><td>2.5 - 5</td></tr></table>	Tree height (m)	mL/tree	0.5 - 4	2.5 - 5
	Tree height (m)	mL/tree				
	0.5 - 4	2.5 - 5				
Leaf feeding beetles including: <i>Paropsisterna</i> species	Uptake will be assisted by post-treatment rainfall which soaks down into the root zone. Generally this requires least 25 mm of rain in a single event. It is recommended that application is before or at the start of the main annual rainfall period. Long term water logging may also inhibit chemical uptake and tree growth. If severe attack takes place prior to the chemical becoming effective in the plant, a knock down insecticide may be required to give short term protection.					
	Treatment of trees at one to two years of age is recommended since this reduces the rate required and gives the trees protection at the time when they are most vulnerable.					
Leaf feeding weevils including: <i>Gonipterus scutellatus</i>	<table><tr><td>4 - 8</td><td>5 - 10</td></tr></table>	4 - 8	5 - 10			
	4 - 8	5 - 10				

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

GRAZING WITHHOLDING PERIOD: Do not allow animals to graze in treated areas for 8 weeks after application.



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