Section 3

AGRICULTURAL ASSESSMENT

1. INTRODUCTION

1.1 Registration Status

There are 9 products containing chlorfenvinphos currently registered in Australia by 4 registrants and these are listed in the following table.

Registered products containing chlorfenvinphos*

Product Name	Registrant
Birlane 500 Insecticide (47478)	Cyanamid Agriculture
David Grays Aerosol Sheep Dressing (42259)	David Gray & Co Pty Ltd
Barricade 'S' Cattle Dip and Spray (45211)	Fort Dodge Australia P/L
Supona Buffalo Fly Insecticide (45594)	Fort Dodge Australia P/L
Defiance 'S' Insecticidal Fly Strike, Mules and Wound Dressing (45736)	Fort Dodge Australia P/L
Coopers Blockade 'S' Cattle Dip and Spray (46815)	Schering-Plough Animal Health
Coopers Suprex 100 Jetting Fluid (33428)	Schering-Plough Animal Health
WSD Jetting Fluid 100 Jetting Fluid for control of flystrike on sheep (39576)	Western Stock Distributors
WSD Aerosol Sheep Dressing (39575)	Western Stock Distributors

***Note:**

1. **This list does not include those products which have not been renewed by applicants but which are still permitted to be sold for two years to clear stocks.**

Chlorfenvinphos Technical Grade Active Constituents (TGACs)

Active Constituent	Approval Holder
Chlorfenvinphos (44031)	Cyanamid Agriculture Pty Ltd
Chlorfenvinphos (46687)	Australian Generics Pty Ltd

Ectoparasite Treatments -Buffalo Fly (Cattle)

Chlorfenvinphos alone is used for control of buffalo fly either as a backrubber treatment or as an overspray application. When used as a backrubber treatment, a mixture is prepared which consists of 1 L concentrate/20 L sump oil. Backrubbers are then charged at a rate of 20 mL prepared mixture per animal every three weeks. Instructions on the construction of suitable types of backrubbers are available to producers from the registrant company and respective State agricultural authorities. Backrubbers are also available from a small number of manufacturers.

When applied as an overspray, chlorfenvinphos is used at the rate of 50 mL of a 0.4% w/v solution as a coarse spray. Adequate coverage is achieved by making 4 passes of the spray along the dorsal midline of each animal from neck to rump. Treatment intervals of 21 days are recommended during the buffalo fly season (November to April), with a minimum re-treatment interval of 10 days. The label recommends no more than 18 overspray treatments in any one year.

Ectoparasite Treatments – Ticks (Cattle)

Chlorfenvinphos, in combination with cypermethrin, gives excellent control of all known resistant tick strains except Parkhurst and Ultimo. This combination of chemicals also controls three host ticks and buffalo fly and may be used on beef and dairy cattle, horses, deer, sheep and goats by means of plunge dips, spray races or hand sprays.

The working strength dilutions are prepared by diluting the concentrate to a 0.01% solution of cypermethrin. This results in a concentration of chlorfenvinphos of 0.055% in the prepared dip solution. Topping up is carried out at the rate of 1 L to each 185 L of water and should occur out before dip levels fall more than 2000 L or 300 L in spray races. In the past, dips have been stirred to ensure uniform concentration of the chemical in the dip by initially passing 20 - 25 cattle through the dip. These cattle are then re-dipped. However, because of concerns in relation to residue levels which may result from this practice, use of stirrer cattle has now been prohibited. Manual paddles or compressed air are now used to ensure that dips are properly mixed. Recirculating spray races are usually run for about 5 minutes before animals are treated.

Recommended retreatment intervals vary between 10 and 21 days depending on the parasite. An interval of 19-21 days is recommended for cattle tick, 14 days for bush ticks and 10 days for paralysis tick. No more than 10 re-treatments should be carried out in any one year.

Ectoparasite Treatments – Sheep

There are five products containing chlorfenvinphos which are registered for the treatment and control of blowfly strike of sheep.

All products are advocated for topical application to struck areas and open wounds to prevent strike. However, two are aerosol formulations which can be sprayed onto the struck area as a treatment or onto wounds for the prevention of flystrike. The others are also applied direct, but by using either a stencil brush or a pressure sprayer. Treatments are to be repeated as necessary.

The label for one of the non-aerosol formulations indicates that a period of 10 days minimum should elapse before the material is re-applied and that it should not be applied more than five times per year. The label for the aerosol formulations indicates that the treatment should be repeated as necessary, but does not specify a maximum number of treatments or a re-treatment interval.

Wound Treatments (Cattle) - Superficial Wounds

A product containing 2.5 g/L chlorfenvinphos *(Defiance 'S' Insecticidal Flystrike Mules and Wound Dressing)* is registered as a treatment for superficial wounds in cattle. The material is to be applied, undiluted, direct to the wound. A dose rate of 0.5 - 1 mL (max) /5 kg liveweight is recommended depending on the size of the wound. It should not be applied at less than 10 day intervals and applied a maximum of 5 times per year. No instructions in relation to methods of application are included on the label

for this use. However, for mulesing and marking wounds, advice on the label suggests that the material may be applied with a stencil brush or pressure sprayer.

Wound Treatments (Sheep)

The same treatment which is used for control of blowfly strike is also used for the treatment of wounds to prevent flystrike.

Pasture

Chlorfenvinphos is also registered for control of *Oncopera spp* in pastures. In this case, for broadcast application, a rate of 850 mL or 1 L/ha is recommended in Tasmania while a rate of 550 or 770 mL/ha is recommended in Victoria and South Australia. In Queensland the rates recommended are 550 mL/ha by broadcast application and 50 mL/100 L by directed application. The same rates recommended for *Oncopera spp* in Tasmania, Victoria and South Australia apply for control of redlegged earth mite and lucerne flea in pasture lucerne. Retreatment intervals or frequencies are not specified on the labels.

However, advice from the Tasmanian Department of Primary Industries and Fisheries indicates that only one application per season is normally required for control of *Oncopera spp* in that State. Occasionally, where there has been a failure due to poor application techniques or adverse weather conditions, there is a need for another spray. Spraying is only undertaken when economic thresholds are reached, and advice is provided to growers by the Department on how to judge when these thresholds have been reached.

Mushroom casings

Chlorfenvinphos is registered for incorporation into mushroom casing for the control of sciarids. The current practice is to apply *Birlane 500 Insecticide* in water at a rate of 100mL/1L water however advice from the industry indicates that only 7 to 8% of the mushroom industry would use this insecticide. It remains active for 10 days after application to casing so it is used as a short-term insecticide at the initial stages of cropping.

Potatoes'

Chlorfenvinphos is registered for the control of potato moth as a broadcast application of 550mL/ha in all States, and as a directed spray in Queensland at a rate of 50mL/100L. It is applied at 14 days intervals which are reduced to 7-10 days during periods of intense moth activity.

1.2 Methods of Application

Ectoparasite Treatments

In Queensland, planned dipping remains the most efficient chemical method of tick control for cattle which are highly susceptible to ticks. European breeds and crossbreeds with less than 3/8 Zebu blood are very prone to tick infestation. Most cattlemen control their ticks by conventional dipping.

One of the practical problems in using chemicals to control ectoparasites is their application to the pests. When plunge or spray dips are used for this purpose, the design and construction of the dips are of prime importance in achieving efficient control.

Cattle - Plunge Dip

Advice from the Queensland Department of Primary Industries indicates that plunge dipping is the most expeditious, convenient, efficient and practical method of controlling cattle ticks.

Careful siting of dips is essential to avoid the possibility of flooding into waterways or affecting surrounding vegetation or native fauna.

A dip consists of an approach, a vat and a draining area. The dipping vat is laid out so that cattle enter and leave it on an uphill plane.

Dips vary in capacity from about 9000 L for small herds to 18000 L for large herds. A standard sized dip in Australia for herds of 500 cattle is 11000 L. A dip with greater capacity can handle more cattle before replenishment is required.

Management of the dip is directly concerned with maintaining an effective and uniform concentration of chemical in the dipping vat, and ensuring that cattle receive an adequate treatment with the fluid.

In order to ensure that adequate chemical is contained in the dip, the dip is firstly charged with the recommended amount of concentrate for the capacity of the dip. However, most chemicals used for ectoparasite control are formulated as concentrates which allows them to be dispersed in water either as tiny droplets or as very small particles. They therefore 'strip' out of the dip liquid and more chemical and water need to be added during the dipping operation to ensure that an adequate concentration of chemical is maintained in the dip. This process is known as replenishment. Reinforcement is the process of adding more concentrate to the dip to ensure an adequate concentration of chemical in the dip.

Frequent replenishment helps control stripping because the stripping rate increases as the dip volume decreases. It is recommended to replenish before the volume has declined by 1500 L.

As with any mixture of chemicals, thorough stirring is required to ensure homogenous mixing. Stirring was once carried out by passing about 30 head of cattle through the dip and then re-dipping them. However, concerns regarding residue levels in cattle handled in this way has resulted in a prohibition of use of stirrer cattle in favour of mechanical agitation of the dip.

The amount of pollution and extraneous matter which ends up in the dip also affects the efficiency of operation of the dip. Various filter mechanisms and simple physical removal of dirt and hair from the dip are used to counteract the pollution of dips.

Cattle - Spray Race

An alternative to plunge dipping is 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 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 driven by either a stationary petrol engine, an electric motor or the power take-off of a tractor.

It is recommended that the race operate at low pressure delivering high volume, eg 140 kPa delivering 90000 L per hour. The sump of a spray race must be calibrated every 200 L by using a water meter or by adding measured quantities of water and marking the side of the sump or a vertically suspended dip stick.

One of the greatest disadvantages of a spray race is that excessive stripping or exhaustion of wash occurs. Producers usually combat stripping by overcharging, reinforcment, replenishment or continuous replenishment. Continuous replenishment is the most effective means of counteracting stripping.

Sheep - Plunge dips

The operation of sheep dips is similar to the operation of cattle dips, apart from the physical size. Accurate calibration permanently marked on the dip is essential for effective dipping. The preferred method for showing the calibration on the dip is to mark the side of the dip in 250 or 500 L graduations with waterproof paint. Assistance to help producers calibrate dips is available from many sources including, chemical companies, local State department advisers or chemical suppliers.

In order to prepare the dip for use, it is partially filled with water and the recommended amount of chemical concentrate pre-mixed in a bucket added. The dip is then filled to the mark whilst stirring constantly with a large paddle or pump. Mixing is continued for at least 5 minutes after filling has been completed. The dip level should be diligently monitored and reinforcing or topping up as per label instructions during dipping. Proper stirring is critical when topping up or reinforcing.

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 net. T-shaped poles are used to push sheep under the dip surface. The first two pens through a dip are the hardest to wet and these should be re-dipped.

Jetting races (Automatic Jetting or Spray Races)

Automatic jetting races give about half the period of protection provided by hand jetting for fly control, 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.

Automatic jetters can be used to apply a preventative fly treatment to protect sheep against impending flystrike. The short term protection afforded by automatic jetting will reduce fly population build up, and where fly pressure is not sustained, will avert fly strike. Automatic jetters are not suitable for lice control

because chemical coverage and penetration is not adequate to ensure most of the lice come in contact with the chemical.

However, where the fly population is large and sustained fly activity is likely to occur, the use of automatic jetters is not advisable. Sheep already struck need to be hand jetted or dressed to ensure that the whole wound is treated.

Hand Jetting

This is the most effective method of applying jetting chemicals, but it is also labour intensive. For the best results all wool in the region to be treated should be thoroughly saturated to skin level. The volume of jetting fluid used will depend on the age of the sheep and the length of the wool. Adult sheep with more than 6 months wool will require 4 to 5 L of wash to cover body and breech. Up to 900 kPa pressure for dense-woolled sheep with nine to twelve months wool growth; 550 to 600 kPa ia satisfactory for sheep with 6 months wool.

Shower Dipping

Off shears shower dipping is a cheap and effective method of lice treatment. Charging the dip with the correct volume of chemical and keeping the concentration constant will give effective off shears lice control.

1.3 Permits

Supply and use of chlorfenvinphos can be permitted by the NRA in certain circumstances such as minor and/or emergency uses and for trial purposes for uses not currently registered. A current permit exists for chlorfenvinphos for use in NSW and Qld for control of cattle tick in horse, deer, goats, sheep, cattle and buffalo, when moving across boarders. It is an off-label minor use permit where the variation to the registered conditions is a decrease in the re-treatment interval from 10 to 3 days.

In addition, there are some State issued permits which pre-date the NRA. In this regard, chlorfenvinphos is permitted in Queensland for regulatory movement treatments of alpacas, buffalo, camels, llamas and circus stock, all of which carry cattle tick and for which there are no other chemicals available.

In some States, use of any registered agricultural chemical is permitted unless it is specifically prohibited. By implication, producers could be using chlorfenvinphos off-label without the knowledge of State authorities.

1.4 Performance Questionnaires

The NRA chose to gain information on the agricultural aspects of the use of chlorfenvinphos by surveying various groups involved as advisers, users and registrants of the chemical. This was done by sending

Performance Questionnaires to State agricultural authorities, commodity and industry organisations, users and registrants. The purpose of the questionnaire was to gather information on use, performance, changed agricultural practices, adverse effects and trade and residues. The results form part of the agricultural assessment which appears in this section.

1.4.1 Use Pattern and Justification for Use

Control of Ectoparasites - Cattle, Sheep, Horses, Goats, Deer, Working Dogs

An examination of completed performance questionnaires for chlorfenvinphos indicates that use of this chemical is considered to be a critical component in strategies developed for control of ectoparasites on livestock. Support for this use comes particularly from the Queensland and NSW agricultural authorities, since there are particular difficulties in these States with ectoparasites; but support for these uses also comes from other States, particularly Victoria, Western Australia and Tasmania. Its use as an ectoparasiticide is not unique, in that it is one of a number of organophosphate chemicals which are used in conjunction with other chemical groups to control cattle tick and buffalo fly in cattle, horses, deer and working dogs and blowfly strike in sheep. In this context it is an integral part of strategies for combating the development of resistance in these parasites. It is also registered as a treatment for superficial wounds in cattle and sheep.

Pasture

Perhaps the most important agricultural use of chlorfenvinphos is in pastures, where it is one of only two chemicals registered for control of a uniquely Tasmanian pasture pest, the corbie *Oncopera intricata* Walker. The Tasmanian Department of Primary Industries and Fisheries has advised that all of Tasmania's 900 000 ha of pasture is subject to attack by this pest on an annual basis. Seasonal conditions influence the severity of attack. The Tasmanian Department of Primary Industries and Fisheries has advised that it has been able to establish threshhold levels of damage to pasture through its Hazard Resistant Pasture Program. Pest activity up to these thresholds does not require control intervention, while pest activity beyond these thresholds indicates that spraying is necessary.

Fenitrothion, which is also under review, is the only other chemical registered for control of this and other pasture pests in Tasmania.

Mushrooms

The Australian Mushroom Growers Association have advised that chlorfenvinphos was first registered in 1980 and originally provided about seven weeks protection from all the major fly pests of cultivated mushrooms. It rapidly became the industry standard treatment, but by 1985, enhanced microbial degradation (EMD) reduced the period of protection offered by chlorfenvinphos to less than three weeks. Despite its shortened period of protection, chlorfenvinphos, when incorporated into the casing layer, still provides protection against phorid infestation for two weeks after casing application. This initial period is important since it has been shown that infestation later than this does not reduce yield.

There is no provision in the registration for watering on, or drenching, the mushroom beds as this produces a concentration gradient down the casing layer, which in turn results in sub-lethal doses and enhances the possibility of the development of insecticide resistance.

The recommended practice is to regularly monitor the farm for the presence of fly pests and if phorids are seen use an appropriate insecticide in the next batch of casing prepared and continue this until there are no or very few phorids to be found. On most commercial farms, casing is applied weekly. Either chlorfenvinphos or fipronil could be used, but chlorfenvinphos is cheaper and will control low level infestations.

Potatoes

Advice from the Australian Vegetable & Potato Growers Federation is that use of chlorfenvinphos for the control of potato moth has been declining over the past ten years with other management measures being widely used to prevent the access of the potato moth to potato tubers. It is now mainly used where these management techniques fail and during seasons in which potato moth pressure is high. It is thus considered to be a useful backup chemical treatment which the industry would like to retain.

Other Uses

Chlorfenvinphos is also registered for control of flies around farm buildings, redlegged earth mite and lucerne flea in lucerne pasture. Although none of the respondents commented on the need for chlorfenvinphos for control of red legged earth mite and lucerne flea, submissions were made in relation to potatoes and mushrooms.

Recommended Spray Programs by State Agricultural Authorities

Several State agricultural authorities have recommended spray programs which include chlorfenvinphos as an important component. A listing of these programs is presented in the following table. It can be seen from this table that the States with the most extensive use of chlorfenvinphos are Queensland and NSW. However, depending on seasonal factors, considerable quantities may be sprayed onto pastures in Tasmania.

State	Spray Program
Tasmania	Control of corbie in pasture
Queensland	Licebuster - for effective control of sheep lice Flybuster - for the effective control of flystrike Both of these 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 Strategic cattle tick control and eradication programs involving ssix treatments at 21 day intervals Regulatory tick control involving supervised treatments of stock moving from infested areas to free areas.

State	Spray Program
	Buffalo fly control using Supona as an overspray and in backrubbers Programs have been developed for agricultural uses to counter illicit use
Western Australia	Blowfly strike
New South Wales	Buffalo Fly Control Program Cattle Tick control and eradication programs Flystrike control recommendations
South Australia	Not recommended
Victoria	Not recommended
Northern Territory	Not recommended
Australian Capital Territory	Not recommended

The continued demand for chlorfenvinphos as an ectoparasiticide is not clear for the foreseeable future because there are a number of conflicting factors (listed below) which will affect the outcome. All that can be deduced with any degree of certainty is that this chemical will be required as part of integrated pest management and resistance management strategies for ectoparasites in sheep, cattle and other livestock for some time to come.

Factors influencing demand are:

1. Blowfly resistance has reduced the protection period supplied by this chemical, but it is still required for treatment of active strike and as a mulesing wound treatment.

2. There is expected to be an increase in the prevalence of Parkhurst and Ultimo resistances in cattle tick which diminish the effectiveness of this chemical.

3. There are initiatives which will reduce chemical usage in general, such as industry awareness of, and desire for, reduced residues on wool and in sheep meats, associated awareness of occupational health and safety concerns and the promotion of minimal chemical use and integrated pest management principles.

4. There will be a decrease in the regulatory treatment of horses crossing the tick line. It is proposed to allow certain classes of competition horses to move between tick areas without treatment.

5. The prevalence of SP resistance in buffalo fly is constantly increasing. However, there have also been reports of low level resistance of buffalo fly to chlorfenvinphos.

The Tasmanian Department of Primary Industries and Fisheries expects demand for the chemical in pastures in that State to continue at about the average of the last five years.

Registrants generally expect the demand for chlorfenvinphos to be maintained. Further trial work with the chemical involving extensions of use and improved formulations has not been ruled out. It is therefore possible for usage to increase in future.

Good dip management is also required - the sump of the dip must be kept clean and a bacteriostat used to avoid infection of shearing cuts. Sheep should be loosely packed so that chemical coverage is maximised.

Shower dipping for lice and fly control is less effective as the length of wool increases.

Backline Treatment

This treatment method involves the application of chemical along the backline of the sheep from the pole to the tail, using a hand operated applicator gun. This method is rapid and requires little equipment and labour input.

With off shears lice treatments dose rates are bodyweight dependent and should be set for the heaviest sheep in the mob. Thus a mob of weathers averaging 45 kg should all receive the dose for sheep greater than 50 kg as a significant number of individuals would weigh more than 50 kg.

Pasture

In Tasmania, pasture spraying is carried out using conventional boom spray rigs applying approximately 100 L water per hectare.

Registration trends

An amount of tecnhical grade chlorfenvinphos (both formulated and unformulated) of the order of 25 tonnes is imported into Australia annually. This material is formulated into a variety of products formulations with concentrations varying between 2.5 g/L and 500 g/L, with a considerable proportion of it being use in the manufacture of ectoparaiticide with a concentration of 138 g/L. of the order of 150,000 litres of formulated product could therefore be use in Australia annually.

Most participants in the review do not anticipate any immediate alteration in the current registration profile for chlorfenvinphos, although at least on of the registrants did not rule out the possibility of extending the use of this chemical into other areas. In addition, it is possible that enw methods of formulation and/or application may extend the commercial life beyond what may have been expected.

Of the State agricultural authorities, only Queensland and new South Wales advised of current or intended trial work with chlorfenvinphos.

NSW Agriculture indicated that current trial work involving chlorfenvinphos concerns efficacy testing of two products for sheep flystrike treatment. They note that previous trial work in that State has involved investigations into dip management,, residue trials and sheep lice and blowfly efficacy trials.

In Queensland, current trial work with chlorfenvinphos relates to its inclusion in an investigation to control silver leaf whitefly and a vegetable pest control program. in the past investigations have involved residues, efficacy and residues in Central Queensland and Meat Research Corporation Residue trials.

DPIF Tasmania indicated that trials had been carried out in the past in relation to development of appropriate application rates and timing for control of corbie and cockchafer in pastures.

2. EFFICACY ASSESSMENT

2.1 Background

One aspect of the contemporary assessment standards with which chemicals must comply in order to achieve and maintain registration is that use of products containing the chemical in accordance with the recommendations approved by the NRA for its use must be effective according to criteria determined by the NRA for the product.

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 appropriate.

These matters have been examined and the results presented in the following report.

2.2 Evaluation of Efficacy

There was general acknowledgement among respondents to performance questionnaires that resistance to organophosphate chemicals was present in some parasites, especially sheep blowfly and cattle tick. However, it was also generally considered that when used according to label directions, chlorfenvinphos still exhibited acceptable efficacy for the purposes claimed.

There was some indication that complaints regarding efficacy had been received by registrants, but very few of these had been shown to be associated with the chemical's performance. Problems with resistance of parasites will clearly result in complaints from time to time, especially in relation to sheep blow fly control. However, registrants indicated that they believe that chlorfenvinphos fulfils a role in the marketplace as a cost-effective tickicide for cattle and blowfly remedy for sheep and therefore there was no intention to remove the chemical from the market place.

Advice from the Australian mushroom growers indicates that enhanced microbial degradation has now shortened the useful life of this, and other organophosphate chemicals. However, despite its shortened period of protection, chlorfenvinphos, when incorporated into the casing layer, still provides protection against phorid infestation for two weeks after casing application. This initial period is important since it has been shown that infestation later than this does not reduce yield.

2.3 Alternatives

Ectoparasiticide use (Sheep and Cattle)

In general, the relevant State agricultural authorities promote husbandry and breeding techniques for reducing the incidence of ectoparasite infestation in cattle. However, these methods do not always provide sufficient protection and chemical intervention is required.

Advice received from the Queensland Department of Primary Industries indicates that there are only two alternative chemicals for control of amidine resistant ticks on cattle - Tixafly (deltamethrin and ethion) and Grenade (cyhalothrin), neither of which can be used on horses or other stock (thus creating major problems with regulatory movement controls). This advice is corroborated by NSW Agriculture.

Queensland further advises that there are no other practical and cost effective chemicals currently available to control SP resistant buffalo fly. The only alternative is Ivomec Pouron, but its cost is prohibitive for long term protection.

There are currently no effective non-chemical methods of controlling buffalo fly for extended periods.

NSW Agriculture advises that there are alternative products for use in sheep which are less hazardous to operators.

Agricultural Uses

State agricultural authorities advise that there are better chemicals than chlorfenvinphos for some agricultural uses.

Pastures

Advice from the Tasmanian DPIF indicates that fenitrothion is the only alternative for pasture pest control in Tasmania. DPIF is presently not in a position to undertake trial work to investigate alternatives and chemical companies have other priorities in relation to registration of new products. Fenitrothion is also under review.

Mushrooms

At present, the mushroom industry has access to several insecticides for use in the growing rooms. These are, in addition to chlorfenvinphos, diazinon, dichlorvos, natural pyrethrins, triflumuron and fipronil. While fipronil will control all major fly pests of cultivated mushrooms (sciarids, phorids and cecids), reliance on one chemical is not sensible, because of previous problems with enhanced microbial degradation. As yet, there is no evidence of development of insecticide resistance in any of the insect and mite pests that occur in mushrooms in Australia, although this is a major problem in Europe and North America.

Chlorfenvinphos is used for controlling phorid infestation in the casing layer and while fipronil is an alternative, chlorfenvinphos is cheaper and will control low level infestations. Fipronil is more effective in managing high level infestations.

Diazinon controls both phorids and cecids as a compost treatment. Dichlorvos and natural pyrethrins are available as aerosol treatments and this type of treatment is essential because if adult sciarids or phorids occur in a room either before casing or without casing treatment, aerosols are the only means available to control them.

Potatoes

Advice from the Australian Vegetable & Potato Growers Federation is that use of chlorfenvinphos for the control of potato moth has been declining over the past ten years with other management measures being widely used to prevent the access of the potato moth to potato tubers. It is now mainly used where these management techniques fail and during seasons in which potato moth pressure is high.

New South Wales Agriculture noted that methamidophos and permethrin are alternatives as well as cultural methods for potato moth control.

2.4 Side Effects

Phytotoxicity

No information was received during the review which suggested that there were any phytotoxic effects associated with use of chlorfenvinphos. Overseas references indicate that chlorfenvinphos is not phytotoxic when used as directed.

Adverse Effects

Information was obtained through the NRA's Adverse Experience Reporting Program (AERP) on events associated with the use of chlorfenvinphos. A number of incidences were reported where treated animals had displayed symptoms consistent with organophosphate poisoning and even death. In these cases the product *Supona Buffalo Fly Insecticide (45594)* had been used at rates ranging from 3.75 to 40 times the recommended label rate. These were clear missuse events. In another report animals displayed signs of OP poisoning which were traced back to something in the product itself rather than misuse.

Advice was received from NSW Agriculture that some horses exhibit sensitivity to treatment with ectoparasiticides containing chlorfenvinphos. This is a rare event given the number of treatments each year in both NSW and Queensland. "Reactions" to spray treatment are often found to have pre-existing skin conditions which are highlighted when the horse is wet. Hydrocarbons are suspected to highlight the skin diseases through evaporation, cooling and erythiemia.

2.5 Resistance Management

There is an increasing incidence of Parkhurst and Ultimo resistances in cattle ticks in Queensland. These pose risks to quarantine barriers on the NSW Queensland border. Inspection of stock prior to treatment

minimise the risk as they must be visibly free of cattle tick prior to treatment. Immature stages of cattle tick, larvae, cannot be detected by this inspection.

In addition, there is every possibility that buffalo fly will eventually become resistant to the organophosphate chemicals.

General organophosphate resistance in sheep blowfly has diminished the effectiveness of chlorfenvinphos for this purpose enormously.

Producers are therefore encouraged to use non chemical management options wherever possible. Such options include trapping of flies, breeding and husbandry techniques and tolerating a degree of pest burden. Coordinating treatment of animals with neighbours is also helpful in prolonging the useful life of chemicals, as parasite populations in a wider area are controlled at the same time, thus assisting to minimise population recoveries.

Ectoparasiticides should then be applied only in response to monitoring which indicates that threshold levels have been reached and treatment is necessary. In order to manage ectoparasite resistance, a number of treatment strategies have been developed, especially in Queensland where the difficulties are most acute. Rotation of chemicals (organophosphate, synthetic pyrethroids and insect growth regulators) is promoted in the Licebuster, Flybuster, Minchem and Chemsafe strategies, together with selective use of chemicals to suit target species and protection period required.

2.6 Summary of Efficacy

Chlorfenvinphos is an important chemical for insect control in a number of key areas of Australian agriculture.

Ectoparasite Control – Cattle

In spite of the fact that there is resistance in the Parkhurst and Ultimo strains of cattle tick, chlorfenvinphos remains an important tickicide especially with increasing resistance to the synthetic pyrethrioid chemicals. In addition, it is an important chemical for control of buffalo fly which has demonstrated little, if any, resistance to chlorfenvinphos.

Ectoparasite Control – Sheep

The use of chlorfenvinphos in sheep has been considerably affected by the occurrence of resistance to organophosphate chemicals in sheep blowfly. Nevertheless, it is still considered by all the participants in the review to be a cost-effective remedy in this situation.

Pastures

Chlorfenvinphos is one of two chemicals registered for control of a number of pasture pest species in Tasmania, including one which is unique to that State. All of Tasmania's 900 000 ha of pasture is subject to attack annually, but only a comparatively small percentage requires treatment, depending on seasonal conditions. The other registered chemical is fenitrothion, which is also currently under review.

Advice from Tasmanian agricultural authorities indicates that there are probably other chemicals which would be effective in this situation, but that unless the respective chemical companies are prepared to undertake the necessary trial work, approval of alternative chemicals will not be possible. The Tasmanian DPIF is not in a position to carry out chemical trial work in relation to this situation.

Mushrooms

Enhanced microbial degradation has now shortened the useful life of this, and other organophosphate chemicals. However, despite its shortened period of protection, chlorfenvinphos, when incorporated into the casing layer, still provides protection against phorid infestation for two weeks after casing application. This initial period is important since it has been shown that infestation later than this does not reduce yield.

Potatoes

Use of chlorfenvinphos for the control of potato moth has been declining over the past ten years with other management measures being widely used to prevent the access of the potato moth to potato tubers. It is now mainly used where these management techniques fail and during seasons in which potato moth pressure is high.

3. RESIDUE ASSESSMENT

3.1 Introduction

Chlorfenvinphos is a non-systemic organophosphorus insecticide which is used against soil-borne and foliage insects in both agricultural and horticultural crops and against ectoparasitic insects such as buffalo flies, lice and ticks on livestock. It was reviewed by the Joint Meeting of Pesticide Residues (JMPR) in 1971, 1984 and 1996. The JMPR review in 1996 recommended the withdrawal of the existing Codex MRLs. This recommendation was further considered by the Codex Committee on Pesticide Residues (CCPR) in 1999. A review of chlorfenvinphos was conducted in 1994 by the Pesticides Safety Directorate (PSD) within the UK Ministry of Agriculture as part of the Routine Review Program.

Residue levels of 0.20 to 0.65 mg/kg were detected in cattle commodities from Australia destined for the USA in late 1993. These levels are at or above the previous US and Australian MRL of 0.2 mg/kg for chlorfenvinphos. Subsequent investigations traced the MRL violations to cattle which had been dipped in the product *Barricade 'S' Cattle Dip and Spray*. The product contains chlorfenvinphos and cypermethrin and is used when transporting cattle from tick infested areas in Queensland to NSW. It is apparent that the use patterns of the registered product in Australia do not match those of the export markets. The (then) Australian Meat Research Corporation expressed an urgent need to address these problems and as a consequence, Projects DAQ.096 and DAN.084 were designed to generate residue data for a range of ectoparasiticides commonly used for buffalo fly and tick control in Queensland and New South Wales.

Barricade 'S' Cattle Dip and Spray has been marketed for a considerable period in Australia. Data from a recent Australian Market Basket Survey and the National Residue Survey (NRS) indicated that the estimated daily intake of chlorfenvinphos was nil for all age-sex categories. No foods were found to contain detectable residues of chlorfenvinphos and the results clearly indicated that the use of the product did not pose a residue problem domestically.

Although MRLs for other agricultural commodities appear in the *MRL Standard,* many are not linked to registered uses and deletion of these MRLs will be recommended.

This review is based primarily on data submitted for the ECRP and will consider other relevant information from previous submissions to the NRA overseas regulatory authorities and Codex.

3.2 Australian and Codex MRLs

The following Australian and Codex MRLs (mg/kg) for chlorfenvinphos are contained in Table 1 of the *MRL Standard* (May 1999) and a Codex document on MRLs (Joint FAO/WHO Food Standards Programme, Codex Committee on Pesticide Residues, the Netherlands, April 1996), respectively. The latter is no longer current since all chlorfenvinphos MRLs except those for brussels

sprouts; cabbages, head; carrot; and cauliflower were recommended for revocation by CCPR at its April 1999 meeting.

Table 1 Australian and Codex chlorfenvinphos MRLs for agricultural uses

Food Commodities	Australian MRL (mg/kg)	Codex MRL (mg/kg)
VB 0400 Broccoli	0.05	0.05
VB 0402 Brussels sprouts	0.05	0.05
VB 0041 Cabbages, Head	0.05	0.05
VR 0577 Carrot	0.4	0.4
VB 0404 Cauliflower	0.1	0.1
VS 0624 Celery	0.4	0.4
FC 0001 Citrus fruits		1
SO 0691 Cotton seed	0.05	0.05
VO 0440 Egg plant [aubergine]	0.05	0.05
VR 0583 Horseradish	0.1	0.1
VA 0384 Leek	0.05	0.05
GC 0645 Maize	0.05	0.05
VO 0450 Mushrooms	0.05	0.05
VA 0385 Onion, Bulb	0.05	0.05
SO 0697 Peanut	0.05	0.05
VR 0589 Potato	0.05	0.05
VR 0494 Radish	0.1	0.05
GC 0649 Rice	0.05	0.05
CM 1205 Rice polished		0.05
VR 0497 Swede	0.05	0.05
VR 0508 Sweet potato	0.05	0.05
VO 0448 Tomato	0.1	0.1
VR 0506 Turnip, garden	0.05	0.05
GC 0654 Wheat	0.05	0.05

Table 2 Australian and Codex chlorfenvinphos MRLs for veterinary uses

Food Commodities	Australian MRL (mg/kg)	Codex MRL (mg/kg)
MO 0812 Cattle, Edible offal of	0.2	
MM 0812 Cattle meat [in the fat]	0.2	
MO 0814 Goat, Edible offal of	0.2	
MM 0814 Goat meat [in the fat]	0.2	
MM 0095 Meat (from mammals other than marine mammals)		0.2 (fat) V
ML 0107 Milk of cattle, goats & sheep		0.008 V
ML 0106 Milks [in the fat]	0.2	
MO 0822 Sheep, Edible offal of	0.2	
MM 0822 Sheep meat [in the fat]	0.2	

(fat) denotes that the MRL applies to the fat of the meat;
V denotes that the MRL accommodates veterinary use.

3.3 Use Patterns

The use patterns presented below are based on the maximum treatment regime of the currently registered products containing chlorfenvinphos. Further detail can be found in Part 1 of the agricultural assessment.

Registered Products	Animals/crops/ situation	Maximum Rate Of Application	Minimum Interval Between Treatments	Maximum Number Of Repeat Treatments	Timing Of Application(s)	Formulation /method of application	With-holding Period
Barricade 'S'Cattle Dip and Spray 45211 *Coopers Blockade 'S' Cattle Dip and Spray* 46815*	Beef cattle, horses, deer, goats and sheep for the control of cattle tick and cattle lice	0.0552 g chlorfenvinphos/100ml as dip concentration	10 days	10 treatments	In early autumn when lice infestation first occur Not specified for cattle tick	Topical solution/ suspension/ plunge dip and spray	8 days ***
Supona Buffalo Fly Insecticide 45594	Beef cattle (used as a backrubber) for the control of buffalo fly	1/20 dilution in sump oil at a rate of 0.2 g per animal	Not specified	Charge backrubber with 20 ml; animals are treated for 3 weeks	During the buffalo fly season	Topical solution/ suspension/ backrubber	Nil
	Beef and dairy cattle (used as an overspray) for the control of buffalo fly	1/50 dilution in water (0.4% chlorfenvinphos) at a rate of 0.2 g chlorfenvinphos per 150 kg b.w. This corresponds to 800 mg per animal of 600 kg b.w.	10 days	≤ 18 treatments per year	During the buffalo fly season	Topical solution/ suspension/ overspray	Nil ***
Defiance 'S'Insecticidal Flystrike, Mules and Wound Dressing 45736	Sheep, cattle and horses for the treatment of wounds, flystrike, mulesing and marking	Sheep: 20 mg/kg b.w Cattle: 0.5 mg/ kg b.w. Horses: 0.5 mg/kg b.w.	10 days	≤ 5 treatments per year	As soon as possible after the diagnosis	Medicated dressing, topical device/ apply topically on affected areas	Meat: 3 days ***
Coopers Suprex 100 Jetting Fluid 33428	Sheep for the control of flystrike and lamb marking	100 g/200L water for jetting; 10 g/12 L water for dressing; 5 g/10L water for lamb marking	Not specified	Not specified	When flies strike and at lamb marking	Medicated dressing/jetting and dressing	Meat: 3
David Grays Aerosol Sheep Dressing 42259	Sheep for the control of fly strike	Thoroughly spray the strike and surrounding area of skin	Not specified	Repeat as necessary	When flies strike	Medicated dressing/spray at affected area	Meat:14 Wool: 2 months ***
WSD Aerosol Sheep Dressing 39575	Sheep for the control of fly strike	Thoroughly spray the strike and surrounding area of skin	Not specified	Repeat as necessary	When flies struck	Medicated dressing/spray affected area	Meat:14
WSD Jetting Fluid 100 Jetting Fluid 39576	Sheep for the control of flystrike and lamb marking	100 g/200L water for jetting; 10 g/12 L water for dressing; 5 g/10L water for lamb marking	Not specified	Not specified	When flies strike and at lamb marking	Medicated dressing/jetting, dressing	Meat: 3

Registered Products	Animals/crops/ situation	Maximum Rate Of Application	Minimum Interval Between Treatments	Maximum Number Of Repeat Treatments	Timing Of Application(s)	Formulation /method of application	With-holding Period
Birlane 500 Insecticide 47478	Farm buildings for the treatment of flies	250 g chlorfenvinphos/ 10L at a rate of 400 ml per m^2 of surface	Not specified	Not specified	Remove animals during application	Emulsifiable concentrate/ spraying	Not applicable
	Pasture and lucerne for the treatment of grub, corbie, earth mite	500 g/ha	Not specified	Not specified	Apply at first sign of pest activity or apply 3-5 weeks after the first autumn rain	Emulsifiable concentrate/ spraying	Grazing WHP of 7 days
	Mushroom casing for the treatment of sciarids	50 g chlorfenvinphos/ 1000L of water per m^3 of casing	Not specified	Not specified	Not specified	Emulsifiable concentrate/ spraying	Not stated
	Potatoes for the treatment of potato moth	275 g chlorfenvinphos/ha	Apply at 11 day intervals and reducing to 7-10 days during period of intense moth activity	Not specified	Spraying at early flowering or earlier if moths are active	Emulsifiable concentrate/ broadcast	1 day

The regular slaughter WHP for both products is 8 days. However, the product labels differ with respect to stirrer cattle. The label of *Barricade 'S'* states "Do not use cattle as stirrers" whereas the label of *Blockade 'S'* recommends a slaughter WHP of 14 days for stirrers.

*** do not use on lactating animals which are producing or may in the future produce milk or milk products for human consumption.

3.4 Metabolism Studies

No new metabolism studies were submitted for evaluation. Fort Dodge Australia Pty Ltd provided literature articles, a technical report titled "*Excretion of metabolites of chlorfenvinphos in the milk of a cow treated with the insecticide*" and the draft report of the 1996 JMPR review to support the metabolism studies.

JMPR reviewed chlorfenvinphos metabolism studies conducted in animals in 1996. Metabolism studies in humans, dogs and rats demonstrated that chlorfenvinphos is absorbed rapidly, metabolised extensively, and excreted primarily in urine. Radiolabel experiments in ruminants indicated that residues occur predominantly in the fat tissues with little or no residues in other tissues. This finding is consistent with chlorfenvinphos being fat-soluble. A metabolic pathway for chlorfenvinphos in ruminants was proposed (see figure 1 at the end of the residue report).

The Routine Review Program of the PSD in the UK reported an animal metabolism profile similar to that described above in its Chlorfenvinphos Review in 1994.

Plant metabolism following soil and foliar applications was also reported by JMPR in 1996. However, the metabolic pathway for chlorfenvinphos in plants was not fully elucidated.

3.4.1 Animal Metabolism Studies

(a) D. H. Hutson, D. A. A. Akintonwa and D. H. Hathway, "The metabolism of 2-chloro-1-(2', 4'-dichlorophenyl) vinyl diethyl phosphate (chlorfenvinphos) in the dog and rat", Biochem. J. 102, 133-142 (1967).

Rats were administered an oral dose of 2 mg/kg of ^{14}C-chlorfenvinphos. Within 96 hours, 87% of the dose was excreted in urine, 1.4% in expired air and 11% in faeces. The majority of the radiolabel (67.5%) was excreted in urine within the first 24 hours.

Dogs were administered a single oral dose of 0.3 mg/kg of ^{14}C-chlorfenvinphos. In the first 24 hours after dosing 86% of the dose was excreted in urine. Little change occurred after 96 hours with 89.4% of the radiolabel being excreted in urine and 4.5% in faeces.

Chlorfenvinphos is completely metabolised in dogs and rats following oral administration; unchanged chlorfenvinphos is absent from the the urine and carcass, when elimination is complete. Urinary metabolites were identified for both rats and dogs and the relative proportions are shown in Table 3.

Table 3 Chlorfenvinphos metabolites in dog and rat urine.

Chlorfenvinphos metabolites	**% of ^{14}C in urine**	
	Rat	Dog
2,4-dichlorophenylethanediol glucuronide	3	3
[1-(2,4-dichlorophenyl)ethyl-D-glucopyranosid] uronic acid	47	4
2,4 - dichlorohippuric acid	5	
2,4- dichloromandelic acid	8	15
vinyl ethyl hydrogen phosphate	37	78

(b) Hutson, D H; Hoadley, E C; & Donninger, C. "Excretion of metabolites of chlorfenvinphos in the milk of a cow treated with the insecticide". Technical Service Report TLTR.0009.69

A Friesian cow weighing 400 kg was injected intramuscularly with 233 mg of ^{14}C-chlorfenvinphos. Milk samples taken on days 1, 2, 3, 4 and 5 after treatment were assayed for radioactivity. Chlorfenvinphos and its metabolites in milk fat were identified. The results are shown in Tables 4 and 5.

Table 4 Radioactive residues in milk from one cow injected intramuscularly with ^{14}C-chlorfenvinphos.

Sampling days (am/pm)	% of administered ^{14}C dose	mg/L of [^{14}C] (expressed as chlorfenvinphos equivalents)
1 (pm)	0.13	0.076
2 (am)	0.04	0.011
2 (pm)	0.01	0.006
3 (am)	0.01	0.004
3 (pm)	0.009	0.006
4 (am)	0.006	0.002
4 (pm)	0.0005	0.0003
5 (am)	0.001	0.0005

Table 5 Distribution of chlorfenvinphos and its metabolites in milk fat from the day 1 milk sample.

Residues	Milk fat residues (expressed as mg/L of whole milk)
chlorfenvinphos	0.049
2, 4-dichlorophenacyl chloride	0.0008
2, 4-dichloroacetophenone	0.0023
1(2,4-dichloro phenyl) ethanol	0.0014
1(2,4-dichloro phenyl) ethane diol	not detected
2, 4-dichloromandelic acid	0.0011
2,4-dichloro benzoic acid	<0.0014
1(2,4-dichloro phenyl)2-chloro ethanol	0.0004
des-ethyl chlorfenvinphos	0.0007

Only a small proportion (0.2%) of the dose was found in milk and the major radioactive entity was parent compound (in the milk fat). The major metabolite found in milk was 2, 4-dichloroacetophenone at a concentration of 0.0023 ppm. A metabolic pathway was proposed for chlorfenvinphos in ruminants.

(c) W. F. Chamberlain and D. E. Hopkins "Absorption and elimination of general chemical 4072 applied dermally to cattle" J. Econ. Ent., 55(1): 86-88, 1962.

This study reported the rapid dermal absorption of chlorfenvinphos after spraying 3 steers with an EC formulation at dosages of 0.1%, 0.25% or 0.5% ^{32}P-labelled chlorfenvinphos. Radiolabelled material reached a maximum concentration in blood 2 hours after treatment. Elimination of the radioactive residues was also rapid such that only low concentrations appeared in urine and faeces one week after treatment. Urinary excretion was the major elimination pathway accounting for 25-32% of the applied dose; faeces accounted for only 1.6-2.1% of the applied dose.

(d) R. H. Roberts, R. D. Radeleff and H. V. Claborn "Residues in the milk of dairy cows sprayed with ^{32}P-labelled general chemical 4072", J. Econ. Ent., 54 (5), 1053, 1961.

A Holstein cow was treated dermally with a water-based formulation consisting of 5 gm of ^{32}P-labelled chlorfenvinphos in 400 ml of spray. A second Jersey cow was treated with a formulation containing lanolin as a sticker and 5 gm of ^{32}P-labelled chlorfenvinphos in 60 ml of spray. Whole milk samples were taken from both animals prior to treatment and at 5 hours and 1, 2, 3, 5, 7, 9 and 10

(Jersey cow) or 12 (Holstein cow) days after treatment. Sample residues were extracted and purified by the method of H. V. Claborn et al and analysed by a radiometric method. The results are shown in Table 6.

Table 6 Radioactive residues in whole milk samples from two dairy cows treated dermally with ^{32}P-labelled chlorfenvinphos.

Time post treatment	Radioactive residues (mg/kg chlorfenvinphos equivalents)	
	Holstein cow	Jersey cow
5 hrs	0.0584	0.0228
1 day	0.0107	0.0048
2 days	0.0055	0.0024
3 days	0.0060	0.0016
5 days	0.0020	0.0008
7 days	0.0008	0.0004
9 days	0.0006	NA
10 days	NA	not detected
12 days	not detected	

Residues were not detectable in pre-treatment samples.
NA – Not analysed

Maximum residue levels in milk occurred in the 5-hour samples and thereafter, the residue levels declined rapidly. There were insufficient measurements to conclude that milk residues were undetectable at days 9 or 10 after treatment.

(e) M. C. Ivey, H. V. Claborn, R. A. Hoffman, O. H. Graham, J. S. Palmer and R. D. Radeleff "Residues of Shell compound 4072 in the body tissues of sprayed cattle", J. Econ. Ent., 59 (2), 279, 1966.

A number of experiments quantified chlorfenvinphos residues in animal tissues and investigated the rate of residue disappearance after dermal application of ^{32}P-labelled chlorfenvinphos. Different dose rates were studied. Residue depletion was also investigated with multiple treatments.

Two calves were sprayed, one with 0.25% and the other with 0.05% ^{32}P-labelled chlorfenvinphos. Omental fat samples were taken from animals slaughtered on days 3, 7 and 15 after treatment and radiometrically analysed. Radioactive residues in omental fat are shown in Table 7.

Table 7 Radioactive residues in omental fat on days 3, 7 and 15 after treatment of calves with 0.25% or 0.05% ^{32}P-labelled chlorfenvinphos spray.

Days post-treatment	Radioactive residue level (mg/kg) for 0.25% spray	Radioactive residue level (mg/kg) for 0.05% spray
3	0.675	0.06
7	0.055	0.001
15	ND	ND

ND - Not detectable

At the commercial application rate of 0.05% spray, residues depleted to 0.001 mg/kg by 7 days post-treatment. Residues were non-detectable for both application rates by day 15 after treatment.

Two calves were sprayed dermally, one with 0.5% ^{32}P-labelled chlorfenvinphos and the other with 0.25% of the material. Both animals were slaughtered 7 days after treatment and samples of renal fat, omental fat, heart, kidney, and muscle were taken for radiometric analysis. The results are shown in Table 8.

Table 8 Radioactive residues in animal tissues from 2 calves slaughtered 7 days after treatment with 0.25 % or 0.5% ^{32}P-labelled chlorfenvinphos spray.

Tissues	Radioactive residue level (mg/kg) for 0.25% spray	Radioactive residue level (mg/kg) for 0.5% spray
Renal fat	0.042	0.204
Omental fat	0.036	0.223
Heart	0.002	0.015
Kidney	0.001	0.008
Muscle	0.001	0.008

Application of the 0.25% spray resulted in residues occurring mainly in fat. With the 0.5% spray, residue levels increased significantly in fat and detectable residues occurred in other tissues. Identification of the individual chemical constituents in the radioactive residues was not performed.

Three Hereford calves were sprayed to saturation with a 0.25% emulsion of chlorfenvinphos. Samples of omental and renal fat, muscle, heart, kidney, liver, brain, and spleen were taken from calves slaughtered on days 7 (calf A), 16 (calf B) or 28 (calf C) after treatment. Samples were analysed by GLC. The results are shown in Table 9.

Table 9 Chlorfenvinphos residues (mg/kg) in tissues of calves sprayed to saturation with 0.25% emulsion of chlorfenvinphos.

Tissues	Chlorfenvinphos residues (mg/kg) at days 7, 16 and 28 after treatment		
	7 days	16 days	28 days
Renal fat	0.085	0.006	<0.005
Omental fat	0.021	<0.005	<0.005
Muscle	<0.004	<0.004	<0.004
Heart	<0.004	<0.004	<0.004
Kidney	<0.004	<0.004	<0.004
Liver	<0.004	<0.004	<0.004
Brain	<0.004	<0.004	<0.004
Spleen	<0.004	<0.004	<0.004

The results indicate that detectable residues were present in renal fat and omental fat on day 7 and in renal fat only on day 16 post-treatment.

The final experiment involved multiple treatments of Hereford cattle with a 0.1% emulsion of chlorfenvinphos. Six animals were sprayed on 12 occasions at weekly intervals (group A). Another

group of six cattle was sprayed on six occasions at two weekly intervals (group B). Omental fat samples were taken by omentectomy from three animals in group A at 7 days after the 1st, 2nd, 4th, 6th, 8th, 10th and 12th spray treatments and from three animals of group B at 14 days after each treatment. Final sampling occurred 14 days (group A) or 28 days (group B) after the final spray. GLC analyses were performed on omental fat for chlorfenvinphos and the metabolite 2,4-dichloroacetophenone. The results are shown in Tables 10 (a) and (b).

Table 10 (a) Chlorfenvinphos residues (mg/kg) in omental fat at 7 days from cattle sprayed weekly with a 0.1% emulsion of chlorfenvinphos (see text for details of spraying/sampling protocol)

Animal No.	Chlorfenvinphos residues (mg/kg) in omental fat						
	1st	2nd	4th	6th	8th	10th	12th
A1	0.012				0.161		0.010
A2	0.009		0.065		0.121		0.010
A3	0.056		0.142		0.245		0.020
A4		0.047		0.051		0.020	
A5		0.070		0.065		0.019	
A6		0.020		0.035		0.009	

Table 10 (b) Chlorfenvinphos residues (mg/kg) in omental fat at 14 days from cattle sprayed biweekly with a 0.1% emulsion of chlorfenvinphos (see text for details of spraying/sampling protocol)

Animal No	Chlorfenvinphos residues (mg/kg) in omental fat					
	1st	2nd	3rd	4th	5th	6th
B1	<0.005		<0.005		0.247	
B2	0.006		0.006		0.170	
B3	<0.005		<0.005		0.080	
B4		0.009		<0.005		0.18
B5		0.008		0.007		0.110
B6		<0.005		<0.005		

Analyses of fat samples from either group of animals demonstrated that the major metabolite of 2, 4-dichloroacetophenone was not detected in any fat sample. Fat samples analysed from group A showed that all samples contained detectable residues; the maximum was 0.25 mg/kg at 7 days after the 8th spray. Fat samples from group B contained low residues at 14 days after the first four sprays, before increasing to a maximum of 0.25 mg/kg at 14 days after the 5th spray, and then decreasing to a maximum level of 0.18 mg/kg at 14 days after the 6th spray. No chlorfenvinphos residues were detected in samples taken from animals slaughtered on days 14 (group A) or 28 (group B) after the last spray of each group.

Conclusion

Metabolism studies in rats and dogs demonstrated that chlorfenvinphos is rapidly absorbed and completely metabolised following oral administration. The majority of radiolabel was eliminated in urine and a lesser amount in faeces within 24 hrs of dosing. Urinary metabolites were identified; no parent compound was present. Following IM administration, metabolites in milk fat were identified and parent compound was shown to be the major radioactive component. Dermal application to cattle was associated with rapid absorption and elimination of radioactive residues with urinary excretion being the major elimination pathway. Highest concentrations of radioactive residues were present in omental or renal fat. Negligible or no measurable residues were reported for liver, kidney, muscle and other tissues. Fat was therefore, identified as the target tissue. The dermal studies also indicated that radioactive residues were not stored in significant amounts in body tissues. Chlorfenvinphos residues in fat depleted to undetectable levels by 28 days following multiple treatments at either one or two weekly treatment intervals. Metabolites were not identified in the dermal metabolism studies, however, the distribution of total radioactive residues was quantitated.

3.4.2 Plant metabolism Studies

(a) K. I. Beynon and A. N. Wright, "The breakdown of ^{14}C-chlorfenvinphos in soils and in crops grown in soils" J. Sci. Fd. Agric., 18, 143, 1967.

(b) Beynon, K. I. and Wright, A. N. "Breakdown of ^{14}C-chlorfenvinphos insecticide on crops" J. Sci. Fd. Agric., 19, 146, 1968.

The metabolism of ^{14}C-chlorfenvinphos in potatoes, cabbages and maize was reported. When ^{14}C-chlorfenvinphos was applied to the foliage of potatoes, cabbages and maize in a glass house, half of the parent compound disappeared within 2-3 days. The major breakdown product was the conjugate of 1-(2',4'-dichlorophenyl)-ethan-1-ol. Traces of des-ethyl chlorfenvinphos were detected but these amounted to only 1% of the corresponding conjugate residue.

Metabolites of chlorfenvinphos following foliar application were found to be more persistent than the parent compound. Accordingly, metabolite residues tended to exceed those of the remaining chlorfenvinphos 5 days after foliar application for maize, 12 days for cabbages, and 30 days for potatoes.

With potatoes, 39% of the applied ^{14}C was found in the foliage after 28 days and <0.5% in the tubers after 80 days. Of the applied radiolabel, 21% was chlorfenvinphos, 11% was a conjugate of 1-(2,4-dichlorophenyl) ethanol while 7.2% was unextractable.

A proposed metabolism of chlorfenvinphos in plants following foliar treatment is shown in Figure 2 at the end of this residue report.

Conclusion

The plant metabolism studies reviewed were not recent (being published in 1967 and 1968) and contained limited experimental details. The full metabolism pathway in plants has not been fully

elucidated. Nevertheless, the results clearly demonstrated that there is no evidence of translocation of any radioactivity from treated leaves to untreated parts of the plant.

3.5 Analytical Methodology

Analytical methodologies for animal tissues and milk have been reviewed by JMPR in 1971 and 1996, respectively. For the purpose of the ECRP, Fort Dodge Australia Pty Ltd re-submitted the analytical methodologies for milk and tissues used for the registration of the products *Barricade 'S' Cattle Dip and Spray*, *Supona Buffalo Fly Insecticide* and *Birlane 500 Insecticide*.

(a) Anon. 1977. Determination of residues of the pyrethroid insecticide WL43467 (NRDC 14) or of WL43479 (NRDC 143) in animal tissues. Sittinbourne Analytical Method Series, SAMS 268-1.

Tissue samples were extracted with a boiling mixture of acetone/petroleum spirit. Fat was removed by partitioning between petroleum spirit and acetonitrile. Extracts were subsequently purified on florisil dampened with water and eluted with diethyl ether/petroleum spirit. The purified product was determined by GC with electron-capture detection (ECD). The limit of quantitation for tissue samples (based on acceptable recovery data) was 0.1 mg/kg. The identity of the isomer was confirmed by GC/MS. No representative chromatograms were provided.

(***b) Anon. 1977. Determination of residues of the pyrethroid insecticide WL43467 (NRDC 14) or of WL43479 (NRDC 143) in animal tissues. Sittinbourne Analytical Method Series, SAMS 268-1 SAMS 265-1.***

Milk samples were extracted with a mixture of diethyl ether and petroleum spirit after addition of potassium oxalate solution and ethanol. Extracts were next partitioned in petroleum spirit solution with acetonitrile. The clean-up procedure involved a reverse phase HPLC and the final product was determined by GC with ECD. The limit of determination was 0.01 mg/kg for the Z-isomer and 0.0025 mg/kg for the E-isomer. The recoveries ranged from 80-115%. Limited validation data but no representative chromatograms were provided.

(c) Knoch, E (1997). chlorfenvinphos (CL 58,085). Method validation of residues of chlorfenvinphos is milk, eggs, cattle fat and muscle. IF 95/24164-00, page 1-78.

Fort Dodge Australia Pty Ltd also provided analytical methodology developed in Germany (which was not submitted with the Australian registration applications for the products) for animal tissues, eggs and milk.

The analytical procedure was based on multiresidue analyses of lipid- and water-soluble pesticides in foods and feeds. Residues were extracted with cyclohexane. The resulting solution was cleaned up by gel-permeation chromatography (using a polystyrene gel) and the interfering substances were eliminated by mini-column chromatography where necessary. Residues were then determined by an

element specific detector (Nitrogen Phosphorus Detector [NPD]). The limits of quantitation were 0.01 mg/kg (milk), 0.02 mg/kg (eggs), 0.02 mg/kg (muscle) and 0.1 mg/kg (fat). Recoveries ranged from 99-116%.

(d) Anon (1966). The determination fo birlane insecticide (2-chloro-1-2,4-dichlorophenyl)vinyl diethylphosphate) in crops and soil – gsa liquid chromatographis method. Woodstock analytical method series. WAMS 25-2.

Crop samples were extracted by maceration with acetone/petroleum spirit. If natural products extracted from the crops interfered with the analysis, a clean-up procedure with florisil was used. Purified samples were analysed by gas-liquid chromatography using ECD which allowed the two isomers to be separately determined. The limit of quantitation was 0.05 mg/kg; recoveries were in the range of 80-100%.

Analytical methodology used in projects DAQ.96 and DAN.084

The analytical method was a modification of the Mills, Oxley and Gaither procedure. Recoveries for the method exceeded 80%. Neither the reference nor method validation information was provided. The method involved the extraction of residues from fat tissues using hexane. Extracts were partitioned into acetonitrile and then back extracted into hexane by aqueous dilution of the acetonitrile extracts. The solution was cleaned up on a florisil column and the resultant solution analysed by GC with ECD.

Comments

Samples were analysed by GC with ECD or NPD detection. The limit of quantitation for tissues (liver, kidney, muscle and fat), milk and crops based on data from recovery studies were 0.1, 0.01 and 0.05 mg/kg, respectively. Validation of the analytical methods and recpveries were considered acceptable.

3.6 Residue Definition

The current Australian residue definition for chlorfenvinphos is the sum of E- and Z-isomers. On the basis of metabolism data submitted, this is considered appropriate and is consistent with the Codex residue definition.

3.7 Residue Trials

Fort Dodge Australia Pty Ltd re-submitted residue trials that were evaluated earlier for product registration of *Barricade 'S' Cattle Dip and Spray (45211), Supona Buffalo Fly Insecticide (45594), Defiance 'S' Insecticidal Flystrike, Mules and Wound Dressing* (45736) and *Birlane 500 Insecticide (47478).*

3.7.1 Veterinary Uses

(a) Bosio, P G (1975). Residues of supona in sheep from Australia. Trial No. S/AU/D17/423/74 Victoria, Australia.

Sheep (n = 11) were plunge dipped in a wash of 0.04% chlorfenvinphos using the product *Supona EX 356;* an additional 3 sheep were untreated controls. Samples of brain, kidney, liver, spleen, muscle, subcutaneous fat, perirenal fat and omental fat were collected for analyses; treated animals were sacrificed on days 1, 3, 6 and 13 after dipping (groups were n = 3 for each day except day 6 when n = 2). The samples were stored at -18°C until analysed. The results are shown in Table 11.

(b) Bosio, P G (1975). Residues of supona in sheep from Australia. Trial No. S/AU/D17/442/74 New South Wales, Australia.

An additional trial was performed to verify the results observed in the trial described under Section 7.1.1 (a). This involved a similar treatment of merino sheep with *Supona EX 356*. Samples of muscle, subcutaneous fat, perirenal fat and omental fat were taken from untreated controls (n = 4) and from treated animals on days 3 and 6 after dipping (n = 4 at each time point). An untreated control was sacrificed prior to treatment and at each sampling point post-treatment. The samples were stored at -18°C until analysed. The results (marked with an asterisk) are shown in Table 11.

Table 11 Chlorfenvinphos tissue residues (mg/kg) for sheep slaughtered on days 1, 3, 6 and 13 following plunge dipping in 0.04% chlorfenvinphos wash.

Days post dipping	Chlorfenvinphos residues (mg/kg) in tissues					
	Liver	Kidney	Muscle	Subcutaneous fat	Perirenal fat	Omental fat
1	<0.005, <0.005, <0.005	<0.005, <0.005, <0.005	0.17, 0.21, 0.06	0.53, 0.46, 0.42	0.25, 0.23, 0.26	0.26, 0.26, 0.40
3	<0.005, <0.005, <0.005	<0.005, <0.005, <0.005	0.01, 0.01, 0.01	0.07, 0.09, 0.09, 0.15*, 0.12*, 0.04*, 0.04*	0.16, 0.12, 0.11, 0.05*, 0.02*, 0.02*, 0.08*	0.62, 0.72, 0.30, 0.05*, 0.04*, 0.02*, 0.03*
6	<0.005, <0.00	<0.005, <0.005	0.08, 0.16, <0.005*, <0.005*, <0.005*, <0.005*	0.35, 0.40, <0.01*, <0.01*, <0.01*, <0.01*	0.10, 0.15, <0.01*, <0.01*, <0.01*, <0.01*	0.42, 0.44, <0.01*, <0.01*, <0.01*, <0.01*
13	<0.005, <0.005, 0.005	<0.005, <0.005, <0.005	<0.005, <0.005, <0.005	<0.005, 0.01, 0.04	0.02, 0.04, 0.05	0.05, 0.03, 0.08

LOQ = 0.05 mg/kg (based on the recovery data provided)
Residue levels for untreated controls were <0.005 mg/kg
* denotes values from the second trial

Comments: The results from the first trial indicated that finite residues occurred in all fat and muscle samples on days 1, 3 and 6 post-dipping. These results were checked by conducting a second trial in which fat and muscle samples were taken from animals slaughtered on days 3 and 6 post-dipping. Data from the second trial indicated that by day 6 after treatment, residues in all samples were

undetectable. The discrepancy between the findings of the two trials suggests that either the residues reported for the first trial were due to sample contamination or that biological variability was pronounced.

However, when these results are considered in conjunction with those reported in Table 12 from an independent residue trial, sample contamination appears to be a plausible explanation. Specifically, on day 6 after the third dipping (the retreatment interval was 4 days) chlorfenvinphos residues depleted to near the LOQ of 0.01 mg/kg. When comparing the two trials, it must be emphasized that the data in Table 11 relate to a single treatment whereas those in Table 12 are for three dippings.

Taking into account the results from the second trial, residues are unlikely to exceed the current MRL of 0.2 mg/kg for **Sheep meat [in the fat]** and **Sheep, Edible offal of** at a retreatment interval of 10 days and a meat WHP of 8 days.

(c) McKee, J & Wallce, B G (1981). Residues of Barricade (cypermethrin) and Supona (chlorfenvinphos) in sheep tissues from Australia. Report SBGR.81.145, Australia.

Twenty-four wethers were allocated to this trial. Three treatment groups (each n = 3) were plunge dipped once on day 0 (group A), twice on days 0 and 4 (group B) and thrice on days 0, 4 and 8 (group C). Another four treatment groups each of three animals, were treated three times on days 0, 4 and 8 (groups D, E, F, G). Two animals were used as untreated controls and one was kept as a "spare". All treated animals were plunge dipped at the maximum recommended dipping concentration of 0.055% chlorfenvinphos and 0.01% cypermethrin using the product *Barricade 'S' Cattle Dip and Spray*. Tissue samples (omental fat, liver, perirenal fat, kidney and muscle) were taken from the untreated controls and treated animals slaughtered on days 0 (group A), 4 (group B), 8 (group C), 9 (group D), 11 (group E), 14 (group F) and 18 (group G). Tissue samples were stored at -18°C until analysed. The results are shown in Table 12.

Table 12 Residues of E- and Z-isomers of chlorfenvinphos (mg/kg) in tissues from sheep plunge dipped at the recommended maximum dipping concentration of 0.055% chlorfenvinphos.

Group No.	Sampling days	Chlorfenvinphos residues (mg/kg) in tissue residues									
		Omental fat		Perirenal fat		Liver		Kidney		Muscle	
		E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP
A	0*	<0.01, 0.01, 0.03	<0.01, 0.03, 0.30	<0.01, <0.01, 0.01	<0.01, 0.02, 0.34	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	0.02, 0.01, <0.01	0.28, 0.02, 0.03
B	4**	0.02, 0.01, 0.02	0.18, 0.04, 0.28	0.03, 0.01, **0.05**	0.23, 0.07, **0.52**	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	<0.01, 0.01, 0.01	0.01, 0.03, 0.10
C	8***	**0.04**, 0.01, 0.02	**0.46**, 0.11, 0.10	**0.05**, 0.01, 0.02	**0.48**, 0.07, 0.10	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	0.01, 0.01, 0.01	0.09, 0.09, 0.03
D	9	0.03, 0.03, 0.03	0.17, 0.14, 0.15	0.03, 0.03, 0.04	0.17, 0.15, 0.18	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	0.01, 0.01, <0.01	0.02, 0.04, 0.02
E	11	0.02, 0.02, 0.01	0.11, 0.08, 0.03	0.02, <0.01, 0.01	0.07, 0.02, 0.03	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	0.01, 0.01, 0.01	0.04, 0.01, 0.01
F	14	<0.01, 0.01, <0.01	0.01, 0.02, 0.01	0.01, 0.01, <0.01	0.02, 0.04, 0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	<0.01, <0.01, <0.01	<0.01, 0.01, 0.01
G	18	<0.01, <0.01, 0.01	<0.01, <0.01, 0.03	<0.01, <0.01, <0.01	0.01, <0.01, 0.02	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	NA, NA, <0.01	0.01, <0.01, <0.01	0.01, 0.01, 0.01

Residue levels of untreated control were <0.01 mg/kg
NA - Not analysed
E- and Z-CFVP denote the E- and Z-isomers of chlorfenvinphos
* Day of 1st dipping; ** day of 2nd dipping; *** day of 3rd dipping

Comments: Chlorfenvinphos residues were highest in perirenal and omental fats. In perirenal fat, residues peaked on day 4 (maximum values were 0.05 mg/kg [E-isomer] and 0.52 mg/kg [Z-isomer]) but were similar on day 8 (0.05 mg/kg and 0.48 mg/kg for the E- and Z- isomers, respectively). Omental fat residues peaked on day 8 (0.04 mg/kg and 0.46 mg/kg for E- and Z- isomers, respectively). On day 18 (9 days after the third and final dipping), all samples had little or no detectable chlorfenvinphos residues. Under the registered use pattern for *Barricade 'S' Cattle Dip and Spray* where the minimum retreatment interval is 10 days (compared to 4 days in this trial) and the slaughter WHP is 8 days, chlorfenvinphos residues are most unlikely to exceed the current MRLs for **Sheep meat [in the fat]** and **Sheep, Edible offal of** (each 0.2 mg/kg).

(d) Reference: Robinson, J., Malone, J. C. and Bush, B., *"Residues of Supona in Sheep"* J. Sci. Fd. Agric., 17, 309, 1966.

This trial was conducted in England. Sheep were treated in wash concentrations of 0.1% or 0.05 % chlorfenvinphos, or by tip-spraying at 0.2% chlorfenvinphos. Tissue samples (perirenal, omental and pericardial fats) were taken from sheep slaughtered on days 3, 7, 14 and 21 after treatment with 0.05% chlorfenvinphos. Similar tissue samples were taken from untreated controls and from treated animals slaughtered on days 7, 14 or 21 after treatment with 0.1% or 0.2% chlorfenvinphos. Two

sheep were slaughtered at each sampling point. Samples were stored at -20°C until analysed. The results are shown in Table 13.

Table 13 Chlorfenvinphos residues (mg/kg) in fat tissues from sheep treated with 0.05, 0.1 or 0.2% chlorfenvinphos.

Treatment	Days post treatment	Chlorfenvinphos residues (mg/kg) in fat tissues		
		Perirenal	Omental	Pericardial
0.05 % chlorfenvinphos	3	0.007, ND	0.010, 0.047	ND, ND
	7	ND, ND	ND, **0.093**	ND, ND
	14	0.010, ND	ND, 0.005	ND, 0.009
	21	ND, ND	ND, 0.006	0.046, ND
0.1% chlorfenvinphos	7	ND, 0.015	0.035, 0.043	ND, ND
	14	ND, ND	0.012, 0.007	0.005, ND
	21	ND, 0.003	ND, ND	ND, 0.016
0.2% chlorfenvinphos tip-spray	7	ND, ND	ND, ND	ND, ND
	14	0.003, 0.008	ND, ND	ND, 0.009
	21	ND, ND	0.011, 0.007	ND, 0.008
Untreated controls	3	ND, ND	ND, ND	ND, NS
	21	NS, 0.003	ND, ND	0.012, 0.003

ND – non-detectable; the limit of detection is 0.003 mg/kg
NS – no samples analysed

Comments: This trial did not address repeat treatments and only two animals were slaughtered at each sampling point. Furthermore, finite residues in pericardial fat were reported for the untreated controls on day 21 post-treatment. It is unclear whether the residues data determined at 21 days post-treatment had been corrected for the finite residues present in the untreated controls. Overall, residue data from this trial were considered suspect and MRL recommendations could not be confidently based on these data.

(e) Perret, G R (1993). Residues of chlorfenvinphos and cypermethrin in cattle tissues for Shell Chemical (Australia). Trial No. S/Au/A20/01/93 Cooyar, Queensland, Australia.

Forty-eight Brahman-cross cows were allocated to treatment groups A, B and C (each n =15) and group D (untreated controls; n = 3). Treatment was with the product *Barricade 'S' Cattle Dip and Spray* at the maximum recommended dipping concentration (0.055% chlorfenvinphos and 0.01% cypermethrin). Group A was dipped once, group B was dipped twice on the same day and group C was dipped twice 10 days apart. Tissue samples (omental fat, loin fat, perirenal fat, muscle, liver and kidney) were taken from a group D animal on days 1, 11 and 25 after the last treatment of group A. For groups A, B and C, similar tissue samples were taken from three animals per group on days 1, 4,

8, 11 and 15 after the last application to the respective groups. Tissue samples were stored at -15°C until analysed. The results are shown in Table 14.

Table 14 Chlorfenvinphos residues (mg/kg) in tissue samples taken from cows dipped at the maximum recommended dipping concentration of 0.055% chlorfenvinphos.

Days post final treatment	Chlorfenvinphos residues (mg/kg) in tissues					
Group A*	**Omental fat**	**Loin fat**	**Perirenal fat**	**Muscle**	**Liver**	**Kidney**
1	**0.30,** 0.26, 0.23	**0.39**, 0.26, 0.37	**0.31**, 0.28, 0.28	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01
4	0.01, 0.01, 0.01	0.03, 0.01, 0.02	0.01, 0.03, 0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, 0.01, <0.01
8	<0.01, <0.01, <0.01	0.03, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01
11	0.02, <0.01, 0.01	0.01, <0.01, <0.01	0.02, 0.02, 0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01
15	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01
Group B**						
1	**0.30**, 0.28, 0.29	0.25, 0.21, 0.21	0.26, 0.25, **0.28**	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	0.01, <0.01, <0.01
4	0.20, 0.14, 0.18	**0.28**, 0.16, 0.25	0.20, 0.17, 0.21	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, 0.01, 0.01
8	0.12, 0.09, 0.08	0.15, 0.14, 0.13	0.07, 0.05, 0.03	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, 0.01
11	0.09, 0.06, 0.06	0.01, <0.01, <0.01	0.01, 0.02, 0.01	<0.01, <0.01, <0.01	<0.01, <0.01, <0.01	<0.01, <0.01, 0.01
15	0.01, <0.01, 0.02	<0.01, <0.01, 0.01	<0.01, 0.01, 0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01
Group C***						
1	**0.31**, 0.26, 0.24	**0.31**, 0.28, 0.29	**0.33**, 0.27, 0.29	< 0.01, <0.01, <0.01	< 0.01, <0.01, 0.01	< 0.01, <0.01, <0.01
4	0.02, 0.04, 0.03	0.02, 0.02, 0.02	0.02, 0.02, 0.02	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01
8	<0.01, 0.01, <0.01	0.01, 0.01, 0.01	0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01
11	<0.01, 0.01, <0.01	< 0.01, <0.01, <0.01	0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01
15	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01	< 0.01, <0.01, <0.01

* Group A was dipped once; ** Group B was dipped twice on the same day; *** Group C was dipped twice 10 days apart.
LOQ = 0.1 mg/kg (based on the recovery data provided).
Residues for untreated controls (Group D) at sampling days 1, 11 and 25 were <0.01 mg/kg for all tissues.

Comments: Finite chlorfenvinphos residues were detected in all fat depots with maximal residues (in bold in Table 14) (mg/kg; omental fat/loin fat/perirenal fat) being as follows:
group A 0.30/0.39/0.31 (all day 1); group B 0.30 (day 1)/0.28 (day 4)/0.28 (day 1); and group C 0.31/0.31/0.33 (all day1). These values decreased rapidly after the last treatment of animals in groups A and C but much more slowly for animals in group B. By day 15 after the last treatment, residue levels depleted to near or below the detection limit of 0.01 mg/kg for all groups. Chlorfenvinphos

residues in muscle, liver and kidney samples at all sampling points were at or less than the LOQ. For group C, the chlorfenvinphos residues were at or below 0.01 mg/kg on days 8 and 11 after the last treatment. Under the registered use pattern where the minimum retreatment interval is 10 days, it is most unlikely that chlorfenvinphos residues in fat would exceed the current MRL of 0.2 mg/kg for **Cattle meat [in the fat]**. Furthermore, the current **Cattle, Edible offal of** MRL of 0.2 mg/kg could be safely lowered to 0.02 or 0.05 mg/kg based on these data. Unfortunately, recovery data were available down to 0.1 mg/kg (i.e. LOQ = 0.1 mg/kg) and the MRL cannot be set less than the LOQ.

(f) McKee, J (1979). Residues of Barricade (cypermethrin) and Supona (chlorfenvinphos) in cattle from Australia. Part II – analysis of tissues. Project D4 Petrie, Queensland.

Eighteen heifers were allocated to 5 treatment groups A, B, C, D and E (each n = 3); the remaining three animals were untreated controls (group F). The animals were plunge dipped in 0.04% chlorfenvinphos and 0.0075% cypermethrin. Groups A, B, C and D were dipped once and group E was dipped twice at an interval of 7 days. Tissue samples (omental fat, perirenal fat, muscle, kidney and liver) were taken from group F (time of sacrifice was not specified) and from the treated animals slaughtered on days 1 (group A), 3 (group B), 4 (group C), and 7 (group D). Similar tissue samples were taken from group E at 7 days after the second dipping. Samples were stored at -18°C until analysed. The results are shown in Table 15.

Table 15 Chlorfenvinphos residues (mg/kg) in tissues from heifers dipped with 0.04% chlorfenvinphos.

Group No.	Days after the first dipping	Chlorfenvinphos residues (mg/kg) in tissues									
		Omental fat		Perirenal fat		Liver		Kidney		Muscle	
		E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP	E-CFVP	Z-CFVP
A*	1	<0.01 0.02 0.02	0.08 0.16 0.05	<0.01 <0.01 0.01	0.06 0.06 0.03	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01
B*	3	<0.01 <0.01 <0.01	0.02 0.01 0.02	<0.01 <0.01 <0.01	0.01 0.01 0.02	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01
C*	4	<0.01 <0.01 <0.01	<0.01 <0.01 0.02	<0.01 <0.01 <0.01	0.01 <0.01 0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01
D*	7	<0.01 <0.01 <0.01	0.01 <0.01 <0.01	0.01 0.01 <0.01	0.01 0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01
E**	14	<0.01 <0.01 <0.01	<0.01 0.02 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01

*Groups A, B, C, and D were dipped once; **Group E was dipped twice at an interval of 7 days; Group F consisted of untreated controls.
LOQ = 0.1 mg/kg (based on the recovery data provided)
Residues for untreated controls (Group F) were <0.01 mg/kg for all tissues.
NA = Not analysed
E- and Z-CFVP denote the E- and Z-isomers of chlorfenvinphos, respectively

Comments: Residues of the Z-isomer were detected in omental fat at each sampling point and ranged from 0.01 to 0.16 mg/kg. At 7 days after the first dipping, residues of both isomers had depleted to at or below 0.01 mg/kg. Chlorfenvinphos residues did not increase in fat samples after the second dipping. No detectable residues of either isomer of chlorfenvinphos occurred in other tissues. Although the trial did not address the maximum recommended dipping concentration (0.055%) for *Barricade 'S' Cattle Spray and Dip*, the results did indicate the rapid depletion of fat residues. It would appear that chlorfenvinphos residues are unlikely to exceed the current MRLs of 0.2 mg/kg for **Cattle meat [in the fat]** and **Cattle, Edible offal of** at the slaughter withholding period of 8 days. The LOQ was 0.1 mg/kg based on the recovery data provided and the edible offal MRL can only be lowered to the LOQ.

(g) Sherren, A J (1979). Residues of Barricade and Supona in cattle from Australia, Part I analysis of milk. Project D4, Queensland, Australia.

Seven dairy cows were allocated into two treatment groups (Groups A and B; each n = 3); the remaining cow was an untreated control. The animals were plunge dipped in 0.04% chlorfenvinphos with group A being dipped once and group B dipped twice at a retreatment interval of 7 days. Milk samples were taken from groups A and B on days 0, 1, 3 and 7 after the first dipping, and from group B only on day 7 after the second dipping. Milk samples were stored at 4°C until analysed. The results are shown in Table 16.

Table 16 Residues (mg/kg) of the E and Z-isomers of chlorfenvinphos in whole milk from dairy cows following plunge dipping.

Days after first treatment	Chlorfenvinphos residues (mg/kg) in whole milk	
Group A*	**E-isomer**	**Z-isomer**
0	0.004, 0.002, 0.007	0.055, 0.028, 0.038
1	<0.002, <0.002, <0.002	0.005, 0.003, 0.008
3	<0.002, <0.002, <0.002	<0.002, <0.002, <0.002
7	<0.002, <0.002, <0.002	<0.002, <0.002, <0.002
Group B**		
0	<0.002, <0.002, <0.002	0.014, 0.017, 0.011
1	<0.002, <0.002, <0.002	0.003, 0.002, 0.004
3	<0.002, <0.002, <0.002	<0.002, <0.002, <0.002
7	<0.002, <0.002, <0.002	<0.002, <0.002, <0.002
14 and 7 days after the second dipping	<0.002, <0.002, <0.002	<0.002, <0.002, <0.002

* Group A was plunge dipped once in 0.04% chlorfenvinphos; ** Group B was plunge dipped twice at an interval of 7 days.
LOQ = 0.0025 and 0.01 mg/kg for E- and Z-isomers of chlorfenvinphos, respectively
Residues for the untreated control were <0.002 mg/kg for both isomers

Comments: Chlorfenvinphos residues were high on the day of dipping (day 0) but decreased rapidly. The highest residue (sum of Z- and E-isomers) in any cow was 0.059 mg/L at day 0. By day 3 chlorfenvinphos residues had depleted to <0.002 mg/L. Moreover, there was no evidence of residue accumulation following repeat treatment (see day 14 data). Taking into account the fat-soluble nature of chlorfenvinphos and the average fat content of whole milk being approximately 4%, the maximum residue expected in milk fat would be 25 x 0.059 mg/L = 1.5 mg/L. This value is considerably higher than the current MRL of 0.2 mg/kg for **Milks [in the fat]**. When biological variation and the fact that the trial application rate was about 72% of the maximum dipping rate (0.055% chlorfenvinphos for *Barricade'S' Cattle Dip and Spray*) are taken into account, an MRL of 2 mg/kg for **Cattle milk [in the fat]** with a nil milk WHP would be required to accommodate this use pattern. Increasing the **Cattle milk [in the fat]** MRL 10-fold has ramifications on public health.

(h) Perret, G R (1990). Residues of chlorfenvinphos in milk for Shell Chemical (Australia) QDPI Queensland, Australia.

Three dairy cows were treated with *Supona Buffalo Fly Insecticide* at the recommended maximum dose rate of 800 mg per animal (Note: The details of the application method were not specified but it would appear to be an over-spray). Milk samples were taken from the treated animals at 12 hours and 1, 3, 5, 7, 10 and 14 days post-treatment. The samples were stored at -15°C until analysed. The results are shown in Table 17.

Table 17 Chlorfenvinphos residues (mg/kg) in milk fat after cows were treated with *Supona Buffalo Fly Insecticide* following (probable) over-spray.

Days post-treatment	Chlorfenvinphos residues (mg/kg) in milk fat
0.5	0.07, 0.10, 0.01
1	**0.16**, 0.05, 0.05
3	0.01, 0.01, 0.01
5	<0.01, <0.01, <0.01
7	<0.01, <0.01, <0.01
10	0.01, <0.01, <0.01
14	<0.01, <0.01, <0.01

Milk fat residues for untreated controls (pre-treatment, n =3) were <0.01 mg/kg for two cows while one cow had milk fat residues = 0.01 mg/kg

Comments: Chlorfenvinphos residues in milk fat peaked at 0.16 mg/L within 24 hours of treatment. Residues decreased rapidly to 0.01 mg/kg by day 3. Under the registered use pattern for *Supona Buffalo Fly Insecticide* (the minimum retreatment interval is 10 days), it is unlikely that residues in milk fat would exceed the current MRL of 0.2 mg/kg for **Milks [in the fat]** with a nil milk WHP.

(i) Tanzer, B W (1989). Supona 200 in backrubbers: a trial to determine chlorfenvinphos residues in the tissues of bovines. QDPI, Queensland, Australia.

Twenty Brahman bulls were subjected to backrubber treatment. A conventional 2 metre backrubber was charged at the rate of 1:20 *Supona 200*: sump oil (dose rate of 0.2 g per animal) and positioned beneath shelter near a water trough which the animals used daily. The backrubber was removed after approximately one month. Fat samples were taken from three bulls by tail biopsy on days 1 and 3

after removal of the backrubber. The results demonstrated that chlorfenvinphos residues were <0.05 mg/kg in the fat samples.

Comments: No details of the analytical methodology were provided. It was unclear whether the trial design would ensure that animals were being treated on a daily basis. No residue data were provided for tissues other than fat. Recovery data and representative chromatograms were not submitted. Whilst the residue trial was considered deficient for the purpose of establishing MRLs, it was apparent that this use pattern would not result in fat residues which exceed the existing **Cattle meat [in the fat]** MRL of 0.2 mg/kg.

Residue trials conducted in response to the chlorfenvinphos residue violation in the USA

These trials were performed to closely simulate conditions prior to port-of-entry inspections in the USA. Accordingly, the minimum treatment interval was 3 days and the tissues analysed were intramuscular and subcutaneous fats. At the original nil slaughter WHP for the product *Barricade 'S' Cattle Dip and Spray*, residues consistently exceeded the MRL of 0.2 mg/kg for **Meat [in the fat]**. Consequently, the nil WHP was amended to 8 days. This amendment was made in response to advice from the (then) Meat Research Corporation in which it was indicated that no residue problems would occur when the product is used at treatment intervals of 4 days and with a slaughter WHP of 8 days.

(j) Mawhinney, H (1996). Residues of ectoparasiticides in tissues of cattle produced under typical farm situations within the cattle tick and buffalo fly infested areas of Queensland. Trial No. DAQ.096, Queensland, Australia.

147 animals of various breeds (Hereford, Santa Gertrudis, Brahman, Braford, Simmental) were allocated to 4 treatment groups (A, B, C, D; each n = 34). Each treatment group was dipped in *Barricade 'S' Cattle Dip and Spray* at concentrations of 0.055% chlorfenvinphos and 0.01% cypermethrin as follows:

- Group A was dipped twice with a treatment interval of 3 days.
- Group B was dipped twice with a treatment interval of 3 days, however, the animals were also used to stir the dip on both treatment days.
- Group C was dipped once.
- Group D was dipped once and also used to stir the dip.

Three animals were included in each group as untreated controls. Samples of loin fat and perirenal fat were collected from groups A, B, C and D at slaughter on days 2, 4, 7, 10, 15, 21 and 30 after the last treatment. The results are shown in Table 19.

Table 19 Chlorfenvinphos residues (mg/kg) in loin fat and perirenal fat from cattle which had been plunge dipped in 0.055% chlorfenvinphos.

Animal group No.	Days after the last treatment	Chlorfenvinphos residues (mg/kg)	
		Loin fat	Perirenal fat
A*	2	0.29, 0.45, 0.37,	
	4	0.26, 0.26, 0.23	0.057, 0.046
	7	0.012, 0.014, 0.065, 0.032, <0.005, 0.03	
	10	0.028, <0.005, 0.013, <0.005, 0.012, <0.005	
	15	0.02, <0.005, 0.03, 0.006, 0.009, 0.022,	
	21	<0.005, 0.035, 0.041, 0.021, 0.034, 0.032,	
	30	<0.005, <0.005, <0.005, <0.005	
B**	2	0.6, 0.21, 0.57	
	4	0.19, 0.35, <0.005	
	7	0.035, 0.009, <0.005, 0.005, 0.009, 0.005,	0.011, <0.005, <0.005, <0.005,
	10	0.006, <0.005, <0.005, <0.005, <0.005, <0.005	<0.005, <0.005
	15	0.02, <0.005, 0.028, 0.031, 0.012, 0.036	
	21	0.022, 0.056, 0.042, 0.006, <0.005, <0.005	
	30	<0.005, <0.005, <0.005, <0.005	
C***	2	0.39, 1.0, 0.05	0.33
	4	0.16, 0.008, 0.024	
	7	0.08, 0.012, 0.01, 0.012, <0.005, <0.005,	0.007, 0.01, 0.007
	10	0.03, <0.005, <0.005, 0.012, 0.008, <0.005	0.017, <0.005, <0.005, <0.005
	15	0.007, <0.005, 0.023, 0.021, 0.021,	
	21	<0.005, <0.005, <0.005, 0.006, <0.005, 0.005	
	30	0.005, <0.005, <0.005, <0.005	
D****	2	0.9, 0.12, 0.14	
	4	0.028, 0.011, 0.031	
	7	0.023, 0.02, 0.008, 0.05, 0.02, 0.009	<0.005, 0.009, 0.007, 0.02
	10	0.011, <0.005, <0.005, 0.009, 0.007, <0.005	<0.005, <0.005, <0.005, <0.005, <0.005
	15	<0.005, <0.005, 0.015, 0.087, 0.02, <0.005,	
	21	0.03, <0.005, 0.02, 0.006, 0.01, <0.005	
	30	<0.005, <0.005, <0.005, <0.005	

*Group A was dipped twice with a retreatment interval of three days.
**Group B was dipped twice with a retreatment interval of three days, however, the animals were also used to stir the dip on both treatment days.
***Group C was dipped once.
****Group D was dipped once and also used to stir the dip.

Comments: This trial analysed loin fat and perirenal fat and in the case of group A, used a retreatment interval of 3 days, in order to simulate the US conditions for residue monitoring. It is apparent that residues were high for 4 days after the final treatment and depleted rapidly thereafter. Under the current use pattern where the minimum treatment interval is 10 days and the slaughter WHP is 8 days, it is unlikely that the current MRL of 0.2 mg/kg for **Cattle meat [in the fat]** would be exceeded. Furthermore, Meat and Livestock Australia (MLA) has established an export slaughter interval (ESI) of 21 days for *Barricade 'S' Cattle Dip and Spray*. Provided cattle are not used as stirrers, the ESI allows sufficient time for chlorfenvinphos tissue residues to deplete to below the minimum reported level of 0.005 mg/kg. This adds an extra safety margin in minimising chlorfenvinphos residue violations in beef exported to the USA. The data for groups B and D (Table 4.19) show that when dipped cattle are also used to stir the dip, tissue residues of chlorfenvinphos are >0.005 mg/kg at the ESI of 21 days. This is also noted in cattle dipped twice at retreatment interval of 3 days (group A).

Neither detail of the analytical methodology nor the LOQ (based on recovery data) was reported. No data were provided for the untreated controls. The trial did not address the Australian use pattern in terms of the minimum retreatment interval (10 days) and the maximum number of applications (10 applications). Despite these deficiencies, the maximum residue of 0.065 mg/kg at 7 days after the last treatment of group A (two dippings 3 days apart) demonstrated that chlorfenvinphos residues are unlikely to exceed the current MRL of 0.2 mg/kg for **Cattle meat [in the fat]** when the Australian use pattern is practised.

(k) Rose, G (1996). Pesticide residues in export beef produced under typical farm siutaions within buffalo fly infested areas of New South Wales and Queensland. Trial No. DAN.084 NSW Agriculture.

Twenty-eight Brahman cattle were allocated to 5 treatment groups (groups A, B, C, D, E; each n = 5); the remaining three animals were untreated controls. The treatment groups were given access to a backrubber containing 16 g chlorfenvinphos/L for three weeks. The backrubber was then either removed or the animals were placed in an adjacent paddock prior to slaughter. Loin fat and renal fat were taken from the untreated controls and the treated animals at slaughter on days 1 (group A), 2 (group B), 4 (group C), 7 (group D) or 10 (group E). The results are shown in Table 20.

Table 20 Chlorfenvinphos residues (mg/kg) in loin fat and perirenal fat from cattle treated for 3 weeks with a backrubber containing 16 g/L of chlorfenvinphos.

Animal Group No.	Days post-treatment	Chlorfenvinphos residues (mg/kg) in fat tissues	
		Loin fat	Perirenal fat
A	1	0.009, 0.016, <0.005, 0.007, <0.005	
B	2	0.008, 0.007, 0.007, 0.011, 0.007	
C	4	0.02, 0.006, <0.005, 0.02, <0.005	0.006, <0.005, <0.005, 0.01, <0.005
D	7	0.01, 0.02, <0.005, 0.03, <0.005	0.006, 0.01, <0.005, 0.006, <0.005
E	10	<0.005, 0.011, <0.005, 0.009, 0.01	

Comments: Details of the analytical methodology and recovery data were not provided. In addition, results for the untreated controls and representative chromatograms were not submitted. Despite these deficiencies, it is most unlikely that the registered use pattern for backrubbers (which includes a nil meat WHP) would result in chlorfenvinphos residues exceeding the current MRL of 0.2 mg/kg for **Cattle, meat [in the fat]**.

(l) Dunham, R J (1980). Cypermethrin/chlorfenvinphos residues data in sheep tissues and goats milk. Project No. S/AU/D4/81 Queensland, Australia.

Four milking goats were plunge dipped on 3 occasions (days 0, 4, and 8) with *Barricade 'S' Cattle Dip and Spray* at the recommended label rate of 0.055% chlorfenvinphos. Milk samples were also taken pre-treatment and on days 0, 4, 8, 9, 11, 14, and 18 after the first treatment. In other words, milk samples were taken on days 1, 3, 6 and 10 after the third and final treatment (day 8). The results are shown in Table 21.

Table 21 Chlorfenvinphos residues (mg/L) in whole milk collected from goats following plunge dipping.

Sampling days	Chlorfenvinphos residues (mg/L) in whole milk
0 (pre-treatment) (am)	0.001
0 (**first treatment**) (pm)	0.032
4 (pre-second treatment) (am)	0.004
4 (**second treatment**) (pm)	0.038
8 (pre-third treatment) (am)	0.002
8 (**third treatment**) (pm)	0.018
9 (am)	0.014
11 (am)	0.005
14 (am)	0.004
18 (am)	0.001

Data are expressed as geometric means.

Comments: The registrant did not provide milk data for the individual animals. Instead, geometric means of milk residues were presented. Neither recovery data nor representative chromatograms were submitted. In the absence of individual animal data, the results are inconclusive and no milk MRL recommendations can be made. Nevertheless, it is clear that the geometric mean residues on days 0, 4, 8 and 9 exceeded the current Australian **Milks [in the fat]** MRL of 0.2 mg/kg (assuming a milk fat content of 4% for the purpose of converting from a milk fat to a whole milk basis).

3.7.2 Agricultural Uses

JMPR (1996) evaluated chlorfenvinphos residues associated with agricultural uses and it was recommended that all MRLs for crop and animal commodities be withdrawn. CCPR (April 1999) has now recommended the revocation of all chlorfenvinphos MRLs except the MRLs for brussels sprouts; cabbages, head; carrot; and cauliflower. These MRLs are to remain unchanged. Animal feeding

studies for cattle grazing treated pasture were briefly reported, and milk residue data from these feeding studies were provided.

The following residue trials were submitted as part of the Special Review Program of chlorfenvinphos/cypermethrin. These trials are considered here because of the registered uses of the product *Birlane 500 Insecticide* on potatoes and pasture.

(a) Mathews, B L (1968). Residues of Birlane in potatoes from Australia. Technical Services report WKTR.0064.68 Neerim, Australia.

The product was applied to the foliage of growing potatoes on 8 occasions at retreatment intervals ranging from 1-2 weeks at the recommended rate of 280 g chlorfenvinphos/ha. Samples of potatoes were taken 5 days after the fourth and eighth sprays. Chlorfenvinphos residues were <0.01 mg/kg in both peeled and unpeeled potatoes.

(b) Bosio, P G (1971). Residues of Birlane in potatoes from Australia. Research report BEGR.0051.71 Springvale, Victoria, Australia.

The product was applied to the foliage of potatoes on 5 occasions at a retreatment interval of 2 weeks; rates used were 280 and 420 g chlorfenvinphos/ha. Samples of potatoes were taken on days 1, 3 and 7 after the fifth and final treatment at each dose rate. Residues of chlorfenvinphos and its metabolite 1- (2, 4-dichlorophenyl)-ethan-1-ol, in the free and conjugated forms, were at undetectable levels.

Comments: Although treatments were not repeated at 7 day intervals, it would appear that detectable residues of chlorfenvinphos in potatoes from the registered use pattern are unlikely. This takes into account, firstly, the metabolic studies in potatoes which indicated low total radioactivity (<0.5%) in tubers at 80 days after the foliar application and secondly, undetectable chlorfenvinphos residues at 7 days after treatment with 2x the recommended rate. The current “at or about” MRL of 0.05 mg/kg for potatoes is therefore considered appropriate.

(c) Hughes, D G; Allen, R V & Edmunds J W (1965). Birlane and DDT residues on grass and hay samples from Australia. Technical note 15/66. Australia

The trial involved spraying grass and hay with *Birlane* at dose rates of 280 and 420 g chlorfenvinphos/ha. Samples were taken at 1, 2, 4, 6 and 8 weeks after treatment and analysed for the Z- and E- isomers of chlorfenvinphos. Residues found on grass at 1 and 2 weeks after spraying exceeded 1 mg/kg but had fallen to about 0.01 mg/kg after 6 weeks. Chlorfenvinphos residues in hay were higher and more persistent than those in grass. Three metabolites, 2, 4-dichloroacetophenone, 2,4 -dichlorophenacyl chloride and 1-(2, 4-dichlorophenyl) ethanol, were identified and determined. Two-thirds of the metabolite residues were comprised of 1-(2, 4-dichlorophenyl) ethanol, the highest level of which was 0.6 mg/kg. The remainder of the residue was primarily 2, 4-dichlorophenacyl chloride.

Based on data for *Birlane 500 Insecticide* provided by Cyanamid Agriculture Pty Ltd, the sale volume for potatoes would appear to account for 90% of the total sales. By comparison, the sale volumes for other registered uses can be considered to be inconsequential. Hence, the additional contribution of residues in animal commodities arising from treated pasture is considered minimal.

In Australia, potatoes are the only crop for which chlorfenvinphos is currently registered. There are no registered products for the remaining crop commodities. Despite this, MRLs are listed in the *MRL Standard* for these crop commodities. This situation arose from a recommendation made at the February 1977 NHMRC meeting to harmonise Australian MRLs with the Codex MRLs for carrots, celery, cauliflower, radish, horseradish, tomatoes, brussel sprouts, cabbages, broccoli, potatoes, onions, leeks, eggplant, mushrooms, peanuts, maize, wheat, cotton seed and rice. The recommendation was made in the absence of residue data. CCPR (April 1999) has now recommended the revocation of all chlorfenvinphos MRLs except those for brussels sprouts; cabbages, head; carrot; and cauliflower. Because there are no registered products for use on agricultural commodities except potatoes in Australia, the regulatory action will have minimal impact on the chemical industry and farmers. Chlorfenvinphos has already been de-registered for use on tomatoes and rice in this country and it is recommended that the *MRL Standard* be amended to reflect this.

In response to the public comment phase, residue data was submitted for the use of chlorfevninphos in mushrooms. The evaluation of this data is noted below.

Experiment: two mushroom trials into the product Birlane (containing 500 g/L chlorfenvinphos) were conducted in Australia during 1980. In one trial, the product was delivered directly to the growing surface of cased trays of mushrooms (referred to in the application as drenching) at a rate of 1g chlorfenvinphos/m^2. Sampling for residue analysis occurred 11 days after treament. In a second trial, mushroom casings were treated with Birlane prior to adding the casings to the trays; the dose rate was 53 g chlorfenvinphos/m^3. Sampling took place 21 days after adding the casings to the trays.

Sample preparation and analytical methods: mushrooms were finely diced prior to extraction. The latter involved homogenising the sample with a mixture of acetone in hexane. No clean up was performed. Quantitaion was by GLC with flame photometric detection. Recoveries at 0.1 mg/kg fortification were 83% for the E-isomer and 96% for the Z-isomer.

Results: residue data for untreated controls, and 3 sub-samples of mushrooms harvested on day 11 post-application (Trial 1) and on day 21 after addition of the treated casings (Trial 2) were presented. These data are shown in Table 1.

Table 22: residues of chlorfenvinphos (mg/kg) in mushrooms

Treatment		Sampling	Sub-samples	Residues (mg/kg)	
Formulation used	Dosage	Treatment to sampling		E-isomer	Z-isomer

		interval (days)			
untreated	untreated		1 2 3	<0.01 <0.01 <0.01	<0.01 <0.01 <0.01
500 g/L EC	Trial 1 (1g/m^3)	11	1 2 3	<0.01 <0.01 <0.01	0.26 0.20 0.26
500 g/L EC	Trial 2 (53 g/m^3)	21	1 2 3	<0.01 <0.01 <0.01	0.09 0.01 0.03

Crop variety: unknown
No. Applications: 1
Analyses: results not corrected for recoveries
Note: Average weights of mushroom samples were:

Trial 1:
sub-sample 1 = 12.3g
sub-sample 2 = 11.5g
sub-sample 3 = 11.8g

Trial 2:
sub-sample 1 = 11.9g
sub-sample = 10.7g
sub-sample = 11.8g

Comments: of the two application methods trialled, application of chemical to the casing prior to their addition to the trays of mushrooms (i.e. as conducted in trial 2) addresses the current label directions. The residue data indicate that neither application method will result in compliance with the current Australian mushroom MRL of 0.05 mg/kg. In this regard, incurred residues were higher in mushrooms treated during the growing period (Trial 1; maximum residue was 0.26 mg/kg) than in those where the casings had been treated in advance of being added to the trays of mushrooms (Trial 2; maximum residue was 0.09 mg/kg). In order that the current use pattern can continue without MRL violations, the Australian chlorfenvinphos MRL for mushrooms will need to be increased from 0.05 mg/kg to 0.2 mg/kg and the label be amended to indicate that the approved withholding period is 21 days. Consideration also needs to be given to the fact that there is no Codex MRL for chlorfevinphos in mushrooms.

3.7.3 Feeding Studies

(a) Allen R V (1966). Residues of Birlane and its metabolites in milk and grass from Australia. Technical Service Note 147/66 Australia.

This trial was performed to determine whether residues of chlorfenvinphos occur in the milk of cattle grazing treated pasture. Pasture was sprayed with *Birlane* at a dose rate of 420 g chlorfenvinphos/ha and pasture samples were taken 4 days, and 1, 2 and 3 weeks after treatment. Maximum residues at the respective sampling times were 22, 6.5, 4.9 and 2.2 mg/kg (Wet weight or dry weight basis of the

samples collected was not specified). Four lactating cows were admitted to graze the pasture two days after its treatment. Milk samples were collected at 4 days, and 1, 2 and 3 weeks after feeding of the treated pasture had commenced. No residues of either chlorfenvinphos or its metabolites were detected in milk. Tissue residue determinations were not undertaken.

3.8 Fat Solubility

Based of the log $P_{o/w}$ values of 3.85 ((Z)-isomer) and 4.22 ((E)-isomer), chlorfenvinphos is considered fat-soluble. This is consistent with the findings of the residue trials reported herein. Chlorfenvinphos is miscible with acetone, dichloromethane, ethyl acetate, hexane, methanol, propan-2-ol and toluene.

3.9 Fate of Residue in Storage and Processing

Neither storage stability data nor processing data were provided. However, a literature article provided by the registrant reported that soil containing chlorfenvinphos residues may be stored for at least 1 month at 0°C without residue decomposition. Also, recovery experiments indicated that extracts containing chlorfenvinphos from crops may be stored for at least 1 month at 0°C without loss of chlorfenvinphos[1].

3.10 Residues in Food in Commerce or at Consumption

Between 01/07/93 to 31/12/95, the NRS reported only one chorfenvinphos residue detection which was in horse fat. Food commodities tested were animal fat, cereals, legumes and beans. Only 0.39% of the total samples in horse fat was found to have detectable residues of chlorfenvinphos; chlorfenvinphos residues in other food commodities were at non-detectable levels. The 1996 monitoring data for similar food commodities identified no chlorfenvinphos residues. The Australian Market Basket Survey conducted in 1994 also indicated that no chlorfenvinphos residues were found in diets based on the 95th percentile energy intake. These results indicate that chlorfenvinphos was used in compliance with good agricultural practices. In summary, the MRLs for chlorfenvinphos were not violated over the period studied.

Information from the Australia Milk Residue Analysis Survey (AMRA) indicates that no detections of chlorfenvinphos have been found during the period January 1995 to June 2000. The collection of samples in this survey is distributed around Australia according to the level of production in each state.

3.11 Maximum Daily Intake Calculations

[1]K. I. Beynon, L. Davies, K. Elgar and G. Stoydin, "*Analysis of crops and soils for residues of diethyl 1-(2, 4-dichlorophenyl)-2-chlorovinyl phosphate*" I. - Development of Method, J. Sci. Fd. Agric., 17, 162 (1966).

The chronic dietary intake risk is estimated by the National Estimated daily intake (NEDI) calculation. The NEDI (based on the Supervised Trial Median Residues [STMRs] of the animal commodities and the consumption figures for 67 kg bw adults as used in the dietary modelling system of the ANZFA) is 15% of the revised ADI for chlorfenvinphos of 0.0005 mg/kg bw/day (calculations can be found at the end of the residue report).Therefore, the chronic dietary exposure is small and the risk is acceptable. This conclusion is consistent with 1996 monitoring data and the 1994 Australian Market Basket Survey which indicated no detectable chlorfenvinphos residues were found in food commodities.

The acute dietary intake risk is estimated by the estimated short term intake (ESTI) calculation. On account of infants' diets comprising predominantly milk, this sub-group population is at most risk from those chemical residues which occur in milk. The ESTI (based on the current MRL of 0.2 mg/kg for **Cattle milk [in the fat]**) for 9.11 kg infants is 35% of the acute reference dose (ARfD) of 0.002 mg/kg bw/day for chlorfenvinphos (the recommended ARfD for chlorfenvinphos is 0.002 mg/kg bw/day by the Chemicals and Non-Prescription Drug Branch, TGA). It is concluded that the acute dietary exposure is small and the risk is acceptable.

From a public health perspective, an Australian **Cattle milk [in the fat]** MRL of 0.2 mg/kg is considered appropriate as it is unlikely to result in dietary intake concerns. By contrast, a **Cattle milk [in the fat]** MRL of 2 mg/kg as required to accommodate plunge and spray dip use patterns is associated with unacceptable dietary intake concerns. Therefore, on public health grounds, a milk [in the fat] MRL of 2 mg/kg cannot be supported.

3.12 Overview and Discussion

International Status

No commitment has been given at the international level to generate metabolism data to rectify the short-falls as identified by the JMPR review in 1996. This has resulted in the CCPR's recommendation to revoke chlorfenvinphos MRLs except those pertaining to brussels sprouts; cabbages, head; carrot; and cauliflower at its April 1999 meeting.

Metabolism Data

The ruminant metabolism studies were conducted between 1961 and 1967 and involved dermal and IM administration of chlorfenvinphos. An oral metabolism study was not conducted in cattle. However, chlorfenvinphos was completely metabolised in rats and dogs following oral administration. In addition, cattle feeding studies in which pasture at 2 days after treatment were fed reported non-detectable residues in milk.

Data from oral metabolism studies in rats and dogs are in contrast to the IM data for cattle. Following IM administration ca 85% of radioactive residues in milk fat were parent compound while the major metabolite (ca 4%) was identified as 2, 4-dichloroacetophenone. The IM study identified the parent compound as the residue marker. This is consistent with chlorfenvinphos being fat-soluble. Following

dermal application to cattle, most of the radioactive residues were in omental or renal fat. Little or no measurable residues were reported in liver, kidney, muscle and other tissues. Thus, fat was identified as the target tissue. Furthermore, the major metabolite 2, 4-dichloroacetophenone identified in the IM study was not found in omental fat following the multiple dermal treatments. These dermal metabolism data are consistent with the findings from residue trials conducted on cattle and sheep.

Chlorfenvinphos metabolites were not characterised in the dermal metabolism studies on cattle. It is conceivable, however, that similar metabolites may be derived following IM dermal administration. This would require minimal metabolism of chlorfenvinphos occurring on passage through the skin.

CCPR (April 1999) recommended the revocation of animal commodity MRLs for chlorfenvinphos on the basis of deficiencies identified in metabolism studies. From a residue definition viewpoint, the submitted metabolism data support the current residue definition of chlorefenvinphos as the sum of E- and Z-isomers.

Limit of Quantitation and Storage Stability Data

The limit of quantitation (LOQ) was 0.1 mg/kg for tissue (muscle, fat, liver and kidney) residues based on data from recovery studies. Despite this, however, tissue residue levels at 0.01 mg/kg were reported and the registrant contended that 0.01 mg/kg was the LOQ. The LOQ of 0.1 mg/kg may simply reflect the choice of concentrations at which recoveries were determined. In more recent trials (DAQ.096 and DAN.084), fat residues of 0.005 mg/kg were reported without providing method validation and recovery details. These concerns were compounded firstly, by the lack of storage stability data in the analytical samples and secondly, by revocation of the chlorfenvinphos MRLs in the USA. The latter means that undetectable residues at a detection limit consistent with the US regulatory method for chlorfenvinphos must be attained in animal tissues if violations in that country are to be avoided.

Considering that fat was identified as the target tissue and non-detectable residues were found in edible offal under the proposed use pattern, it is unlikely that edible offal will be used for monitoring purposes. Although the applicant did not provide LOQ at the lowest quantifiable level for muscle, kidney and liver, it is apparent that the current LOQ of 0.1 mg/kg for these tissues would suffice.

As fat will be used for monitoring purposes, and LOQ of <0.1 mg/kg for fat residues would be considered appropriate. It is apparent from the residue data submitted that an LOQ of 0.02mg/kg for fat residue can be achieved. Thus the determination of LOQs at <0.1 mg/kg is considered unnecessary.

No storage stability data for animal commodities were provided.

Residues in Animal Commodities – Tissues

Under the current veterinary use patterns for the registered products, it is unlikely that the residue levels of chlorfenvinphos for cattle and sheep would exceed the current MRLs of 0.2 mg/kg for **Cattle meat [in the fat]**, **Cattle, Edible offal of**, **Sheep meat [in the fat]** and **Sheep, Edible**

offal of. The critical good veterinary practice and thus the MRLs for animal commodities are determined by the use of *Barricade 'S' Cattle Dip and Spray* and *Coopers Blockade 'S' Cattle Dip and Spray* and *Supona Buffalo Fly Insecticide*. This is because higher dose rates are required with plunge dipping.

Although the maximum number of applications was not addressed in the residue trials, it is apparent from the depletion profile that by day 7 or 10 after the last treatment, fat and edible offal residues had depleted to or below the minimum reported level of 0.01 mg/kg. Hence, there is unlikely to be a cumulative effect observed with repeat treatments at 10 day intervals. This is demonstrated in the residue trials for sheep and cattle where repeat treatment intervals of 4, 10, and 7 days, respectively, were used.

When taking into consideration the residue data provided for sheep and cattle, it is apparent that under the registered use pattern, the proposed chlorfenvinphos MRL residue level of 0.1 mg/kg for fats in cattle and sheep is unlikely to be exceeded except with stirrer cattle. However, in view of the advice from the Queensland DPI and the identical MRLs for **Cattle meat [in the fat]** previously established by Codex and the US, a chlorfenvinphos MRL of 0.2 mg/kg for **Cattle meat [in the fat]** and **Sheep meat [in the fat]** should be maintained in conjunction with a slaughter WHP of 8 days (Note: Because Codex MRLs were revoked at the July 1999 meeting of CAC and the US MRLs have already been revoked, it is crucial from a trade perspective that ESIs are in place).

In the residue trials, chlorfenvinphos residues in liver and kidney were reported to be below 0.01 mg/kg at all sampling points. Based on the recovery data provided, however, the limit of quantitation for tissue samples was 0.1 mg/kg. Therefore, a chlorfenvinphos MRL of *0.1 mg/kg for **Cattle, Edible offal of** and **Sheep, Edible offal of** is recommended.

Although *Coopers Blockade 'S' Cattle Dip and Spray* is an image product of *Barricade 'S' Cattle Dip and Spray*, the label instructions for the two products differ. The current registered label for *Coopers Blockade 'S' Cattle Dip and Spray* instructs that stirrer cattle require a slaughter WHP of 14 days while cattle treated once require a slaughter WHP of 8 days. By contrast, the *Barricade 'S' Cattle Dip and Spray* label has a restraint against the use of stirrer cattle. The restraint was a recommendation flowing from residue trial results; the trials were conducted in response to a residue violation in the USA. Therefore, a restraint statement which reads "*Do no mix the solution by using cattle as stirrers"* should be included on the label of *Coopers Blockade 'S' Cattle Dip and Spray.* This is compatible with cattle husbandry practices in northern Australia where graziers generally do not identify stirrer cattle as such, and there can be no guarantee that a 14 day WHP will apply to stirrer cattle and an 8 day WHP to all other cattle.

Residue trials were conducted for cattle and sheep only. Despite this, *Barricade 'S' Cattle Dip and Spray* may be used to control tick on cattle, horses, deer, goats, sheep and working dogs. The existing MRLs for goat commodities (excluding milk) were based on a decision taken by the Pesticide and Agricultural Chemical Committee (PACC) in 1980 to extend MRLs established for meat of cattle and sheep to meat of goats. Although no residue trial data for goats were submitted for evaluation, the decision taken by PACC is considered acceptable.

Residues in Animal Commodities – Milk

A residue trial was performed on lactating cows at a dipping concentration of 0.04% chlorfenvinphos, however, the maximum label rate of 0.055% chlorfenvinphos was not addressed. Even at 72% of the maximum label rate, chlorfenvinphos residues of 1.5 mg/L in milk fat were observed. These residues vastly exceed the current MRL of 0.2 mg/kg for **Milks [in the fat]**. Raising the **Milks [in the fat]** MRl to 2.0 mg/kg would accommodate the plunge and spray dip use patterns on lactating dairy cattle.

However such an increase would have a two-fold ramification. Firstly, infants' acute infant dietary exposure to chlorfenvinphos would be increased from 35% to 351% of the ARfD. Secondly, it may have an adverse effect on Australian trade given the recent recommendation by the CCPR (April 1999) to revoke the Codex milk MRL. Another factor which needs to be taken into account is the real possibility of chlorfenvinphos residues appearing in milk as a result of treating non-lactating cows.

Therefore the use of *Barricade 'S' Cattle Dip and Spray, Coopers Blockade 'S' Cattle Dip and Spray* cannot be supported on lactating dairy cattle without the following restraint statement: **DO NOT USE on lactating cows or within 42 days of calving where milk or milk products may be used for human consumption** should be added to the product labels.

Milk residue trials for goats were presented, however, the goat residue trial was deficient in that milk residues for individual animals were not reported. Instead, geometric means of milk residues were provided. Furthermore, there were limited experimental details of the analytical methodology. The current **Milks [in the fat]** MRL for chlorfenvinphos is considered inappropriate due to the deficiencies identified in the goat residue trial. In view of the registered use on pasture, milk residues arising from grazing also need to be considered. However, the low usage on pasture and the undetectable residues found in milk from cattle grazed two days after treatment alleviates milk residue concerns which may otherwise arise from the use on pasture. It is concluded that the current **Milks [in the fat]** MRL is inappropriate to cover use on goats and sheep and other lactating animals other than cattle. The following restraint is to be added: **DO NOT USE on female sheep or goats that are producing or may in the future produce milk for human consumption or processing.**

Supona Buffalo Fly Insecticide is currently registered for use on dairy cows bit no milk WHP is specified on the label. There is the restraint that this product not be used on animals producing milk for human consumption when applied as a backrubber. If milk from treated cattle is intended for human consumption then the label must specify a withholding period for milk. Based on the currently registered use pattern, an MRL of 0.2 mg/L for **Cattle milk [in the fat]** and a NIL milk WHP is considered appropriate for *Supona Buffalo Fly Insecticide.* Furthermore, an ESTI calculation for infants shows that the acute dietary exposure is safe i.e. the ESTI is 35% of the ARfD for chlorfenvinphos.

Residues in Agricultural Commodities

Birlane 500 Insecticide is currently the only chlorfenvinphos-based product registered for use on potatoes and pastures. Because of its low usage on pasture and because the label carries a grazing WHP of 7 days for pasture, there should be no residue concerns arising as a result of animals consuming treated pastures.

In order that the current use pattern can continue without MRL violations, the Australian chlorfenvinphos MRL for mushrooms will need to be increased from 0.05 mg/kg to 0.2 mg/kg and the label amended to indicate a withholding period of 21 days.

Product registrations supported by arguments

Defiance 'S' Insecticidal Flystrike Mules and Wound Dressing is used as an antiseptic and insecticidal dressing for the treatment of blowfly strike of sheep and for use during mulesing and marking operations. It also helps protect wounds from blowfly strike on sheep, cattle and horses. The product is used as a single application (0.14 g chlorfenvinphos per 55 kg sheep and 0.25 g chlorfenvinphos per 500 kg cattle) in operations such as mulesing, marking, dehorning and castration. Considering that low dosages are used as single treatments of young animals, it is unlikely that significant chlorfenvinphos residues would occur in marketable animal commodities.

Neither arguments nor residue data were provided for ECRP review of *David Grays Aerosol Sheep Dressing* and *WSD Aerosol Sheep Dressing*. Since the registered use patterns of these products are closely similar to that of *Defiance 'S' Insecticidal Flystrike Mules and Wound Dressing*, arguments put forward to support the registration of *Defiance 'S'Insecticidal Flystrike Mules and Wound Dressing* are considered applicable to *David Grays Aerosol Sheep Dressing* and *WSD Aerosol Sheep Dressing*. Therefore, residue data are not required and the current use patterns are considered acceptable.

No residue trials were conducted with *Supona Buffalo Fly Insecticide* when used as an over-spray on beef cattle (the present trial data were for dairy cattle). It was argued that the registered dose rate of 0.8 g chlorfenvinphos per animal is unlikely to result in residue levels exceeding the current MRLs of 0.2 mg/kg for **Cattle meat [in the fat]** and **Cattle, Edible offal**. This argument was based on a trial conducted on cattle treated in a plunge dip with the wash concentration of 0.04% chlorfenvinphos. This represents an effective dose of 1.6 g chlorfenvinphos per animal (assuming an individual animal removes 4 L of dip wash). Therefore, the dose rate of 0.8 g chlorfenvinphos per animal for *Supona Buffalo Fly Insecticide* when used as an overspray is less than the dose rate associated with plunge dipping at 0.04% chlorfenvinphos. Taking into account the lower dose rate and the longer retreatment interval for *Supona Buffalo Fly Insecticide*, it is unlikely that chlorfenvinphos residues would exceed the current MRL of 0.2 mg/kg for **Cattle, meat [in the fat]** and **Cattle**, **Edible offal of** (with a nil slaughter WHP).

At the initiation of the review registrants did not submit arguments and/or residue data for the chlorfenvinphos ECRP review of the following products: *Coopers Suprex 100 Jetting Fluid* and *WSD Jetting Fluid 100 Jetting Fluid for Control of Flystrike on Sheep*.

In response to the public comment period a proposal to extend the WHP to 8 days without the need for additional data was given. This was supported on residue grounds and there was no need for additional data.

Figure 1 Proposed metabolic pathway for chlorfenvinphos in ruminants

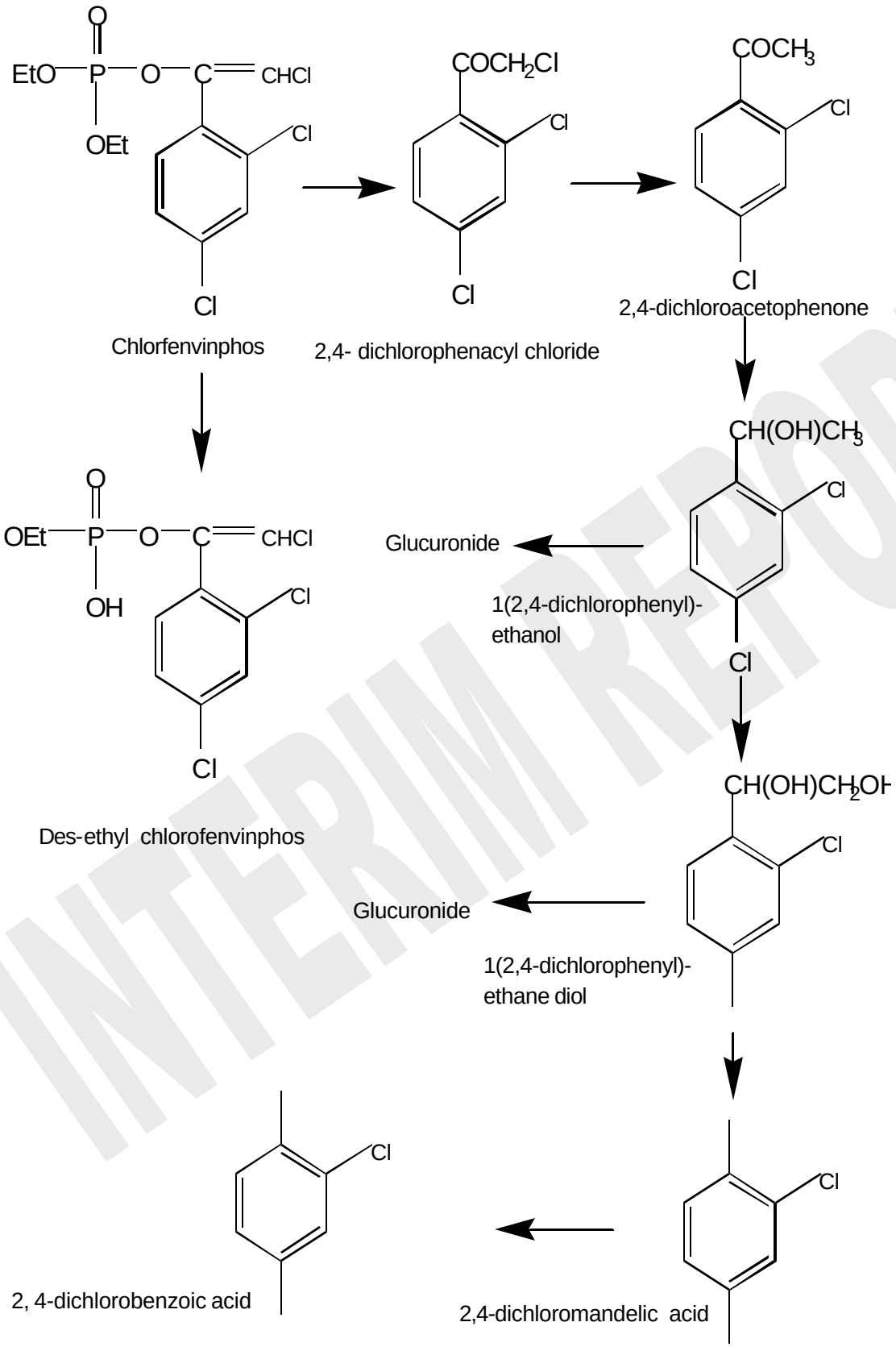
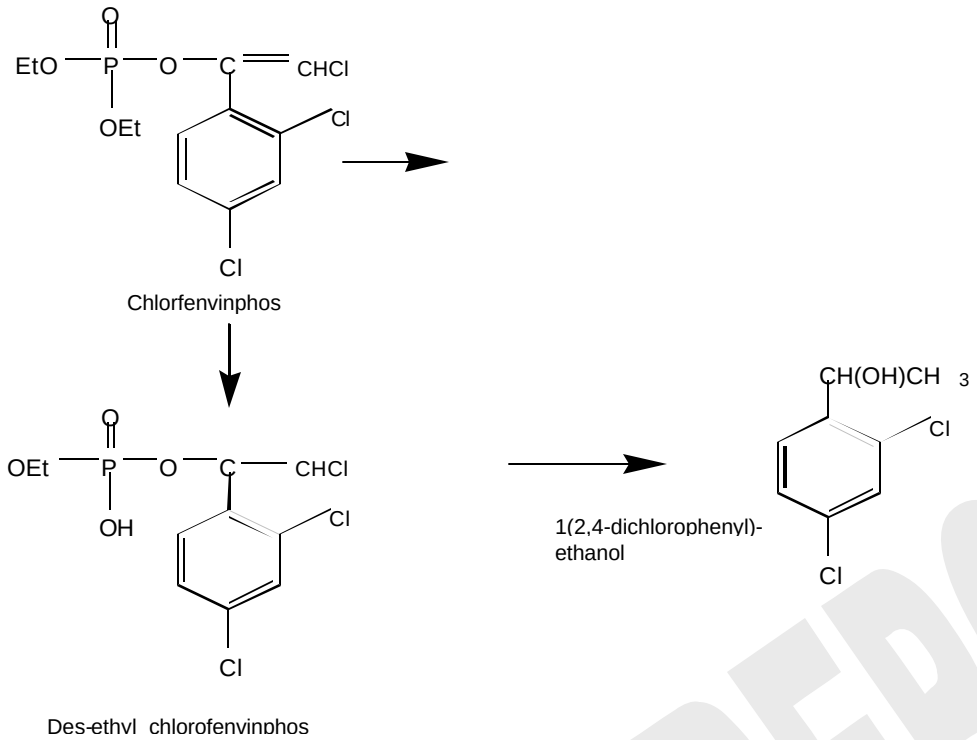


Figure 2 Proposed metabolic Pathway for chlorfenvinphos in plants



Appendix 3a CHLORFENVINPHOS

Calculation of NEDI (revised ADI for chlorfenvinphos = 0.0005 mg/kg of bodyweight/day [19/10/98]) for a 67 kg bw adult.

Commodity	Food consumption ## Kg/person/day	STMR mg/kg	NEDI mg/adult
Cattle milk#	0.603	0.0028	0.0016884
Cattle, edible offal of	0.00011	*0.10	0.000011
Cattle meat [in the fat]	0.014538	0.01	0.00014538
Sheep, edible offal of	0.00001	*0.10	0.000001
Sheep meat [in the fat]	0.002794	0.01	0.00002794
Potato	0.0658	*0.05	0.00329
Total			0.00516372 7.70704E-05 mg/kg body weight **

- At or about the limit of determination
- ** Equivalent to 15.4% of the hypothetical ADI

These calculations have been made in accordance with 'Guidelines for Predicting Dietary Intake of Pesticide Residues' (World Health Organisation).

NEDI – national Estimated Daily Intake
ADI – Acceptable Daily Intake
STMR – Supervised Trail Median Residue (Derived from Tables 17, 14 and 12 for Cattle milk, Cattle [in the fat] and sheep meat [in the fat], respectively).

- The intakes are derived from dietary modelling systems of ANZFA (22 March 1999) which takes into account mean intakes from respondents. For meat [in the fat] in cattle and sheep, the intakes take account of 20% fat in the meat (the intakes for meat in cattle and sheep are 0.07279 and 0.01397 kg respectively).

- the STMR in milk fat = 0.07 mg/kg. For the purpose of calculating the NEDI, the corresponding Milk (whole commodity) STMR= 0.0028 mg/kg (assuming 4% fat content) were used.

Appendix 3b CHLORFENVINPHOS

Calculation of ESTI (ArfD for chorfenvinphos = 0.002 mg/kg of bodyweight/day) for a 9.11 kg bwt infant.

Commodity	Food consumption Kg/infant/day	MRL mg/kg	ESTI mg/infant
Cattle milk #	0.8	0.008	0.0064
Total			0.0064 0.000702525 mg/kg bodyweight **

- At or about the limit of determination
- ** Equivalent to 35.1 % of the hypothetical ARfD

These calculations have been made in accordance with 'Guidelines for Predicting Dietary Intake of Pesticide Residues' (World Health Organisation).

ESTI – Estimated Short-term Intake
ARfD – Acute Reference Dose
MRL – Maximum Residue Limit

- Assuming an infant's dietary intake of 800 ml whole milk per day and a Cattle milk [in the fat] MRL of 0.2 mg/kg (equivalent to 0.008 mg/kg when expressed on a whole milk basis).

Note that the infant body weight is 9.11 kg.

4. TRADE ASSESSMENT

4.1 Background

Another aspect of the 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 undue 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 recognized international forums (such as the Codex Alimentarius Commission) and whether the importing country is a member of the reviewing organisations or recognizes 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;
- The ability of respective industries to meet quality or quantity demands of customers without current use levels of the chemical.

These matters have been examined and the results follow.

4.2 Exports to Other Countries

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

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 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 levels of another OP insecticide, diazinon, 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 being 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 Residue Implications of Sheep Ectoparasiticides which proposed changes to use patterns, application techniques and processing technology. This issue is being addressed through the current NRA review of selected sheep ectoparasiticides.

4.2.1 Wool

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

4.2.2 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.

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.

4.2.3 Milk

In the year 1998/99 the Australia export industry for dairy products was worth around $2 billion. Cheese made up 34% of these exports with skim milk powder also being a significant contributor (24%). Asian markers were the main importer of Australian dairy products. Victoria produces the majority of exported produce (85%).

4.2.4 Other

Potatoes

Although chlorfenvinphos is registered for use on potatoes, it is clear from the efficacy assessment that use of this chemical in the potato industry has declined to the extent that it is only used in circumstances where other management strategies have broken down. It is therefore extremely unlikely that use of chlorfenvinphos will affect trade in potatoes.

Mushrooms

The mushroom industry has a total value of the order of $150 million, but there is no export of this crop. Difficulties related to distances from the export markets and the perishable nature of the crop are still being considered in relation to export of mushrooms.

4.3 Potential Trade Problems

Potential trade problems could arise from the presence of residues in export produce, particularly meat and wool or from the inability of the respective industries to meet the criteria (eg quality, quantity etc.) demanded by their customers.

Both the meat and wool industries have taken steps to avoid the possibility of export industries being put at risk by the presence of residues in the respective commodities.

The NRA Review of Sheep Ectoparasiticides

In this context it is noted that the NRA has examined the use of all ectoparasiticides in sheep at the request of the Australian Wool Industry Residue Management Council. Specifically, the Council requested the NRA to:

(a) conduct a review of all currently registered long wool treatments with particular priority given to long wool backline products; and

(b) provide clear guidelines for the chemical industry on the type of data required to address emerging trade and marketing needs with respect to residual pesticide on wool

The Council's concerns have arisen from residue monitoring data collected from a number of sources which show significant residues of pesticides in greasy wool. It is considered that residues of this kind, at the levels reported, may affect the future marketability of Australian greasy wool.

The levels of residues being detected in greasy wool could result in levels of pesticides in effluent from scouring plants approaching or exceeding maximum regulatory environmental standards,which apply both in Australia and overseas. For example the following table illustrates the potential difficulties in the U.K.

Pesticide	Environmental Standards (EQS) ng/L	Mean residue level (mg/kg wool) required to meet standards	Maximum acceptable residue level (mg/kg wool) at different levels of use		Present use pattern in Australia (1996/97)	
			50% of flock treated	25% of flock treated	Av. residue levels (mg/kg wool)	% flock treated*
Organophosphate	10	0.56	1.12	2.24	4.5	75

* % flock treated figures for organophosphates based on diazinon figures.

In addition, the data have raised concern about the occupational safety of registered back-line long-wool products because of excessively high residue levels remaining on the tip of the wool staple along the back-line of the sheep at the time of shearing.

The NRA conducted the review under the oversight of a Steering Committee comprised of representatives from the IWS, the wool industry, the agvet chemical industry, Environment Australia, Worksafe Australia and the NRA.

The primary purpose of the review as defined by the Steering Committee was to:

(a) address concerns about the impact of pesticide residues on wool arising from use of registered sheep ectoparasiticides on:
- occupational hazard to shearers and other wool handlers;
- the environmental impact of pesticide residues in scouring effluent; trade of Australian wool

(b) establish acceptable residue limits for pesticides on greasy wool and withholding periods (if appropriate), which take into account trade, environmental and occupational health and safety considerations as well as the animal welfare implications of flystrike and lice.

In addition, the review considered application techniques and application rates for sheep ectoparasiticides to the extent that they impact on residual pesticide levels.

The issues which were examined by the review in the context of these terms of reference were as follows:
- fate of pesticide residues in wool
- public health
- occupational health and safety (dermal absorption hazard, dermal irritation hazard, breakdown products of diazinon)
- environment
- trade and other wool industry issues
- animal welfare and productivity
- long wool treatment of lambs
- repeat applications

Of interest in this section of the ECRP Review of chlorfenvinphos are the findings of the report into residue implications of sheep ectoparasiticides which affect use of chlorfenvinphos.

In summary, it has been recommended that the registration status of long wool products containing chlorfenvinphos (and other OPs) be reconsidered subsequent to a more thorough examination of shearer exposure to wool grease. Any treatment of long woolled sheep should only be carried out within defined withholding periods (for processing, human consumption, handling). If treatment is required within these periods, vendor declarations or analytical certificates should identify the resultant wool.

In terms of residue detections in export commodities, the only residues which have been reported have been in horse fat and these have been well below the MRL.

4.4 Overseas Registration Status

Chlorfenvinphos is registered in a number of countries including those listed below.

Sweden	The Netherlands	Spain
Denmark	Austria	Italy
Ireland	France	Japan
India	Luxembourg	Greece
Belgium	Portugal	

Trade names for products containing chlorfenvinphos which are registered in overseas countries include 'Birlane', 'Supona', 'Sapecron' and 'Steladone'.

Chlorfenvinphos is formulated overseas into dusts, emulsifiable concentrates, seed treatments, granules and wettable powders.

CODEX MRLs for all commodities except brussel sprouts, cabbages head, carrot and cauliflower were withdrawn in April 1999.

Registration of chlorfenvinphos in the United States was cancelled in 1991. The United States Environmental Protection Agency (USEPA) had proposed to review chlorfenvinphos as part of its Re-registration program (RED) however the registrant chose not to support it through this process.

The UK Ministry of Agriculture, Fisheries and Forestry (MAFF) is currently undertaking a review of organophosphates (OPs), including chlorfenvinphos. Data for the review was initially requested from registrants in September 1998. At this time there were only two chlorfenvinphos pesticide products approved by MAFF in the UK (Sapecron 240 EC and Birlane 24), both agricultural products. Sapecron 240 EC was not supported by the approval holder at phase II of the review (notification of support). The product was therefore revoked and is not approved for use in the UK after 31 August 2000. Support for Birlane 24 was withdrawn by the approval holder at phase III of the review (data submission) in September 1999. The product was therefore revoked and is not approved for use in the UK after 31 December 2001.

The Canadian Pest Management Regulatory Agency (PMRA) is also undertaking a review of OPs however chlorfenvinphos has not been given a priority for review. The review of 29 organophosphates currently underway should be completed by 31 December 2000. There are currently four products registered for use in Canada. In lieu of a re-evaluation decision, these products could potentially be renewed for use on a year to year basis only until such times as a re-evaluation decision is made on this active, or if the registrants choose not to renew registration.

4.4.1 Use Patterns in Relevant Countries Overseas

Detailed information on use patterns (including rates of use, frequency of application etc.) in overseas countries is not readily available.

However, information from the United States indicates that chlorfenvinphos is used in that country for control of rootflies in root vegetables, brussel sprouts and onions, as a seed treatment for control of wheat bulb fly in winter wheat, Colorado beetle and other pests in potatoes, leafhoppers and stem borers on rice, cotton whitefly in cotton, phorid and sciarid fly larvae, and fruit fly on maize and sweet corn. It is also an insecticide for use on livestock.

4.4.2 MRLs in Overseas Countries

The MRLs relevant to overseas trade are animal product MRLs, in particular, meat products.
It is not expected that there should be any difficulties with MRLs in overseas countries since they are the same as those which have been set in Australia. However, investigations into residues in beef in response to residue detections in the USA showed that an extension of the withholding period from nil to 8 days was necessary to ensure that compliance with MRLs was achieved.

4.4.3 Codex MRLs

At the 31st session of CODEX, it was determined that except for brussel sprouts, cabbages head, carrot and cauliflower, all of the CODEX MRLs for chlorfenvinphos, including those for meat were recommended for withdrawal. This may have potential trade implications should countries adopt the position taken by Codex. However, a number of factors need to be considered when determining trade implications associated with the use of chlorfenvinphos. These include, the standard adopted by the importing country, the likelihood of residues, which is minimal in the case of chlorfenvinphos, the amount of produce exported, and the monitoring activities that are conducted by the importing country.

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

4.5 Export Slaughter/Harvest Intervals (ESIs)

An ESI of 21 days established by the MLA for chlorfenvinphos should achieve non-detectable tissue residues, provided cattle are not used to stir the dip and avert any adverse impact on trade with the USA.

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.

The results of this trial in respect of chlorfenvinphos indicated that the chlorfenvinphos residual concentrations reached a maximum within four days post treatment and had depleted to acceptable concentrations by day six. In many cases, however, the maximum reached greatly exceeded the MRL (Australia, Codex and USA) of 0.2 mg/kg.

In a further development, the use of animals to stir the dips has now been removed from labels, so that this practice is no longer permitted.

Since the Australian MRL is no longer compatible with the CODEX MRLs, there may be the need to establish an export slaughter interval in addition to the Australian withholding period.

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

4.6 Data Submitted to Support Compliance with Overseas MRLs

Data have not been submitted to support compliance with overseas MRLs. However, because of concerns raised particularly in the USA and Europe over residues of ectoparasiticides in Australian beef and other livestock produce such as wool, a number of initiatives have been taken to investigate the residual levels of these chemicals in the various commodities.

In the case of chlorfenvinphos, the overseas MRLs are identical to those for Australia and therefore compliance with Australian MRLs will mean automatic compliance with overseas MRLs. Although a withholding period for chlorfenvinphos had not been required prior to the investigations of residues, data collected showed that a withholding period of 8 days would be appropriate to ensure that residues in beef would not exceed the MRL.

The residues section of the overall report deals more fully with this matter.

4.7 Recent Residue Violations

In early November, after public submissions to the Review had closed, import testing by the US Food Safety Inspection Service (FSIS) detected chlorfenvinphos in Australian beef at a level of 0.26 mg/kg. The US does not have an import tolerance for chlorfenvinphos and the level detected was above the Australian MRL of 0.20 mg/kg.

Ten years of National Residue Survey (NRS) data in which no detections of chlorfenvinphos were reported, was used to demonstrate this was an isolated incident linked to the inappropriate use of the chemical by a single producer. There had, however, been and incident in 1993 when chlorfenvinphos was detected in beef exported to the US at levels exceeding the MRL.

The FSIS lifted test and hold restrictions on produce derived from the implicated establishment following negative test results from 15 additional samples.

Korea was the only country to react adversely to the advice provided in relation to the US residue finding.

4.8 Authorities and Grower Views on Use

All animal production sectors of Australian agriculture represented during the survey of the current usage of chlorfenvinphos indicated that this chemical was a vital component in production strategies affecting the viability of their respective farming situation or the situations which they represented. State agricultural authorities identified the following situations/industries which would be severely handicapped in terms of export production by reduction in the current availability of chlorfenvinphos*.

	Crops/situation			
State	**pastures**	**sheep**	**Cattle (beef and dairy)**	**Horses and other cattle tick hosts**
Qld	-	Blowfly, lice	Buffalo fly, cattle tick	Cattle tick control during movement of horse from infested to non-infested areas
NSW	-	Blowfly	Buffalo fly suppression	Cattle tick control during movement of horse from infested to non-infested areas
Vic	*Oncopera spp*	Blowfly strike	-	-
WA	-	Blowfly strike	-	-
Tas	*Oncopera spp*	-	-	-

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

RECOMMENDATIONS

The evaluation has identified two deficiencies in the data package which are common to all chlorfenvinphos-containing products. These are addressed under the first sub-heading and form the basis for Recommendations 1.

Metabolism, Analytical Methodology and Storage Stability

Recommendation 1: Satisfactory storage stability data for residues in animal commodities is to be provided.

Recommendation 2: To allow the continued use of the registered products for veterinary purposes while data are being generated to satisfy recommendations 1 above, the following temporary MRLs are recommended.

Temporary MRLs for chlorfenvinphos:

MO 0812 Cattle, Edible offal of	**T*0.1 mg/kg**
MM 0812 Cattle meat [in the fat]	**T0.2 mg/kg**
MO 0814 Goat, Edible offal of	**T*0.1 mg/kg**
MM 0814 Goat meat [in the fat]	**T0.2 mg/kg**
MO 0822 Sheep, Edible offal of	**T*0.1 mg/kg**
MM 0822 Sheep meat [in the fat]	**T0.2 mg/kg**
ML 0812 Cattle milk [in the fat]	**T0.2 mg/kg**

Note: The final edible offal MRLs will be established based on any new data submitted and may differ from *0.1 mg/kg shown above.
T- denotes that the MRL is temporary to enable further experimental work to be conducted in Australia or overseas, and will be reconsidered at some future date.

Issues relating to residues in animal tissue commodities and trade

In the absence of Codex chlorfenvinphos MRLs for all animal commodities, the occurrence of chlorfenvinphos residues in export commodities may impact adversely on Australian trade. With respect to trade in meat and edible offal:

Recommendation 3: registrants should be requested to provide an ESI (in consultation with the MLA) for each chemical product. An ESI of 21 days has already been established for *Barricade 'S' Cattle Dip and Spray* and *Coopers Blockade 'S' Cattle Dip and Spray.*

Issues relating to residues in milk and milk products and trade

As international tolerances for chlorfenvinphos have been revoked, the potential exists for trade implications associated with trade of milk and milk products.

The only area where a trade risk exists would be if chlorfenivnphos was to be used as a plunge dip on lactating cattle. This use pattern results in residues that exceed the milk MRL.

The following label statements are recommended.

Recommendation 5: the label of *Barricade 'S' Cattle Dip and Spray* and *Coopers Blockade 'S' Cattle Dip and Spray* should be amended by adding:

> **DO NOT USE on lactating cows or within 42 days of calving where milk or milk products may be used for human consumption.**
>
> **DO NOT USE in female sheep or goats that are producing or may in the future produce milk for human consumption.**

Recommendation 6: in addition the label of *Coopers Blockade 'S' Cattle Dip and Spray* should be amended by adding:

> **DO NOT mix the dipping solution by using cattle as stirrers**

Recommendation 7: The label of *Supona Buffalo Fly Insecticide* should be amended by adding:

> **WITHHOLDING PERIOD:**
> **MILK: NIL**

Issues relating to residues in agricultural commodities and trade

Recommendation : With the exception of potatoes and mushrooms, all agricultural commodities in the *MRL Standard* should be deleted.

An MRL for potatoes will be established as follows:

VR 0589 Potato *0.05 mg/kg

An MRL for mushrooms will be established as follows:

VO 0450 Mushrooms 0.2 mg/kg

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