

The use of
CHEMICALS
in the
Forestry
Commission



EDITOR'S NOTES

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 all areas of research.

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.

Although these have been internal publications setting our recommendations for Forestry Commission staff which are specifically relevant to conditions in F.C. nurseries and forests, there has been a considerable interest by many people outside our organisation. In the past we have been able to make copies of both the "Entopath News" and "Entopath News Chemical Control Supplement" freely available.

Unfortunately the latter is proving more and more expensive to produce and distribute. It is therefore with some reluctance that we now have to charge for copies.

The title has been changed to "The Use of Chemicals in the Forestry Commission". The information and recommendations given are relevant to conditions in the Forestry Commission's nurseries and forests, and no responsibility can be taken for treatments applied elsewhere.

O.N. Blatchford
Editor

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GENERAL POINTS

This booklet deals with the use of chemicals in the forest and forest nursery. Common forest insect pests, diseases, weeds and animals are listed in alphabetical order by their common names together with pesticides recommended for their control, dosage rates and application methods. Where applicable, Forestry Commission publications are listed against the agency. It should be noted that control prescriptions given here replace any given in these publications published earlier. Those faced with damage problems are urged to consult the relevant publication for additional information on damage recognition, biology of agent, etc.

Most pesticides are poisons to a greater or lesser degree. It is essential, therefore, when using them, to follow a code of practice which ensures:-

- a) an effective control measure against the agency concerned;
- b) the safety of those handling the operation;
- c) the absolute minimum of harm to the environment.

Before using pesticides the information given here must be understood and all safety precautions rigidly adhered to.

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 below). 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 in the forest;
- been tested experimentally against specific forest pathogens, insects or weed conditions; or
- where no related compound is given in the Approved List.

Copies of the list of Approved Products for each year can be obtained (£2 per copy) from the Ministry of Agriculture, Fisheries and Food, Publications Branch, Tolcarne Drive, Pinner, Middlesex HA5 2DT, 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 subject to the poisons rules.

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 the manufacturers concerned 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.

The following four sections are adapted from the section headed "Some Advice on the Safe Use of Agricultural Chemicals", in the current Approved Products Booklet.

POISONS RULES

Certain products are subject to the provisions of the Pharmacy and Poisons Act 1933 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 Chemical Manufacturers and Suppliers (pages 91-93).

HEALTH AND SAFETY (AGRICULTURE) (POISONOUS SUBSTANCES) REGULATIONS

Users of chemicals included in these regulations are required by law to observe certain precautions. They should obtain a copy of the official leaflet APS/1, "The Safe Use of Poisonous Chemicals on the Farm" which fully explains the regulation requirements.

PROTECTION OF USERS, ANIMALS AND WILDLIFE

Particular attention should be paid to paragraphs headed *CAUTION* in this Supplement. They indicate:-

- Whether there are any special user risks attached to a chemical even if it is not included in the Health and Safety (Agriculture) (Poisonous Substances) Regulations.
- Whether there are risks to bees, domestic animals, fish, or other wildlife. Risks to bees can be minimised by avoiding spraying whenever possible when crops are in flower, and by keeping down flowering weeds. Fish are susceptible to many chemicals.

PROTECTIVE CLOTHING AND EQUIPMENT

Appropriate protective clothing must be made available to all users of pesticides and those handling containers. The best general protection is provided by waterproof and oil-proof jackets and trousers. Wellington boots, not leather ones, should be used when working with pesticides. When working with oil-borne sprays, eg 2,4-D and 2,4,5-T, oil-resistant Wellingtons are necessary. Staff using oil-borne sprays should wear face masks to intercept fine droplets which may otherwise irritate throats and lungs. Oil-resistant rubber gloves, and goggles or face shield, should always be used when handling concentrates.

Protective clothing must be kept clean and in good repair. Damaged clothing or equipment must be properly repaired or replaced. When not in use, clothing and equipment must be kept in a dry, vermin-proof store. Many pesticides and oil diluents have a distinctive and often unpleasant smell; some, if in contact with the skin for long periods, can cause dermatitis. For these reasons protective clothing should not be taken home unless it is to be washed. Upholstery in vehicles used to transport staff to and from their place of work should also be cleaned regularly. Details of protective clothing to be worn when spraying herbicides are on pages 85-86, and for other chemicals in the relevant sections.

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.
- Keep all pesticides under lock and key.
- Retain makers 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 drink bottles.

Handling of Concentrates

- Always follow the instructions on the container or makers' leaflet.
- Wear protective clothing 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 areas of skin.

Mixing

- Calculate accurately the correct quantity of concentrate to add to the required volume of carrying liquid.
- For calculating concentrations see pages 11-12.
- 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.
- 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 (ie HV, LV, VLV or ULV). This must be functioning properly and be free from leaks and blockages. (See pages 5-10)
- Make sure that the area to be treated is clear of both the public and domestic animals.
- Inform all interested parties, such as local beekeepers, sporting tenants, neighbouring landowners etc., of intention to spray well in advance.
- 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.
- Clean all protective clothing used before storing. Respirator filters should be changed according to makers' instructions.
- Wash out spraying equipment soon after use, using large quantities of water.
- Empty containers and surplus materials must be correctly and safely disposed of. As there are legal requirements for this, refer to information given on page 5.

PUBLICITY FOR SAFE USE OF CHEMICALS

The following leaflets are available, free of charge, from the Ministry of Agriculture:-

Code of Practice for Ground Spraying
Do's and Don'ts for Users of Chemical Sprays
To All Operators of Spray Machines
Poisoning by Pesticides - First Aid Measures
Code of Practice for the Use of Herbicides on Weeds,
in Watercourses and Lakes
Code of Practice for the Disposal of Unwanted
Pesticides and Containers on Farms and Holdings
The Safe Use of Poisonous Chemicals on the Farm
Dermatitis among Land Workers

Pesticides, a Code of Conduct, is available at 5p from Joint BAA - Wild Life Education and Communications Committee, Alembic House, Albert Embankment, London SE1.

WORKING METHODS AND EQUIPMENT FOR APPLICATION OF PESTICIDES

We would remind our Forestry Commission readers that the Training Branch provides courses on working methods and equipment for application of pesticides, especially herbicides, at three levels:-

- Forest Officers and Chief Foresters
- Head Foresters, and Foresters in charge of spraying operations
- Forest Workers

Much useful information on herbicide application is contained in FC Bulletin 48, *Weeding in the forest* and FC Booklet 40, *Chemical control of weeds in the forest*.

TYPES OF SPRAYER

KNAPSACK (NON-MOTORISED)

Two main types are available:-

The *pressurised sprayer* is made of metal or strong plastic. The whole volume of spray liquid is under pressure from air pumped into the sprayer, after filling, to approximately 5.6 kgf/cm² (80 psi). These sprayers tend to be heavy, have limited capacity and are uncomfortable to wear, but they do not require constant pumping. The Cooper Pegler Falcon is an example of this style.

The semi-pressurised sprayer holds up to 20 litres of spray liquid. Pressure is provided in a small pressure dome by semi-continuous pumping while spraying. As the main volume of spray is not under pressure the knapsack is made in a more comfortable shape. The Cooper Pegler CP3 Forestry Model is an example of this type.

Every sprayer must have:-

- A pressure regulating valve adjustable to the pressures required for the particular jets being used. (Pressure regulators can be obtained from sprayer manufacturers).
- A pressure indicator gauge on the lance which can be removed during spraying.
- Spare washers and jets. There are three patterns of spray jets:-

Jets giving a fan of spray droplets.

Jets giving a hollow cone of spray (rarely used in forest operations).

Jets giving a solid cone of spray.

There is also a variable jet which can be adjusted according to need from a solid narrow cone to a wide angle hollow cone. The variable jet is suitable for basal bark spraying frill girdles when set for a solid narrow cone.

For weed control in the forest, sprayers operated at low pressure are best, because the risks of drift are minimised. "Flood" jets which produce a wide angle fan of droplets at low pressure are good and widely used when spraying herbaceous weeds. Such jets are also useful for spraying paths and fallow ground in nurseries.

Ceramic fan jets working at medium pressure should be used on knapsack sprayers for insecticide and fungicide sprays and for weed control in the nursery.

MISTBLOWERS

Motorised knapsack sprayers emitting very fine spray in a current of air can be used for medium-scale low volume spraying jobs. The recommended make is the Stihl SG17. Tractor mounted mistblowers are available. For details of their use see FC Bulletin 48.

LIVE REEL SPRAYERS

Where it is not practicable for reasons of slope etc. to use a knapsack sprayer, a live reel sprayer such as a "Pharos" can be used. Details are given in FC Bulletin 48. It can be modified to give a high volume with high pressure for spraying log stacks.

ROTARY ATOMISERS

Rotary Atomisers are used for controlled drop band applications (CDBA) and controlled drop incremental application (CDIA). The design and speed of the disc controls the size of droplet produced. CDBA and CDIA require very little if any diluent, and application rates can be between 0.005 and 30.0 litres/hectare. CDIA techniques are described in FC Leaflet 62, *Ultra Low Volume Spraying*.

Three types of machine are recommended:-

- For producing 300 micron droplets. Used for placed application (CDBA) of herbicides onto low vegetation, eg grasses and herbaceous broadleaved species. (The Micron HERBI).
- For producing 70-150 micron droplets. Used for incremental spraying (CDIA) of fungicides and insecticides, and for spraying herbicides onto heather, woody broadleaved weeds and bracken. (The Micron ULVA or ULVA 8).
- For producing 30-100 micron droplets. The very small droplets are suitable for the treatment of flying insects. The full potential of this machine has yet to be evaluated. (The Micron Mini ULVA).

GRANULE DISTRIBUTORS

NON-MOTORISED

The non-motorised applicators depend upon gravity feed and are designed to either produce a band treatment at either side of a row of trees or to apply a spot application of a measured dose around each tree.

The recommended equipment is the Huntly Applicator, which is obtainable from Invermorgan, 52 Telford Road, Inverness. It is only suitable for spot application.

MOTORISED

Motorised knapsack applicator. A machine is produced by Horstine Farmery Ltd which provides a band of treatment along rows of trees.

Mistblower adaptations. The Stihl SG17 knapsack mistblower can be provided with a ready modification for applying granules in a band along tree rows.

Tractor mounted applicators. Horstine Farmery Ltd produce numerous sophisticated machines for applying granules which can be mounted on tractors. A spiked land wheel ensures that the correct rate is applied independent of tractor speed.

(FC Bulletin 48 gives greater detail).

VOLUME APPLICATION

HIGH VOLUME SPRAYING (HV)

Over 700 litres/hectare.

Not recommended for herbicide application where high volumes result in much waste and ground contamination due to run off. Better results with practically no run off can be obtained by using controlled drop application (CDBA or CDIA) at VLV and ULV rates.

Where insecticides or fungicides are applied to stacked timber, bundles of plants, nursery beds or containerised plants, Heavy Volume spraying to run off is frequently recommended.

MEDIUM VOLUME SPRAYING (MV)

200-700 litres/hectare

These rates give a good overall cover in most situations.

Equipment: Boom sprayer, live reel sprayer, knapsack sprayer.

LOW VOLUME SPRAYING (LV)

50-199 litres/hectare

Good cover is achieved by the break-up of spray solution into fine droplets by means of an airblast which then disperses them.

Equipment: Mistblower.

VERY LOW VOLUME (VLV)

10-49 litres/hectare

CDBA must be used at these low rates to obtain adequate cover and even droplet dispersal. 20-30 litres/hectare currently used for placed spraying.

Equipment: Rotary atomiser (300 micron) or aerial applications.

ULTRA LOW VOLUME (ULV)

Under 10 litres/hectare

CDBA or CDIA must be used to obtain adequate cover and droplet dispersal.

Equipment: Rotary Atomisers (30-300 micron), one of the three types available.

CALIBRATION

The desired application rate will only be achieved by correct calibration. The variables which have to be controlled to achieve this are:-

Walking speed
Swath width
Nozzle output

Walking Speed

A walking speed should be selected which can readily be sustained by the operator. 3.2 km/hr (2 mph) is recommended, but the selected speed can be increased or decreased according to terrain and ground conditions.

Swath Width

Swath width is determined by the type of operation, eg. for weeding, normally just wide enough to prevent vegetation growing outside the swath width from falling in onto the crop in the autumn. A swath of at least one metre in width is usually recommended.

Nozzle Output

Nozzle output is governed by the size of nozzle hole used and the pressure at which the sprayer is operated.

KNAPSACK SPRAYERS

When the required walking speed, application rate and swath width are known, the nozzle output for strip spraying can be calculated as follows:-

$$\begin{array}{ccccccc} \text{Nozzle Output} & = & \text{Walking Speed} & \times & \text{Application Rate} & \times & \text{Swath Width} \\ \text{(litres/min)} & & \text{(metres/hr)} & & \text{(litres/ha)} & & \text{(metres)} \\ & & & & \hline & & & & 600,000 \end{array}$$

Having calculated the nozzle output, the pressure control valve of the sprayer should be adjusted until this output is achieved. The nozzle selected should be one which gives the required swath width when held at a convenient height and which does not permit drift.

Volume of application should be selected so that a good cover of the vegetation in the swath is achieved without run-off.

Spot spraying requires a different calculation of volume per tree (or spot) as follows:-

$$\begin{array}{ccccccc} \text{Volume per tree} & & \text{Volume per treated ha} & & \text{Area of spot} \\ \text{or spot} & = & \text{(litres)} & \times & \text{(m}^2\text{)} \\ \text{(millilitres)} & & & & \hline & & & & 10 \end{array}$$

The time required to treat a spot should be timed in seconds, using a watch with a second hand and the pressure control valve adjusted so that the calculated volume is delivered in the observed time.

MISTBLOWERS

Mistblowers can be calibrated in the same way as knapsack sprayers, but it is necessary to calculate the distance one tankful should cover, and practise spraying out the tank in this distance (with water) before spraying.

The calculation is as follows:-

$$\frac{\text{Capacity of sprayer (litres)} \times 10,000}{\text{Application rate (litres)} \times \text{swath width (metre)}} = \text{distance per fill in metres}$$

GRANULAR APPLICATORS

Granular applicators are calibrated in the same way as knapsack sprayers, substituting kilogrammes for litres in the calculation.

$$\frac{\text{Walking speed (metres/hr)} \times \text{application rate (kg/ha)} \times \text{swath width (metres)}}{600,000}$$

= Output required in kg/minute

Granular applicators cannot be adjusted as finely as knapsack sprayers; hence the speed of walking may require adjusting once the closest applicator output has been set. The following calculation can be made.

$$\text{Speed of walking (metres/hr)} = \frac{\text{Applicator output (kg/min)} \times 600,000}{\text{Rate (kg/ha)} \times \text{swath width (metres)}}$$

Walking speed should be controlled by practising walking the distance which should be covered in one minute before commencing application.

CONTROLLED DROP APPLICATORS

Calibration is described in:-

- (CDIA) 70-150 u droplet
 - FC E(E) Regional Work Study Team Report No 26 (Olney Series) on Ultra Low Volume Spraying in the appendices with the Micron ULVA and ULVA 8 machines.
- (CDBA) 250-300 u droplet
 - FC E(E) Regional Work Study Team Report No 27 (Olney Series) called Placed Herbicide Spraying with the Micron Herbi in Appendix II and II(A).

CALCULATION OF CONCENTRATION

DILUTING TO PRESCRIBED DOSAGE

Pesticides are mainly formulated as emulsifiable concentrates (e.cs), or wettable powders (w.ps). Occasionally some are supplied as the neat technical material or active ingredient (ai), eg 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, or 10 lb ai/gal. Similarly a 20% e.c. contains 0.2 kg ai/litre or 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 kgs 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

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

- 25 mls of malathion concentrate is then mixed with the volume of water prescribed in the treatment (ie. LV, MV or HV etc. - see above).

DILUTING TO A GIVEN PERCENTAGE

EMULSIFIABLE CONCENTRATES (e.cs)

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

$$z = \frac{X \times 100,000}{y} \quad \begin{array}{l} X = \text{desired strength in per cent} \\ y = \text{strength of concentrate in per cent} \\ z = \text{required quantity of concentrate in mls} \end{array}$$

eg. to obtain a 0.125% solution of DDT using Didimac 25%

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

ie. 500 mls of concentrate are required per 100 litres water.

WETTABLE POWDERS (w.ps)

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 (gms) of product/100 litres diluent

METRIC IMPERIAL EQUIVALENT

1 square metre	=	1.20 square yards
1 hectare	=	2.47 acres
1 litre	=	0.22 gallons
1 kilogramme	=	2.20 pounds
1 square yard	=	0.84 metres
1 acre	=	0.40 hectares
1 gallon	=	4.55 litres
1 pound	=	0.45 kilogrammes

UNIT/UNIT EQUIVALENTS

1 kilogramme/hectare	=	0.1 gramme/m ²
1 kilogramme/hectare	=	0.892 pounds/acre
1 pound/acre	=	1.121 kilogramme/hectare
1 kilogramme/litre	=	10.02 pounds/gallon
1 gramme/litre	=	0.01002 pounds/gallon
1 litre/hectare	=	0.089 gallons/acre
100 gallons/acre	=	1123 litres/hectare
100 gallons/acre	=	455 litres/acre
10 stems/hectare	=	4 stems/acre

PURCHASING ARRANGEMENTS

The Chief Purchasing Officer will go out to tender annually for Forestry Commission requirements for pesticides using the chemical name, not the brand name. Annual price lists will be issued to Commission staff as an appendix to the supplement when tenders are accepted.

INSECTICIDES

All insecticides are poisons. It is imperative that the "Routine Safety Precautions" given on Pages 3-4 are CAREFULLY READ, UNDERSTOOD and the SAFETY PRECAUTIONS RIGIDLY FOLLOWED whenever they are used.

There are eight insecticides recommended in this section which are given first of all with "Special Notes", "Handling Precautions" and "Trade Names and Suppliers".

This is followed by the forest insect pests and methods of control using these 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.]

INSECTICIDES

CHLORPYRIFOS LD50 135-163 mg/kg, an organophosphorus 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 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.

DDT LD50 113-118 mg/kg, a persistent organochlorine insecticide.

Special Notes

- Dangerous to bees.
- Harmful to fish and livestock

Handling Precautions

- Wash concentrate from skin and eyes immediately.
- Wash hands before meals and after work.

NB. The Forestry Commission has agreed to limit its use of DDT to circumstances where no preferable, less persistent insecticide is available for the purpose. Potential users of DDT in the Forestry Commission must satisfy these requirements AND obtain permission for its use from Forest Management Division at Headquarters, Edinburgh.

Suppliers

Atlas Products and Services Ltd. Fraser Road, Erith, Kent DA8 1PN.

Bugge's Insecticides Ltd., 141 London Road, Sittingbourne, Kent.

J.W. Chafer Ltd., Chafer House, 19 Thorne Road, Doncaster,
S. Yorks. DN1 2HQ.

Croptex Ltd., Gonerby Hill Foot, Grantham, Lincs. NG31 8JB.

May & Baker Ltd., Agrochemicals Division, 37/39 Manor Road,
Romford, Essex RM1 2TL.

Shell Chemicals (UK) Ltd., Agricultural Division, 39-41 St Mary's
Street, Ely, Cambs. CB7 4HG.

Stanhope Chemical Products, Victory House, 99-101 Regent Street,
London W1R 8LJ.

Steetley Chemicals Ltd., Chemicals Manufacturing Division,
Abbey Mills Chemical Works, Stratford, London E15 3NX.

DIAZINON LD50 300-850 mg/kg, an organophosphorus 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 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 and after work.

Trade Names and Suppliers

Liquid formulations:

Kelthane 20 - Murphy Chemicals Ltd. (See under Chlorpyrifos).

PBI Dicofol 20 - Pan Britannica Industries Ltd., Britannica House,
Waltham Cross, Herts EN8 7DY.

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 and after work.

Trade Names and Suppliers

Liquid formulations:

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

Dicofen - Pan Britannica (See under Diazinon).

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 and after work.

Trade Names and Suppliers

Gamma-Col - Plant Protection Division, ICI Ltd., Fernhurst,
Haslemere, Surrey GU27 3JE.

PBI Lindane 20 - Pan Britannica (See under Diazinon).

Strykol BHC - Boots Farm Sales Ltd., Nottingham NG2 3AA.

Dusts:

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

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 and after work.

Trade Names and Suppliers

- 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 LLO 0SB.

TAR OIL. Insecticide.

Special Notes

- The Poisons Rules apply to these products. (See page 2).
- 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 and after work.

Trade Names and Suppliers

- Miscible Winter Washes - Carbo-Craven, Craven Chemical Co., 20-30 Church Street, Evesham, Worcs WR11 6DS.
- Hutchinson's Standard Tar Oil 80%, H.L. Hutchinson Ltd. North End, Wisbech, Cambs, PE13 1PE.
- Sterilite Tar Oil Winter Wash 80% Miscible Quality, Tenneco Organics Ltd. Rockingham Works Avonmouth, Bristol, BS11 0YT

- Emulsion Winter - Morteegg Emulsion. Murphy Chemical Ltd.
 Washes (See under Chlorpyrifos).
- Sterilite Tar Oil Winter Wash 60% Stock Emulsion.
 Tenneco Organics Ltd (See under Miscible Winter Washes).

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 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 through this beetle's stained gallery systems 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 m² 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

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

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

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*, 1928 (out of print).

The larvae of Chafer beetles damage nursery seedlings and transplants by feeding upon, and often severing their 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 (OTIORRHYNCHUS 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 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.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

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 at 1.5 kg ai/ha HV or DDT* at 2 kg ai/ha HV. The spray may be repeated in August if necessary. It should be understood that HCH will provide a practical control in most circumstances and DDT should, therefore, be reserved for severe outbreaks.

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 Record 115, *Dutch elm disease*, 1977.

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

For control programmes of Dutch elm disease see under Fungicides section.

FELTED BEECH COCCUS (CRYPTOCOCCUS FAGI). 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.

GREEN SPRUCE APHID (ELATOBIMUM ABIETINUM). FC Research and Development Paper 116.

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

MATERIALS AND APPLICATION

It can be controlled 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.

* DDT SHOULD ONLY BE USED IN EMERGENCY, SEE NOTE ON PAGE 14.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

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 m² bark area. Only the outer surfaces of stacks are densely colonised 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 (HYLOBIUS ABIETIS). 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. Ensure adequate dispersal by mixing the concentrate in a few litres of water only to start with. Preferably loosen the bundles of transplants to be dipped, shake off all loose soil particles, and immerse the upended bundles in the mixture to cover the complete top and up to ¼ of the main root, but not the fibrous root system. The bundles should be agitated sufficiently to ensure penetration to the plant's stems. Remove bundles from the mixture and allow surplus insecticide to drain back into the tank. This treatment will provide protection against both *Hylobius* 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.

In 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 either chlorpyrifos (Dursban) at 2.5% or 5% DDT* as a dipping treatment in water for plant dipping. If either are used, 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.

* DDT SHOULD ONLY BE USED IN EMERGENCY, SEE NOTE ON PAGE 14.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

PINE LOOPER MOTH (BUPALUS PINIARIUS) FC 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.

PINE ROOT APHIS (PROCIPHILUS SPP.)

This root-feeding aphis 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 grams per m². Or, in the case of container plants, a soil drench with diazinon at manufacturers recommended rate for root aphids.

PINE SHOOT BEETLE (TOMICUS PINIPERDA) FC Leaflet 3, 1978.

MATERIALS AND APPLICATION

Unattacked logs, where delay in removal from the forest is foreseen, may be protected from infestation by applying 0.5% gamma HCH in water at the rate of 0.7 litres mixture per m² superficial stack area (2 sides, 2 ends and top).

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 m² bark area, ie 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 (RHYNCHONIA BUOLIANA) FC Record 83, 1972.

Insecticidal control is rarely justified unless the crop has a particularly high value (eg in seed orchards or 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 reafforestation programmes. *Hylobius* control measures are adequate.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

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. Spray when first seen 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

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/m² 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 20m 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/1000 litres HV. Spray when damage is first seen August to October.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

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.

STRAWBERRY WEEVIL (OTIORRHYNCHUS 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 by either 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 2000 litres 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.

BEFORE USING ANY INSECTICIDES READ THE FULL INSTRUCTIONS ON PAGES 3-4.

FUNGICIDES

ARMILLARIA MELLE (Honey fungus) FC Leaflet 6, 1978; FC Pathology Advisory Note, *Honey fungus in ornamental plantings*; FC Bulletin 14, *Forestry Practice*, 1978.

At present, there is no satisfactory method of controlling this disease which does not entail the removal or destruction of infected roots and stumps. However, results from recent experiments give hope that before too long an effective and relatively simple chemical means of eradicating the fungus from stumps in the ground, at least in certain circumstances, may be available.

BOTRYTIS CINEREA (Grey mould) 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 a week later and thereafter at 10-14 day intervals if damage is continuing.

Although in the past freshly made Bordeaux mixture has been recommended, the practical difficulties in its mixing and use are not justified now that other, more effective and convenient materials are readily available.

Thiram - Both liquid and wettable powder formulations are suitable. Mix 3.2 kg/ai in 1000 litres water and apply at HV.

Captan - In most experiments thiram has given better control than captan. Captan can damage seedlings. Mix 2.5 kg/ai in 1000 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 fungicides fail to give control or where an exceptionally valuable crop is at risk. Mix 0.5 kg/ai in 1000 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 and after work.
- Captan is harmful to fish.

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 cause stunting in seedlings.

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 usually encountered where unsterilized loam is used in the growing medium. The use of a sterile medium should prevent the problem.

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).

MATERIALS AND APPLICATION

Post emergence drenching

Captan - Mix 1.1 kg ai in 1000 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/m² of seedbed).

CAUTION

- Captan is harmful to fish.

Pre-sowing sterilization

Dazomet - gives the additional benefit over formalin of weed control. For brands and methods of application refer to page 47 in the Herbicides Section.

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 in light soils or six in heavy clay soils before sowing, 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.

5 litres undiluted formalin is required per 10 m² in Scotland, but in England and Wales 2.5 litres per 10 m² 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 ² test plot	Water to be added to 5 litres of undiluted formalin to treat 10 m ²
Over 10 litres	100 litres
7.5 - 10 litres	75 litres
5.0 - 7.5 litres	50 litres

CAUTION

- Formalin can be irritating to skin, eyes, nose and mouth.
- The Poisons Rules apply to these products.

DIDYMASCELLA THUJINA (Keithia disease, or Needle blight of Western red cedar) 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 m²). 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 (eg West Scotland and 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 page 85).
- 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.

FOMES ANNOBUS FC Leaflet 5, 1974; FC Bulletin 14, *Forestry Practice*, 1978.

Chemical treatment of freshly cut conifer stumps prevents their colonization by airborne spores of *F. annosus* 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; it is the most effective if used on uninfected sites from the first rack-cutting or thinning onwards.

In pure pine stands, but not in any other situation, *F. annosus* 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 *F. annosus*. 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 *F. annosus* control in all pine stands and requires special care in storage, preparation and use.

Stump treatment against *F. annosus* is obligatory in all Forestry Commission forests (UM 48 and Section E 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 Chieftain Stump Treatment Applicator (Chieftain Forge Ltd). Alternatively, use a brush and any convenient container.

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.

Very roughly speaking, 5 litres of liquid will treat 4 m^2 of stump surface.

Urea - for any conifer. Available as Agrico. Supplied ready dyed for forest use in packs of 3 x 5 kg bags or 15 x 1 kg bags (100% ai). Dissolve 1 kg ai in 5 litres water. It is easiest dissolved by adding the chemical slowly to the water while stirring.

Peniophora gigantea - for pine only. *P. gigantea* + the dye Hexacol Violet BNP Extra. *P. gigantea* is supplied as cards of five sachets or boxes of five 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.

Disodium octaborate - for any conifer. Available as Polybor. Supplied as 25 kg bags (100% ai). Dissolve 0.5 kg ai in 5 litres water. It is easiest dissolved by adding the chemical slowly to the water while stirring. Add 1.0 g (half level teaspoon) Lissamine Turquoise AN dye, or 2.0 g (1 level teaspoon) Patent Blue A.

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 and after work.

LOPHODERMIIUM PINASTRI (Needle-cast of pine) 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 2.1 kg ai in 1000 litres water and apply at HV. Apply fungicide to the foliage of nursery seedlings and transplants once at the end of July, August and September. If this programme fails to control the disease, try beginning earlier and reducing the interval between applications.

Maneb - Any of the proprietary brands of wettable powders containing up to 80% maneb may be used. Mix 2.25 kg ai in 1000 litres water and apply at HV. Apply as for zineb above.

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 and after work.

MERIA LARICIS (Needle cast of larch) FC Leaflet 21, 1963 (out of print).
FC Bulletin 14, *Forestry Practice*, 1978; FC Bulletin 43, *Nursery Practice*,

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 1000 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 and after work.

MICROSPHAERA ALPHITOIDES (Oak mildew) 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 2 or 3 weeks later 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 according to the manufacturer's instructions for the control of powdery mildew on apple or American gooseberry mildew.

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 and after work.
- Dinocap is dangerous to fish.

PHYTOPHTHORA spp. (Phytophthora root rot). Bulletin 14, *Forestry Practice*, 1978; FC Pathology Advisory Note, *Phytophthora root rot*.

This is a soil-borne disease which attacks a wide range of woody plants of all sizes but is particularly damaging in nurseries regularly producing large numbers of ornamental Lawson cypresses, other cypresses, rhododendrons and azaleas, heaths and heathers.

Soil sterilization will at best give a temporary improvement. Plants surviving the first year after treatment will be at risk in subsequent years.

Chemicals are available which will allow susceptible plants to be raised apparently healthily on infected ground, but these merely suppress the disease and it is likely to develop once treatment ceases, as when the plants are sold.

When annual losses are so great as to warrant control, it will probably be advisable either to abandon that area as a nursery for woody plants or to change to production in containers isolated from the infected soil. For further information consult the Ministry of Agriculture's Agricultural Development and Advisory Service (ADAS) or one of the Forestry Commission Research Stations.

VERTICILLIUM spp. (Verticillium wilt) FC Bulletin 14. *Forestry Practice*, 1978.

MATERIALS AND APPLICATION

This soil-borne disease attacks a wide range of non-coniferous woody plants, but is particularly damaging in nursery areas carrying maples year after year. It is best avoided by growing susceptible species on an uninfected area. If this cannot be done, sterilization of infected soil with *methyl bromide* or *chloropicrin* may give satisfactory control (consult the Ministry's Agricultural Development and Advisory Service (ADAS) for further information and for contractors' addresses).

CAUTION

- Methyl bromide and chloropicrin are highly toxic to man.
- Methyl bromide may be used only by certified contractors.
- The use of chloropicrin is only slightly less hazardous and is subject to various statutory regulations.

PROTECTION OF WOUNDS AGAINST DECAY. Arboricultural Leaflet 1, *External signs of decay in trees*, 1977 (HMSO prepared by FC for DOE).

Large ornamental trees are frequently rendered dangerous by fungal decay entering the wood through wounds made by the breakage or pruning of branches. Since such decay can be neither cured nor arrested, appropriate treatment of the fresh wound is necessary to prevent decay starting.

Systematic research is needed to determine the best treatment and at present we cannot recommend for this purpose any of the proprietary products sold specifically for treating large wounds. On general grounds, however, they should first be treated with a non-soluble proprietary timber preservative, Stockholm tar or creosote and then with a tough bituminous material of the kind used for waterproofing roofs to prevent the preservative weathering. The aim should be to get as much

preservative to soak into the wound as possible. The bitumen should be inspected annually and maintained intact. For this treatment to be effective it must be applied soon after the wound is made.

DUTCH ELM DISEASE FC Forest Record 115, *Dutch elm disease*, 1977.

A small proportion of the elm population consists of trees of such high amenity value that their owners are very prepared to inject them with fungicide in order to increase their chances of survival. Injection must be linked with disease control by sanitation and results are better on young, vigorous trees than on old, more slow-growing ones; and better on Smooth-leaved than on English elm. Injection must be carried out annually and under most circumstances the costs are likely to be greater than the benefits. The information on material and application given below does not constitute a recommendation, merely guidance on the treatment as it now stands. Even with injection there can be no guarantee that a tree will survive the current epidemic.

MATERIALS AND APPLICATION

CARBENDAZIM - The proprietary brand Lignasan contains carbendazim as the hydrochloride. One rate is suggested for protective treatment on trees less than 1.8m girth at breast height, another higher rate for curative treatment and for protective treatment on trees larger than 1.8m gbh. Application is by injection under pressure through holes spaced around the base of the tree. A number of tree surgeons can undertake this treatment.

CAUTION

- Wear protective gloves when handling concentrate.
- The commercial formulation available at present is inflammable.

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 lie about in places where they are likely to be eaten by animals or played with by small children.

AMMONIUM NITRATE

A soluble salt normally supplied as granules or prills*. This material is an active salt and an irritant in cuts and eyes. It is also a strong oxidising agent.

* 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

"Nitrotop" - Fisons

"TN 34" - Thames Nitrogen

"UKF Nitrashell" - UKF

AMMONIUM NITRATE WITH CALCIUM CARBONATE

A mixture of a soluble salt with chalk, in granular form. Slightly acidifying or neutral.

Use: 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.

Brands: "Nitro-chalk" - ICI
"Nitrashell 26" - UKF

AMMONIUM SULPHATE

A crystalline soluble salt which may contain a little free acid. It is active and therefore an irritant.

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 metallic applicators and machines after use.

COMPOUND FERTILISERS

A number of compounds (ie. 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, usually relatively pure. It may contain useful amounts of magnesium, when it is called dolomitic or magnesian limestone.

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 crystallisation, is called kieserite.

Use: For correcting magnesium deficiency in nursery stock.

CAUTION

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

POTASSIUM CHLORIDE

A soluble salt, also known as muriate of potash or pink potash. Active and irritating 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 ori-masks and clear lens goggles (BS 2092).
- Because the material is corrosive, metal applicators and machines should be cleaned out after use.

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.
- Ori-nasal masks 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 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 cleanliness 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: Top-dressing nitrogen-deficient forest crops.

CAUTION

- Poisonous if ingested in large amounts, but this is unlikely (in contrast to its use in solution as a stump protection). Non-irritant.
- Care should be taken not to spill into water courses or lakes as this could cause undesirable growth of plants.
- Markers and loaders should be suitably clothed and protected.

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.

WILDLIFE

VERTEBRATE POISONS

GREY SQUIRREL FC Leaflet 56, *Grey squirrel control*, 1973

MATERIALS AND APPLICATION

Warfarin - 0.02% w/w on whole grain wheat. This may only be presented (Grey Squirrels [Warfarin] Order 1973) in hoppers with a tunnel entrance not less than 230 mm long and not more than 100 mm internal square dimensions. 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 FC Forest Record 90, *Voles and field mice*, 1974.

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 x 15 m across the area to be treated. 250 g (or 8 ozs) 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.

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.

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.

Phosphine gas - Arrex cartridges can be used as an alternative to spoon gassing. These are very much safer to transport than cyanide. One is ignited on a match-box and placed 150 mm down each hole before a turf is used, grass side down, to block the hole. They should be stored in a dry store well away from children.

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 first-aid kit, such as the Kelocyanor pack, for use by a doctor in an emergency.
- They must wash their hands before smoking or eating.
- 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).

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 hardwoods 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/cm² 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

- Aaprosect 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 as an alternative to Aaprosect 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 Aaprosect. It has a strong but not unpleasant odour and is not phytotoxic to growing plants. Retreatments will be required every few weeks.

HERBICIDES

This section is intended as an easy and quick guide to the use of herbicides. More background and detailed recommendations are available in:- FC Research Branch Paper 24, *Weed control in forest nurseries*, 1967 (out of print); FC Bulletin 43, *Nursery practice*, 1972; FC Booklet 40, *Chemical control of weeds in the forest*, 1975; FC Bulletin 48, *Weeding in the forest*, 1974; SM43 (FC internal document only), *Weeding in the forest* (Forest Management Memorandum); FC Leaflet 62, *Ultra low volume herbicide spraying*, 1975.

The recommended herbicides are dealt with in alphabetical order for each nursery weeding situation, and for each forest weed or weed mixture to be controlled. Methods of application in the latter are dealt with in order of the preference stated in SM43. The nature of the herbicides mode of action is stated, followed by the method of application and rates to be used. The best time for application, and any limitations which each herbicide may have in terms of weed control and the tolerance of crops to the herbicide, are given. Herbicides are classed as "RECOMMENDED", "PROVISIONAL" or "INFORMATION" at the start of each section.

"PROVISIONAL" treatments are those which have not been fully proven, while "INFORMATION" treatments are those showing considerable promise experimentally. The tables on pages 46 and 57 enable a suitable herbicide to be selected for most weeding situations in the nursery or the forest.

Particularly relevant safety precautions to be taken are given in a separate section which lists the herbicides alphabetically. The sections on choice, handling and application of chemicals (pages 1 to 12) should be read in conjunction with this section if one has not done so recently. Selection of protective clothing for each herbicide is made simply by referring to the table of recommendations on pages 85-86.

- Before using a herbicide always read the instructions for use given on the label.
- Always keep a herbicide concentrate in its original container.
- Dispose of all surplus dilutions, never store them.

GENERAL POINTS ON WEED CONTROL

WEED CONTROL IN NURSERIES

Heavy weed growth in nurseries reduces seedling and transplant growth. It is better to keep a nursery totally clean by chemical means than to treat only parts of a nursery, or hand weed less intensively, in an attempt to reduce costs. Current chemical control methods reduce weeding costs enormously in relation to hand weeding costs. Weed control measures should be taken as quickly as possible, even in advance of weed emergence with those chemicals which provide this facility.

Weeds should not be allowed to set fertile seed, which can occur within a few weeks of weed emergence with many annual species.

The herbicides listed present the nursery manager with a range of herbicides which will prevent weed growth safely for almost every nursery weeding situation: a position which nurserymen have not experienced until quite recently, and of which full advantage should be taken.

The common weeds in forest nurseries are *Poa annua* (Annual meadow grass), *Senecio vulgaris* (Groundsel), *Spergula arvensis* (Corn spurrey), *Stellaria media* (Chickweed), *Capsella bursa-pastoris* (Shepherds Purse) and *Rumex acetosella* (Sheep's sorrel). All are readily controlled with herbicides listed but not in every weeding situation, eg. *Rumex acetosella* can only be dealt with readily after the first-year seedbed.

WEED CONTROL IN THE FOREST

Control of Grasses and/or Herbaceous Broadleaved Weeds in Young Plantations

Competition by perennial grasses in young plantations is a common problem, often giving rise to high weeding costs. Grasses and herbaceous broadleaved weeds can be controlled by herbicides without damaging crops, although on occasions precautions may have to be taken. The main herbicides recommended are atrazine, chlorthiamid, dichlobenil with dalapon, dichlobenil, propyzamide, paraquat, glyphosate and "Velpar".

It is important to choose a herbicide which will control specific weeds on the site to be sprayed, and it should be selected in accordance with SM43 for Forestry Commission operations. Table 1 gives the susceptibility of common forest grasses to the various herbicides based on satisfactory weed control persisting for at least the growing season of application.

The effectiveness of each herbicide varies with soil type, weather conditions and time of application. The susceptibilities given in the table are a guide only, and assume that the herbicide will be used as recommended in the text.

If a suitable mechanical means of control is both available and known to be less costly, eg. rolling, it should also be given due consideration.

Control of Bracken

Bracken competes strongly with young trees for light during the latter part of the growing season and this results in reduced height growth. At the end of the year bracken collapses and can smother and flatten small trees with its weight, increasingly so if snow lies on top of them both. Bracken is rarely sufficiently advanced in the spring to afford protection from frosts and is not worth retaining for this purpose. Weeds which take over from bracken can usually be equally easily controlled by chemicals. If this is not the case it may be advantageous to retain a bracken cover by hand weeding.

The herbicides used for bracken control are asulam and glyphosate. These chemicals control the rhizomes of bracken and prevent or retard further growth of fronds in the following growing season.

Control of Heather

Calluna vulgaris (heather) is an upland or lowland heath plant which, by means of strong root competition on sites of low nutrient status, retards significantly the growth of all trees.

Its eradication or suppression is an essential of good forest management. Currently 2,4-D ester is recommended for this purpose but glyphosate has been shown to give good control. Suppression with a herbicide on low nutrient status sites should be coupled with appropriate fertiliser input, in an attempt to suppress *Calluna* growth by closing crop canopy as quickly as possible.

Control of Woody Broadleaved Weeds

Woody broadleaved weeds constitute a complex range of weeding situations, requiring a variety of weeding methods. In addition to this complexity, the removal of woody broadleaved species may be undesirable on ecological, amenity and conservation grounds.

The individual manager will have to decide his own objectives in relation to the conservation and amenity requirements of an area bearing a crop which may, for example, be choked by woody broadleaved species, or an area bearing uneconomical scrub which could economically be converted to a worthwhile crop.

Ammonium sulphamate, 2,4,5-T or glyphosate can be used for controlling woody broadleaved weed species.

The chemical control of woody broadleaved species is dealt with under three sections:-

- Foliar treatment
- Stem treatment (a) Basal bark
 (b) Frill girdling, Notching and Tree injection
- Cut stump

Control of Woody Broadleaved Species and Herbaceous Broadleaved Mixtures

Following clear fell operations such mixtures can prove problematical and require treatment with a 2,4-D/2,4,5-T mixture or glyphosate. This can often be carried out as one operation.

TABLE 1

SUSCEPTIBILITY OF COMMON GRASSES IN THE FOREST TO RECOMMENDED HERBICIDE

Grass Species	Herbicide and Rate (kg ai/ha)		Atrazine 4-6 kg/ha		Weibac 1.8 kg/ha		Dichlobenil + Chlorthiamid 3-4.5 kg/ha		Dichlobenil + Dalapon (mixture) 3-4.5 kg/ha+4-6 kg/ha		Glyphosate 0.5 kg/ha		Paraquat 1 kg/ha		Propyzamide 1.5 kg/ha	
<i>Agropyron repens</i> (Couch grass) (C)	MR	S	MS	MS	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Agrostis gigantea</i> (Common bent grass)	MS	S	MS	MS	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Agrostis</i> spp.	S	S	S	S	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Anthoxanthum odoratum</i> (Sweet vernal)	S	S	MR	S	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Arrhenatherum elatius</i> (False oat) (C)	MR	S	S	S	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Calamagrostis epigejos</i> (C)	R	MS	MR	MR	MS	MS	R	-	-	-	-	-	-	-	-	-
<i>Dactylis glomerata</i> (Cock's-foot) (C)	R	S	MS	MS	S	S	MR	MR	S	S	MS	MS	S	S	S	S
<i>Deschampsia caespitosa</i> (Tufted-hair grass) (C)	R	MS	MS	MS	S	S	MS	MS	S	S	MS	MS	S	S	S	S
<i>Deschampsia flexuosa</i> (Wavy-hair grass)	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
<i>Festuca arundinacea</i> (Tall-fescue)	MS	S	S	S	S	S	MS	-	-	-	-	-	-	-	-	-
<i>Festuca pratensis</i> (Meadow-fescue)	MS	S	S	S	S	S	MS	-	-	-	-	-	-	-	-	-
<i>Festuca ovina</i> (Sheep's-fescue)	S	S	S	S	S	S	MS	-	-	-	-	-	-	-	-	-
<i>Festuca rubra</i> (Red-fescue)	S	S	S	S	S	S	MS	-	-	-	-	-	-	-	-	-
<i>Holcus lanatus</i> (Yorkshire-fog)	S	S	S	S	S	S	MS	S	S	S	MS	MS	S	S	S	S
<i>Holcus mollis</i> (Creeping soft-grass)	R	S	MS	MS	S	S	MR	MS	S	S	MS	MS	S	S	S	S
<i>Molinia caerulea</i> (Purple-moor grass) (C)	R	S	MS	S	S	S	S	S	S	S	MS	MS	S	S	S	S
<i>Poa annua</i> (Annual meadow grass)	S	S	S	S	S	S	MS	S	S	S	MS	MS	S	S	S	S
<i>Poa pratensis</i> (Meadow-grass)	MS	S	S	S	S	S	MS	S	S	S	MS	MS	S	S	S	S
<i>Poa trivialis</i> (Smooth-stalked meadow grass)	S	S	S	S	S	S	MS	S	S	S	MS	MS	S	S	S	S

Abbreviations

S = Susceptible: control should be excellent

MS = Moderately susceptible: control should be adequate

MR = Moderately resistant: control may be inadequate

R = Resistant: little effect or control obtained

(C) = Coarse grasses (all others can be considered as soft grasses)

Control of Rhododendron

Areas covered with rhododendron are amongst the most difficult and expensive to reclaim. This weed can become a very real problem if allowed to establish itself in existing plantations. Everything possible should be done to prevent this happening, by tackling it while young or growing as suckers from old stumps.

At present 2,4,5-T or glyphosate can be used to control regrowth of this weed.

Note

It is important to bear in mind that not all chemicals recommended for pre-planting treatment can be similarly recommended for post-planting treatment, and rates of application often have to be reduced in the latter case at the expense of the degree of weed control gained.

NURSERY WEED CONTROL AND SOIL STERILISATION

TABLE II

HERBICIDES FOR USE IN THE NURSERY

(For further details on use see appropriate section)

Weeding situation Herbicides	Seedbeds			Trans-plant Beds	Poplar stool Beds	Fallow	Paths and waste ground
	Pre-sowing	Pre-Emergence	Post-Emergence				
Atrazine				Ø			
Dazomet	Ø						
Diphenamid		Ø	Ø				
Glyphosate						Ø	Ø
Nitrofen		Ø	Ø				
Paraquat (P.R.)		Ø			Ø	Ø	Ø
Propyzamide			*	Ø	+		Ø
Simazine		(Large * seeded hardwoods) (covered by 25mm of soil)	(Seedlings over 50mm tall)	Ø	Ø		Ø
Sodium chlorate						Ø	

Notes: Ø = "RECOMMENDED"

* = Recommended for special situations or with reservations. It is therefore important to read the appropriate section "PROVISIONAL".

+ = In experimental stage and giving good results - "INFORMATION", but not for use on a large scale until a Research Information Note is circulated.

(P.R.) = Poisons Rules apply.

WEED CONTROL IN SEEDBEDS - PRE-SOWING TREATMENTS

DAZOMET (STERILISATION) ("RECOMMENDED")

A soil sterilant which breaks down in soil to release the gas Methyl iso thiocyanate which controls weed seeds and pathogens, hence promoting improved seedling health and height growth. Is sold as Basamid (98% w/w) by BASF.

APPLICATION

Apply as a prill (98% w/w prill) 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 unsterilised 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 cultivations 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 sterilised soil in the seedbeds. Reinfection from alleys can be a problem with this method, and overall treatment is always preferable if it is practicable.

Time

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 (20 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.

WEED CONTROL IN SEEDBEDS - PRE-EMERGENT TREATMENT

DIPHENAMID ("RECOMMENDED")

A soil acting herbicide which prevents the emergence of germinating weeds; in particular, annual grasses. Is sold as a wettable powder called "Enid 50W".

APPLICATION

Applied as 8 kg of 50% w/w commercial product per hectare (4 kg ai/ha) in water at a medium volume of at least 500 litres/ha, from sowing to seven days after sowing conifer seed.

LIMITATIONS

- SS, NS, CP, LP, SP, DF, GF, NF, JL, HL, EL, WH, RC, Oak, Beech Sycamore and *Nothofagus* spp. have shown good crop tolerance to diphenamid.
- Birch, Alder and other small seeded broadleaved species occasionally suffer a reduction in the numbers which germinate.

Note

Soil moisture enhances the herbicidal action. Irrigation during dry weather will improve the weed control afforded.

NITROFEN ("RECOMMENDED")

A soil acting herbicide which prevents the emergence of germinating weeds; eg *Poligonum* spp. and annual grasses. Is sold as "Tok E-25".

APPLICATION

Applied as 16 litres of 25% w/v emulsifiable concentrate per hectare (4 kg ai/ha) in water at a medium volume of at least 500 litres/ha, from sowing to seven days after sowing conifer seed. Soil moisture enhances herbicidal action.

LIMITATION

- The limitations are identical to those given for diphenamid p. 48.

Note

Soil moisture enhances herbicidal action as for diphenamid p. 48.

PARAQUAT ("RECOMMENDED")

A contact weedkiller which is particularly effective against weeds which have germinated prior to emergence of tree seedlings.

APPLICATION

Applied as 3 litres of 20% w/v concentrate per hectare (0.6 kg ai/ha) in water at medium volume, between sowing and three days before emergence. The expected date of emergence can be found by uncovering a few seeds and inspecting their radicles. Seedbeds with seeds having radicles 5 mm long or greater should not be sprayed, nor should seedbeds where sparse emergence has commenced.

LIMITATIONS

- Always apply at low pressure.
- Subject to the Poisons Rules (see Section on Poisons Rules).

Note

Paraquat application requires careful timing to avoid damaging the crop and diphenamid or nitrofen treatments are preferable.

SIMAZINE (LARGE SEEDED BROADLEAVED SPECIES) ("PROVISIONAL")

A residual herbicide which interferes with leaf processes associated with photosynthesis and which does not poison roots directly. It only kills germinating weeds.

APPLICATION

It can only be applied to first-year seedbeds of large-seeded broadleaved species, e.g., oak, beech, sweet chestnut. They must be covered by not less than 25 mm of soil and application made immediately after the cover is laid. Applied as 4 kg product per hectare of 50% wettable powder or 4 litres of 50% flowable formulation per hectare (2 kg ai/ha) in water at medium volume.

Note

Flowable formulations cost approximately 30% more than wettable powder forms per treated hectare, but flowable forms assure a constant concentration of herbicide.

WEED CONTROL IN SEEDBEDS - POST-EMERGENT TREATMENT

DIPHENAMID ("RECOMMENDED")

A soil acting herbicide which prevents the emergence of germinating weeds; in particular, annual grasses.

APPLICATION

Applied as an overall spray at 8 kg of 50% wettable powder per hectare (4 kg ai/ha) in water at a medium volume of at least 500 litres/ha, at any time after all seedlings have fully emerged, but normally two weeks should elapse after full emergence before treatment if following a pre-emergent treatment. Repeat applications can be made if necessary thereafter at intervals as close as six weeks.

LIMITATIONS

- As for pre-emergent applications, p. 48.
- Birch, alder and other small seeded broadleaved spp. are not affected by post-emergent applications.

NITROFEN ("PROVISIONAL")

A soil acting herbicide which prevents the emergence of germinating weeds; eg Polygonum spp. and annual grasses.

APPLICATION

Applied as 16 litres of 25% w/v emulsifiable concentrate per hectare (4 kg ai/ha) in water at a medium volume of at least 500 litres/ha., at any time after all seedlings have fully emerged, but normally two weeks should elapse after full emergence before treatment if following a pre-emergent treatment. Repeated applications as for diphenamid post-emergent can be made.

LIMITATIONS

- All conifers as for the pre-emergent application p.48 can be treated. Larches may be liable to leaf scorching.
- Broadleaved species should not be treated as leaf scorching results.

PROPYZAMIDE ("INFORMATION")

A soil acting herbicide which prevents the emergence of germinating weeds and kills existing established weeds. (Is known to control Rumex acetosella to a considerable degree).

APPLICATION

Applied as 2 kg of 50% wettable powder per hectare (1 kg ai/ha) in water at medium volume as an overall spray. Apply after seedlings have hardened off and between October to December inclusive (January can be

included in colder northern nurseries). Applications during the remainder of the year when warmer air temperatures prevail may not be fully effective, and such applications could result in damage to the crop.

LIMITATION

- Only SS and LP have been experimentally tested for crop tolerance which was good.

SIMAZINE (RISING 2 + 0 and 1 u 1 CONIFER SEEDBEDS ("PROVISIONAL"))

A residual herbicide which interferes with leaf processes associated with photosynthesis, and which does not poison roots directly. It only kills germinating weeds.

APPLICATION

Applied as 2 kg product per hectare of 50% wettable powder or 2 litres of 50% flowable formulation per hectare (1 kg ai/ha) in water at medium volume, at any time of year prior to weed emergence.

LIMITATIONS

- Apply only to clean beds as a preventative herbicide.
- Not more than two applications per annum with at least four months between applications.
- It is not advisable to spray within two weeks of an undercutting operation.
- Crops should be at least 5 cm tall when sprayed.
- Crops must be allowed to attain dormancy before spraying at end of the first growing season.

Note

Flowable formulations cost approximately 30% more than wettable powder forms per treated hectare, but flowable forms assure a constant concentration of herbicide.

WEED CONTROL IN TRANSPLANT BEDS

ATRAZINE ("RECOMMENDED")

A translocated herbicide with some contact action. It can be taken in through the foliage as well as by the roots of susceptible plants.

APPLICATION

Only applied to conifer transplant lines as 4 kg of 50% wettable powder per hectare, or as 4 litres of 50% flowable formulation per hectare (2 kg ai/ha) in water at medium volume. Transplants raised from 1 + 0 seedlings may be treated. Apply at any time of the year, but best weed control is achieved in the spring months prior to flushing in the crop.

LIMITATIONS

- Atrazine does not control germinating weed seeds as well as simazine. If the soil is clean, use simazine.
- Avoid spraying heavy soils prior to expected rain storms to prevent wash off into water holding areas, which will cause local overdosing.

PROPYZAMIDE ("RECOMMENDED")

A soil acting herbicide which prevents the emergence of germinating weeds and kills existing established weeds. Prolonged cold weather is a requisite of its action.

APPLICATION

Applied as 3 kg of 50% wettable powder per hectare (1½ kg ai/ha) at medium volume to either conifer or broadleaved transplants, October to December inclusive (January may be included for northern nurseries).

LIMITATION

- Applications of propyzamide should not be made immediately after autumn simazine treatments otherwise damage may occur to conifers.

SIMAZINE ("RECOMMENDED")

A residual herbicide which interferes with leaf processes associated with photosynthesis and which does not poison roots directly. It only kills germinating weeds.

APPLICATION

Applied as 4 kg of 50% wettable powder per hectare or 4 litres of 50% flowable formulation (2 kg ai/ha) in water at medium volume immediately after lining out; best results are obtained if simazine is applied while the soil is clean.

LIMITATIONS

- Do not treat poplar or ash.
- Treat European larch and *Picea omorika* at half rate.
- The soil next to root collars should be moist and sufficiently compacted to prevent simazine washing directly down into the root zone. Irrigation prior to transplanting and chemical treatment can help to moisten the soil to assist better take of transplants, while permitting better soil compaction prior to simazine application.
- Transplants should not be less than 5 cm tall.

CONTROL IN POPLAR STOOL BEDS

PARAQUAT ("RECOMMENDED")

A contact herbicide for use against emerged weeds.

APPLICATION

Applied as 5 litres of 20% w/v concentrate per hectare (1 kg ai/ha) at medium volume and low pressure, at any time whenever weeds emerge.

LIMITATIONS

- Always apply at low pressure.
- Subject to the Poisons Rules (see section on Poisons Rules).
- Poplar stools and growth must be fully protected from the paraquat spray.

SIMAZINE ("RECOMMENDED")

A residual herbicide which interferes with leaf processes associated with photosynthesis and which does not poison roots directly. It only kills germinating weeds.

APPLICATION

Applied as 4 kg of 50% wettable powder or 4 litres of 50% flowable formulation per hectare (2 kg ai/ha) in water at medium volume, March to April onto clean beds.

LIMITATION

- Some cuttings inserted in groups for raising stools are susceptible to simazine, hence only established stools should be chemically weeded.

PROPYZAMIDE ("INFORMATION")

A soil acting herbicide which prevents the emergence of many germinating weeds and kills several established weeds, especially grasses. Compositae such as *Carduus* spp. and *Senecio* spp. are resistant.

APPLICATION

Applied as 3 kg of 50% wettable powder per hectare (1½ kg ai/ha) in water at medium volume as an overall spray of stools or cuttings. It should be applied during October, November or December in lowland Britain and January can be included in upland Britain.

LIMITATION

- Only 15 poplar species and varieties etc have been tested, further details of which are available in Research Information Note 23/77/SILS.

WEED CONTROL ON FALLOW GROUND

GLYPHOSATE ("RECOMMENDED")

A translocated herbicide taken in through leaves. It is particularly useful for controlling rhizomatous grasses, *Equisetum* spp., *Rumex* spp., and other difficult broadleaved weeds. Supplied as "Roundup" by Monsanto.

APPLICATION

Applied as 5.5 litres of 36% w/v concentrate per hectare (2 kg ae/ha) in water at medium volume, at any time provided the weeds to be controlled are in leaf. Best control is achieved when the species to be controlled is growing most actively.

LIMITATION

- It may take several weeks to act during winter months when weed metabolism is low, but control should only take up to four weeks during summer months before cultivation and cropping can be done.

PARAQUAT ("RECOMMENDED")

A contact herbicide acting only on the foliar part of plants by disrupting photosynthesis.

APPLICATION

Applied as 5 litres of 20% w/v concentrate per hectare (1 kg ai/ha) in water at medium volume on weeds which are not rhizomatous, throughout the year, and can be repeated prior to or after cultivation if weeds re-invade.

LIMITATIONS

- Always apply at low pressure.
- Subject to the Poisons Rules (see section on Poisons Rules).
- Rhizomatous grasses, *Equisetum* spp, *Rumex* spp and other species which can recommence growth from the soil-borne part of the plant, will regrow even after cultivation combined with paraquat treatment.

SODIUM CHLORATE ("RECOMMENDED")

A total weedkiller, only recommended for use on weeds which are difficult to eradicate, eg. *Rumex* spp, *Equisetum* spp.

APPLICATION

Applied as 225 to 450 kg 100% w/w granules per hectare in water at medium volume (not all forms of sodium chlorate are 100% w/w). Application in the summer is best when weed foliage is present (June-October), but autumn and spring applications at the higher rate can be effective.

LIMITATION

- At least six months must elapse between application and sowing or lining out. A cress test should be carried out prior to sowing or transplanting on the treated area.

WEED CONTROL ON PATHS, ROADS AND WASTE GROUND

GLYPHOSATE ("RECOMMENDED")

A translocated herbicide taken in through leaves. It is particularly useful for controlling rhizomatous grasses, *Equisetum* spp, *Rumex* spp, *Convolvulus* spp, and other difficult broadleaved weeds. Supplied as "Roundup" by Monsanto.

APPLICATION

Applied as 3 litres of 36% w/v concentrate per hectare (1 kg ai/ha) in water at medium volume, at any time provided the weeds to be controlled are in leaf. Best control is achieved in the summer when the species to be controlled is growing most actively (preferably prior to seed formation). Plants normally take a week or two to show signs of control.

LIMITATION

- Protect ends of seedbeds and transplant beds from spray drift.

PARAQUAT ("RECOMMENDED")

Paraquat is a contact herbicide acting only on the foliar part of plants by disrupting photosynthesis.

APPLICATION

Paraquat applied as 5 litres of 20% w/v concentrate per hectare (1 kg ai/ha) in water at medium volume. To improve the persistence of control, simazine (a residual herbicide which interferes with leaf processes associated with photosynthesis and which does not poison roots directly. It only kills germinating weeds.) may be added to the spray solution as 4 kg of 50% wettable powder per hectare (2 kg ai/ha) and applied with the paraquat. Apply at any time throughout the year.

LIMITATIONS

- Always apply at low pressure.
- Subject to the Poisons Rules (see section on Poisons Rules).
- Paraquat (or Paraquat/simazine) should be sprayed at a very low pressure and seedbeds and transplant beds protected from spray drift.

PROPYZAMIDE ("RECOMMENDED")

A soil acting herbicide which prevents the emergence of germinating weeds and kills existing established weeds. Prolonged cold weather is a prerequisite of its action.(Is known to control *Rumex acetosella*).

APPLICATION

Applied as 4 kg of 50% wettable powder per hectare (2 kg ai/ha) in water at medium volume, October to December inclusive (January may be included for northern nurseries).

LIMITATION

- Weed control should last throughout the year, but can be assured by a spring application of simazine at the rates stated as for the previous section.

TABLE III

FOREST WEED CONTROL

HERBICIDES FOR USE IN THE FOREST

Weed type herbicide	Grasses		Grasses and herbaceous broadleaved weeds		Herbaceous broadleaved weeds		Bracken		Heather		Woody weeds and herbaceous broadleaves		Woody weeds (General)		Rhododendron	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Ammonium sulphamate																
Asulam																
Atrazine	*	ø	*	Control of grasses only												
Chlorthiamid	*	ø	*	ø	*											
2,4-D					ø	ø			ø	ø			*	Tree injection only		
2,4-D and 2,4,5-T (Mixture)											ø	ø				
Dichlobenil	*	ø	*	ø	*											
Dichlobenil/ Dalapon (MIX)	*	ø	*	ø												
Glyphosate	ø	ø	ø	ø	ø	ø	*	*	+	+	*	*	*	*	+	+
Paraquat (P.R)	ø	ø	ø	ø	*											
Propyzamide	ø	ø		Control of grasses only												
2,4,5-T																
"Velpar"	*	*											ø	ø	ø	ø

KEY TO TABLE III

- Ø = ("RECOMMENDED")
- * = Recommended for special situations or with reservations.
It is therefore important to read the appropriate
section ("PROVISIONAL").
- + = In experimental stage and giving good results
("INFORMATION") but not for use on a large scale until
a Research Information Note confirming recommendations
is circulated.
- (P.R.) = Subject to the Poisons Rules.
- Pre = Pre-planting
- Post = Post-planting
-

GRASSES AND GRASS/HERBACEOUS BROADLEAVED MIXTURES

ATRAZINE

A translocated herbicide with some foliar contact action but which is primarily taken in through the roots. It is available as a flowable formulation, a wettable powder or in granular form. It is most useful on soft and fine grasses (see susceptibility of grasses in Table I) and of limited use against herbaceous broadleaved species, unless applied at the higher rate later in the season.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 8 to 12 litres of 50% w/v flowable formulation per hectare at very low volume (mixing one part flowable formulation with 1½ parts water) through a controlled drop hand applicator, or as 8 to 12 kg of 50% w/w wettable powder per hectare at medium volume in water, or as 100 to 150 kg of 4% w/w granules per hectare, all product rates being equivalent to 4-6 kg ai/ha. Applications earlier than February are not recommended.

POST-PLANTING ("RECOMMENDED")

APPLICATION

(See Pre-Planting section). Apply February to May. (February and March applications usually give the best results).

LIMITATIONS

- The higher rate will be required to achieve control on coarse grasses.
- Not effective on soils with an organic peat layer.
- NS, WH and EL are sensitive to the higher rate in April and May and should only be treated at the lower rate during these months.
- Hardwoods should only be treated during dormancy in spring.
- *Holcus mollis*, although a soft grass, is not readily controlled.

CHLORTHIAMID ("PREFIX")

A soil acting granular herbicide which breaks down to dichlobenil after a few days in the soil, to be absorbed into the underground parts of shoots and roots as the vapour phase of dichlobenil. This then disrupts the cambial tissues causing death of the weed. Partially successful against some herbaceous broadleaved weeds but most useful for grass control.

PRE-PLANTING ("RECOMMENDED" - LOWLAND BRITAIN ONLY)

APPLICATION

Applied as 40-60 kg of 7½ w/w granules per hectare (3.0-4.5 kg ai/ha). At least one month should elapse after treatment before planting. Treatment should be carried out in January to March period.

LIMITATION

- Chlorthiamid is less effective on organic soils.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 40-60 kg of 7½ w/w granules per hectare (3.4-4.5 kg ai/ha). January to early March. Allow new plants at least two months to settle in before treatment.

LIMITATIONS

- It is less effective on organic soils having more than 5 cm depth of peat.
- DF, WH, larches and *Abies* species should only be treated at the lower rate and only if the operator is prepared to take great care and ensure (c) is carried out.
- Even distribution of granules at the correct rate is essential, and granules should not be allowed to come to rest in contact with the root collars of the trees being weeded.

Notes

- Yellowing of crop trees is a symptom of one of dichlobenil's breakdown compounds, and after going rather brittle trees can recover to normal colour and growth the following season.
- Trees will only die at these rates if the correct application technique is not adhered to and due care not taken by the operator.
- Not suitable for use in Christmas tree plantations of NS.

DICHLobenil ("CASORON G")

A soil acting granular herbicide which becomes a vapour in the soil and is absorbed into the underground parts of shoots and roots, and disrupts the cambial tissues causing death of the weeds. Successfully controls grass and partially controls some herbaceous broadleaved weeds dependent upon their date of emergence. Late emergers will not be controlled.

PRE-PLANTING ("RECOMMENDED" - LOWLAND BRITAIN ONLY)

APPLICATION

Applied as 40-60 kg of 6¼ w/w granules per hectare (2.7-4.0 kg ai/ha). At least one month should elapse after application before planting. Applications should be made in the January to March period.

LIMITATION

- Dichlobenil is less effective on organic soils.

POST PLANTING ("RECOMMENDED")

APPLICATION

Applied as 40-60 kg of 6¼ w/w granules per hectare (2.7-4.0 kg ai/ha), preferably January to March. Allow new plants two months to settle in before treatment.

LIMITATIONS and Notes

(See Post-Planting for Chlorthiamid on page 60)

DICHLOBENIL/DALAPON ("FYDULAN")

(See the mode of action as described for dichlobenil). The inclusion of 10% dalapon in the granules increases their capacity to kill coarse grasses. In this instance dalapon is mainly taken in through the roots and underground stems. Such a mixture is likely to give better weed control on highly organic soils than dichlobenil alone. Later applications will kill or retard the growth of some herbaceous broadleaved weeds.

PRE-PLANTING ("RECOMMENDED" - LOWLAND BRITAIN ONLY)

APPLICATION

Applied as 40-60 kg of 6¼% dichlobenil w/w granules per hectare (2.7-4.0 kg ai/ha dichlobenil with 4-6 kg ai/ha dalapon). The lower rate of 40 kg/ha is usually adequate, but crops will tolerate 60 kg/ha if this rate is required to obtain adequate weed control. Application should be made in the January to March period. At least one month should elapse after treatment before planting.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 40-60 kg of 6¼% dichlobenil with 10% dalapon w/w granules per hectare (2.7-4.0 kg ai/ha dichlobenil with 4-6 kg ai/ha dalapon per hectare). The lower rate of 40 kg/ha is usually adequate but crops will tolerate 60 kg/ha if this rate is needed to gain adequate weed control. Apply January to early March. Allow new plants at least two months to settle in before treatment.

LIMITATIONS and Notes

(See post-planting for Chlorthiamid on page 60)

GLYPHOSATE

A herbicide which is translocated after contact with aerial vegetative parts to underground root structures and has a hormonal action. Controls both annual and perennial weeds including rhizomatous ones, whether herbaceous broadleaved species or grasses.

[See Research Information Note 27/77/SIL(S)]

PRE-PLANTING ("RECOMMENDED" - LOWLAND BRITAIN ONLY)

APPLICATION

Applied as 1.5 litres of 36% w/v concentrate per hectare (0.5 kg ae/ha) in water at VLV through a controlled drop band applicator or at medium volume. Application at VLV is believed to increase the activity of the application.

POST-PLANTING ("RECOMMENDED" - LOWLAND BRITAIN ONLY)

APPLICATION

(See Pre-Planting)

LIMITATIONS

- Due to its contact action, trees are damaged by overall sprays during the active growing period and the use of a tree guard is recommended.
- The following species tolerate overall sprays at 0.5 kg ae/ha following hardening of leader growth (approx. July onwards), SS, NS, DF, CP, LP, SP, RC, LC. DF are damaged by very early spring treatments.
- Tsuga, larches and all broadleaved species are susceptible to damage at all dates when overall applications are made.

PARAQUAT

A contact herbicide which disrupts the photosynthetic processes of the aerial parts of plants. Controls both grass and herbaceous broadleaved weeds.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 5 litres of 20% w/v concentrate per hectare (1 kg ai/ha) in water at medium volume and low pressure. Apply to green growing vegetation in February to April for spring planting, and July to November for autumn planting.

LIMITATIONS

- Leave at least 3 days between spraying and planting.
- Regrowth of rhizomatous grasses can be expected.
- NEVER APPLY THROUGH A MISTBLOWER OR A CONTROLLED DROP APPLICATOR.
- ALWAYS APPLY AT LOW PRESSURE.
- SUBJECT TO POISONS RULES (See section on Poisons Rules).

POST-PLANTING ("RECOMMENDED")

APPLICATION

(See Pre-Planting). Apply February to November, provided the vegetation is green.

LIMITATIONS

- As for pre-planting, except for the first item.
- Crop trees must be protected with a guard.
- Weed foliage should not be allowed to become tall enough to brush against crop trees after paraquat application.

PROPYZAMIDE

A soil acting residual herbicide which slowly volatilises in cold soil and is taken up by germinating weeds and through the roots of existing weeds, especially grasses. Herbaceous broadleaved weeds which emerge in late season will not be controlled. Early species may be partially controlled.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 40 kg of 4% granules per hectare (1½ kg ai/ha), as 3 kg of 50% w/w wettable powder/ha (1½ kg ai/ha), in water at medium volume, or as a flowable formulation of VLV (1½ kg ai/ha) October to December (January can be included for northern Britain). Planting can be carried out the following spring. Good control is dependent upon persistent low soil temperature following application.

LIMITATIONS

- Organic soils decrease the activity of propyzamide, and treatment of soils with a greater depth of peat than 10 cm is not currently recommended. Trials are being carried out at higher rates on organic soils.
- *Dactylis glomerata*, *Holcus mollis* and *Calamagrostis epigejos* are resistant.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 40 kg of 4% granules per hectare (1½ kg ai/ha), or as 3 kg of 50% wettable powder/ha (1½ kg ai/ha) in water at medium volume or as a flowable formulation of VLV (1½ kg ai/ha). Apply October to December (January can be included for northern Britain). Good control is dependent upon persistent low soil temperature following application.

LIMITATIONS

(As for Pre-Planting)

Note

No conifer or broadleaved species have yet been damaged by applications at 1.5 kg ai/ha.

VELPAR

Acts on the foliar parts as well as the roots of plants due to soil activity following application. It controls many herbaceous plants as well as even the most coarse grasses.

PRE-PLANTING ("PROVISIONAL")

APPLICATION

Applied as 2 kg of 90% water soluble powder/ha (1.8 kg ai/ha) using a knapsack sprayer at MV. It can be applied from mid-February through to June and gives best results in May and June.

LIMITATIONS

- The powder has a low solubility and ULV and VLV methods are not yet available.
- The powder is irritating to the nose, eyes and air passages. Particle face mask and goggles must be worn when handling the powder which is fine and tends to puff out of containers.

POST-PLANTING ("INFORMATION")

APPLICATION

Applied as 2 kg of 90% water soluble powder/ha (1.8 kg ai/ha) using a knapsack sprayer at MV. It can be applied from mid-February to the end of August if necessary but a tree guard must be used with all species from mid-April to the end of June.

LIMITATIONS

- (As for Pre-Planting)
- Only CP, LP, SP, SS and NS can be treated.
- Larches and hardwoods are killed. Other conifers are sensitive.

HERBACEOUS BROADLEAVED SPECIES ONLY

2,4-D ESTER

A herbicide which in this instance is absorbed via the foliage and which then acts as a plant-growth regulator. It is of no importance for grass control but gives good control of rushes.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 10 litres of undiluted 40% w/v special controlled drop formulation per hectare (4.0 kg ae/ha) at VLV through a controlled drop band applicator, or as 8 litres of undiluted 50% w/v emulsifiable concentrate per hectare (4.0 kg ae/ha) in water at medium volume. Apply April to August.

LIMITATION

- Only of use for autumn planting.

POST-PLANTING ("RECOMMENDED")

APPLICATION

(See Pre-Planting). Apply April to August.

LIMITATIONS

- Not in hardwood crops.
- Not during hot weather to avoid volatilisation of 2,4-D onto crop trees.
- Conifer crops must be protected from the spray.
- If agricultural land adjoins plantation, leave an untreated 50-metre buffer between it and the treated area.
- Beekeepers with hives in the vicinity should be advised of heather control programmes.

PARAQUAT ("RECOMMENDED") or GLYPHOSATE ("RECOMMENDED")

PRE-PLANTING AND POST-PLANTING

Applied as for grasses and grass/herbaceous broadleaved mixtures when broadleaved species are just emerging or have commenced early growth, may give control at less risk to the crop than 2,4-D and at a more desirable time (See Limitations under the appropriate chemicals).

CHLORTHIAMID, DICHLOBENIL ("RECOMMENDED")
or DICHLOBENIL/DALAPON (MIXTURE)

Applied as for grasses and grass/herbaceous broadleaved mixtures well before bud-break in the crop to avoid crop damage, hence weed control may be less effective. (See Limitations for each chemical in appropriate section).

BRACKEN

ASULAM

A translocated herbicide which is taken up by the foliage and translocated to the rhizomes. Growth is then regarded or fails entirely the following season and rhizomes may be killed.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 7 litres of 40% w/v concentrate per hectare (2.8 kg ae/ha) through an incremental drift applicator at ultra low volume, or as 7-10 litres of 40% w/v concentrate per hectare (2.8-4 kg ae/ha) in water at low volume through a mistblower or at medium volume through a knapsack sprayer etc. Apply late June to August, after frond tips have unfurled.

LIMITATION

- Rates have to be increased the later in the season one applies asulam, and applications should be made well before the onset of senescence.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 5 litres of 40% w/v concentrate per hectare (2.0 kg ae/ha) through an incremental drift applicator at ultra low volume, or as 5-10 litres of 40% w/v concentrate per hectare (2-4 kg ae/ha) in water at low volume through a mistblower or at medium volume by knapsack sprayer etc. Apply late June to August, after frond tips have unfurled.

LIMITATIONS

- Rates have to be increased the later in the season one applies asulam, and applications should be made before the onset of senescence.
- Access for spraying should be made by pushing fronds aside and not by cutting them.
- Hand cutting cannot be done until one month has elapsed from the time of treatment if it is necessary to free a crop in the year of treatment.
- WH should not be treated at more than 7 litres/ha. (= 2.8 kg ae/ha).
- Out of the hardwoods only beech is known to be tolerant to asulam.
- Spraying prior to rain is not recommended. At least two days of reasonably dry weather are required after treatment to permit foliar absorption.

GLYPHOSATE

A translocated herbicide taken up by the foliage and translocated to the rhizomes. Some die back of foliage can be expected in the year of application and in the following season rhizomes fail to send out fronds. Glyphosate is most effective on moist vegetation when relative humidity and air temperatures are high.

PRE-PLANTING ("PROVISIONAL")

APPLICATION

Applied as 2 litres of 36% w/v concentrate (0.7 kg ae/ha) with water through a controlled drop applicator (ULVA 8) through a mistblower at LV, or through a knapsack sprayer at MV. Apply July and August after frond tips have unfurled.

POST-PLANTING ("PROVISIONAL")

APPLICATION

Applied as for Pre-Planting treatment.

LIMITATIONS

- Only SS, NS, LP, SP, CP, DF, RC, and LC can be treated. Hardwoods and larch cannot be treated. *Tsuga* are likely to be damaged.
- Access for spraying should be made by pushing fronds aside and not by cutting.
- One month should elapse after treatment before cutting bracken down.
- Spraying prior to rain may reduce herbicide effectiveness. Six hours without rain after treatment is necessary to permit foliar absorption.

HEATHER (MAINLY CALLUNA VULGARIS)

2,4-D ESTER

A plant growth regulator which is absorbed mainly by the aerial parts of heather, before being translocated throughout the plant.

A low volatile ester with volatility equal to or lower than the iso-octyl ester is recommended. Nonyl esters are also recommended.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 15 litres of 40% w/v controlled drop formulation per hectare (6 kg ae/ha) through an incremental drift applicator at VLV, or as 12 litres of 50% w/v emulsifiable concentrate per hectare (6 kg ae/ha) in water at low volume through a mistblower or at medium volume through a knapsack sprayer etc. Apply April to mid-September inclusive.

LIMITATIONS

- Low volume and VLV applications may be slightly less effective.
- Beekeepers with hives in the vicinity should be advised of heather control programmes.
- Programmes should be controlled to prevent tainting of any water supplies used for human consumption. More than 0.01 parts of 2,4-D/million parts of water is unacceptable.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 10-15 litres of 40% w/v controlled drop formulation per hectare (4-6 kg ae/ha) through a controlled drop applicator at VLV, or as 8-12 litres of 50% w/v emulsifiable concentrate per hectare (4-6 kg ae/ha) in water at low volume through a mistblower or at medium volume through a knapsack etc. Application between two rows of trees gives the best result, regardless of the type of equipment used. Apply April to mid-September for medium volume application, mid July to mid-September for VLV and mistblower applications at low volume.

Rates

- (i) N. Britain - May to August at 5 kg ae/ha. April and September at 6 kg ae/ha.
- (ii) S. Britain - May to August 4 kg ae/ha. April and September at 5 kg ae/ha.

Note

If the "Herbi" CDA is used, heather kill is less effective but crop tolerance is better and rates need to be increased by 25%.

LIMITATIONS

- See Pre-Planting.
- SS, SP, CP, NS and DF are tolerant to foliar deposits of 2,4-D after their main period of growth has ceased.
- LP, WH, RC, larches: foliage is not tolerant to 2,4-D unless treated at medium volume with a placed spray.
- Only medium volume applications can be relied upon to avoid unacceptable damage in crops under 1m in height.
- VLV and mistblowing if directed away from trees is acceptable in crops over 1m in height.
- The higher rate is required in earlier and later applications.
- See Special Precautions - 2,4-D and 2,4,5-T on surface water catchment areas, on page 79.

GLYPHOSATE

A herbicide which translocates after application to foliage. Roots are subsequently killed. Control of heather is not very apparent during the season of application, becoming evident in the year following treatment.

PRE-PLANTING ("INFORMATION")

APPLICATION

Applied as 3.0 litres of 36% w/v liquid per hectare (1 kg ae/ha) through a controlled drop applicator at ULV or VLV, a mistblower at LV or a knapsack sprayer at MV. Apply June to August inclusive.

LIMITATIONS

- While bees are unaffected by glyphosate heather flowering may well be affected by June and July applications. Beekeepers should be advised not to site hives on areas to be sprayed.

Notes

There are no "special" precautions required as for 2,4-D in water catchment areas but other precautions should be observed (page 82). Trout tolerate 48 ppm in static water for 96 hours, therefore stream contamination in running water is much less likely to do harm than 2,4-D. Size of programme is not limited.

Aerial application is possible.

POST-PLANTING ("INFORMATION")

APPLICATION

Applied at rates and volumes similar to pre-planting treatments. Dates of application are limited to late July and August when leaders and growth has hardened for overall spraying. Placed spraying may permit

early applications with an acceptable level of damage but should not be done earlier than late June. Trees should also be at least a metre tall.

LIMITATIONS

- Only NS, SS, LP, SP, and CP can be treated with an overall spray.
- DF, RC, LC and WH can be treated in July and August with carefully placed sprays at MV when they are at least 1 metre tall.
- Mistblowers should be directed at the heather and not at the trees.

Notes

There are no "special" precautions required as for 2,4-D (page 82) for water tainting but other precautions should be observed. Size of programme is not limited.

Aerial application is possible.

WOODY WEEDS AND HERBACEOUS BROADLEAVED MIXTURES

2,4-D/2,4,5-T MIXTURES

Both are plant growth regulator herbicides to which broadleaved species are especially susceptible, and should only be used together when the herbaceous broadleaved weeds pose a real problem to future planting.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as a mixture of 3.5 litres of 30% controlled drop formulation of 2,4,5-T with 4.0 litres of 40% w/v CD formulation of 2,4-D per hectare through a controlled drop applicator (1 kg ae/ha of 2,4,5-T with 1.6 kg ae/ha of 2,4-D) at ULV, or as 5 litres of 60% w/v emulsifiable concentrate per hectare (3 kg ae/ha) in water at low volume by mistblower or at medium volume by knapsack sprayer etc. Apply June to September.

LIMITATION

- Control will be achieved the following year, but some preparation of dead thicket woody weeds may be required to permit planting.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Mix 8 parts of 40% w/v CD formulation of 2,4-D with 7 parts of 30% w/v CD formulation of 2,4,5-T and apply at 5.0-7.5 litres per hectare (1.1-1.6 kg ae 2,4-D with 0.7-1.0 kg ae 2,4,5-T per hectare respectively) at ULV, or as 4-5 litres of 60% w/v emulsifiable concentrate per hectare (2.4-3.0 kg ae/ha) in water at low volume by mistblower or in water at medium volume by knapsack etc.

Apply late summer after conifers have ceased the main period of shoot elongation and have formed resting buds, but before herbaceous broadleaved weeds and woody weeds show signs of autumn senescence (approx. mid-August to early October in southern Britain, and late July to the end of September in northern Britain).

LIMITATIONS

- The lower rates at the latest dates should be used on WH, RC, LC.
- Do not apply as overall sprays to LP, *P. radiata*, *P. pinaster* and larches. Placed sprays are acceptable from late summer onwards if direct spraying of crop trees is avoided.
- Can only be used in hardwood crops from late summer onwards if great care is taken to avoid direct spraying of crop trees with placed sprays.
- See Special Precautions - 2,4-D and 2,4,5-T on surface water catchment areas, on page 79.

GLYPHOSATE

A herbicide which translocates after application to foliage. Roots are subsequently killed. Herbaceous weeds will dieback after treatment but woody weeds may not show noticeable kill until following season.

PRE-PLANTING ("PROVISIONAL")

APPLICATION

Applied as 3 litres of 36% liquid per ha (1 kg ae/ha) in water through a CD incremental applicator at ULV or VLV, a mistblower at LV or a knapsack sprayer at MV. Apply June to August inclusive.

LIMITATIONS

- No "special" precautions are necessary for glyphosate for water tainting but other precautions should be observed (page 82).
- Of the hand held methods, mistblowing gives the most effective kill but is likely to give a higher degree of crop damage to unhardened trees.

Notes

Size of programme is not limited by "special" precautions.

Aerial application is possible.

POST-PLANTING ("PROVISIONAL")

APPLICATION

As for pre-planting except application date ranges from late June to August inclusive if tree growth of the crop is sufficiently hardened.

LIMITATIONS

- Only SS, NS, SP, LP, CP, DF and RC can be treated.
- No "special" precautions are necessary as with 2,4,5-T for water tainting in catchment areas (page 79). Other precautions should, however, be observed.
- Mistblowing may give a higher degree of crop damage than other methods but will also usually provide a better herbicide effect.
- Larches, all hardwoods and *Tsuga* are damaged by overall applications.

Notes

Size of programme is not limited by "special" precautions.

Aerial application is possible.

WOODY WEEDS - FOLIAR TREATMENTS

2,4,5-T

A plant growth regulating herbicide to which broadleaved species are especially susceptible.

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 10 litres of 30% w/v CD formulation per hectare (3 kg ae/ha) through an CD incremental applicator at VLV, or as 7 litres of 50% w/v emulsifiable concentrate per hectare (3.5 kg ae/ha) in water at low volume through a mistblower or at medium volume by knapsack sprayer etc. Apply June to late August/September before first signs of leaf senescence. (Gorse, broom and bramble can be controlled by winter sprays).

LIMITATIONS

- 1-2 years should be allowed for dieback and collapse of dense woody weeds prior to planting.
- See Special Precautions - 2,4-D and 2,4,5-T on surface water catchment areas, on page 79.

POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 7 litres of 30% w/v CD formulation per hectare (2.1 kg ae/ha) through an CD incremental applicator at ULV, or as 4.5-7.0 litres of 50% w/v emulsifiable concentrate per hectare (2.25-3.50 kg ae/ha) applied in water at low volume by mistblower or medium volume by knapsack sprayer etc.

Application confined to the period when conifer crop has ceased shoot growth and formed resting buds and before the leaves of the woody weeds are showing signs of autumn senescence. (Bramble, gorse and broom can be sprayed throughout the autumn and winter to within 14 days of the conifer crop flushing in the spring).

LIMITATIONS

(As for Post-planting treatment with 2,4-D/2,4,5-T mixture (page 71).

GLYPHOSATE

A herbicide which translocates readily after application to foliage. Roots are subsequently killed, preventing much re-suckering. Control is not always evident in the year of application, becoming obvious in the season following treatment.

PRE-PLANTING ("PROVISIONAL")

APPLICATION

Applied as 3 litres of 36% w/v liquid per hectare (1 kg ae/ha) through a CD incremental applicator at ULV or VLV, a mistblower at LV or a knapsack sprayer at MV. Apply June to August inclusive.

LIMITATIONS

- No "special" precautions are necessary as with 2,4,5-T (page 79) for water tainting but other precautions should be observed.
- Of the hand held methods, mistblowing gives the most effective kill but is also likely to give a higher degree of crop damage to unhardened trees.

Notes

Size of programme is not limited by "special" precautions.

Aerial application is possible.

POST-PLANTING ("PROVISIONAL")

APPLICATION

Applied as 3 litres of 36% w/v liquid per hectare (1 kg ae/ha) through a CD incremental applicator at ULV or VLV, a mistblower at LV or a knapsack sprayer with water at MV. Apply late June to August inclusive provided tree growth has hardened.

LIMITATIONS

- Only SS, NS, SP, LP, CP, DF and RC can be treated.
- No "special" precautions are necessary as with 2,4,5-T (page 79) for water tainting but other precautions should be observed.
Size of programme is not limited.
- Of the hand held methods, mistblowing gives the most effective kill but is also likely to give a higher degree of crop damage to unhardened trees.

Note

Aerial application is possible.

WOODY WEEDS - STEM TREATMENTS

A. BASAL BARK

2,4,5-T

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as 2-3 litres of 70-80% w/v unformulated low-volatile ester or 3-5 litres of 50% emulsifiable low-volatile ester per 100 litres of paraffin (1.4-2.4 kg ae/100 litres of paraffin) to the whole circumference of the bottom 30-45 cm of the stem until saturated to the point of run-off. Apply all the year round but avoidance of the growing season of the conifer crop is advisable.

LIMITATIONS

- Broadleaved crops can be treated post-planting, but damage from volatilisation of 2,4,5-T during hot weather restricts treatment to winter months.
- See Special Precautions - 2,4,D and 2,4,5-T on surface water catchment areas, on page 79.

B. FRILL GIRDLING AND NOTCHING

2,4,5-T (FRILL GIRDLING)

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

After cutting frills with a light axe or bill-hook, rates, formulation, etc., are as for Basal Bark treatment (see above). Apply as for basal bark.

LIMITATIONS

(See Basal Bark)

AMMONIUM SULPHAMATE - (FRILL GIRDLING)

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied at a concentration of 0.4 kg ammonium sulphamate per litre of water to freshly cut frills in the stems of unwanted trees. Apply all the year round.

LIMITATION

- The chemical corrodes metal appliances and should be applied with a plastic watering can.

AMMONIUM SULPHAMATE - (NOTCHING)

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied as dry crystals to notches cut round the stem of trees over 15-20 cm breast height diameter at a rate of 15 g ammonium sulphamate per notch. Notches should be not more than 10 cm apart edge to edge. Apply all the year round.

2,4,5-T - (TREE INJECTION)

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Injected as 1.0 ml per injection point of 50% w/v emulsifiable ester (0.5 kg ae/litre) at 75 mm centres round the circumference of species that are susceptible or moderately susceptible to 2,4,5-T. (Resistant species should be treated at 50 mm centres around the stem circumference); or as 1.0 ml per injection point of 78% w/v unformulated ester diluted 1 to 1 with paraffin (0.4 kg ae/litre). Apply all the year round.

LIMITATIONS

(See Special Precautions - 2,4-D and 2,4,5-T on surface water catchment areas, on page 79).

2,4-D AMINE - (TREE INJECTION)

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Injected as 1.0 ml per injection point of 50% w/v amine salt formulation (0.5 kg ae/litre) at 75 mm centres round the circumference of species susceptible or moderately susceptible to 2,4,5-T. (Resistant species should be treated at 50 mm centres around the stem circumference. Apply all the year round).

C. CUT STUMP TREATMENT

2,4,5-T ESTER

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied in paraffin at a concentration of 2 to 3 litres of 70-80% w/v unformulated low volatile ester or 3 to 5 litres of 50% w/v

emulsifiable low volatile ester per 100 litres of paraffin (1.4 to 2.4 kg ae/100 litres of paraffin) to the whole stump, ensuring that sapwood and bark are saturated to run-off. Apply immediately after felling and certainly not more than one week after felling. Apply at any time of the year.

LIMITATIONS

- Resistant species which produce coppice shoots may have to be treated twice to eliminate later regrowth.
- Avoid spraying when stumps are wet or frozen.
- See Special Precautions - 2,4,D and 2,4,5-T on surface water catchment areas, on page 79.

POST-PLANTING ("RECOMMENDED")

APPLICATION

(As for Pre-planting). Avoid application late April to early June in case volatilisation of 2,4,5-T damages the flushing crop, and restrict spraying to October - March.

LIMITATIONS

- As for Pre-Planting.
- Avoid spraying crop trees.

AMMONIUM SULPHAMATE

A highly soluble crystalline herbicide which is absorbed through leaves, roots and exposed surfaces.

PRE- AND POST-PLANTING ("RECOMMENDED")

APPLICATION

Applied at a concentration of 0.4 kg of crystals per litre of water to freshly cut stumps, or as 6 g of crystals per centimetre of stump diameter to freshly cut stump surfaces. Apply all the year round.

LIMITATIONS

- 12 weeks should be allowed to elapse between treatment and planting a crop.
- Post-planting treatments are likely to cause damage to crop trees by poisoning roots. 2,4,5-T should be preferred for post-planting purposes.

WOODY WEEDS - RHODODENDRON

2,4,5-T ESTER

PRE-PLANTING - ("RECOMMENDED")

APPLICATION

Applied as 2.5 to 3.2 litres of 78% w/v unformulated ester in paraffin (2.0 to 2.5 kg ae/100 litres of paraffin), or as 4 to 5 litres of 50% w/v emulsifiable ester in 100 litres of water or paraffin (2.0 to 2.5 kg ae/100 litres of diluent) to all accessible surfaces. Apply at any time of the year, leaving one month between treatment and planting date.

LIMITATIONS

- Spray only between October and March if sensitive crops adjoin the treated area.
- Regrowth should be treated not later than the first year after cutting and before regrowth exceeds 1.5m, otherwise any treatment may become uneconomic.

POST-PLANTING ("RECOMMENDED")

APPLICATION

(As for Pre-planting but only emulsifiable esters can be used with safety to the crop). Apply only during the crop's dormant season, ie. after setting of bud and end of leader elongation (mid-October to March).

LIMITATIONS

(As for Pre-Planting)

AMMONIUM SULPHAMATE

PRE-PLANTING ("RECOMMENDED")

APPLICATION

Applied as a solution with a concentration of 0.4 kg of crystals per litre of water to all accessible surfaces at medium or low volume. A non-ionic wetter should be added to the spray solution at 6 ml per litre of spray solution. Apply all the year round.

LIMITATION

- 12 weeks should be allowed to elapse between treatment and planting a crop.

POST-PLANTING (NOT RECOMMENDED)

GLYPHOSATE

PRE-PLANTING ("INFORMATION")

APPLICATION

Applied as 3 litres of w/v liquid (1 kg ai/ha) with water through a mistblower at LV or a knapsack sprayer at MV from June to August.

Note

Regrowth should be treated as soon as it appears and preferably before it exceeds 1 metre tall.

POST-PLANTING ("INFORMATION")

APPLICATION

Applied as for pre-planting treatments but from late June to August when crop trees have hardened-off.

LIMITATIONS

- Only NS, SS, SP, LP, CP, DF and RC can be treated.
- Larches, all hardwoods and *Tsuga* are damaged by overall applications.
- Mistblowing may damage crop trees more than MV applications but will also give better control.

Note

Size of programme is not limited by "special" precautions.

SPECIAL PRECAUTIONS

2,4-D AND 2,4,5-T ON SURFACE WATER CATCHMENT AREAS

The large-scale use of growth-regulating hormones such as 2,4-D and 2,4,5-T on surface water catchment areas involves the risk of heavy wash-off of chemical in water running over the soil surface into streams or reservoirs from which water is drawn for human consumption. (In this context, water percolating through the soil profile into permeable strata below is a hazard which for the present can be ignored). Therefore the scale of usage must be restricted to bring any contamination that may occur down to a tolerable level with an adequate safety margin.

The problem with these chemicals in this context is their tainting properties, not their toxicity, and generally water authorities are unwilling to accept any more than 0.01 parts of weedkiller per million parts of water in a water supply.

The concentration of herbicides in wash-off, should it occur shortly after spraying, is likely to be very much above the limit given in the previous paragraph. We have therefore to ensure that water from the sprayed area is sufficiently diluted by water from adjacent unsprayed areas so as not to provide an unpleasant taste by the time the water reaches any point where it is drawn for human consumption.

The factor of greatest importance is the site. On peat soils, most of the water falling in a period of heavy rain is likely to run-off. In free-draining mineral soils, with loose surface texture, there will be very little run-off. Other soils will represent all stages between these extremes.

Almost as important is the weather. The longer the interval between spraying and rain falling, the more chemical will be absorbed by the plants and soil and the less will be washed off. Spraying with 2,4-D or 2,4,5-T is not recommended if rain is expected in 24 hours. It follows that the area sprayed per day is also important.

If we wish to guard against the chance that the weather forecast will be wrong and that, contrary to expectation, heavy rain falls within 24 hours or so of spraying, to avoid any risk of tainting, the area sprayed in any day must be restricted as follows:-

We assume that the amount of herbicide washed off will be in proportion to the rainfall up to a maximum of an inch (25 mm) of rain, but that 50% of the herbicide will be absorbed by plants and soil. Then the concentration of 2,4-D in water from areas sprayed at 5 kg/ha (the rate of 2,4-D for control of *Calluna* on planted ground) will be roughly 10 parts per million. As 0.01 parts per million is the most water authorities will permit, it is clear that where most of the rainfall is likely to run-off, the area sprayed should not be more than 1/1000 of the total catchment area to the point where water is withdrawn.

If the point where water is withdrawn is a reservoir, there will be a further dilution with water therein. In this case, the sprayed area may be increased to 1/500 of the water catchment area feeding the reservoir.

If 2,4-D is being applied post-planting at 4.0 kg/ha the areas sprayed should be no more than 1/800 or 1/400 of the catchment respectively, and pro rata for other rates of application of 2,4-D.

In many upland areas, local water authorities may be able to assist in determining water catchment areas down to points where they draw water. It may be more difficult however to determine the location and area of catchments supplying isolated farms, etc.

Fresh Water Fishery and Local Water Authorities must be consulted if it is desirable to use 2,4-D or 2,4,5-T in any surface water catchment area.

Contamination of water courses due to accidental spillage must be avoided by siting all concentrate containers well away from water courses and drainage channels, and sealing containers when not in use.

Contamination by vandals must be guarded against by keeping concentrates locked away while not in use.

Contamination due to excessive surface water run-off following heavy rain, must be avoided by application only during settled weather to unsaturated soils.

Director Research and his staff are in direct contact with the British Waterworks Association and the Water Research Centre on this topic, and will be pleased to discuss the use of herbicides in relation to water supplies.

OTHER PRECAUTIONS WHEN USING 2,4,5-T AND 2,4-D

PROTECTION OF OPERATORS

2,4-D and 2,4,5-T have a very low level of toxicity to man and animals, but prolonged exposure, notably to oil solutions, may cause skin or eye irritation to some individuals. Suitable gloves and goggles should be worn by personnel mixing spray materials. Prolonged breathing of fine droplets of 2,4,5-T in oil can irritate the respiration system. Face shields and ori-nasal masks must be used by those applying 2,4,5-T in oil.

SAFETY PRECAUTIONS

NURSERY HERBICIDES NOT USED IN THE FOREST

DAZOMET

- Dazomet and its decomposition products are irritating to the skin, eyes, nose and mouth. Wear gloves, goggles and ori-nasal mask when working with this product. Wash from skin and eyes in the event of accidental contamination.
- Avoid breathing the fumes given off from the prill either during or after application.
- Prill fumes will injure adjoining crops if they are close by.
- Wellington boots should be worn inside the trousers.

DIPHENAMID, NITROFEN, SIMAZINE

- Gloves and rubber Wellington boots should be worn, and hands washed before meals and at the end of the day's work.

SODIUM CHLORATE

- Gloves and Wellington boots and waterproof coat should be worn, and hands washed before meals and at the end of the day's work.
- Dry sodium chlorate may be ignited by friction. Always use a formulation containing a fire retardant.
- Wash contaminated clothing after work and avoid fire hazard. Dry contaminated clothing can ignite at relatively low temperature.

FOREST HERBICIDES

AMMONIUM SULPHAMATE

- Wellingtons, gloves and trousers (or leggings) should be worn for the methods of application described (see Table of Protective Clothing Required, page 86). Wash hands before meals and at the end of the day.
- Highly corrosive to most metals, hence only sprayers in which the spray solution has no contact with metal parts can be used without damage occurring to equipment.

ASULAM

- See Table of Protective Clothing Required, which varies with different application methods.
- Wash hands before meals and at the end of the day's work.
- Poisonous weeds can be made more palatable to grazing stock after spraying, Domestic stock should be kept away from sprayed areas if such weeds are present, for at least two weeks or until the weeds are dead and dried out.

ATRAZINE

- See Table of Protective Clothing Required, which varies according to application methods.
- Wash hands before meals and at the end of the day's work.

CHLORTHIAMID, DICHLOBENIL AND DALAPON/DICHLOBENIL MIXTURES

- See Table of Protective Clothing Required.
- Wash hands before meals and at the end of the day's work.
- Harmful to fish if it enters water courses by accidental spillage.

GLYPHOSATE

- See Table of Protective Clothing Required.
- Wash hands before meals and at the end of the day's work.

PARAQUAT

- See Table of Protective Clothing Required. Face or eye shields are necessary when handling the concentrate to prevent accidental splash-back of the liquid contacting the face. WEAR FACE SHEILD when handling and applying the diluted formulation.
- The Poisons Rules apply to this herbicide (see the current issue of *Approved Products for Farmers and Growers*, and SM3).
- Keep farm stock away from treated area for at least one day.
- Spillage into water courses must be avoided, therefore keep the concentrate away from drainage channels.

PROPYZAMIDE

- See Table of Protective Clothing Required.

2,4-D

- See Table of Protective Clothing Required under appropriate method of application.
- Control spray drift by (a) using medium volume or VLV technique (CDBA 270-300 micron droplets) to limit drift; and/or (b) allowing a 50-metre buffer zone between treatment area and adjoining agricultural land, sensitive forest crops, etc. When mistblowers or controlled drop incremental applicators (CDIA 80-190 micron droplet) are used.
- Wash out equipment thoroughly after use.
- Harmful to fish, especially esters (nonyl and iso octyl esters are the least harmful and should be used).
- Spillage into water courses must be avoided, therefore keep the concentrate away from drainage channels.
- See Special Precautions - 2,4-D and 2,4,5-T on surface water catchment areas on page 79.

2,4,5-T

- As for 2,4-D.

Toxicity Levels	LD50 Mammals	LC50 Fish	LC50 Birds	LD50 Bees
Ammonium sulphamate	3900 rats			
Asulam	>5000 mice	>5000 R.trout	>4000 mallard	> 1000
Atrazine	3080 rats		Low.mallard	
Chlorthiamid	757 rats	41 Harlequin (24 hrs)		
2,4-D amine	666 rats			
2,4-D ester	>700 rats			
Dazomet	500 rats			
Dichlobenil	3160 rats	18 guppy (48 hrs)		
Dichlobenil/Dalapon	3160/7570			
Diphenamid	1050 rats			
Glyphosate	4320 rats	48 R. trout	>4640 mallard	>100
Nitrofen	2550 rats			
Paraquat	155 rats			
Propyzamide	5260 rats			
Simazine	>5000 rats	Low	Low.	
Sodium chlorate	1200 rats			
2,4,5-T ester	500 rats			
"Velpar"	1690 rats	320 R.trout	> 5000 mallard	

Oral LD50 = Lethal dose for 50% of the test animals (mg/kg, 48 hrs.)

LC50 = Lethal concentration for 50% of test animals (p.p. million

96 hrs in static water.for fish,8 days for mallard duckling)

LD50 for bees in mg/bee (48 hrs).

The greater the figure in ppm etc. the lower the toxicity level.

SPRAYING EQUIPMENT (FOR FURTHER DETAILS SEE BULLETIN 48)

Knapsack sprayers	<u>Cooper Pegler CP3 (Forestry Model) and accessories</u> Cooper Pegler & Co.Ltd., Burgess Hill, Sussex RH15 9LA
Mistblowers:	<u>Stihl SGL7</u> Thomas Niven Ltd., Dalston Road, Carlisle, Cumbria.
Controlled Drop- Applicators (ULV & VLV)	<u>Micron ULVA, ULVA 8 and HERBI</u> Micron Sprayers Ltd., Three Mills, Bromyard, Hereford and Worcester.
Tree Injector:	<u>Axe Type 3101</u> Spear & Jackson (Tools Ltd), St Pauls Road, Wednesbury, Staffs. <u>Fickningsspruta</u> Skogsmateriel AB, PO Box 12-199, S102-25 Stockholm 12, Sweden. <u>Container</u> Cooper Pegler & Co.Ltd., Burgess Hill, Sussex RH15 9LA.
Granule Applicator: (Motorised)	Horstine Farmery Ltd., North Newbald, York YP4 3SP.
(Hand)	Huntly Applicator "Invermorgan", 52 Telford Road, Inverness.
Live Reel Sprayer:	<u>Pharos</u> The Dorman Spraying Co.Ltd., Brays Lane, Ely, Cambs.
Stump Treatment Applicator: (Fomes control)	Chieftain Forge Ltd., Burnside Road, Bathgate, West Lothian.

TABLE IV

PROTECTIVE CLOTHING REQUIRED

Clothing	Crystals		Dichlobenil		Asulam 2,4,5-T Glyphosate CDLA 70-150um droplet	Atrazine 2,4,5-T Glyphosate CDBA 250-300um droplet	Atrazine "Velpar" Propyzamide in water		Glyphosate in water	Paraquat in water
	MV	LV	Granules	Dalapon/ Dichlobenil			MV	LV		
Boots, Wellington	E	E	E				E	E	E	E
Waterproof or oil resistant										
Trousers or leggings	D	E	D				E	E	E	E
Thornproof, waterproof										
or oil resistant										
Jacket, Thornproof (1) (2)	-	D	-				D	E	D	D
Waterproof or oil resistant										
Gloves, oil and	E	E	E				E	E	E	E
Chemical resistant	-	-	D(4)				E(5)	E	D	E
Face Shield or Goggles	-	-	D(4)				E(5)	E	-	-
Oxi-nasal Mask	-	-	D(4)				-	-	-	-
Hat or Hood	-	-	-				-	-	-	-
Waterproof or oil resistant										
Ultra Low Volume Spraying	-	-	-				-	-	-	-
Suit										

MV Medium Volume - applied by Knapsack Sprayer, Live Reel Sprayer or Tractor Mounted Sprayer.

LV Low Volume - applied by Mistblower.

CDA Controlled Droplet Application - applied by Rotary Atomiser.

E = Essential, laid down under Pesticides Safety Precautions Scheme or considered necessary in relation to working conditions in forestry.

D = Discretionary - These items are not necessary for protection but if requested by the operator they should be made available.

Continued on page 86.

TABLE IV continued

PROTECTIVE CLOTHING REQUIRED

Clothing	Asulam 2,4,5-T, 2,4-D 2,4,5-T/2,4-D in water		2,4,5-T in Paraffin	2,4,5-T Paraffin Ammonium sulphamate Tree Injection	Sodium chlorate (Dazomet prill) Atrazine, Diphensamid Simazine, Nitrofen Paraquat, Propyzamide Nurseries only	Paraquat MV
	MV	LV				
Boots, Wellington						
Waterproof or oil resistant	E	E	E	E	E	E
Trousers or leggings (1)						
Thornproof, waterproof	E	E	E	E	D	D
or oil resistant						
Jacket, Thornproof (1)						
Waterproof or oil resistant	D	E	E	D	-	-
Gloves, oil and (1)						
chemical resistant	E	E	E	E	E	E
Face shield or goggles	D(4)	E	D	D	D	E
Paper Face Mask (3)	-	E	D	-	-	-
Hat or Hood (1)						
Waterproof or oil resistant	-	E	D	-	-	-
Ultra Low Volume Spraying						
suit	-	-	-	-	-	-

Notes: (1) Selection of waterproof or oilproof clothing should be made according to the materials being sprayed.

(2) An ori-nasal dust mask will suffice for all spraying operations, particularly if worn with a face shield. If the smell of a spray is objectionable to the operator then a respirator with vapour filter must be used.

(3) A face shield and ori-nasal dust mask is required when filling applicators.

(4) A face shield and ori-nasal dust mask must be worn when handling "Velpar" powder, but is discretionary when spraying the liquid at MV.

ALPHABETICAL INDEX TO MANUFACTURERS AND SUPPLIERS

INDEX NO.

- 1 Agricola Chemicals Ltd., Talbot Wharf Chemical Works, Port Talbot, W. Glamorgan SA13 1RL.
- 2 Agrigano Fertilisers Ltd., Hast Hill, Hayes, Bromley, Kent.
- 3 Albright & Wilson Ltd., Agricultural Sector, Glaston Park Glaston, Uppingham, Leics LE15 9BX.
- 4 Anglian Crop Services Ltd., Weasenham Lane, Wisbech, Cambs PE13 2RN.
- 5 Atlas Products and Services Ltd., Fraser Road, Erith, Kent DA8 1PN.
- 6 BASF United Kingdom Ltd., Agrochemical Division, Lady Lane, Hadleigh, Ipswich, Suffolk IP7 6BQ.
- 7 Battle, Hayward and Bower Ltd., Victoria Chemical Works, Crofton Drive, Allenby Road Industrial Estate, Lincoln LN3 4NP.
- 8 Bayer U.K. Ltd., Agrochem Division, Eastern Way, Bury St. Edmunds, Suffolk IP32 7AH.
- 9 Berkshire Factors Ltd., Dale House, London Road, Sunningdale, Berks.
- 10 Boots Farm Sales Ltd., Nottingham NG2 3AA.
- 11 Borax Consolidated Ltd., Borax House, Carlisle Place, London SW1P 1HT.
- 12 Bos Chemicals Ltd., Gedney, Spalding, Lincs PE12 0BL.
- 13 BP Trading Ltd., Heating & Agricultural Branch, Britannic House, Moor Lane, London EC2Y 9BU.
- 14 Bugge's Insecticides Ltd., 141 London Road, Sittingbourne, Kent.
- 15 Burts & Harvey Ltd., Crabtree Manorway, Belvedere, Kent DA17 6BQ.
- 16 J.D. Campbell & Sons Ltd. and J.D. Campbell (Sales) Ltd., 18 Liverpool Road, Great Sankey, Warrington, Lancs.
- 17 J.W. Chafer Ltd., Chafer House, 19 Thorne Road, Doncaster, S. Yorks DN1 2HQ.
- 18 Chipman Ltd., Horsham, Sussex.
- 19 Ciba-Geigy Agrochemicals, Whittlesford, Cambridge CB2 4QT.
- 20 Cleanacres Ltd., Andoversford, Cheltenham, Glos GL54 4LZ.
- 21 Cleanacres (Northern) Ltd., Station Yard, Kirton-in-Lindsey, Gainsborough, Lincs DN21 4BE.
- 22 Craven Chemical Co., 20-30 Church Street, Evesham, Worcs WR11 6DS.
- 23 Cropsafe Ltd., Salisbury Road, Downton, Salisbury, Wilts.

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- 24 Croptex Ltd., Gonerby Hill Foot, Grantham, Lincs NG31 8JB.
- 25 Dyanamid of Great Britain Ltd., Agricultural Division, Fareham Road, Gosport, Hants PO13 OAS.
- 26 Diamond Shamrock Chemicals (UK) Ltd., 147 Kirkstall Road, Leeds, W. Yorks LS3 1JN.
- 27 Dow Chemical Co. Ltd., Heathrow House, Bath Road, Hounslow, Middlesex TW5 9QY.
- 28 Duphar-Midox Ltd., Smarden, Ashford, Kent TN27 8QL.
- 29 Du Pont (UK) Ltd., Biochemicals Department, Maylands Avenue, Hemel Hempstead, Herts HP2 7DP.
- 30 Ecological Laboratories, c/o John Lawrence (Dover) Ltd., Dover, Kent CT16 2LF.
- 31 Farm Protection Ltd., Glaston Park, Glaston, Uppingham, Leicestershire LE15 9BX.
- 32 Fisons Ltd., Hauxton, Cambridge CB2 5HU.
- 33 Fisons Ltd, Fertiliser Division, Harvest House, Felixstowe, Suffolk IP11 7LP.
- 34 Hargreaves Fertiliser Industries Ltd., Skeldergate Bridge, York YO1 1DR.
- 35 Hoechst-Cassella Dyestuffs Ltd., 48 Seymour Grove, Old Trafford, Manchester M16 0LN.
- 36 Hoechst U.K. Ltd., Agricultural Department, Hoechst House, Salisbury Road, Hounslow, Middlesex TW4 6JH.
- 37 H.L. Hutchinson Ltd., North End, Wisbech, Cambs PE13 1PE.
- 38 ICI Ltd., Agricultural Division, Fertiliser Marketing Dept. PO Box 1, Billingham, Cleveland TS 23 1LB (Sales offices in Bristol, Cambridge, Guildford, Lincoln, Shrewsbury and York).
- 39 ICI Dyestuff Division, Piccadilly Plaza, Manchester M60 7JT.
- 40 Lindsey and Kesteven Fertilisers Ltd., Wigford House, Brayford Pool, Lindoln LN5 7BL.
- 41 E.C. Longmate Ltd., Terrington St John, Wisbech, Cambs PE14 7RY.
- 42 Malton Fertilisers Ltd., 31 Wheelgate, Malton, N. Yorks YO17 0HY.
- 43 A.H. Marks & Co.Ltd., Wyke Lane, Wyke, Bradford, W. Yorks BD12 9EJ.
- 44 May and Baker Ltd., Agrochemicals Division, 37/39 Manor Road, Romford, Essex RM1 2TL.
- 45 Monsanto Ltd., Agricultural Division, Thames Tower, Burleys Way, Leicester LE1 3TP.
- 46 Montedison (UK) Ltd., 11a West Halkin Street, London SW1X 8LF.
- 47 Murphy Chemical Ltd., Wheathampstead, St.Albans, Herts AL4 8QU.
- 48 Chas. Page & Co.Ltd., Acorn House, Victoria Road, London W3 6XU.
- 49 George A. Palmer Ltd., Oxney Road, Peterborough PE1 5YZ.

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- 50 Pan Britannica Industries Ltd., Britannica House, Waltham Cross,
Herts EN8 7DY.
- 51 Pesticide Chemicals Ltd., Preference House, Old Market Place,
Nutsford, Cheshire.
- 52 Plant Protection Division, Imperial Chemical Industries Ltd.,
Fernihurst, Haslemere, Surrey GU27 3JE.
- 53 Pointing Ltd., Prodhoe, Northumberland NE42 6NJ.
- 54 Rodent Control Ltd., 70/78 Queens Road, Reading, Berks.
- 55 Rohm & Haas (UK) Ltd., Lennig House, 2 Masons Avenue, Croydon,
Surrey CR9 3NB.
- 56 Roussel Laboratories Ltd., Roussel House, North End Road,
Wembley Park, Middlesex HA9 ONF.
- 57 Sandoz Products Ltd., Agrochemical Division, Station Road,
King's Langley, Herts WD4 8LJ.
- 58 Scottish Agricultural Industries Ltd., 25 Ravelston Terrace,
Edinburgh EH4 3ET.
- 59 Shell Chemicals U.K. Ltd., Agricultural Division,
39-41 St Mary's Street, Ely, Cambs CB7 4HG.
- 60 Sheppy Fertilisers and Chemicals Ltd., Rushenden Road,
Queenborough, Kent ME77 5HH.
- 61 Sorex (London) Ltd., Fulton House, Empire Way, Wembley,
Middlesex.
- 62 Soil Fertility Drums Ltd., Hartham, Corsham, Wilts SN13 0QA.
- 63 Thos. Southern & Sons, 18 Liverpool Road, Great Sankey,
Warrington, Lancs.
- 64 Stanhope Chemical Products, Victory House, 99-101 Regent Street,
London W14 8LJ.
- 65 Stauffer Chemical S.A., Baystrait House, Station Road,
Biggleswade, Beds SG18 8AL.
- 66 Steetley Chemicals Ltd., Chemicals Manufacturing Division,
Abbey Mills Chemical Works, Stratford, London E15 3NX.
- 67 Steetley Chemicals Ltd., (incorporating Vitax Ltd.), Liverpool
Road North, Burscough, Ormskirk, Lancs L40 0SB.
- 68 Stokes Bomford Ltd., Chemical Division, Springhill, Lower
Moor, Pershore, Worcs.
- 69 Synchemicals Ltd., 44 Grange Walk, London SE1 3EN.
- 70 Tenneco Organics Ltd., Rockingham Works, Avonmouth, Bristol
BS11 0YT.
- 71 Thames Nitrogen Co. Ltd., Ferry Lane Works, Rainham, Essex
RM13 9DJ.
- 72 Thompson and Capper Ltd., Speke Hall Road, Liverpool 24.
- 73 Timac Fertilisers Ltd., 22 High Street, Calne, Wilts SN11 0BS.

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- 74 Tom Fertilisers Ltd., New Wharf, Shoreham-by-Sea, Sussex.
- 75 Tripart Farm Chemicals Ltd., 9 Marsh Lane, Gaywood, Kings Lynn, Norfolk.
- 76 Tuco Chemical Co., Division of Upjohn Ltd., Fleming Way, Crawley, Sussex RH10 2WJ.
- 77 UKF Fertilisers Ltd., Ince, Chester CH2 4LB.
- 78 Universal Crop Protection Ltd., Nicholson House, Nicholson's Walk, Maidenhead, Berks SL6 1LJ.
- 79 Webbs Fertilisers Ltd., Riverside, Saltney, Chester CH4 8RR.
- 80 Welcome Foundation Ltd., Crewe Hall, Crewe, Cheshire CW1 1UB.

CHEMICALS
CODE NO. TO MANUFACTURERS AND SUPPLIERS

INSECTICIDES

Chlorpyrifos	27,47
Diazinon	19
Dicofol	47,50
D.D.T.	5,14,17,24,44,59,64,66
Fenitrothion	19,50,64
Gamma HCH	10,50,52
Malathion	31,47,64,66
Tar oil winter wash (Poison Rules apply)	22,36,47,70

FUNGICIDES

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Captan	44,47,48,52,65
Carbendazim	29
Cycloheximide	76
Dazomet	6
Dinocap	14,15,44,47,52
Disodium octaborate	11
Formalin	80
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Maneb	6,12,14,24,31,44,47,56,64,78
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Sulphur	14,36,57
Thiram	12,52
Urea	72
Zineb	4,12,15,46,47,50,52,66,75,78

FERTILISERS

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

Ammonium sulphate	2,49,60
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Forest Fertilisers

Ammonium nitrate	3,33,34,38,40,42,49,58,71,77,79
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Potassium chloride mixed with Rock phosphate	58,62,73
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Rock phosphate (* granular only)	40,49,58,60,62*,79
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Triple super phosphate	2,33,49,60,74
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Urea	38,40,42,58,79
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N.B. Forestry Commission staff should obtain fertilisers through centrally placed contracts (except for small quantities for nursery use).

WILDLIFE POISONS AND REPELLANTS

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Cyanide	10,52, Local Agricultural Merchants
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"Dendrocol 17"	9
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"Fowikal"	9
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"RCR Arrex cartridges"	54
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Warfarin 0.2%	54,61
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Warfarin 0.5%	10,54
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HERBICIDES

F = Forest herbicide

N = Nursery herbicide

Ammonium sulphamate	F	7
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Asulam	F	44
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Atrazine	F+N	17,19,32
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Chlorthiamid ("Prefix")	F	59
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2,4-D Amine	F	10,15,16,18,36,43,52,59,64,67,69,75,78
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2,4-D Ester (*ULV)	F	16,17,21,24,44,69 (13*)
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HERBICIDES continued ...

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Dichlobenil ("Casoron G")	F	28
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Nitrofen	N	50,55
Paraquat (Poison Rules apply)	F+N	18,52
Propyzamide	F+N	50,55,59
Simazine	N	10,16,17,19,32,47,59,68
Sodium chlorate	N	18,32
2,4,5-T Ester (*ULV)	F	10,16,18,32,43,52 (13*)
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"Enquiries relating to this publication should be addressed to the Publications Officer, Forestry Commission Research Station, Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH"

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