INSECT MANUAL

Identification and Control of Insect Pests in Plantations

TECHNICAL INSTRUCTIONS

Prepared by Silviculture Branch
Department of Conservation and Land Management
Western Australia

INSECT MANUAL

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1. INTRODUCTION

The plantation development strategy adopted by CALM since 1980 is based entirely on the acquisition of cleared agricultural land for planting tree crops. Many of these sites provide breeding grounds for a variety of insects, some of which can damage tree crops.

The aim of this manual is to provide a reference source for plantation managers in the identification, life cycle, habitat, potential for tree damage, and the control of the common insect pests. Management strategies to reduce the impact of insect damage are also be discussed.

This document will be reviewed and updated on a regular basis by staff from the Division of Research and Silviculture Branch.

2. SCOPE OF THIS DOCUMENT

This manual identifies 19 insects that are recorded as being injurious to tree crops. These are:

***	1.	WINGLESS GRASSHOPPER	*(Phaulacridium vittatum)*
***	2.	AUSTRALIAN PLAGUE LOCUST	*(Chortoicetes terminifera)*
***	3.	BUDWORM	*(Helicoverpa punctigera)*
**	4.	AFRICAN BLACK BEETLE	*(Heteronychus arator)*
**	5.	SPRING BEETLES	*(Liparetrus, Colpochila* and *Heteronyx* spp.*)*
**	6.	RUTHERGLEN BUG	*(Nysius vinitor)*
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**	11.	IPS BARK BEETLE	*(Ips grandicollis)*
*	12.	PINE ADELGID	*(Pineus pini)*
**	13.	VEGETABLE WEEVIL	*(Listroderes difficilis)*
***	14.	GARDEN WEEVIL	*(Phlyctinus callosus)*
*	15.	APPLE WEEVIL	*(Otiorhynchus cribricollis)*
**	16.	SIREX WOODWASP	*(Sirex noctilio)*
**	17.	LEAFBLISTER SAWFLY	*(Phylacteophaga froggatti)*
**	18.	CATASARCUS WEEVILS	*(Catasarcus* spp.*)*
***	19.	CUTWORMS	*(Agrotis* spp.*)*

*** Insects that are considered to cause damage of economic importance. Chemical control is recommended subject to the provisions of Section 4.2 of this manual.

** Insects that are considered to cause damage of economic importance. However, broad-scale control is either too expensive or impractical. Chemical treatment is **NOT** recommended unless trees are of particular genetic importance or are in research plots.

* Insects that are not considered to cause significant damage. Chemical treatment is **NOT** recommended unless trees are of particular genetic importance or are in research plots.

Whilst prescriptions for insecticidal control of insects appear in this manual, methods to restrict the impact of insects on trees are also given. These include bio-control and pasture management, where a system or experience is available.

2.1 CONTACTS AND RESPONSIBILITIES FOR INSECT CONTROL

The responsibility for the preparation of insect control strategies lies with the Manager of Silviculture Branch

All enquiries in relation to this document should be directed through the Manager, Silviculture Branch to Mr Ray Fremlin, CALM, Busselton.

The Agricultural Protection Board controls the Australian plague locust for which it has developed forward warning programs. Contacts are: The Principal officer, Protection, APB, South Perth or the Regional Agricultural Protection Officers.

District managers are responsible for arranging the application of insecticides on CALM land.

Contractor and contractual arrangements to apply insecticides on share farmed properties is the responsibility of the District Manager, after consultation with the Manager, Sharefarming.

All aspects of this document relating to the safe handling, safe application and disposal of empty containers is the responsibility of the Health, Safety and Welfare Officer, CALM, Como.

2.2 DISTRIBUTION OF THIS DOCUMENT

The distribution of this manual is restricted to the offices listed below. Updated sections will be issued only for these copies. For this reason do not copy the entire manual as sections may be superseded.

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2.	Manager, Environmental Protection Branch, SOHQ
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40.	Research Centre, Woodvale
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51.	~~Not issued~~ Dr Syd Shea
52.	Dr F McKinnell, Crawley
53.	Dr I Abbott, Como
54.	Dr J Farr, Manjimup
55.	Mr J Brealey, Manjimup
56.	Mr P Grime, Dwellingup
57.	Mr G Ellis, Manjimup
58.	Mr J Bartle, Como
59.	Australian Workers Union, Perth
60.	Miscellaneous Workers Union, Perth
61.	Mr D Bicknell, Esperance

3. INSECTS KNOWN TO BE INJURIOUS TO TREES

3.1 WINGLESS GRASSHOPPER

Other common names: Nil

Scientific name: *Phaulacridium vittatum* (Sjostedt)

Recognition: Adults are brown and up to 20mm long, with orange hind legs. Most individuals have one pair of small nonfunctional wings. There are two forms of adult, with or without a white stripe on each side of the thorax. Juvenile grasshoppers go through 5 stages (nymphs) before reaching adulthood. Newly hatched nymphs are less than 4mm long and dark grey.

Habitat: Foliage. Any green material will be eaten. After November, dry annual pasture becomes less palatable and the hoppers depend on trees for shade and green food necessary for egg production.

Life cycle: Normally one generation per year. Eggs (12 eggs/pod) are laid in bare, sandy, well drained soil during summer. They hatch between September and December, depending on the season. Nymphs mature in 5 stages from November onwards.

Distribution: Endemic to Western Australia where it is found between Dandaragan and Esperance. Occurs on the coastal strip, approximately 50km wide. Not inland.

Status of damage potential: A serious pest of lucerne, summer green pasture and many tree species growing on agricultural land. Nymphs will feed on capeweed, particularly the flower petals. Young trees can be killed, including pines and eucalypts, although *E. globulus* is eaten as a last resort.

Factors contributing to damaging outbreak: Survival of the first instar (nymphs) grasshoppers depends on open spaces between plants. Dense pasture with 100% ground cover is the best control for the wingless grasshopper. Seasons or management practices that result in patchy spring pasture provide highest survival of nymphs, Summer green feed is important, so summer or autumn rainfall provides optimum conditions for the insect.

History of damaging outbreaks: Serious damage recorded in the Albany region on *E. grandis* and on *E. globulus* in the Scott river area. Pines and eucalypts have been killed on the coastal plain between Harvey and Esperance.

Control: Control by insecticides (maldison ULV) is most effective in the early nymph stage, before insects disperse. ULV formulations kill adults provided the application technique is correct (Technical Instruction Sheet No. 1). A 2 metre wide cultivated strip around plantations can be used for baiting (Technical Instruction Sheet No. 2).

Broad area spraying of weeds with herbicides should be avoided and sprayed strips should be no wider than necessary.

3.2 AUSTRALIAN PLAGUE LOCUST

Other common names: plague locust

Scientific name: *Chortoicetes terminifera* (Walker)

Recognition: A large insect more than 25mm to 40mm long. The adult is brownish or green. The extremities of the otherwise clear hind wings are tipped with black. The inside of the hind leg is red.

Habitat: Any green foliage

Life cycle: The locust lays its eggs in almost any kind of soil provided it is compact and free of dense cover. Up to 70 eggs are laid in each pod. The incubation period depends on the time of the year, temperature and soil moisture. During summer, eggs develop very quickly and hatch after two weeks. If the soil is dry the eggs enter a state of quiescence and development stops. The eggs remain like this until rain penetrates the soil. Quiescence can delay hatching for about a month, but if dry, hot conditions persist, the eggs will desiccate and die. During winter egg development is very slow. Eggs developing in winter may enter diapause, which like quiescence stops the development of the eggs. Overwintering eggs do not need rain to induce hatching. After emerging from the egg the young hopper is smaller than a housefly (3mm) and dark in colour. It reaches maturity in about 4 to 8 weeks.

Distribution: It appears that locusts cannot persist indefinitely in the south-west. Local populations arise initially from locusts migrating into the region, but their numbers decline because of unfavourable summer conditions.

Status of damage potential: This insect has been increasing in numbers in Western Australia. Therefore, there is the potential for a serious outbreak causing damage to pine and eucalypt crops.

Factors contributing to damaging outbreaks: Summer rain increases the likelihood of the insect populations developing into plagues.

History of damaging outbreaks: There have been no reports of serious damage in plantations. However, farm trees have been killed by this insect.

Control: Spraying with ULV formulations of fenitrothion by either aircraft or ground misters is recommended (Technical Instruction Sheet No. 9).

Cultivation of fields harbouring eggs will not have a significant effect on the size of subsequent populations in the area.

Although there are a number of natural enemies of the Australian plague locust, it is not anticipated that they will influence the population significantly.

3.3 BUDWORM

Other common names: Heliothis

Scientific name: *Helicoverpa punctigera* Wallengren

Recognition: The caterpillars grow up to 4cm long and vary in colour from mid green through orange to dark brown. Stripes extend the length of the body. Moths are about 2cm long, brownish white and about 3cm across the outstretched wings. There is a prominent dark patch on the hind wings.

Habitat: Pasture, lucerne and most broadacre crops

Life cycle: Egg to pupal stage usually takes about one month. Caterpillars emerge from October onwards, depending on the season

Distribution: Throughout Western Australia

Status of damage potential: The caterpillars can cause severe damage to young *P. radiata* plantations. No serious damage has been recorded in eucalypt plantations.

Factors contributing to damaging outbreaks: Ungrazed pastures allows the population of budworm to build-up. Total spraying with herbicides encourages caterpillars to attack pines.

History of damaging outbreaks: Severe damage has occurred to newly planted *P. radiata* plantations on the coastal plain, in the Blackwood valley and on the south coast. The worst cases were recorded in 1989. However, isolated occurrences of damage have been reported in previous years.

Control: Small numbers of caterpillars do not usually cause sufficient damage to warrant spraying. However, in large numbers, severe damage and mortality will occur. Spraying with a synthetic pyrethroid is effective (Technical Instruction Sheet No. 3). It is important to identify a potentially damaging outbreak while caterpillars are small. The presence of large numbers of moths does not necessarily lead to a damaging outbreak of caterpillars. The stage of host plants determines the number of eggs that are laid. Parasitic flies, wasps and egg parasites are the most important parasitoids in Western Australia. Predatory bugs, lacewings and spiders contribute in reducing the population of budworms. The Heliothis virus is also prevalent.

Strip spraying to control weeds instead of total spraying provides an alternative food source and reduces the impact of budworm on young *P. radiata*.

A program to introduce parasites from overseas is being carried out by the Department of Agriculture.

3.4 AFRICAN BLACK BEETLE

Other common names: Nil

Scientific name: *Heteronychus arator* (Fabricius)

Recognition: The adult beetle is about 14mm long, shiny black and slow moving. The larvae are of cockchafer appearance, up to 35mm long, glossy white with a brown head, six strong legs and a dark end to the abdomen. The beetles are attracted to light.

Habitat: Widespread in pasture situations. Recorded as being responsible for serious damage in *E. globulus* plantations from soon after planting to 2 years old. No recorded damage in *P. radiata* plantations.

Life cycle: There is one generation of insects per year. Eggs are laid in September and adults are active throughout the year but more so in summer. Mass flights of adults have been recorded in late summer-autumn.

Distribution: Native to South Africa, this insect was introduced into Western Australia and first recorded in 1938. It is now present throughout the South West of WA.

Status of damage potential: African black beetle has been responsible for serious losses in newly planted *E. globulus* plantations.

Factors contributing to damaging outbreaks: Damage from adults is most likely to occur with new generation beetles from mid summer - late autumn and again in spring. Favoured by mat-forming grasses (eg, Kikuyu and paspalam). Total spraying of weeds with herbicides may encourage beetles to attack trees. Population increases are apparent following two consecutive dry seasons or a dry spring. High spring rainfall reduces the population.

History of damaging outbreaks: Recorded in the Wellington catchment, Serpentine, Pemberton, Unicup, Baldivis and at Bridgetown. The beetle kills trees by girdling the stem at ground level. Larvae live on grass roots and organic matter.

Control: There is no economic method of controlling African black beetle with insecticides in plantation situations. Where outbreaks occur in small plots or nurseries injection of the soil with chlorpyrifos is feasible (Technical Instruction Sheet No. 4). Retaining strips of vegetation between rows of trees may provide beetles with alternative food. Removal of kikuyu grass at least 3 months in advance of planting may reduce damage by the African black beetle.

3.5 SPRING BEETLES

Other common names: Scarab beetles

Scientific name: Mostly *Liparetrus* spp., but may be confused with *Colpochila* spp. and *Heteronyx* spp. All are melolonthine scarabs.

Recognition: Adult melolonthines range in size from 5-30 mm, and are usually reddish-brown or tan. Larvae are white, C-shaped and live in the soil feeding on roots of grasses and trees. Adults are usually highly mobile and fly in swams. *Liparetrus* are day-fliers, whereas *Colpochila* and *Heteronyx* fly at dusk and night, and are attracted to lights.

Habitat: Occur in pastured and forested areas. Are more prolific adjacent to wooded areas since this is where adults do most of their feeding. Not recorded from pines.

Life cycle: Eggs are laid in the soil, usually during the warmer months. Larval stage may last for 1-2 years, depending on species. Adults are active all year, with peak activity between September and March.

Distribution: Many species are endemic to the south-west, but members of all three genera are found throughout Australia.

Status of damage potential: Spring beetles have been responsible for total defoliation of eucalypt species. However, spraying is not considered feasible except where valuable genetic material or research plots are involved.

Factors contributing to damaging outbreaks: Variable. Some species need drying conditions to emerge, whereas other species only emerge after significant rainfall.

History of damaging outbreaks: Damage recorded at Unicup, Manjimup, Wellington catchment, Albany and Esperance areas. Spring beetles are ubiquitous and cause heavy defoliation at a critical time (late winter) when seedlings are small.

Control: Spraying entire plantations with insecticides is not considered feasible because of the mobility of the adults. Where valuable genetic material exists or to save trees in research plots, spraying the foliage with trichlorfon may be feasible (Technical Instruction Sheet No. 5).

3.6 RUTHERGLEN BUG

Other common names: Nil

Scientific name: *Nysius vinitor* Bergroth

Recognition: Adults are 3-4mm long, narrow bodied and with prominent black eyes. The body is grey-brown with darker markings. Transparent wings are folded flat when the adult is at rest. Nymphs are dark red to yellow and more swollen in shape than the adults. All stages emit an acrid odour when disturbed or crushed.

Habitat: Pasture, field crops, young pine and eucalypt plantations. Rutherglen bug feed preferentially on oily seed heads and flowers such as rape, wild radish, and turnip. As these dry off in spring, winged adults migrate to any green plant for food and shelter. Summer weeds that are strongly aromatic, such as *Chenopodium* spp. (goosefoot, fathen, mintweeds), are suitable for bug survival and breeding.

Life cycle: Eggs are laid on soil, on grass and on flowerheads of weeds. During summer, nymphs grow through 5 moults in one month. Winter is passed as an adult. Breeding commences in early spring. Outbreaks can occur in November-December.

Distribution: Native to all southern states of Australia

Status of damage potential: Up to 10% mortality has been attributed to Rutherglen bug at Baldivis in 1988. This insect has the potential to cause significant damage to tree crops, particularly *E. globulus*. When pasture crops die off in late spring, large numbers of adults can infest pine and eucalypt plantations. They suck sap, causing chlorosis and wilting of the foliage and may kill small trees. The flightless nymphs eat only seeds. Where outbreaks are potentially serious, spraying should be contemplated.

Factors contributing to damaging outbreaks: Wet winter followed by mild to dry spring which allows lush growth of weeds. Damage is often accentuated by soil cultivation between rows in late spring.

History of damaging outbreaks: Recorded damage at Baldivis (1988), Unicup (1989) and Augusta (1989).

Control: Foliar spray with maldison ULV is recommended by the Department of Agriculture (Technical Instruction Sheet No. 6).

Deep ploughing of weeds during winter/early spring will reduce numbers of overwintering adults.

3.7 BLUEGUM PSYLLID

Other common names: Nil

Scientific name: *Ctenarytaina eucalypti* (Maskell)

Recognition: Small, grey lice-like nymphs 1.5-2mm long, preferring whorls of juvenile foliage of *E. globulus*. Produces large quantities of white waxy secretions.

Habitat: *E. globulus* plantations

Life cycle: Four nymph stages. All stages from nymphs to adults are found throughout the year in New Zealand.

Distribution: Introduced , presumably from Tasmania. Are widespread in Western Australia. So far recorded from Esperance (1989), Wellington catchment (1988) and Augusta (1990).

Status of damage potential: The nymphs suck sap, causing deformation and shrivelling of expanding young bluegum leaves. This results in premature senescence and defoliation. Bluegum psyllid is not recorded as causing serious damage.

Factors contributing to damaging outbreaks: Trees planted into waterlog prone soils are more likely to be attacked. The build-up of sugars in the leaves of trees that are affected by waterlogging is likely to provide increased food levels for psyllid survival.

History of damaging outbreaks: No information

Control: Spraying is **NOT** recommended except where valuable genetic material is involved, or for trees in research plots. In these circumstances a foliar spray of dimethoate is effective (Technical Instruction Sheet No. 7).

3.8 PASTURE DAY MOTH

Other common names: Nil

Scientific name: *Apina callisto* (Angas)

Recognition: A dark brown to black caterpillar with 2 yellow spots near the posterior. Length up to 60mm. The adult is brown with creamy-yellow markings on the wing and orange rings round the body. It flies in autumn by day.

Habitat: Pasture

Life cycle: One generation per year. The adult flies during the day in autumn. Eggs are laid in pasture and hatch soon after the onset of rain. When fully grown, larvae burrow into the soil to pupate.

Distribution: A native species, occurring throughout the south west of Western Australia.

Status of damage potential: Large outbreaks can occur resulting in defoliation of eucalypts. Not recorded attacking pines. Spraying may be appropriate for large outbreaks.

Factors contributing to damage potential: Appears to favour broadleaved weeds (especially *Erodium* and capeweed).

History of damaging outbreaks: A serious outbreak requiring spraying occurred in the Wellington catchment in 1989.

Control: Spraying with synthetic pyrethroid is effective (Technical Instruction Sheet No. 3).

Strip spraying of weeds provides an alternative food supply and will reduce the likelihood of serious damage.

3.9 AUTUMN GUM MOTH

Other common names: Nil

Scientific name: *Mnesampela privata* (Guenee)

Recognition: Caterpillars are pale yellow-brown with dark brown/green markings when young, becoming dark green/brown with age and developing 2 red patches containing 2 yellow swellings on each segment. Length to about 30mm. Severely attacked trees are characterised by having only the larval shelters remaining at the tops of defoliated branches.

Habitat: Juvenile leaves of *E. globulus* and other blue-grey leafed eucalypt species are preferred.

Life cycle: Eggs are light green and are laid in batches of approximately 50 in February/March and July/August. Caterpillars feed for 2-3 months and then pupate in the ground.

Distribution: Indigenous to most states

Status of damage potential: Not considered to be a serious pest in Western Australia. Commonly associated with attacks on isolated trees. Young caterpillars feed as a group and skeletonize the leaf, leaving the veins. Older caterpillars consume the whole leaf. Only a few curled leaves remain, in which the caterpillars shelter during the day. Damage is most common on young trees up to 3m tall. In NSW this insect causes severe defoliation.

Factors contributing to damaging outbreaks: No information

History of damaging outbreaks: Recorded at Manypeaks in 1987 on isolated trees. At Jerramungup (1988), Channybearup (1989) and Pemberton (1988).

Control: Spray with synthetic pyrethroid (Technical Instruction Sheet No. 3).

3.10 CHRYSOMELID BEETLES

Other common names: Leaf beetles

Scientific name: Family Chrysomelidae. Genera include *Paropsis, Chrysoptharta* and *Trachymela*. Many species have been recorded on plantation and farm trees.

Recognition: Both the larvae and the adults feed on young foliage of eucalypts. Larvae have a pair of eversible, cow-horn shaped glands on the top of the abdomen, and are usually yellow and black striped. Adults superficially resemble ladybirds in shape, but are larger, have padded feet and long antennae. Adults usually brightly coloured, but fade to a uniform dull colour on death.

Habitat: Eucalypts in general, some species preferred. Not known from pines.

Life cycle: Eggs are laid at any time that dults are present, with a peak between October and January. Eggs are laid on leaves, on petioles and stems or under bark. Larvae feed on leaves during day or night, depending on species. Larvae of some species hide under bark during the day. Larvae usually form aggregations during early stages. Pupation occurs in the soil. Adults feed from September to March.

Distribution: Indigenous

Status of damage potential: Only one record of damage caused by larvae . Potential for serious damage unknown. Larvae consume the entire area of small leaves. Adults feed mainly on leaf margins giving the leaf a characteristic crenulated appearance. In Tasmania, several species of chrysomelids can cause heavy defoliation.

Factors contributing to damaging outbreaks: No information

History of damaging outbreaks: A single outbreak recorded from the Harvey coast in 1988.

Control: Spray with a synthetic pyrethroid (Technical Instruction Sheet No. 8).

3.11 IPS BARK BEETLE

Other common names: five spined bark beetle; southern pine engraver; American bark beetle.

Scientific name: *Ips grandicollis* (Eichhoff)

Recognition: The adult beetle is reddish brown to black and between 2.5mm and 4.5mm long. A concave depression at the dorsal posterior end is rimmed with 10 spines (see Information Sheet No. 34)

Habitat: *P. radiata* and *P. pinaster* plantations. Also to be found in plantations of other pine species.

Life cycle: The male bores through the bark and attracts the female, which lays eggs in the walls of the galleries. Young beetles emerge through small holes (2mm in diameter) in the bark. During summer the life cycle is about 6 weeks. Between September and May there may be 5-6 generations.

Distribution: Present throughout the south west of WA

Status of damage potential: Unlikely to cause significant damage in pine plantations unless trees are under stress.

Factors contributing to damaging outbreaks: Unthinned, stressed plantations. Large amounts of logging debris in the warmer months can precipitate a population explosion which can lead to attacks on live trees as food becomes scarce.

History of damaging outbreaks: In most drought deaths and deaths associated with fungi, *Ips* can be implicated. However, *Ips* is not considered to be a serious primary cause of deaths in pine plantations.

Control: Insecticidal control is not feasible.

Proper management of plantations to ensure trees are not stressed will ensure damage is minimal.

Predators and parasitoids have been introduced. It is too early to assess the success of these introductions.

3.12 PINE ADELGID

Other common names: chermes; pine woolly aphid

Scientific name: *Pineus pini* (Macquart)

Recognition: Aphid-like insects < 1mm long, usually aggregated into large colonies obvious to the naked eye. Wingless female morph produces a white "woolly" wax secretion to protect the colony.

Habitat: Base of pine needles, where they puncture the bark of the branchlet and suck up sap.

Life cycle: No information. Likely to be complicated with two types of female.

Distribution: Originally Britain. Present in plantations in the south west of WA for at least 40 years.

Status of damage potential: Attacks isolated to trees in *P. radiata* and *P. pinaster* plantations. Has not been associated with deaths of trees. Some increment loss can be expected on those trees affected. Branch twisting of *P. pinaster* attributed to pine adelgid has been recorded. Considered to be a serious pest in *P. pinaster* plantations in South Africa.

Factors contributing to damaging outbreaks: Tree stress caused by nutrient deficiency, off-site planting or drought.

History of damaging outbreaks: Isolated occurrences throughout pine plantations. Greater incidence in the Sunklands.

Control: Coccinellids and cecidomylids reported to predate on pine adelgid overseas.
Progeny trials indicate a high heritability of pine for resistance.
Avoid off-site planting.

3.13 VEGETABLE WEEVIL

Other common names: Nil

Scientific name: *Listroderes difficilis* Germain

Recognition: Grey in colour up to 10mm long, with two short white stripes at an angle on each side of the back. Has a central white line on the back of its head and the typical snout common to many weevils. The larvae are legless, with a brown head and the abdomen is not enlarged. This weevil can fly.

Habitat: Market gardens (especially crucifers) and pastures. Adults feed at night and during the day rest in the lower needles of young *P. radiata* trees on which they have been recorded feeding.

Life cycle: Eggs are deposited on bark, larvae which are found during winter feed primarily on leaves. Pupation occurs in the soil. Damage to pines has been observed in spring and early summer.

Distribution: Introduced from Brazil and now widespread throughout Australia

Status of damage potential: Not considered a serious threat to young plantations. Spraying is warranted where infestations are large.

Factors contributing to damaging outbreaks: Unknown

History of damaging outbreaks: Has been responsible for damage in private *P. radiata* plantations near Bridgetown in 1986. Spraying was carried out on this occasion.

Control: Spray at night with synthetic pyrethroid (Technical Instruction Sheet No. 8). A tachinid fly and several wasp parasites were introduced by CSIRO (NSW) but successful establishment was not achieved.

3.14 GARDEN WEEVIL

Other common names: Nil

Scientific name: *Phlyctinus callosus* Boheman

Recognition: Medium size weevil with a bulbous abdomen and a prominent lighter coloured strip running across the back. Usually grey-brown colour. Has characteristic snout common to many weevils. Larvae are legless with a brown head and the abdomen is not enlarged.

Habitat: Adult hides during the day. Clusters in curled leaves and in crevices. A pest of pastures and crops.

Life cycle: Eggs are deposited in bark. Larvae feed on roots and pupation occurs in the soil.

Distribution: Introduced and widespread

Status of damage potential: Not considered to be a serious pest, although defoliation of isolated young *P. radiata* has been recorded. Spraying is not considered necessary unless attacks occur in research plots.

Factors contributing to damaging outbreaks: Not known, but the weevil can build up to large numbers on some weeds - especially sorrel.

History of damaging outbreaks: Isolated occurrence of damage in *P. radiata* plantations at Albany in spring and early summer in 1987.

Control: Spray at night with synthetic pyrethroid (Technical Instruction Sheet No. 8).

3.15 APPLE WEEVIL

Other common names: curculio beetle

Scientific name: *Otiorhynchus cribricollis* Gyllenhal

Recognition: Medium size weevil with a slightly bulbous abdomen. Uniform brown colouring. Has characteristic snout common to many weevils. Larvae are legless with a brown head.

Habitat: Pasture and in or near orchards. It descends trees during the day and hides under debris. Recorded feeding on *P. radiata* .

Life cycle: Eggs are deposited in bark and larvae feed in the soil. Pupation occurs in the soil.

Distribution: Introduced and widespread

Status of damage potential: Not considered to be a serious pest in *P. radiata* plantations. This weevil was associated with damage in private plantations near Bridgetown in 1986.

Factors contributing to damaging outbreaks: Possibly proximity to orchards, but also some pasture (unknown) situations.

History of damaging outbreaks: Associated with damage to private *P. radiata* plantations in the Bridgetown area in 1986.

Control: Spray at night with synthetic pyrethroid (Technical Instruction Sheet No. 8).

3.16 SIREX WASP

Other common names: sirex woodwasp

Scientific name: *Sirex noctilio* Fabricius

Recognition: The female sirex is steel-blue in colour with a pointed projection at the rear of her abdomen. The adult male wasp is steel-blue with a wide orange band on his abdomen. The body length of adult wasps range from 10mm to 40mm. The larvae are creamy white with a dark point at the rear end. The maximum length of a larva is 40mm.

Habitat: Pine plantations

Life cycle: During the summer the female wasps drill into the living tree to lay their eggs. After a two week incubation period the sirex larva hatches and immediately begins tunnelling through the tree, first towards the heartwood and then back to the outer layers of the sapwood. This tunnelling can continue up to two years.

In the sapwood the larva pupates and the adult wasp emerges. The adult bores its way out of the tree leaving a round exit hole of between 3 and 7mm, depending on the size of the wasp.

Adult wasps emerge and fly any time from January to May, peaking in February and March. It is during the flight season that sirex mate and lay their eggs.

Distribution: Originally Europe, but introduced to New Zealand and thence to Tasmania, Victoria, South Australia and NSW. Sirex has been intercepted on occasions in the 1960's, but has not established in WA. It can be transported in untreated pine.

Status of damage potential: Sirex as a vector of a wood rotting fungus can cause catastrophic damage to pine plantations. This insect poses a great threat to pine plantations.

Factors contributing to damaging outbreak: Stressed trees

History of damaging outbreaks: None recorded in WA. Serious damage has occurred in Eastern Australia.

Control: No insecticidal control is feasible.

Predators and parasitoids have been introduced into Eastern Australia successfully.

This is a reportable insect. Any sightings are to be reported to Dr. Ian Abbott, CALM Como, so that introduction of the relevant bio-control programme can be implemented.

For further information refer to Attachment 7; Sirex Plan (1988).

3.17 LEAFBLISTER SAWFLY

Other common names: eucalyptus leafmining sawfly

Scientific name: *Phylacteophaga froggatti* Riek

Recognition: The larvae which cause the damage to eucalypts are yellow with dark spots, up to 5mm long. The larvae mine beneath the upper leaf surface and each pupates in a blister. This gives the leaf a scorched appearance. The adult is a small wasp with an orange head and thorax and black abdomen.

Habitat: The foliage of many eucalypt species, particularly of the subgenus *Symphyonyrtus*, is attacked. Damage is often confined to the lower 3m of the tree.

Life cycle: Eggs are laid singly or in rows near the leaf midrib but beneath the leaf surface. A small, raised, black lump on the upper side of the leaf marks the position of the egg. Each generation takes about 6 weeks. The larva pupates in an oval cocoon within the blister. Adult wasps do not feed and live for about one week. The life cycle slows down in winter to about 8 weeks.

Distribution: Introduced to Perth in 1978 and thence the whole of the south west of WA.

Status of damage potential: Leafblister sawfly is recorded as causing significant damage to young *E. globulus* plantations. Defoliation of half the tree has been observed with small trees being totally defoliated. This is a significant pest in eucalypt plantations. However, spraying with insecticides is not feasible because of the need for frequent applications due to there being many generations of the insect each year.

Factors contributing to damaging outbreaks: Undoubtedly the combination of an introduced insect with ineffective local predator/parasitoid control.

History of damaging outbreaks: Significant damage to young *E. globulus* was reported from Waroona (1989), Pemberton (1990) and Albany (1989).

Control: Insecticidal control on a broad scale is not feasible because of the need for frequent applications. Where outbreaks occur in special interest plantings dimethoate (systemic insecticide) can be sprayed. (Technical Instruction Sheet No. 7).

Biocontrol is a feasible option. Parasites were introduced with apparently good results in the early 1980's. The status of this program is not known.

3.18 CATASARCUS WEEVILS

Other common names: Nil

Scientific name: *Catasarcus* spp.

Recognition: There are at least 41 different types. The most common has a black and ochre stippled abdomen; the thorax is black, while the head has two ochre coloured lines running down its "snout". Overall the insect is a large robust creature, about 15mm long. When disturbed they can play dead, tucking their legs tightly beneath them and dropping from the leaf or branch upon which they have been feeding or resting. The weevils chew leaves around the edges, giving a scalloped appearance.

Habitat: Eucalypt trees

Life cycle: The life cycle is unknown. It is probable that eggs are laid close to the host tree as adults cannot fly.

Distribution: A widely distributed native insect

Status of damage potential: It is uncertain if the damage caused by this insect is serious. It is claimed by some that trees can be seriously retarded or killed, while others find that trees can withstand defoliation. Has been observed to attack pines and eucalypts.

Factors contributing to damaging outbreaks: Not known, although observations suggest that stressed and young trees are most affected.

History of damaging outbreaks: Records of damage from the Esperance area, particularly on tuart *(E. gomphocephala)*. Damage has also been recorded in the south Stirling area on *E. globulus*.

Control: Spray at night with synthetic pyrethroid if necessary. (Technical Instruction Sheet No. 8).

3.19 CUTWORMS

Other common names: Depends on species. Include pink or brown cutworm, black cutworm, Bogong moth.

Scientific name: *Agrotis* spp. Three species are recorded: *A. munda* (brown cutworm), *A.infusa* (Bogong moth) and *A. ipsilon* (black cutworm, not common in the south west of WA).

Recognition:
green to dark pink. Mature larvae are about 4cm long with dark spots along each side of the body. Moths have a 4cm to 5.5cm wing span; colour variable from dark grey to brown, with markings on the forewings. Caterpillars hide in the soil by day and come out at night to feed.

Habitat: Weeds, vegetable crops, cereals. Damage is most severe on young plants which have recently germinated or been planted. Has been found on recently planted *E. globulus* seedlings.

Life cycle: Eggs are laid in clusters close to the soil. Newly hatched caterpillars feed on tissues of the more succulent foliage of weeds and cultivated plants, but as they grow older they cut through stems at the plant base. There are several generations per year. The life cycle is completed in about 7 weeks but this varies according to temperature. Adults are strong fliers and may travel many kilometres.

Distribution: Common throughout agricultural areas of Australia

Status of damage potential: The caterpillars chew stems of seedlings at ground level causing the stems to be girdled or cut through at the base. Older plants may be defoliated. Not considered a serious problem in plantations.

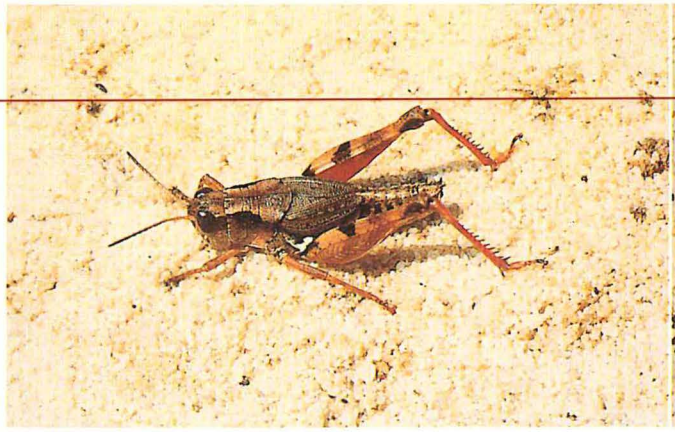
Factors contributing to damaging outbreaks: Heavy weed growth especially on recently flooded ground.

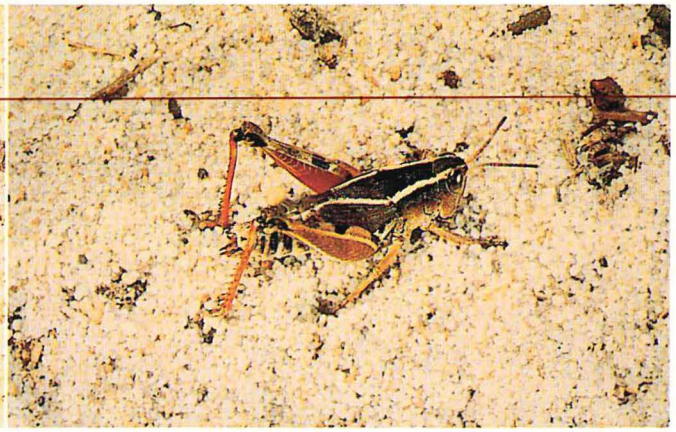
History of damaging outbreaks: Most common as a field or pasture pest. Two reports of damage in *E. globulus* plantations; Chowerup (research plot) and Harvey in late July early August 1990.

Control: Cultural control can be achieved by grazing heavily up to the time of planting. Plant wet areas late in the season. Chemical control is not recommended except where valuable genetic material is involved or the likelihood of serious damage is high (eg. past history of insect in the area). A weed free area of about 10m around the edge of a plantation will prevent insects moving into the plantation from heavily vegetated areas outside.

When insecticidal control is necessary spraying with a synthetic pyrethroid is recommended (Technical Instruction Sheet No. 3).

3. ILLUSTRATIONS

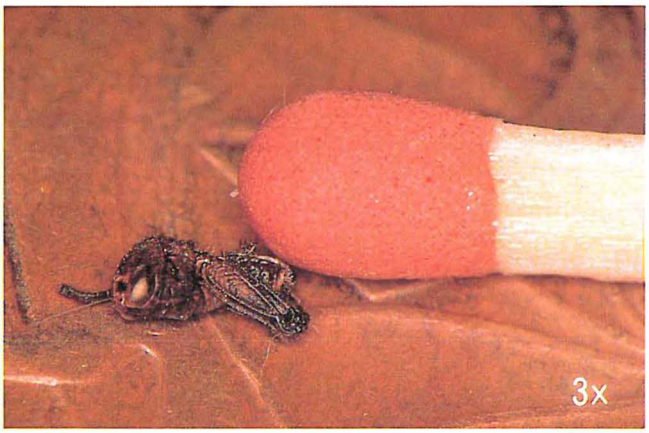




Adult wingless grasshopper

Two forms are recognized, with or without a pair of white stripes on each side of the thorax. Most adults have short, undeveloped wings but small numbers in the population can have functional wings. The inside of the hind legs are orange.

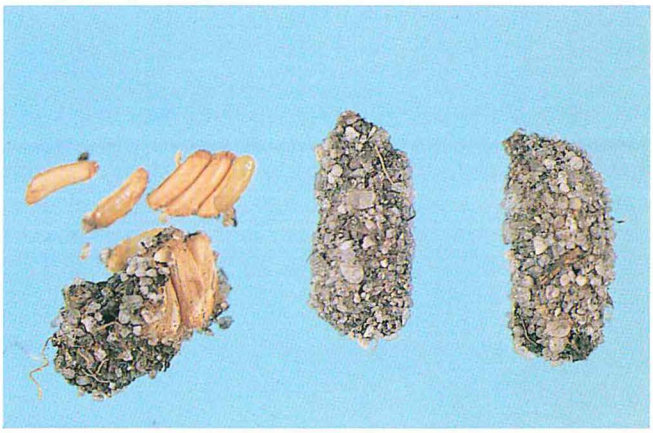
Photos - Kevin Richards



Wingless grasshopper nymph

The newly emerged wingless grasshopper is less than four millimetres long and is a uniform dark grey. The nymphs develop through five stages (instars) before becoming adults.

Photo - Rob Emery



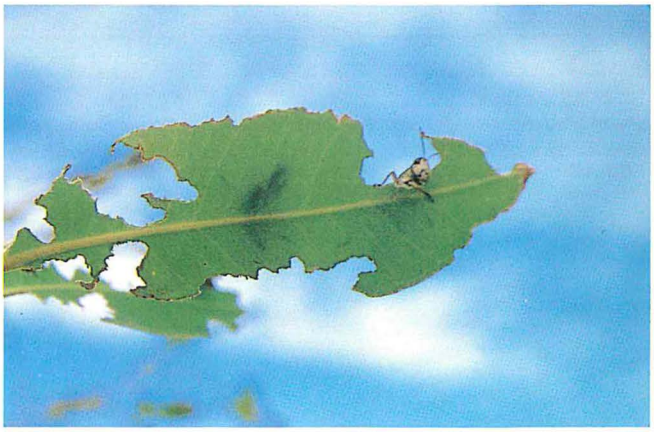
Wingless grasshopper eggs and pods

Eggs are laid in small cylindrical pods about 8mm long. Each pod contains 10 to 15 eggs. Sandy bare areas in which to lay eggs are preferred.

Photo - Rob Emery

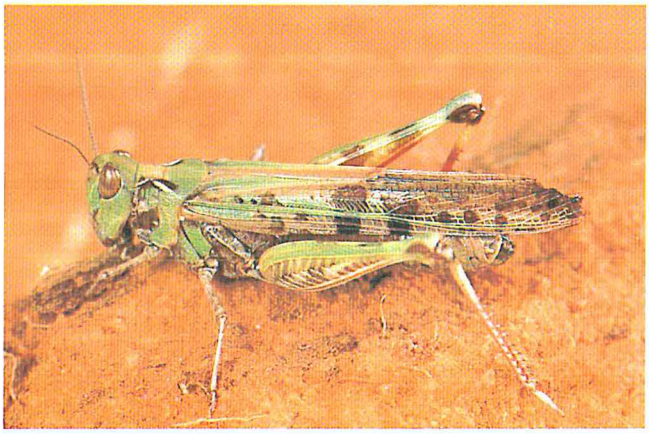
Eucalypt tree defoliated by wingless grasshoppers.

Photo - Rob Emery

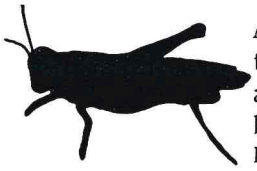


Close-up showing damage to eucalypt leaf caused by the wingless grasshopper.

Photo - Rob Emery



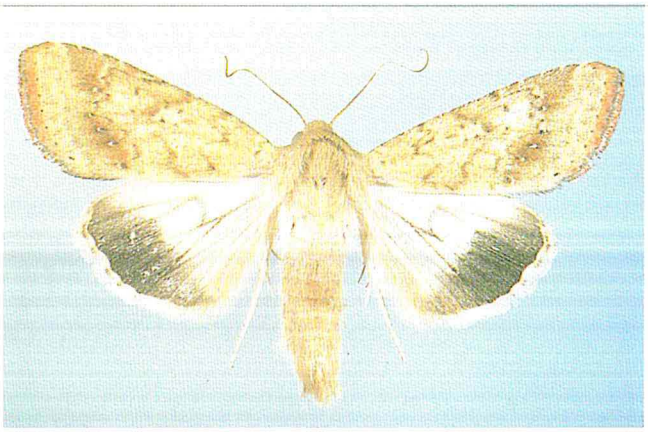
Adult Australian plague locust



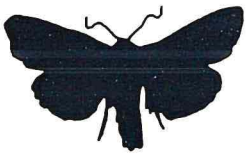
Adult locusts vary in colour from green to brown. The insides of the hind legs are red. This species features a dark blotch on the end of the hind wing.
Photo - WADA

Budworm larva

The caterpillars vary from green, through orange to dark brown. Stripes extend the length of the body.
Photo - Ray Fremlin



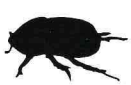
Adult budworm moth



This species is recognized by the rapid zig-zag flight. Individuals may be darker than the specimen shown here. The moth features a dark patch on the hind wings.
Photo - Kevin Richards

Damage to *P. radiata* caused by budworm caterpillars. When alternative food sources are unavailable budworm can kill trees by stripping off the bark.
Photo - Ray Fremlin

African black beetle



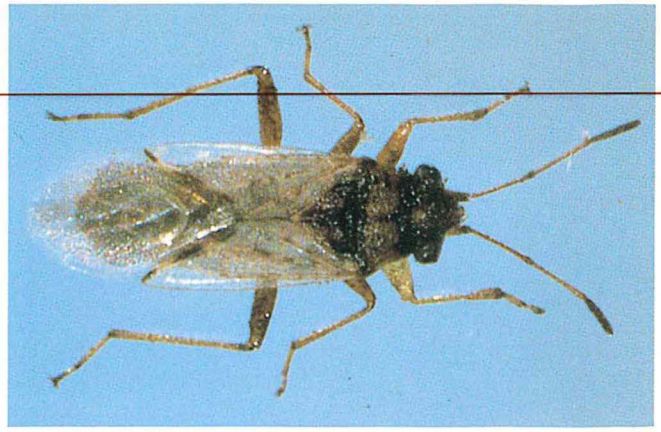
The adult beetle is a typical cockchafer, glossy black and about 14mm long. It is sluggish, spending most of its time underground.
Photo - Stewart Learmonth

Larvae of the African black beetle

The body of the larva is typically "C" shaped. It has a brown head, enlarged abdomen and three pairs of strong legs.
Photo - Kevin Richards

Adult spring beetle

The beetle is bronze-brown. The species pictured has a darker thorax. Larvae are typical cockchafers living in the ground feeding on plant roots.
Photo - Kevin Richards

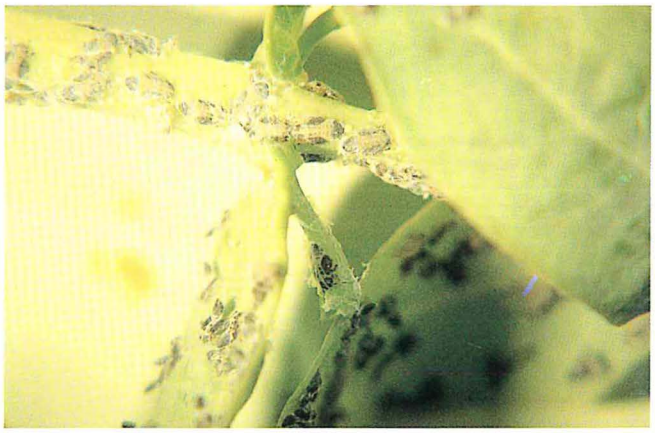


Adult Rutherglen bug

A greyish-brown bug with black eyes and two pairs of silvery wings. The nymphs are more swollen in shape than the adult, and are deep yellow to red at first before turning a darker colour.
Photo - Kevin Richards

Bluegum psyllid nymphs and adults

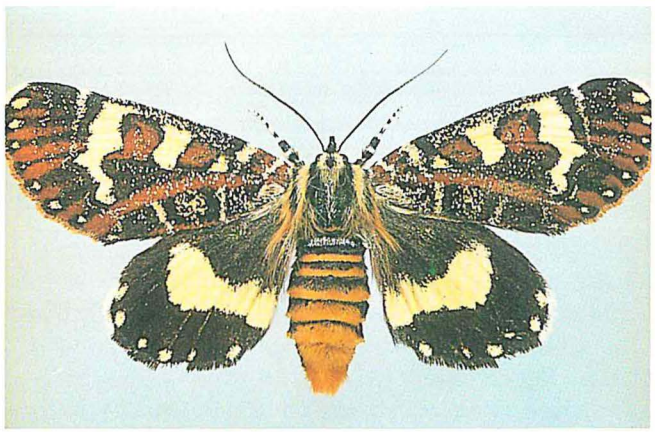
This psyllid is specific to *E globulus*. The nymphs are smaller but similar in appearance to the adults. The insect appears greyish in colour to the naked eye.
Photo - Peter Skinner



The bluegum psyllid prefers to feed in the whorls of the juvenile foliage of *E. globulus* and produces a waxy secretion.
Photo - Peter Skinner

Larvae of the pasture day moth

The caterpillar grows up to 60mm long, is dark brown to black with two yellow spots near the posterior end.
Photo - Kevin Richards



Adult pasture day moth

This large moth is brown with creamy-yellow markings on the wings and orange rings round the body. It flies by day in autumn.
Photo - Kevin Richards

Autumn gum moth larvae

Caterpillars are yellow-brown with dark brown-green markings when young, becoming dark green-brown with age and developing two red patches containing two yellow swellings on each segment.

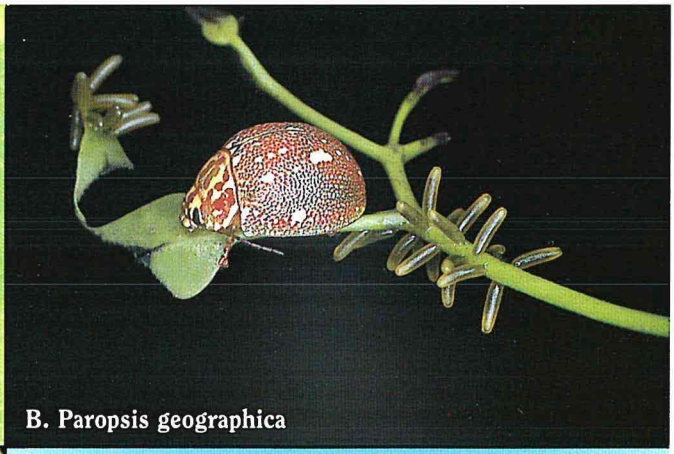
Photo - Peter Skinner

Larval shelters of the autumn gum moth

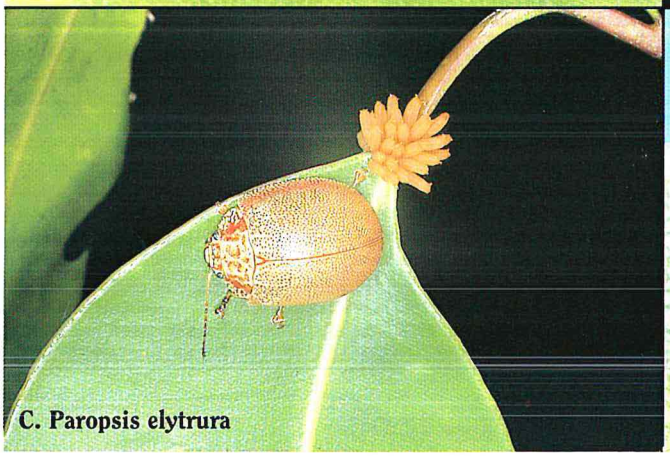
The caterpillars build shelters by curling leaves over in which they hide during the day. Often these shelters are all that remain on an otherwise defoliated tree.

Photo - Peter Skinneer

A. Chrysophtharta sp.



B. Paropsis geographica



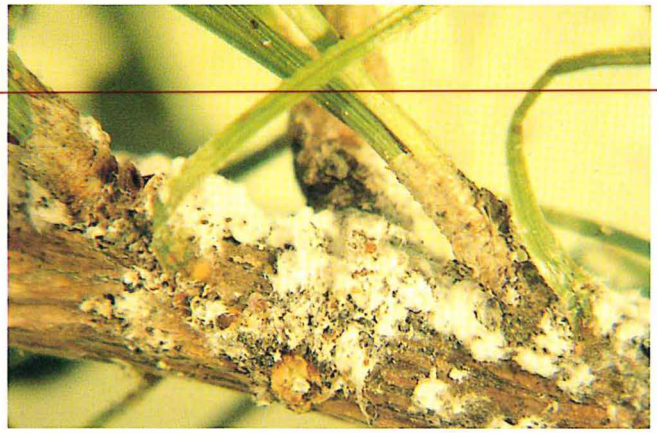
C. Paropsis elytrura

D. Chrysophtharta sp.

Chrysomelid beetles, including the genera *Chrysophtharta* and *Paropsis*, are widespread and locally common in the southwest. Adults are easily recognisedd from ladybirds *(Coccinellidae)* by their larger size, padded feet and long antennae. Eggs are laid on the underside of new leaves, on twigs or under bark. Larvae often form aggregations while feeding on leaves.

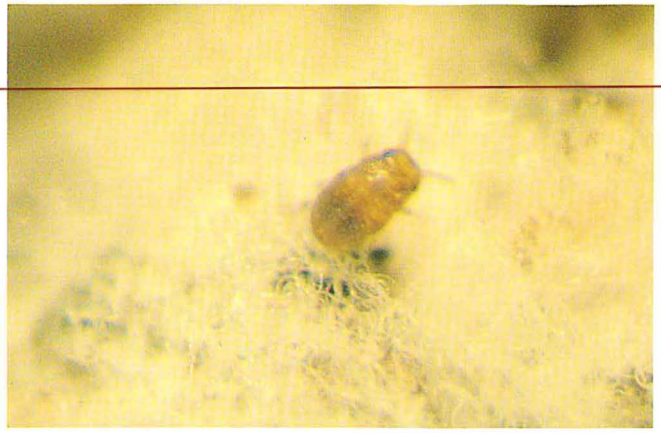
Photos - A. WADA
B. G. Tribe
C. G. Tribe
D. WADA
E. P. Kelly

E. Chrysophtharta sp.



Pine adelgid

This aphid-like insect is less than 1mm long and is identified by the mass of white woolly wax that is produced by the female.
Photo - Peter Skinner



Pine adelgid

Aggregating into large colonies, these insects feed on the sap of *P. radiata* and *P. pinaster*.
Photo - Peter Skinner

Vegetable weevil

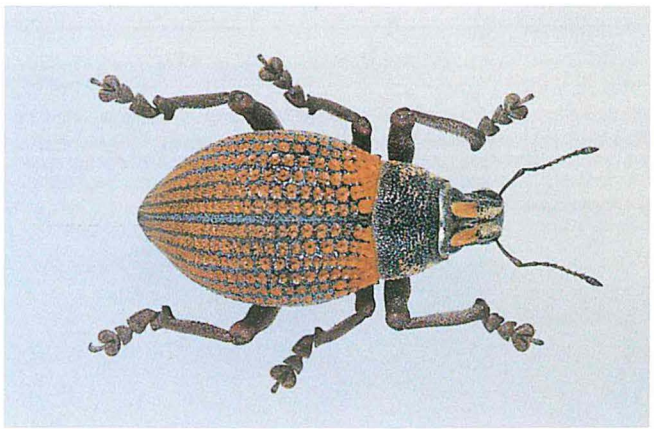
A medium size grey weevil with two short white stripes at an angle on each side of the back and a central white line on the thorax. Hides during the day.
Photo - Stewart Learmonth

Garden weevil

Usually grey-brown, this weevil has a bulbous abdomen and a prominent lighter coloured stripe angled across the back. Feeds at night, hiding under vegetation during the day.
Photo - WADA

Apple weevil

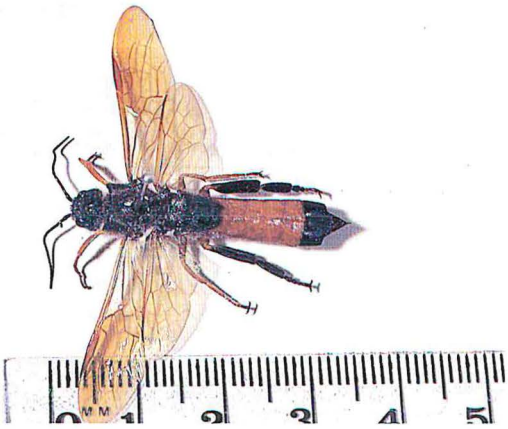
This weevil is a uniform shiny dark brown colour with a slightly bulbous abdomen. Like many weevils it feeds at night, descending the trees to hide under debris during the day.
Photo - Stewart Learmonth



Catasarcus weevil

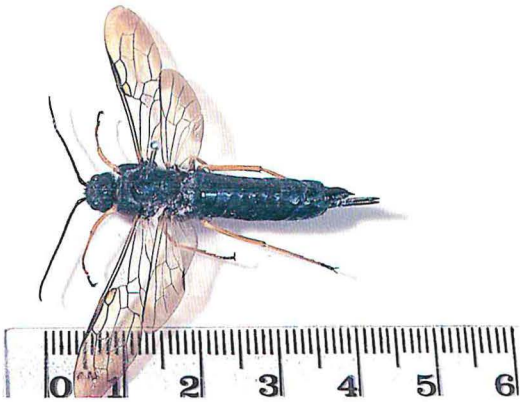
This genus restricted to Western Australia and South Australia is represented by at least 41 types. This one is common in the Esperance area.
Photo - Kevin Richards

Characteristic scalloped appearance of damaged eucalypt leaves caused by the catasarcus weevil.
Photo - Kevin Richards



Male adult sirex wasp

The male wasp is steel-blue with a wide orange band on his abdomen.
Photo - Jiri Lochman



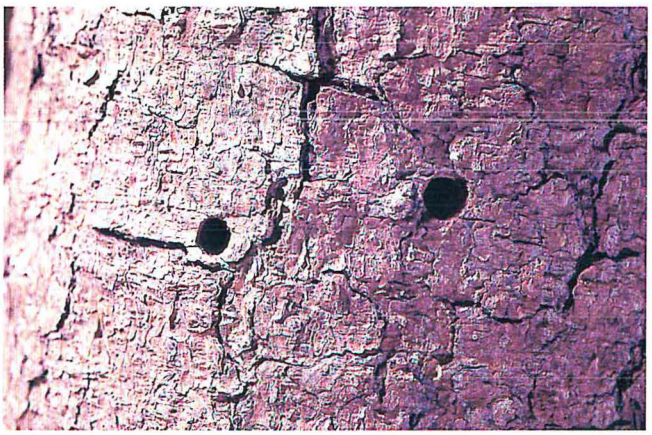
Female adult sirex wasp

The female wasp is steel-blue with a pointed projection at the rear of her abdomen. the body length of both sexes ranges from 10mm to 40mm.
Photo - Jiri Lochman

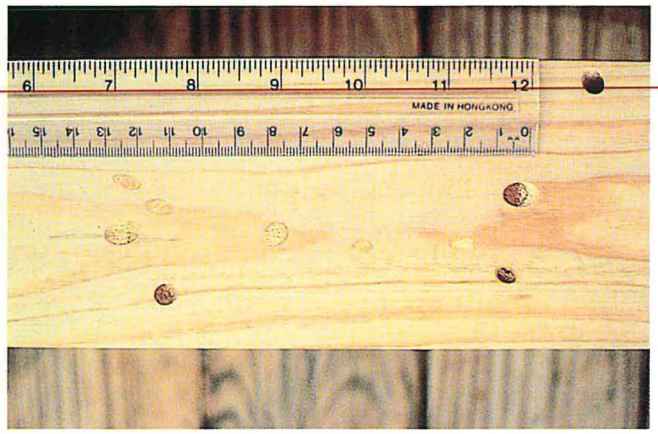
Larva of the sirex wasp

Sirex larvae are creamy-white with a dark point at the rear end. The larvae tunnel through the tree for up to two years before pupating in the tree.
Photo - Woods and Forests, SA

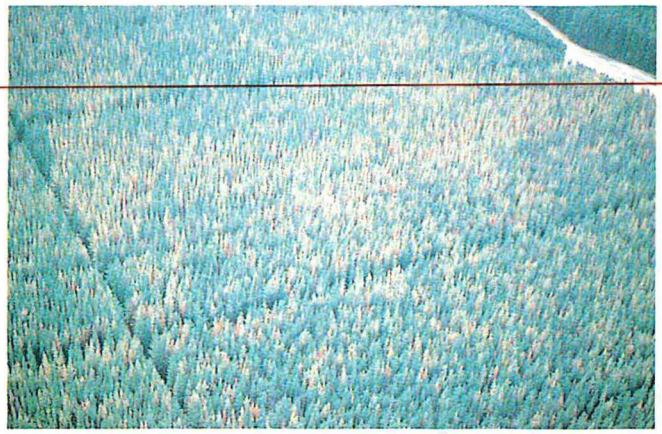
Fungal staining of the cambium after the tree is attacked by the sirex wasp. This fungus is the cause of tree mortality and is recognized by the orange-brown streaks under the bark.
Photo - Woods and Forests, SA



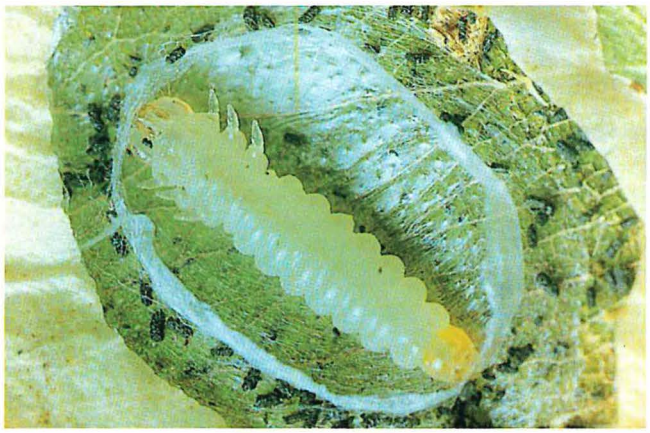
Exit holes of the adult sirex wasp in the bark of *P. radiata*.
Photo - Jiri Lochman



Exit holes and larval tunnels in a pine board.
Photo - Woods and Forests, SA



A plantation of *P. radiata* in South Australia severely damaged by sirex wasp.
Photo - Woods and Forests, SA



Leafblister sawfly larva

The larvae which cause damage to eucalypts are yellow with dark spots. The larvae mine beneath the surface of the leaf and pupate in a blister.
Photo - WADA

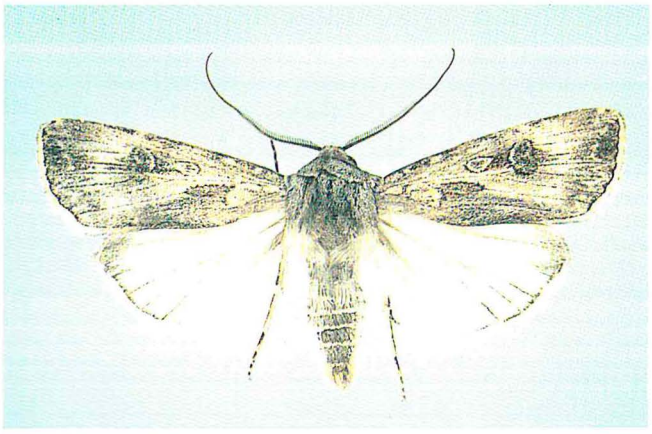
Adult leaf blister sawfly

This small wasp has an orange head and thorax with a black abdomen, and prominent black eyes. The wasp is up to 5mm long.
Photo - WADA

Damage caused to the leaves of eucalypts by the leafblister sawfly.
Photo - WADA

Cutworm larva

There are several species of cutworm in Western Australia which vary in colour but all are turgid and soft. Cutworm cut off seedling trees close to the ground and usually hide under the surface during the day, often close to the damaged plant.
Photo - Phillip Michael

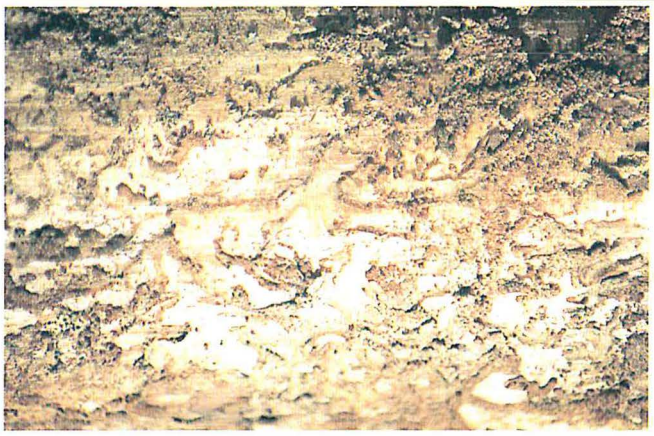


Cutworm moth

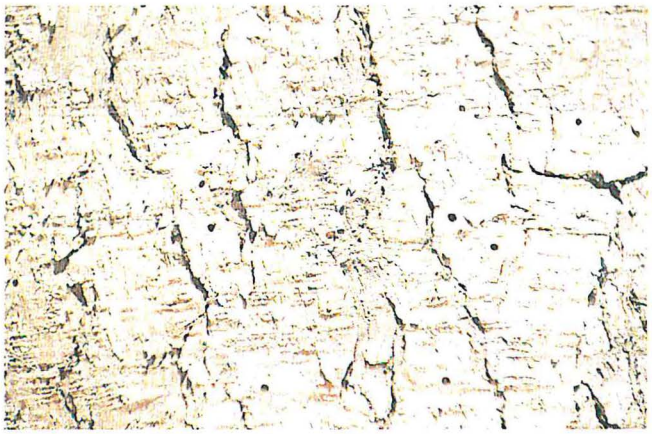
The adult is stout bodied with a wing span up to 55mm. The forewings are patterned brown or dark grey. The hind wings are usually white.
Photo - Kevin Richards

Adult ips bark beetle

- The beetle is reddish-brown to black and between 2.5mm and 4.5mm long. A concave depression at the rear end is rimmed with 10 spines.
Photo - Stephen Dick



Larval galleries of the ips bark beetle under the bark of a *P. radiata* tree. Stressed trees are more likely to be attacked, although healthy trees may be attacked when the population is high and food is short.
Photo - Stephen Dick



Emergence holes of adult ips bark beetle from a *P. radiata* tree. Attacks often occur first in the upper section of the stem. The presence of light brown frass in the whorls of branches indicates an attack of beetles in the upper section of a tree.
Photo - Stephen Dick

4. CONTROL MEASURES

4.1 ASSESSMENT OF DAMAGE POTENTIAL

It must be emphasised that early detection and quick response is essential to minimise damage by insects.

In localities where **Australian Plague Locusts** are known to occur the Agricultural Protection Board provides a prediction, based on surveys of egg beds, of the probability of an outbreak (see Section 2.1 of this manual for contacts).

All newly planted and one year old *P. radiata* must be surveyed for the presence of **Budworm**, at a weekly interval, from the beginning of October until the threat of attack is over at the end of January (see Attachment 1 for field survey and recording procedures).

Egg beds (sandy, well drained areas) of the **Wingless Grasshopper** must be located for early identification (from September onwards) of nymphs in order that effective control is achieved (see Attachment 1).

For other insect pests broadscale insecticidal control is not feasible. However, the occurrence of damage in plantations must be assessed and reported to the Manager, Silviculture Branch (see Attachment 1).

Any insect found to be attacking trees should be caught and sent for identification to Dr Ian Abbott, CALM, Como (see Attachment 2 for insect identification and forwarding procedure).

4.2 AUTHORISATION OF CONTROL MEASURES

The control measures contained in this manual are authorised by the Executive Director.

Authority to use any prescription contained in this manual to control an outbreak of insects must come from the Regional Manager after notifying the Manager, Silviculture Branch (see Attachment 3 for procedures).

No method other than those contained in this manual may be used to control insects. Where an appropriate prescription does not exist, it should be referred to the Manager, Silviculture Branch, preferably with a recommendation.

The implementation of any insecticidal prescription in this manual must comply with the provisions on the label and the relevant CALM 729.

Notifications:
It is advisable to notify property owners adjacent to newly established plantations that insecticides will be used if an insect attack occurs. When there is a decision to spray adjacent property, owners must be notified no less than 24 hours before spraying commences.

4.3 RESPONSIBILITY OF CONTRACTORS

All contractors employed by CALM to spray insecticides must abide by the provisions and methods contained in this manual, the Chemicals Users Manual and relevant state regulations. Reference to this must be incorporated in the contract document.

Contractors **must** be licensed pesticide applicators with specific endorsement for the insecticide to be used.

4.4 PRESCRIPTIONS FOR THE APPLICATION OF INSECTICIDES

(Technical Instruction Sheets)

The Technical Instruction Sheets provide the recommended techniques for the control of insect pests in pine and eucalypt plantations. Any variation to the procedures in this section must be authorised by the Manager Silviculture Branch and the Health, Safety and Welfare Officer.

Insecticides, formulations and method of application are generally those recommended by the Department of Agriculture or the Agriculture Protection Board. Where local experience has demonstrated that an alternative is effective, this alternative is provided.

Ground application of insecticides is favoured. Aerial application is not generally economic but remains an option, particularly if arranged jointly with neighbours when egg beds (grasshoppers) overlap property boundaries.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests

Target Species: Wingless grasshopper *(Phaulacridium vittatum)*

Job Description: Spraying of wingless grasshoppers in pine and eucalypt plantations and shelter belts.

Insecticide/s: * alphamethrin ULV **16gm/L**
Alternative: * alphamethrin EC **100gm/L**

Trade Name/s: Dominex 16 ULV (CropKing)
Alternative: Dominex 100 (Agchem)

Rate of Application:

Ultra low volume application:
Dominex 16 ULV at **1L/ha**

Note: This formulation is not to be diluted.

Alternative: Dominex 100 at **160ml/ha** in **840ml/ha** of diesel.

Low volume application:
Aerial: Dominex 100 at **160ml/ha** in **18 L/ha** of water and **2 L/ha** DC-Trate.

Ground mister: Dominex 100 at **160ml/ha** in **18 L/ha** of water and **2 L/ha** DC-Trate.

High volume application:
Boomsprayer: Dominex 100 at **160ml/ha** in **40 to 100 L/ha** of water.

Application Method: Spraying is most effective on newly emerged hoppers before they start dispersing. However, the following rates and methods have been demonstrated to effectively control 4th instar hoppers. Both knockdown and some residual control can be expected from these treatments.

Aerial application of ULV formulations:
Aircraft **must** be fitted with rotary atomisers.

Add the required quantity directly to the spray tank. Water should be drained from the aircraft tank and spray lines before using Dominex 16 ULV.

Apply first thing in the morning on a day that promises to be warm.

Do not spray in calm conditions or when the wind is variable. Spray in cross winds of <13kph.

Aerial application of EC formulations:
Aircraft to be fitted with rotary atomisers or hydraulic nozzles.

Apply first thing in the morning on a day that promises to be warm.

Do not spray in calm conditions or when the wind is variable. Spray in cross winds of <13kph.

Mister application:
Apply first thing in the morning on a day that promises to be warm.

Do not spray in calm conditions or when the wind is variable. Spray in cross winds of <13kph.

Boomsprayer application:
Preferably apply early in the morning on a fine warm day. Cease spraying when temperatures exceed 26^{0}C. Do not spray in winds that exceed 13kph.

Important:
Do not spray over or near rivers, streams and dams. Dominex is toxic to bees.

* These products are not registered for use against this insect. A special permit for their use has been issued by the Health Department.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 6/12/91

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Insect/s: wingless grasshopper
(Phaulacridium vittatum)

Job Description: A barrier bait treatment to provide protection to trees. Treatment uses a bait (flaky bran) with insecticide.

Insecticide: maldison ULV **1.18kg/L**

Trade Name: Maldison ULV (Amalgamated)
Maldison ULV (Nufarm)
Branbait M (Pre-mixed)
(Kimberley)

Mixing: Spray **30mL** of maldison ULV over each kilogram of flaky bran.

Application Method: The application rate for bran bait can vary from **3 to 12kg/ha**; use higher rates where the plant cover or grasshopper infestation is more dense. For large areas use a fertiliser spreader to spin the bait out, or fit a blower mister with a venturi suction to blow the bran out over a 10m to 20m wide swath. Alternatively, trickle the bran out behind a vehicle.

Baits are most effective when applied to bare ground. Cultivated strips provide ideal sites for bait placement. Baits are not effective against younger nymphs.

For further information refer to WADA Farmnote No. 62/90.
Stock withholding period - 3 days.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species:
Budworm *(Helicoverpa punctigera)*
* Pasture day moth *(Apina callisto)*
* Autumn gum moth *(Mnesampela privata)*
Cutworms *(Agrotis* spp.*)*

Job Description:
ULV misting to control the above pests in plantations.
Alternative: 100 EC in water to control these pests in plantations.

Insecticide/s:
alphamethrin ULV **16gm/L**
Alternative: alphamethrin EC **100gm/L**

Trade Name/s:
Crop King Dominex 16 ULV (Incitec)
Alternative: Agchem Dominex 100 (Incitec)

Rate of Application:
Ultra low volume application:
Crop King Dominex 16 ULV at 750ml/ha. Higher rates may be used (up to 1.9 L/ha) depending on residual control required and size of insect pests.

Note: This formulation is not to be diluted. Agchem Dominex 100 may be used ultra low volume at 120ml in 1 litre of anti-evaporant (eg, DC-Trate) per hectare.

Boomspray:
Agchem Dominex 100 at 120ml/ha in 100L of water per hectare. Higher rates (up to 300ml/ha) may be used depending on residual activity required and size of insect pest.

Application Method:
ULV formulation:
Apply with a power mister or knapsack power mister. Apply with a cross wind of a velocity no higher than 13km/hr. Use the higher rate when caterpillars are 10mm or longer.

EC formulation:
Apply with either a boomsprayer, mister or packsprayer. Spraying must cease when winds exceed 13km/hr. Treatment is most effective when caterpillars are small (<15mm long).

There is a stock withholding period of 1 day.

* Dominex is not registered for use against these insects. A special permit for its use has been issued by the Health Department.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species: African black beetle
(Heteronychus arator)

Job Description: Control of African black beetle in nurseries and research plots. This prescription is not appropriate for broadscale application.

Insecticide/s: chlorpyrifos, **500gm/L**

Trade Name/s: Lorsban 500 EC (Dow)
Deter Insecticide (Amalgamated)

Rate of Application: Nurseries - **3 or 6L** in **100L/ha** of water

Field plots - **2L** in **500 - 1000L/ha** of water

Application Method: Nurseries - apply the spray to the soil proir to sowing seed, ensuring thorough incorporation to a depth of 15cm by irrigation or cultivation. Use high rate under heavy insect pressure.

Field plots - apply as soon as infestation is observed.

Stock withholding period - 2 days.

BRANCH MANAGER ..... CHEMICALS OFFICER T A Wood.

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species: * spring beetles *(Liparetrus* spp.*)*

Job Description: Spraying of adult beetles on the foliage of eucalypts. This prescription is not recommended for broadscale application because of the mobility of the insects.

Insecticide/s: trichlorfon **625gm/L**

Trade Name/s: Dipterex Liquid Insecticide Spray.(Bayer)

20/10/93 Ray Eremin recommends any synthetic pyrethroid eg Dominex (Alphamethrin) - contact spray

Rate of Application: **125mL** in **100L** of water

Application Method: Apply using a packsprayer, or if the trees are small use a boomsprayer. Repeat applications may be necessary.

Stock withholding period - 2 days.

* Dipterex is not registered for use against this insect. A special permit for its use has been issued by the Health Department.

BRANCH MANAGER ..... CHEMICALS OFFICER T.A. Wood

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species: Rutherglen bug *(Nysius vinitor)*

Job Description: Spraying adult insects on the foliage of young eucalypts.

Insecticide/s: maldison ULV **1.18kg/L**

Trade Name/s: Maldison ULV (Amalgamated)
Maldison ULV (Nufarm)

Rate of Application: **1L/ha.**
Note: ULV formulations are not to be diluted.

Application Method: Spray using a mister. Multiple applications may be necessary.

Stock withholding period - 1 day.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species:
* bluegum psyllid
(Ctenarytaina eucalypti)
* leafblister sawfly
(Phylacteophaga froggatti)

Job Description: Foliar spray of feeding insects. This prescription is recommended for high value trees only. It is not for broadacre application.

Insecticide/s: dimethoate, **400gm/L**

Trade Name/s:
Perfekthion EC 40 (BASF)
Rogor Diostop EC (Schering)
Dimethoate Systemic Insecticide (Nufarm)
Lane Rogor 40 (Amalgamated)
Roxion Dimethoate 400 EC (Hoechst)
Saboteur EC 40 (Incitec)

Rate of Application:
Packsprayer: **75mL** in **100L** of water
Mister: **750mL/ha**

Application Method: Apply using a packsprayer or mister. This is a systemic insectcide but may need to be re-applied at intervals

Stock withholding period - 1 day.

* These products are not registered for use against these insects. A special permit for their use has been issued by the Health Department.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species:
* vegetable weevil *(Listroderes difficilis)*
garden weevil *(Phlyctinus callosus)*
apple weevil *(Otiorhynchus cribricollis)*
* catasarcus weevils *(Catasarcus spp.)*
* chrysomelid beetles

Job Description: ULV misting to control beetles and weevils infesting pine plantations or eucalypt trees. Spraying must proceed only when serious loss of trees is likely to occur.

Insecticide/s: alphamethrin ULV **16gm/L**
Alternative: alphamethrin EC **100gm/L**

Trade Name/s: Crop King Dominex 16 ULV (Incitec)
Agchem Dominex 100 (Incitec)

Rate of Application:

Ultra Low volume formulation: Crop King Dominex 16ULV at 750ml/ha.

Note: This formulation is not to be diluted.

Agchem Dominex 100 may be used at 120ml in 1 litre of anti-evaporant (eg, DC-Trate) per hectare as an ultra low volume application.

EC formulation: Agchem Dominex 100 at 120ml/ha in 100 litres of water per hetare.

Application Method: For weevils application is most effective at night or late evening as insects rest under cover during the day. Spray with mister, packspray or boomsprayer.

Stock withholding period - 1 day.

* These products are not registered for use against these insects. A special permit for their use has been issued by the Health Department.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests.

Target Species: Australian plague locust
(Chortoicetes terminifera)

Job Description: Ultra Low Volume spraying of nymphs in pine and eucalypt plantations.

Insecticide/s: fenitrothion 1000gm/L

Trade Name/s: Fenitrothion 100 (Nufarm)
Fenitrogard (Wellcome)

Rate of Application: **325mL** in **80 - 150L/ha** of water for boomsprayer application **or, 2.5 - 3L/ha** of water for mist application.

Application Method: Apply using a mister or boomsprayer in light to moderate winds. Spraying must cease when winds exceed 13km/hr.

Stock withholding period - 7 days.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 5-12-90

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

ISSUED TO SOUTH COAST REGION ONLY

TECHNICAL INSTRUCTION SHEET

Recommendation for chemical control of insect pests

Target Species: Budworm *(Helicoverpa punctigera)*

Job Description: Aerial spraying of Budworm using ULV formulation.
Alternative: 100 EC in water plus DC Trate.

Insecticide/s: alphamethrin ULV **16gm/L**
Alternative: alphamethrin EC **100gm/L**

Trade Name/s: Dominex 16 ULV (Incitec)
Alternative: Dominex 100 (Incitec)

Rate of Application: **Ultra low volume application:**
Dominex 16 ULV at 750ml/ha to 1.2L/ha.
Use low rate where trees are small(<0.5 Metres) and pasture is sparse. Increase rate to 1.2L/ha where pasture is dense and when caterpillars are 10mm or longer.

Note: This formulation is not to be diluted.

Low volume application:
Dominex 100 at 120ml/ha in 3 litres of water and 2 litres of DC-Trate.

Application Method: Add the required quantity directly to the spray tank. Water should be drained from the aircraft tank and spray lines before using Dominex 16 ULV.

The aircraft should be fitted with rotary atomisers or hydraulic nozzles.

It is preferable to spray during the cool parts of the day with light cross winds (<13kph). Avoid spraying in calm conditions or when winds are variable.

Important: avoid spraying over or near rivers, streams or dams.

BRANCH MANAGER ..... CHEMICALS OFFICER .....

DATE 6/11/91

N.B. Mention of trade names does not imply endorsement of these products over other registered products which may perform equally well.

5. APPLICATION EQUIPMENT

The most efficient method of applying insecticides is by misting equipment. Misters generate droplets in the range 80 to 250 microns and it is these droplet sizes that provide the best chance of the insecticide reaching the target. Misting machines are designed to apply very low volumes of liquid per hectare. Because of the small droplet size precaution must be taken to avoid inhalation and contact of the insecticide with desirable insects. It may be necessary to use EC formulations where small outbreaks occur or where, for logistic reasons, it is impracticable to use misters.

For soil dwelling insects (eg, African black beetle) boomspray application is necessary to control populations. Emulsifiable concentrates (EC formulations) are used. Boomspray equipment can be attached to either tractors, four wheeled motorcycles or to the tray of a utility.

5.1 DEFINITIONS

ULV stands for Ultra Low Volume and refers to applied rates of 150ml to 2 litres per hectare.

Some insecticides are formulated ULV and are applied neat. Others are mixed with spraying oils, but the mixture does not exceed 3 litres per hectare. For best results use only insecticides specially formulated ULV.

LV stands for Low Volume and refers to applied rates of 3 to 20 litres per hectare.

EC stands for Emulsifiable Concentrate, and are mixed with water. These formulations are sprayed at rates from 5 to 10 litres per hectare when applied by mister. Some EC formulations can be applied at lower rates by adding 25% (of the applied volume) D-C TRON oil. This reduces evaporation and allows lower water rates to be used, particularly when temperatures are above 20^{o}.

5.2 TYPES OF EQUIPMENT

Knapsack power misters - these units are ideal for spraying small infestations and plots. They are also suitable for spraying in terrain that is inaccessible to heavy machinery. Knapsack sprayers operate at swath widths of 5 to 7 meters.

Power misters - the most common type of power mister is portable and operated from the tray of a utility. A flexible blower allows the machine to be operated up and down a field. Swaths of 30 meters are common, but may be up to 100 meters depending on the particular machine and formulation of insecticide. Misters powered from the power take-off of a tractor are also widely used.

Boomsprayers - the most commonly used boomsprayer is the tractor powered unit, fitted with conventional hydraulic nozzles. These units usually have tank capacity of less than 900 litres. Above this the unit is trailed. Boom length varies between 1m and 30m. Irrespective of size, all booms should be fitted with an adjustable break-away hinge on each arm, near the tractor, so that the boom can swing backwards if it hits an obstruction.

To accommodate different nozzle types and to spray different band widths , it is necessary that the height of the boom can be adjusted relative to the frame. On wide booms it is desirable to fit skids or wheels to each end to maintain equal height adjustment. Self - levelling booms are available, although they only work on relatively flat ground.

It is important to ensure that there is adequate agitation in the tank so that the pesticide is thoroughly mixed with the carrier.

Knapsack sprayers - there are two types of knapsack sprayers: those that have a separate pressurised chamber that enables constant output pressure, and those that the spray reservoir is pressurised (pneumatic). The former is recommended. All knapsack sprayers should be fitted with an output pressure regulator and a pressure gauge.

5.3 CALIBRATION

Knapsack power misters:

1. Measure sprayer output. Fill reservoir with water and mark the level. Select a setting for the metering jet. Most are numbered. This setting will control the volume output per hectare.

   Run the motor (throttle fully open) with the output valve open for one minute. Refill the reservoir to the mark using a calibrated measure and record the volume added.

2. Measure swath width. Lay strips of water sensitive paper (Kromecote) at 2 metre intervals across the direction of the wind until 10 or more pieces have been placed. Allow 2 metres from the first piece of paper for blast projection and walk past the line of paper strips. The droplet pattern will show up as spots on each card. Note where an even distribution begins and where it starts to taper off. Measure the distance between these two points. This is the swath width.

3. Calculate speed of travel. Measure out 100 metres and time yourself walking over this distance. To determine your speed in kilometres/hour, divide 360 by the number of seconds taken to walk the 100 metres.

4. Calculate sprayer output per hectare.

$$\text{output volume (L/ha)} = \frac{\text{mister output (L)} \times 600}{\text{swath width(m)} \times \text{speed of travel (Km/hr)}}$$

   Adjust the output to the required amount (litres of ULV product per Hectare) by altering either the travelling speed or selecting a different jet setting. Note: ULV formulations are not usually mixed with water. Therefore, a calculation to determine the amount of insecticide to mix in the reservoir is not necessary.

Power misters:

1. Measure sprayer output. Fill the tank with water and mark the level. Select a jet setting (consult manufacturers guide for output settings) remembering that this must remain fixed unless re-calibrated.

   Run the motor for one minute with the control valve open. Measure the output by refilling the tank to the mark using a calibrated measure. Record volume in litres.

2. Decide on speed of travel. The vehicle must be fitted with a tachometer. An accurate speed cannot be maintained with a speedometer. Misters must not be operated at speeds of more than 8km/hr or the spray pattern will be disturbed by the vehicle slipstream. It is advisable to check speed by measuring off 100 metres and recording the time (in seconds) to travel the distance. Calculate speed in kilometres per hour by dividing 360 by the number of seconds.

3. Measure swath width. Set the blower orifice at a 45° angle backwards and upwards (fig. 1). Lay out strips of water sensitive paper downwind and at right angles to the wind, first at two metre intervals (first one 2m from the blower orifice) for two strips and the rest at 10 metre intervals until 6 or 8 strips are laid out. Drive past the line of paper strips at the selected speed with the mister operating. The droplet pattern will show up as spots on the cards. Note where an even distribution begins and where it starts to taper off along the line.

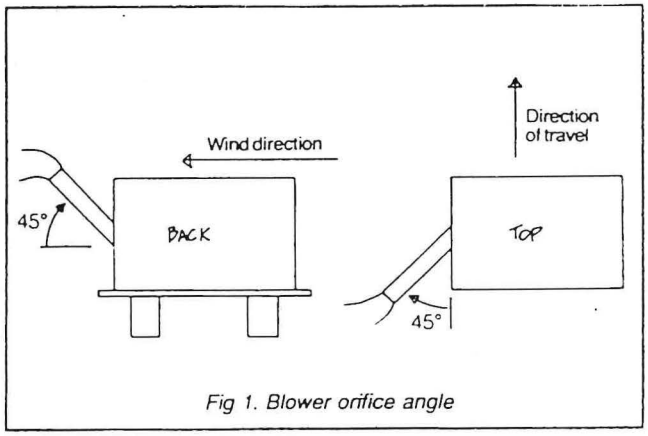


Fig 1. Blower orifice angle

Figure 1

Measure the distance between these two points. This is the swath width (fig. 2).

Recommended swath widths: ULV formulations - 30 to 100 metres
LV (oil diluted) - 20 to 45 metres
Water based insecticides - 25 to 40 metres
EC formulations - 20 to 45 metres

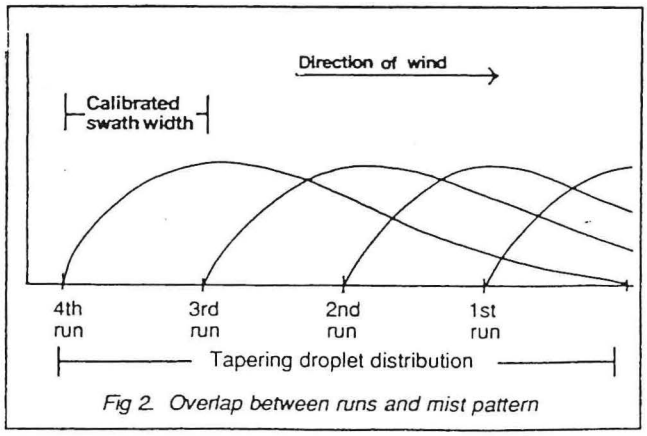


Fig 2. Overlap between runs and mist pattern

Figure 2

4. Calculate sprayer output.

$$\text{output volume (L/ha)} = \frac{\text{mister output (L) x 600}}{\text{speed (km/hr) x swath width (M)}}$$

Adjust the output to the prescribed amount by adjusting the seed of travel or altering the jet orifice. Note: ULV formulations are not diluted. Therefore, when using these products you do not have to calculate the amount to add to the tank.

5. Amount of chemical to add to the tank (EC formulations).

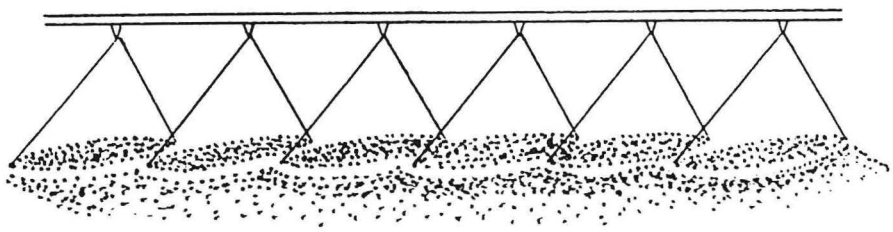
$$\text{Amount to add to tank} = \frac{\text{tank capacity (L) x rate of insecticide/ha}}{\text{sprayer output (L/ha)}}$$

Boomsprayers:

1. Take out all nozzles and soak in water. Use a nylon toothbrush to clean the nozzles.

2. Flush out the tank with clean water while the nozzles are out.

3. Replace the nozzles being careful not to over-tighten. Cone nozzles are recommended (Hardi 1553, or similar). If fan nozzles are used ensure that the nozzles are set at the correct angle - slightly offset to prevent neighbouring nozzles interfering with each others pattern (fig. 3).



Nozzles slightly offset to prevent interference

Figure 3

4. Set the pump at operating pressure (normally 150 to 300 kPa).

5. Run the pump, collecting the spray from each nozzle for one minute. Measure the amount of water from each in litres. Repeat this at least 5 times and use the average for your calculations.

6. Check that no nozzles differ by more than 10% from the average. If so, replace them.

7. Measure out a distance of 100 metres. Time the vehicle over this distance at normal operating speed. Divide 360 by the time taken in seconds. This is the speed in kilometres per hour.

8. Calculate the sprayer output using the following formula:

$$\text{sprayer output (L/ha)} = \frac{\text{output of all nozzles in one minute (L) x 600}}{\text{swath with (m)* x speed (km/hr)}}$$

* Swath width is calculated by measuring the distance between the two outside nozzles and adding the distance between two adjacent nozzles (fig. 4).

If the output is outside the range recommended for application (see relevant Technical Instruction Sheet), alter it by varying the speed or recalibrate using different size nozzles.

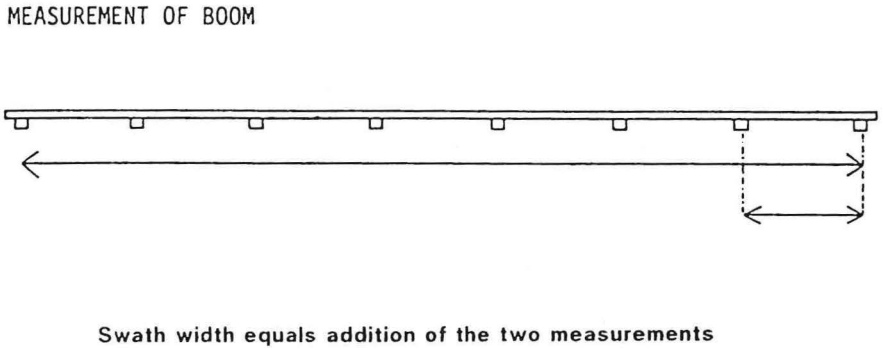


Figure 4

9. Work out the amount of insecticide to add to the tank.

$$\text{amount to add to the tank} = \frac{\text{capacity of tank (L) x rate of insecticide (L/ha)}}{\text{sprayer output (L/ha)}}$$

10. Set the boom to the correct height (consult nozzle manufacture's specification).

Packsprayers:

Where ground dwelling insects are to be sprayed the packsprayer is calibrated in much the same way as a boomsprayer. Walking speed has to be determined and the swath width established by measuring the spray pattern on a smooth surface

A prescribed concentration of this insecticide is used to control insects on the foliage of young trees (refer to relevant Technical Instruction Sheet).

Mixing instructions:

Commence filling the tank with clean water. Start the pump and check that the agitator is working. Half fill the tank before adding concentrate. Always filter water entering the tank. Always remove the suction hose from the dam immediately the pump is stopped to prevent liquid siphoning back into the dam.

Remain with the sprayer while filling to prevent overflow and possible contamination of waterways.

Only mix enough material for the task. Disposing of unused mixes is difficult!

When handling insecticides **always** use protective clothing (refer to relevant CALM 729).

Always read and follow the instructions on the label of the insecticide container.

Do not use material from an unlabelled container.

Most liquid and flowables will readily mix with the carrier fluid (usually water) but they should be poured through the lid filter in case of precipitation or crystallization of the concentrate in the container.

If using ground driven equipment, agitate the spray solution with a stick or paddle to ensure dispersion of the concentrate before moving off. Before spraying, drive a good distance with the agitator operating to ensure the solution is thoroughly mixed.

If spraying ceases for any length of time, ensure the mixture is adequately agitated before recommencing.

Recover all empty containers each day and dispose of in the prescribed manner (refer to relevant CALM 729.

5.3 MAINTENANCE OF EQUIPMENT

After use, wash down the outside of the mister and the vehicle. This will prevent contamination from subsequent physical contact.

Remove the nozzles or jet assembly and leave overnight in a cleaning solution (see below). Reassemble and repair as required.

Wash inside of the tank with cleaning solution and flush through lines.

Follow manufacturer's instructions in relation to the running and stand-down of motors.

BE CAREFUL NOT TO CLEAN EQUIPMENT WHERE CONTAMINATED WATER MAY DRAIN INTO A WATERCOURSE.

Cleaning agents:

Organophosphorus insecticides (maldison, fenitrothion triclorfon, chlorpyrifos)	-	Make up a solution of soda and sodium hypochlorite (150gm each/100 litres water). Followed by at least two flushes of water.
Synthetic pyrethroids (alphamethrin)	-	Use a solution of 150g of washing soda/100 litres of water, or 1 litres of household ammonia/100 litres water.

5.4 WEATHER CONDITIONS

Spray in light wind conditions (4 to 10km/hr) if possible. Cease spraying if winds exceeds 13km/hr.

Relative humidity should be between 40% and 70%, and the ideal temperature is between 10^{o} and 20^{o}

Do not spray in dew-wet conditions (particularly organophosphorus insecticides) or on evenings when a dew is expected.

Avoid spraying while rain is falling or imminent.

6. ENVIRONMENTAL CONSIDERATIONS

The objective of insect control strategies is to minimise insect damage to plantations without permanent damage to the environment. Where practical, this will be achieved by cultural techniques, including biocontrol. Whilst it is accepted that there will be occasions when insecticides will need to be applied to prevent insect damage to plantations, cultural techniques must be utilised, where possible, to prevent a build-up of the insect population (refer to section 3 of this manual).

Where the use of insecticides cannot be avoided the following provisions apply.

6.1 BUFFERS

No spraying to be carried out within **15 metres** of a neighbouring property unless the owner gives permission. When power misters are used, care must be taken to avoid drift into adjoining property.

No spraying to occur within **20 metres** of a running stream or river. Every effort must be made to spray with favourable winds to avoid contamination of waterways.

6.2 MONITORING OF INSECTICIDE RESIDUES

Sampling is mandatory where spraying has occurred to provide a data base in order to establish the fate and impact of insecticides in the environment. Field monitoring will be on the basis of soil and water samples taken before and for a period after spraying has occurred.

Soil:

Sampling interval - 1. immediately prior to application,
2. immediately after application,
3. 1 week after application,
4. 2 weeks after application,
5. 3 weeks after application.

Sampling will continue after this time (at weekly intervals) if residues are recorded.

Sampling method - Samples will be taken from random points coinciding with changes in soil type.

Approximately 50 samples to be taken from a depth between **0 - 10cm** from the soil surface across each soil type.

Sampling tools must be carefully cleaned between sample positions (different soil types) to avoid contamination.

Samples from each soil type are to be bulked together and placed in plastic bags and identified with the date, plantation, compartment, location number (soil type) [eg, 1.8.90: Vasse 4: 1 (sandy loam)].

Water:

Running streams or rivers will be sampled at the point immediately downstream of the treated area. Samples will be collected in bottles provided specifically for the purpose (contact the Government Chemical Laboratories for supplies).

Care must be taken to ensure that there is no contamination of the samples from sources outside the treated area.

Sampling interval -

1. immediately prior to application
2. at 2 hourly intervals during application
3. following every rain event >10mm until stream flow ceases. In the event of rain during summer that does not generate streamflow, no sampling will be carried out.
4. as soon as stream flow commences in the following season (1 sample only).

Samples (soil and water) are to be sent to either the Government Chemical Laboratories or the Australian Reference Laboratories in Perth.

Summarised results are to be sent to Mr Ray Fremlin, CALM, Busselton.

7. ACKNOWLEDGEMENTS

Although this manual was prepared by Silviculture Branch there were many contributors. These were: Mr Rob Emery, Mr Peter Rutherford, Mr Stewart Learmonth, Mr Phillip Michael, Mr Michael Grimm, Mr John Moore and Mr Kevin Richards of the Western Australian Department of Agriculture; Mr Peter Coyle of the Agricultural Protection Board, Western Australia, and Dr Ian Abbott, Dr Janet Farr, Mr Graham Hall, and Mr Gavin Ellis of CALM.

References used in the preparation of this manual:

WADA Farmnote No. 46/85; Heliothis pests in crops

WADA Farmnote No. 62/90; Wingless grasshoppers and their control

WADA Farmnote No. 75/88; Identifying soil insects - beetles

WADA Farmnote No. 104/83; Grasshoppers and locusts in WA

WADA Farmnote No. 100/88; Insect and related pests of lawns

WADA Farmnote No. 116/84; Insect pests of eucalypts and other native plants

WADA Farmnote No. 98/88; Pests of young trees

WADA Farmnote No. 63/90; Australian plague locust

WADA Farmnote No. 165/83; Cutworms - pests of crops and pasture

Bulletin 4185; Insect and Allied Pests of Extensive Farming. Entomology Branch, WADA

CALM Information Sheet No. 34; Ips bark beetles - Pests of Pines

South Australian Woods and Forests Department. Sirex Woodwasp in South Australia.

APB Infonote No. 16/90; Australian Plague Locust

APB Infonote No. 17/88; Decontaminating spray equipment

APB Infonote No. 19/88; Calibration of knapsack power misters

APB Infonote No. 20/88; Calibration of a power mister

APB Advisory Leaflet No. 92; Locusts and grasshoppers

Bulletin 4142; Pesticides Registered in Western Australia; 30 June 1988

8. *Appendices*

Appendix 1

Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION			
MANUFACTURER'S NAME	Nufarm Limited	REGULAR TELEPHONE NO.	03 282-1000
		EMERGENCY TELEPHONE NO.	008 033498
ADDRESS	103 Pipe Road, Laverton North. Vic. 3026.		
TRADE NAME	MALDISON ULV INSECTICIDE	C.A.S. No.	121-75-5
SYNONYMS	None	U.N. No.	None

II HAZARDOUS INGREDIENTS		
MATERIAL OR COMPONENT	% w/v	HAZARD DATA
Maldison*	118	Moderate toxicity: Acute oral LD50 (rats) 1500mg/kg

* An anticholinesterase compound

III PHYSICAL DATA			
BOILING POINT 760 MM HG	156 - 157oC	MELTING POINT	2.9oC (pure)
SPECIFIC GRAVITY (H20.1)	1.230	VAPOUR PRESSURE	4x10-10mm Hg @ 30oC
VAPOUR DENSITY (AIR.1)	11.5	SOLUBILITY IN H2O % BY WT	145ppm @ 20oC
% VOLATILES BY VOL	Nil	EVAPORATION RATE (BUTYL ACETATE.1)	<1
APPEARANCE AND ODOUR	Clear brown liquid with characteristic odour.		

IV FIRE AND EXPLOSION DATA HAZCHEM: 3 Z NFPA: 2-1-0

FLASH POINT (TEST METHOD)	>150oC (Tag open cup)	AUTOIGNITION TEMPERATURE		Unknown	
FLAMMABLE LIMITS IN AIR % BY VOL		LOWER	NA	UPPER	NA
EXTINGUISHING MEDIA	Foam, water fog, dry chemical, BCF or carbon dioxide. Use water spray to cool containers threatened by fire.				
SPECIAL FIRE FIGHTING PROCEDURES	Breathable air apparatus must be worn if material is involved in fires in confined spaces. Keep upwind.				
UNUSUAL FIRE AND EXPLOSION HAZARD	May emit toxic fumes of carbon monoxide, phosphorus oxides, or sulphur oxides if involved in fires or subjected to extreme heat.				

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA: LD50 1500mg/kg (rat)

ROUTES OF EXPOSURE

INHALATION Inhalation of spray mists should be avoided but during normal handling a low risk exists.

SKIN CONTACT May cause reddening but serious damage not expected to occur.

SKIN ABSORPTION Can be absorbed through unbroken skin in toxic amounts although risk is relatively low.

EYE CONTACT Will cause discomfort but permanent damage is not expected.

INGESTION A moderate hazard exists with the material.

EFFECTS OF OVER EXPOSURE

ACUTE OVER EXPOSURE Nausea, vomiting, salivation, diarrhea, twitching and convulsions if exposure is excessive.

CHRONIC OVER EXPOSURE Adverse effects on the liver or kidneys may be evident if exposure is repeated excessively.

EMERGENCY AND FIRST AID PROCEDURES In ALL cases notify physician.

EYES Irrigate for 15 minutes with copious quantities of water with eyelids open.

SKIN Remove contaminated clothing and launder before re-use. Wash affected areas thoroughly with soap and water. Treat with atropine as

INHALATION Remove to fresh air until recovered. below.

INGESTION If swallowed induce vomiting. Use Ipecac Syrup (APF) if available. Give one atropine tablet every quarter hour until dryness of the mouth occurs.

NOTES TO PHYSICIAN

A cholinesterase inhibitor.
Atropine treatment may be required or treat with up to 10mg of IV diazepam - curare therary is contraindicated. Do NOT give adrenergic amines, aminophylline, succinylcholine, phenothiazines or reserpine alkaloids or oils.

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY
The material will decompose non-violently when exposed to strong acids or alkalis thus losing its efficacy.

INCOMPATIBILITY
Violent reaction may occur whith chlorine or inorganic peroxides.

HAZARDOUS DECOMPOSITION PRODUCTS
None more hazardous than the parent compound except when material is involved in fires.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION
None expected.

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
Contain spill and absorb with sand or proprietary absorbent (vermiculite).
Prevent from entering drains, waterways or sewers.
Collect in sealed open-top containers for disposal.

NEUTRALIZING CHEMICALS Final clean-up may be carried out by using lime on residual material and hosing to drain.

WASTE DISPOSAL METHOD
By industrial incineration or dumping at a site approved by local authorities.

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS
Natural only although a local exhaust should be provided if the material is handled in confined spaces.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL) An "agricultural" mask should be worn during spraying operations.

EYE Safety goggles or glasses must be worn.

GLOVES PVC or neoprene should be worn.
Never use cotton or leather as these are porous.

OTHER CLOTHING AND EQUIPMENT
Wear long sleeves, long trousers and suitable footwear.

	IX SPECIAL PRECAUTIONS
PRECAUTIONARY STATEMENTS	(Schedule 6 Poison) POISON NOT TO BE TAKEN KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING.
OTHER HANDLING AND STORAGE REQUIREMENTS	Wash exposed parts of the body thoroughly after use and before eating, drinking and smoking. Secure an emergency supply of six atropine tablets (0.6mg) and Ipecac syrup for each person and keep them handy on the job. **TRANSPORT DETAILS** Considered Non-Hazardous for transport by the Australian Code for the Transport of Dangerous Goods by Road and Rail.

PREPARED BY J. R. SHAW (Occupational Health Co-Ordinator)

ADDRESS 103 Pipe Road, Laverton North. Victoria. 3026.

DATE 24th October, 1989.

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

MANUFACTURER'S NAME	Nufarm Limited	REGULAR TELEPHONE NO.	03 282-1000
		EMERGENCY TELEPHONE NO.	008 033498
ADDRESS	103 Pipe Road, Laverton North. Vic. 3026.		
TRADE NAME	FENITROTHION 1000	C.A.S. No.	122-14-5 for a.i. 108-88-3 for Toluol
SYNONYMS	None	U.N. No.	2784

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	% w/v	HAZARD DATA
Fenitrothion	100	Toxic-a cholin-esterase inhibitor
Toluol	9	Toxic Flammable 3.1

III PHYSICAL DATA

BOILING POINT 760 MM HG	110°C for solvent a.i. decomp >140°C	MELTING POINT	<0°C
SPECIFIC GRAVITY (H20.1)	1.26 @ 20°C	VAPOUR PRESSURE	8mm Hg @ 20°C
VAPOUR DENSITY (AIR.1)	3.2*	SOLUBILITY IN H2O % BY WT	Emulsifies
% VOLATILES BY VOL	10	EVAPORATION RATE (BUTYL ACETATE.1)	2.4*
APPEARANCE AND ODOUR	Clear, amber liquid with characteristic odour.		

* For solvent.

* For solvent

IV FIRE AND EXPLOSION DATA HAZCHEM: 2 Y E NFPA:				
FLASH POINT (TEST METHOD)	5°C (c.c.)	AUTOIGNITION TEMPERATURE	480°C but a.i. will decomp at 100-140°C	
FLAMMABLE LIMITS IN AIR % BY VOL *	LOWER	1.2	UPPER	7.1
EXTINGUISHING MEDIA	Foam, carbon dioxide, dry chemical.			
SPECIAL FIRE FIGHTING PROCEDURES	Breathable air apparatus should be worn in confined spaces.			
UNUSUAL FIRE AND EXPLOSION HAZARD	Emission of toxic fumes or vapours would be expected if material involved in fires.			

V HEALTH HAZARD INFORMATION	
HEALTH HAZARD DATA:	An anticholinesterase compound: Acute oral LD50 (rats) 832mg/kg
ROUTES OF EXPOSURE	
INHALATION	Only considered a hazard during spraying operations.
SKIN CONTACT	Negligible damage to skin is expected to occur especially when related to the high danger from absorption.
SKIN ABSORPTION	Readily absorbed even through unbroken skin and considered the most dangerous toxic route.
EYE CONTACT	Will cause irritation, and absorption into the body system may also be significant.
INGESTION	Not considered a serious hazard unless accidently swallowed.
EFFECTS OF OVER EXPOSURE	
ACUTE OVER EXPOSURE	Intestinal cramps, tightness of the chest, blurred vision, headache, diarrhea, salivation, convulsion
CHRONIC OVER EXPOSURE	Some delayed neurotoxic effects have been noted but no other chronic effects observed.
EMERGENCY AND FIRST AID PROCEDURES	In ALL cases notify physician.
EYES	Irrigate thoroughly with copious quantities of water for 15 minutes.
SKIN	Remove contaminated clothing and wash affected areas thoroughly with soap and water. Launder clothes before re-use.
INHALATION	Remove patient to fresh air and treat with atropine (as below) if required.
INGESTION	If swallowed induce vomiting. Give Ipecac Syrup APF if available. Give one atropine tablet every fifteen minutes until dryness of the mouth occurs.
NOTES TO PHYSICIAN	

A cholinesterase inhibitor. Atropine treatment may be required - curare therapy is contraindicated. Treat hydrocarbon pneumonitis secondary to pulmonary oedema.

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY
Will break down in the presence of alkalis or strong acids.

INCOMPATIBILITY
Avoid alkalis such as caustic soda and strong oxidising agents.

HAZARDOUS DECOMPOSITION PRODUCTS
Only expected to occur when involved in fires or subjected to intense heat.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION
None expected

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
Absorb into sand or proprietary absorbent and collect in closed top containers. Keep people away from area.

NEUTRALIZING CHEMICALS
Dilute caustic soda or soda ash for final clean up ONLY.

WASTE DISPOSAL METHOD
By dumping at a site approved by local authorities or by industrial incineration.

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS
Natural only except in confined spaces when forced ventilation should be used.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT Do NOT use leather.

RESPIRATORY (SPECIFY IN DETAIL) An "agricultural" type face mask should be used during spraying operations or in confined spaces.

EYE Goggles preferred. Safety glasses absolute minimum.

GLOVES PVC or rubber gloves with cotton liner for comfort.

OTHER CLOTHING AND EQUIPMENT
Always handle in long sleeves and trousers.
Wear appropriate footwear and possibly a PVC or rubber apron.
Wash protective clothing daily.

IX SPECIAL PRECAUTIONS	
PRECAUTIONARY STATEMENTS	(Schedule 6 Poison) POISON NOT TO BE TAKEN KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING Read first aid instructions and environmental statements on label.
OTHER HANDLING AND STORAGE REQUIREMENTS	A flammable liquid. Stow away from foodstuffs. Do not smoke or drink while handling material. Wash hands thoroughly before eating, drinking and smoking. **TRANSPORT DETAILS** Pesticides, organophosphorus, liquid, flammable, toxic, FP <23°C, nos. UN No. 2784 Class: 3.1 Packaging Group: II Subrisk: 6.1(b) Hazchem: 2 Y E EPG: 3A3
PREPARED BY	M. G. Bradbury (Manufacturing Manager)
ADDRESS	103 Pipe Road, Laverton North. Victoria. 3026.
DATE	9th January, 1990.

Incitec Ltd

Paringa Road, Gibson Island, Murarrie
Brisbane, Australia
P.O. Box 140, Morningside, Qld 4170
Telex: 40747 Fax: 390 9310
Telephone: 390 9300
Emergency Telephone 008 023 133

MATERIAL SAFETY DATA SHEET

DOMINEX 100

IDENTIFICATION

Product Name: DOMINEX 100 MSDS No. 348

Trade Name:
Agchem Dominex 100.

Other Names:
Alphamethrin; Alfamethrin; Cypermethrin; Barricade; Stockade; Ammo; Ambush.

Use:
Synthetic Pyrethroid Pesticide.

Manufacturer's Name/Address
Agchem Pty. Ltd.,
Port Wakefield Road,
Virafield Gardens, SA 5107.

U.N. Number: N/A
Dangerous Goods Class: N/A
Hazchem Code:
Poisons Schedule: S6

Physical Description/Properties
Appearance and Odour
Yellow-brown liquid with aromatic odour.

Boiling Point:	135 deg C	Specific Gravity:	No data
Vapour Pressure:	No data	Melting Point:	N/A
Vapour Density:	No data	Evaporation Rate:	High
Solubility (Water):	Insoluble	Percent Volatiles:	> 60 %

Fire/Explosion Hazard

Flash Point (C):	62 deg C	Autoignition (C):	No data
LEL:	No data	UEL:	No data

Ingredients

Ingredient	Proportion	CAS Nr.
ALPHAMETHRIN	100 g/l	52315-07-8
SOLVESSO 150	>60 %	
XYLENTS	To 100 %	

MATERIAL SAFETY DATA SHEET for DOMINEX 100

HEALTH HAZARD INFORMATION

HEALTH EFFECTS

The synthetic pyrethroid compounds are only a relatively new development and no known cases of poisoning have yet been recorded.
There have been some reports of transient facial tingling (parasthesia), which last for a few hours after exposure.
Prolonged or repeated exposure can cause central nervous system effects and allergic skin reaction. Alphamethrin has caused lung tumours in mice, but the material is not considered to be a carcinogen or a cumulative poison.

Swallowed:
Can result in nausea, vomiting, diarrhoea & abdominal pain. Overexposure may result in central nervous system disturbance with tremors, weakness, convulsions, coma, & possibly death from respiratory depression.
Toxicity : Oral LD50 (rat) = 70 mg/kg (Alphamethrin technical).

Eye:
Moderate eye irritant.

Skin:
Contact with skin will result in moderate irritation & small amounts may be absorbed through the skin. Causes facial tingling & skin sensitisation.
Repeated or prolonged effects may cause dermatitis.
Toxicity : Dermal LD50 (rabbit) = >2000 mg/kg.

Inhaled:
Inhalation of spray mist causes shortness of breath & laboured breathing.
Inhalation of high concentrations can produce central nervous system depression, which can lead to loss of coordination, impaired judgement and if exposure is prolonged, unconsciousness.

FIRST AID

Swallowed:
Do NOT induce vomiting. Give milk or water to drink. Seek medical advice.

Eye:
Hold eyes open, flood with water for 15 minutes & see a doctor.

Skin:
Remove contaminated clothing and wash skin thoroughly with soap & water.
Seek medical advice if irritation persists.

Inhaled:
Remove from contaminated area to fresh air. If breathing is difficult, give oxygen (if available) and commence resuscitation if necessary.
Seek medical advice.

ADVICE TO DOCTOR

If indicated, empty stomach. Treat symptomatically. The main hazard with liquid hydrocarbon solvent formulations is aspiration of the solvent into the lungs resulting in a chemical pneumonitis.

MATERIAL SAFETY DATA SHEET for DOMINEX 100

PRECAUTIONS FOR USE

EXPOSURE LIMITS
No exposure limit has been assigned to this material.

VENTILATION
Use in well ventilated area only.

PERSONAL PROTECTION
When using do not eat, drink or smoke.
Wash thoroughly before smoking, eating or using toilet facilities.
Prevent skin contact by wearing coveralls or full length trousers with a long sleeved shirt, PVC or rubber gloves and a faceshield.
If there is risk of inhalation of spray, wear full facepiece respirator fitted with combined organic vapour & particulate filter AS1716 approved.

FLAMMABILITY
Combustible liquid.

SAFE HANDLING INFORMATION

STORAGE and TRANSPORT
Not defined as a Dangerous Good by the Australian Code for the Transport of Dangerous Goods by Road and Rail.

Store apart from seeds, fertilizers, animal and human foodstuffs.
Store in a cool place, away from naked lights, flames or oxidising agents eg Nitram.
This product is a S6 scheduled poison and must therefore be stored, maintained & used in accordance with the relevant State Poisons Act.

SPILLS and DISPOSAL
Keep bystanders away from spill site & don appropriate protective clothing. Use absorbent (soil, sand, sawdust, vermiculite or other inert material) to absorb spilt product. Sweep up, collect and seal in drum for disposal. Hose down area with copious amounts of water. Avoid any contamination of sewers, streams or watercourses.

Do not reuse container and decontaminate before disposal. Refer to State Land Waste Management Authority.

FIRE/EXPLOSION HAZARD
Combustible liquid.
Decomposition products are not hazardous.
Fight fire from upwind. If downwind, in confined area or in smoke or fumes, wear self contained breathing apparatus (SCBA).
Extinguish fire with foam, CO2, dry chemicals or BCF.
Contain any run-off. Advise Fire Brigade of nature of hazard.

MATERIAL SAFETY DATA SHEET for DOMINEX 100

OTHER INFORMATION
Toxic to fish.

SPECIAL NOTES

NOTE
The information contained in this publication is by way of general comment only. Because conditions of use, suitability of product and application conditions are beyond our control this publication is not and does not purport to offer particular advice in respect of any product. The authors and Incitec Ltd hereby expressly disclaim any liability to any person, property or thing in respect of any of the consequences of anything done or omitted to be done by any person in reliance, whether wholly or in part, upon the whole or any part of the contents of this publication.

Contact Point: Martin Jennings
Telephone: 07 390 9358

Date: 28/ 5/90

Incitec Ltd

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Telephone: 390 9300
Emergency Telephone 008 023 133

MATERIAL SAFETY DATA SHEET

DOMINEX 16 ULV

IDENTIFICATION

Product Name: DOMINEX 16ULV MSDS No. 349

Trade Name:
Crop King Dominex 16ULV.

Other Names:
Alpha-Cypermethrin; Resolved Cypermethrin; Bestox.

Use:
Synthetic Pyrethroid Pesticide.

Manufacturer's Name/Address
Consolidated Fertilizers Ltd.
Paringa Road, Gibson Island,
Murarrie, Queensland 4172.

U.N. Number: 2903
Dangerous Goods Class: 6&3
Hazchem Code: 3WE
Poisons Schedule: S6

Physical Description/Properties
Appearance and Odour
Yellow-brown liquid with aromatic odour.

Boiling Point:	No data	Specific Gravity:	No data
Vapour Pressure:	No data	Melting Point:	N/A
Vapour Density:	No data	Evaporation Rate:	High
Solubility (Water):	Insoluble	Percent Volatiles:	10 - 60 %

Fire/Explosion Hazard

Flash Point (C):	41 deg C	Autoignition (C):	No data
LEL:	No data	UEL:	No data

Ingredients

Ingredient	Proportion	CAS Nr.
ALPHAMETHRIN	16 g/l	52315-07-8
XYLENE	10 - 60%	1330-20-7
SOYA BEAN OIL	> 60 %	8001-22-7

MATERIAL SAFETY DATA SHEET for DOMINEX 16ULV

HEALTH HAZARD INFORMATION

HEALTH EFFECTS

The synthetic pyrethroid compounds are only a relatively new development and no known cases of poisoning have yet been recorded.
There have been some reports of transient facial tingling (parasthesia), which last for a few hours after exposure.
Prolonged or repeated exposure can cause central nervous system effects and allergic skin reaction. Alphamethrin has caused lung tumours in mice, but the material is not considered to be a carcinogen or a cumulative poison.
Solvent (xylene) exposure may cause conjunctivits, dermatitis, irritation to respiratory tract, nausea, vomiting, fatigue, headache & vertigo.

Swallowed:
Can result in nausea, vomiting, diarrhoea & abdominal pain. Overexposure may result in central nervous system disturbance with tremors, weakness, convulsions, coma, & possibly death from respiratory depression if a large enough quantity has been ingested.
Toxicity : Oral LD50 (rat) = 70 mg/kg (Alphamethrin technical).

Eye:
Moderate eye irritant.

Skin:
Contact with skin will result in moderate irritation & small amounts may be absorbed through the skin. Causes facial tingling & skin sensitisation.
Repeated or prolonged effects may cause dermatitis.
Toxicity : Dermal LD50 (rabbit) = >2000 mg/kg.

Inhaled:
Inhalation of spray mist causes shortness of breath & laboured breathing.
Inhalation of high concentrations can produce central nervous system depression, which can lead to loss of coordination, impaired judgement and if exposure is prolonged, unconsciousness.

FIRST AID

Swallowed:
If victim is conscious, do not induce vomiting. Give a glass of water.
Do NOT give induce vomiting or give anything by mouth if the victim is unconscious. Seek medical advice.

Eye:
Hold eyes open, flood with water for 15 minutes & see a doctor.

Skin:
Remove contaminated clothing and wash skin thoroughly with soap & water.
Seek medical advice if irritation persists.

Inhaled:
Remove from contaminated area to fresh air. If breathing is difficult, give oxygen (if available) and commence resuscitation if necessary.
Seek medical advice.

MATERIAL SAFETY DATA SHEET for DOMINEX 16ULV

ADVICE TO DOCTOR

If indicated, empty stomach. Treat symptomatically. The main hazard with formulations is aspiration of the solvent into the lungs resulting in chemical pneumonitis.

PRECAUTIONS FOR USE

EXPOSURE LIMITS

Threshold Limit Value - Time Weighted Average (TLV-TWA) = 100 ppm (Xylene). The exposure limit is expressed as a time weighted average (TWA) concentration over an 8 hour working shift, for a 5 day working week, and is the limit recommended by the ACGIH, (TLVs for 1989-1990).

Biological Exposure Index (BEI) for xylenes:-
Index : Total Methylhippuric acids in urine.
Time : End of Shift
BEI : 1.5 g/g creatinine.

VENTILATION

Use in well ventilated area only.

PERSONAL PROTECTION

When using do not eat, drink or smoke.
Wash thoroughly before smoking, eating or using toilet facilities.
Prevent skin contact by wearing coveralls or full length trousers with a long sleeved shirt, PVC or rubber gloves and a faceshield.
If there is risk of inhalation of spray, wear full facepiece respirator fitted with combined organic vapour & particulate filter AS1716 approved.

FLAMMABILITY

Flammable liquid. Avoid all ignition sources. Flameproof equipment required in areas where this chemical is used. Nearby equipment must be earthed.

SAFE HANDLING INFORMATION

STORAGE and TRANSPORT

Labelling : "Flammable Liquid" 3 & "Harmful" 6 class labels & UN No. 2903.
Correct Shipping Name : PESTICIDES, LIQUID, TOXIC, FLAMMABLE, N.O.S.
Documentation : As per Section 4 of the Australian Dangerous Goods Code.
Dangerous Goods Class : 3.2 and 6.1(b).
Do not load with Dangerous Goods Classes 1, 2.3, 4.2, 5.1, 5.2 and 7.
Do not load with foodstuffs or foodstuffs empties.
Packaging Group : III.
Emergency Procedure Guide : 6C1
Transport by air : Refer to IATA Regulations for UN No. 2903.

Store apart from seeds, fertilizers, animal and human foodstuffs.
Store in a cool place, away from naked lights, flames or oxidising agents eg Nitram. Keep containers sealed (airight) when not in use.

MATERIAL SAFETY DATA SHEET for DOMINEX 16ULV

This product is a S6 scheduled poison and must therefore be stored, maintained & used in accordance with the relevant State Poisons Act.

SPILLS and DISPOSAL

Keep bystanders away from spill site & don appropriate protective clothing. Use absorbent (soil, sand, sawdust, vermiculite or other inert material) to absorb spilt product. Sweep up, collect and seal in drum for disposal. Hose down area with copious amounts of water. Avoid any contamination of sewers, streams or watercourses.

Do not reuse container and decontaminate before disposal. Refer to State Land Waste Management Authority.

FIRE/EXPLOSION HAZARD

Flammable liquid.
High thermal stability. Decomposition products are not hazardous.
Fight fire from upwind. If downwind, in confined area or in smoke or fumes, wear self contained breathing apparatus (SCBA).
Extinguish fire with foam, CO2, dry chemicals or BCF.
Contain any run-off. Advise Fire Brigade of nature of hazard.

OTHER INFORMATION

Toxic to fish.

SPECIAL NOTES

NOTE

The information contained in this publication is by way of general comment only. Because conditions of use, suitability of product and application conditions are beyond our control this publication is not and does not purport to offer particular advice in respect of any product. The authors and Incitec Ltd hereby expressly disclaim any liability to any person, property or thing in respect of any of the consequences of anything done or omitted to be done by any person in reliance, whether wholly or in part, upon the whole or any part of the contents of this publication.

Contact Point: Martin Jennings
Telephone: 07 390 9358

Date: 2/ 4/90

MATERIAL SAFETY DATA SHEET for DOMINEX 16ULV

AMENDMENT TO SAFE HANDLING INFORMATION

STORAGE AND TRANSPORT

Labelling : "Flammable Liquid" 3 class labels and UN No. 1142.
Correct shipping name : FLAMMABLE LIQUID PREPARATIONS, N.O.S.
Documentation : As per Section 4 of the Australian Dangerous Goods code.
Dangerous Goods Class : 3.2
Do not load with Dangerous Goods Classes 1, 2.3, 4.2, 5.1, 5.2 and 7.
Do not load with foodstuffs or foodstuffs empties.
Packaging group : III
Emergency Procedure Guide : 3A1
Transport by air : Refer to IATA Regulations for UN No. 1142.

Store apart from seeds, fertilizers, animal and human foodstuffs.
Store in a cool place, away from naked lights, flames or oxidizing agents.
Keep containers sealed (airtight) when not in use.
This product is an S6 poison and must therefore be stored, maintained and used in accordance with the relevant State Poisons Act.

DOW CHEMICAL (AUSTRALIA) LIMITED

EMERGENCY RESPONSE (ALL HOURS) PHONE : 008 03 3882

PRODUCT NAME: LORSBAN* 50EC INSECTICIDE PRODUCT CODE: 45377

EFFECTIVE DATE: FEBRUARY 19, 1988. DOC. NO: HAA7

1. INGREDIENTS:

Chlorpyrifos		CAS No. 2921-88-2	505 gm/l
Solvents:	1,1,1-trichloroethane	CAS No. 71-55-6	306 gm/l
	Xylene	CAS No. 1330-20-7	270 gm/l
INERTS, including proprietary emulsifiers			balance

2. PHYSICAL DATA:

BOILING POINT:	Approximately 75°C
VAPOUR PRESSURE:	Not determined. (Est. to be at least 50mmHg)
VAPOUR DENSITY (Air=1):	Approximately 5
SOLUBILITY IN WATER:	Emulsifiable
SPECIFIC GRAVITY:	1.19 @ 20/20°C
APPEARANCE:	Straw coloured liquid
ODOUR:	Not determined.

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: 31°C METHOD USED: PMCC

FLAMMABLE LIMITS (STP in Air): Have not been determined for mixture; however, it is anticipated that Lower Flammability Limit may be 1% and Upper Flammable Limit 17% (based on Flammability data for each solvent).

EXTINGUISHING MEDIA: Foam, water fog, carbon dioxide and dry chemical.

FIRE AND EXPLOSION HAZARDS: Flammable - volatile flammable solvent in formulation. Mixture of vapours of each solvent and air may form an explosive mixture. Toxic irritating gases from decomposition of active ingredient at 160° - 200°C. Intact drums exposed to excessive heat, e.g. a fire, may rupture, keep drums cool with water spray.

FIRE-FIGHTING EQUIPMENT: Wear protective clothing and use positive pressure self-contained breathing apparatus.

4. TRANSPORTATION INFORMATION:

Substance Name: PESTICIDE ORGANOPHOSPHOROUS, LIQUID, TOXIC, FLAMMABLE, N.O.S.

UN No: 3017 Class: 6.1 Sub. Class: 3 Class Label: 6.1(b),3.
HAZCHEM CODE: 3WE Packaging Group: III GTEPG: AS1678: 6C1.

5. REACTIVITY DATA:

STABILITY: (Conditions to avoid) Do not overheat. Store at ambient temperature. FLAMMABLE.

INCOMPATIBILITY: (Specific materials to avoid) Oxidizing material. Consult manufacturer for specific cases.

CONTINUED ON NEXT PAGE

PRODUCT NAME: LORSBAN* 50EC INSECTICIDE PRODUCT CODE: 45377

EFFECTIVE DATE: FEBRUARY 19, 1988. DOC. NO: HAA7

6. REACTIVITY DATA: (continued)

HAZARDOUS DECOMPOSITION PRODUCTS: On heating, chlorpyrifos decomposes to form toxic, odourous, volatile, flammable organic sulphides. Products of thermal decomposition of 1,1,1-trichloroethane include hydrogen chloride and traces of phosgene and chlorine.

HAZARDOUS POLYMERISATION: Will not occur.

6. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ENVIRONMENTAL DATA: Prevent contamination of water supplies - active ingredient is toxic to fish and wildlife.

ACTION TO TAKE FOR SPILLS/LEAK: Contain spill, with sand, soil or inert absorbent materials to avoid entry of run-off into water sources. Recover spilled material or absorb with inert material such as sand, sawdust or clay granules. Do not use water for clean up.

DISPOSAL METHOD: Bury clean-up material from spills in an approved landfill in accordance with State and/or Local government regulations.

7. HEALTH HAZARD DATA:

EYE: May cause moderate transient (temporary) irritation of the eye and corneal injury. In test animals irritation was absent 10 days after exposure.

SKIN CONTACT: May cause very slight transient (temporary) irritation of skin. Product is not considered to be a potential skin sensitizing agent.

SKIN ABSORPTION: A single skin exposure is not likely to result in absorption of harmful amounts of the product. The LD50 for skin absorption in rabbits is greater than 2000 mg/kg.

INGESTION: May be harmful. Single dose acute oral toxicity is moderate. The LD50 for male rats is 310 mg/kg and female rats is 230 mg/kg. If aspirated (liquid enters the lung), may cause lung damage or even death due to chemical pneumonia, a condition caused by petroleum or petroleum-like products.

INHALATION: Excessive exposure to product mist may produce organophosphate type cholinesterase inhibition. Excessive exposure to solvent vapour may cause, in order of increasing concentration: eye and upper respiratory tract irritation, feeling of increased body heat, central nervous system effects such as headache, dizziness, inco-ordination, drowsiness, unconsciousness. For a similar formulation, the LC50 (4 hours) for rats is between 2.0 and 2.5 mg/l.

SYSTEMIC AND OTHER EFFECTS: Excessive exposure may produce organophosphate type cholinesterase inhibition. Signs and symptoms of excessive exposure to active ingredient may be headache, dizziness, inco-ordination, muscle twitching, tremors, nausea, abdominal cramps, diarrhea, (continued)

CONTINUED ON NEXT PAGE

PRODUCT NAME: LORSBAN* 50EC INSECTICIDE PRODUCT CODE: 45377

EFFECTIVE DATE: FEBRUARY 19, 1988. DOC. NO: HAA7

7. HEALTH HAZARD DATA: (continued)

SYSTEMIC AND OTHER EFFECTS: (continued) sweating, pinpoint pupils, blurred vision, salivation, tearing, tightness in chest, excessive urination, convulsions. Repeated excessive exposures to high concentrations of vapour of solvents may cause liver and kidney injury and effects on blood cells. Repeated or prolonged exposure to high concentrations of vapour of solvent may also cause irregular heartbeat (cardiac arrythmia). Active ingredient did not cause cancer in long-term animal studies. Neither xylene nor 1,1,1-trichloroethane were found to be carcinogenic in separate bioassay studies in laboratory animal studies. Active ingredient did not cause birth defects in laboratory animals. Xylene has been reported to cause effects on the fetus when administered to pregnant laboratory animals. For 1,1,1-trichloroethane, exposures having no adverse effect on the mother should have no effect on the fetus. In animal studies, active ingredient has been shown not to interfere with reproduction. Based on a majority of negative data and some equivocal or marginally positive results, active ingredient is considered to have minimal mutagenic potential. Results of in vitro ("test tube") and in vivo mutagenicity tests on xylene have been negative. For 1,1,1-trichloroethane, results of in vitro ("test tube") mutagenicity tests have been inconclusive and tests in animals have been negative.

8. FIRST AID:
If poisoning occurs, contact a doctor or Poisons Information Centre.

EYES: If in eyes, hold eyes open, wash with flowing water for at least 15 minutes. Consult a doctor.

SKIN: If skin contact occurs, remove contaminated clothing and wash skin thoroughly with flowing water and soap (if available). Consult a doctor if irritation persists. If poisoned by skin absorption, give Atropine tablets as described below (see INGESTION). Promptly attend a hospital or doctor for medical assistance.

INGESTION: If swallowed, induce vomiting, preferably using IPECAC Syrup APF, if available. Give one Atropine tablet every quarter hour until dryness of the mouth occurs. Transport to doctor or hospital promptly. Refer to section "Note to Physician" below, before inducing vomiting.

INHALATION: Remove to fresh air if effects occur. If not breathing apply mouth-to-mouth resuscitation. If breathing difficult, oxygen can be given by trained personnel. Call a doctor and/or transport to a Medical facility.

NOTE TO PHYSICIAN: Because rapid absorption may occur through lungs if aspirated and cause systemic effects, the decision of whether to induce vomiting or not should be made by a doctor. If lavage is performed, suggest endotracheal and/or oesophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. Suggest serum and/or red blood cell cholinesterase determination. Atropine by injection is the preferable antidote. Oximes may or may not be therapeutic but it is recommended they not be used in place of Atropine. (continued)

CONTINUED ON NEXT PAGE

PRODUCT NAME: LORSBAN* 50EC INSECTICIDE PRODUCT CODE: 45377

EFFECTIVE DATE: FEBRUARY 19, 1988. DOC. NO: HAA7

8. FIRST AID: (continued)

NOTE TO PHYSICIAN: (continued) Supportive care. Treatment based on judgment of the doctor in response to reactions of the patient.

9. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): Current TLV recommended by NHMRC are:-
Chlorpyrifos - skin : 0.2 mg per cubic metre
1,1,1-trichloroethane: 350 ppm. xylene: 100 ppm

VENTILATION: Control airborne concentrations below the exposure guidelines. Use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guidelines. When respiratory protection is required for certain operations, use an approved air-purifying (organic vapour) respirator. For emergency and other conditions where the exposure guidelines may be greatly exceeded, use a positive-pressure, self-contained breathing apparatus.

SKIN PROTECTION: Use protective clothing impervious to this material. A recommended material is polyvinyl alcohol (PVA). Selection of specific items such as gloves, boots, apron or full-body suit will depend on operation. Remove contaminated clothing immediately, launder clothing before reuse. Contaminated leather items such as footwear, belts and watchbands should be removed and destroyed.

EYE PROTECTION: Chemical goggles are recommended because eye contact with this material may cause pain, even though it is unlikely to cause injury.

10. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Keep out of reach of children.
Handle with reasonable care. Product is poisonous if absorbed by skin contact or inhaled or swallowed. Avoid contact with skin and eyes. Avoid breathing vapour of product or spray mist. Practice good personal hygiene practices. Wash hands and face thoroughly before eating, drinking or smoking and at the end of each work day. Concentrated vapours of this product are heavier than air and will collect in confined areas such as pits and storage tanks. Do not enter area where vapour of this product are suspected unless breathing apparatus is used.
Do not ship or store with food, feedstuffs, drugs or clothing.

MSDS Status: Revision of existing MSDS (3/11/1986), revised 1,2,3,4,6,7,8 and 9.
Note; new EMERGENCY RESPONSE Phone Number : 008 033 882

THE INFORMATION HEREIN PRESENTED IS GIVEN IN GOOD FAITH, BUT NO WARRANTY, EXPRESSED OR IMPLIED IS MADE. CONSULT DOW CHEMICAL (AUSTRALIA) LIMITED FOR FURTHER INFORMATION.

LAST PAGE

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RHÔNE-POULENC

RHÔNE-POULENC RURAL AUSTRALIA PTY LTD

261 TINGIRA STREET,
PINKENBA, QLD 4008, AUSTRALIA
POSTAL ADDRESS: P.O. BOX 335,
HAMILTON CENTRAL 4007, AUSTRALIA
FAX: (07) 260 1041 TELEX: AA40540
TELEPHONE: (07) 260 1091

MATERIAL SAFETY DATA SHEET

25 June 1990

PRODUCT.: ROGOR 400

Infosafe:0002A Status: ISSUED RHORURAL 22/06/90 Data Source:RHORURAL

PRODUCT IDENTIFICATION

UN No....:3017	D.G.Class:6.1(b)	CAS No...:N.A.
Hazchem..:3WE	Sub. Risk:3	Poisons..:6 (Fe)
G.T.EPG..:N.A.	Spec.EPG.:GENERAL	Pack. Grp:III

Tradenames.:	Manuf.: ManCode:	Supplier:
Rogor 400	RHORURAL	RHORURAL

Use.....:
For control of insect pests in a wide range of crops.

Synonyms...: No other synonyms

Ingredients:	—CAS No:—	Proportion:
Dimethoate	60-51-5	40.0% w/v
Cyclohexanone	68477-31-6	54.0% w/v
General Surfactants		10.0%

Other Ingredients Data:
No other ingredients

Physical Description / Properties:
Appearance:
A clear pale yellow liquid with a strong unpleasant mercaptan odour.
Formula...:
O,O-dimethylS-methylcarbamoylmethyl phosphorodithioate (Dimethoate)
Vapour Pressure....:10-5 mbar @ 20°C
Volatile Component.:53.0%
Specific Gravity...:1.080 @ 20°C
Flash Point.....:43°C
Molecular Weight...:229.28 (Dimethoate)
pH.....:4.3
Form.....: Liquid
Other Physical Data:
Solubility in Water : Miscible

PRODUCT.: ROGOR 400

Infosafe:0002A Status: ISSUED RHORURAL 22/06/90 Data Source:RHORURAL

HEALTH HAZARD INFORMATION

Acute Effects

Eye:
Strong eye irritant

Skin:
May be harmful. Skin sensitiser.
SKIN ABSORPTION : Dangerous if absorbed through the skin

Inhaled:
May be harmful. Symptoms as if swallowed.

Swallowed:
Dangerous if ingested. Sypmtoms listed below.

Other Health Effects:
EFFECTS OF OVEREXPOSURE/ACUTE OVEREXPOSURE : Nausea, vomiting, salivation, blurred vision, contraction of pupils, unconsciousness.

Chronic Effects:
Twitching of muscles, nausea, blurred vision, respiratory difficulty.

First Aid

Eye:
Immediately irrigate with copious quantity of water for at least 15 minutes.
Eyelids to be held open.
Seek medical advice.

Skin:
Wash with plenty of soap and water.

Inhaled:
Remove victim to fresh air.
Seek medical advice.

Swallowed:
Give plenty of water to drink and induce vomiting.Use fingers in the throat, Ipecac Syrup (APF) or similar emetic.Seek immediate medical assistance.

Other First Aid:
DO NOT attempt to give anything to a semi-conscious or unconscious person.
In the case of poisoning by any exposure route, contact a doctor or Poisons Information Centre.

Advice to Doctor:

PRODUCT.: ROGOR 400

Infosafe:0002A Status: ISSUED RHORURAL 22/06/90 Data Source:RHORURAL

HEALTH HAZARD INFORMATION - (continued)

This product is an organophosphate, which is an anticholinesterase agent. Administer Atropine.

CONSULT POISONS INFORMATION CENTRE

Sydney	(02) 519 0466	Perth	(09) 381 1177
Melbourne	(03) 345 5678	Canberra	(062) 43 2154
Brisbane	(07) 253 8233	Hobart	(002) 38 8485
Adelaide	(08) 267 7000	Darwin	(089) 20 7211

Toxicity Data:

Moderately toxic by oral route
Oral LD50(rat): 250 mg/kg (Dimethoate Technical)
Slightly toxic by dermal route

PRECAUTIONS FOR USE

Exposure Limits:

No occupational exposure standards have been established for the product or its ingredients.

Ventilation:

Use in a well ventilated area only.

Personal Protection:

No specific requirements, however the wearing of the following personal protective equipment is advisable :

- Safety glasses, goggles or faceshield as appropriate
- PVC or rubber gloves
- Long sleeved overalls buttoned at the neck and wrist
- Approved S.A.A. 1716 respirator for pesticide mists
- Rubber boots

Flammability:

Flammable.

Environment:

Highly toxic to aquatic life.
Avoid contamination of ponds, streams, rivers and water courses
Highly toxic to bees
Avoid use of product on plants in flower while bees are foraging.

Other Precautions:

To be used STRICTLY in accordance with label instructions

RHÔNE-POULENC RURAL AUSTRALIA PTY LTD

PRODUCT.: ROGOR 400

Infosafe:0002A Status: ISSUED RHORURAL 22/06/90 Data Source:RHORURAL

SAFE HANDLING INFORMATION

Storage and Transport:

Wear long sleeved overalls and gloves while handling. Wash thoroughly after handling. DO NOT smoke, eat, drink or chew until after washing.
Store in a cool, dry place in sealed containers, away from direct sunlight.
Store away from food, feed or any other items intended for human or animal consumption.
Do not store in or around homes, and keep out of the reach of children.
Avoid contact with eyes, skin, and clothing, or inhalation of product.

Packaging and Labeling:

Use product strictly in accordance with label instructions

Spills and Disposal:

Contain spill and absorb with earth, sand, sawdust, clay, sweeping compound or absorbant material and store in sealed drums, for safe disposal.
Avoid contact with skin, eyes and clothing, or inhalation.
WASTE DISPOSAL METHOD : Approved land fill or contact Rhône-Poulenc Rural Australia Pty Ltd.

Reactivity Data:

CONDITIONS CONTRIBUTING TO INSTABILITY : Extreme heat and fire
INCOMPATIBILITY : Incompatible with strong oxidizing agents, decomposed by alkalis.
HAZARDOUS DECOMPOSTION PRODUCTS : May give off oxides of nitrogen, sulphur and phosphorous if heated to decomposition.

Fire/Explosion Hazard:

Extinguish fire with the following:
Use foam or dry agent
Full protective gear including breathing apparatus (SAA 1716) must be worn

Other Safe Handling:

NEUTRALIZING CHEMICALS : Alkalis, hydrated lime, caustic soda

ADDITIONAL INFORMATION

Technical Data:

Refer to Rhône-Poulenc Technical Manual or contact a Rhône-Poulenc office.

Additional Data A:

EMERGENCY CONTACTS

PRODUCT.: ROGOR 400

Infosafe:0002A Status: ISSUED RHORURAL 22/06/90 Data Source:RHORURAL

ADDITIONAL DATA A: - (continued)

Police or Fire Brigade : Dial 000 - If ineffective Dial 1100 (Exchange)

Organization	Location	Telephone	Ask for
Australian Chemicals Ltd	Australia Wide	008 033 111	Emergency Response Co-ordinator

Contact Points:
Mr Neil Haigh, Quality Control Chemist or Mr Leon Huinck, Manufacturing Manager Ph. (07) 260 1091

End: Infosafe printed: 25 June 1990 By:

N.A. = Not Applicable or Not Available

Bayer

BAYER

47-67 Wilson Street
PO Box 159
Botany NSW 2019
Telephone: 02 666 9841
Telex: AA 120444
Fax: (61) 02 666 3584
Telegrams: Bayer Sydney

Material Safety Data Sheet

Dipterex Liquid Insecticide Spray	Emergency Telephone No. Business Hours: (02) 666 9841	After Hours: (02) 57 7811 (02) 524 2876 (02) 449 2316

Section 1 — Product 270 474

Manufacturer's Name and Address	Bayer Australia Ltd, 47-67 Wilson Street, Botany, NSW 2019		
Common Name	trichlorfon	Chemical Family	organophosphate
Chemical Name	Dimethyl-2,2,2-trichloro-1-hydroxyethyl-phosphonate		
Product Type	insecticidal soluble concentrate		

Section 2 — Hazardous Ingredients

Material or Component	g/l
trichlorfon	625

DISTRIBUTED BY ROBERT LINTON, PTY. L... ST CANNING HIGHWAY, VICTORIA PARK, W.A. 6100

PL · 361645.2.

UN Number	3017	HAZCHEM Code:	3WE

Section 3 — Physical Properties

Appearance and Odour	clear, colourless, solution	pH	n.e.
Boiling Point (°C)	n.e.	Volatiles (% Volume)	49
Vapour Pressure (Kilopascals)	a.i.: 1×10^{-5} mbar at 20°C	Evaporation Rate (Butylacetate = 1)	n.e.
Vapour Density (Air = 1)	n.e.	Melting Point	n.e.
Solubility in Water, % By Wt.	miscible	Density (Kilograms/Litre)	1.21

Section 4 — Flammability and Explosive Properties

Flash Point (°C) — Method	> 41 A.P.	Flammability Limits in Air (% Volume)	Lower n.e. / Upper n.e.
Fire Extinguishing Media	Water fog or foam		
Special Fire Fighting Procedures	Wear full protective clothing and self-contained breathing apparatus.		
Unusual Fire and Explosion Hazards			

Dipterex Liquid
Insecticide Spray

Section 5 — Health Hazard Data

Toxicity Data

LD_{50} Oral (Ingestion)

rat	500	mg/kg

LD_{50} Dermal (skin contact)

rat	> 5000	mg/kg

Emergency and First Aid Procedures

Skin contact presents the greatest danger. If individual becomes ill, drowsy, vomits or becomes unconscious, assume poisoning has occurred.

Contact a doctor or Poisons Information Centre.

Poisoning (or inhaling)	Remove the patient to fresh air and make comfortable. Ensure that patient is kept strictly at rest. Remove all contaminated clothing, including shoes. Wash affected areas with water, using soap if available. Keep patient warm. If patient is not breathing, oxygen may be given, but only under supervision of a trained person. If swallowed, induce vomiting using Ipecac Syrup (APF) if available. Give one atropine table (0.6 mg) every quarter hour until dryness of the mouth occurs. Transport patient to hospital or doctor.
Skin Contact	Remove all contaminated clothing, including shoes. Wash affected areas with water, using soap if available. Give atropine tablets as above. Transport patient to hospital or doctor.
Eye Contact	Hold eye open and wash continually with water for at least 15 minutes. Transport patient to hospital or doctor.

Dipterex Liquid
Insecticide Spray

Section 6 — Reactivity Data

Stability.

Stable ☒ Conditions to Avoid

Unstable ☐

Materials to Avoid

Strong oxidising agents.

Hazardous Decomposition Products

If involved in a fire: HCl; P_2O_5; SO_2

(Hydrochloric Acid gas; Phosphorus Pentoxide; Sulphur Dioxide)

Hazardous Polymerization

Will Not Occur ☒ Conditions to Avoid

May Occur ☐

Section 7 — Spill or Leak Procedures

Steps to Take in Case Material is Released or Spilled

Prevent spillage from spreading or entering waterways and underground drains by banking with sand or earth.
Stop leaks if possible.
Do not allow the chemical to contact skin or eyes. If contact occurs, immediately follow FIRST AID directions.
Wear rubber or PVC boots, gloves, goggles and self-contained breathing apparatus for clean-up operations.
Avoid breathing fumes.
Work from up-wind side of spill.
Do not smoke, eat or drink during clean-up operations.

Waste Disposal Method

Absorb on hydrated lime, sand or soil. Place in a drum along with any soil, etc. which is contaminated. Rinse area with detergent and small amount of water. Absorb this with hydrated lime and place in drums and seal. Spread hydrated lime liberally over the affected area.
Contact manufacturer of chemical regarding safe disposal if in doubt, or if spill is larger than 20 litres or if other goods are contaminated.
On completion of clean-up, remove and wash all protective clothing and equipment with detergent and water. Shower using liberal quantities of soap and water.

Section 8 — Special Protection Information

Protective Clothing Required.

Overalls	☒		Face Shield	☒	Type:
Boots	☒		Respirator	☐	Type:
Gloves	☒	Type: Rubber			

Dipterex Liquid
Insecticide Spray

Section 9 — Special Precautions

Handling and Storage Precaution

Do not store near any material intended for use or consumption by humans or animals.

Store in a dry and cool place.

Do not contaminate ponds, waterways, and drains with this product or used container. Store in original container, tightly closed in a safe place under lock and key. Wash out container thoroughly and dispose of safely.

Other Precautions

The concentrate is poisonous. Avoid contact with the skin and eyes and avoid breathing the vapour. When handling the concentrate and preparing the spray use rubber gloves and face shield. If spilled on skin and on completion of each spraying, wash thoroughly with soap and water. Wash contaminated clothing before re-use. Do not eat or smoke while spraying.

Secure an emergency supply of atropine tablets (0.6 mg) and Ipecac Syrup (APF).

This Material Safety Data Sheet is essentially similar in format to OSHA-20 and also conforms to ACIC recommendations. An expanded layout has been used to emphasise First Aid Procedures, Safe Product Handling and to provide relevant toxicological information. Where applicable specific chemical composition details are provided to allow the product to be classified according to UN Number, UN Hazard Class, HAZCHEM coding, etc.

The information contained herein is based on data available to Bayer Australia Ltd. from both our own technical sources and from recognised published references and is believed to be both accurate and reliable.

Bayer Australia Ltd. has made no effort to censor nor to conceal deleterious aspects of this product.

Since we cannot anticipate or control the many different conditions under which this information and our products may be used, each user should review these recommendations in the specific context of the intended application and confirm whether they are appropriate.

Due care should be taken to make sure that the use or disposal of this product is in compliance with appropriate Federal, State and Local Government regulations.

Prepared By: D.S. Drane Title: Information Officer Date 15.7.86

Appendix 2

CALM 729's

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME:	DIPTEREX LIQUID INSECTICIDE SPRAY
ACTIVE INGREDIENT:	625 gm/lt trichlorfon
CLASSIFICATION:	Insecticide
FORMULATION:	Clear colourlessliquid
USE:	Control spring beatles
PROTECTIVE CLOTHING Mixing:	Dual cartridge respirator, goggles, L/S overalls, PVC long apron, impervious gloves and boots.
Application:	Dual cartridge respirator, L/S overalls, impervious gloves and boots.
PERSONAL PRECAUTIONS:	Avoid contact with skin and eyes. Wash skin with soap and water immediately after use and before eating, drinking or smoking. Wash clothing regularly or when known to be contaminated.
HAZARD TO HEALTH:	Degree of toxicity: Swallowing - Moderate Skin Absorption - Moderate Inhalation - Moderate
FIRST AID: Swalling:	Induce vomiting, use ipecac syrup. Give 1 atropine tablet every 15 minutes until dryness of mouth occurs.
Splashing in eyes:	Wash eyes thoroughly with clean running water for 15 minutes.
Spillage over person:	Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Launder clothes before reuse.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer.

Seek medical advice as soon as possible.

ENVIRONMENTAL LIMITATIONS:	Can have effect on fish specis. Avoid contamination of drains and streams withpossible run off.
STORAGE:	Store in original sealed containers in cool locked chemical store.
SPILLAGE:	Prevent spillage by banking with sand or earth. Collect contaminated soil into sealable drums for disposal at approved local authority site.
DISPOSAL OF CONTAINER:	Triple rinse, and dispose of at local authority approved site.
MANUFACTURER:	BAYER AUSTRALIA

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: DOMINEX 100 : DOMINEX 16 ULV

ACTIVE INGREDIENT: 100 g/l alphamethrin or
16 g/l alphamethrin in ULV product

CLASSIFICATION: Insecticide

FORMULATION: Straw coloured liquid

USE: Control of vegetable weavil, garden weavil, apple weavil and catasarcus weavil.

PROTECTIVE CLOTHING
Mixing: Dual cartridge respirator, goggles, L/S overalls, PVC apron, impervious gloves and boots.

Application: Dual cartridge respirator, L/S overalls, PVC impervious gloves and boots.

PERSONAL PRECAUTIONS: Avoid contact with skin and eyes. Wash skin with soap and water immediately after use and before eating, drinking or smoking. Wash clothing regularly or when known to be contaminated.

HAZARD TO HEALTH: Stored in body - No

Degree of toxicity:

Swallowing	-	Moderate
Skin Absorption	-	Moderate
Inhalation	-	Moderate

FIRST AID:
Swalling: Do not induce vomiting. Give milk or water.

Splashing in eyes: Wash eyes thoroughly with clean running water for 25 minutes. If irritation persists, seek medical advice.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Launder clothes before reuse.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer.
(Seek medical advice as soon as possible)

Advice to Doctor:

ENVIRONMENTAL LIMITATIONS: Product is toxic to fish and bees so avoid contamination of waterways and ponds.

STORAGE: Store in original sealed containers in cool locked chemical store.

SPILLAGE: Avoid spread of spillage with sand, soil, sawdust or absorbent granules. Sweep up contaminated soil and place in sealable drums for disposal at approved local authority site.

DISPOSAL OF CONTAINER: Triple rinse, and dispose of at local authority approved site.

MANUFACTURER: AGCHEM PTY LTD

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: SABOTEUR EC 40: ROGOR DISTOP: LANE ROGOR 40: DIMETHOATE SYSTEMIC: ROXION 400 EC

ACTIVE INGREDIENT: 400 g/l dimethoate

CLASSIFICATION: Insecticide

FORMULATION: Liquid emulsifiable concentrate

USE: Control of bluegum phyllids, leaf blister saw fly

PROTECTIVE CLOTHING
Mixing: Dual cartridge respirator, goggles, L/S overalls, PVC apron, impervious gloves and boots.

Application: Dual cartridge respirator, L/S overalls, PVC gloves and boots.

PERSONAL PRECAUTIONS: Avoid contact with skin and eyes. Wash skin with soap and water immediately after use and before eating, drinking or smoking. Wash clothing regularly or when known to be contaminated.

HAZARD TO HEALTH: Stored in body - May be a cumulative poison

Degree of toxicity:		
Swallowing	-	Moderate
Skin Absorption	-	Moderate
Inhalation	-	Moderate

FIRST AID:
Swalling: Induce vomiting, use ipecac syrup. Give 1 atropine tablet every 15 minutes until dryness of mouth occurs.

Splashing in eyes: Wash eyes thoroughly with clean running water for 15 minutes.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Launder clothes before reuse.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer as soon as possible.

ENVIRONMENTAL LIMITATIONS: Toxic to fish, bees and some wildlife species therefore avoid over use of this product.

STORAGE: Store in original sealed containers in cool locked chemical store.

SPILLAGE: Soak up spilled material with sand or suitable earth. Collect into sealable drums for disposal at approval local authority site.

DISPOSAL OF CONTAINER: Triple rinse, and dispose of at local authority approved site.

MANUFACTURER: INCITEC: SCHERING:
AMALGAMATED; NUFARM; HOECHST; INCITEC;
SCHERING COMPANIES

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: FENITROTHION 100 : FENITROGARD LIQUID

ACTIVE INGREDIENT: 1000 g/l fenitrothion

CLASSIFICATION: Insecticide

FORMULATION: Clear amber liquid - unpleasant odour

USE: Control of Australian plague locust

PROTECTIVE CLOTHING
Mixing: Dual cartridge respirator, goggles, L/S overalls, PVC apron, impervious gloves and boots.

Application: Dual cartridge respirator, L/S overalls, impervious gloves and boots.

PERSONAL PRECAUTIONS: Avoid contact with skin and eyes. Wash skin with soap and water immediately after use and before eating,drinking or smoking. Wash clothing regularly or when known to be contaminated.

HAZARD TO HEALTH: Stored in body - No

Degree of toxicity:		
	Swallowing	- Moderate
	Skin Absorption	- Moderate
	Inhalation	- Moderate

FIRST AID:
Swalling: Induce vomiting, use ipecac syrup if available. Give 1 atropine tablet every 15 minutes until dryness of mouth occurs.

Splashing in eyes: Wash eyes thoroughly with copious quantities of water for 15 minutes.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Launder clothes before re-use.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer.
(Seek maedical advice as soon as possible)

Advice to Doctor: Fenitrothion is an anticholinesterase compound.

ENVIRONMENTAL LIMITATIONS: DO NOT contaminate waterways, streams domestic or irrigation water supplies.

STORAGE: Store in original sealed containers in cool locked chemical store.

SPILLAGE: Absorb into sand or proprietary absorbent and collect material into sealable container for disposal at approved local authority site.

DISPOSAL OF CONTAINER: Triple rinse and dispose at local authority approved site.

MANUFACTURER: NUFARM LTD & WELLCOME AUSTRALIA

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: MALDISON ULV Concentrate

ACTIVE INGREDIENT: 1180 g/l maldison

CLASSIFICATION: Insecticide

FORMULATION: Clear yellow liquid - unpleasant odour

USE: Wingless Grasshopper and Rutherglen bug control. Use as per label instructions.

PROTECTIVE CLOTHING
Mixing: Dual cartridge respirator, goggles, combination overalls, PVC apron, gloves and boots.

Application: Dual cartridge respirator, combination overalls, PVC gloves and boots.

PERSONAL PRECAUTIONS: Avoid contact with skin and eyes. Wash skin with soap and water immediately after use and before eating, drinking or smoking. Wash clothing regularly or when known to be contaminated.

Hazard To Health: Stored in body - No

Degree of toxicity:		
Swallowing	-	Moderate
Skin Absorption	-	Moderate
Inhalation	-	Moderate

FIRST AID:
Swalling: Induce vomiting, use ipecac syrup if available. Seek medical advice.

Splashing in eyes: Wash eyes thoroughly with clean running water for 15 minutes.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Give one Atrophine tablet every 15 minutes till dryness of mouth occurs.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer.

Advice to Doctor: Give Atropine and contact Poisons Information Centre.

ENVIRONMENTAL LIMITATIONS: May be harmful to birds, fish and bees. DO NOT contaminate waterways, streams domestic or irrigation water supplies.

STORAGE: Cool dry place in sealed drums in locked chemical store.

SPILLAGE: Contain with sand, earth or absorbent material and store in sealed drums. Dispose of at approved local authority site.

DISPOSAL OF CONTAINER: Double rinse crush or puncture drum before removal to local authority approved site.

MANUFACTURER: NU FARM LTD

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: LORSBAN 50 E.C.

ACTIVE INGEDIENT: Chlorpyrifos 500 gm/Litre

CLASSIFICATION: Insecticide

FORMULATION: Straw coloured liquid

USE: African blackbeetle, Grasshopper and soil borne insect control.

PROTECTIVE CLOTHING
Mixing: Long sleeve overalls, PVC gloves, boots and apron. Goggles and twin cartridge respirator for organic vapours.

Application: L/S overalls, PVC gloves and boots. Twin cartridge organic vapour respirator.

PERSONAL PRECAUTIONS: Avoid contact with skin and eyes or ingestion to lungs. Wash skin with soap and water immediately after use and before eating, drinking or smoking. Wash clothing regularly or when known to be contaminated.

HAZARD TO HEALTH: Stored in body - No

Degree of toxicity:

Swallowing	-	Moderate
Skin Absorption	-	Moderate
Inhalation	-	Moderate
Eye	-	Moderate

FIRST AID:
Swalling: Induce vomiting with Ipecac Syrup and refer to doctor promptly. The decision whether to induce vomiting or not should be made by a doctor.

Splashing in eyes: Wash eyes thoroughly with clean running water for 15 minutes.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and clean running water. Consult a doctor if irritation persists.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer.

ENVIRONMENTAL LIMITATIONS: Prevent contamination of streams as ingredient is toxic to fish and widlife.

STORAGE: Store in original sealed containers in cool locked chemical store.

SPILLAGE: Contain spill with sand, soil or inert absorbent materials to avoid run off into water sources - bury material at approved Shire site.

DISPOSAL OF CONTAINER: Triple rinse container and add rinse to spray unit. Crush or puncture container and dispose of at local authority approved site.

MANUFACTURER: DOW CHEMICAL (AUST) LIMITED

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

INSTRUCTIONS FOR SAFE USE OF CHEMICALS

(To be used in conjunction with the Chemical Users Manual, 1980)

TRADE NAME: SUMICIDIN 200: SUMICIDIN ULV CS0

ACTIVE INGEDIENT: 200g/l fenvelerate: 40g/l fenvelerate

CLASSIFICATION: Insecticide

FORMULATION: Amber Liquid

USE: Control Budworm, Pasture day moth & Autumn Gum moth.

PROTECTIVE CLOTHING
Mixing: Twin cartridge respirator, L/S overalls, PVC apron, impervious gloves and boots and goggles or face shield.

Application: Twin cartridge respirator, L/S overalls, impervious gloves and boots & face shield or goggles.

PERSONAL PRECAUTIONS: Avoid swallowing, can be irritating to skin & eyes. If substantial skin contact occurs may cause temporary facial numbness. Wash with soap and water before eating, drinking or smoking after use of chemical. After each days use wash clothing, gloves and face shield.

HAZARD TO HEALTH: Stored in body - No

Degree of toxicity:		
Swallowing	-	Moderate
Skin Absorption	-	Moderate
Inhalation	-	Moderate

FIRST AID:
Swalling: If more than 15 minutes from Hospital induce vomiting preferably with Ipecac Syrup.

Splashing in eyes: Wash eyes thoroughly with clean running water for 15 minutes.

Spillage over person: Remove contaminated clothing, wash skin thoroughly with soap and water.

Accidents involving swallowing, splashing in eyes or gross skin contact, see local medical officer as soon as possible after accident.

ENVIRONMENTAL LIMITATIONS: May be harmful to fish and bees therefore avoid contamination of waterways, streams and rivers. Do not spray when bees are foraging on flowering plants.

STORAGE: Store in original sealed containers in cool locked chemical store but separate from herbicides.

SPILLAGE: Absorb spill in lime, or wet area with 5% Soda Ash solution and absorb on sand, earth or non combustible absorbent material. Collect material into drum and dispose at approved Shire site.

DISPOSAL OF CONTAINER: Triple rinse, and dispose of at local authority approved site.

MANUFACTURER: SHELL CHEMICALS

9. Attachments

PLANTATION INSECT SURVEY

1. BUDWORM *(Helicoverpa punctigera)*

WEEVILS *(Phlyctinus callosus) (Listroderes difficilis)*

1.1. Site Information

Location .....

Tree Species .....

Tree Age .....

Insect Name .....

1.2. Survey Technique

Commencing the second week in October, randomly select lines of 20 trees (one line for every 20 hectares of plantation) and mark with pegs. This is necessary only for 1 year old plantations; although 2 year old plantations can be damaged.

Starting at weekly intervals, inspect the lines for the presence of budworms. When caterpillars are discovered on trees commence recording their numbers for each location on the form overleaf. Once budworms are recorded it is necessary to inspect plantations every 3 days.

When an average of 5 caterpillars are recorded in each row of 20 trees commence spraying.

BUDWORM AND WEEVIL RECORD SHEET

Location No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DATE:															
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PLANTATION INSECT SURVEY

2. WINGLESS GRASSHOPPER

2.1. Site Information

Location .....

Tree Species .....

Tree Age .....

2.2. Survey Technique

Begin inspecting plantations in September. At random intervals estimate the number of nymphs to every square metre. Record your estimate on the form overleaf. Also record if damage to trees is occurring.

Eucalypt plantations are more susceptible to damage by wingless grasshopper than pine plantations.

2.3. Method of Recording

Estimate of numbers: Few (F) 0 - 30m^2 Moderate (M) 30 - 100m^2 Dense (D) >100m^2

Level of damage: Nil (0); Light (1); Moderate (2); Severe (3)

No damage (0) is when insects may or may not be present but no damage to trees is evident.

Light damage (1) is where obvious damage to foliage is apparent; however, <10% of the foliage is affected.

Moderate damage (2) is when 10% - 50% of the foliage is affected. Some shoots may have been removed.

Severe damage (3) is when >50% of the foliage is affected, shoots have been removed and some damage to the stems is occurring.

Example:

Location No.	1		2		3		4		5		6		7		8	
	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii
DATE: 22.3.91	F	O	M	O	D	1	D	2	M	1	M	O	F	O	M	1

WINGLESS GRASSHOPPER RECORD SHEET

Location No.	1		2		3		4		5		6		7		8	
	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii	i	ii
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PLANTATION INSECT SURVEY

3. Other injurious insect species

DAMAGE (circle whichever applicable)

Leaf	Shoot	Branch/Stem	Root
skeletonised	snipped off	broken	chewed
chewed	wilted	gnawed/girdled	dry
blisters	dead	holes	lesions
blotchy	deformed	galls	deformed
galls	other	scales	other
scales		other	
other (specify below)			

If leaf then: are the leaves affected

mature:	old	new
juvenile:	old	new

Damage Description: _____

_____

_____

_____

EXTENT OF DAMAGE (Estimation)

Within Tree (circle whichever applies)

100% 75% 50% 25% 10% <10%

Comments: _____

_____

_____

Within Plantation % Trees Affected

100% 75% 50% 25% 10% <10%

Comments: _____

_____

_____

_____

PROVIDE SAMPLE OF DAMAGE AND/OR INSECT

Send sample and a copy of this form to Entomology Section, Attention: Dr Ian Abbott, CALM Research, Como.

Send original form to Ray Fremlin, Busselton.

INSECT IDENTIFICATION

Please identify the attached specimen(s):

Code Number(s): In the style of "your initials, year/sample No." (eg, JC 90/1). Please record this number in your records. It will be used in correspondence.

_____

Locality of collection: _____

Host species: _____

Any useful details: _____

_____

_____

_____

Date: _____

Collector: _____

Address: _____

_____

Telephone: _____

Advice about preserving specimens

To aid in identification it is essential that insect specimens are supplied in a suitable condition. It is not usually possible for the forest entomology staff to do immediate identifications, so it is in your interest to ensure material is properly killed and preserved.

Insects will generally survive for more than a week if placed in a container in a refrigerator, but it is important to kill easily damaged specimens such as moths and butterflies immediately. Most insects are readily killed by placing in an airtight container with a tissue soaked in a little nail polish remover (acetone).

Kill and preserve soft bodies specimens such as insect larvae, termites etc in ethanol (ethyl alcohol), if available, diluted with 30% water. Hard bodied insects (beetles, wasps, ants etc) may be frozen, if necessary.

For insects attached to plant material, enclose the entire sample in a plastic bag and seal. It is usually a good idea to preserve separately a subsample of the insects.

Please do not supply only one specimen of insect, unless there were no others present. About 10 to 20 specimens (depending on size) are preferred.

Send to: Dr Ian Abbott, CALM, Como.

FOREST ENTOMOLOGIST

INSECT CONTROL - PROCEDURES FOR IMPLEMENTATION
(use of insecticides)

Inspect and sample new plantations
at weekly intervals
Send samples to: Dr Ian Abbott, Como

If it is considered that insect damage
could be of economic significance
complete Attachment 1

If decision is to spray fill out Application
to Spray Insects form (Attachment 4) request approval from Regional Manager

Regional manager to notify Afforestation Manager
and Manager Sharefarming

Regional Manager to notify the District Manager
of approval to spray within one day

Districts to arrange contractors to spray

District to supervise spraying operations
to ensure that the provisions contained in
this manual are adhered to

APPLICATION TO SPRAY INSECTICIDES

Location: .....

Insect pest: .....

Inspected by: .....

Spray action recommended by: .....

Is a prescription for control available? **YES** **NO**

If **NO** to last question, has Silviculture Branch been notified? **YES** **NO**

Method of application: Power mister knapsack mister
boomsprayer knapsack aircraft
other .....

Date of proposed spraying: .....

Insecticide to be used: .....

Who is to do the work: .....

Licence No. (if applicable): .....

Environmental Considerations:

Are there running streams in or adjacent to the area? **YES** **NO**

Are there neighbours to be notified? **YES** **NO**

Are there apiary sites in the vicinity? **YES** **NO**

Are there other environmental factors to be considered? **YES** **NO**

If **YES** what? .....

.....

.....

Officer Applying ..... Date .....
Approval YES NO

District Manager ..... Date .....
Approval YES NO

Regional Manager ..... Date .....
Approval YES NO

Manager Silviculture Branch notified Date .....

This sheet to be processed irrespective of decision to proceed or not with spray.

RECORD OF APPLICATION

Location: .....

Insect pest: .....

Officer in Charge: ..... Date: .....

Completed Application to Spray Insecticides attached: YES NO

Prescription followed (reference no.): .....

Method of application: power mister knapsack mister
boomsprayer knapsack aircraft
Other .....

Date application commenced: .....

Date application completed: .....

Insecticide used: ..... Volume used: .....

Comments (time of day application was carried out, reasons for stoppages etc):

.....

.....

.....

.....

Map of applied area attached: YES NO

Area (ha) treated: .....

Time taken to complete application (hrs): .....

Who completed work: .....

Licence No. (if applicable): .....

Weather conditions: RH: ..... Wind speed: average .....
range .....

Temperature range: .....

Comments: .....

.....

.....

Cost: Herbicide $..... Application $..... Administration $.....

Environmental Considerations

Neighbours notified: Date .....

Apiary Sites checked: Date .....

Streamflows checked: Date .....

Comments: .....

.....

.....

Sampling

Soil Samples	Date	Time
1. Pre-application 2. Post application 3. First week 4. Second week 5. Third week		

Water Sample		Date	Time	Rainfall in previous 24hrs (mm)
Pre-application				
During application	1.			
	2.			
	3.			
	4.			
	5.			
	6.			
Post appplication (including following season)	1.			
	2.			
	3.			
	4.			
	5.			
	6.			

Samples (soil and water) forwarded to Analytical Laboratories: Date .....

Results of samples forwarded to Mr Ray Fremlin: Date .....

Comments: .....

.....

.....

District Manager: ..... Date: .....

Regional Manager: ..... Date: .....

Copy to: Manager, Silviculture Branch (Attention: Mr Simon Penfold)

THIS SHEET IS TO BE FULLY COMPLETED FOR EACH APPLICATION AND EACH PROPERTY TREATED.

Health Department of Western Australia

9037/89:00927MC1:SS
Mr M Cousins

Mr Ray Fremlin
Senior Forester - Softwood Silviculture
Department of Conservation and Land Management
PO Box 104
COMO WA 6152

Reference is made to your memorandum dated 20 September 1990 concerning use of certain insecticides on insects not appearing on registered labels.

You are advised that permission is given for the following uses.

1. Trichlorfon for control of Spring beetles (Lidaretus spp) by spraying of adult beetles on the foliage of eucalypts.

2. Dimethoate for control of Bluegum psyllid (ctenarytaina eucalypti) and Leafblister sawfly (Phylacteophaga froggatti) by foliar spray of feeding insects.

3. Alphamethrin for control of Budworm (Helicoverpa punctigera), Pasture day moth (Apina callisto), Autumn gum moth (Mnesampela privata) and Cutworms (Agrotis spp) in pine plantations.

4. Alphamethrin for control of Vegetable weevil (Listroderes difficilis), Garden weevil (Phlyctinus callosus), Apple weevil (Otiorhynchus cribricollis), Catasarcus weevils (Catasarcus spp) and Chrysomelid beetles in pine plantations or eucalypt trees.

P Psaila-Savona
PRINCIPAL MEDICAL OFFICER
PUBLIC HEALTH

28 September 1990

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Sirex Plan (1988)

1. PURPOSE

To detail the
- measures necessary for monitoring for the presence of Sirex;
- silvicultural practices that would disfavour Sirex establishment;
- procedures to be followed when an outbreak occurs;

and the persons responsible for their implementation.

2. BACKGROUND

Sirex noctilio is a woodwasp native to Europe. It was introduced to New Zealand in the 1920s and from there to Tasmania, Victoria, South Australia and New South Wales. Although intercepted occasionally at Fremantle in the 1960s, recent surveys have found no evidence that it has established in Western Australia. Vigilant quarantine has evidently ensured that any infested wood has been destroyed.

The female wasps oviposits from November to April in sapwood of physiologically-stressed pine. Spores of a wood-rotting fungus are introduced at the same time. This fungus spreads through the cambial layer and eventually ringbarks the tree. Timber is also degraded by larval tunnels and emergence holes of adults (4-7mm in diameter).

The larva lives within the heartwood and sapwood usually for up to one year, sometimes two. In South Australia the peak period for emergence of adults is February and March.

Stands growing on shallow soils, close to full stocking or overstocked, containing many suppressed trees and experiencing high mortality are most susceptible to infestation. The Greenhouse Effect could aggravate physiological stress of trees even in well-managed plantations. Radical thinning of stands will alleviate stress on trees. Poor quality sites should be avoided for planting of pines.

Biological control of Sirex using nematodes and parasitic wasps has been proved feasible in Victorian plantations that have been poorly managed (eg, through delayed thinning, nutritional deficiencies). Nematodes and parasitoids suppress the reproductive capacity of Sirex and contribute to reducing infestations to economically acceptable levels.

Wasp-infested trees are inoculated with the nematode *Deladenus siricidicola.* One form of this nematode can invade Sirex larvae and ultimately destroy the egg embryos within ovaries, thus making female wasps sterile. These wasps can still mate and oviposit normally but they introduce nematode-infested nonviable eggs and the Sirex fungus into the sapwood. (These females can therefore still kill pine trees).

3. STAND MANAGEMENT

3.1 Purpose

To undertake silvicultural measures to sustain the vigour of pine trees in plantations.

3.2 Background

Stands are most susceptible to Sirex attack when under moisture stress. For this reason stands must be thinned on time in order to minimise moisture stress.

3.3 Method

A plan for the first thinning of stands will be prepared by the Regional Inventory Officer. Where this thinning is likely to be delayed beyond age 10 years on drought-prone sites, the Softwood Silviculturist must be notified.

4. MONITORING

4.1 Purpose

To detect the presence of Sirex as soon as possible after its arrival by means of 'trap trees'.

4.2 Background

This method puts selected pine trees under stress in November, before they are stressed naturally (usually in Autumn). These trees are therefore out of phase with surrounding trees and provide a strong focus of attraction for wild Sirex populations. This method supersedes the previously used method of examining pine boles for presence of exit holes of adult wasps. The prescription is based on that used successfully in Victoria.

4.3 Scope

Suitable for *Pinus radiata* and *P. pinaster* in all areas of the South-west.

4.4 Method

Tree Selection

* Choose 5 pine trees in one plot convenient for inspection, and close to where Sirex could be introduced (eg, highway, town, port).

* Give priority to healthy, thinned stands growing on deep soils, containing few suppressed trees, and experiencing no mortality.

* Ideal DBHOB = 10-20cm.

* Double and multi-headers, and also asymmetical trees, should be used to minimise wastage.

* Trees can either be in a group or in a row.

* Trees should preferably be near a road to facilitate monitoring.

Herbicide Injection

* Inject the outer sapwood at breast height of each tree with herbicide (use either a Phillips drenching gun or Vaxmaster vaccination gun).

* Use a rate of 2ml per 10cm of circumference for trees <20cm diameter and 2ml per 5cm of circumference for trees >20cm diameter.

* Mid Spring to early Summer is satisfactory, but in Victoria best results were obtained in mid November.

* 2, 4-D, MCPA, picloram or dicamba are suitable but dicamba is preferred in Victoria because of its slow rate of action on pine. In WA this is marketed as Banex. Injected trees die slowly and remain attractive to Sirex throughout most of the flight season. (Stem injection is preferred to ringbarking because it makes the whole bole attractive to Sirex, whereas after ringbarking only the bole below the injury is attractive).

Subsequent Examination

* Check trees the following May or June, as they should be technically dead then.

* Fell poisoned trees and check for fungal staining under bark by removing slices of bark with an axe. Inspect tree for exit holes. Be careful not to confuse staining with Ips infestation.

* Crosscut the orange-stained stems of trees at 1m intervals, starting 1.5m from the base, and search for larvae.

* Preserve any larvae present in 70% ethanol (bulk the samples from one locality) and despatch them promptly to the Forest Entomologist, Como Research Centre, along with the following data: District, specific location, date, collector's name.

* Three billets, under appropriate security, should be sent to the Forest Entomologist, Como for breeding out of adult Sirex. The remaining billets are to be destroyed on site.

* Submit all details of plantations examined to the Softwood Silviculturalist (John Kaye, Bunbury).

* Reinspect trees for exit holes in May of the following year.

Supervision

* These procedures are to be supervised by the District Plantation Officer.

Frequency

* These procedures will be repeated each year in plantations stipulated by the Softwood Silviculturalist.

Routine monitoring at pine mills

* Timber inspectors are to liaise with staff at these mills about the need to be alert to Sirex larvae or fungal staining of wood. In addition, logging contractors should be made aware of how to identify Sirex wasp.

Involvement of private plantation owners

* Liaison offer (Private plantations) (Peter Beatty, Manjimup) will contact private plantation owners through AFDI (Australian Forestry Development Institute) to inform them of CALM's program and seek their cooperation in adopting this monitoring program.

5. ACTION ON DETECTION

5.1 Identification confirmed by Forest Entomologist (Ian Abbott/Janet Farr).

5.2 Softwood Silviculturalist arranges for the area of the outbreak to be assessed, the infested plantations to be quarantined and the movement of pine material from there to be prohibited. If only a few trees are found infested, a search and destroy operation for complete eradication may be an achievable goal.

5.3 If eradication is not an achievable aim, the Forest Entomologist contacts the Keith Turnbull Research Institute (KTRI), Victorian Department of Conservation, Forests and Lands, requesting shipment of nematodes and parasitoids.

Team Leader, Biological Control	(Dr Ross Field) (03) 785 0106
Technical Officer	(03) 785 0134

Nematodes can be supplied within two weeks if fewer than 200 trees are to be inoculated. If more trees are involved, early notification is needed as it would take six weeks to prepare the amounts of inoculum required.

5.4 KTRI has offered to bring the first shipment of nematodes (in aqueous solution) to Perth and train CALM personnel in preparing the gel and inoculating trees.

Gel preparation will be the responsibility of the Chemistry Laboratory, Como Research Centre (J McGrath).

For details of inoculation preparation, storage and transport, see Appendix 1.

5.5 Softwood Silviculturalist is to coordinate inoculations of trees. For inoculation procedure and job safety analysis, see Appendix 2.

5.6 Forest Entomologist in consultation with Softwood Silviculturalist is to request shipment of parasitoids from KTRI. These will only be sent during Spring or Summer.

Softwood Silviculturalist is to coordinate their collection at Perth Airport and their release in infested plantations.

APPENDIX 1

INOCULUM PREPARATION, STORAGE AND TRANSPORT **

1. Add 350ml hot water (just boiled) to mixer bowl.

2. Sprinkle 90g Gelatine onto surface of hot water. (Do not add all at once).

3. Mix * at speed 4 until Gelatine dissolved. (At least 1 min).

4. While Gelatine is dissolving, prepare 1200ml iced water (approximately 2 C), 5 tubs = 5 million nematodes, and 0.5ml food dye. Add 1200ml cold water once the ice has melted.

5. Increase to maximum speed until maximum volume is attained (approximately 1 minute).

6. As soon as maximum volume is attained, reduce speed to 4 and quickly add nematodes and food dye, continue mixing until dye is evenly distributed (approximately 30 seconds).

7. Pour or shake mix into plastic bags provided - recover as much material from whisk and bowl as is practicable.

8. Rinse whisk and bowl in hot water before next mix - rinse empty nematode tubs and store in bag for ultimate return to CSIRO Tasmania.

9. Clean all equipment at end of mixing day.

STORAGE AND TRANSPORT

1. Inoculum should be stored and transported in foam eskys between 5 C and 20 C.

2. Nematodes in concentrate must be stored at 5 C - concentrate and flummery must never be frozen.

3. The amount of inoculum stored overnight must be kept to a minimum and any stored must be used first on the following day - if inoculum must be stored overnight, it should be at 5 C. Check refrigerator temperatures regularly and adjust as required.

FOOD DYE CODING

Aeroplane food dyes will be added to each mix, to allow identification of the day of mixing.

The code to be followed is:

Monday	-	blue
Tuesday	-	pink
Wednesday	-	green
Thursday	-	red
Friday	-	yellow

* Mixer: Kenwood Major Model A907D

** Courtesy of Woods and Forests Department, South Australia

APPENDIX 2

INOCULATION PROCEDURE *

Objective

To achieve at least 50% parasitism of Sirex adults by inoculation of recently Sirex-killed wood, with appropriately spaced doses of 1,000 nematodes.

Materials

Inoculation flummery - see Appendix 1
Long handled rebound punch - photograph attached
Inoculating sauce bottle with pipette tip

Methods

Select "recently" killed Sirex infected trees to be inoculated. i.e. fungal stain present and no exit holes.

Trees are felled and roughly trimmed along the top; the trimming allows for easy and safe access to the stem for inoculation.

Inoculations holes are made using the long handled rebound punch. Hole depth should average about 10mm.

Hole spacing should be:

- log diameter >15cm - 2 rows of staggered holes along the log 30cm apart in about the 10 to 2 clock position.
- log diameter <15cm - a single row of holes 30cm apart down to about 8cm diameter S.E.

PLAN VIEW
(not to scale)

The inoculation flummery (mixed fresh daily) is generally supplied to the site in 6 1 polythene bags in an esky with ice pack. The aim is to keep the flummery between 5 C and 15 C.

The flummery is squeezed into sauce bottles through a hole cut in the corner of the bag. The sauce bottles have a plastic pipette tip glued into their nozzles for more effective injection.

The tip is inserted into the bottom of the hole, and slowly removed as flummery is squeezed into the hole.

The hole is filled with flummery then compacted with a finger or thumb. This compaction is to ensure intimate contact between the flummery and the inside of the hole.

* Courtesy of Woods and Forests Department, South Australia

Constraints

Trees must be recently dead, with regular occurrence of brown fungal staining. Wood moisture content >50% is preferred, but is not always attainable.

Inoculation should take place between mid April and August.

Flummery temperature should be kept between 5 C and 15 C Inoculation on days >20 C should be avoided as warm temperatures dry out the flummery too quickly, probably leading to death of the nematodes before they enter the wood.

SIREX MONITORING SHEET

DISTRICT:

Plot Number: .....
Plantation: .....
P. year: .....
Compartment: .....
Grid Reference: .....
Date of Poisoning: .....
Date of First Inspection: .....
Date of Second Inspection: .....

☑ indicates present

☒ indicates absent

Where parasites or predators present use the following abbreviations:

PREDATORS: *Thanasimus dubius* = Th
Temnochila verescens = Te

PARASITOIDS: *Roptrocerus xylophagorum* = Ro
Dendrosoter sulcatus = De

	TREE NUMBER				
	1	2	3	4	5
Tree Diameter (cm)					
1st Inspection					
Dead					
Dying					
Alive					
Ips					
Predators					
Parasitoids					
Sirex Exit Hole					
Other					
2nd Inspection					
Dead					
Dying					
Alive					
Ips					
Predators					
Parasitoids					
Sirex Stain					
Sirex Larva					
Sirex Exit Holes					
Other					