



Department of Primary Industry

ENTOMOLOGY SECTION

RECOMMENDATIONS FOR THE CONTROL OF PESTS 1983

TECHNICAL REPORT 83/4

Department of Primary Industry
P.O. Box 417
Konedobu, N.C.D.
Papua New Guinea

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RECOMMENDATIONS
FOR THE CONTROL OF PESTS
1983

Edited by
B.M. Thistleton

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Konedobu, N.C.D.
Port Moresby

TECHNICAL REPORT 83/4 JUNE 1983

Department of Primary Industry
Entomology Section

FOREWORD

These recommendations are another in the series of publications that this Department is producing in the interests of the safe use of pesticides.

As this Department is preparing legislation to control the use of pesticides in Papua New Guinea, it has been considered necessary to publish in one document all the recommended uses of insecticides for insect pest control.

It is intended that future editions of this publication will include my Department's recommendations for all the other agricultural chemicals, i.e., fungicides, herbicides, etc, used in this country.

I believe that this will prove to be a valuable guide for agriculturalists in Papua New Guinea, to help them use chemicals as effectively as their other tools.

B.BAI
Secretary for Primary Industry

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Corn Earworm

Rice

Brown Planthopper

Pink Stemborer

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Rice Bugs

Sorghum

Armyworm

Corn Earworm

Sorghum-head Caterpillar

Sorghum Midge

VEGETABLES

Aibika

Aibika Flea Beetle

Aibika Leafroller

Aibika Looper Caterpillar

Aibika Stemborer

Brassicas

Cabbage Cluster Caterpillar

Diamond-back Moth

Capsicum

Fruit Caterpillars

Cucurbits

Black Leaf-footed Bug

Fruit Fly

Leaf-eating Ladybirds

Pumpkin Beetles

Legumes

Bean Fly

Bean Pod Sucker

Corn Earworm

Cowpea Aphid

Green Vegetable Bug

Leaf-eating Beetles

Leaf-eating Ladybirds

Legume Pod Borers

Winged Bean Blotch Miner

Potato

Aphids

Potato Tuber Moth

Taro Beetle

Sweet Potato

Sweet Potato Hawkmoth

Sweet Potato Leafminer

Sweet Potato Weevil

Taro

Taro Beetle

Taro Hawkmoth

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INTRODUCTION

This publication lists the majority of pest control recommendations of the Entomology Section of the Department of Primary Industry (DPI). It has been written as a source of information for agricultural officers and other technical personnel working in the field of pest control. It is not intended for use by farmers for whom Entomology Bulletins (published in Harvest) and Information Bulletins (published by DPI research stations) are available.

Most of the recommendations listed have been tested in field trials in Papua New Guinea (PNG) by DPI entomologists. However in some cases, where no trial work has yet been carried out, but where a recommendation is felt to be desirable, the information has been obtained from relevant trials carried out overseas. These recommendations have been modified to suit conditions and cultivation practices in PNG. Recommendations will be updated as further research is carried out and these will be published in future editions of this publication.

The recommendations listed include both the use of cultural and biological control methods, and the use of insecticides. If they work in a given situation cultural and biological methods are to be preferred. Indeed many pests are under natural biological control and the use of insecticides against these, or against other pests in the same crop, can upset the natural balance of parasites and predators and actually aggravate the pest problem.

However in many situations the use of insecticides is still necessary and it is worthwhile here to point out two drawbacks of their use. Firstly many, if not all, the insecticides commonly used are toxic (poisonous) to humans to varying degrees. To try to educate people in the care needed when insecticides are used DPI has published an Entomology Bulletin on the Safe Use and Handling of Insecticides. The Code of Practice from this bulletin is reprinted on page 48 of this publication.

To reduce the hazards to the user of insecticides, particularly those people who have no training in pesticide application, the Entomology Section of DPI follows a policy of recommending only the safer chemicals. The World Health Organization (WHO) has published a classification of pesticides by hazard (Anon. 1975) and this divides chemicals into four categories, IA, IB, II and III, in decreasing order of toxicity. Only insecticides in categories II and III, and unclassified insecticides (safer than III), are listed in this publication.

Occasionally, for specific purposes, it is necessary to use more toxic insecticides from categories IA and IB of the WHO classification. These insecticides must be handled with great care and the correct protective clothing worn during use. Recommendations for these more toxic insecticides will be made by DPI entomologists if the need arises, and if the entomologist is satisfied that the user has the necessary training to handle these chemicals.

The second drawback is the fact that some insecticides which are relatively safe to the user, and are therefore included in this publication, suffer from the disadvantage that they are very persistent (do not break down quickly) in the environment. Residues of these insecticides remain in an active form in the soil or in water supplies for months, or even years, after their application. These insecticides must be used with great care and in particular, must not be used where there is any chance of them contaminating waterways. Insecticides in this category are organochlorine compounds such as DDT, chlordane and lindane. Wherever they are mentioned in the Tables of Recommendations they are marked with an asterisk (*).

If you use any of the recommendations listed here and it does not give the desired degree of control please advise one of the DPI entomologists listed on page 54 . He will want to investigate the situation and will be able to make another recommendation for the control of the pest.

The recommendations listed are the result of a large amount of work by entomologists employed by DPI, both in the past and at the present time. They are too numerous to mention by name, but credit should go to all of them for the information contained in this publication.

These recommendations are provided by DPI as a service to the farming community of PNG. DPI can accept no responsibility whatever for adverse effects, either to crops or to users, caused by their use, however closely the directions are followed.

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NOTES ON THE TABLES OF RECOMMENDATIONS

These notes are intended to explain the layout of the Tables of Recommendations:

1. Crops are arranged into main sections such as Vegetables, Fruits, etc.
2. Within each section the crops are listed alphabetically.
3. Within each crop pests are listed alphabetically by common name. The scientific names are given beneath the common name for each pest.
4. If a crop is not listed then there are no standard recommendations for pest control on this crop. If you have a pest problem on one of these crops contact one of the DPI entomologists listed on page 54.
5. On each page there are recommendations for both cultural and biological methods of control, and for insecticidal methods of control. There are two sets of headings across the top of each page, one for each type of control.
6. Cultural and biological methods of control are printed straight across the page.
7. Insecticidal methods of control are arranged in columns following the sequence:

a) Insecticide

common name only. Some common trade names are listed on page 58. Insecticides marked * are persistent in the environment (see page 2).

b) Concentration or amount applied

this is given in percentage active ingredient in the spray mix and/or in the amount of active ingredient to be applied per hectare. In most cases the percentage active ingredient is based on a high volume rate of approximately 1000 litres of spray mix per hectare. This figure is most useful for small scale growers who use simple knapsack sprayers. For those growers with larger areas of crop who apply chemicals at low volume rates of application (e.g. with motorized misting machines) the rate of active ingredient per hectare should be used. The tables on page 50 show the amounts of product to use for various application rates.

c) How and when to apply

d) Waiting period

this is the minimum period between the last application of the insecticide and the harvest of the crop. In some cases waiting periods are not applicable.

ABBREVIATIONS USED IN THE TABLES OF RECOMMENDATIONS

ai	active ingredient
cm	centimetre
g	gram
ha	hectare
kg	kilogram
L	litre
m	metre
m ²	square metre
mg	milligram
ml	millilitre
ppm	parts per million
w/v	weight per volume (used of a liquid product, e.g. 5% w/v indicates that there are 5 g ai in 100 ml of product)
w/w	weight per weight (used of a solid product, e.g. 5% w/w indicates that there are 5 g ai in 100 g of product)

A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS

Method

PEST

Insecticide

B. INSECTICIDE RECOMMENDATIONS

Concentration or
amount applied

How and when to apply

Waiting
period

REMARKS

COMMERCIAL TREE CROPS

COCOA

Cocoa Amblypelta <i>Amblypelta theobromae</i> and other <i>Amblypelta</i> species.	B. Lindane *	150 - 200 g ai per ha.	Spray only pods, trunk and main branches.	No waiting period if used as recommended.	For further details see Smith (1979a).
Cocoa Mirids <i>Helopeltis clavifer</i> <i>Pseudodoniella typica</i> <i>P. laensis</i> <i>P. pacifica</i>	A. Maintain a complete canopy. Remove host plants in the vicinity. For <i>Helopeltis</i> remove <i>Flemingia</i> , <i>Acalypha</i> , <i>Polyscias</i> ; do not plant under <i>Eucalyptus</i> <i>deglupta</i> . For <i>Pseudodoniella</i> remove wild <i>Ficus</i> spp.				Only treat infested areas. For further details see Smith (1979a).
	B. Lindane *	75-100 g ai per ha in 28L of water.	Spray alternate lines of cocoa during dry weather after dew has dried from leaves. Repeat spray essential after 14 days.	No waiting period if used as recommended.	
		8kg of 1.3% dust or 4kg of 2.6% dust per ha.	Dust alternate lines of cocoa during dry weather but while the leaves are still covered with early morning dew, which helps to retain the dust on the leaves. Repeat dusting essential after 14 days.	No waiting period if used as recommended.	

* see page 2

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
COCOA					
Cocoa Pod Borers <i>Cryptophlebia encarpa</i> <i>Olethreutes</i> sp.	A. Control mirid infestation. Harvest ripe pods regularly.				Most frequently attack mature pods but larvae rarely reach the beans. For further details see Baker (1976), Smith (1979a).
Cocoa Trunk Longicorns <i>Glenea aluensis</i> <i>G. lefebueri</i>	A. Block hygiene. Drainage of wet areas.				Addition of 1% metalaxyl to "paint mix will help to prevent bark canker infection. For further details see Smith (1979a,c)
	B. Fenthion	1.5% solution in 25% white oil	Apply with brush to bark over occupied channels after removal of rubbish from outside bark. Regular rounds at 4-6 weekly intervals.	No waiting period if used as recommended.	
	B. Dichlorvos	1.5% solution in 25% white oil			
Cocoa Webworm <i>Pansepta teleturga</i>	A. Increase shade level				Necessary only in young cocoa with enclosed canopy and under light shade. For further details see Bailey (1979), Smith (1979a).
	B. Dimethoate	0.3%	Apply with brush to damaged bark area.	No waiting period if used as recommended.	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
COCOA					
Coffee Stemborer <i>Zeuzera coffeae</i>	A. prune and burn infested branches.				For further details see Smith (1979a).
Defoliating Caterpillars <i>Achaea janata</i> <i>Ectropis sabulosa</i> <i>Hyposidra talaca</i> <i>Mambara inconspicua</i> <i>Pinzulenza kukish</i> <i>Tiracola plagiata</i>	A. Plant cocoa under coconuts to prevent damage, or use <i>Glyricidia</i> rather than <i>Leucaena</i> shade.		Spot spray where necessary.	No waiting period if used as recommended.	Usually only necessary in cocoa less than two years in the field. Normally controlled by natural enemies. For further details see Smith (1979a).
	B. Carbaryl	0.2%			
	B. Acephate	0.1%			
Giant African Snail <i>Achatina fulica</i>	See Vegetables General section.				
Giant Cocoa Termites <i>Neotermes</i> spp.	A. Careful pruning to remove dead wood and prevent stumps from forming.				For further details see Smith (1971a,b,g).
	B. Chlordane*	0.2%	Open galleries with knife. Pour about 300 ml into each nest.	No waiting period if used as recommended.	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	B. INSECTICIDE RECOMMENDATIONS		How and when to apply	Waiting period	
Insecticide	Concentration or amount applied				
COCOA					
Grey Weevils	A. Increase shade level by planting temporary species. Keep grass growth well cut.				Damage occurs only to young trees and in less shaded areas. For further details see Smith (1979a).
Oribius spp. Paratactus bihirensis Platyacus ruralis Trigonops caranithorax	B. Acephate	0.3%	Spot spray if necessary	No waiting period if used as recommended.	
	B. Permethrin	0.01%			
Kurukum Ants Oecophylla smaragdina	A. If present on the pods tending mealybugs, these can be a nuisance to harvesting gangs. For advice on control when problems arise contact a DPI entomologist (addresses on page 54).				
Mealybugs Planococcus citri Ceroplastodes chiton	B. Malathion and white oil (mixed)	0.05% and 1%	Spray where necessary.	No waiting period if used as recommended.	Only needed in young, unjour-quetted cocoa. Attended by ants (frequently Anoplolepis longipes) For further details see Smith (1979a).
Pantorhytes Pantorhytes spp.	A. Remove alternate hosts: Pipturus argenteus, Schuurmansia henningsii, Melochia odorata, Macaranga sp., Trema cannabina, Cananga odorata. Plant barrier strips of kunai, Pueraria, Mimosa. Plant under coconut. Introduce crazy ants to infested blocks. Hand pick and destroy adults.				

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
COCOA					
Pantorhytes (continued)	B. Permethrin	100 g ai per ha	6 weekly spray intervals for 18 months. Thereafter 3 monthly intervals.	No waiting period if used as recommended.	Expensive and logistically difficult. Apply with mist blower.
	B. Fenthion	1.5% solution in 25% white oil	Apply with brush to bark over occupied channels.	No waiting period if used as recommended.	Regular treatment will reduce larval infestation to low level within a few months. Addition of 1% metaxyl to "paint" mix will help to prevent bark canker infection. For further details see Moxon (1981) and Smith (1979a,d,e,f 1980)
	B. Dichlorvos	1.5% solution in 25% white oil			
Rats	B. Difenacoum Brodifacoum	Commercial baits	Place bait at regular intervals throughout affected area. Replace weekly for 3-4 weeks.	No waiting period if used as recommended.	Control of rats generally adequate for 12-18 months after baiting. For further details see Smith (1979a).

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	<u>B. INSECTICIDE RECOMMENDATIONS</u>				
	Insecticide	Concentration or amount applied	How and when to apply	Waiting period	

COCOA

Rats Flying Foxes Parrots	A. Attend to plantation hygiene. Destroy breeding and shelter areas. Harvest mature pods regularly. Encourage natural predators.				Only attack mature pods. For further details see Smith (1979a).
Rhyparids <i>Rhyparida</i> spp.	A. Keep grass growth well cut back.				Spraying necessary only in cocoa under 3 years old. For further details see Smith (1979a).
	B. Carbaryl	0.2%	Spot spray where necessary, new flush growth only.	No waiting period if used as recommended.	

COCONUT

Black Palm Weevil <i>Rhynocophorus bilineatus</i>	A. Prevent damage to palms through bush knives, slasher or roller cuts and rhinoceros beetle damage. Plug or cover wounds with a creosote based preservative.				Prophylactic spray; use where necessary.
	B. Chlordane*	2% 0.5 L per palm	Spray base of palm every 3 months.	No waiting period if used as recommended.	
Coconut Bole Weevil <i>Sparganobasis subcruciatus</i>	B. Chlordane*	2% 0.5 L per palm	Spray base of palm (bottom 1m of trunk) every 3 months.	No waiting period if used as recommended.	Prophylactic spray; use where necessary.

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
COCONUT					
Coconut Flower Bug <i>Axiagastus cambelli</i>	A. Normally controlled by parasites and predators, especially the kurukum ant (<i>Oecophylla smaragdina</i>). The crazy ant (<i>Anoplolepis longipes</i>) possibly causes increase in damage by interfering with natural enemies.				
B. Trunk injection technique can be used, Contact a DPI entomologist (addresses on page 54) for details.					
Coconut Leaf Hispid <i>Brontispa longissima</i>	B. Trichlorphon	0.1%	Spray as necessary to run off. Use of dye in spray mix advised.	No waiting period if used as recommended.	Generally only needed in nursery areas.
Coconut Leafminer <i>Promecotheca papuana</i>	B. DDT*	150-200g ai of dust per ha.	Dust into canopy. Repeat after two months if necessary.	No waiting period if used as recommended.	
	B. Lindane*				
	B. Lindane*	0.1%	Spray into canopy. Repeat after two months if necessary.	No waiting period if used as recommended	
Coconut Nut Fall Bugs <i>Amblypelta cocophaga</i> <i>A. lutescens papuensis</i> <i>A. gallegonis bougainvillensis.</i> <i>A. theobromae</i>	A. The Kurukum ant (<i>Oecophylla smaragdina</i>) is an active predator. Replacement of kurukums by crazy ants (<i>Anoplolepis longipes</i>) may cause increase in damage by interference with natural enemies.				
B. Lindane*	0.1% spray or 150 - 200g ai of dust per ha.	Spray or dust into canopy. A second application after 3-4 weeks will probably be necessary.	No waiting period if used as recommended.		

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	B. INSECTICIDE RECOMMENDATIONS				
	Insecticide	Concentration or amount applied	How and when to apply	Waiting period	
COCONUT					
Coconut Nut Fall Bugs (continued)	B. Trunk injection technique can be used. Contact a DPI entomologist (addresses on page 54) for details.				
Coconut Spathe Moth <i>Tirathaba rufivena</i>	A. Normally controlled by parasites and predators. The crazy ant (<i>Anoplolepis longipes</i>) has been recorded in association with spathe moth outbreaks.				
	B. Trunk injection technique can be used. Contact a DPI entomologist (addresses on page 54) for details.				
Rhinoceros Beetle, Asiatic <i>Oryctes rhinoceros</i>	A. Release adults infected with baculovirus. Apply <i>Metarhizium</i> infected media to breeding sites. Exercise strict sanitation by removal and destruction of breeding sites (Compost heaps, dead standing or felled coconut palms).				For further details see Gorick (1979a, 1979b).
Rhinoceros Beetle, New Guinea <i>Scapanes australis</i>	A. Exercise strict sanitation by removal and destruction of breeding sites or covering rotting logs with <i>Pueraria phaseoloides</i> .				For further details see Perry (1976).
	B. Lindane*	6% granules 30-60 g per palm	Distribute granules through spear and leaf axis at 3 monthly intervals (or more frequently if necessary).	No waiting period if used as recommended.	
Sexava <i>Segestidea</i> spp. <i>Segestes</i> spp.	A. Predators and parasites are frequently active. May need to be introduced to outbreak area. Contact a DPI entomologist (addresses on page 54) for advice. Ring weeding and raking of soil at base of palm may allow greater desiccation of eggs and parasite efficiency.				

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS	
	Method					
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period		
Concentration or amount applied		How and when to apply				
COCONUT						
Sexava (continued)	B. Malathion	ULV formulation. 700 ml per ha	Aerial application.	No waiting period if used as recommended.	Difficult to arrange in PNG. Little insecticide persistence.	
	B. Fenitrothion	ULV formulation 700 ml per ha				
	B. Chlordane*	0.5L ^{2%} per palm	2 basal sprays at 2-3 monthly intervals.	No waiting period if used as recommended.		May interfere with egg parasites. Slow to reduce outbreak.
	B. Sticky band	30 cm wide band	Apply to tree 1 m from base. Renew by rubbing at 14 day intervals.	No waiting period if used as recommended.		Slow to reduce outbreak.
	B. Trunk injection technique can be used. Contact a DPI entomologist (addresses on page 54) for details.					For further details Young (1981a, 1981b).
Taro Beetle Papwana spp.	B. Lindane*	6% granules 10g per planting bag or hole	Applied to polythene bags in nursery or to new plantings. Repeat every 3 months if necessary.	No waiting period if used as recommended.	Usually only causes damage in nursery or seed beds.	

* see page 2

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	B. INSECTICIDE RECOMMENDATIONS			Waiting period	
Insecticide	Concentration or amount applied	How and when to apply			
COFFEE					
Coffee Ring Borer <i>Meroleptus cinctor</i>	A. Sweet potato is an alternate host. Removal of all runners and other weeds from nurseries and coffee gardens is therefore very important. Pruning.				
	B. Fenthion	0.5%	Apply with brush to main stems of all bushes to a height of about 1m or to where bark becomes smooth.	No waiting period if used as recommended.	For further details, see Smith (1977d).
Coffee Stem Borer <i>Zeuzera coffeae</i>	A. Prune and burn infested branches.				
Green Scale <i>Coccus</i> sp. nr <i>celatus</i> . <i>Coccus vindis</i>	B. Chlordane*	2%	Spray bases of infested bushes. Repeat after 2 months if necessary.	No waiting period if used as recommended.	To kill attendant ant species. Once ants removed natural enemies should reduce numbers to a low level. Do not spray on foliage or fruit.
	B. Malathion and White Oil	0.05% and 1% Add 2.5ml of wetting agent to each litre of spray mix.	Spray foliage of infested bushes.	No waiting period if used as recommended.	Used in conjunction with chlordane treatment for ants. For further details see Smith (1976).

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
COFFEE					
Shot-hole Weevils <i>Apirocalus</i> spp. <i>Aulacophrys fascialis</i> <i>Oribius</i> spp.	B. Acephate	0.3%	Spray foliage. If populations are high repeat sprays are necessary.	No waiting period if used as recommended.	Rarely necessary
	B. Permethrin	0.01%			
OIL PALM					
Bagworms	A. Parasites should be introduced as soon as outbreak is observed. Contact a DPI entomologist (addresses on page 54) for advice.				Aerial application difficult to use in areas other than large estates. Expected that use will be limited to large scale outbreaks.
Species of Psychidae	B. Malathion	ULV formulation 700ml per ha	Aerial application at 4 week intervals.	No waiting period if used as recommended.	
	B. Trunk injection technique favoured, but chemicals can only be used under the direction of a DPI entomologist (addresses on page 54).				
Nettle Caterpillars	Recommendations are the same as for bagworms.				
Species of Limacodidae					

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
OIL PALM					
New Guinea Rhinoceros Beetle <i>Scapanes australis</i>	A. Rhinoceros beetle breeding sites are in rotting timber which should be removed or covered by covercrop <i>Pueraria phaseoloides</i> ,				Economic damage found only in young palms (up to 5 years old). Some localities suffer repeated attacks but in most cases the palms recover.
	B. Lindane *	6% granules 30-60g per palm	Distribute granules in spear and leaf axils at 3 monthly intervals.	No waiting period if used as recommended.	
Sexava <i>Segestidea</i> spp. <i>Segestes</i> spp.	A. Parasites should be introduced as soon as outbreak is observed. Contact a DPI entomologist (addresses on page 54) for advice.				Aerial application difficult to use in areas other than large estates. Expected that use will be limited to large scale outbreaks. For further details see Young (1981a, 1981b).
	B. Malathion	ULV formulation 700 ml per ha	Aerial application. 10 week intervals between sprays.	No waiting period if used as recommended.	
	A. Trunk injection technique favoured, but chemicals can only be used under the direction of a DPI entomologist (addresses on page 54).				
Taro beetle <i>Papuana</i> spp.	B. Lindane *	6% granules 10g per planting	Applied to soil surface to planting bag. Repeat at 3 monthly intervals.	No waiting period if used as recommended.	Only causes damage to young palms up to 4 leaf stage. Frequency of attack seasonal and often in same area of nursery. Can cause 70% seedling death.

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	<u>B. INSECTICIDE RECOMMENDATIONS</u>			Waiting period	
	Insecticide	Concentration or amount applied	How and when to apply		

RUBBER

There are no recommendations at present. For advice on pest problems contact a DPI entomologist (addresses on page 54).

TEA

Tea tortrix
Homona trachyptera
Adoxophyes aniara
 Various species of mites, etc.

- A. Most potential pests of tea appear to be under good biological control at present and the use of insecticides is not generally recommended.
- Recommendations for specific problems, usually in shade house conditions, are made by DPI as the need arises.
- Contact a DPI entomologist (addresses on page 54) for advice.

FRUITS

BANANA

Banana Fruit Fly
Dacus musae

- A. Keep fruit covered while ripening (eg. with several layers of banana, leaves or harvest fruit early to prevent stinging, but at a stage which will later ripen.

For further details see Smith (1977a, 1977b).

Banana Scab Moth
Nacoleia octasema

B. DLT*

0.1%

Spray before bracts open.

No waiting period if used as recommended.

Banana Weevil Borer
Cosmopolites sordidus

A. Chlordane*

0.2%

Water solution around bases of infested plants. Repeat at 6 monthly intervals.

No waiting period if used as recommended.

Flying Foxes

- A. Wrap fruit in leaves or polythene bags.

See also FRUIT GENERAL.

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
CITRUS					
Citrus Leafminer <i>Phyllocnistis citrella</i>	B. Diazinon	0.1%	Spray after new flush leaves have fully expanded.	14 days.	
White-wax Scale <i>Aspidiotus destructor</i>	A. Parasites have been introduced. It is hoped that these will reduce numbers to a low level.				
FRUIT GENERAL					
Flying Foxes	A. Destruction of roosting sites, shooting, prompt harvesting of fruit.				
Fruit Flies <i>Dacus</i> spp.	A. Pick fruit promptly. Clear away fallen or rotting fruit. Remove any wild fruits in which fruit flies are breeding near your garden.				
	B. Dimethoate	0.05%	Spray weekly if required	7 days	Only spray if other methods of control fail.
	B. 'Dak-pot' fruit fly lure.	Commercially produced lure.	Hang lures around garden. Male fruit flies will be attracted and killed thus reducing overall population.		For further details see Ismay (in press).

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	<u>B. INSECTICIDE RECOMMENDATIONS</u>			Waiting period	
	Insecticide	Concentration or amount applied	How and when to apply		

FRUIT GENERAL

Fruit Piercing Moth <i>Othreis fullonia</i>	A. Harvest promptly. Remove larval host plant , <i>Erythrina</i> , from vicinity. Good hygiene.				
Rats	A. Harvest promptly, exercise good hygiene, poison with rat bait. Protect natural enemies - owls, hawks, snakes.				

PINEAPPLE

Pineapple Mealybug <i>Dysmicoccus brevipes</i>	B. Diazinon and white oil	0.05% and 1%	Spray as required.	14 days.	
Taro Beetle <i>Papuana</i> spp.	A. Chemical control not generally recommended. Harvest fruits promptly.				

GRAIN CROPS

MAIZE

Corn Earworm <i>Heliothis armiger</i>	B. Carbaryl	5% dust	Apply a small amount to the end of the cob at silking.	No waiting period if used as recommended.	This insect damages the end of the cob but does not normally reduce yield. Control measures not usually necessary.
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PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	B. INSECTICIDE RECOMMENDATIONS			Waiting period	
Insecticide	Concentration or amount applied	How and when to apply			
RICE					
Brown Planthopper <i>Nilaparvata lugens</i>	B. Acephate	0.05% 500g ai per ha	Spray at base of plants weekly from heading stage.	3 days	
	B. Carbaryl	0.1% 1 kg ai per ha		3 days	
Pink Stemborer <i>Sesamia inferens</i>	B. Diazinon	1 kg ai per ha of granules.	Apply at seedling stage.	No waiting period if used as recommended.	
Rice Leafrollers <i>Cnaphalocrocis medinalis</i> <i>Marasmia poeyalis</i>	B. Dimethoate	0.1% 1 kg ai per ha	Spray as required	7 days	
Rice Bugs <i>Leptocorisa</i> spp.	B. Acephate	0.1% 1 kg ai per ha	Spray weekly from milk-ing stage.	3 days	
SORGHUM					
Armyworm <i>Mythimna separata</i>	B. Acephate	0.1% 1 kg ai per ha	Spray as necessary	3 days	Carbaryl is phytotoxic to some varieties. For further details see Vance and Dori (1979).
	B. Carbaryl	0.1% 1 kg ai per ha		3 days	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
SORGHUM					
Corn Earworm <i>Heliothis armiger</i>	B. Acephate	0.1% 1 kg ai per ha	Spray immediately after flowering when 3 or more larvae per head counted.	3 days	For further details see Vance and Dori (1979).
Sorghum-head Caterpillar. <i>Mamestra bipunctella</i>	B. Carbaryl	0.1% 1 kg ai per ha	Spray as required	3 days	Carbaryl is phytotoxic to some varieties.
	B. DDT*	0.1% 1 kg ai per ha		30 days	For further details see Vance and Dori (1979).
Sorghum Midge <i>Contarinia sorghicola</i>	A. Slash wild sorghum species and volunteer crops around edge of block prior to flowering. Follow recommended crop agronomic practices to ensure that crop flowers over as short a period as possible. Burn and plough in remnant sorghum after harvest. When sorghum flowers check edge of block for signs of adult midges.				
	B. Carbaryl	0.1% 1 kg ai per ha	Spray during flowering period. Repeat after 4 days if necessary.	3 days	Carbaryl is phytotoxic to some varieties.
	B. DDT*	0.1% 1 kg ai per ha		30 days	For further details see Dori (1981, 1982), Vance and Dori (1979).

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	Insecticide	<u>B. INSECTICIDE RECOMMENDATIONS</u>		Waiting period	
		Concentration or amount applied	How and when to apply		

VEGETABLES

AIBIKA

Aibika Flea Beetle <i>Nisotra</i> sp.	B. Carbaryl	0.1%	Spray every two weeks if necessary.	3 days	
	B. Malathion	0.05%		3 days	
Aibika Leafroller <i>Sylepta derogata</i>	B. Carbaryl	0.1%	Spray weekly if necessary.	3 days	
Aibika Looper Caterpillar <i>Anomis flava</i>	B. Carbaryl	0.1%	Spray every one to two weeks if necessary.	3 days	
Aibika Stemborer <i>Earias vitella</i>	B. Dimethoate	0.05%	Spray stems of aibika at weekly intervals if necessary.	7 days	Infections seldom severe enough to require insecticidal control.
	B. Formothion	0.05%		7 days	

BRASSICAS

Cabbage Cluster Caterpillar <i>Crociodolomia binotalis</i>	B. As for Diamond-back Moth, see below.				
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PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
BRASSICAS					
Diamond-back Moth <i>Plutella xylostella</i>	B. Acephate	0,05% 500g ai per ha...	Spray every week. Ensure that both upper and lower surfaces of the leaves are adequately wetted.	3 days	Destroy the remains of plants after harvesting. Insecticide resistance seems to be developing in certain areas.
	B. Pirimiphos-methyl	0.1% 1 kg ai per ha		3 days	
	B. Tetrachlorvinphos	0.05% 500g ai per ha		3 days	
	B. Permethrin	0.00125% 12.5 g ai per ha		No waiting period if used as recommended.	
	B. Permethrin	0.005% 50 g ai per ha	Spray every three weeks. Ensure that both upper and lower surfaces of the leaves are adequately wetted.	No waiting period if used as recommended.	For further details see Thistleton (1980b).
CAPSICUM					
Fruit Caterpillars <i>Heliothis armiger</i> <i>Spodoptera litura</i>	B. Acephate	0.1%	Spray weekly from start of fruit set.	3 days	
	B. Permethrin	0.005% or 0.01%		3 days	
	B. Tetrachlorvinphos	0.1%		3 days	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
CUCURBITS					
Black Leaf-footed Bug <i>Leptoglossus australis</i>	B. Acephate	0.1%	Spray as required	3 days	
Fruit Fly <i>Dacus cucurbitae</i>	A. Prompt harvesting of fruit				See also Fruit Flies on page 19.
	B. Dimethoate	0.05%	Spray weekly from flowering.	7 days	
	B. Formothion	0.05%		7 days	
Leaf-eating Lady-birds <i>Henosepilachna signatipennis</i>	B. Carbaryl	0.1%	Spray weekly if necessary.	3 days	
	B. Malathion	0.05%		3 days	
Pumpkin Beetles <i>Aulacophora</i> spp.	B. Carbaryl	0.1%	Spray weekly if necessary.	3 days	
	B. Malathion	0.05%		3 days	
LEGUMES					
Bean Fly <i>Ophiomyia phaseoli</i>	B. Dimethoate	0.03%	Apply 3 days after emergence and then weekly for another 3 weeks.	7 days	
	B. Formothion	0.03%		7 days	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
LEGUMES					
Bean Pod Sucker <i>Riptortus</i> spp.	B. Acephate	0.05% 500g ai per ha	2-3 sprays once pod set begins.	3 days	Other insecticides may be necessary on broad acre crops. Contact a DPI entomologist (addresses on page 54 for details.
	B. Dimethoate	0.03%		7 days	
	B. Formothion	0.03%		7 days	
Corn Earworm <i>Heliothis armiger</i>	B. Acephate	0.05% 500g ai per ha	Spray as pods appear	3 days	
	B. Permethrin	0.005% - 0.01% 50-100 g per ha		3 days	
Cowpea Aphid <i>Aphis craccivora</i>	B. Acephate	.025% 250 g ai per ha	Spray as required	3 days	
Green Vegetable Bug <i>Nezara viridula</i>	B. Acephate	0.05% 500 g ai per ha	2-3 applications once pod set begins.	3 days	For further details see Young (1981c, 1982)
	B. Dimethoate	0.05% 500 g ai per ha		7 days	
	B. Formothion	0.05% 500 g ai per ha		7 days	

PEST	A. CULTURAL 'AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
LEGUMES					
Leaf-eating Beetles	B. Carbaryl	0.1%	Spray leaves as soon as damage becomes apparent.	3 days	
Various species of Chrysomelidae	B. Malathion	0.05%		3 days	
Leaf-eating Ladybirds	B. Carbaryl	0.1%	Spray leaves as soon as damage becomes apparent.	3 days	
<i>Henosepilachna signa- tipennis</i>	B. Malathion	0.05%		3 days	
Legume Pod Borers	B. Lindane*	0.08% 800g ai per ha	Spray at flowering.	30 days	
<i>Maruca testulalis</i> <i>Lampides boeticus</i>	B. Chlorpyrifos	.04% 400g ai per ha		10 days	
Winged Bean Blotch Miner	B. Dimethoate	0.03%	Spray when mines first appear.	7 days	
<i>Leucoptera</i> sp.	B. Formothion	0.03%		7 days	

* see page 2

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
POTATO					
Aphids Various species of Aphididae	B. Acephate	0.05% 500g ai per ha	Spray every 2 weeks in the field. Potatoes on sprouting racks should be sprayed weekly.	3 days	Only necessary to reduce spread of viruses in crops intended for use as seed. Lower rates of acephate will also control aphids. A recommendation of 0.05% is given here since this rate also kills potato tuber moth (see below).
Potato Tuber Moth Phthorimaea operculella	A. Efficient hilling of the growing plants will prevent females from ovipositing on the tubers. If chemical control is considered necessary use:				
	B. Acephate	0.05% 500g ai per ha	Spray every 2 weeks in the field. Potatoes on sprouting racks should be sprayed weekly.	3 days	
Taro Beetle Papuana spp.	B. The percentage of tubers damaged by this insect is usually low. There is at present no satisfactory chemical for controlling this pest on potatoes. Although lindane is recommended for controlling taro beetle on taro, it should NOT be used on potatoes due to tainting and residue problems.				

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
SWEET POTATO					
Sweet Potato Hawkmoth <i>Agrius convolvuli</i>	A. Chickens and toads (where they are found) usually keep numbers to low levels. If necessary use:				
	B. Carbaryl	0.1%	Spray once only.	3 days	
Sweet Potato Leaf-miner <i>Bedellia somnulentella</i> .	B. Carbaryl	0.1%	Several weekly sprays if necessary.	3 days	
Sweet Potato Weevil <i>Cylas formicarius</i>	A. Rotate crops at intervals of not less than twelve months and exercise good cultivation and sanitation in gardens. There are no insecticide recommendations at the present time. In cases of severe infestation contact a DPI entomologist (addresses on page 54) for advice.				
TARO					
Taro Beetle <i>Papuana</i> spp.	B. Lindane*	0.84 kg ai per ha Granules	Apply in planting hole.	No waiting period if used as recommended.	Difficult to control with insecticides. For further details see Perry (1977.)

* see page 2.

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
TARO					
Taro Hawkmoth <i>Hippotion celerio</i>	A. Handpick larvae and feed to pigs or chickens. It has been demonstrated at Keravat that taro can withstand considerable defoliation before yield declines. Spraying of insecticides is therefore only necessary where severe defoliation is expected.				For further details see Perry (1977).
	B. Carbaryl	0.1%	Spray as required.	3 days	
Taro Leafhopper <i>Tarophagus proserpina</i>	B. Acephate	0.1%	Spray as required.	3 days	May be beneficial to reduce spread of virus diseases. For further details see Perry (1977).
TOMATO					
Fruit Caterpillars <i>Heliothis armiger</i> <i>Spodoptera litura</i>	B. Acephate	0.1%	Spray weekly from start of fruit set.	3 days	
	B. Permethrin	0.005% or 0.01% 50-100 g ai per ha		3 days	
	B. Tetrachlorvinphos	0.1%		3 days	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
VEGETABLES GENERAL					
Aphids Various species of Aphididae	B. Acephate	0.5%	Spray as required	3 days	
Cutworm <i>Agrotis ipsilon</i>	B. DDT*	0.1%	Apply as a soil drench before planting or around the bases of young seedlings.	No waiting period if used as recommended.	For further details see Kimber and Calcinai (1980), Thistle-ton (1980a).
	B. Diazinon	0.1%			
	B. Lindane*	0.02%			
	A. In small plots empty tin cans with both ends removed can be pushed into the soil around small seedlings.				
Giant African Snail <i>Achatina fulica</i>	See slugs and snails (below)				For further details see Anon (1977), Greve (1981).
Grasshoppers Various species	B. Carbaryl	0.1%	Spray as required.	3 days	
	B. Lindane*	0.02%		30 days	

* see page 2

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
VEGETABLES GENERAL					
Leaf-eating caterpillars	B. Acephate	0.1%	Spray as required.	3 days	
<i>Heliothis</i> spp. <i>Plusia</i> spp. <i>Spodoptera</i> spp. etc.	B. Carbaryl	0.1%		3 days	
Shot-hole Weevils	A. Gardens should be clean weeded. In small plots adults can be collected by hand and destroyed.				Repeat spraying often necessary.
<i>Oribius</i> spp.	B. Acephate	0.3%	Spray as required	3 days	
	B. Permethrin	0.01%		3 days	
Slugs and Snails Various species	B. Metaldehyde or baits containing metaldehyde	Commercial products or mix 1 kg of sawdust, 1.5 kg of cement and 10g of metaldehyde with a little water. Place to dry on a flat surface, in the shade. When hard break into pieces about 2 cm across.	Place baits around affected area at 1m intervals. Within this barrier place more baits to kill any snails that may have penetrated into garden. Baits should be inspected at weekly (or more frequent) intervals and renewed as necessary.		Wash hands well after handling snail baits. For further details see Anon. (1977), Greve (1981).
Sucking Bugs Various species	B. Acephate	0.1%	Spray as required.	3 days	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
CARDAMON	SPICES				
Cardamon Mirid <i>Ragwelellus horvathi</i>	A. For small areas, inspect all new growth at six weekly intervals, remove and destroy insects. Remove alternate hosts near the block: <i>Alpinia purpurata</i> , <i>Alpinia</i> sp., <i>Heliconia indica</i> and <i>Pollicia thyrsofolia</i> are the most common.				
	B. Lindane*	Dust, 150-160 g ai per ha	Dust using hand or motorized knapsack and utilising wind movement.	14 days	Large scale plantings only. For further details see Smith (1977a 1981).
Cardamon Seed Wasps <i>Eurytoma</i> sp. <i>Sycophila</i> sp.	A. Remove alternate hosts near the block: these are probably <i>Alpinia purpurata</i> <i>Hedychium coronarium</i> and other species of the family Zingiberaceae. Harvest ripe capsules regularly. There may be differences in infestation rates between varieties.				
Cardamon Stemborer <i>Dichocrocis</i> sp. nr <i>punctiferalis</i>	A. Prune and destroy infested stems. If alternate host plants can be identified these should be destroyed.				
Cardamon Weevil <i>Ganae pulchella</i>	A. Hand pick adults and destroy. Varietal difference apparent - plant Mysore variety.				
Rats	A. Harvest ripe pods regularly.				
Thrips (genet sp. indet.)	B. Malathion	0.1%	Spray affected clumps at monthly intervals.	14 days	

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	Insecticide	<u>B. INSECTICIDE RECOMMENDATIONS</u>		Waiting period	
		Concentration or amount applied	How and when to apply		

DOMESTIC

DOMESTIC

Ants

Various species of Formicidae

A. Good household cleanliness is important in controlling ants. They are attracted to crumbs, food particles and scraps. Fats and dripping are also attractive.

B. Baits containing sugar and boric acid.

Commercial products.

B. Borax, glycerine, and sugar.

Mix borax in glycerine, 1:1 by volume. Make a sugar syrup, 2/3 sugar to 1/3 water, weight to volume. Mix borax/glycerine with syrup, 1:10 parts by volume. Put into empty bottle tops.

Place baits where they will not contaminate foods and cooking utensils.

B. Borax glycerine and meat stock.

As above but substitute meat stock for the sugar syrup.

B. Dusts containing boric acid.

Commercial products.

Apply into harbourages used by ants, but only in dry locations.

Sugar based baits may not always be successful since some ants only forage for protein. In these cases use the borax/glycerine/meat stock mixture.

All these baits should be placed out of the reach of children.

Excess dust should be swept up and precautions taken not to inhale it.

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
DOMESTIC					
Ants (continued)	B. Fenitrothion	2%	Spray into harbourages and points of entry.	-	Care should be taken not to contaminate cooking utensils and foodstuffs.
Bed Bugs <i>Cimex hemipterus</i>	B. Malathion	2%	Spray into harbourages (mattresses, joints and springs of beds, inside tubes of tubular steel beds, behind skirting boards, pelmets, architraves and in the fabric of the house). Repeat at weekly (pyrethrins) or fortnightly (malathion) intervals until infestation is cleared.	-	Care should be taken when spraying mattresses not to soak them. Remove bed and bedding to outside if possible for spraying. The hot sun causes the insects to become active. Do not contaminate cooking utensils or foodstuffs. Do not use aerosol sprays in confined spaces. ALL doors and windows should be open.
	B. Pirimiphos-methyl	0.1%		-	
	B. Pyrethrins	Commercial aerosol sprays		-	
Cockroaches <i>Periplaneta american</i> <i>P. australasiae</i> and other species.	Nocturnal insects usually only seen at night, which is the best time to determine the extent of an infestation. They normally harbour in crevices under and behind drawers, in wall cavities, under and behind book cases and other items of furniture, and under the paper used to line cupboards and drawers.				

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
DOMESTIC					
Cockroaches (continued)	B. Dusts containing boric acid or an insecticide	Commercial products	Apply to sites listed above	-	Take care not to contaminate cooking utensils and food.
	B. Pyrethrins	Commercial aerosol sprays	Spray sites listed above according to label instructions.	-	Take care not to contaminate cooking utensils and food.
	B. Propoxur	Commercial aerosol sprays		-	
	B. Fenitrothion	2%	Spray sites listed above.	-	Treat only the harbourages. A blanket spray of a room is both dangerous and wasteful.
Fleas <i>Ctenocephalides canis</i> <i>C. felis</i>	B. Treated collars	Commercial products	Use strictly as directed on label.	-	DO NOT allow a wet cat or dog to wear a collar.
B. Carbaryl	5% dust	Rub 100g of dust into the animals fur, working it well into the areas most favoured by flies - the claws, behind the ears, on the underside of the body and in long hair or fur.	-		

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
DOMESTIC					
Fleas contd.			This treatment should be repeated at weekly intervals until the pests are eradicated.		Do not use on puppies and kittens less than 4 weeks old.
	B. Malathion	Commercial preparation specifically produced for flea control.	Wash animal in diluted insecticide according to label instructions, paying particular attention to the areas listed above.	-	Wash hands after use.
	B. Diazinon			-	
	B. Malathion	-	Spray or apply dust to pets bedding, to the ground where they rest or to cracks and crevices in the floors of rooms visited by the pets, where eggs and larvae of fleas will be found.	-	Take care not to contaminate cooking utensils and food.
	B. Carbaryl	-		-	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
DOMESTIC					
Head Lice <i>Pediculus capitatus</i>	B. Insecticide washes or shampoos.	Commercial preparations specifically for head lice.	Use as directed on the label.	-	Use only preparations specifically made for the control of head lice and obtained from a chemist shop. DO NOT use any other products; it could endanger your life.
House Flies <i>Musca domestica</i> and other species	A. Practise good hygiene around the house and garden (dispose of food scraps; keep dustbin clean, cover or dispose of garden waste, compost etc).				This spray can stain. For further details see Ismay (1982).
	B. Diazinon	1% 1 litre per 20 m ²	Spray indoors onto surfaces where flies rest. The insecticide will remain effective for 2-6 weeks, depending on temperature and humidity.	-	
	B. Lindane*	2% Use wettable powder formulation.	Spray refuse tips etc.	-	

* see page 2.

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
DOMESTIC					
Rats and mice	B. Baits containing an anticoagulant eg. Difenacoum Brodifacoum	Commercial Products.	Place small quantities of bait in those parts of the house affected by rats and mice. It is important to ensure a continuous supply of bait for as long as it is being taken. If, at commencement of baiting, all baits are consumed in 2-3 days increase the number until some bait remains at the "baiting sites". Thereafter the number of sites can be reduced.	-	Anticoagulant rodent baits are toxic to pigs. Baits should, therefore, be placed to be out of reach of pigs and other domestic animals. Store and place baits out of reach of children. Rat and mice control in plantations and warehouses requires careful planning. Advice should be sought from the nearest DPI entomologist (addresses on page 54). before any control programme is initiated.

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	<u>B. INSECTICIDE RECOMMENDATIONS</u>				
	Insecticide	Concentration or amount applied	How and when to apply	Waiting period	

PUBLIC HEALTH

The recommendations in this section are as used in the Malaria Control Programme of the Department of Health, who have kindly made this information available.

Mosquitoes <i>Anopheles</i> spp. <i>Aedes</i> spp. <i>Culex</i> spp,	B. DDT*	75% wettable dispersible powder 500g in 7.5 L water 2 g ai per ha	Applied with compression pump to the interior of human dwellings - walls, roofs, furniture, under eaves of houses and verandas, under house if raised, outdoor latrines. Residual effect 3-9 months (average 6 months).	-	Very little, if any, toxic effects on humans living inside DDT treated houses. Cats may be affected if the application is not done properly. Poultry may accumulate the insecticide by eating killed insects, but doses up to 3000 mg/kg are insufficient to produce poisoning. For permanent houses with painted interior surfaces DDT emulsion (25% emulsifiable concentrate) may be used.
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* see page 2

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
PUBLIC HEALTH					
Mosquitoes (continued)	B. Temephos	55-110g ai per ha of emulsifiable concentrate 500E. 1g of sand core granules 1.5G (1% temephos) per 10 L of water.	Apply to ground waters with compression pump to control larvae. Repeat every 7-10 days. Apply to water containers by hand, ejector or spoon, to control larvae. Repeat every 4-6 weeks.	-	Very low toxicity to warm blooded animals. It is suitable for the treatment of potable water, thus providing a means of treating mosquito larvae in drinking water supplies at a damage rate of not greater than 1p.p.m. No effect on common aquatic organisms at damage rates used for mosquito control. Operators should wear protective gloves when handling concentrates and be aware of symptoms of organophosphate poisoning.
	DDT IS NOT RECOMMENDED FOR USE AS A LARVICIDE. Pirimiphos - methyl may be used in place of temephos.				

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
PUBLIC HEALTH					
Mosquitoes (continued)	B. Malathion	Technical concentrate minimum 95% w/v ai applied at 9-28L per ha (vehicle mounted mist blowers) or 440-1200 ml per ha (vehicle mounted low volume mist blowers). Can be mixed with oils for making dilute sprays.	Applied with vehicle mounted and or man carried mist blowers. For emergency situation special equipment is utilised. For routine dilute spraying regular compression pumps may be used. Used for control of adult mosquitoes during epidemics of mosquito born diseases (e.g. dengue fever, dengue haemorrhagic fever). During epidemics 2-3 ULV applications may have to be made within one week. Frequency determined by surveying adult mosquito population.	-	Not recommended for use as a larvicide - it is held in reserve as an effective adulticide for use during epidemics of mosquito borne diseases. Malathion is one of the safer organophosphate insecticides and has been widely used in mosquito control programmes, where exposure of humans and domesticated animals would occur in the treated area.

PEST	<u>A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS</u>				REMARKS
	Method				
	Insecticide	<u>B. INSECTICIDE RECOMMENDATIONS</u>		Waiting period	
Concentration or amount applied		How and when to apply			

ALL COMMODITIES

STORED PRODUCTS

Various pests.	B. Fumigant gases	In certain circumstances the recommended methods of insecticide application (detailed below) will be unable to control an infestation of stored products insects - eg. where a commodity has been stored in dirty premises and/or not been treated with an insecticide when it was taken into storage. In such cases fumigation, using gas to kill the insect infestation, may be possible. ALL FUMIGANT GASES ARE TOXIC TO MAN. FUMIGATION SHOULD ONLY BE UNDERTAKEN BY TRAINED COMMERCIAL OPERATORS.			For further details see Anon (1979).
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COFFEE AND COCOA STORES

Various pests	A. It is important that warehouses and stores are kept clean. Good warehouse hygiene is the first step in controlling insect pests of stored products.				Brush down walls and floors to remove all dust and accumulated commodity residues before applying fabric spray. Not to be applied to the bag stacks which should be covered to prevent any insecticide contamination. Bags should NOT be stacked in contact with treated surfaces.
	B. Fenitrothion	$1\frac{1}{2}$ 5L per 100 M ² of surface.	Spray onto the cleaned structure and walls of the store. Apply to run off.	-	

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
GRAIN LEGUMES AND LEGUME SEEDS					
Bruchids <i>Callosobruchus chinensis</i> <i>C. maculatus</i>	B. Vegetable Oil (Maize oil, peanut oil, coconut oil, etc.)	10 ml per kg of seed.	Mix well to completely cover the surface of all seeds.	No waiting period.	This method is recommended for small scale and subsistence level storage. For large scale storage details of recommended protectants are available. Contact a DPI entomologist (addresses on page 54) for advice.
MAIZE AND SORGHUM					
Lesser Grain Borer <i>Rhizopertha dominica</i> Maize Weevil <i>Sitophilus zeamais</i> Rice weevil <i>S. oryzae</i> Tropical Warehouse Moth <i>Ephestia cautella</i> .	B. Fenitrothion dust mixed with carbaryl dust.	500g per tonne of grain equivalent to 6 p.p.m. fenitrothion and 4 p.p.m. carbaryl.	Mix well with grain. This gives about 3 months protection.	No waiting period at this application rate.	Only for use in grains intended for stock feed.
		1 kg per tonne of grain equivalent to 12 p.p.m. fenitrothion and 8 p.p.m. carbaryl	Mix well with grain. This gives about 3-6 months protection.	6 months.	Will depress germination of sorghum. Fenitrothion by itself does not control <i>Rhizopertha dominica</i> .

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
MAIZE, SORGHUM AND PEANUTS					
Lesser Grain Borer <i>Rhizopertha dominica</i>	B. Fenitrothion and bioresmethrin + piperonyl butoxide	2.5L (100% w/v) and 4L (5% w/v) made up to 200L with water and applied at 1L per tonne.	Apply as a spray to the commodity as it is taken into storage.	3 months for maize, sorghum and shelled peanuts. 14 days for inshell peanuts.	Maize and sorghum must be dried to a moisture content below 13.5% (wet basis). The use of a moisture meter is essential. Peanuts must be dried to at least 9% moisture content when in shell and to at least 7% moisture content when shelled. The use of a moisture metre is essential. Fenitrothion by itself does not control <i>Rhizopertha dominica</i> .
Maize Weevil <i>Sitophilus zeamais</i>					
Rice Weevil <i>S. oryzae</i>					
Tropical Warehouse Moth <i>Ephestia cautella</i>					

PEST	A. CULTURAL AND BIOLOGICAL CONTROL RECOMMENDATIONS				REMARKS
	Method				
	Insecticide	B. INSECTICIDE RECOMMENDATIONS		Waiting period	
Concentration or amount applied		How and when to apply			
OTHER SEEDS					
Various pests	B. Diatomaceous earth (used in swimming pool filters).	10g per kg of seed.	Insecticidal dust must be well mixed with seed before storing.	-	NOT TO BE USED FOR SEED INTENDED FOR FOOD.
	B. Lime (kambang)	50g per kg of seed.		-	Avoid breathing in the dust, a respirator should be used. This method is recommended for small scale and subsistence level seed storage. For large scale seed storage details of recommended protectants are available. Contact a DPI entomologist (addresses on page 54) for advice.

100-1000

When you have finished spraying with the sprayer, clean your hands and your clothes.

Do not spray or spray any person or animal or any other living thing.

Do not spray or spray any food or feed or any other thing that is to be eaten.

Do not spray or spray any thing that is in a container.

Do not spray or spray any thing that is in a container or on a surface that is to be used for food or feed.

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100-1000

(100-1000) 100-1000

V CODE OF PRACTICE

100-1000 100-1000

SAFE USE AND HANDLING OF INSECTICIDES

A CODE OF PRACTICE

(summary of Thistleton and Greve, 1980)

1. BEFORE USE

- 1.1 Use only those insecticides recommended by the Department of Primary Industry.
- 1.2 Read the instructions on the label carefully. Follow precautions exactly.
- 1.3 Store insecticides in a safe place where they cannot be reached by children or domestic animals. Do not store insecticides in the same room as food or drink.
- 1.4 ALWAYS keep the insecticide in the original container. NEVER use other containers such as beer or lollywater bottles. Check the containers regularly to make sure that they are not leaking.
- 1.5 Only buy as much insecticide as you will use in a few months, so that you do not need to store it for too long.
- 1.6 Make sure that the right protective clothing and equipment is available.

2. DURING USE

- 2.1 Handle the concentrate carefully and wear the right protective clothing.
- 2.2 Do not use more insecticide than is recommended.
- 2.3 Do not mix up more insecticide than you will use on one day.
- 2.4 Do not overfill the spray container.
- 2.5 When spraying wear the right protective clothing.
- 2.6 Do not spray if it is very windy. Do not spray near children or other people, animals or prepared food.
- 2.7 NEVER suck or blow blocked nozzles - use a piece of straw or small stalk.
- 2.8 Do not eat, drink or smoke while handling or applying the insecticide.

3. AFTER USE

- 3.1 After you have finished spraying wash the sprayer, then yourself and your clothes.
- 3.2 Do not eat, drink or smoke until you have washed and changed your clothes.
- 3.3 Do not empty spare insecticide or wash the sprayer near a drinking water supply.
- 3.4 Destroy or dispose of all empty insecticide containers safely.
- 3.5 Do not use empty insecticide containers for storing or carrying food or drink.
- 3.6 Observe the recommended Waiting Period between the last spray and harvest.
- 3.7 If you feel sick after using an insecticide go and see a doctor straight away.
Make sure that you can tell him the exact name of the insecticide.

TABLES OF AMOUNT OF PRODUCT TO USE FOR DIFFERENT APPLICATION RATES

How to use the tables

1. If you want to know how much product to use to give a particular concentration of active ingredient use Table 1.

For example you have a product containing 50% w/w (if a solid) or 50% w/v (if a liquid) of active ingredient and you wish to produce a mix containing 0.05% active ingredient. The table shows that you should mix 10 grams (if the product is a solid) or 10 millilitres (if the product is a liquid) with enough water to make a total of 10 litres of spray mix.

2. If you want to know how much product to use per hectare to give a certain amount of active ingredient per hectare use Table 2.

For example you have a product containing 50% w/w or w/v of active ingredient and you wish to apply 500 grams of active ingredient per hectare. The table shows that you should use 1 litre or 1 kilogram of product per hectare.

3. If you want to know how much product to mix with a given quantity of liquid to give a certain amount of product per hectare use Table 3.

For example you wish to apply 1 litre or 1 kilogram of product per hectare at a rate of 1000 litres of spray mix per hectare. The table shows that you should mix 10 grams or 10 millilitres with enough water to make a total of 10 litres of spray mix.

4. If the exact value that you want is not shown in the table you can obtain it by addition.

For example you wish to apply 1.5 kilograms of product in 100 litres of water per hectare. Looking at Table 3 1.5 kilograms is not listed. Find the value you want by the following means:

Take the value for 1 kilogram product in 100 litres of water per hectare	= 100
Take the value for 0.5 kilogram product in 100 litres of water per hectare	= 50
Add these two values together	= 150
This shows that you should mix 150 grams or 150 millilitres of product with enough water to make a total of 10 litres of spray mix.	

TABLE 1. AMOUNT OF PRODUCT IN GRAMS (FOR SOLIDS) OR MILLILITRES (FOR LIQUIDS) FOR 10 LITRES OF SPRAY MIX TO GIVE A REQUIRED CONCENTRATION.

% ACTIVE INGREDIENT REQUIRED IN SPRAY MIX	% ACTIVE INGREDIENT IN PRODUCT (AS ON LABEL - %w/w or %w/v)																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	.00125*	2.5	1.3	-	-	.5	-	-	-	-	.3	-	-	-	-	-	-	-	-	-
	.005*	10	5	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	.01*	20	10	-	-	4	-	-	-	-	2	-	-	-	-	-	-	-	-	-
	.02	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	2	2	2	2
	.03	60	30	20	15	12	10	9	8	7	6	6	5	5	4	4	4	3	3	3
	.04	80	40	26	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	2
	.05	100	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5
	.08	160	80	52	40	32	27	23	20	18	16	14	13	12	11	11	10	10	9	8
	.1	200	100	67	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	10
	.2	400	200	133	100	80	67	57	50	44	40	36	33	31	29	27	25	24	22	20
	.3	600	300	200	150	120	100	86	75	67	60	55	50	46	43	40	38	35	33	30
	1.0	2000	1000	667	500	400	333	286	250	222	200	182	167	154	143	133	125	118	111	100

* With regard to the recommendations given in this book, the very low concentrations of spray mix are only applicable to permethrin. When using these low concentrations the concentrate is much easier to measure if you use one with a low percentage active ingredient.

TABLE 2. AMOUNT OF PRODUCT IN KILOGRAMS (FOR SOLIDS) OR LITRES (FOR LIQUIDS) PER HECTARE TO GIVE A REQUIRED QUANTITY OF ACTIVE INGREDIENT PER HECTARE.

% ACTIVE INGREDIENT IN PRODUCT (AS ON LABEL - %w/w or %w/v)																						
AMOUNT OF ACTIVE INGREDIENT REQUIRED PER HECTARE (GRAMS)		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	12.5	.25	.13	-	-	.05	-	-	-	-	.03	-	-	-	-	-	-	-	-	-	-	.0125
	50	1	.5	-	-	.2	-	-	-	-	.1	-	-	-	-	-	-	-	-	-	-	.05
	100	2	1	-	-	.4	-	-	-	-	.2	-	-	-	-	-	-	-	-	-	-	.1
	150	3	1.5	1	.75	.6	.5	.43	.38	.33	.3	.27	.25	.23	.21	.2	.19	.18	.17	.16	.15	.15
	200	4	2	1.3	1	.8	.67	.57	.5	.44	.4	.36	.33	.31	.29	.27	.25	.24	.22	.21	.2	.2
	250	5	2.5	1.7	1.3	1	.83	.71	.63	.56	.5	.45	.42	.38	.36	.33	.31	.29	.28	.26	.25	.25
	300	6	3	2	1.5	1.2	1	.86	.75	.67	.6	.55	.5	.46	.43	.40	.38	.35	.33	.32	.3	.3
	400	8	4	2.7	2	1.6	1.3	1.1	1	.80	.8	.73	.67	.62	.57	.53	.5	.47	.44	.42	.4	.4
	500	10	5	3.3	2.5	2	1.7	1.4	1.3	1.1	1	.91	.83	.77	.71	.67	.63	.59	.56	.53	.5	.5
	800	16	8	5.3	4	3.2	2.7	2.3	2	1.8	1.6	1.5	1.3	1.2	1.1	1.1	1	.94	.89	.84	.8	.8
	1000	20	10	6.7	5	4	3.3	2.9	2.5	2.2	2	1.8	1.7	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1	1
AMOUNT OF ACTIVE INGREDIENT REQUIRED PER HECTARE (KG.)																						

NOTE THAT THE VALUES GIVEN IN THIS TABLE ARE KILOGRAMS OR LITRES. MULTIPLY THE VALUES BY 1000 TO GIVE GRAMS OR MILLILITRES.

TABLE 3.

AMOUNT OF PRODUCT IN GRAMS (FOR SOLIDS) OR MILLILITRES (FOR LIQUIDS) FOR 10 LITRES OF SPRAY MIX TO GIVE A REQUIRED AMOUNT OF PRODUCT PER HECTARE.

AMOUNT OF SPRAY MIX PER HECTARE (LITRES)

	100	200	300	400	500	600	700	800	900	1000	
.03	3	1.5	1	.8	.6	.5	.4	.4	.3	.3	30
.1	10	5	3	3	2	2	1	1	1	1	100
.5	50	25	17	13	10	8	7	6	6	5	500
1	100	50	33	25	20	17	14	13	11	10	1000
2	200	100	67	50	40	33	29	25	22	20	2000
3	300	150	100	75	60	50	43	38	33	30	3000
4	400	200	133	100	80	67	57	50	44	40	4000
5	500	250	167	125	100	83	71	63	56	50	5000
6	600	300	200	150	120	100	86	75	61	60	6000
7	700	350	233	175	140	117	100	86	78	70	7000
8	800	400	266	200	160	133	114	100	89	80	8000
9	900	450	300	225	180	150	129	113	100	90	9000
10	1000	500	333	250	200	167	143	125	111	100	10000
20	2000	1000	667	500	400	333	286	250	222	200	20000

AMOUNT OF PRODUCT PER HECTARE (KG OR L)

AMOUNT OF PRODUCT PER HECTARE (G OR ML)

ADDRESSES OF DPI ENTOMOLOGISTS

PORT MORESBY

D.P.I., P.O. Box 417, Konedobu, National Capital District.

KERAVAT (RABAU)

Lowlands Agricultural Experiment Station, Keravat, East New Britain Province.

LAE

Bubia Agriculture Research Centre, P.O. Box 73, Lae, Morobe Province.

MT HAGEN

Kuk Agricultural Research Station, P.O. Box 339, Mt Hagen, Western Highlands Province.

DAMI

Dami Oil Palm Research Station, P.O. Box 165, Kimbe, West New Britain Province.

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SOME COMMON TRADE NAMES FOR PESTICIDES LISTED

Acephate	: ORTHENE 75 SP.
Anticoagulant baits for rats	: H & C RAT BAIT; RACUMIN CONCENTRATE RAT POISON; RACUMIN MOUSE AND RAT BAIT; RATAK.
Bioresmethrin and piperonyl butoxide	: COOPER'S BRM 5/50 GRAIN PROTECTANT.
Carbaryl	: CARBARYL; CARBARYL PLANT AND PET INSECTICIDE; SEPTENE LIQUID; SEPTENE 80.
Chlordane	: CHLORDANE; CHLORDANE ANT AND EARWIG KILLER; CHLORDANE 80%.
Chlorpyrifos	: LORSBAN 25W
DDT	: DDT 25% MISCIBLE OIL
Diazinon	: DIAZINON 20%; GESAPON; NEOCID.
Dichlorvos	: DICHLORVOS; MAFU 50 INSECTICIDE; NUVAN 50EC; VAPONA 50.
Difenacoum	: RATAK.
Dimethoate	: PERFETHION; ROGOR; ROGOR 30; ROGOR 40.
Dusts containing insecticide, domestic use	: BAYGON INSECTICIDE DUST; BAYTEX INSECTICIDE DUST.
Fenitrothion	: CATERKIL; FENITROGARD LIQUID INSECTICIDE; FENITROGARD POWDER INSECTICIDE; FOLITHION 50 INSECTICIDE SPRAY; SUMITHION.
Fenitrothion dust/ carbaryl dust mixture	: FOLITHION C GRAIN DUST INSECTICIDE.
Fenthion	: LEBAYCID INSECTICIDE SPRAY.
Formothion	: ANTHIO

Lindane : GAMMAPHEX; GAMMEXANE NO. 7 MISCIBLE OIL; GAMMEXANE NO. 10 DUST; GAMMEXANE NO. 20 TIMBER SPRAY; LINDANE GRANULES, LINDANE 16%.

Malathion : MALACON 50; MALATHION 50; MALATHION ULV; MALATHION 10 BUG APHIS SPRAY; MALATHION 50 BUG APHIS SPRAY; RURAL MALATHION 50BC.

Metalaxyl (fungicide): RIDOMIL

Metaldehyde : METALDEHYDE 'T'.

Metaldehyde baits : BLITZEM; SNAIL AND SLUG PELLETS.

Permethrin : AMBUSH 50EC; AMBUSH 10EC;

Pirimiphos-methyl : ACTELIC 50EC.

Propoxur : BAYGON 80WP INSECTICIDE SURFACE SPRAY; BAYGON 200 COCKROACH SPRAY; BAYGON HOT FOG FOGGING INSECTICIDE; BAYGON PLUS INSECTICIDE SURFACE SPRAY; BAYGON INSECTICIDE DUST.

Propoxur - aerosol sprays : BAYGON HOUSEHOLD INSECTICIDE SURFACE SPRAY

Pyrethrins - aerosol sprays : VARIOUS TRADE NAMES.

Temephos : ABATE 1SG.

Tetrachlorvinphos : GARDONA 50WP.

Trichlorphon : KLORFON; DIPTEREX LIQUID INSECTICIDE SPRAY; DIPTEREX SP80 INSECTICIDE SPRAY; LEPIDEX.

White Oil : WHITE OIL; MISCIBLE SUMMER OIL; SHELL SUPERIOR WHITESPRAY.

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