

# The use of **CHEMICALS**

(OTHER THAN HERBICIDES)

in forest  
and nursery

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THE USE OF CHEMICALS  
(OTHER THAN HERBICIDES)  
IN FOREST AND NURSERY  
— 1983

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## PREFACE

Since 1954 the Research and Development Division has issued a chatty domestic newsletter called "Entopath News" two or three times a year. Produced by the Entomology and Pathology Branches, it has served to keep Forestry Commission staff aware of the latest developments and recommendations in forest protection.

In 1963, to help the practising forester to keep abreast of the rapidly changing use of chemicals and new materials becoming available, a special "Entopath News Chemical Control Supplement" was brought out. This gave a comprehensive account of the practical use of herbicides, insecticides and fungicides. The supplement was revised every two or three years and subsequently chemicals for wildlife control and fertilising were added.

In 1979 the revision was called "The Use of Chemicals in the Forestry Commission". Now in response to requests from field staff it has been decided to separate herbicides (which change rapidly) from the other chemicals (which require revision less frequently). This is therefore the first issue of "The Use of Chemicals (other than herbicides) in Forest and Nursery" (Forestry Commission Booklet 52). The text has been written by staff of the Research and Development Division: C. J. King (insecticides), R. G. Strouts (fungicides), W. O. Binns (fertilisers), H. W. Pepper (wildlife chemicals) and P. B. Lane (general notes).

It is suggested that this publication is kept with its companion volume "The Use of Herbicides in the Forest" (Forestry Commission Booklet 51) to give a comprehensive reference to the use of all chemicals in the forest.

Although produced primarily for internal use by FC staff, all these publications have been made available to the private forestry sector. It should be noted that the information and recommendations given are relevant to conditions in the Forestry Commission's forests, and no responsibility can be taken for treatments applied elsewhere.

O N Blatchford  
Editor



# CONTENTS

<b>GENERAL NOTES FOR THE USE OF CHEMICALS</b>	7
Introduction	7
Safety precautions and safe working methods	10
Protective clothing and personal equipment	12
Calculation of concentration	17
<b>INSECTICIDES</b>	21
Forest insect pests	27
<b>FUNGICIDES</b>	35
Diseases	35
<b>FERTILISERS</b>	47
<b>WILDLIFE CHEMICALS</b>	51
Vertebrate poisons	51
Chemical repellants	54
<b>ABBREVIATIONS AND SYMBOLS</b>	55
<b>INDEX TO DAMAGING AGENTS AND CHEMICALS</b>	57
<b>MANUFACTURERS AND SUPPLIERS OF CHEMICALS</b>	61
Alphabetical index to manufacturers and suppliers	62





# GENERAL NOTES FOR THE USE OF CHEMICALS

## INTRODUCTION

### Nomenclature of pesticides

Pesticides are from time to time referred to by one of the following different types of names: e.g.

Chemical name: thiabendazole hypophosphite

Common name: TBZ

Product name: Ceratotect

The chemical name is normally complex and hard to remember. It is abbreviated for industrial and commercial purposes into the common name. It is around the common name that the stock of information on properties and uses of the pesticide is assembled. For marketing purposes and to meet particular situations, one or more products will be developed, sometimes all with identical chemistry but often based on a variety of different salts or esters of the active ingredient (the pesticide itself). It is the individual product formulation which is the subject of scrutiny and eventual clearance (for safety) by the Pesticides Safety Precautions Scheme (PSPS) and subsequent approval (for efficacy) by the Agricultural Chemicals Approval Scheme (ACAS). Any change in the formulation of a cleared or approved product must be referred to PSPS and ACAS for further clearance and approval respectively.

### Pesticides Safety Precautions Scheme

It is Forestry Commission policy to use only pesticide formulations which have been fully cleared as to composition and usage through the Pesticides Safety Precautions Scheme. Under this Scheme manufacturers agree not to market a product containing any chemical for use in agriculture, or introduce a new use of a chemical already on the market, or introduce a new formulation which could show an increased hazard, until recommendations for safe use have been agreed with the Government departments concerned (if necessary on the advice of the Advisory Committee on Pesticides).

Recommendations are given on the labels, and are also published in the form of loose-leaf Recommendation Sheets. A copy of the current Sheet for any particular chemical can be obtained from the Ministry of Agriculture, Fisheries and Food, Pesticides Branch, Great Westminster House, Horseferry Road, London SW1P 2AE.

**BEFORE YOU USE A PESTICIDE – READ THE LABEL**

It has been designed for your protection.

## INTRODUCTION

### **Agricultural Chemicals Approval Scheme**

This is a voluntary scheme under which proprietary brands of agricultural chemicals can be officially approved. Its purpose is to enable users to select, and advisers to recommend, efficient and appropriate crop protection chemicals and to discourage the use of unsatisfactory products. The scheme is operated on behalf of the Agricultural Departments of the United Kingdom by the Agricultural Chemicals Approval Organisation. Approval is granted by the Organisation for specific uses under United Kingdom conditions when the Organisation is satisfied that the product fulfils the claims made on the label. Such approval is only given to products after first being cleared under the Pesticides Safety Precautions Scheme (see above). A list of Approved Products is published annually in the Approved Products for Farmers and Growers booklet. Materials not given in the Approved List are only recommended here when these have proved their value and effectiveness over a considerable period of general use of these chemicals in the forest, or have been tested experimentally against specific forest conditions.

Copies of the List of Approved Products for each year can be obtained (1983 edition £4.25 per copy) from the Ministry of Agriculture, Fisheries and Food (Publications), Lion House, Willowburn Trading Estate, Alnwick, Northumberland NE66 2PF (Telephone Number 0665 602881) or from the main offices of the Agricultural Departments of Scotland and Northern Ireland. It contains much information on the safe use of pesticides and lists the pesticides which are subject to the poisons rules.

<p style="text-align: center;"><b>APPROVED PRODUCT LABELS CARRY FULL INSTRUCTIONS FOR USE ALWAYS READ THE LABEL</b></p>
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### **British Agrochemical Supply Industry Scheme Ltd. (BASIS)**

In March 1978 a registration scheme for the Distribution of Crop Protection Products was launched with the following objectives:

1. Ensuring a high standard of safety in the distribution (and application) of crop protection products.
2. Ensuring that staff at any level engaged in the handling of crop protection products are competent and belong to establishments and organisations with people having specialized knowledge of their safety and efficacy.
3. Promoting and encouraging the safe and efficient usage of such products by professional users in agriculture, horticulture and forestry with due regard to the environment.

All products cleared by the PSPS (except rodenticides and wood preservatives) are covered by the scheme. A "distributor" is any individual,

company or organisation retailing or applying under contract, crop protection products for professional use in agriculture, horticulture or forestry.

A list of registered distributors can be obtained from:

The Secretary, BASIS Ltd., Bank Chambers,  
2 St John Street, Ashbourne, Derbyshire DE6 1GH.

### **Poisons Rules**

Certain products are subject to the provisions of the Poisons Act 1972 and the Poisons List\* and Poisons Rules\* made under it. These regulations include general and specific provisions for the labelling, storage and sale of scheduled poisons. Any products governed by this rule are marked in the list of manufacturers and suppliers of chemicals (see p. 61) or can be found in the Approved Products for Farmers and Growers Handbook.

\*Obtainable from HMSO.

### **Health and Safety (Agriculture) (Poisonous Substances) Regulations 1975†**

Users of chemicals included in these Regulations are required by law to observe certain precautions. They should obtain a copy of the official booklet 'Poisonous Chemicals on the Farm', HS(G)2\*, which fully explains the Regulation requirements. Products governed by these Regulations can be found in the Approved Products for Farmers and Growers Handbook.

\*HMSO, Price £2.50.

†Statutory Instrument 1975 No. 282 available from HMSO.

### **Safe disposal of surplus pesticides**

The best approach to adopt is to ensure that no surplus pesticide is left behind after a control programme. It is much better to leave a small area untreated (to be tidied up later or deferred to next year) than to over purchase and be left with unusable surplus.

If pesticides do become surplus, consider the following options listed in order of preference:

- (i) Incorporate them in the next season's programme.
- (ii) Invite the supplier to collect unopened containers which are still in good condition.
- (iii) Spray the pesticide onto a suitable stretch of plantation or non-crop ground where some benefit may accrue and where no risk of damage exists.
- (iv) Enlist the service of a reputable chemical disposal firm.

**Never** tip surpluses into mineshafts, quarries, watercourses or lakes.

**Always** observe all safety instructions on the pesticide label.

For further guidance, obtain and read the following MAFF Booklet: B2198 'Guidelines for the disposal of unwanted pesticides and containers on farms and holdings (1980)'. Available free from MAFF (Publications), Lion House, Willowburn Trading Estate, Alnwick, Northumberland NE66 2PF.

## **SAFETY PRECAUTIONS AND SAFE WORKING METHODS**

### **Training**

The Forestry Commission's Education and Training Branch provides courses at two levels on working methods and equipment for application of pesticides:

- (a) for Forest Officers and Chief Foresters, a short technical update Chemical Weed Control Course
- (b) for Head Foresters and Foresters in charge of spraying operations, a full Chemical Weed Control Course.

It is the duty of the Head Forester or Forester in charge of spraying to train the operators, passing on the skill and knowledge gained during their own training. For FC staff, details of training courses can be found in the Training Handbook. Education and Training Branch will supply relevant training guides and further advice if required.

Private sector readers should arrange training through the Forestry Training Council, c/o Forestry Commission, 231 Corstorphine Road, Edinburgh EH12 7AT.

### **The Forestry Safety Council and Forest Safety Guides**

The Forestry Safety Council (FSC) has been set up to co-ordinate all aspects of safety and to improve and foster safe working practices in the forest industry.

As an aid to the training of operators, the FSC publishes a series of Safety Guides each of which gives advice on safety aspects of a particular forest operation. These Guides have no legal status as such but courts have recognized their authority in the past and they could be used to decide legal liability.

Forest Safety Guides currently available which are relevant to the application of pesticides are:

- FSC 2 Ultra Low Volume Herbicide Spraying (rev. 4/81)
- FSC 3 Application of Herbicides by Knapsack Spraying (rev. 4/81)
- FSC 4 Application of Granular Herbicide (rev. 4/81)
- FSC 34 First Aid (rev. 12/82).

Each Forest Safety Guide is accompanied by a Safety Check List intended for use by supervisors, safety representatives, etc.

Guides are obtainable from:

The Secretary  
Forest Safety Council  
c/o Forestry Commission  
231 Corstorphine Road  
Edinburgh EH12 7AT

## SAFETY PRECAUTIONS AND SAFE WORKING METHODS

Both operator and supervisor should be provided with a copy of the relevant leaflet which they should read and fully understand before starting any of the operations covered by these titles..

### ROUTINE PRECAUTIONS

It is essential that these precautions are read carefully and followed explicitly whenever chemicals are to be used.

#### **Storage**

- A cool, dark, **frost free** store is desirable for all chemicals. Ensure that the store is constructed and labelled in accordance with Health and Safety regulations and with the requirements of the local Fire Officer. FC staff must refer to Silvicultural Memorandum No. 3.
- Keep all pesticides under lock and key.
- Retain maker's labels and leaflets for reference.
- Clearly label all containers, including those containing unused diluted material.
- Isolate all pesticides from people and animals.
- Check periodically for leakage and spillage; dispose of faulty containers.
- Never transfer pesticides to other containers, especially not to empty drink bottles.

#### **Handling of concentrates**

- Always follow the instructions on the container or maker's leaflet.
- Wear protective clothing as recommended on the container label (or that listed against the specific pesticide given later).
- Avoid all contact of the concentrate with the skin and eyes. If this occurs wash off **IMMEDIATELY** using copious quantities of water. Remove any contaminated clothing **IMMEDIATELY** if it has absorbed pesticide concentrate and wash affected area of skin.

#### **Mixing**

- Calculate accurately the correct quantity of concentrate to add to the required volume of carrying liquid. Always add the concentrate to the carrying liquid: **NEVER** vice versa.
- Never mix pesticides where any spillage or run off can find its way into watercourses. Never allow puddles or pools of pesticide to form.
- All measuring and mixing vessels should be reserved solely for these purposes.

## **SAFETY PRECAUTIONS AND SAFE WORKING METHODS**

- Stir thoroughly until mixing is complete. Agitate regularly to avoid settling out of suspended material.

### **Application**

- Select the correct equipment for delivering the pesticide as recommended (i.e. MV, LV, VLV or ULV). This must be functioning properly and be free from leaks and blockages.
- Make sure that the area to be treated is clear of both the public and domestic animals.
- Inform well in advance all interested parties, such as local beekeepers, sporting tenants, neighbouring landowners, water authorities, etc., of intention to spray.
- Avoid excessive spray drift onto non-target areas.
- Wear the full protective clothing recommended for the pesticide in use.

### **After application**

- Wash hands before smoking, eating, drinking and attending to personal needs.
- Remove protective clothing before eating and drinking.
- Before storing clean all protective clothing used. Respirator filters should be changed according to makers' instructions.
- Wash out spraying equipment soon after use, using large quantities of water. Do not contaminate water courses.
- Dispose of empty containers and surplus materials correctly and safely. As there are legal requirements for this, refer to information given on p. 9.

## **PROTECTIVE CLOTHING AND PERSONAL EQUIPMENT**

### **General**

The appropriate protective equipment, listed in Tables I and II, must be made available on a personal basis to all users of pesticides, including those handling pesticide containers.

All protective equipment must be kept clean and in good repair. Any damaged item must be properly repaired or replaced.

On completion of the spraying programme all equipment must be thoroughly cleaned and stored in a dry place away from direct sunlight, vermin and pesticides. Many pesticides have a distinctive and often unpleasant smell. Some, if in contact with the skin for long periods, can cause dermatitis. For these reasons protective equipment should not be taken home unless it is to be washed. Care should be taken to ensure that the contaminated outside of the clothing does not come into contact with the clean inside.

TABLE I  
CLOTHING AND EQUIPMENT REQUIRED

Operation	Application equipment	Wellington boots	Trousers	Gore-Tex Jacket	Hood	Gloves	Face shield	Filtering		Note
								Face piece	Ear respirator	
Handling, mixing and filling (pesticides)	All types	E	E	E	E	E	E	E	—	(1)
Applying solid materials (granules, crystals, dusts)	1. Gravity/placement	E	E	D	D	E	D	D	—	(1)
	2. Motorized	E	E	D	D	E	E	E	E	(1)
Medium volume (MV) spraying	Knapsack	E	E	E	D	E	D	D	—	(1)+(2)
Low volume (LV) spraying	Motorized mistblowers	E	E	E	E	E	E	E	E	(1)
Controlled drop band (CDBA) or spot spraying (CDSA)	Herbi and Spot Herbi	E	E	D	D	E	D	D	—	(1)
	Ulva 8	E	E	E	E	E	E	E	—	(1)
Controlled drop incremental spraying (CDIA)	Ulva 16	E	E	E	E	E	E	E	E	(1), (2)+(3)
Spraying from tractor mounted equipment	MV, LV, CDBA and CDIA	E	E	E	E	E	E	E	E	(1), (2)+(3)

E = **Essential:** either advised under Pesticide Safety Precautions Scheme or considered necessary in relation to working conditions in forestry.

D = **Discretionary:** these items are not usually required but should be supplied on request to the operator or when noticeable exposure to a pesticide may arise through operations in unusual circumstances.

Recommendations for protective equipment requirements for use with application equipment not listed above should be obtained from Eastern Region Work Study Team (see back cover for address).

**Notes:** (1) Filtering facepiece respirators give adequate protection, particularly in combination with the faceshield. If the smell of pesticide is objectionable a respirator with vapour filter should be supplied.

(2) Face shield is essential when spraying paraquat or hexazinone.

(3) When operating tractors fitted with "Q" cabs, to which forced air ventilation units complete with an approved spray filter have been fitted, then none of the listed items need to be worn when spraying pesticides.

Listed items must be worn, however, during handling, mixing and filling operations and when working on and cleaning the sprayer.

## PROTECTIVE CLOTHING AND PERSONAL EQUIPMENT

TABLE II  
LIST OF RECOMMENDED PRODUCTS AND SUPPLIERS

EQUIPMENT	RECOMMENDATIONS	SUPPLIERS
Wellington boots	Dunlop Safety 8807 Nitrile/PVC Knee Boots Price £7.69 or Dunlop Safety 8808 as above with steel mid-sole Price £9.44	Greenham Tool Co. Ltd. 671 London Road Isleworth Middlesex TW7 4EX
Shoe chains	Rudd Shoe Chains Size 1: Shoe sizes under 5 Size 2: Shoe sizes 5-9 Size 3: Shoe sizes over 9 Price £5.62	Rudd Chains Ltd. 1-3 Belmont Road Whitstable Kent CT5 1QT
Spray suits (Trousers and jacket with hood)	Gore-Tex Suits PC48 available in small, medium and large sizes Price £34.00	FC Supplier: Blairadam Clothing Store Clentry, Kelty, Fife KY4 0JQ Private sector supplier: E. McBean & Co. Ltd. Woodilee Industrial Estate Kirkintilloch Glasgow G36 3UZ
Gloves	Edmont Buna NX 37-175 Length 12", sizes available: 7 to 11. It is recommended that 2 pairs of gloves are issued to each operator. Price £1.10	W. C. Willis & Co. Ltd. 6 Methil Street Scotstoun Glasgow G14 0BH
Face shield	James North No. FS 1318 BW Price £3.82	James North & Son Ltd. PO Box 3, Hyde Cheshire SK14 1RL
Face shield for use with safety helmet for tractor drivers	FC H417 aluminium frame for Safety Helmet. Price £6.30 FL8PC 8" clear polycarbonate screen, wide flare. Price £4.74	Protector Safety Ltd. Great George Street Wigan Greater Manchester WN3 4DE
Filtering facepiece respirator. (Previously known as ori-nasal mask)	3 M's 8500 Non-Toxic Particle Mask, or 3 M's 8710 for odorous pesticides. Generally requires replacing after 2 hours use on a misty day or every 4 hours on a dry day. Price 8500 Box 50 £8.00 Price 8710 Box 20 £14.89	Herts Packaging Co. Ltd. 29 Mill Lane Welwyn Herts AL6 9EU



## PROTECTIVE CLOTHING AND PERSONAL EQUIPMENT

<b>Respirators</b>		
(a) Protection against vapours	Toxiguard Agricultural Respirator Type RQ 2000 fitted with 2 RC86 cartridges. Cartridges require changing every 8 hours. Price £6.71 Cartridges £1.39	Protector Safety Ltd. Greater George Street Wigan Greater Manchester WN3 4DE
(b) Protection against fine drops	Baxter Pneau Seal Dust Mask fitted with dust cartridge BS 2091. Cartridge requires changing every 8 hours. Price £9.58 Cartridge £1.09	Davern Workwear Ltd. 174 Station Road March Cambridgeshire
<b>Personal hygiene</b>		
Barrier cream	Rozalex Wet Guard available in 450 ml containers for personal issue. Price per case of 6 £12.11	Sterling Industrial Chapeltown Sheffield S30 4YH
Waterless skin cleanser	Rozacleanse Waterless available in 450 ml containers for personal issue. Price per case of 6 £9.60	Sterling Industrial Chapeltown Sheffield S30 4YH
Liquid soap	Rozalex Industrial available in 450 ml containers for personal issue. Price per case of 6 £8.04	Sterling Industrial Chapeltown Sheffield S30 4YH
Paper towels	Hi Dri Hand Towels. A case of 24 sleeves, each approximately 200 towels. Price per case £17.16	Kimberley Clark Ltd. Industrial Division Larkfield Kent ME20 7PS

**Note:** (1) This list is included as a guide to sources of supply and is **not** a comprehensive compilation of suppliers for recommended products. The omission of names of other possible suppliers does not imply that their services are unsatisfactory.  
 (2) 1982 prices are quoted only as an indication of likely costs. Current quotations should be sought by prospective purchasers.

## PROTECTIVE CLOTHING AND PERSONAL EQUIPMENT

### CLEANING RECOMMENDATIONS

#### GORE-TEX SUITS

Grossly contaminated areas should immediately be rinsed well with water. Problems have arisen in connection with washing Gore-Tex spraying suits, as some pesticides become slimy when mixed with soapy water. When this reaction occurs on the neoprene panels of the Gore-Tex trousers, the neoprene becomes swollen and tacky. To overcome this problem, the suit manufacturers have advised that the neoprene panels should be washed only with clear water, while the rest of the suit may be washed as usual, preferably with a pure soap powder. High pressure hoses should not be used to wash down the suits. Suits should be handled with care as rough treatment may cause blistering and reduce the liquid-repellent properties.

#### WELLINGTON BOOTS

Any undiluted pesticide should be washed off with water within ten minutes of contamination. After work, the outside should be washed down with water and both inside and outside allowed to dry.

#### GLOVES

Areas contaminated by undiluted pesticides should be thoroughly rinsed with water within ten minutes of contamination. At the end of each day the gloves should be washed inside and out with soap/detergent and water, rinsed thoroughly with clean water, wiped dry inside and out, and allowed to dry thoroughly, avoiding extremes of heat and exposure to bright sunlight.

#### RESPIRATORS

It is important that respirators be cleaned each day with warm water plus a mild detergent and sterilized with a disinfectant.

## CALCULATION OF CONCENTRATION

### Diluting to prescribed dosage

Pesticides are mainly formulated as emulsifiable concentrate (e.c.), or wettable powder (w.p.). Occasionally some are supplied as the neat technical material or active ingredient (ai), e.g. 2,4,5-T unformulated ester.

The percent concentration quoted for e.c. formulations is nearly always a weight/volume (w/v) percentage: 100% emulsifiable concentrates contain 1 kg ai/litre (10 lb ai/gallon). Similarly a 20% e.c. contains 0.2 kg ai/litre (2 lb ai/gallon).

The percent concentration quoted for wettable powders is a weight/weight (w/w) percentage. A 100% w.p. is pure active ingredient (plus a wetting agent). A 75% w.p. contains 25% by weight of inert material and 75% of active ingredient and wetter.

For instance, to dilute according to the prescription “1.5 kg ai/hectare of malathion”:

— Malathion comes to you as a 60% e.c. It therefore contains 0.6 kg ai/litre.

— To treat 1 ha, therefore you need  $\frac{1.5}{0.6}$  litre of concentrate (= 2.5 l).

For, say, 100 metres of seedbed you need  $\frac{1.5}{0.6} \times \frac{100}{10,000} = \frac{1}{40}$  litre  
= 25 ml

— 25 ml of malathion concentrate is then mixed with the volume of water prescribed in the treatment (i.e. LV, MV or HV, etc., – see p. 55).

### Diluting to a given percentage

#### EMULSIFIABLE CONCENTRATE (e.c.)

To determine volume of concentrate to use in 100 litres water to make up a particular dilution:

$$z = \frac{X \times 100,000}{y}$$

X = desired strength in per cent  
y = strength of concentrate in per cent  
z = required quantity of concentrate in ml

e.g. to obtain a 0.125% solution using a 25% concentrate

$$= \frac{0.125}{25} \times 100,000 = 500 \text{ ml}$$

i.e. 500 ml of concentrate are required per 100 litres water.

#### WETTABLE POWDER (w.p.)

To determine the weight of wettable powder required in 100 litres water to make up a particular dilution:

$$z = \frac{X \times 100,000}{y}$$

X = desired strength in per cent  
y = strength of concentrate in per cent  
z = required weight (g) of product/100 litres diluent.

## CALCULATION OF CONCENTRATION

### Equivalents

#### VOLUME

1 fl.oz = 28.41 ml = 0.962 fl.oz (US) = 8 standard teaspoonsful = 2 standard tablespoonsful  
1 pint = 568 ml = 20 fl.oz = 1.2 pint (US)  
1 gal = 4.55 l = 160 fl.oz = 1.2 gal (US)  
1 bushel = 36.37 l = 8 gal = 1.25 ft<sup>3</sup> = 70–80 lb of potting soil  
1 ft<sup>3</sup> = 0.283 m<sup>3</sup> = 28.3 l = 6.23 gal  
1 yd<sup>3</sup> = 0.765 m<sup>3</sup> = 21 bushels = 14–16 cwt of potting soil = 7½ cwt (approximately) prepared mushroom compost.  
1 ml/1,000 ft<sup>3</sup> = 3.52 ml/100 m<sup>3</sup>  
8 fl.oz/100 gal = 0.5 ml/l = 2½ ml/gal = 0.05%  
1 fl.oz/1,000 ft<sup>3</sup> = 100 ml/100 m<sup>3</sup> = 28.4 ml/1,000 ft<sup>3</sup>  
1 fl.oz/ft<sup>2</sup> = 306 ml/m<sup>2</sup> = 9 fl.oz/yd<sup>2</sup>  
1 pint/ft<sup>2</sup> = 6.12 l/m<sup>2</sup>  
1 gal/yd<sup>2</sup> = 4.98 l/m<sup>2</sup> = 1.25 gal (US)/yd<sup>2</sup>  
1 gal/100 ft<sup>2</sup> = 49.5 l/100 m<sup>2</sup> = 416 gal/acre

#### WEIGHT

1 oz = 28.35 g = weight of 1 fl.oz water  
1 lb = 453.6 g = 16 oz  
1 cwt = 50.8 kg = 112 lb  
1 ton (long) = 1,016 kg = 1.016 tonne = 2,240 lb  
1 oz/yd<sup>2</sup> = 33.9 g/m<sup>2</sup> = 303 lb/acre  
1 oz/gal = 6.25 g/l = 0.625% w/v  
1 lb/100 gal = 100 g/100 l = 0.1% w/v  
1 lb/acre = 1.2 kg/ha  
1 g/1,000 ft<sup>3</sup> = 3.52 g/100 m<sup>3</sup> = 35 µg/l  
1 oz/1,000 ft<sup>3</sup> = 100 g/100 m<sup>3</sup>  
1 oz/yd<sup>3</sup> = 37 g/m<sup>3</sup> = 40 ppm in potting compost = approx. 80 ppm in prepared mushroom compost.

#### AREA

1 ft<sup>2</sup> = 929 cm<sup>2</sup> = 0.093 m<sup>2</sup> = 144 in<sup>2</sup>  
1 yd<sup>2</sup> = 0.836 m<sup>2</sup> = 9 ft<sup>2</sup>  
100 ft<sup>2</sup> = 9.3 m<sup>2</sup> = 11.1 yd<sup>2</sup>  
1 acre = 0.405 ha = 4,840 yd<sup>2</sup> = 2.5 verges (Guernsey) = 2.25 verges (Jersey).

TABLE III Quantities of liquid concentrates required to prepare 45 litres (10 gal) of spray

Percentage concentration required on dilution	Percentage of active ingredient in concentrate													Millilitres (1 teaspoon = 4 ml approx.)	Fluid ounces (1 fl oz = 28 ml)	Pints (1 pint = 568 ml)
	5	10	15	18	20	25	30	40	50	60	70	80	100			
0.002	18	9	6	5	4½	3½	3	2½	1¾	1½	1¼	1	1			
0.004	1¼	¾	15	10	9	7	6	4½	3½	3	2½	2	1¾			
0.005	1½	¾	15	17	12	9	8	5½	4½	4	3½	2¾	2			
0.01	3¼	1½	1	25	23	18	16	11	9	7½	6½	5½	4¼			
0.02	6½	3¼	2	1¾	1½	1¼	1	24	18	15	13	11¼	8½			
0.025	8	4	2¾	2¼	2	1½	1½	1	23	19	16	14	11			
0.03	9½	4¾	3¼	2¾	2¼	2	1¾	1¼	1	26	19	17	13½			
0.04	12¾	6½	4¼	3½	3¼	2½	2	1½	1¼	1	23	22½	18			
0.05	16	8	5¼	4½	4	3¼	2¾	2	1½	1¼	1¼	1	23			
0.08	1¼	12¾	8½	7	6½	5	4¼	3¼	2½	2	1¾	1¼	1	23		
0.1	1½	16	10¾	8¾	8	6½	5¼	4	3¼	2¾	2¼	2	1¾			
0.2	3¼	1½	1	17¾	16	13	10½	8	6½	5¼	4½	4	3¼			
0.5	8	4	2¾	2¼	2	1½	1¼	1	16	13¼	11½	10	8			
1.0	16	8	5¼	4½	4	3¼	2½	2¼	2	1¾	1¼	1	¾			

# CALCULATION OF CONCENTRATION

TABLE IV Weights of wettable powder concentrates required to prepare 45 litres (10 gal) of spray

Percentage concentration required on dilution	Percentage of active ingredient in concentrate											
	10	15	20	25	30	40	50	60	70	80	100	
0.002	9	6	4½	3½	3	2¼	1¾	1½	1¼	1¼	1	Grammes (1p piece = 2.5 g approx.) (5p piece = 5 g approx.)
0.004	½	12	9	7	6	4½	3½	3	2½	2	1¾	
0.005	¾	½	¾	½	¾	5½	4½	4	3½	2¾	2	
0.05	1½	1	¾	¾	½	½	¾	¾	6½	5½	4¼	
0.02	3¼	2	1½	1¼	1	¾	¾	¾	½	11¼	8½	Ounces (20p piece = 0.25 oz approx.) (1 oz = 28 g)
0.025	4	2¾	2	1½	1½	1	¾	¾	½	½	11	
0.03	4¾	3¼	2¼	2	1¾	1¼	1	1	¾	¾	½	
0.04	6¼	4¼	3¼	2½	2	1¾	1¼	1	¾	¾	½	
0.05	8	5¼	4	3¼	2¾	2	1½	1¼	1¼	1	¾	Pounds (1 lb = 454 g)
0.08	12¾	8½	6½	5	4¼	3¼	1	2	1¾	1½	1½	
0.1	1	10¾	8	6½	5¼	4	3¼	2¾	2¼	2	1¾	
0.2	2	1¼	1	13	10½	8	6½	5¼	4¼	4	3¼	
0.5	5	3¼	2½	2	1¼	1¼	1	13¼	11½	10	8	
1.0	10	6½	5	4	3¼	2½	2	1¾	1½	1¼	1	

Acknowledgements are given to Dr. N. W. Hussey for permission to reproduce the tables on pp. 19-20 from the book *The Pests of Protected Cultivation* by N. W. Hussey, W. H. Read and J. J. Hesling, 1969.

## INSECTICIDES

All insecticides are poisons. It is imperative that the **Routine Precautions** given on pp. 11–12 are *carefully read, understood* and the *safety precautions rigidly followed* whenever they are used.

There are seven insecticides recommended in this section. Each is introduced with information on “special notes”, “handling precautions” and “trade names and suppliers”.

The subsequent section presents a list of forest insect pests and details methods of control using the recommended insecticides.

**Note:** LD50 = LETHAL DOSE required to kill 50% of test animals expressed in mg of chemical to kg of body weight. All figures are for oral doses. Therefore the lower the LD50 quoted the higher the mammalian toxicity.

The use of DDT for forestry applications (formerly limited by agreement) is now prohibited.

### CHLORPYRIFOS

LD50 135–163 mg/kg, an organophosphorous insecticide.

#### Special notes

- Do not use if under medical advice not to work with anticholinesterase compounds.
- Dangerous to bees and fish.

#### Handling precautions

- Wear rubber gloves and face shield when handling the concentrate.
- Wash concentrate from skin or eyes immediately.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

#### Trade names and suppliers

##### *Liquid formulations*

Dursban 48E – Dow Chemical Company Ltd., Heathrow House, Bath Road, Hounslow, Middlesex TW5 9QV.

Dursban 48E – Murphy Chemical Ltd., Wheathampstead, St Albans, Herts AL4 8QU.

## INSECTICIDES

### **DIAZINON**

LD50 300–850 mg/kg, an organophosphorous insecticide and acaricide.

#### **Special notes**

- Do not use if under medical advice not to work with anticholinesterase compounds.
- Dangerous to bees.
- Harmful to fish, livestock, game, wild birds and animals.

#### **Handling precautions**

- Wear rubber gloves and face shield when handling the concentrate.
- Wash concentrate from skin and eyes immediately.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

#### **Trade names and suppliers**

##### *Liquid formulations*

Diazitol – Ciba-Geigy Agrochemicals, Whittlesford, Cambridge CB2 4QT.

### **DICOFOL**

LD50 684–809 mg/kg, an organochlorine acaricide

**Special notes** None.

#### **Handling precautions**

- Wash hands before meals, before attending to personal needs and after work.

#### **Trade names and suppliers**

##### *Liquid formulations*

Kelthane 20 – Murphy Chemical Ltd. (See under Chlorpyrifos).

PBI Dicofol – Pan Britannica Industries Ltd., Britannica House, Waltham Cross, Herts EN8 7DY.

Kelthane – Rohm & Haas (U.K.) Ltd., Lennig House, 2 Mason's Avenue, Croydon, Surrey CR9 3NB.



## **FENITROTHION**

LD50 250–500 mg/kg, an organophosphorus insecticide.

### **Special notes**

- Do not use if under medical advice not to work with anticholinesterase compounds.
- Dangerous to bees, fish, livestock, game, wild birds and animals.

### **Handling precautions**

- Wear rubber gloves and face shield when handling the concentrate.
- Wash concentrate from skin or eyes immediately.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

### **Trade names and suppliers**

#### *Liquid formulations*

Ciba-Geigy Fenitrothion 50 EC – Ciba-Geigy (See under Diazinon).

Dicofen – Pan Britannica (See under Dicofol).

Fenstan EC50 – Stanhope Chemical Products, Victory House, 99–101 Regent Street, London W14 8LJ.

## **GAMMA HCH (= gamma BHC and Lindane)**

LD50 88–91 mg/kg, a persistent organochlorine insecticide.

### **Special notes**

- Dangerous to bees.
- Harmful to fish and livestock.

### **Handling precautions**

- Wash concentrate from skin or eyes immediately.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

### **Trade names and suppliers**

#### *Liquid formulations*

Gamma-col – Plant Protection Division, ICI plc, Fernhurst, Haslemere, Surrey GU27 3JE.

PBI Lindane 20 – Pan Britannica (See under Dicofol).

Strykol BHC – Boots Farm Sales, Nottingham NG2 3AA.

#### *Dusts*

HCH Dust – Boots Farm Sales Ltd., Nottingham NG2 3AA.

## INSECTICIDES

### MALATHION

LD50 2,800 mg/kg, an organophosphorus insecticide and acaricide.

#### Special notes

- Do not use if under medical advice not to work with anticholinesterase compounds.
- Harmful to bees and fish.

#### Handling precautions

- Wear rubber gloves and face shield when handling the concentrate.
- Wash concentrate from skin or eyes immediately.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

#### Trade names and suppliers

##### *Liquid formulations*

Malastan 60 – Stanhope Chemical Products (See under Fenitrothion).

Malathion 60 – Farm Protection Ltd., Glaston Park, Glaston, Uppingham, Leicestershire LE15 9BX.

Murphy Malathion 60 – Murphy Chemical Ltd. (See under Chlorpyrifos).

Vitax Malathion 60 – Steetley Chemicals Ltd. (incorporating Vitax Ltd.), Liverpool Road North, Burscough, Ormskirk, Lancs LL0 0SB.

### TAR OIL

Insecticide.

#### Special notes

- The Poisons Rules apply to these products (See page 9).
- Irritating to skin, eyes, nose and mouth and may cause dermatitis.
- Dangerous to fish.

#### Handling precautions

- Wear gloves when handling concentrate.
- Wash concentrate from skin and eyes immediately.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

#### Trade names and suppliers

##### *Miscible winter washes*

Carbo-Craven – Craven Chemicals Co., 20–30 Church Street, Evesham, Worcs WR11 6DS.

Sterilite Tar Oil Winter Wash 80% Miscible Quality – Tenneco Organics Ltd., Rockingham Works, Avonmouth, Bristol BS11 0YT.

## INSECTICIDES

### *Emulsion winter washes*

Mortegg Emulsion – Murphy Chemical Ltd., Wheathampstead, St Albans, Herts AL4 8QU.

Sterilite Tar Oil Winter Wash 60% Stock Emulsion – Tenneco Organics Ltd., Rockingham Works, Avonmouth, Bristol BS11 0YT.



## FOREST INSECT PESTS

### ADELGIDS

FC Leaflet 2, *Adelges cooleyi*, 1960.

FC Leaflet 7, *Adelgids attacking spruce and other conifers*, 1968.

FC Forest Record 104, *Towards integrated control of tree aphids*, 1975.

Bulletin 42, *Conifer woolly aphids (Adelgidae) in Great Britain*, 1971.

#### Materials and application

These can be controlled by spraying with gamma HCH at 0.56 kg ai/ha MV. "Pineapple" gall formation on Christmas trees is most effectively controlled by spraying at the above rates on mild days from November to the end of February.

Needle distortion and discoloration of Douglas fir in the nursery by *Adelges cooleyi* may be controlled by applying HV tar oil winter wash, at the manufacturer's recommended rates, when the trees are dormant during winter months.

### AMBROSIA BEETLES OR PINHOLE BORERS (*Trypodendron lineatum*)

#### Materials and application

Timber degrade associated with this beetle's stained gallery system may be prevented by applying gamma HCH at 0.5% in water before the end of April, to logs at risk. Apply the mixture at the rate of 0.7 litres per m<sup>2</sup> of superficial stack area (2 sides, 2 ends and top). Post-infestation treatment is not practicable. If gamma HCH is not available, a spray of 0.5% chlorpyrifos (Dursban) in water at the above rate should prove effective.

### BARYPITHES WEEVILS (*Barypithes araneiformis*, *B. pellucidus*)

Small, night-feeding weevils damaging nursery seedlings.

#### Materials and application

When damage is first seen, control by spraying with gamma HCH (e.c.) 0.42 kg ai/ha HV.

## FOREST INSECT PESTS – INSECTICIDES

### **BLACK PINE BEETLES** (*Hylastes* spp.)

FC Leaflet 58, *The Large pine weevil and Black pine beetles*, 1974.

Small, cylindrical beetles which damage and often kill young conifers by root feeding when recently felled conifer areas are replanted. For control see under Large pine weevil.

### **CHAFERS** (*Melolontha melolontha*, *Phyllopertha horticola*, *Serica brunnea*)

FC Leaflet 17, *Chafer beetles*, 1948 (out of print).

The larvae of Chafer beetles damage nursery seedlings and transplants by feeding upon, and often severing, the roots. Damage occurs in the summer months and is most common on heavier soils.

#### **Materials and application**

Where there is a history of chafer damage, work 0.5% gamma HCH dust at 125–190 kg/ha into the top 10 cm of soil before sowing or transplanting. For occasional control, apply the same treatment as above hoed-in between transplant lines.

### **CLAY WEEVILS** (*Otiorhynchus singularis*, *Strophosomus melanogrammus*)

Adults of these weevils feed upon the fine shoots, leaves and needles of a great variety of tree species, and are active from April to October.

#### **Materials and application**

Spray either as routine in April, or when damage is first evident, with gamma HCH at 0.3 kg ai/ha MV.

### **CONIFER SPINNING MITE** (*Oligonychus ununguis*)

Damage is first evident in the autumn when Christmas tree foliage takes on a bronzed appearance. In the following year, needles become yellowed and spun together with masses of webbing.

#### **Materials and application**

Spray when eggs hatch in late May with dicofol at 0.5 kg ai/ha MV.

### **CUTWORMS** (*Agrotis* spp., *Noctua pronuba*, *Euxoa nigricans*)

Caterpillars of these species emerge from the soil at night-time to feed upon nursery seedlings. Two distinct larval feeding periods occur, the first from

## FOREST INSECT PESTS – INSECTICIDES

July to September/October, the second commencing in mild conditions during February until pupation in May. Older larvae are difficult to kill with insecticide treatments but are effectively controlled by cultivation of seedbeds as part of the annual rotation.

### **Materials and application**

The young larvae may be controlled by spraying seedbeds as routine in July, or when damage is first seen, with gamma HCH 1.5 kg ai/ha HV. The spray may be repeated in August if necessary.

### **ELM BARK BEETLES** (*Scolytus scolytus*, *S. multistriatus*)

FC Forest Record 94, *Biology of Dutch elm disease*, 1974.

FC Leaflet 54, *The control of Dutch elm disease*, 1974.

FC Forest Record 115, *Dutch elm disease*, 1977.

Only a limited use of insecticides is possible. Under certain conditions insecticides may be used for preventing the infestation of unattacked logs. For this, see under Pine shoot beetle.

### **FELTED BEECH COCCUS** (*Cryptococcus fagisuga*)

FC Leaflet 15, 1956.

FC Forest Record 96, *Beech bark disease*, 1974.

### **Materials and application**

Treatment of large areas of affected trees is not practicable. Trees of amenity value may be treated with tar oil winter wash 5% HV during dormancy. Do not spray in frosty weather or when trees are wet. Alternatively, apply diazinon 12.5 g ai/litre in water MV during March–May, covering affected tree trunks and branches thoroughly.

### **GREAT SPRUCE BARK BEETLE** (*Dendroctonus micans*)

FC Bulletin 38, 1966 (out of print).

The discovery or suspected presence of this new pest should be reported immediately through Forestry Commission channels. Statutory regulations on movement of timber are part of the control system for this insect (S.I. 1982 No. 1457).

### **Materials and application**

All infested trees must be felled and peeled. The peeling area, the stumps and the peelings (if they cannot be burnt) should be sprayed with 0.5% gamma HCH in water.

### **GREEN SPRUCE APHID** (*Elatobium abietinum*).

FC Research and Development Paper 116.

Needle loss in spruces due to heavy infestations of this aphid normally occurs in the late spring.

## FOREST INSECT PESTS – INSECTICIDES

### Materials and application

Control by applying malathion at 1.5 kg ai/ha MV to nursery stock or Christmas trees in March/April or when the aphids are first seen. Regular treatment in August is more effective and should be adopted in situations where defoliation risk is known to be high.

### LARCH SHOOT BEETLE (*Ips cembrae*)

For control of unattacked logs see under Pine shoot beetle.

### Materials and application

To control *Ips* in infested logs apply 0.5% gamma HCH in paraffin or diesel oil at the rate of 0.5 litres per m<sup>2</sup> bark area. Only the outer surfaces of stacks are densely colonized and penetration of the stacks by the spray is therefore not necessary. As in the treatment of Pine shoot beetle, chlorpyrifos (Dursban) may be substituted for gamma HCH if necessary.

### LARGE PINE WEEVIL (*Hyllobius abietus*)

FC Leaflet 58, 1974.

Severe and often fatal bark stripping of young conifers on replanted conifer sites by this large weevil can be controlled for 1–2 years by dipping transplants prior to planting out.

### Materials and application

Firstly prepare a tank or large drum with the required quantity of 1.6% Gammacol or a gamma HCH e.c. formulation in water. To ensure adequate dispersal begin by mixing the concentrate in a few litres of water only, then dilute to the required volume. Loosen the bundles of transplants, shake off all loose soil particles, and immerse the upended bundles in the mixture to cover the complete top and up to  $\frac{1}{4}$  of the main root, but not the fibrous root system. The bundles should be agitated sufficiently to ensure coverage of each plant's stem surface. Remove bundles from the mixture and allow surplus insecticide to drain back into the tank. This treatment will provide protection against both *Hyllobius* and *Hylastes*. Before planting out or exposing treated plants to weather, it is vital that the insecticide deposits be dry (when, if Gammacol is used, a chalky appearance will be noted). Heel plants in under cover if necessary.

With exceptionally high infestations it may be necessary to boost dipping treatments by spraying plants *in situ*. Apply gamma HCH e.c. at 0.125% in water onto the stems to the point of run-off in dry weather.

**Note:** If gamma HCH preparations are not available it is possible to use chlorpyrifos (Dursban) at 2.5% in water for plant dipping. If this is used,



## FOREST INSECT PESTS – INSECTICIDES

keep fine roots out of contact with the chemical. Chlorpyrifos is not as persistent as gamma HCH.

All treated trees should be regularly inspected from April to October in the second year after planting and a top spray applied if damage is observed.

### **PINE BEAUTY MOTH** (*Panolis flammea*)

As for Pine looper moth.

### **PINE LOOPER MOTH** (*Bupalus piniarius*)

FC Forest Record 119, 1978.

Control of infestations of these moths invariably involves carefully balanced decisions concerning the use of the most environmentally suitable insecticide and method of spraying. Therefore control enquiries should be referred to the Entomology Branch (for address see back cover).

### **PINE ROOT APHID** (*Stagona pini*)

This root-feeding aphid can occur in nursery beds and older container grown stock.

#### **Materials and application**

Control is by removal and burning of affected plants, and spot treatment of infected soil by hoeing-in 0.5% gamma HCH dust at 13–20 g per m<sup>2</sup>. For container plants, a soil drench with diazinon at manufacturer's recommended rate for root aphids is an alternative treatment.

### **PINE SHOOT BEETLE** (*Tomicus piniperda*)

FC Leaflet 3, 1978.

#### **Materials and application**

Where delay in removal from the forest is foreseen unattacked logs may be protected from infestation by applying 0.5% gamma HCH in water at the rate of 0.7 litres mixture per m<sup>2</sup> superficial stack area (2 sides, 2 ends and top).

## FOREST INSECT PESTS – INSECTICIDES

To control emergence of *T. piniperda* from infested logs, apply 0.5% gamma HCH in paraffin or diesel oil at the rate of 0.5 litres per m<sup>2</sup> bark area. Stacks should be broken to achieve good coverage.

If gamma HCH is not available, chlorpyrifos (Dursban) may be substituted and used at the above concentrations and rates.

### **PINE SHOOT MOTH** (*Rhyacionia buoliana*)

FC Forest Record 83, 1972.

Insecticidal control is rarely justified unless the crop has a particularly high value (e.g. in seed orchards or for specimen trees).

#### **Materials and application**

To control bud mining by larvae of this moth apply fenitrothion at 1.125 kg ai/ha MV at the end of March to early April. Correct timing is important. Spray within two weeks of the first new resin tents appearing around the bud whorls. Repeat the spray after two weeks if activity persists.

### **PISSODES WEEVILS** (*Pissodes pini*, *P. notatus*)

FC Leaflet 29, 1952 (out of print).

An occasional pest closely associated with the Large pine weevil in conifer re-forestation programmes. *Hylobius* control measures are adequate.

### **POPLAR LEAF BEETLES** (*Phyllodecta* spp., *Chrysomela populi*)

#### **Materials and application**

Control of the leaf-feeding larvae of these beetles should only be undertaken in nurseries, stool beds or for high value amenity trees. When first seen spray with gamma HCH 0.56 kg ai/ha MV.

### **SAWFLIES (Hymenoptera)**

Control attacks to broadleaved and coniferous trees in the forest nursery by spraying as for Poplar leaf beetles.

### **SCIARIDS (Diptera)**

The tiny whitish black-headed larvae of these sciarid fungus gnats can become a serious pest of seedlings in polyhouses. They feed on and in the fine roots, causing death of plants.

#### **Materials and application**

The presence of the adult midges indicates the need for control using 0.02% solution of malathion as a drench, 0.24 kg ai/ha HV. (= 0.024 g/m<sup>2</sup> for polyhouse).

### **SPRINGTAILS (Collembola)**

#### **Materials and application**

Damage to conifer seedbeds during April–June can be controlled by spray application of malathion at 1.2 kg ai/ha HV, as a 0.1% solution. Preferably this should be done when insects are first seen, even prior to seedling emergence or germination, as resultant damage (death and distortion of plants) may only appear later. However, this is one of the few insects against which a prophylactic treatment is permissible in those nurseries known to be liable to attack by springtails, where an application should be made at, or just before, germination and repeated a fortnight later. Further applications should be made whenever the insects are seen and applications should be extended to cover all ground for at least 20 m beyond the beds being protected.

### **SPRUCE BELL MOTH (*Epinotia tedella*)**

#### **Materials and application**

Browning and thinning of Christmas tree foliage by needle mining larvae can be controlled by applying fenitrothion at 1.1 kg ai/1,000 litres HV. Spray when damage is first seen, August to October.

### **SPRUCE SHOOT APHID (*Cinara pinicola*)**

#### **Materials and application**

Spray in early spring, or when first seen, with malathion at 1.5 kg ai/ha MV.

## FOREST INSECT PESTS – INSECTICIDES

### **STRAWBERRY WEEVIL** (*Otiorhynchus ovatus*)

Damage caused by adults of this weevil is similar to that of the Clay weevils and should be treated as such. However, the larval stage, active in the summer months, feeds on the finer roots of nursery stock.

#### **Materials and application**

Control larval damage either by applying 0.5% gamma HCH dust at the rate recommended for Chafer, if infestation is anticipated, or by a soil drench of gamma HCH applied to wet soil at 1.2 kg ai/ha in 2,000 litres of water.

### **WOOLLY BEECH APHIS** (*Phyllaphis fagi*)

#### **Materials and application**

Spray in May, or when the aphids are first seen on the undersides of beech leaves, with malathion 1.5 kg ai/ha MV. Repeat if infestation re-occurs.

## FUNGICIDES

Only those diseases which are of some importance in Forestry Commission nurseries or plantations and for which control chemicals can play an effective part are dealt with here. Therefore several diseases included in *The Use of Chemicals in the Forestry Commission* (1978) have been omitted.

Information on the control of diseases not mentioned here is available on request from either FC Research Station (for addresses see back cover).

## DISEASES

### DAMPING OFF

FC Bulletin 43, *Nursery Practice*, 1972.

FC Bulletin 14, *Forestry Practice*, 1978.

Damping off is usually fungal in origin. Once it is established among seedlings, treatment may have little effect, though captan drenches may check its spread in seedbeds if applied immediately damage is seen and repeated at 10–14 day intervals until deaths cease. These will have no effect if the damage is not fungal. Captan itself can temporarily retard the growth of seedlings.

If the disease is a recurrent problem in open nurseries, pre-sowing chemical sterilization should give good control of both damping off caused by fungi and similar root rots associated with nematodes (eelworms).

Drenching cannot be unequivocally recommended for seedlings in containers in greenhouses because of the risk of waterlogging in the conditions of poor drainage and low evaporation which often prevail. In greenhouses, damping off is unlikely to occur if a sterilized medium and clean irrigation water are used and good greenhouse hygiene is practised. Mains water is preferable and spring or artesian well water is usually safe, but whatever the source, storage tanks must be kept covered and clean.

### Materials and application

#### *Post-emergence drenching*

**Captan** – Mix 1.1 kg ai in 1,000 litres water and apply until the soil is saturated to a depth greater than the rooting depth of the seedlings (in the region of 5.0 litres/m<sup>2</sup> of seedbed).

### CAUTION

— Captan is harmful to fish.

## DISEASES – FUNGICIDES

### *Pre-sowing sterilization*

**Dazomet** – A soil sterilant which breaks down in the soil to release the gas methyl isothiocyanate which controls pathogens and weed seeds, hence promoting improved seedling health and height growth. It is sold as Basamid (98% w/w) by BASF.

Apply as a prill (98% w/w ai) over the whole seedbed area to be treated at the rate of 380 kg product per hectare, using a Sisis Lospred or Truspred to obtain even distribution. Rotovate immediately into the upper 15 to 20 cm of soil. The soil should be moist but not wet, and wet sections should be avoided. Cultivate twice at right angles across the section using 'L' shaped tines at 200 revs per minute and a forward speed of 2 kilometres per hour (1.25 mph). Seal the soil surface immediately with a heavy smooth roller and leave it firm and free of cracks. For small areas, cover the ground with a durable polythene sheet weighted down at the edges.

At least six weeks must elapse before the soil is cultivated to release any residual gas. Cultivation must be thorough, taking care not to cultivate to a greater depth than that obtained during incorporation in order to avoid bringing unsterilized soil to the surface layers. Cultivate twice at right angles using a tine cultivator as a preliminary treatment followed by a rotovation. After rotovation leave for a week and then carry out the cress test as described later. If gas is found to be present repeat the cultivation and testing procedure.

If nursery soils are known to be so heavy as to make gas release cultivation during the winter months difficult, the following alternative method may be used:

Throw the seedbeds up before application and apply dazomet to the seedbeds only. Incorporation of the prill and gas release cultivations then follow as previously explained, taking care not to mix untreated soil from the alleys between seedbeds with sterilized soil in the seedbeds. Reinfection from alleys can be a problem with this method, and overall treatment is always preferable if it is practicable.

Apply in late August to early September when soil temperatures are likely to be above 7°C and are unlikely to fall below 4°C for any length of time during the six weeks after incorporation.

### *The cress test*

Take at least six sets of soil samples at random from the treated area. Sample to approximately twice the treated depth (i.e. about 30–40 cm) and divide each sample to give an upper treated and a lower untreated half. Each portion should be quickly placed into separate well-labelled jam jars with the minimum of soil disturbance and the soil levelled before sprinkling cress seed over it. Seal the jars immediately on site and then place in a warm well lit room. Prepare similar control samples of untreated soil from a suitable part of the nursery. After germination compare the control sample with the other samples from

the treated area. Growth should be vigorous, healthy and even in all jars before seed sowing commences in the spring. Special care should be taken with seedbed sections which are prone to waterlogging, or which have variable soil, to ensure that samples take in the full range.

**Note:** Dazomet treatment stimulates growth in the season following application, and can give partial improvement in the second season if the same area is again used for seedbeds or transplant lines. It is not recommended that the same area be treated year after year. Rotate the area treated over a minimum of four years.

**Formalin** – A 38%–40% solution of formaldehyde in water. This has little effect on weed growth and, taking labour costs into account, is more expensive than dazomet as a soil sterilant. Available as horticultural grade formalin (from horticultural and agricultural suppliers). Apply diluted in water (see below) as a drench to prepared seedbeds at least three weeks before sowing in light soils or six in heavy clay soils, between November and February, but not when the soil is waterlogged or covered by snow or glazed frost. If the smell of the chemical persists after these periods cultivate to a depth of 10 cm (not more) and allow residual vapour to escape before sowing.

Five litres undiluted formalin is required per 10 m<sup>2</sup> in Scotland, but in England and Wales 2.5 litres per 10 m<sup>2</sup> has been found sufficient. The amount of water used depends on the amount the soil will accept. To gauge this, measure the amount of water a square metre of bed will absorb before it begins to run off into the alleys, then dilute the formalin as follows:

Water required to drench 1 m <sup>2</sup> test plot	Water to be added to 5 litres of diluted formalin to treat 10 m <sup>2</sup>
Over 10 litres	100 litres
7.5–10 litres	75 litres
5.0–7.5 litres	50 litres

#### CAUTION

- Dazomet is strongly phytotoxic, and moderately toxic to mammals.
- Dazomet and formalin can be irritating to skin, eyes, nose and mouth.
- The Poisons Rules apply to formalin and formaldehyde.

## DISEASES – FUNGICIDES

### **FOMES ROOT AND BUTT ROT** (*Heterobasidion* (*Fomes*) *annosum*)

FC Leaflet 5, 1974.

FC Bulletin 14, *Forestry Practice*, 1978.

Chemical treatment of freshly cut conifer stumps prevents their colonization by airborne spores of this fungus but has no effect on infections already established in the stump. The value of chemical treatment therefore decreases as the incidence of infected stumps in a stand increases: preventative treatment is of greatest benefit if used on uninfected sites from the first rack-cutting or thinning onwards.

In pure pine stands, but not in any other situation, *Fomes* may be controlled more effectively with a special preparation of the saprophytic fungus, *Peniophora gigantea*. This fungus is also of greater value than chemicals in the treatment of stands already infected by *Fomes*. However, *P. gigantea* should be used only after consultation with one of the Forestry Commission's Research Stations, as it is not necessarily the appropriate means of *Fomes* control in all pine stands and requires special care in storage, preparation and use.

Stump treatment against *Fomes* is obligatory in all Forestry Commission forests (see Section E Subsection b and Appendix IV of the Produce Code).

### **Materials and application**

Within half an hour of felling, brush debris from stump and apply the chemical or *P. gigantea* copiously to all exposed wood. Preferably use the specially designed Chieftan Stump Treatment Applicator (Chieftan Forge Ltd.). Alternatively, use a brush and any convenient container.

Very roughly speaking, 5 litres of liquid will treat 4 m<sup>2</sup> of stump surface.

**Urea** – for any conifer. Normally purchased in bulk from SAI Horticulture Ltd. (100% ai), but can be supplied ready dyed for forest use as Agrico from Thompson and Capper Ltd., in packs of 3 × 5 kg bags or 15 × 1 kg bags (see p. 63 for addresses). Dissolve 1 kg in 5 litres water. It is easiest dissolved by adding the chemical slowly to the water while stirring. Add 2.0 g (1 level teaspoon) Kenacid Turquoise V5898 dye to each 5 litres of urea solution. To prevent freezing, add 0.5 kg sodium chloride (common salt) to each 5 litres urea solution.

**Peniophora gigantea** – for pine only. *P. gigantea* + the dye Supra Blue 75328. *P. gigantea* is supplied as cards of 5 sachets (and as boxes of ten cards) containing a concentrated suspension of living fungal spores. The dye is supplied in 1 kg tins. Mix 1 sachet of *P. gigantea* and 1 g dye (half a level teaspoon) in 5 litres water. A fresh suspension must be used each day. Sachets must be stored as instructed by the suppliers to prevent the death of the spores. Properly stored, the sachets remain usable for about three months.



## DISEASES – FUNGICIDES

DO NOT use *P. gigantea* in pressurized sprayers and DO NOT use containers for *P. gigantea* if they have contained any chemical, as the spores may be killed and the treatment rendered ineffective.

Both materials are suitable for use on water catchment areas.

### CAUTION

- Urea is harmful to ruminants.
- Store and use in such a way that animals cannot consume the solution or the prill (Entopath News No. 67, March 1972).
- Wash hands before meals, before attending to personal needs and after work.

## DISEASES – FUNGICIDES

### **GREY MOULD** (*Botrytis cinerea*)

FC Leaflet 50, 1964.

FC Bulletin 43, *Nursery Practice*, 1972.

FC Bulletin 14, *Forestry Practice*, 1978.

This disease is usually most damaging in densely crowded seedbeds. Overstocking and heavy weed growth should therefore be avoided, especially with the more susceptible species.

#### **Materials and application**

Infection often occurs on the lower parts of the plants. If this is the case, ensure that the fungicide is applied to those parts in particular.

#### *For susceptible species*

(Douglas fir, Japanese larch, Lodgepole pine, Western hemlock and southern origins (Washington, Oregon) of Sitka spruce).

- In seedbeds: if infection is noticed, apply fungicide immediately and again at intervals (10–14 days during the period of shoot growth; 2–3 weeks when shoot growth has ceased) until no further infection is evident.
- Following autumn frost damage, apply fungicide immediately, once only.
- Treatment of transplants should not be necessary.

#### *For very susceptible species*

(*Cupressus*, *Cryptomeria*, *Sequoia*, *Sequoiadendron*).

- As a routine measure, apply fungicide to plants in their first and second years every three weeks from late summer to the onset of winter weather.
- If earlier infection occurs, treat as for susceptible species (see above).

#### *Conifer seedlings in containers in greenhouses*

In these humid, crowded conditions *Botrytis* damage is likely to be more frequent and more severe than in the open. Regular inspections must be made, particularly of the lower, hidden foliage in dense blocks of plants. If *Botrytis* is found, a fungicidal spray should be applied without delay, followed by a second spray one week later, and thereafter spray at 10–14 day intervals if damage continues.

**Thiram** – Both liquid and wettable powder formulations are suitable. Mix 3.2 kg/ai in 1,000 litres water and apply at HV.

**Captan** – In most experiments thiram has given better control than captan. Captan can temporarily retard the growth of seedlings. Mix 2.5 kg/ai in 1,000 litres water and apply at HV.

**Benomyl** – This is more effective than either thiram or captan against *Botrytis* in horticulture, but as its regular use can result in the appearance of benomyl-tolerant strains of the fungus, we recommend it only for occasional application, for example where the other

## DISEASES – FUNGICIDES

fungicides fail to give control or where an exceptionally valuable crop is at risk. Mix 0.5 kg/ai in 1,000 litres water and apply at HV.

### CAUTION

- Thiram can be irritating to skin, eyes, nose and throat.
- Wear protective gloves when handling concentrate.
- Wash concentrate from skin or eyes immediately. Avoid inhaling dust. If necessary for personal comfort, wear a dust mask.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.
- Captan is harmful to fish.

## DISEASES – FUNGICIDES

### **KEITHIA DISEASE OF WESTERN RED CEDAR** (*Didymascella thujina*)

FC Leaflet 43, 1974.

FC Bulletin 14, *Forestry Practice*, 1978.

FC Bulletin 43, *Nursery Practice*, 1972.

As this disease can cause serious annual losses where substantial numbers of *Thuja plicata* are regularly raised, routine spraying with cycloheximide is advised to control it in such nurseries. Plants need protection only in their second and third years in the nursery. On occasional crops, spraying should begin immediately infection is seen in spring.

#### **Materials and application**

**Cycloheximide** – available as Acti-Dione TGF supplied specifically for the control of *Keithia*, in packs sufficient to treat one fifth of an acre (810 m<sup>2</sup>). Mix and use as directed on the pack. Spray once in late March and again in late April. In the wetter parts of the country (e.g. West Scotland, NW England and Wales) a further spray in mid-June is advisable. On occasional crops apply immediately infection appears in spring and repeat at the given intervals.

#### **CAUTION**

- Cycloheximide is dangerous to livestock and fish.
- This is a part II Substance under the Health and Safety (Agriculture) (Poisonous Substances) Regulations, and users are required by law to wear full protective clothing when using it (see pp. 12–16).
- Wash all protective clothing thoroughly after use, especially the inside of gloves.
- Remove heavily contaminated clothing immediately.
- Wash splashes from skin or eyes immediately.
- Avoid all contact by mouth.
- Wash hands and exposed skin before eating, drinking or smoking and after work.

## LOPHODERMMIUM NEEDLE CAST OF PINE

(*Lophodermium seditiosum*)

The causal agent of this disease was formerly known as *L. pinastri* and the disease is dealt with under that name in:

FC Leaflet 48, 1964.

FC Bulletin 14, *Forestry Practice*, 1978.

FC Bulletin 43, *Nursery Practice*, 1972.

This disease may be a recurrent problem on Scots and Corsican pine nursery stock being raised near older pine trees. In such cases routine protective sprays become necessary. Protective spraying is not justifiable elsewhere, though occasional unpredictable outbreaks sometimes occur. Spraying after damage appears is unlikely to arrest the disease in infected plants.

### Materials and application

**Zineb** – Any of the proprietary brands of wettable powders containing 65–75% zineb may be used. Mix 1.2 kg ai in 1,000 litres water and apply at HV. Apply fungicide to the foliage of nursery seedlings and transplants at monthly intervals from mid-July to mid-November.

**Maneb** – Any of the proprietary brands of wettable powders containing up to 80% maneb may be used. Mix 2.25 kg ai in 1,000 litres water and apply at HV. Apply as for zineb above.

**Benomyl** – In experiments in American nurseries this has provided excellent control at the rate of 1 kg ai in 1,000 litres at HV. Apply as for zineb above. As the prolonged use of benomyl has given rise to benomyl-tolerant strains of some fungal pathogens, routine annual *Lophodermium* control should not rely exclusively on this one fungicide.

### CAUTION

- Zineb and maneb can be irritating to the skin, eyes and nose.
- Wear protective gloves when handling concentrates.
- Wash concentrate from skin or eyes immediately.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

## DISEASES – FUNGICIDES

### **MERIA NEEDLE CAST OF LARCH** (*Meria laricis*)

FC Leaflet 21, 1963 (out of print).

FC Bulletin 14, *Forestry Practice*, 1978.

FC Bulletin 43, *Nursery Practice*, 1972.

This is a problem mainly of European larch nursery stock being raised close to older larch trees in the wetter parts of the country. It is usually worse where plants are left for two consecutive years in the same place. If not controllable by choice of nursery site or cultural practice, it can be controlled with annual sprays. Attacks on Hybrid and Japanese larch are too unpredictable and uncommon to warrant routine protection.

#### **Materials and application**

**Sulphur** – Any of the proprietary wettable and colloidal formulations is suitable. Mix according to the manufacturer's instructions for the control of powdery mildew on apple or American gooseberry mildew. Apply at flushing and at 3–4 weekly intervals until August or the onset of hot, dry weather. Should wet weather return after discontinuing treatment, resume spraying until August.

**Zineb** – Any of the proprietary wettable powders containing 65–75% zineb may be used. Mix 2.9 kg ai in 1,000 litres water and apply at HV. Apply at flushing and again at 3–4 weekly intervals until August or the onset of hot, dry weather. Should wet weather return after discontinuing treatment, resume spraying until August.

#### **CAUTION**

- Zineb can be irritating to the skin, eyes and nose.
- Wear protective gloves when handling concentrate.
- Wash concentrate from the skin or eyes immediately.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.

**OAK MILDEW** (*Microsphaera alphitoides*)

FC Leaflet 38, 1956 (out of print).

FC Bulletin 14, *Forestry Practice*, 1978.

FC Bulletin 43, *Nursery Practice*, 1972.

**Materials and application**

Control is warranted only in nurseries. Fungicides are effective if applied at the first signs of mildew, but heavy infections are difficult to control. Repeat applications every 2 weeks if mildew reappears.

**Sulphur** – Any of the proprietary wettable and colloidal formulations is suitable. Mix and apply according to the manufacturer's instructions for the control of powdery mildew on apple or American gooseberry mildew.

**Dinocap** – Any of the proprietary liquid or wettable powder formulations is suitable. Mix and apply as for sulphur above.

**Benomyl** – Mix and apply as for sulphur above. As the prolonged use of this fungicide has resulted in the appearance of some benomyl tolerant strains of powdery mildew in agricultural crops, routine annual oak mildew control should not rely exclusively on benomyl.

**CAUTION**

- Dinocap can be irritating to skin, eyes and nose.
- Wear rubber gloves when handling the concentrate.
- Wash concentrate from skin or eyes immediately.
- Avoid all contact by mouth.
- Avoid working in spray mist.
- Wash hands and exposed skin before meals, before attending to personal needs and after work.
- Dinocap is dangerous to fish.





## FERTILISERS

### ALPHABETICAL LIST OF FERTILISER MATERIALS COMMONLY USED IN FORESTRY

#### General caution

While none of the materials to be mentioned is particularly toxic or a strong poison, all should be kept safely under lock and key if stored for any length of time, and none should be allowed to remain in places where they are likely to be eaten by animals or played with by small children.

#### FC Publications

Leaflet 63. *Fertilisers in the forest: A guide to materials*, 1975.

Booklet 41. *Fertilisers in the establishment of conifers in Wales and Southern England*, 1974.

### AMMONIUM NITRATE

A soluble salt normally supplied as prills (small pellets made by dropping the molten material through a rising current of air).

#### Use

In the forest for correcting nitrogen deficiency.

#### CAUTION

- Avoid the dust and wear gloves when handling.
- Keep out of water courses.
- Store away from other combustible materials and not in wooden buildings.
- Absorbs moisture readily from the air. If allowed to liquefy and then dry into a solid mass, a severe shock wave can, under some conditions, cause it to explode: therefore ensure bags are sealed and perfect before storing.
- Clean out metallic dispensers or machines after use.
- If applied from the air, markers and loaders should wear appropriate protective clothing.

#### Brands

Nitracc – Albright and Wilson

Nitram – ICI

Nitro-Top – Fisons

UKF Nitrashell – UKF

## FERTILISERS

### AMMONIUM NITRATE WITH CALCIUM CARBONATE

A mixture of the soluble salt with chalk, in granular form. Slightly acidic or neutral.

#### Use

In forest nurseries for top-dressing nitrogen-deficient seedbeds and transplant lines.

#### CAUTION

- Avoid the dust and wear gloves when handling.
- Clean out metallic dispensers or machines after use.

#### Brand

Nitro-chalk – ICI

### AMMONIUM SULPHATE

A crystalline soluble salt which may contain a little free acid. An active salt and an irritant in cuts and eyes.

#### Use

Top-dressing nitrogen-deficient seedbeds and transplant lines in forest nurseries where the soil pH is too high.

#### CAUTION

- Avoid the dust and wear gloves when handling.
- Keep out of water courses.
- Clean out metallic dispensers or machines after use.

## COMPOUND FERTILISERS

A number of compounds (i.e. materials supplying two or more major nutrients) are used in forest nurseries. These are all granular and present no particular difficulties or hazards, though as with other materials the dust can be irritating. The usual precautions against spillage and keeping out of water courses must be observed, though the latter will seldom be a problem in forest nurseries. As with other fertiliser materials they are slightly corrosive, so machines should be cleaned after use and gloves should be worn if they are handled more than briefly.

### **LIMESTONE, GROUND**

Crushed limestone is usually relatively pure. Dolomitic or magnesian limestone may contain useful amounts of magnesium.

#### **Use**

For raising the pH of extremely acid nursery soils.

#### **CAUTION**

- Avoid inhaling the dust and keep it out of the eyes.
- No other hazards.

### **MAGNESIUM SULPHATE**

This material, also known as Epsom salts, is a soluble salt, but less irritating than for example ammonium nitrate or potassium chloride. Another form, containing less water of crystallization, is called kieserite.

#### **Use**

For correcting magnesium deficiency in nurseries.

#### **CAUTION**

- Ingesting more than small quantities may cause discomfort.
- Otherwise harmless.

### **POTASSIUM CHLORIDE**

A soluble salt, usually crystalline, also known as muriate of potash or pink potash. Active and an irritant in cuts and eyes.

#### **Use**

For top-dressing potassium-deficient crops, usually only on peats and peaty gleys and most commonly in mixture with rock phosphate.

#### **CAUTION**

- Avoid the dust and wear gloves when handling.
- Loaders and markers for aerial application should wear a filtering facepiece respirator (ori-nasal mask) and clear lens goggles (BS 2092).
- Clean out metallic dispensers and machines after use.

## FERTILISERS

### ROCK PHOSPHATES

These are normally used only in the unground form (coarsely ground and then screened). Granulated forms are also suitable and are sometimes on offer, but may need different spreading equipment.

#### Use

For newly planted trees on infertile soils and as a top-dressing for phosphorus-deficient crops.

#### CAUTION

- The dust may be irritating if inhaled.
- A filtering facepiece respirator (ori-nasal mask) and goggles should be worn if rock phosphate is applied from the ground in windy weather, and at all times by markers and loaders if it is applied from the air.
- Ensure the material does not blow into reservoirs and water courses, otherwise algal blooms may result.

#### Source

Imported mainly from Tunisia and Morocco but batches from other areas may be offered (see Leaflet 63 for more information on suitability of different sources).

### TRIPLE SUPERPHOSPHATE

A granular phosphatic fertiliser.

#### Use

For top-dressing small areas of phosphate-deficient forest crops when its better handling qualities and relative cleanness make it preferable to the cheaper rock phosphate.

#### CAUTION

- Avoid spillage into water courses as high concentrations could cause algal blooms in lakes or reservoirs.
- Keep away from plant roots: damage or death may follow if triple superphosphate comes directly in contact with tree roots.

### UREA

A synthetic organic nitrogen fertiliser, usually prilled.

#### Use

For top-dressing nitrogen-deficient forest crops.

#### CAUTION

- Poisonous if ingested in large amounts, though this is unlikely (in contrast to its use in solution as a stump protectant). Non-irritant.
- Avoid spillage into water courses or lakes as this could cause undesirable growth of plants.
- Markers and loaders should be suitably clothed and protected.

## WILDLIFE CHEMICALS

### VERTEBRATE POISONS

#### GREY SQUIRREL

FC Leaflet 56, *Grey squirrel control*, 1980.

##### Materials and application

**Warfarin** – 0.02% w/w on whole grain wheat. This may only be presented in hoppers with a tunnel entrance not less than 230 mm long and not more than 100 mm internal square dimensions (Grey squirrels [Warfarin] Order 1973). It may not be used at all in counties in which red squirrels are present: these are designated in the Order.

##### CAUTION

- Warfarin should only be used for grey squirrel control during the period April to July in and around woodlands vulnerable to damage.
- Treated bait must never be left where domestic stock or other animals can eat it.
- Wash hands before meals and after using or mixing poisoned baits.
- Wear gloves when mixing liquid concentrate with whole wheat.

#### FIELD VOLE

##### Materials and application

**Warfarin** – 0.025% w/w on cut wheat or pinhead oatmeal (fine or medium grade). The bait can be prepared by mixing 1 part by weight of 0.5% warfarin concentrate with 19 parts by weight of bait. The treated bait must be placed under cover, not in the open. Land drains or plastic drain pipes cut into tubes 250 mm long by approximately 50 mm diameter are suitable. These should be placed in vole runs near the intersection of a square grid 15 m × 15 m across the area to be treated. 250 g (or 8 oz) of poisoned bait should be placed in each tube. Light plastic tubes should be pegged or held down by a turf sod. They should be visited every second day and topped up as required until the bait take decreases. The tubes can then be visited once weekly for a month. At the end of that time all uneaten bait and the covers must be removed from the area and the untaken bait burnt.

## WILDLIFE CHEMICALS

### CAUTION

- Treated bait must never be left where domestic stock or other animals can eat it.
- Wash hands after mixing or using the bait.
- Store surplus treated bait or poison in a dry place well away from animals.
- Wear gloves when mixing concentrate with whole wheat.

### RABBIT

FC Leaflet 67, *Rabbit management in woodlands*, 1977.

#### Materials and application

**Cyanide powder** introduced into rabbit burrows with a spoon or pump.

*Spoon gassing* – Approximately 25 g (a level tablespoon of powder) is placed in a heap 150 mm (6 in) down each hole. Each hole is sealed with a sod, grass side down, to prevent the powder being covered with earth.

*Pump gassing* – A hand pump can be used with warrens of up to fifty holes. A power pump is necessary for bigger warrens.

### CAUTION

- Cyanide powder is subject to the Poisons Rules.
- At least two trained people should be involved in any gassing operation.
- They should never work in strong winds or wet weather.
- They should always work with their backs to the wind.
- It is essential that they carry with them capsules of the antidote amyl nitrite, and a Cuxon Gerrard Cyanide emergency treatment outfit for use by a doctor in an emergency.
- They must wash their hands before smoking, eating, or attending to personal needs.
- The cyanide powder must be kept in a sealed air-tight container at all times.
- Such containers should be kept well away from animals and people in a cool, well-ventilated, dry store.
- Empty containers should be punctured, filled with soil and buried.  
(Note: FC staff are referred to IM 217).

**Phosphine gas** – Phostoxin tablets are cleared by PSPS for rabbit control only and can be used as an alternative to spoon gassing. These are very much safer to transport than cyanide. One tablet is placed 300 mm down each hole and sealed in with turf, grass side down. Phostoxin tablets are supplied in flasks, each containing 30 tablets. The flasks should be stored in a cool, well ventilated, dry place.

CAUTION

- Phosphine gas is highly toxic to all forms of animal and human life.
- Only trained operators should be involved in any phostoxin gassing operation.
- Rubber gloves must be used when handling tablets.
- Never use in wet weather.
- During a gassing operation flasks should be kept capped at all times other than when tablets are being removed.
- The flask in use should not be put in a pocket.
- Never replace tablets in a flask.
- At the end of the day any unused tablets remaining in a flask must be buried.
- Do not store flasks that have been opened.

## CHEMICAL REPELLANTS

FC Leaflet 73, *Chemical Repellants*, 1978.

### DEER AND RABBIT BROWSING

#### Materials and application

**Aaprotect** – This chemical repellent can be sprayed on conifers and sprayed or painted on broadleaves to reduce browsing damage by deer or rabbits. It should be used only in the dormant season. For spraying, Aaprotect is diluted one part of repellent to one part water by volume by adding the water to the repellent. Smearing or painting can be done with the undiluted material. A knapsack sprayer with a jet of approximately 0.9 mm aperture and a spray pressure of 2 kgf/cm<sup>2</sup> gives an even cover of a tree and uses approximately 25 ml of the spray solution on a Norway spruce 30 cm high. The sprayer should be thoroughly washed out after use.

**Dendrocol 17** – is suitable only for preventing winter browsing by deer. It does not need diluting and can be sprayed from a B20L hand-sprayer. One squeeze of the hand-trigger should be given to the terminal bud(s) of each tree shoot to be protected. The material is not soluble in water and the sprayer should be decontaminated with a 25:1 petrol/oil mixture after use.

#### CAUTION

- Aaprotect is an irritant to skin, eyes, nose and throat.
- Dendrocol must not be inhaled or ingested.
- Wear gloves and avoid breathing spray.
- Wash hands after use.

### ROE DEER BROWSING IN GARDENS

#### Materials and application

**Fowikal** – may be used at any time of year where short-term protection for roses or ornamental shrubs is required. It can be sprayed or painted on the plants in the same way as Aaprotect. It has a strong but not unpleasant odour and is not phytotoxic to growing plants.

Re-treatment will be required every few weeks.



## ABBREVIATIONS AND SYMBOLS

ACAS	Agricultural Chemicals Approval Scheme
ai	active ingredient
BASIS	British Agrochemical Supply Industry Scheme Ltd.
CDBA	Controlled droplet band applicator (-tion)
CDIA	Controlled droplet incremental applicator (-tion)
CDSA	Controlled droplet spot applicator (-tion)
cm	centimetre(s)
e.c.	emulsifiable concentrate
FC	Forestry Commission
FSC	Forestry Safety Council
g	gramme(s)
ha	hectare(s)
HV	High Volume – over 700 litres/hectare
kg	kilogramme(s)
kgf	kilogrammes force
l	litre(s)
LD	Lethal Dose
LV	Low Volume – 50–200 litres/hectare
m	metre(s)
mg	milligramme(s)
ml	millilitre(s)
mm	millimetre(s)
MV	Medium Volume – 200–700 litres/hectare
ppm	parts per million
PSPS	Pesticides Safety Precautions Scheme
rev.	revised
ULV	Ultra Low Volume – under 10 litres/hectare
VLV	Very Low Volume – 10–50 litres/hectare
w.p.	wettable powder
w/v	weight per volume
w/w	weight per weight



## INDEX TO DAMAGING AGENTS AND CHEMICALS

Aaprotect	54
Adelgids (Aphids)	27
<i>Adelges cooleyi</i>	27
<i>Agrotis</i> spp. (Cutworms)	28
Ambrosia beetle (Pinhole borers, <i>Trypodendron lineatum</i> )	27
Ammonium nitrate	47
Ammonium nitrate with calcium carbonate	48
Ammonium sulphate	48
<i>Barypithes</i> weevils	27
Benomyl	40, 43, 45
Black pine beetles ( <i>Hylastes</i> spp.)	28
<i>Botrytis cinerea</i> (Grey mould)	40
<i>Bupalus piniarius</i> (Pine looper moth)	31
Captan	35, 40
Chafers	28
Chlorpyrifos (Dursban)	21, 27, 30, 32
<i>Chrysomela populi</i> (Poplar leaf beetle)	32
<i>Cinara pinicola</i> (Spruce shoot aphid)	33
Clay weevils	28
Collembola (Springtails)	33
Conifer spinning mite	28
<i>Cryptococcus fagisuga</i> (Felted beech coccus)	29
Cutworms	28
Cyanide powder	52
Cycloheximide	42
Damping off	35
Dazomet	36
DDT	21
Deer	54
Dendrocol 17	54
<i>Dendroctonus micans</i> (Great spruce bark beetle)	29
Diazinon	22, 29, 31
Dicofol	22, 28
<i>Didymascella thujina</i> (Keithia disease of WRC)	42
Dinocap	45
Diptera (Sciarids)	33
Dursban (Chlorpyrifos)	21, 27, 30, 32
<i>Elatobium abietinum</i> (Green spruce aphid)	29
Elm bark beetles ( <i>Scolytus</i> spp.)	29
<i>Epinotia tedella</i> (Spruce bell moth)	33
Epsom salts (Magnesium sulphate)	49
<i>Euxoa nigricans</i> (Cutworms)	28

## INDEX TO DAMAGING AGENTS AND CHEMICALS

Felted beech coccus ( <i>Cryptococcus fagisuga</i> )	29
Fenitrothion	23, 33
Field vole	51
<i>Fomes annosus</i>	38
Formalin	37
Fowikal	54
Gammacol	23, 30
Gamma HCH = BHC = Gamma BHC = Lindane	23, 27–32, 34
Great spruce bark beetle ( <i>Dendroctonus micans</i> )	29
Green spruce aphid ( <i>Elatobium abietinum</i> )	29
Grey mould ( <i>Botrytis cinerea</i> )	40
Grey squirrel	51
<i>Heterobasidion annosum</i> ( <i>Fomes annosus</i> ) (Butt rot)	38
<i>Hylastes</i> (Black pine beetle)	28
<i>Hylobius abietis</i> (Large pine weevil)	30
Hymenoptera (Sawflies)	32
<i>Ips cembrae</i> (Larch shoot beetle)	30
Keithia disease of WRC ( <i>Didymascella thujina</i> )	42
Larch shoot beetle ( <i>Ips cembrae</i> )	30
Large pine weevil ( <i>Hylobius abietis</i> )	30
Limestone, ground	49
<i>Lophodermium seditiosum</i> ( <i>L. pinastri</i> ) (Needle cast of pine)	43
Magnesium sulphate (Epsom salts)	49
Malathion	24, 33, 34
Maneb	43
<i>Melolontha melolontha</i>	28
<i>Meria laricis</i> (Needle cast of larch)	44
<i>Microsphaera alphitoides</i> (Oak mildew)	45
Muriate of potash (Potassium chloride)	49
Needle cast of larch ( <i>Meria laricis</i> )	44
Needle cast of pine ( <i>Lophodermium seditiosum</i> )	43
Nitro-chalk	48
<i>Noctua pronuba</i> (Cutworms)	28
Oak mildew ( <i>Microsphaera alphitoides</i> )	45
<i>Oligonychus ununguis</i>	28
<i>Otiorynchus ovatus</i> (Strawberry weevil)	34
<i>Otiorynchus singularis</i>	28

## INDEX TO DAMAGING AGENTS AND CHEMICALS

<i>Panolis flammea</i> (Pine beauty moth)	31
<i>Peniophora gigantea</i>	38
Phosphine gas	52
<i>Phyllaphis fagi</i> (Woolly beech aphid)	34
<i>Phyllodecta</i> spp. (Poplar leaf beetles)	32
<i>Phyllopertha horticola</i>	28
Pine beauty moth ( <i>Panolis flammea</i> )	31
Pine looper moth ( <i>Bupalus piniarius</i> )	31
Pine root aphid ( <i>Stagona pini</i> )	31
Pine shoot beetle ( <i>Tomicus piniperda</i> )	31
Pine shoot moth ( <i>Rhyacionia buoliana</i> )	32
Pinhole borer ( <i>Trypodendron lineatum</i> , Ambrosia beetle)	27
Pink potash (Potassium chloride)	49
<i>Pissodes</i> weevils	32
Poplar leaf beetles	32
Potassium chloride	49
 Rabbit	 52, 54
<i>Rhyacionia buoliana</i> (Pine shoot moth)	32
Rock phosphate	50
Roe deer	54
 Sawflies (Hymenoptera)	 32
Sciarids (Diptera)	33
<i>Scolytus</i> spp. (Elm bark beetles)	29
<i>Serica brunnea</i>	28
Springtails (Collembola)	33
Spruce bell moth ( <i>Epinotia tedella</i> )	33
Spruce shoot aphid ( <i>Cinara pinicola</i> )	33
<i>Stagona pini</i> (Pine root aphid)	31
Strawberry weevil ( <i>Otiorhynchus ovatus</i> )	34
<i>Strophosomus melanogrammus</i>	28
Sulphur	44, 45
 Tar oil	 24, 27, 29
Thiram	40
<i>Tomicus piniperda</i> (Pine shoot beetle)	31
Triple superphosphate	50
<i>Trypodendron lineatum</i> (Ambrosia beetle, pinhole borer)	27
 Urea	 38, 50
 Warfarin	 51
Woolly beech aphid ( <i>Phyllaphis fagi</i> )	34
 Zineb	 43, 44



## MANUFACTURERS AND SUPPLIERS OF CHEMICALS

(Note: Insecticides are shown on pages 21 to 25)

<b>FUNGICIDES</b>	<b>Index No.</b>
Benomyl	8
Captan	23, 35
Cycloheximide	2
Dazomet	3, 17, 35
Dinocap	6, 27
Formalin (Poison, see p. 9)	From local horticultural and agricultural suppliers
Kenacid Turquoise code V5898	9
Maneb	3, 5, 7, 8, 11, 18, 21, 27, 28, 40
Peniophora gigantea	10
Sulphur	3, 14, 21, 30, 38
Supra Blue 75328	24
Thiram	5
Urea	29, 36
Zineb	7, 19, 21, 38, 40

## FERTILISERS

### Nursery fertilisers

Normally obtainable through local agricultural merchants, but manufacturers and suppliers are listed for one material which is sometimes hard to obtain, viz:

Ammonium sulphate	20, 22, 32
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### Forest fertilisers

Ammonium nitrate	1, 12, 13, 15, 20, 31, 39
Potassium chloride mixed with rock phosphate	16, 20, 31, 34, 37*
Rock phosphate	16, 20, 31, 32, 34, 37
Triple superphosphate	12, 16, 20, 22, 32, 34, 37
Urea	15, 16, 20, 31, 32, 34
	*600 tons minimum

**Note:** Forestry Commission staff should obtain fertilisers through centrally placed contracts (except for small quantities for nursery use).

## WILDLIFE POISONS AND REPELLANTS

Aaproct	2
Cyanide (Poison, see p. 9)	23, Local agricultural merchants
Dendrocol 17	4
Fowikal	4
Phostoxin tablets	25
Warfarin 0.2%	26, 33
Warfarin 0.5%	26, Local agricultural merchants

## ALPHABETICAL INDEX TO MANUFACTURERS AND SUPPLIERS

### Index No.

1. Albright & Wilson Ltd., Agricultural Sector, Glaston Park, Glaston, Uppingham, Leics LE15 9BX.
2. Applied Horticulture Ltd., Maringdean Road, Billingshurst, W. Sussex RH14 9EH.
3. BASF United Kingdom Ltd., Agrochemicals Division, Lady Lane, Hadleigh, Ipswich, Suffolk IP7 6BQ.
4. Berkshire Factors Ltd., Dale House, London Road, Sunningdale, Berks.
5. Bos Chemicals Ltd., Lowgate, Gedney, Spalding, Lincs PE12 0BL.
6. J.D. Campbell Ltd., 18 Liverpool Road, Great Sankey, Warrington, Cheshire WA5 1QR.
7. Diamond Shamrock Agrochemicals Ltd., Bayheath House, 4 Fairway, Petts Wood, Kent BR5 1EG.
8. Du Pont (UK) Ltd., Biochemicals Department, Wedgwood Way, Stevenage, Herts SG1 4QN.
9. Durham Chemical Distributors Ltd., Union Mills, Oxford Road, Gomersall, W. Yorks BD19 4JW.
10. Ecological Laboratories, c/o John Lawrence (Dover) Ltd., Dover, Kent CT16 2LF.
11. Farm Protection Ltd., Glaston Park, Glaston, Oakham, Leics LE15 9BX.
12. Fisons Ltd., Fertiliser Division, Harvest House, Felixstowe, Suffolk IP11 7LP.
13. Hargreaves Fertiliser Industries Ltd., Skeldergate Bridge, York YO1 1DR.
14. Hoechst UK Ltd., Agriculture Division, East Winch Hall, East Winch, Kings Lynn, Norfolk PE32 1HN.
15. ICI plc, Agricultural Division, Fertiliser Marketing Depot, P.O. Box 1, Billingham, Cleveland TS23 1LB (Sales offices in Bristol, Cambridge, Guildford, Lincoln, Shrewsbury and York).
16. Lindsey and Kesteven Fertilisers Ltd., Wigford House, Brayford, Pool, Lincoln LN5 7BL.
17. Midox Ltd., Glaston Park, Glaston, Oakham, Leics LE15 9BX.
18. N.R. Minden Ltd., 8 Hodford Road, London NW11 8NP.
19. Montedison (UK) Ltd., 7/8 Lygon Place, Ebury Street, London SW1W 0JR.
20. George A. Palmer Ltd., Oxney Road, Peterborough PE1 5YZ.
21. Pan Britannica Industries Ltd., Britannica House, Waltham Cross, Herts EN8 7DY.



## ALPHABETICAL INDEX TO MANUFACTURERS AND SUPPLIERS

22. Patullo, Higgs and Co. Ltd., Hast Hill, Hayes, Bromley, Kent BR2 7AI.
23. Plant Protection Division, Imperial Chemical Industries plc, Fernhurst, Haslemere, Surrey GU27 3JE.
24. Pointing Ltd., Prudhoe, Northumberland NE52 6NJ.
25. Rentokil Ltd., Sentilok Works, Sturminster Newton, Dorset DT10 1BZ.
26. Rodent Control Ltd., 70/78 Queens Road, Reading, Berks.
27. Rohm & Haas (UK) Ltd., Lennig House, 2 Mason's Avenue, Croydon, Surrey CR9 3NB.
28. Roussel Laboratories Ltd., Roussel House, North End Road, Wembley Park, Middlesex HA9 0NF.
29. S.A.I. Horticulture Ltd., 25 Revelston Terrace, Edinburgh EH4 3ET.
30. Sandoz Products Ltd., Agrochemicals, Norwich Union House, 16/18 Princes Street, Ipswich, Suffolk IP1 1QT.
31. Scottish Agricultural Industries Ltd., 25 Revelston Terrace, Edinburgh EH4 3ET.
32. Sheppey Fertilisers and Chemicals Ltd., Rushenden Road, Queenborough, Kent ME77 5HH.
33. Sorex (London) Ltd., Fulton House, Empire Way, Wembley, Middlesex.
34. Soil Fertility (Dunns) Ltd., Hartham, Corsham, Wilts SN13 0QA.
35. Stauffer Agrochemicals (UK) Ltd., 201 Harpur Centre, Horne Lane, Bedford MK40 1PH.
36. Thompson and Capper Ltd., Speke Hall Road, Liverpool 24.
37. Timac Fertilisers Ltd., 22 High Street, Calne, Wilts SN11 0BS.
38. Tripart Farm Chemicals Ltd., 17 Beulah Street, Gaywood, Kings Lynn, Norfolk PE30 4DN.
39. UKF Fertilisers Ltd., Ince, Chester CH2 4LB.
40. Universal Crop Protection Ltd., Park House, Maidenhead Road, Cookham, Maidenhead, Berks SL6 9DS.

Enquiries relating to this publication should be addressed to the Publications Officer, Forestry Commission Research Station, Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH.



# FORESTRY COMMISSION SOURCES OF ADVICE

## Conservancy, District and Forest Offices

*Policy and general operational advice*

See telephone directory under Forestry Commission for local office

## R & D Division (*specialist advice*)

Forest Research Station, Alice Holt Lodge, Wrecclesham,  
Farnham, Surrey GU10 4LH  
(0420-22255)

Northern Research Station, Roslin,  
Midlothian EH25 9SY  
(031-445-2176)

*Protective clothing and applicators*

Work Study Officer, Eastern Region Work Study Team,  
c/o Forestry Commission District Office, Santon Downham,  
Brandon, Suffolk IP27 0TJ  
(0842-810271)

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