Section 3

AGRICULTURAL ASSESSMENT

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1. INTRODUCTION

The NRA collated information on the agricultural aspects of the use of diazinon from a number of sources including:

- labels of registered products;
- surveys of advisers, users and registrants of the chemical carried out by sending Performance Questionnaires to State agricultural authorities, commodity and industry organisations, users and registrants;
- consultation with registrants, State authorities and commodity groups.

Diazinon products are registered for a wide range of insecticide uses which include ectoparasite control on livestock, cropping uses, industrial pest control and household and garden use. Information supplied by registrants and State agricultural authorities indicates that diazinon remains a major chemical in the control of various ectoparasites in livestock, especially sheep and cattle.

Although diazinon is registered for use in major cropping industries such as cereals, oilseeds and fruit orchards, advice from State agricultural authorities and commodity organisations indicates that it is no longer an insecticide of choice for agricultural uses, with the exception of certain horticultural crops such as pineapples, bananas and mushrooms and regionally-based use on a variety of vegetable crops. It could thus be considered a minor chemical for agricultural uses.

Diazinon products are also registered for domestic, commercial and industrial pest control, for ornamentals and turf and preventative treatment of skins and hides.

In the home, diazinon products are registered for control of a range of household insect pests and for use on companion animals in the form of washes and flea collars. Home garden products are registered for control grubs in lawns and for control of aphids and caterpillars on certain vegetables.

2 EFFICACY ASSESSMENT

2.1 Registration Status

Diazinon is registered in a number of countries throughout the world. There are over 100 products containing diazinon currently registered in Australia by over 30 registrants and these are listed in Table 1.

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TABLE 1 DIAZINON PRODUCTS UNDER REVIEW

NCRIS Number	Product Name	Registrant
41698	Country Diazinon 800 Insecticide	A & C Rural Pty Ltd
37640	KFM Blowfly Dressing	Captec Pty Ltd
32915	Campbell Pennside Flowable Microencapsulated Insecticide	Colin Campbell (Chemicals) Pty Ltd
32916	Campbell Pennside Lawn Grub Killer	Colin Campbell (Chemicals) Pty Ltd
40259	Campbell Knox-Out Flowable Microencapsulated Insecticide	Colin Campbell (Chemicals) Pty Ltd
42023	David Grays Ant Dust	David Gray & Co. Pty Limited
42024	David Grays Ant Spray	David Gray & Co. Pty Limited
42034	David Grays Diazinon Lawn Insect Killer	David Gray & Co. Pty Limited
42286	David Grays Diazinon 200	David Gray & Co. Pty Limited
46721	David Grays Diazinon 800 Insecticide	David Gray & Co. Pty Limited
40653	Exelpet Yard And Kennel Flea Control Concentrate	Exelpet Products (A Division Of Effem Foods Pty Ltd)
41018	Exelpet Water Resistant 5 Month Flea Collar For Cats	Exelpet Products (A Division Of Effem Foods Pty Ltd)
41019	Exelpet Water Resistant 5 Month Flea Collar For Dogs	Exelpet Products (A Division Of Effem Foods Pty Ltd)
46406	Y-Tex Optimizer Insecticidal Cattle Ear Tags	Flycam Pty Ltd
32917	Chemspray Diazinon Insecticide	Garden King Products Pty Ltd
32922	Garden King Diazamin 200 Insecticide	Garden King Products Pty Ltd
45014	Healthy Companion 5 Month Flea Collar For Cats Water Resistant With Elastic Safety Strap	Healthy Companion Pty Ltd
45024	Healthy Companion 5 Month Flea Collar For Large Dogs Water Resistant	Healthy Companion Pty Ltd
45025	Healthy Companion 5 Month Flea Collar For Dogs Water Resistant	Healthy Companion Pty Ltd

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NCRIS Number	Product Name	Registrant
31959	Hortico Diazinon Ant Killer Dust Insecticide	Hortico (Aust) Pty Ltd
31960	Hortico Ant Killer Spray Insecticide	Hortico (Aust) Pty Ltd
41307	Hortico Lawn Grub & Insect Killer	Hortico (Aust) Pty Ltd
41783	Diazol Sheep Dip, Jetting Fluid And Blowfly Dressing	Makhteshim-Agan (Australia) Pty Limited
45856	Masterpet Coloured 5 Month Flea Collar For Dogs	Masterpet Pty Ltd
45857	Masterpet Coloured 5 Month Flea Collar For Cats	Masterpet Pty Ltd
48917	Crawly Cruncher Household Insecticide Surface Spray	National Chemical Pty Ltd
45396	Spike Insecticidal Cattle Ear Tags	Novartis Animal Health Australasia Pty Ltd
47052	Neocid 200P Insecticide	Novartis Animal Health Australasia Pty Ltd
37773	Coloured 5 Month Superpet Flea Collar For Dogs	Pets International Pty Ltd
37774	Superpet Coloured 5 Month Flea Collar For Cats	Pets International Pty Ltd
39572	Wsd Diazinon For Sheep, Cattle, Goats And Pigs	Rebop Holdings Pty Ltd T/As Western Stock Distributors
39573	WSD Fly Strike Powder To Control Flystrike And For Wound Dressing For Animals	Rebop Holdings Pty Ltd T/As Western Stock Distributors
39574	WSD Mulesing Powder Wound Dressing Following Mules Operation - General Wound Dressing For Sheep, Cattle And Goats	Rebop Holdings Pty Ltd T/As Western Stock Distributors
32226	Rentokil Home Pest Insecticidal Surface Spray	Rentokil Initial Pty Ltd
33475	Coopers Di-Jet Sheep Dip/Jetting Fluid, Cattle And Pig Spray	Schering-Plough Pty Ltd
33867	Coopers Mulesing Powder Insecticide	Schering-Plough Pty Ltd
46231	Coopers Fly Strike Powder Insecticide	Schering-Plough Pty Ltd
46295	Coopers 4-In-1 Dip	Schering-Plough Pty Ltd
42502	R.S.P.C.A. 5 Month Flea Collar For Cats Water Resistant	Southport Imports Pty Ltd
42506	R.S.P.C.A. 5 Month Flea Collar For Dogs Water Resistant	Southport Imports Pty Ltd
46481	CPV Diazinon Insecticidal Nuciwash	Universal Manufacturing & Laboratories Pty Ltd

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NCRIS Number	Product Name	Registrant
38866	Virbac 5 Month Flea Collar For Small Dogs Water Resistant	Virbac (Australia) Pty Limited
38867	Virbac 5 Month Flea Collar For Cats Water Resistant With Elastic Safety Strap	Virbac (Australia) Pty Limited
38873	Virbac Jetdip 4 In 1 Sheep Dip	Virbac (Australia) Pty Limited
38874	Virbac Jetdip Sheep Jetting Fluid & Blowfly Dressing	Virbac (Australia) Pty Limited
38897	Virbac Mulesing And Fly Strike Powder	Virbac (Australia) Pty Limited
39079	Virbac Petcare Preventef 5 Month Flea Collar For Dogs	Virbac (Australia) Pty Limited
39569	Virbac Petcare Preventef 5 Month Flea Collar For Cats	Virbac (Australia) Pty Limited
40524	Virbac Working Dog 7 Month Waterproof Flea Collar For Dogs	Virbac (Australia) Pty Limited
42611	Virbac Kleen-Dok With Diazinon An Insecticidal Wound Dressing For Cuts And Abrasions In Sheep And Cattle	Virbac (Australia) Pty Limited
40019	Gammawash D Insecticidal Dog Wash	Wesfarmers Dalgety Ltd

Crops/animals/situations appearing on currently registered product labels have been listed in the following tables.

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Table 2 Crops in which diazinon products are registered

Vegetables	Field crops	Orchard Crops	Other
Brussels Sprouts	Cereals	Citrus	Rhubarb
Squash	Kohlrabi	Cumquats	Blueberries
Broccoli	Peas	Trifoliate Orange	Grape Vines
Globe Artichoke	Kale	Apples (including dormant)	Lucerne
Silverbeet	Soybeans	Macadamia Nuts	Pastures
Beetroot	Maize	Pears (including dormant)	Kiwifruit
Celery	Cotton	Bananas	Mushrooms
Cabbage	Sorghum	Stone Fruit/Stone Fruit (Dormant)	Cantaloupe
Beans	Sugar Cane		Pumpkin
Gherkins	Turnips		Turf (including lawns around trees)
Chokos	Pineapples		Hops
Garlic	Rape		Watermelons
Cucumbers	Rice		Ornamentals (including dipping of nursery plants)
Marrows	Chou Moellier		
Cauliflower	Oilseeds		
Capsicum	Potatoes		
Onions	Sweet Corn		
Lettuce			
Eggplant			
Tomatoes			
Carrots			
Parsnip			

Table 3 Animals for which diazinon is registered

Cattle	Goats	Horses	Pigs
Sheep	Dogs	Cats	

Table 4 Other situations in which diazinon is registered

Domestic (including homes, flats), Public and Industrial Pest Control (including commercial and industrial buildings)	Skins and Hides	Ponds/Stagnant water	Garbage Containers
Farm Buildings / Animal housing (including Kennels, Stables and Piggeries)	Ships, Aircraft, Buses, Trains and general vehicles	Refuse Areas	

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2.2 Current Use Patterns

Although diazinon is registered for a wide range of uses in Australian agricultural and animal production, the performance questionnaires indicated that it has a comparatively narrow range of applications in which it is consistently used as a major component of pest control strategies.

It is particularly important in sheep and cattle husbandry as an ectoparasiticide and as an insecticide in a number of smaller, though significant, industries such as pineapples, bananas, onions, mushrooms and ornamentals. It is also widely available for use in pet and home garden situations.

2.2.1 Ectoparasite Control in Beef and Dairy Cattle and Sheep

Diazinon is widely used in Australian livestock industries as an ectoparasiticide and has major advantages in this context in that it has a quick knockdown effect and relatively low price. As an organophosphate, it is used in rotation with products from other chemical groups in resistance management strategies.

The major use of diazinon in cattle is for control of buffalo fly through use of backrubbers, ear tags and shower dips. It is also used for lice control.

In the sheep industry, diazinon is used as a wound treatment (eg mulesing, marking, docking) and for control of lice, itch mite and ked. In addition, in spite of documented resistance in blowflies, it is still used for the prevention and control of blowfly strike.

2.2.2 Other Ectoparasite Control

Diazinon is approved for use as a general wound dressing. It is also used in pigs (mange mites, lice), dogs (fleas, lice, sarcoptic mange mites and as an aid in tick control), goats (lice, mange) and horses (fleas, and all lice).

In relation to dogs and cats, it is noted that while there are a number of flea and tick collars registered for use in these animals, this method of application is becoming less frequently used as a means of controlling these pests. In addition, dog washes with this chemical as an active constituent are also becoming less frequently used as other methods and chemicals become available. Increasing use of alternative chemicals such as insect growth regulators and oral administration of chemicals has reduced use of diazinon in these situations.

Reports of dog fatalities and poisonings associated with the use of older diazinon preparations which have deteriorated in improperly sealed and/or stored containers, have also led to reduce use of diazinon.

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Questionnaires completed by the chemical industry suggest that continued use of diazinon in companion animal situations may be limited.

2.2.3 Domestic, Public and Industrial Pest Control

Diazinon is registered for control of all major household pests including cockroaches, bed bugs, carpet beetle, spiders, fleas, silverfish, ants, flies, maggots, mosquito larvae, earwigs, slaters and crickets. However, only one State authority indicated that diazinon is a key chemical for use in general pest and ant control in the pest control industry.

2.2.4 Home Garden Use

Diazinon is approved for use in the home garden in beans (bean fly), citrus (citrus leaf miner) and brassicas (cabbage white butterfly, centre grub, cluster caterpillar, grey cabbage aphid).

2.2.5 Agricultural Use

Plantation and Orchard Crops

Diazinon is registered for use on the following plantation and orchard crops: bananas, apples, pears, grapes, kiwifruit, macadamias, citrus, blueberries, pineapples, stonefruit, cantaloupe, watermelon. It is registered for use alone or in combination with spraying oils to control scales, aphids and thrips in pome and stone fruit. Diazinon is recommended by NSW Agriculture as part of a spray program for the control of San Jose scale in pome fruit. However, the Australian Apple and Pear Growers Association has indicated that diazinon has not been used in the majority of the apple and pear growing regions for a number of years and they will not be seeking continued registration.

It is also registered for control of mealy bug and scale in pineapples, spined citrus bug, citrus leaf miner and grasshoppers in citrus and banana weevil borer and banana rust thrips in bananas. In this regard, advice was received from some Queensland growers during the review that diazinon is used as part of pest control strategies for pineapples and bananas in that State. In bananas it is used as a bunch spray or bell injection and is particularly important in the control of rust thrips. Golden Circle Ltd, a commodity organisation representing the pineapple industry confirmed that diazinon was an integral part of mealy bug and pineapple scale control in the industry and that the industry would experience considerable difficulties without access to this chemical. Advice from the Queensland Fruit and Vegetable Growers indicates that diazinon is no longer important to the citrus industry in Qld. The Australian Macadamia Society Limited considers that diazinon is important in the control of feltid coccid and perhaps other macadamia tree pests.

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In general, advice received from State agricultural authorities suggests that diazinon is not frequently used in most plantation and orchard crops because there are more effective alternatives available.

Vineyards

The Victorian Department of Natural Resources and Environment has advised that use of diazinon for the control of mealybugs is considered to be a strategic component of pest control in viticulture in that State. Thus, the department has included it in their Grapevine Pest Control Chart for this purpose.

Vegetables

Diazinon is registered for control of a number of pests in a wide range of vegetable crops as listed in Table 2.

Advice from the Australian Vegetable & Potato Growers Federation (AUSVEG) indicated that diazinon is '...not used as an insecticide in the vegetable industry.' They highlighted a special situation where poultry litter is incorporated into sandy soils in the Swan Plains region of Western Australia, where 'stable fly' causes severe irritation to vegetable industry workers. To control stable fly, diazinon is applied to the soil early in the cropping cycle. (This is not a registered use of diazinon).

However, consultation with commodity groups and State authorities indicated that diazinon is important to the vegetable industry on a regional basis. Agricultural uses of diazinon that were considered by State agricultural authorities as being strategic for agricultural production were relatively minor uses. Examples are whitefly in brassicas in the Sydney basin (NSW), Oriental Cornborer in rhubarb (Qld), webworms in silverbeet and beetroot (Qld), cutworms in carrots (Qld) and various pests in beans (Qld).

NSW Agriculture advised that diazinon is considered to be very important for the control of whitefly on brassicas and that it is used extensively in the Sydney basin to control caterpillars in vegetable crops. Similarly, Agriculture Western Australia identified off-label use of diazinon by cauliflower growers in the Manjimup area for control of onion maggot.

The Australian Onion Industry Assocation considers that diazinon is a required chemical for control of onion maggots and thrips, though use patterns appear to vary between the States. There would also appear to be a particular call for use of diazinon for control of onion maggots in onions and garlic (off label) in NSW and South Australia.

Other crops where diazinon is currently used include sweetcorn, peas, capsicums and lettuce in Queensland.

Mushrooms

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Diazinon is registered for control of phorids and cecids (fly pests) in mushrooms. It is effective as a compost plus casing treatment against cecids. There is no provision in the registration for drenching the mushroom beds. Advice from the Australian Mushroom Growers Association Ltd indicates that casing is prepared by mechanically mixing water with dry peatmoss/limestone. If necessary, diazinon is evenly incorporated into the casing at this point. The casing is then applied as a 4-5 cm thick layer over the compost.

It is noted that this use pattern does not appear to correspond with that specified on the labels of a number of products which specify application at spawning and after casing. It is possible that these label directions may not reflect current cultural practices in the industry.

2.2.6 Field Crops and Pastures

Diazinon is registered for use on a number of field crops as detailed in Table 2. Although diazinon is registered for control of locusts in various field crops, advice to the review was that it is rarely, if ever, used to control outbreaks of this pest. As far as the Australian Plague Locust Commission (APLC) is concerned, fenitrothion ULV is the insecticide of choice for this situation. This preference is reflected in locust control endeavours by State agricultural authorities and landholders as well. Other crops/pests for which it is registered are sorghum /sorghum midge, grasshoppers and rice/plant hoppers, bloodworm. However, once again, there are other chemicals that are more frequently used for these pests. With particular reference to rice, advice was received that plant hoppers were a difficulty in the Queensland rice industry, but that they were rarely a problem in NSW because of the colder climate. There is some use of diazinon to control bloodworm but it is by no means a major chemical for this use.

Similarly, although diazinon is registered and used in the following pasture situations, it would appear that other chemicals may be preferred. Advice from State agricultural authorities indicates that fenitrothion and chlorfenvinphos are preferred for control of a number of important pasture pests:

- pastures—webworm, armyworm, cutworm;
- lucerne—lucerne jassid, spotted alfalfa aphid.

2.2.7 Lawns/Turf

Diazinon is registered for control of Argentine stem weevil, African black beetle, mole cricket and grass eating caterpillars, argentine ants, cutworms, couch tip maggot, couch mite, couch mealy bug, and couch flea beetle.

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2.2.8 Nursery and ornamental industries

Diazinon is registered for treatment of nursery plants for control of aphids, thrips, mealy bugs, scale insects, plant bugs and beetles in NSW and Vic and for control of fungus gnats in Qld. The Nursery Industry Association of Australia indicated that it was the only chemical registered for control of fungus gnats and that this is a key use. Nursery plant disinfestation with diazinon is required by WA and Qld before nursery stock is allowed to move into those States from other States.

Queensland DPI identified the control of staphylinid beetles in potted ornamentals as a further important use.

2.2.9 Skins and Hides

Diazinon is one of a number of insecticides used for control of skin and hide beetles. Information received from skin and hide processors suggests that management practices now make infestation of hides with beetles rare. However, diazinon and other chemicals are still used for fly control, especially when preparing skins or salted hides for export. Pallets are sprayed before they are loaded into containers to prevent fly numbers from building up during transit and creating a problem during unloading.

2.2.10 Recommended Spray Programs by State Agricultural Authorities

Most State departments have recommended spray programs that include diazinon as a strategic component.

Table 6 Spray programs including diazinon recommended by State agricultural authorities

State	Spray Program
Tasmania	• Reduction of Pesticide Residues in Wool • Venomous Ant Control (*Myrmecia spp*)
Queensland	• Licebuster - for effective control of sheep lice • Flybuster - for the effective control of flystrike Both of these programs are under review to accommodate need for reducing chemical residues in wool • Minchem - to promote strategies for minimum chemical use to control endo and ecto parasites on sheep. These programs will be integrated into one using an integrated pest management approach. • Chemsafe - a training program to improve user skills particularly in occupational health and safety areas • Buffalo fly control

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	• Brassicas for the control of a range of pests
South Australia	• No information submitted
Western Australia	• Ectoparasite Control on Livestock
Victoria	• Chemical Residues on Wool • Grapevine Pest Control Chart - Mealy Bugs
New South Wales	• Control of San Jose Scale on Pome Fruit • Sheep Ectoparasite Control
Northern Territory	• Not Recommended
Australian Capital Territory	• Not Recommended

2.3 Methods of Application

2.3.1 Ectoparasite Control in Beef and Dairy Cattle

In order for a chemical to be effective as an ectoparasiticide it needs to be delivered to the site of infestation or potential infestation in sufficient quantities to be effective for the maximum period of time. In the sheep and cattle industries, large numbers of animals need to be treated with a minimum of labour input. Several methods of application have been found to meet these parameters to a greater or lesser degree as set out below.

Backrubbers

Backrubbers are usually about 3 metres long, made of carpet underfelt rolled around 4 mm chain to which swivels are attached at either end. Fifty-seven gauge prawning net is laced tightly around the felt roll for the felt's protection. The rubbers are soaked in a specified mixture of sump oil and diazinon (for example 1% ai) and suspended above the ground at a height whereby the cattle can rub the uppermost parts of their bodies. Trees or posts as supports are used for this purpose.

Some sources indicate that this method of application is the cheapest form of buffalo fly control. Provided the rubber is designed and made properly, it will effectively control flies and save labour.

Ear tags

This method of application is another important self application method. One slow release tag, containing 15g diazinon, is placed in each ear, the time of application recorded and the tags removed after 16 weeks. Thus two sets of ear tags, containing a total of 30g diazinon, can be used to cover the six months of the fly season.

Shower Dip (Spray Race)

This method of application involves the mechanical spraying of cattle by means of specially constructed power operated spray races. The spray race consists of a system of pipes fitted with spraying nozzles fixed on a concrete base between sheet metal

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walls. The spray mixture is drawn up from a sump and forced at pressure through the pipes to the spray nozzles by means of a pump.

Diazinon is applied at 0.05% ai in a high volume spray, or 0.1% ai in low volume spray. One of the greatest disadvantages of a spray race is that excessive stripping or exhaustion of wash occurs. Producers usually combat stripping by overcharging, reinforcement, replenishment or continuous replenishment. Continuous replenishment is the most effective means of counteracting stripping.

2.3.2 Ectoparasite Control in Sheep

Plunge dips

Dips are initially charged at a typical rate of 0.01%-0.02% ai, and in recharging and topping up it is aimed to maintain the initial concentration of active constituent in the dip. A sheep might remove 2L-5L of solution from the dip, depending on size of animal and wool cover. For effective dipping, sheep need to be totally immersed twice in the dip and then checked for effective wetting in the draining pen. The hardest part of the sheep to wet is the back of the neck. T-shaped poles are used to push sheep under the dip surface to ensure wetting of this area of the animals.

Automatic Jetting or Spray Races

Automatic jetting races have generally been found to be less effective than other methods because the penetration and distribution of chemical is not as effective. However, automatic jetting races allow rapid treatment of sheep (up to 1000/hr) for fly control and are of value in regions where mob sizes are large. In addition, research by NSW Agriculture has shown that significant improvements in the efficiency of this method of application can be achieved by alterations in design of the equipment.

Hand Jetting

This is the most effective method of applying jetting chemicals, but it is also labour intensive. It involves an operator using a hand wand/comb to apply chemical under pressure directly into the fleece of the sheep to achieve thorough saturation. There are a number of generic and proprietary jetting wands that may be used to achieve efficient application of the chemical. Diazinon is typically applied at 0.04% active constituent, with 2L-5L being applied to each sheep, depending on size, wool cover etc.

Shower Dipping

Off-shears shower dipping is a cheap and effective method of lice treatment since extra handling of sheep can be minimised and complete saturation of the animals is easier to achieve. Of course, the dip must be kept clean and a bacteriostat used to avoid infection of shearing cuts.

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Although this method can also be used for longer woolled sheep, more care is required to achieve thorough wetting of sheep (and hence administration of the chemical) as the length of the wool increases.

Backline Treatment

This treatment method involves a spray-on application of chemical along the backline of the sheep from the pole to the tail (can also involve a breech treatment), using a hand-operated applicator gun. This method is rapid and requires little equipment and labour input. Backline treatment can be applied off-shears or as a long wool treatment. Diazinon is applied at 0.15% ai off-shears, using approximately 3mL per kg live weight. Long wool treatment uses 5.25mL-10.5mL undiluted product (9.6% ai) depending on length of wool.

2.3.3 Wound dressing

Insecticidal wound dressings containing diazinon are usually applied directly to the wounds by puffer, brush or spray when used as general wound dressings or fly strike treatments. When used as a wound treatment in sheep for the prevention of blowfly strike (eg mulesing, marking, docking) and treatment of struck sheep, it is applied to the surrounding wool as well as to the wound itself.

Where diazinon is the only active, a concentration of 15 g/L is common for this use. Where it is prepared with other repellent and disinfectant actives, the level of diazinon is commonly between 1 and 3 g/L.

2.3.4 Domestic, Public and Industrial Pest Control

When used as a surface spray, concentrations of diazinon are usually 4-5 g/L depending on pest/pest growth stage. Ready-to-use sprays are usually 38 g/L. When used for commercial pest control operations, rates of use are generally 5 g/L for use in hand sprayers and 12 g/L for misters, against all major household pests. Concentrations of 0.5 - 1 g/L are approved for public health spraying of maggots, mosquito larvae etc.

2.3.5 Home Garden Use

Concentrations of diazinon recommended for use in ‘pump-up’ sprayers in the home garden vary between 0.25 g/L (eg thrips, beanfly) and 1.6 g/L (cabbage white butterfly, cluster caterpillar etc).

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2.3.6 Companion Animal Use

Diazinon products are marketed in the form of flea collars and liquid washes for control of fleas, lice and ticks. Dog washes contain 35g/L or 50g/L in ready-to-use products, while flea collars typically contain 150g/kg in a solid, slow-release matrix.

2.3.7 Agricultural Uses

Plantation and Orchard Crops

A general rate of use of 52 g ai/100 L is used for control of various pests in fruit and plantation crops. The amount of chemical applied per hectare will vary widely according to the size, shape and layout of the orchard. Exceptions to the general rate include a lower rate of 24 g ai/100 L for mealy bug in grape vines and a higher rate of 100 g ai/100 L for banana weevil borer and macadamia felted coccid. The specification of these rates apparently assumes high volume application through orchard air blast sprayers.

A rate per hectare of 1.2 - 2.4 kg ai/ha is recommended for mealy bug control in pineapples. These rates are applied at 2500-3000 L/ha through boom sprayers.

Field Crops and Pastures

Diazinon is registered for control of Australian Plague Locust, Spur Throated Locust, Migratory Locust and Grasshoppers at a rate of 560 g ai/ ha. However, diazinon is not a major chemical used in these applications. Alternatives such as fenitrothion and monocrotophos are much more widely used than diazinon. ULV formulations of fenitrothion, in particular, have been used by the Australian Plague Locust Commission and State locust control authorities. Fipronil has also been approved for locust control and is used at very low application rates.

Diazonon is also registered for control of lucerne jassid, spotted alfalfa aphid, pasture webworm, armyworm, cutworm in pastures (including lucerne) and cabbage moth and cabbage white butterfly in chou moellier, rape and turnips. Rates in these situations vary between 280 and 800 g ai/ha depending on crop type/stage of growth and pest type/stage of growth.

Vegetables

Rates per hectare, per 100 L (boom spray application) and for knapsack sprayers are recommended on various labels. The rates recommended per hectare vary between 120 g ai/ ha (24 g ai/ 100 L) and 4 kg ai/ha although the majority of approved rates in vegetables are 560 g ai/ ha (112 g ai/ 100 L). In some cases, a range is specified to account for plant size, with the highest rate approximately double the lowest rate (eg 560-1120 g ai/ha; 2.4-4 kg ai/ha).

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Mushroom Production

Advice from the Australian Mushroom Growers Association Ltd indicates that, when required, diazinon is evenly incorporated into the casing when it is being prepared. The casing is then applied as a 4-5 cm thick layer over the compost.

It is noted that this use pattern does not correspond with that specified on the label of a number of products which specify application at spawning (112 g ai/ 10 L/ tonne) and after casing (24 g ai/ 10 L/ tonne). It would appear that these label directions may not reflect current cultural practices in the industry.

2.3.8 Lawns/Turf

Diazinon is recommended for control of argentine stem weevil, african black beetle, mole cricket and grass eating caterpillars, Argentine ants, cutworms, couch tip maggot, couch mite, couch mealy bug, and couch flea beetle. The rates of use recommended in this situation vary between 0.4 g/L and 3 g/L.

2.3.9 Ornamentals (including Nursery use)

Advice was received that diazinon is used off-label in Tasmania for control of Black Fungus Gnats in potting mix, particularly for potted chrysanthemums. However, advice from growers (Nursery Industry Association of Australia) and other State agricultural authorities (Queensland Department of Primary Industries) suggests that it is fairly widely used in the floriculture industry in Australia for this use. For example it is used in South Australia for control of fungus gnats in pansies, petunias and other potted flowers. In addition, it is a WA quarantine requirement that nursery stock be treated (dipping or flood spraying) with diazinon before being allowed into the State. Solutions of 2mL-6mL per 10L are used for these purposes.

2.3.10 Skins and Hides

The recommended rate of use for control of skin and hide beetles is 5 g/L applied using a hand sprayer attached by a hose to a motorised pump. However, it is noted that the major use in this industry appears to be for control of flies on export shipments of salted hides. The hides are sprayed on pallets before being loaded into containers to prevent the build up of flies during shipment.

2.4 Usage Trends

A number of factors influence the amount of diazinon used in Australian agriculture. In some fields of use there is likely to be a decreased use.

For example, in relation to the wool industry, blowfly resistance has reduced the protection period afforded by this chemical and there is increasing use of alternatives.

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In addition, the potential for non-agricultural issues such as occupational health and safety and environment arising out of the presence of residual levels of ectoparasiticides in wool to adversely affect trade is pressuring for the industry to adopt residue minimisation strategies including reduced overall usage. Similarly, there is a general impetus to ensure that residues of chemicals in food products (eg sheep meat, milk, cheese etc) are also reduced.

Agricultural authorities and producer organisations are also promoting minimum chemical use, resistance management and integrated pest management strategies that should lead to an overall reduction in chemical usage.

However, the increasing incidence of synthetic pyrethroid resistance in buffalo fly populations will increase the demand for diazinon and other organophosphate chemicals for use in cattle.

In general, State agricultural authorities expect demand to remain stable or decrease.

Registrants also generally expect the demand to be stable or decrease. This is in spite of increases in sales of some products because of the withdrawal of some of the larger chemical companies from the diazinon market. These increases are expected to be largely balanced by a decrease in sales of pet products as users turn to newer chemicals such as fipronil. During 1996-97, an amount of technical grade diazinon (both formulated and unformulated) of the order of 163 tonnes was imported into Australia.

Most participants in the review do not anticipate any alteration in the current registration profile for diazinon. However, some of the registrants intend to extend registration of their products into new situations to take up market areas that have been left open by other companies which have discontinued their diazinon products. On the other hand, registrants of pet ectoparasiticide products such as dog washes and collars expect there to be a significant reduction in use of diazinon for such applications.

Similarly, most registrants indicated that they did not expect to undertake any further development work in relation to their products. However, some indicated that further improvement of formulations may be undertaken. One of the registrants indicated that they had not ruled out further research into use of diazinon.

Considerable trialwork has been undertaken with diazinon in the past, particularly in relation to its use in sheep. Investigations into use of diazinon in rice, mushrooms and potatoes have also been undertaken.

At present, State agricultural authorities in Queensland, Victoria, Tasmania and New South Wales have advised of current or intended trial work with diazinon. Apart from NSW (gnats in ornamentals) there is no trial work being undertaken by State agricultural authorities in cropping situations.

Table 7 Current or Proposed Trialwork by State agricultural authorities

State	Current or Proposed Trialwork
New South Wales	• Efficacy trials with other chemicals for control of gnats in ornamentals • Sheep flystrike control/treatment • Sheep lice control/treatment • Chemical residues • Application techniques
Victoria	• Evaluation as an ectoparasiticide on sheep • Residues in wool following use • Research with short wool up to six weeks post shearing
Tasmania	• Residues in wool following use
Queensland	• Residues in wool following use and consequent modifications to husbandry practices

Trial work so far has indicated that there could be room for alteration to the use patterns defined on registered labels. Indications in relation to use of diazinon as an ectoparasiticide in sheep are that reduced use in long wool will be required to reduce residues. In addition, there may be opportunities to lower dose rates for lice control in short and long wool.

Clearly, any such alterations would need to be examined in the light of current NRA guidelines for registration of sheep ectoparasiticides and supported with a comprehensive data package before being adopted by the industry.

2.5 Evaluation of Efficacy

In reconsidering diazinon, the NRA must be satisfied that diazinon products continue to be effective as claimed on the product labels.

Growers, commodity organisations, State agricultural authorities and the chemical industry have been surveyed for information on the performance of the chemical in the field, addressing aspects such as management strategies, methods of application and chemical failures. In particular, information has been sought on whether the way in which the chemical is presently used is the same as when it was first registered and whether the present label directions are still applicable.

Information was received during the review that diazinon is an important ectoparasiticide because it has a quick-acting knock-down effect on lice and flies. In relation to flystrike, OPs are the only class of chemical providing immediate kill of maggots on sheep.

Although not part of NRA considerations in relation to registration of veterinary chemical products, it is important to note from a growers perspective, that the lower relative cost of diazinon is a significant factor in choosing to use this chemical.

Several State agricultural authorities indicated that they had been requested to investigate cases of lice and blowfly control failures and poor protection to treated stock. Such incidents could have a number of possible explanations, including resistant populations of the pest, poor application techniques, or in the case of lice,

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failure to implement important follow-up management initiatives (such as segregation of treated sheep).

However, advice from State authorities as a result of their investigations indicates that the most prevalent reasons for failure of treatments relate to inefficient application of the chemical or failure to correctly interpret or follow label instructions. It should be noted, however, that these apply to all chemicals used in ectoparasite control, not just diazinon.

Calibration of dips, failure to maintain dip/sump concentrations, incorrect set up of pumping equipment and design of shower dips and jetting races are of particular importance in relation to inefficient application of the chemical. In general, automatic jetting races apply chemicals less efficiently and in variable doses compared to other equipment and so while they can be used for short term protection against flies, they are of questionable value in lice control.

2.6 Alternatives

2.6.1 Ectoparasite Control

State agricultural authorities promote husbandry and breeding techniques for reducing the incidence of ectoparasite infestation. However, these still do not provide sufficient protection to do away with chemical intervention altogether. Thus, they advise that there are currently no practical alternatives to the use of diazinon in back rubbers and ear tags for the provision of long term buffalo fly control.

Although dung beetles have been widely introduced they are not proving to be a widespread success for fly control.

As far as sheep are concerned, synthetic pyrethroids and insect growth regulators can at present replace use of diazinon and other OPs in most situations. However, both of these classes of chemicals are comparatively slow acting and so, despite increasing evidence that blowflies are developing resistance to diazinon and other OPs the quick knock-down characteristic makes diazinon very valuable at present for the control of blowflies in long wool. As indicated above, OPs are the only class of chemical presently providing immediate kill of blowfly maggots.

Trapping systems for sheep blowflies have also been developed and are proving to be a useful method of reducing fly numbers, especially in the light of concerns regarding residues of ectoparasiticides in wool. However, trapping is unlikely to be able to contain severe flywaves and in fact, is not designed to replace chemical control mechanisms. It is simply an additional management tool that growers can use to reduce their reliance on chemicals methods of control.

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2.6.2 Domestic, Public and Industrial Pest Control

There are many other insecticides registered for control of insect pests in these situations. Examples are deltamethrin, permethrin and bendiocarb.

In addition, WA advised that numerous complaints in relation to its use in this context had been investigated. These usually centred around poisoning of pets, misapplication, odour and over use because of its relatively low cost. In fact, a prosecution had been mounted against a licensed pest control operator for dangerous over use.

The Tasmanian DPIF advised that there are two other effective powders for venomous ant (jack jumper, *Myrmecia pilulosa*) control in that State.

2.6.3 Agricultural Use

Diazinon is important in its agricultural use insofar as it is approved in a number of minor use situations (eg minor pests of major crops or major pest of minor crops). Although there are other chemicals available that could possibly replace diazinon in minor use situations, they are not approved for these uses. There is usually a question of commercial viability in extending use of new chemicals into minor use situations.

It is noted in this regard that chlorpyrifos is now registered for control of mealy bug and scale in pineapples. However, the chemicals are usually used alternately to minimise the possibility of a build up of resistance and chlorpyrifos is not considered a replacement for diazinon, but complementary in the control of these pests.

The NT agricultural authority indicated that diazinon has been replaced by fipronil and prothiofos for control of banana weevil borer in the NT. However the use of diazinon in banana production continues in Queensland.

In relation to the minor uses of diazinon, Queensland emphasised that these uses were important for the continued viability of the respective industries. It was also advised that it is considered that there are other chemicals that could be used in many of these situations but that they have not been registered or approved.

Mushroom Production

Pest monitoring is an essential component of IPM. If cecids are noticed when casing is being prepared, diazinon is recommended. Although chlorfenvinphos is also registered as a casing treatment, diazinon is preferred if phorids are observed. If a phorid or cecid problem persists, it could be necessary to use a compost treatment and diazinon is the only material registered. Although fipronil is registered as a casing treatment for phorids or cecids, it is not registered as a compost treatment and there are concerns that increasing its use will increase the possibility of insecticide resistance and subject it to the possibility of EMD (Enhanced Microbial Degradation).

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2.6.4 Lawns/Turf

The use of diazinon in this type of situation has been removed in the USA because of adverse environmental effects, particularly on birds. There are a number of other satisfactory turf insecticides (eg chlorpyrifos) with a similar spectrum of activity but which do not exhibit the same level of adverse impact on the environment.

2.6.5 Ornamentals

As indicated previously, advice from growers and State agricultural authorities suggests that diazinon is fairly widely used in the nursery industry in Australia for control of fungus gnats in potting mix. The NSW State agricultural authority has indicated that *Bacillus thurigiensis israeliensis* is an effective alternative for this use.

2.6.8 Skins and Hides

Diazinon is one of a number of chemicals that are registered for control of skin and hide beetles. No information was presented during the review to suggest that there was any deterioration in effectiveness in this application. However, information was obtained which suggested that different use patterns and pests may now prevail in this industry. Advice was obtained which suggested that the major treatment of hides is for control of flies and is carried out prior to pallets of salted hides being loaded into containers for shipping overseas. Diazinon has been found to be efficacious in this context.

2.7 Phytotoxicity and Adverse Drug Reactions

Russetting has occurred on green and yellow apple varieties and damage has occurred to ornamentals. The Tasmanian Department of Primary Industries and Fisheries has advised that phytotoxicity has been observed in the following ornamentals:

Anthurium, Aster, Dianthus, Gardenia, Lilium, Orchid, Rose, Stephanotis, Violet, Hibiscus, Pilea, Acer, Azalea, Cissus, Codiaeum, Cordyline, Cyclamen, Dracaena, Ivy, Hoya, Hydrangea, Poinsettia, African Violet.

Overseas information indicates that some varieties of lettuce are also affected by diazinon.

There have been a number of incidents of poisonings reported, including animal deaths, mainly associated with use of certain formulations of diazinon which have been stored in improperly sealed containers. Under certain conditions, diazinon can react to form highly toxic breakdown products. The causes of this chemical reaction and steps taken to prevent or minimise the formation of these breakdown products are dealt with in detail in the chemical assessment section of this review.

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Various State agricultural authorities report that they have investigated deaths or poisonings associated with the use of diazinon in cattle, dogs and horses. Toxicity to sheep has also been investigated by one State agricultural authority but was not substantiated.

2.8 Resistance Management

2.8.1 Ectoparasite Control

There is documented resistance in blowfly to organophosphate chemicals, including diazinon, and there is every possibility that buffalo fly will eventually become resistant to the organophosphate chemicals. There is also some evidence of cross resistance in sheep lice.

Resistance management and integrated pest management programs have been developed by State agricultural authorities to assist producers avoid or delay the development of resistance and prolong the useful life of the chemical. Management practices to avoid total reliance on chemicals are essential aspects of recommendations for control of sheep body lice and sheep blowflies (eg husbandry - shearing and crutching to reduce the attractiveness of sheep to blowflies; breeding techniques to reduce the incidence of lice infestation - ensuring lice infested sheep do not enter clean flocks.) However, these techniques are usually not sufficient in themselves and chemical intervention is required. In relation to use of diazinon in this context, the WA State agricultural authority advised that it still provided 4 weeks of protection and that this period of protection is acceptable in its jurisdiction as fly waves are often short, especially in summer.

2.8.2 Domestic, Public and Industrial Pest Control

None of the participants in the review indicated that there were any resistance problems in relation to these pests.

2.8.3 Agricultural Use

As for other organophosphate chemicals (with the exception of mevinphos), resistance of Diamond back moth in brassicas is high. No other information in relation to resistance of agricultural pests to diazinon was supplied during the review. However, it is clear that in some pests there is general OP resistance and that this would therefore apply in some degree to diazinon.

Advice from the Australian Mushroom Growers Association Ltd indicates that there is no evidence of development of insecticide resistance in any of the insect and mite pests that occur in mushrooms in Australia. Such resistance is, however, a major

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problem in Europe and North America and careful management of available insecticides is required to avoid the development of resistance.

2.9 Summary of Efficacy

In order to ascertain whether diazinon complies with contemporary assessment standards for efficacy, the NRA surveyed groups in the community who supply, provide technical advice on the use of, or use, this chemical. Performance questionnaires were therefore designed for large and small scale users of the chemicals, commodity organizations, State departments of agriculture and the chemical industry. Diazinon is an important chemical for insect control in a number of key areas of Australian agriculture.

2.9.1 Ectoparasite Control in Livestock

The most important use of diazinon is in the control of various ectoparasites in livestock, especially sheep and cattle. In the sheep industry, it is used as a wound treatment (eg mulesing, marking, docking) and for control of lice, itch mite and ked. In addition, in spite of documented resistance in blowflies, it is still used for the prevention and control of blowfly strike.

The major use of diazinon in cattle is for control of buffalo fly through use of backrubbers, ear tags and shower dips (spray races). It is also used for lice control. Although resistance is not a difficulty in buffalo fly at present, it appears inevitable that this pest will eventually attain resistance to this chemical. However, until that time it remains an important control chemical.

Diazinon is also registered for control of ectoparasites on other animals such as pigs, deer, dogs and horses. However, its use in these applications is declining. In addition to a decline in the use of dog collars and washes, there have been a number of incidents of poisonings reported, including animal deaths, mainly associated with use of older formulations of diazinon which have been stored in improperly sealed containers. Under certain conditions, diazinon can react to form highly toxic breakdown products. Although action has been taken by manufacturers to prevent this occurring, the association of diazinon with this phenomenon appears to have been retained in the public perception. Alternative chemicals and methods of treatment are also becoming increasingly available.

2.9.2 Agricultural Use

Although there is some use of diazinon in agriculture, its use in this area is not as important as in livestock production.

However, State agricultural authorities, in particular the Queensland Department of Primary Industries, indicated that there are uses in agriculture which are important for minor industries. In this context it was noted that diazinon is considered to be a

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strategic chemical for the pineapple industry and although chlorpyrifos is also registered, both chemicals are considered necessary for resistance management purposes. In other situations, possible alternative chemicals are not registered or approved.

The Australian mushroom industry advised that a total farm integrated pest management program based on physical exclusion, compost preparation, cultural control and strategic use of insecticides has been developed in Australia. Diazinon is one of the key insecticides used in the program.

Diazinon is also registered for use in lawns and turf and to control hide beetle in skins and hides. The former use resulted in activity to review diazinon use in the USA because of bird deaths associated with its use on golf courses and sod farms. This review has been broadened to include all aspects of diazinon use and it would appear that restriction of use of diazinon will result from this action.

It is clear that diazinon is still effective in the situations in which it is registered. However, in many instances, there are more effective alternatives or alternatives which do not have difficulties associated with use such as toxic breakdown products, odour etc. The exceptions to this are its use in sheep and cattle, where it is still seen as a pivotal component of fly control strategies.

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3. TRADE ASSESSMENT

3.1 Background

Another aspect of the NRA's contemporary assessment standards with which chemicals must comply in order to achieve and maintain registration is that use of the chemical must not result in any unacceptable risk to trade between Australia and other countries.

To evaluate the risk to trade when reviewing a product, matters taken into consideration include the following:

- Compatibility of MRLs with trading partners (including whether or not MRLs have actually been set in the importing country, compatibility of use patterns etc.)
- Registration status in the importing countries (including whether or not the material is banned or restricted in those countries)
- Review status in recognised international forums (such as the Codex Alimentarius Commission) and whether the importing country is a member of the reviewing organisations or recognises those organisations
- Detection of violative residues by the National Residue Survey
- Detection of violative residues in domestic produce which may indicate problems with overall use patterns
- Violations of importing countries' residue limits detected as a result of any residue monitoring carried out by the respective importing countries.

These matters have been examined and the results follow.

3.2 Registration Status

See Section 2.2 (Current Usage - Registration Status) and Section 3.6 (Overseas Registration Status)

3.3 Exports to Other Countries:

Use of diazinon in Australian agriculture has the potential to significantly impact on Australia's trade with other countries in that it is considered to be a critical component of strategies for control of ectoparasites in livestock, especially sheep and cattle. Although this is the only registered use of diazinon which significantly impacts on trade, its importance to these industries is such that it has been recognised by all wool producing States as a pivotal chemical for control of blowflies and lice in sheep.

In recent years, in common with other agricultural commodities, wool has been subject to an increasing demand for reduced pesticide residues from the various markets into which it is sold. Although pesticide residues are present mainly in the grease component of the wool and this is not as important a component of the trade as it was some years ago, the perception in the public that wool may be contaminated in some way by pesticide residues is a distinct marketing disadvantage. Australia's major competitors scour most of their

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wool before export and therefore remove a considerable proportion of the pesticide load. On the other hand, Australia exports 70% of its wool as greasy wool for scouring overseas and effluent standards in the countries which import Australian wool have become increasingly more stringent in recent years. For example, US buyers of raw greasy wool have notified Australian suppliers that they will not accept any raw wool grease with diazinon levels in excess of 40 mg/kg.

Nevertheless, Australian wool is presently comparable with competitor products as far as the presence of pesticide residues is concerned. However, the Australian wool industry, in common with Australian agriculture generally, wishes to promote its product as natural and produced in an environmentally friendly manner. It has therefore adopted strategies to further reduce the levels of pesticides in Australian wool. These are presented in detail in the NRA's report on the Review of Sheep Ectoparasiticides and involve proposed changes to use patterns, application techniques and processing technology.

Use of diazinon in livestock also affects trade in meat and meat products. In general because the Australian MRL for mammalian meat agrees with trading partner MRLs there are no difficulties in this area. An exception is Canada which has set a lower MRL, and steps have been taken by the industry and regulators to accommodate this difference.

In addition, diazinon is considered to be a pivotal chemical by some States in the production of two major fruit export crops, citrus and grapes. However, it is unlikely that trade in these commodities would be affected by use of diazinon in their production as indicated below. In particular, diazinon does not appear in records of monitoring (both export and domestic) for residues of pesticides in these commodities.

Other important uses of diazinon are in mushroom and pineapple production and the ornamental industry. Export of mushrooms is minimal because of difficulties maintaining quality during transport to markets and Australia actually imports approximately 25000 tonnes of canned pineapples to satisfy domestic demand. However, in spite of this, some 11000 tonnes of canned pineapples are exported to New Zealand annually, this being the only export market of any significance. Very small quantities of fresh fruit are exported to Kuwait, Singapore and Germany.

The affect of residues of diazinon on ornamentals exports is completely unknown. Nevertheless, it is clear that the presence of residues on ornamentals is not a factor in trade considerations at this point in time since there are no countries which have developed or imposed residue standards for these commodities.

3.3.1 Wool

Approximately 99% of total Australian wool production enters international trade. In spite of considerable fluctuations, wool remains a vital export earner

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for Australia returning more than $3.5 billion in 1996-97, which is more than 4% of national merchandise earnings and ranks among the most important export industries in the country.

Some 86% of all wool passing through the Australian auction system comprises combing fleece and oddment types which are ultimately processed on the worsted system (usually made from longer fibres, are fine, smooth, firm, and durable and used for fine dress fabrics and suitings). The remaining 14% being the shorter or carding wools such as locks, crutchings and lambs wool, is directed to the woollen system (usually made from shorter fibres, are thick and full and are used for such full-bodied items as tweed fabrics, knitwear and blankets).

Western Europe and Asia continue as the major export markets, accounting for 50% of total Australian wool exports.

The beginning of the nineties saw an increase in demand for knitwear which saw a revival in the woollen sector. Because manufacturing capacity in the woollen sector had been allowed to decline in the eighties, the demand, notably in Japan, caught some processors unprepared, leading to depletion of stocks of woollen yarn, fabric and apparel while stocks in the worsted sector increased.

At the same time, activity in Eastern Europe and the Commonwealth of Independent States (CIS) was severely depressed due to poor demand, shortage of funds to purchase raw materials, loss of export markets and civil war. China's wool textile industry has been revived by low wool prices and increased foreign investment, while manufacturers in South Korea and Taiwan continued to be active.

Over recent years there has been a trend to increased early stage processing of Australian wool before export. The main scope of domestic processing remains with worsted types for export in scoured or combed form. Processed wool represents of the order of 30% of total wool exports.

3.3.2 Meat

For a number of years beef has been the largest single Australian rural export with sales varying between $2.75 billion in 1991-92 and $2.53 billion in 1996-97 with a high of $3.2 billion in 1993-94. During the same period, mutton and lamb sales varied between $383 million and $518 million. Lamb sales more than doubled during the period, while mutton sales increased by approximately $7 million.

The long term outlook for Australia's meat and livestock industries is slightly more positive than it has been because of developments in the world economic outlook and trade policy environment in 1993-94. The major development was the completion of the Uruguay Round trade talks, which ABARE (Australian Bureau of Agricultural and Resource Economics) estimates should be worth $340 million to the Australian beef industry.

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In 1993-94, Japan emerged as the largest and most valuable export market for Australian beef and veal. Exports to the USA have had to be controlled from time to time through a quota entitlement scheme because of limits to beef imports imposed by the US government. However, a more satisfactory system of access has been negotiated which has the potential to add up to $230 million annually to Australia's earnings in this trade.

The Middle East has been the most important market for Australian mutton, with the largest market being Saudi Arabia and the fastest growing Iran. Significant development has taken place in trade with the Commonwealth of Independent States. Although the Middle East is normally also the major market for Australian lamb, the USA is also a major importer and in fact was the largest importer in 1993-94.

3.3.3 Other

Diazinon is registered for use and recommended by State authorities in two important fruit export crops. These are citrus (Queensland - citrus leaf miner) and grapes (Victoria - mealy bug). However, residues of diazinon have not been detected in these commodities (eg by the National Residue Survey) and it is likely that the explanation for this lies in the occurrence and relative importance of the pests.

In this regard, it is noted that the major exporting State for citrus is South Australia but that diazinon is only registered in NSW and Queensland for citrus leaf miner control. Entomologists confirm that citrus leaf miner is not a significant pest in the major export citrus producing State and therefore the likelihood of residues of diazinon from this use in export citrus is considerably reduced.

Similarly, mealybug is not a consistent major pest of grapevines and specific control using pesticides such as diazinon is not warranted every season.

In terms of value, the largest fresh fruit exports are currently citrus fruits, grapes and pome (apple and pear) fruit. In fact, oranges are the most valuable horticultural export crop followed by fresh apples, fresh grapes and fresh pears.

Citrus

Fresh citrus products worth $111 million to the Australian economy were exported in 1996-97. Exports of citrus juices and other processed citrus products are also an important part of the industry's operations. In 1992-93 the value of these exports amounted to $22 million.

The major export market sector is South East Asia which currently takes about 75% of the total citrus exports. Other important market areas include New Zealand, USA, Canada and the Middle East.

Grapevines

The Victorian Department of Natural Resources and Environment has advised that diazinon is an important chemical for control of mealy bug in grape production. It is noted that it is also registered in South Australia and Western Australia for this purpose. Both dried fruit (sultanas) and fresh table grapes could be affected. Wine is also a valuable export commodity which potentially could be affected by use of diazinon in the production of grapes used in wine making. ABARE indicates that exports of wine were valued at $470 million during 1996-97.

Exports of table grapes were around 14000 tonnes in 1996-97, worth approximately $34 million and although there is a general trend upwards in exports, they tend to reflect good or difficult production seasons.

Markets which are, or have recently been, important as export markets include Singapore, Malaysia, Indonesia, Hong Kong, United Kingdom and New Zealand. There are other markets in which the industry is interested but either have problems with quarantine restrictions or other trade impediments. These markets include Japan, Taiwan and Korea.

As far as dried vine fruits are concerned, the principal export crop is sultanas. In 1996-97 approximately $41 million worth of dried vine fruit (mostly sultanas) were exported from Australia. Germany, the United Kingdom, Canada, Japan and New Zealand are the major overseas markets accounting for about 80% of Australia's exports. The remainder is sold to other parts of Europe and Asia.

3.4. Potential Trade Problems

It is likely that the source of trade problems will be the presence of unacceptable residues of diazinon in traded commodities such as wool and beef and other meats through use of the chemical as an ectoparasiticide. It is less likely that problems will arise in mammalian meat commodities because MRLs in most trading partners in these commodities are the same as those set in Australia (0.7 mg/kg). However, the exception is Canada, which has set a much lower level (0.1 mg/kg).

Wool

The potential for trade problems (and other problems such as occupational health and safety and environmental) to arise because of residues of ectoparasiticides, including diazinon, in wool has been recognised by the Australian wool industry. In order to forestall any possible deleterious effects on the industry, this matter has been thoroughly examined in a comprehensive review of sheep ectoparasiticides carried out by the NRA at the request of the Australian Wool Industry Residue Council.

The review made a number of recommendations in relation to the way in which ectoparasiticides are used and wool is marketed and processed which

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would assist in overcoming any problems which might arise from current practices in the wool industry.

More details on this review are contained elsewhere in this report. However, it is sufficient to indicate at this point that current and future trade in Australian wool should not be affected by the presence of residues of ectoparasiticides in the wool.

Meat (Mammalian)

Because of its wide use in livestock, it is possible that unacceptable residues of diazinon may result in meat and other animal commodities and thereby cause difficulties in trade in these commodities. The National Residue Survey has certainly detected residues of diazinon in its monitoring of export meat. However, these levels have been well within the MRL for diazinon.

A summary of residues detected in meat (in the fat) follows.

Residues of diazinon detected in animal products by the National Residue Survey*

Commodity	% of samples with diazinon residues**
beef fat	0.37
porcine fat	0.91
ovine fat	0.64
poultry fat	0.94

*** Meat sample results from 1/1/95 to 31/12/97**

**** All residue detections were below 0.5xMRL**

It is commented that Australian MRLs for these commodities are generally the same as those for trading partners. A comparison of some trading partner MRLs follows:

Comparison of selected MRLs for diazinon

Commodity	Countries' MRL/Tolerance for diazinon (mg/kg)				
	Australia	Canada	Japan	United States	Codex
Meat	0.7	0.1	No information	0.7	0.7

It is clear that Canada is exceptional in relation to the establishment of MRLs for diazinon and that violations of the Canadian MRL could have occurred. However, as indicated below an export slaughter interval of 10 days (as opposed to the Australian withholding period of 3 days for other markets) has been set for this market.

3.5 Advantages of product

In the cattle industry, diazinon is an organophosphate chemical to which buffalo fly has not yet exhibited a high level of resistance. This is an advantage in devising resistance management strategies, because it is a representative chemical from a chemical group with different chemistry and a different mode of action to most other chemicals registered for control of this pest.

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In the sheep industry, although there is resistance to diazinon in sheep blowfly, the level of resistance is still manageable. Diazinon is generally recognised as a most useful chemical because it has a quick knock-down effect on lice and flies. Although there are alternative chemicals available (mainly synthetic pyrethroids and insect growth regulators), these are slow acting in comparison.

Ear tags and backrubbers are the only practical means of providing long term control of buffalo fly. Diazinon is the only chemical registered for use in backrubbers on dairy cattle.

One of the major advantages cited by producers and agricultural authorities was the relative cost of diazinon. It would appear that diazinon is significantly lower in price than OP chemicals in general and mush less expensive than alternatives such as insect growth regulators and synthetic pyrethroids. Although cost effectiveness is outside the scope of NRA reviews, it is clear that it is a significant factor in determining chemical use by producers.

3.6. Overseas Registration Status

Diazinon is registered in many countries including those listed in the following table. To date, no information has been discovered which suggests that action has been taken in any country to place a total ban on this chemical, although limitations in certain use situations have been imposed.

Thus, a Special Review by the US EPA of all products containing diazinon and recommended for use on golf courses and sod farms was announced in January 1986. The Special Review was based on the hazard to non-target birds from diazinon's use on these two sites. The Preliminary Determination proposed cancellation of registrations and denial of applications for diazinon products used on these two sites.

The EPA carefully reviewed all of the new information and all the comments that were submitted. The Agency still concludes that the hazard to birds from diazinon use on golf courses and sod farms outweighs the minor benefits and that cancellation of these uses is the only appropriate action. In addition the EPA is concerned about the hazard to birds from diazinon use in other situations. The database is inadequate to evaluate the hazard on all the remaining situations at this time. Consequently, the EPA is requiring the data necessary to fully evaluate this problem through the re-registration process. A Registration Standard was due for completion by the end of 1997.

Finland	The Netherlands
Denmark	Austria
Ireland	France
United Kingdom	Spain
Belgium	Italy
Greece	Japan
United States	China
India	Brazil

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Sweden	Portugal

Trade names for products containing diazinon which are registered in overseas countries include Diazol, Diacur, Diazide, Spectracide, Diazajet, Knox Out, Neocidol.

It is formulated overseas into dusts, emulsifiable and oil solutions, granules, seed dressings, ULVs, wettable powders and by microencapsulation.

3.6.1. Use Patterns in Relevant Countries Overseas

Detailed information on use patterns in overseas countries (including rates timing and frequency of use) has not been examined. However, information from the United States indicated that diazinon was used in that country in the following crops/situations to control the nominated pests:

Soil insects, and pests of fruits (eg apples apricots, bananas, cherries, grapes, melons, nectarines, peaches, pears, pineapples, plums, prunes, strawberries, watermelons), vegetables (eg beets, broccoli, Brussels sprouts, cabbage, carrots, cauliflower, celery, collards, corn, cucumbers, endive, kale, guar, lettuce, lime beans, mustard, onions, parsley, parsnips, peppers, potatoes, radishes, spinach, squash, sweet potatoes, Swiss chard, tomatoes, turnips), tobacco, forage, field crops (eg corn, soybeans, sugar cane, range, pasture, grasslands, ornamentals. It is used in commercial, industrial and domestic premises for control of cockroaches, silverfish, ants, flies and fleas. In turf it is used for control of grubs and nematodes and is also used generally as a seed treatment and for fly control. As an ectoparasiticide it is used on sheep.

In other countries, as well as the above uses, it is also used in rice for control of stemborers and leafhoppers and has many livestock uses.

The US EPA's review of all products containing diazinon resulted in agreement between registrants and the regulator to terminate all indoor and a range of agricultural uses of diazinon. The indoor uses include applications for pet collars, aircraft, food and feed handling establishments, greenhouses, schools, residences, commercial buildings, sports facilities, stores, warehouses and hospitals. Among the 28 agricultural uses to be discontinued are applications to a variety of fruit, vegetable and cotton crops, along with uses for forestry, tobacco and pastures.

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3.6.2 MRLs in Overseas Countries

A comparison of some trading partner MRLs follows:

Comparison of selected MRLs for diazinon

Commodity	Countries' MRL/Tolerance for diazinon (mg/kg)				
	Australia	Singapore	Japan	United States	Codex
Meat	0.7	No information	No information	0.7	0.7
Fruits	0.5		None set**	None set*	0.5
Vegetables	0.5		None set**	None set*	0.5
Citrus fruits	0.7		None set**	None set	None set
Sugar cane	0.5		None set	0.75	None set
Cereal grains	0.1		None set**	None set*	None set

* General fruit, vegetable and cereal grain MRLs have not been set. However, individual MRLs have been set for some individual commodities. In general, these agree with Australian MRLs.

** General fruit, vegetable and cereal grain MRLs have not been set. However, where individual fruit and vegetable MRLs have been set, they have been set at 0.1 mg/kg

Generally, Australian MRLs for diazinon are comparable with trading partners. The exceptions to this are Japanese MRLs and Canadian meat MRLs (not listed above). These MRLs have been set at 0.1 mg/kg which is well below the equivalent Australian MRLs and there is potential for residue violations. Action has been taken by industry groups and regulators in relation to the Canadian MRL and there is a relatively minor trade with Japan in the commodities for which the MRLs may not be compatible. In any case residue surveys of the Australian diet (Australian Market Basket Survey) show that residues of diazinon which appear in these commodities on the Australian domestic market are well below the Japanese MRLs (See Section 3.11). It would be expected that the situation with export produce would reflect the domestic situation.

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3.6.3. Codex MRLs

Following is a comparison of Australian and Codex MRLs.

Comparison of Australian and Codex MRLs

Commodity	Australian MRL (mg/kg)	Codex MRL (mg/kg)
Cereal grains	0.1	None set
Citrus fruits	0.7	None set
Edible offal (mammalian)	0.7	0.7
Eggs	0.05	None set
Fruits (except citrus fruits; olives; peach)	0.5	0.5
Kiwifruit	0.5	0.2
Meat (mammalian) (in the fat)	0.7	0.7
Milks (in the fat)	0.5	0.02
Olive oil, crude	2	None set
Olives (unprocessed)	2	None set
Peach	0.7	0.7
Poultry, Edible offal of	0.05	None set
Poultry meat	0.05	None set
Sugar cane	0.5	None set
Sweet corn (corn-on-the-cob)	0.7	0.02
Tree nuts	0.1	None set
Vegetable oils, crude (except olive oil, crude)	0.1	None set
Vegetables	0.7	0.5

In general, where Australian MRLs and Codex MRLs are set the Australian MRLs are slightly higher. The notable exception to this is mammalian meat and edible offal (mammalian) which are the same.

The only situation in which there would appear to be a potential difficulty is in citrus, where diazinon is a preferred chemical for citrus leaf miner control in Queensland. In this case there is an important export crop in which diazinon is used as a preferred chemical to control a relatively important pest and there is an incompatibility in the MRLs. Nevertheless, Australian residue surveys do not indicate that there are any residues of significance in citrus. In fact, diazinon was never detected by the National Residue Survey while it was analysing fruit and vegetables and it has not been detected in the most recently published Australian Market Basket Survey (1994).

A complete examination of the residue situation is contained in the Residues section of the report.

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3.7. Export Slaughter Intervals

In response to the residues found in Australian beef in the USA, the Meat Research Corporation funded trials to examine the residues found in beef following typical farm treatments for tick and buffalo fly. Different treatment regimes were used with a variety of chemicals.

Samples were collected from cattle slaughtered between half and fourteen days after treatment. Subcutaneous fat was collected from all animals and for some treatments muscle, kidney and renal fat were also collected.

Chemicals varied in how long residues persisted in the animal. There was also considerable variation between animals in the amount of residue detected after a particular treatment, particularly in the case of synthetic pyrethroid treatments. Multiple treatments tended to accumulate chemicals.

Residues of diazinon were well below all tolerances except the Canadian of 0.1 mg/kg and the ESI was set at 10 days for the Canadian market only, the withholding period (3 days) still applies as the ESI for all other markets.

Further discussion of residues in animal commodities is contained within the section on residues.

3.8. Labelling Related to Trade

3.9.

It is clear that recommendations relating to modifications to labelling will result from the NRA's review of sheep ectoparasiticides. It is foreshadowed in the draft report that modifications to use patterns will be one of the strategies proposed to ensure that residues of ectoparasiticides (including diazinon) are kept to an absolute minimum.

An export slaughter interval of 10 days for beef destined for the Canadian market is also recommended because of the lower Canadian residue limit for diazinon in beef.

3.9. Data Submitted to Support Compliance with Overseas MRLs

Significant studies have been conducted by DPIQ and NSW Agriculture on the uptake and depletion of residues of ectoparasiticides in cattle produced under typical farm situations within the cattle tick and buffalo fly infested areas of Queensland and New South Wales.

This information was provided to the reviewers for information, since both the study of residues in beef and wool were established and carried out separately to the ECRP Review.

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As far as beef is concerned, it was clear on the basis of the data collected during the study, that the Australian withholding period of 3 days was adequate to enable beef to comply with the Australian MRL. Since the US tolerance is set at the same figure as the Australian MRL, it is clear that compliance with the Australian withholding period as an export slaughter interval will also ensure compliance with US residue requirements.

Only the Canadian market has a lower MRL and the data indicated that a period of 10 days would be required to ensure compliance of Australian beef in that market.

3.10. Authorities and Grower Views on Use

All animal production sectors of Australian agriculture represented during the survey of the current usage of diazinon indicated that this chemical was a vital component in production strategies affecting the viability of their respective farming situations or the situations which they represented. State agricultural authorities identified the following situations/industries which would be severely handicapped in terms of export production capacity by reduction in the current availability of diazinon (note that diazinon is generally considered to be a minor chemical for cropping use):

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Table 6 - Uses advised as strategic for primary industry in respective States by State agricultural authorities*

Crops/Situations /Animals	State / Essential Uses							
	Qld	NSW	Vic	SA	WA	Tas	NT	ACT
Sheep	Blowfly Lice	Lice	Ectoparasite Control		Blowfly	Blowfly Lice		
Beef and Dairy Cattle	Buffalo Fly	Buffalo Fly						
Other Livestock		Buffalo Fly	Ectoparasite Control					
Pineapple	Mealy Bug, Ants and Pineapple Scale							
Bananas	Rust thrips							
Onion	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips	Onion maggot, thrips
Garlic	Onion maggot							
Carrots	Cutworms							
Cauliflower					Onion maggot (*Delia platura*)			
Rhubarb	Oriental cornborer							
Silverbeet	Webworms							
Beetroot	Webworms							
Beans	Flower caterpillar, blossom caterpillar, bean fly							
Mushrooms	Phorids, cecids							
Macadamia		Feltid coccid, other macadamia tree pests						
Home Gardens								
Cucurbits (capsicum, carrot, celery, sweet corn)	Caterpillars, cutworms			No information supplied		jack jumper nests (*Myrmecia pilosula*) - can be life-threatening for humans		
Grape Vines								
Nursery Plants (including	Fungus gnats, staphylinid		Required by WA and Tas for					

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ornamentals)	beetle Required by WA and Tas for disinfestation of nursery plants		disinfestation of nursery plants					
Domestic, Public and Industrial Pest Control					General pest and ant control			
Brassicas		Whitefly						

*** Note: These uses may be considered essential although there are other products registered for the nominated pests. This may be because diazinon is considered to be an essential part of a resistance management strategy or an integrated pest management strategy.**

3.11. Other

The most recent Australian Market Basket Survey provides the following information on diazinon in the Australian diet.

The ADI for diazinon is 1.0 µg/kg bw/day

The estimated intake in diets based on the average energy intake range from 0.0112 µg/kg for an adult female to 0.0228 µg/kg for a child aged 2.

The estimated intake based on the 95th percentile energy intake range from 0.0186 µg/kg for an adult female up to 0.0267 µg/kg for a child aged 2.

The maximum levels of diazinon found in Australian foods in the most recent Market Basket Survey are:

Beef, minced	0.08 mg/kg
Bran, wheat unprocessed	0.01 mg/kg
Bread, white	0.01 mg/kg
Bread, wholemeal	0.01 mg/kg
Cabbage, white	0.01 mg/kg
Carrots	0.01 mg/kg
Celery	0.01 mg/kg
Eggs	0.02 mg/kg
Extruded snack foods	0.01 mg/kg
Kidney beans, canned	0.01 mg/kg
Lettuce	0.04 mg/kg
Mushrooms	0.05 mg/kg
Onions	0.02 mg/kg
Pork, minced	0.01 mg/kg
Potatoes	0.01 mg/kg
Pumpkin	0.02 mg/kg
Sausages	0.01 mg/kg
Sweetcorn, canned	0.02 mg/kg

Diazinon residues have also been detected in several export commodities by the National Residue Survey (See Section 2.2.4). These residues have been well below the MRLs for these commodities.

3.12 Summary of Trade

Diazinon is widely used in Australian livestock industries as an ectoparasiticide and implications of diazinon use in these fields constitute the major consideration in relation to affects on trade of use of diazinon. It has major advantages in this context in that it has a quick knockdown effect and is an organophosphate chemical which is helpful in terms of establishing resistance management strategies.

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Beef and wool are the commodities with the most potential to be affected by residues remaining from use of diazinon in sheep and cattle. These are the two major Australian primary product exports with a total value to the Australian economy of the order of $6 billion. The major uses of diazinon in sheep are for the prevention and control of blowfly strike through use as a wound treatment (eg mulesing, marking, docking etc) and for control of lice, itch mite and ked through use of plunge dips, jetting races and hand jetting. Its major use in cattle is for control of buffalo fly and to a lesser extent, ticks and lice when used in shower dips (spray races), backrubbers and ear tags.

Wool

In order to forestall any possible deleterious trade effects on the Australian wool industry, issues related to the presence of ectoparasiticides in wool have been thoroughly examined in a separate, comprehensive review of sheep ectoparasiticides carried out by the NRA at the request of the Australian Wool Industry Residue Council.

The review made a number of recommendations in relation to the way in which ectoparasiticides are used and wool is marketed and processed which would assist in overcoming any problems which might arise from current practices in the wool industry.

More details on this review are contained elsewhere in this report. However, it is sufficient to indicate at this point that current and future trade in Australian wool should not be affected by the presence of residues of ectoparasiticides, including diazinon, in the wool.

Meat

As far as the meat industry is concerned, all countries apart from Canada, have meat residue limits which coincide with the Australian residue limit. This means that compliance with the Australian withholding period by beef producers will enable them to comply with the requirements of all countries except Canada. For Canada, an export slaughter interval of 10 days is recommended.

Cropping industries

Although diazinon is registered in a broad range of crops including vegetables, field crops and fruits, information supplied by respondents to the performance questionnaires indicates that it is not usually used as the insecticide of choice in these industries.

Exceptions are its use in citrus and grapevines. However, it is clear that residues of diazinon should be very rare because of the way diazinon is used in these crops. In fact, residues of diazinon have not been detected in any monitoring programs which included these commodities.

In addition, one respondent suggested that there is significant use by small scale market gardeners growing vegetables for local markets. Nevertheless, because of the comparatively minor amounts used in larger scale vegetable production, it is extremely unlikely that significant residues would be present in export vegetables. Similarly, diazinon is used for a number of minor uses where there are no registered or approved alternatives and which have no trade implications.

It is noted however, that residues of diazinon (well below the MRLs for the respective crops) were detected in the 1994 Market Basket Survey in some vegetables. In contrast, residues of diazinon were never detected in horticultural produce during the period in which the National Residue Survey (NRS) was monitoring fruit and vegetables.

Regulatory activity

There is regulatory activity in relation to diazinon in the USA, but it has not yet affected use of diazinon in livestock or the respective tolerances. This regulatory activity involved initially use of diazinon on golf courses and sod farms and was precipitated by bird mortalities associated with these uses. There has also been regulatory activity in relation to diazinon in India where its use on plant hoppers in rice has been cancelled because use results in adverse effects on brown planthopper predators.

Overseas regulatory activity has not affected Australia's trade with other countries.

In summary then, potential difficulties in trade have been recognised by commodity organizations and regulators and action taken to avoid these difficulties through appropriate changes in production and management techniques.

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