

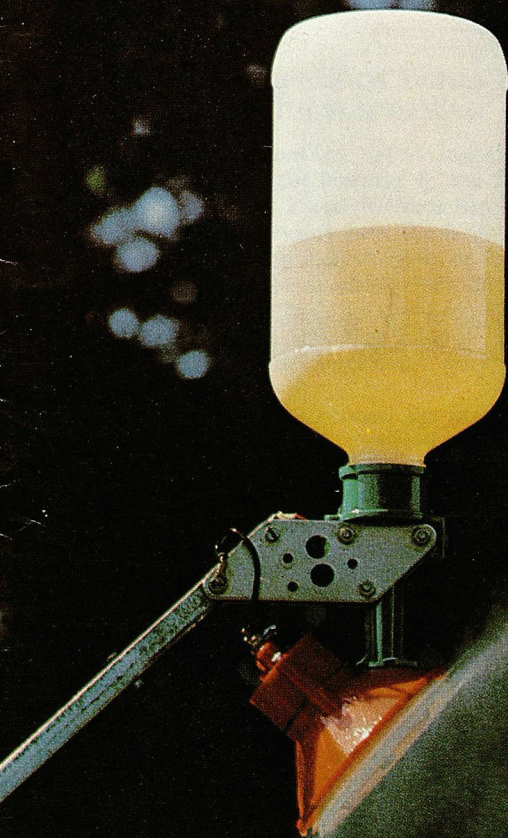
HMSO

Forestry Commission  
Leaflet

62

# Ultra low volume herbicide spraying

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Forestry Commission  
**ARCHIVE**

## **ABSTRACT**

This leaflet describes the principles of Ultra Low Volume (ULV) spraying, the equipment required, and the method of applying a range of herbicides in the forest. The future use of ULV methods for herbicide placed sprays is briefly discussed.

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*Front cover:*

Plate 1. The ULVA 8 sprayer producing droplets

# ULTRA LOW VOLUME HERBICIDE SPRAYING

by E. V. ROGERS, N.D.F., M.I.For., C.M.I.W.Sc.

*Work Study Branch, Forestry Commission*

## THE PRINCIPLES OF ULTRA LOW VOLUME (ULV) SPRAYING

The total amount of active ingredient of herbicides used for weeding in the forest is usually between 2 and 10 litres per hectare. To spread this evenly over the large area of leaf surface using a mistblower or knapsack sprayer it must be diluted in 100–700 litres of water. These methods are slow, require water to be carried to and distributed around the site, and are often unpleasant work for the operator.

ULV application spreads the herbicide by producing very large numbers of relatively uniform-sized droplets which are dispersed by gravity and the natural movement of air very evenly over the plantation.

The ULV droplets average 100 microns ( $\frac{1}{10}$  mm) in diameter. This means that approximately 2,000,000,000 droplets are produced from one litre of herbicide.

ULV sprays for forest use are usually formulated in a non-phytotoxic oil and are used without further dilution. The oil formulation prevents the droplets from evaporating between the sprayer and the leaf surface and when they land they are very rain-fast.

## THE SPRAYERS

The basic machine is the ULVA (Ultra Low Volume Applicator) made by Micron Sprayers Ltd. It consists of a plastic tube which can hold 8 or 16 batteries and acts as a handle for the applicator head. The head contains a two tier disc which is spun by a 12 volt, 7 watt, motor. The discs are fed with herbicide from a one litre bottle via a nozzle. Each disc has 360 small teeth on the periphery which act as issuing points for the droplets. Droplet size

depends on the speed of the disc and can be calculated from the formula:

$$\frac{600,000}{\text{RPM of disc,}}$$

e.g. if the disc revolves at 6,000 revolutions per minute the droplet size will be 100 microns.

The herbicide formulation is fed by gravity onto the spinning disc when the one litre bottle is inverted. The flow rate is controlled by the size of the aperture of the nozzle and an air bleed. There are four colour-coded nozzles, each of which has a nominal flow rate, these are:

Yellow:  $\frac{1}{2}$  millilitre/second  
Red: 1 millilitre/second  
Grey: 2 millilitres/second  
Green: 3 millilitres/second

**The actual flow rate depends on the viscosity of the liquid and the temperature; so that calibration is necessary before starting to spray.**

The ULVA 8 (Plate 2) is a development of the ULVA. The upper half of the handle is a square section tube which, for easy transport, collapses into the battery compartment when the 8 batteries are removed. The ULVA 8 is 40 cm longer than the ULVA when extended.

## BATTERIES

The ordinary D size Zinc Chloride battery (e.g. HP2) is not suitable for ULV herbicide spraying as it loses power too quickly. Alkaline manganese batteries are recommended. If 8 batteries are used for  $\frac{1}{2}$  a day and rested for about 20 hours before being used again they will give 15–20 hours total spraying time.

For large programmes, rechargeable

TABLE 1  
SUMMARY OF RECOMMENDATIONS

Situation	Herbicide Formulation	Condition of Crop	Condition of Weed Species	Time of Application	Volume Litres/ha	Applicator	Recommended Nozzle	Swath Width	Remarks
<b>Pre-planting:</b> Preparation of 1-3 year coppice regrowth in cut-over old woodland or scrub.	Silvaproton T	Unplanted. (Actively growing conifers or hardwoods nearby may be affected by the volatilisation of 2, 4, 5 T in mid summer). Do not plant within 6 weeks of spraying.	Susceptible or moderately susceptible broadleaf coppice and seedlings up to 1.5m average height.	Mid June until leaf changes colour in autumn (mid Sept.-end of November). Gorse and broom can be treated all year.	10	ULVA 8	Green	5m	Gorse, broom, bramble, rose and susceptible hardwoods will be killed or very severely cut back. A repeat spot treatment may be used in September on any regrowth.
<b>Post-planting:</b> Cleaning of plantations of conifers that are resistant to 2, 4, 5 T.	Silvaproton T	Resistant conifers over 2 years old and up to 1.5m average height.	Susceptible broadleaf coppice or seedlings and climbers up to 1.5m average height.	Mid August, after the leading shoot has hardened off, until the leaf of the weeds starts to take autumn colouration.	7	ULVA 8	Green	5m	Many susceptible weed species will be killed. Resistant species cut back severely. There may be some leaf scorch on the conifers but they will soon recover.

<b>Bracken: Pre-planting.</b>	<b>Asulox</b>	Unplanted	Bracken should just have finished its fronds and still be rather soft.	July-Mid August	7-5	ULVA 8	Grey	5m	The bracken will show little sign of having been sprayed. It can be flattened before planting. There should be very little regrowth.
<b>Bracken: Post-planting.</b>	<b>Asulox</b>	Resistant conifers. Preferably under the bracken canopy.	As above. If an early weeding has taken place, the bracken should have had time to regrow.	As above. The higher rates should be used for the later application.	5-7.5	ULVA 8	Red or Grey	5m	The bracken should be weeded by hand or machine to free the trees 3-4 weeks after spraying. There should be little regrowth for 2-3 years at least.
<b>Heather Forestry Commission Leaflet 64 gives further details - see p. 15 herein.</b>	<b>Silvapron D</b>	Unplanted. Post-planting. Over 1m high pine or mixed crops. Less than 1m high pure Sitka spruce only.		June-July. Mid July-early September.	15 10 (15 in Sept. only)	ULVA or ULVA 8 ULVA	Green or Grey Red or Grey	5m Single lane	A high percentage kill of the heather can be expected. Final assessment should not be made until June of the year following.





Plate 2. The ULVA 8 in use

Cadmium Nickel batteries can be used. These have an excellent power output. They are charged overnight and each charging will give 5-6 hours spraying. Approximately 80 spraying days are required to break-even in cost with Alkaline Manganese batteries.

#### ANCILLARY EQUIPMENT FOR ULV SPRAYING

To obtain the best results, the herbicide must be applied accurately. To ensure this the following ancillary equipment is recommended. A list of suppliers is included in the Appendix.

##### **Windmeter (Plate 3)**

A wind measuring device which should be carried by the operator to check that the

wind speeds are within the limits shown on page 10. The meter should be held into the wind at the height at which the sprayer disc will be operating and the maximum reading obtained by moving it about.

##### **Smoke Pellets (Plate 4)**

A small pellet, which burns for about a minute, is recommended, particularly for incremental spraying, so that the operator can see the direction of the wind. The pellet can be lit inside a small tin, special care being taken to prevent a fire hazard.

##### **Disc Speed Meter (Plate 5)**

Droplet size is dependent on disc speed which can be checked by means of a vibrating wire meter. It should be held against the rim of the



Plate 3. Using the Dwyer windmeter



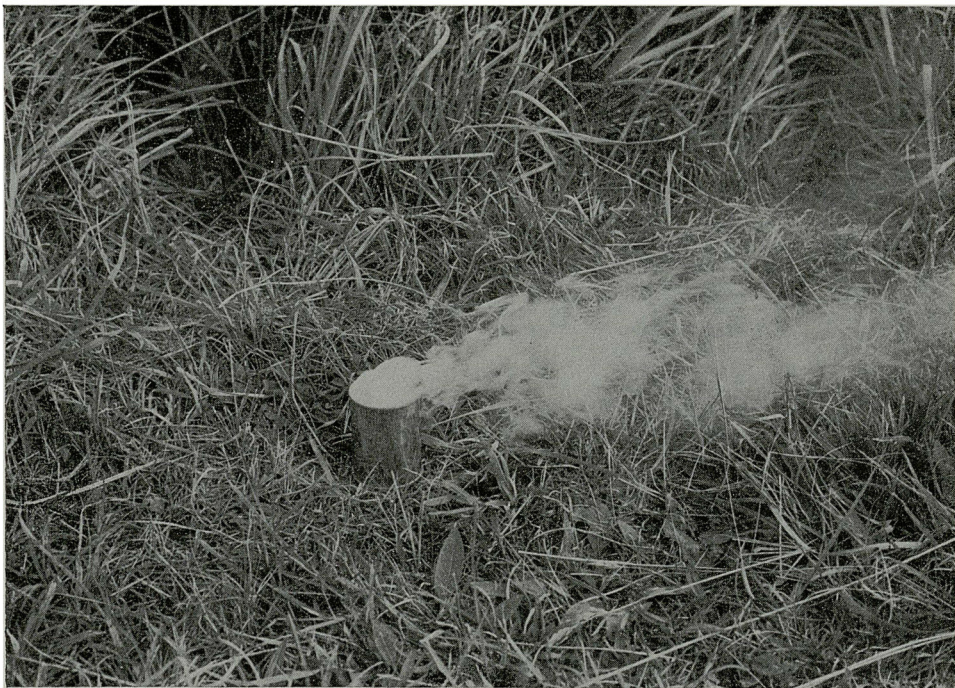


Plate 4. Smoke pellet burning in a small tin

sprayer head, without feeding the disc with herbicide, and the wire moved in and out until it reaches its maximum vibration. 8,000–5,500 RPM is suitable for spraying. If the speed of the disc falls below 5,500, the batteries should be changed (or recharged) or the motor and wiring checked for faults.

#### **Calibration Jug**

Calibration is explained on page 12. A plastic jug, graduated in millilitres, is required for calibration and should be kept in a plastic bag to keep it clean. A 60-second stop watch or watch with a sweep second hand is also required.

#### **Tool Kit**

To obtain maximum efficiency, the operator

should be able to carry out repairs and change motors, nozzles etc in the field. A small kit is recommended (see Appendix, page 18).

#### **Bottle Carriers**

Adapted milk bottle crates can be used to carry up to six one-litre bottles. These are particularly useful to get materials to the site in hill country.

#### **Knapsack Dispenser**

To avoid changing the one litre bottles on the ULVA every five to six minutes when using the green nozzle, a five litre knapsack has been developed from which the one litre bottle can be refilled via a tube and snap connector.



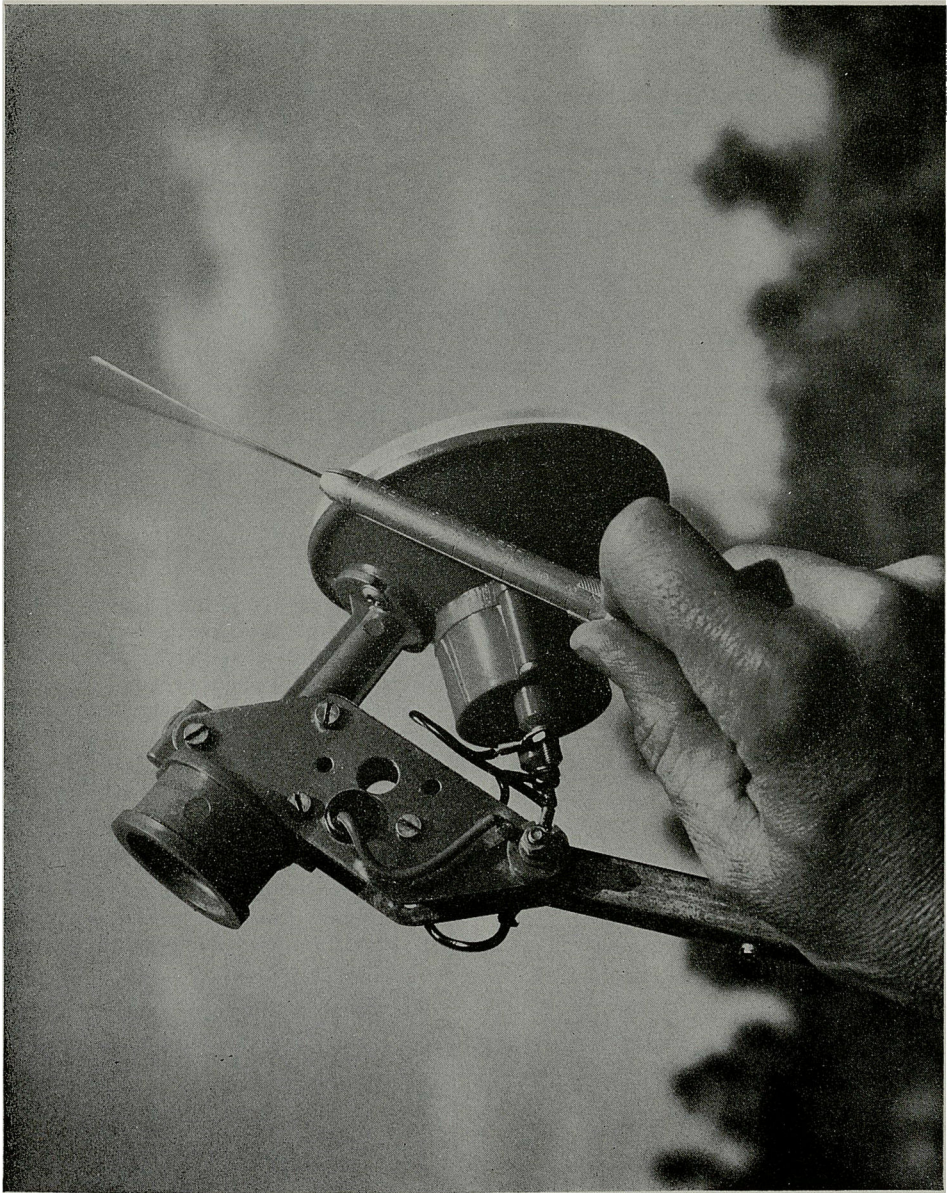


Plate 5. Measuring disc speed with the Vibra-tak

## PROTECTIVE CLOTHING

(Plate 6)

The wearing of protective clothing by the operator is recommended. The small volumes and even droplet size of ULV spraying have made it possible to develop a new type of protective clothing much more comfortable than that used in other types of forest herbicide spraying.

### The ULV Suit

The suit has two layers. The outer layer absorbs and spreads the droplets, the inner prevents the herbicide reaching the operator's clothes. The suit is air permeable and comfortable to wear.

Strong polyurethane coated nylon trousers are available for spraying in deep heather and brambles, etc.

After three to six days of use, the suit should be given a wash in hot water and detergent powder, rinsed, and dried.

The ULV suit is not waterproof but is suitable for wear in heavy mist.

### Respiratory Protection

A disposable paper face mask is recommended, two to four masks should be used per day according to conditions. Heavy mist or perspiration will saturate the mask and impede breathing. The mask will not stop the smell of the herbicide; a fume filter respirator must be used if the operator considers the smell offensive.

### Face Shield

A face shield is recommended to protect the eyes, facial skin and reduce contamination of the face mask. Demisting fluid should be applied to the inside surface and the outer kept clean with a paper towel.

### Boots and Gloves

Oilproof gloves and Wellingtons are recommended when spraying Silvapron T and D; waterproof will suffice for Asulox spraying.

Gloves should always be worn for handling equipment or the herbicide formulations.

### Washing Facilities

A barrier cream can be used on the hands if desired. Soap and water, or Waterless Hand Cleaner, and towels should be available for use before smoking or eating and after work.

## WEATHER CONDITIONS

### Temperature

Most herbicides are more effective if applied during warm sunny weather. Oil-based ULV formulations flow rather more slowly when cold which may affect the rate of application. Avoid leaving them outside overnight in cold weather.

### Wind Speed

Incremental spraying relies on gravity and the wind to distribute the droplets. Gravity makes a 100 micron droplet fall at 27 cm/second in still air so a wind speed of at least 2 mph must be used to distribute the spray. In a 5 mph wind most of the spray will fall in the first 5 metres downwind but some is carried further and produces the very even application effect of ULV spraying. Maximum windspeed should not gust above 12 mph; 2-7 mph is ideal.

For inter-row heather control, movement of the sprayer from side to side across the swath assists in distributing the droplets. A maximum windspeed of 12 mph is recommended for heather control.

### Wind Direction

Ideally the wind should be at right angles to the line of walking but a satisfactory result will be obtained provided the wind direction is not within 20 degrees of the line of walking. Wind direction is not so important when spraying heather between the rows of trees, but for the operator's comfort it should not be directly up or down the row. The direction of





Plate 6. Protective Clothing for ULV Spraying



the wind in hill country or forest is often not the same as that indicated by the clouds.

### Rain

Oil based ULV formulations are rain-fast hence it is safe to spray when rain is expected. Wet vegetation is no deterrent to ULV droplets which will impact onto leaf surfaces through a film of water. Spraying during rain is not recommended as the operator would require waterproof and oilproof protective clothing which is uncomfortable to wear.

### CALIBRATION

Each herbicide formulation has its individual flow rate, and, especially with the oil formulated herbicides, this rate changes with temperature. It is important therefore to check the flow rate from time to time so that walking speed can be adjusted or the nozzle changed to avoid incorrect application rates. Using a measuring jug, the rate can be checked by timing the flow of herbicide through the nozzle and dividing the volume, in millilitres, by the number of seconds. It is also important to check the walking speed and distance walked per litre from time to time.

### TRAINING

Although ULV spraying is simple, the principles need to be well understood if the best results are to be obtained. The operator needs to know how and why to calibrate the sprayer,

how to check the operation of the machine and, because it is a light sophisticated tool in a rugged environment, how to do running repairs in the field.

### OPERATOR SAFETY

The herbicide formulations recommended for ULV spraying have all been cleared by the Pesticides Safety Precautions Scheme and are safe if used according to instructions which are printed on the label.

### SAFETY OF SURROUNDING CROPS

Although most of the herbicide will fall within the spraying area, the smaller size droplets are carried downwind and damage can be expected to the more vulnerable parts of susceptible species for 40–50 m downwind. In trials, no effect has been found beyond 80 m. It would be inadvisable however to spray if susceptible horticultural crops are situated nearby downwind.

### METHODS OF SPRAYING

#### Incremental Spraying (Fig. 1)

Most spraying relies on the spray being deposited directly onto a swath. Incremental spraying, which is the usual ULV spraying method, allows the spray to overlap several swaths. The operator moves upwind and by the time his spray has reached three to five

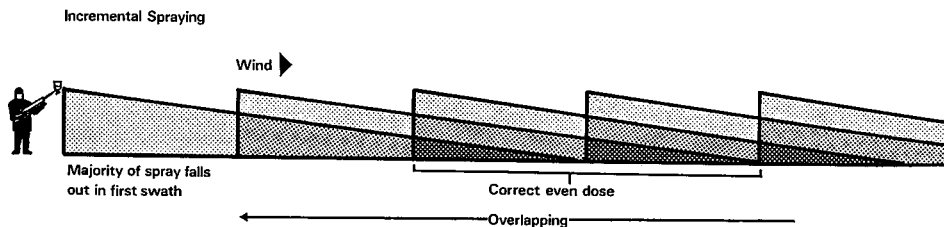


Figure 1. Incremental spraying

swaths, the correct dosage will have been applied. This method gives a very even and thorough distribution of the spray.

### Spraying of Woody Weeds and Bracken (Fig. 2 and Plate 7)

Incremental spraying is used to control woody weeds and bracken. The site should be examined early in the summer to see what preparatory work such as rack cutting is required and to map surrounding forest and agricultural crops. Cutting of access in woody weeds should be carried out some weeks prior to spraying to allow coppice shoots to develop. Access should be *pushed* through

bracken immediately prior to spraying so that the operator can maintain a constant walking speed.

When weather conditions and time are suitable the site should be re-examined prior to spraying, especially if there are adjacent agricultural crops. One or five litre bottles are distributed around the site so that the minimum of walking is required to pick them up when a refill is required. The operator walks through the crop in swaths of approximately five metres, starting downwind, having made allowance for a safety zone if required. The speed of walking should be about three km/hour. The average height of the crop being

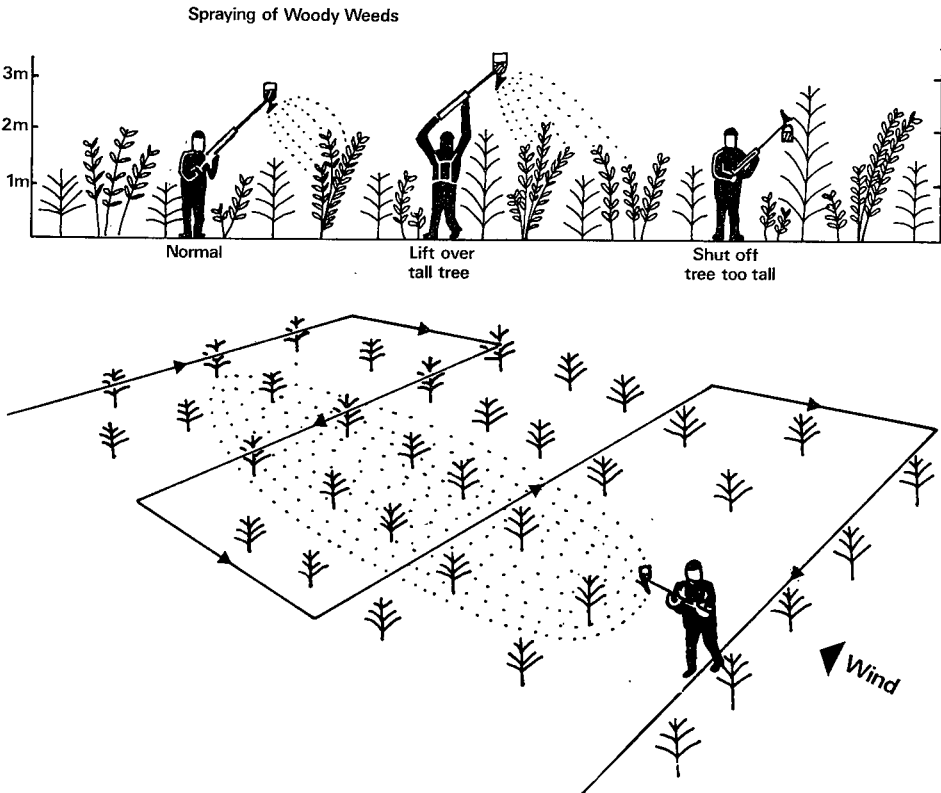


Figure 2. Spraying of Woody Weeds, showing details of application and path followed by operator



Plate 7. Incremental spraying



treated should not be above 1.5 m to allow the ULVA to be kept 1 m above the crop trees. If an oversized tree is passed the ULVA can be turned over to stop spraying as the operator passes.

### Heather Spraying (Fig. 3)

Spraying of heather is completely different from incremental spraying. One litre bottles are distributed on the area so that they can be conveniently picked up as spraying proceeds. The operator walks up each row holding the ULVA head 20 cm above the heather and moving it from side to side to help distribute

the spray between the trees, at the same time attempting to avoid directly spraying the lower branches. The operator proceeds upwind through the crop.

For a more detailed description of heather spraying see Forestry Commission Leaflet No. 64 *Chemical Control of Heather in Plantations* (HMSO, in press).

## SUMMARY OF RECOMMENDATIONS

See Table 1 pages 4-5.

### Heather Spraying

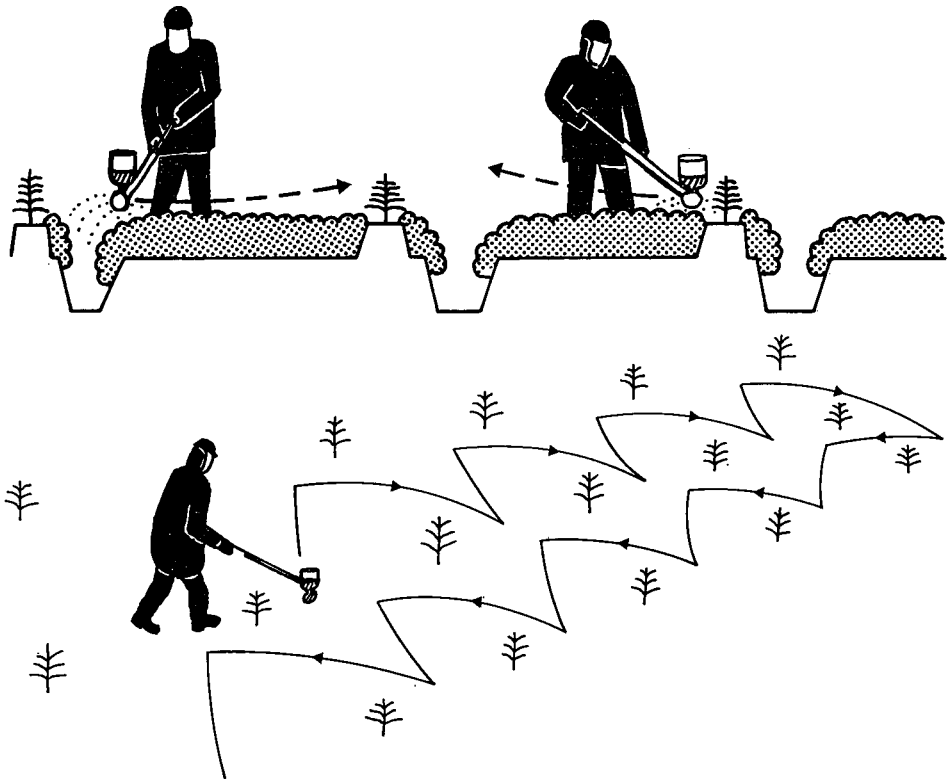


Figure 3. Heather spraying, showing details of application and path followed by the operator

## OUTPUT AND COSTS

ULV control of woody weeds and bracken is quicker and cheaper than knapsack application or mistblowing. An output of 3-4.5 hectares a day should be obtainable for incremental

spraying and 1-2 hectares a day for single row heather spraying. The main savings in heather control are in hilly areas where water does not have to be used as a diluent.

The costs of the operations per hectare (July 1975) are as follows:

TABLE 2  
COSTS

	Herbicide £	Labour £	Overheads £	Batteries and Equipment £	Total £
<b>Silvapron T</b>					
Pre-planting treatment at 10 litres/ha	17.9	2.0-3.0	0.7-1.0	0.2-0.3	20.8-22.2
Post-planting treatment at 7 litres/ha	12.5	2.0-3.0	0.7-1.0	0.2-0.3	15.4-16.8
<b>Asulox</b>					
Pre- or post-planting at 5-7.5 litres/ha	10.2-15.3	2.0-3.0	0.7-1.0	0.2-0.3	13.1-19.6
<b>Silvapron D</b>					
Post-planting single row 10 litres/ha	10.6	4.4-8.9	1.5-2.9	0.5-1.0	17.0-23.4

These costs are based on a 30 per cent incentive allowance on basic pay as at July 1975, and £2.92 per day labour overheads. Cutting access is not included.

## FURTHER DEVELOPMENT WORK

Very effective grass control has been obtained, using a Micron Herbi Herbicide Applicator, with Ciba-Geigy's flowable formulation of Atrazine, Weedex A 500 FW.

The Herbi has low speed motor producing 300 micron droplets which fall out in a 1.2 m wide swath. Work is in progress to develop this machine for forestry. A placed spray of Silvapron T will be possible with this machine

to control brambles etc. in conifer crops or, it is hoped, mixed crops. Flowable formulations of other herbicides are being produced for grass and herbaceous weeds.

## ACKNOWLEDGEMENTS

Mr J. M. Mackenzie and Mr K. Wallis have supplied much of the information on heather control.

Plates Nos. 1, 3, 5-7 are by BP Trading Ltd. The other photographs are by the author.

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4. *Weeding in the Forest—A Work Study Approach*. Forestry Commission Bulletin No. 48. HMSO, 1974. £2.10. W. O. Wittering.



## APPENDIX

### SUPPLIERS

#### HERBICIDES

Silvapron T and D are manufactured by BP Trading Ltd., Agricultural Branch, Britannic House Moor Lane, London EC2Y 9BU and supplied through local BP authorised distributors.

Asulox is manufactured by May & Baker Ltd., Dagenham, Essex and supplied through local agents.

#### SPRAYERS

##### ULVA, ULVA 8

Micro Sprayers, Ltd.  
Three Mills  
Bromyard  
Herefordshire

#### TOOL KIT

The following items are recommended:

- 1 Reel 40/60 Multicore solder
- 1 SP 40 D Weller soldering iron
- 1 Pair Footprint 6" pliers 2742
- 1 Stanley screwdriver No. 2 Pozi 5332
- 1 Stanley screwdriver 2½" 5016
- 1 Stanley screwdriver 3" 5006
- 1 Card Multicore tape solder
- 1 Pair 8A BIB wire strippers
- 1 Proto 4" adjustable wrench 704S
- 1 Proto tool roll 2407

All these items can be supplied by:  
Pillar Engineering Supplies, Ltd.  
PO Box 74  
100 Dysart Way  
Leicester LE1 9JF

#### ANCILLARY EQUIPMENT

##### Batteries

Alkaline Manganese batteries No. 7232 are manufactured by Varta Batteries, Ltd., Varta House, Hangar Lane, London W5 1EH.

##### Wind Meter Dwyer:

Peter Clifford Aviation, Ltd.  
Oxford Airport  
Kidlington  
Oxon

**Smoke Pellets** Boxes of 100:

Brock Fireworks, Ltd.  
Gateside  
Sanquhar  
Dumfries

**Disc Speed Meter** Vibra-tak (High Range):

Rupert Ledger, Ltd.  
White Waltham Air Park  
Lenfield Estate  
Maidenhead  
Berks

**5 Litre Knapsack Refill System** for ULVA and ULVA 8

G.M. Forest Supplies  
Castle Acre Road  
Great Massingham  
Kings Lynn  
Norfolk

**Milk Crate** for holding six one litre bottles (modification is necessary)

12 × 1 pint hand crate from:  
Dairy Supply Company  
Wincanton Engineering, Ltd.  
Whitby Avenue  
Park Royal  
London NW10 7RT

### **PROTECTIVE CLOTHING**

**ULV Spraying Suit:**

Abridge Overalls, Ltd.  
Victoria Gardens  
Burgess Hill  
Sussex

**Face Shield** No. FS/1318/BW with 8 inch (20 cm) clear visor:

James North & Sons, Ltd.  
PO Box No. 3  
Hyde  
Cheshire SK14 1RL

**Face Mask** 3M's brand 8500, in boxes of 50:

Herts Packaging Co.  
53 London Road  
St Albans  
Herts

**Gloves** No. 485 11 inch (27·5 cm), or No. 487 14 inch (35 cm):

James North & Sons, Ltd.  
PO Box No. 3  
Hyde  
Cheshire SK14 1RL

**Oil Proof Boots** Edmar chemically resistant boot:

Clark, Hoy & Co., Ltd.  
Fen Street  
Canning Town  
London E16 1JT

#### GENERAL

G.M. Forest Supplies of Castle Acre Road, Great Massingham, Kings Lynn, Norfolk, are able to supply most of the goods listed in this appendix.

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