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**HERBICIDE UPDATE (SPRING 1996), by Ian Willoughby**

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**Summary**

This Note summarises Forestry Commission research findings concerning herbicides during 1995 and details relevant changes in regulations, approved products, herbicide costs and applicators affecting the use of herbicides in forestry. This Note will be revised when necessary, to update the information contained in Forestry Commission Field Book 8 *The use of herbicides in the forest*.

**Disclaimer**

This Research Information Note is not intended as an endorsement or approval of any product or service to the exclusion of others that may be available. The Forestry Commission accepts no responsibility for any loss or damage resulting from following any advice in this Note.

Research trials are by nature on a small scale compared with operational practice. Users are advised to test small areas to gain familiarity with new products and techniques, before engaging in large scale treatments.

**Introduction**

1. The changeable nature of the forestry herbicide field, coupled with its inherent complexity, can sometimes make the subject appear unfathomable to the busy forest manager.

Forestry Commission Field Book 8 *The use of herbicides in the forest* (Willoughby and Dewar, 1995) aims to reduce the subject into easily digestible sections, covering legislation, good working practices, approvals and application techniques. However, changes in legislation, approvals and research findings make it necessary to update and change the recommendations in Field Book 8 between revisions. This Note is issued as a brief summary for users, to advise them of some of the most important changes in the forestry herbicide field over the past year. A new publication, Field Book 14 (Willoughby and Clay, 1996) will deal with the implications of the revised long-term off-label arrangements for herbicide use in farm woodlands and short rotation coppice; this should be regarded as a supplement to rather than a substitute for Field Book 8.

**Recent research findings*****Glasshouse trials***

Recent glasshouse experiments carried out on contract by David Clay of Avon Vegetation Research at Long Ashton Research Station, have yielded the following results.

2. *Deschampsia flexuosa*

*Deschampsia flexuosa* (wavy hair grass) can be a serious problem weed in recently established plantations on sandy and peaty soils in the UK. Propyzamide, a commonly used winter applied grass killer, is not completely effective against *Deschampsia flexuosa*. The other commonly used herbicide, glyphosate, is not always effective, and must be applied as a directed spray within the growing season, so increasing application costs. In a series of pot trials in glasshouses, cycloxdim

(Laser) and imazapyr (Arsenal) were both found to be more effective than traditional glyphosate or propyzamide regimes. Cycloxdim can be safely sprayed over most conifer and broadleaved species in active growth, which allows cheap mechanised applications to take place. Unfortunately cycloxdim does not yet have forestry approval but this is being sought by the manufacturers. User trials may be possible under experimental permit. Forestry Commission managers should contact Research Division should they wish to take this further.

Imazapyr is a broad spectrum herbicide which will control and prevent regrowth of *Deschampsia flexuosa* and most other grass and herbaceous weeds for up to 2 years after treatment. It can only be used as a pre-plant treatment at least 5 months prior to planting Corsican pine, Scots pine or Sitka spruce.

Table 1 summarises some of the options now available for the control of *Deschampsia flexuosa* in forestry.

### 3. Annual nursery weeds

There is a lack of information about which residual herbicides will give long-term control of problem annual weeds in forest nurseries. Table 2 shows the effect of six commonly used nursery herbicides on six problem weed species grown in a light sandy soil. The herbicides were applied at three rates – one-third recommended rate, recommended rate and three times normal recommended rate. These results give guidance on specific herbicide choice for problem nursery weeds. The dose rates and products used are shown in Table 3.

Except for metazachlor, which is also approved for farm forestry use, these herbicides must only be used in forest nurseries. Full details of regimes, crop tolerance and product rates can be found in Forestry Commission Technical Paper 3 *Forest nursery herbicides* (Williamson *et al.*, 1993).

### 4. Rhododendron control

Imazapyr (Arsenal 50F) is the most effective forestry approved herbicide available for the control of rhododendron.

The speed of translocation of imazapyr in rhododendron was investigated in a glasshouse trial. This showed that effective control can be achieved by leaving as little as 2 days after herbicide application, before cutting treated bushes.

A further trial investigated whether imazapyr can spread from sprayed to unsprayed plants through root contact. Mixtures of Sitka spruce and rhododendron grown as mixed and pure species, were tested. Results suggested that transfer of imazapyr from the roots of treated plants to adjacent trees is unlikely to occur. However, root grafting between plants or trees of the same species grown closely together may facilitate translocation to non-target vegetation.

Imazapyr can also be used as a pre-planting treatment to clear the sites of heavy growth of a variety of grass, herbaceous and woody weed species. It remains active in the soil and can continue to prevent weed germination for one to two growing seasons after application. A pot trial investigated the possibility of imazapyr present in woody debris affecting the growth of newly planted trees. No effect was found on ash or Sitka spruce, and it is reasonable to conclude that it is safe to cultivate a site after spraying with imazapyr, prior to planting recommended tree species.

Full results of the Avon Vegetation Research trials in 1994 are detailed in the contract report (Clay and Dixon, 1995), which is available on request.

## **Field trials**

### 5. *Deschampsia*

Field trials at Thetford Forest District confirm the results reported above for *Deschampsia flexuosa* control.

**Table 1. Options for controlling *Deschampsia flexuosa***

| Active ingredient | Formulation                     | Product                                    | Manufacturer           | Approval status                         | Method of application            | Efficacy on established <i>Deschampsia flexuosa</i> | Residual control of germinating weeds | Rate                                 | Adjuvant                              | Cost/ha (treated)  |
|-------------------|---------------------------------|--|------------------------|---|----------------------------------|---|---------------------------------------|--------------------------------------|---------------------------------------|--------------------|
| Cycloxdim         | 200g/litre                      | Laster/Stratos                             | BASF                   | Experimental approval only for forestry | Overall (mechanised) or directed | ✓✓  | No                                    | 1.12-2.25 l/ha *1                    | 0.8% Actipron essential               | £50<br>£101        |
| Glyphosate        | 360g/litre                      | Roundup Pro Blactive *2                    | Monsanto               | Forestry label approval                 | Directed                         | ✓   | No                                    | 5 l/ha                               | 0.1% Agral or 2% Mixture B beneficial | £35                |
| Imazapyr          | 50g/litre                       | Arsenal 50F                                | Cyanamid/Nomix Chipman | Forestry label approval                 | Pre-plant only                   | ✓✓  | Yes                                   | 7.5 l/ha                             | 0.1% Agral beneficial                 | £150               |
| Propyzamide       | 400g/litre<br>50% w/w<br>4% w/w | Kerb Flowable<br>Kerb 50W<br>Kerb Granules | P.B.I./Rohm + Haas     | Forestry label approved                 | Overall (mechanised) or directed | ✓   | Yes                                   | 3.75 l/ha<br>3.0 kg/ha<br>38.0 kg/ha | No                                    | £90<br>£81<br>£152 |

Key: ✓✓ = Good degree of control possible.

✓ = Moderate to good control possible.

\*1 = Best control will be achieved at rates of 2.25 l/ha; this is the recommended application rate. Levels of control at 1.12 l/ha are more variable, but are usually at least as good as glyphosate or propyzamide.

\*2 = Alternative approved products are available; refer to later section of this Note for details.

Table 2. The effect of six nursery herbicides on weeds sown before and one month after spraying

| Herbicide          | Weed species |        |        |        |           |        |          |        |         |        |           |        |    |
|--------------------|--------------|--------|--------|--------|-----------|--------|----------|--------|---------|--------|-----------|--------|----|
|                    | Epilobium    |        | Poa    |        | Stellaria |        | Spergula |        | Senecio |        | Cardamine |        |    |
|                    | Time 1       | Time 2 | Time 1 | Time 2 | Time 1    | Time 2 | Time 1   | Time 2 | Time 1  | Time 2 | Time 1    | Time 2 |    |
| Chlorthal-dimethyl | MS           | R      | MS     | MR     | MS        | R      | R        | MS     | R       | R      | MS        | R      | R  |
| Diphenamid         | S            | MR     | S      | S      | MS        | MS     | MS       | MS     | MR      | MS     | MS        | S      | MS |
| Lenacil            | S            | S      | S      | S      | S         | S      | S        | S      | S       | S      | S         | S      | S  |
| Metamitron         | S            | R      | S      | S      | S         | S      | S        | S      | S       | S      | S         | S      | S  |
| Metazachlor        | S            | S      | S      | S      | S         | S      | S        | S      | S       | S      | S         | S      | S  |
| Napropamide        | S            | S      | S      | S      | MS        | MS     | MS       | MS     | MS      | MS     | MS        | S      | S  |

Notes:

- Time 1 = Weeds emerging from 2 days after herbicide applied to bare soil.
- Time 2 = Weeds emerging from 1 month after herbicide applied to bare soil.
- S = Killed by all doses.
- MS = Some survival at lowest dose.
- MR = Little effect, but 50% growth reduction from recommended dose.
- R = No significant growth reduction at any dose.

Weeds:

- Epilobium ciliatum* - American willowherb
- Poa annua* - Annual meadow grass
- Stellaria media* - Common chickweed
- Spergula avensis* - Corn spurrey
- Senecio vulgaris* - Groundsel
- Cardamine hirsuta* - Hairy bitter-cress

**Table 3. Dose rates for nursery herbicide experiments**

| <i>Chemical</i>    | <i>Product</i> | <i>% a.i. + Formulation</i> | <i>Doses (kg/ha a.i.)</i> |      |       |
|--------------------|----------------|-----------------------------|---------------------------|------|-------|
|                    |                |                             |                           |      |       |
| chlorthal-dimethyl | Dacthal        | 75% w/w WP                  | 1.5                       | 4.5  | 13.5  |
| diphenamid         | Enide 50W      | 50% w/w WP                  | 1.67                      | 5.0  | 15.0  |
| lenacil            | Venzar         | 80% w/w WP                  | 0.59                      | 1.76 | 5.28  |
| metamitron         | Goltix WG      | 70% w/w WG                  | 1.17                      | 3.5  | 10.5  |
| metazachlor        | Butisan S      | 500 g/l SC                  | 0.42                      | 1.25 | 3.75  |
| napropamide        | Devrinol       | 450 g/l SC                  | 1.35                      | 4.05 | 12.15 |

#### 6. Use of broad spectrum herbicides in the dormant season

Trials were carried out to test whether broad spectrum herbicides are effective in controlling weeds without damage to crop trees when applied as an overall spray to fully dormant trees. Dormant season sprays would be of use in restocking and new planting where directed applications are impractical or too costly. Tables 4 and 5 summarise the findings of this trial.

**Table 4. Crop tolerance from herbicides applied in the dormant season**

| <i>Species</i>      | <i>Glufosinate ammonium</i> | <i>Glyphosate</i> | <i>Amitrole</i> |
|---------------------|-----------------------------|-------------------|-----------------|
| Sitka spruce        | X                           | ✓✓                | X               |
| Norway spruce       | X                           | ✓✓                | X               |
| Douglas fir         | X                           | ✓ <sup>1</sup>    | X               |
| Corsican pine       | X                           | ✓✓                | X               |
| Scots pine          | X                           | ✓✓                | X               |
| Lodgepole pine      | X                           | ✓✓                | X               |
| Japanese larch      | ✓✓                          | ✓✓                | X               |
| Oak                 | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Ash                 | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Sycamore            | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Beech               | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Cherry              | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Birch               | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Alder               | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Chestnut            | ✓✓                          | ✓ <sup>2</sup>    | X               |
| Poplar <sup>4</sup> | ✓✓                          | ✓ <sup>2</sup>    | ✓✓ <sup>3</sup> |
| Willow <sup>4</sup> | ✓✓                          | ✓ <sup>2</sup>    | ✓✓ <sup>3</sup> |

Notes:

- ✓✓ Safe to apply over the species listed, so long as trees are fully dormant, at the rates detailed in Table 5.
- ✓ Safe in most cases to apply over the species listed, so long as trees are fully dormant, at the rates listed in Table 5, but some damage may sometimes occur.
- X Not safe to spray over species listed; use as a directed spray only.
- <sup>1</sup> Douglas fir is much more sensitive than other conifers; aim to use directed sprays whenever possible.
- <sup>2</sup> In the Headley nursery trial, broadleaves were not damaged by applications of glyphosate at 1.5 l/ha. However, other trials have given variable results; it is probably safer to use glufosinate ammonium.
- <sup>3</sup> The poplar and willow used in the experiment were cuttings, where the cut surface had had time to harden off.
- <sup>4</sup> In the spring, over cuttings only.

Note that in the Headley nursery experiment, all trees appeared dormant – **buds were tightly closed, stem elongation had ceased, leader growth had hardened and deciduous species had dropped all their leaves**, but March applications were less damaging than those made in January.

**Table 5. Product and rate details for dormant season herbicide applications**

| <i>Product</i>  | <i>Active ingredient</i>        | <i>Manufacturer</i>                          | <i>Rate</i>           |
|---|---------------------------------|--|-----------------------|
| Challenge/<br>Harvest   | 150 g/l glufosinate<br>ammonium | AgrEvo                                       | 5 l/ha                |
| Roundup Pro Biactive<br>(various other<br>products available) | 360 g/l glyphosate              | Monsanto<br>(various other<br>manufacturers) | 1.5 l/ha <sup>1</sup> |
| Weedazol  | 225 g/l amitrole                | Bayer  | 20 l/ha               |

Note:

- <sup>1</sup> Glyphosate can be used up to 2.0 l/ha in the uplands.

Directed sprays of broad spectrum herbicides reduce the risk of crop damage, and allow the use of higher product rates to control difficult weeds. However, glyphosate at 1.5 l/ha (up to 2 l/ha is listed as safe on the product label for the uplands) is recommended as a safe overall treatment for conifers, and glufosinate ammonium at 5 l/ha for broadleaves in early March, provided trees are fully dormant, i.e buds tightly closed, stem elongation ceased, leader growth hardened, and leaves or needles shed in deciduous species. It should be noted that a period of mild weather prior to application, particularly at the end of winter or early spring, may make trees more susceptible to damage. In addition, applications to damaged bark, or directly to fine roots, are likely to cause damage, particularly from glyphosate which is rapidly translocated.

Amitrole is an alternative treatment for dormant poplar and willow cuttings only, if applied in early spring at 20 l/ha or less.

Glufosinate ammonium, glyphosate and amitrole will control a wide spectrum of grass and herbaceous species in winter and early spring, provided weeds are green and actively growing, and applications are made in frost free conditions. Glufosinate ammonium will work quickest, but it is probably less effective at controlling deep rooted and perennial species than glyphosate or amitrole.

Glyphosate and glufosinate ammonium both have full forestry approval, but glufosinate ammonium only has approval for use between 1 March and 30 September at the present. Amitrole is approved only for use in farm woodlands and short rotation coppice under the long-term off-label arrangements.

Full details of this trial are published in Willoughby (1996).

#### 7. Rhododendron

Field trials on the control of rhododendron regrowth from cut stumps are summarised in Edwards and Morgan (1996). These trials show that an application of imazapyr as a 20% solution to cut stumps within 5 days of cutting, completely inhibits any regrowth. More details on the use of imazapyr in forestry can be found in Research Information Note 233, *Rhododendron control by imazapyr* (Edwards, Morgan and Tracy, 1993) and Field Book 8.

#### 8. Birch

Nursery trials in 1985 showed that isoxaben (Gallery 125 or Flexidor 125, both forestry approved) applied at 2 l/ha can effectively control up to 85% of birch seedlings germinating early in the following growing season. This may be an alternative to cutting and stump treatment of established birch in plantations. The isoxaben products should be applied to fine, clod free soil, prior to weed emergence in the spring. As detailed in Field Book 8, isoxaben will also control a range of germinating herbaceous weeds, and can be used as a tank mix with propyzamide in the winter to give residual control of a range of germinating herbaceous and grass weeds.

### Regulatory changes

9. The labels of products containing 2,4-D require users to wear personal protective clothing when applying them at the specified volume (dilution) rates. They also state specifically that volumes of less than 200 l/ha may not be used. This means that 2,4-D products may not be used through very low volume applicators such as the ULVAFOREST. Managers wishing to control heather pre-planting using the ULVAFOREST may still use glyphosate in this role. Further details of the regulations affecting reduced volume applications can be found in Field Book 8.

Although the maximum approved product rate for atrazine in forestry is 13 l/ha, Field Book 8 suggests a maximum rate for use in broadleaved plantations of 9 l/ha. If soils are light, or trees under stress, it is safest to restrict rates to a maximum of 6.5 l/ha. Ash is particularly sensitive. This will reduce efficacy against grasses, and unless managers are involved in farm forestry (new planting on better land), where they can use a mix of 5 l/ha atrazine with 4 l/ha cyanazine, it may be better to use alternative grass killers such as propyzamide.

No other major changes in pesticide approvals relevant to forestry users have taken place since the publication of Field Book 8, but consultation is taking place over the definition of fields of use for pesticide products. Further information will be issued if this results in any changes to the approvals.

### Costs

10. Table 6 gives guidance on costs of all approved forestry herbicides. These costs do NOT include application costs, and are INDICATIVE ONLY – they do not necessarily reflect precise prices available from individual suppliers.

**Table 6. Forestry approved herbicides – guideline herbicide costs November 1995**

| <i>Active ingredient</i>    | <i>Cost/litre or kg</i> | <i>Cost of herbicide/<br/>treated ha (£)</i> |
|-----------------------------|-------------------------|--|
| ammonium sulphamate         | 3.00                    | Variable                                     |
| asulam                      | 9.00                    | 45.00–90.00                                  |
| atrazine                    | 3.00                    | 27.00–40.50                                  |
| clopyralid                  | 65.00                   | 33.00–65.00                                  |
| cyanazine                   | 13.00                   | 52.00  |
| 2,4-D                       | 4.00                    | 32.00–52.00                                  |
| dalapon/dichlobenil         | 6.00                    | 210.00–390.00                                |
| 2,4-D/dicamba/triclopyr     | 18.00                   | 54.00–90.00                                  |
| dicamba                     | 23.00                   | 115.00                                       |
| diquat/paraquat             | 8.00                    | 24.00–44.00                                  |
| fluazifop-p-butyl (250 g/l) | 90.00                   | 135.00                                       |
| glufosinate ammonium        | 11.00                   | 33.00–55.00                                  |
| glyphosate                  | 7.00                    | 10.50–70.00                                  |
| imazapyr                    | 20.00                   | 150.00–300.00                                |
| isoxaben                    | 51.00                   | 102.00                                       |
| metazachlor                 | 30.00                   | 75.00  |
| paraquat                    | 8.00                    | 24.00–44.00                                  |
| pendimethalin               | 9.00                    | 45.00  |
| propaquizafop               | 48.00                   | 34.00–72.00                                  |
| propyzamide                 |                         |  |
| granules                    | 4.00                    | 152.00                                       |
| wetable powder              | 27.00                   | 81.00  |
| flowable                    | 24.00                   | 90.00  |
| triclopyr                   | 20.00                   | 40.00–160.00                                 |

**Notes:**

The above costs are indicative only, and do not take account of any discounts or extra costs for order size or delivery, etc.

The costs per hectare shown are per treated hectare for herbicide only, and do not include the cost of application. Thus, if spots or strips around trees are treated instead of the whole area, costs will be considerably less for a gross hectare of woodland. Field Book 8 gives details on the calculation of costs of herbicide treatment depending on area treated and application technique used.



## Applicators

11. Several Technical Development Branch publications which relate to forestry herbicide use have been produced in 1995.

Information Note 11/94 gives details of the Bastion 15 Knapsack Sprayer. This sprayer should be considered when orders are being placed for knapsack sprayers.

Technical Note 1/95 details Ulvaforest boom modifications, and Report 13/94 describes the Airtec system modification of the upland Ulvaforest.

Technical Note 8/95 gives an introduction to the use of tractor-mounted sprayers in farm woodlands.

The above publications, and further information on applicators and equipment for use with forestry herbicides, are available from: Technical Development Branch, Forestry Commission Research Division, Ae Village, Dumfries, DG1 1QB. Telephone: 01387 860264.

## References

Edwards, C. and Morgan, J.L. (1996). Control of *Rhododendron ponticum* by stump application of herbicides following mechanical clearance. *Proceedings of Crop Protection in Northern Britain*, March 1996.

Edwards, C., Tracy, D.R. and Morgan, J.L. (1993). *Rhododendron control by imazapyr*. Forestry Commission Research Information Note 233.

Williamson, D., Mason, B., Morgan, J. and Clay, D. (1993). *Forest nursery herbicides*. Forestry Commission Technical Paper 3.

The above are available from Forestry Commission Research Division, Alice Holt Lodge, Wrecclesham, Farnham, Surrey, GU10 4LH. Telephone: 01420 22255.

Clay, D.V. and Dixon, F.L. (1995). *Forest herbicide evaluation – pot experiments 1994*. Unpublished report by Avon Vegetation Research to the Forestry Commission Research Division. Available on request to Silviculture and Seed Research Branch, Alice Holt Lodge.

Willoughby, I. and Clay, D.V. (1996). *Herbicides for farm woodlands and short rotation coppice*. Forestry Commission Field Book 14. HMSO, London.

Willoughby, I. and Dewar, J. (1995). *The use of herbicides in the forest*. Forestry Commission Field Book 8. HMSO, London.

The above 2 Field Books are available by mail order from HMSO Publications Centre, PO Box 276, London, SW8 5DT. Telephone: 0171 873 9090. Orders for HMSO publications may also be placed with HMSO Bookshops and all good booksellers.

## APPENDIX

### Approved products as of December 1995

#### *Products with full forestry label approval*

| <i>Active ingredient</i>                       | <i>Product (manufacturer)</i>  |
|--|--|
| ammonium sulphamate                            | Amcide (BH&B)  |
|  | Root-out (Dax Products)  |
| asulam   | Asulox (RP Environmental)  |
| atrazine                                       | Atlas atrazine (Atlas)   |
|  | Atrazol (Sipcam)   |
|  | Unicrop Flowable Atrazine (Unicrop)  |
|  | Dicotox Extra (RP Environmental)   |
| 2,4-D  | MSS 2,4-D Ester (Mirfield)   |
| 2,4-D/dicamba/triclopyr<br>dalapon/dichlobenil | Broadshot (Cyanamid)   |
|  | Fydulan G (Nomix-Chipman)  |
|  | <i>Note: stocks in existence at time of writing, but manufacture has ceased.</i> |
| dicamba  | Tracker (PBI)  |
| diquat/paraquat                                | Farmon PDQ (Farm Protection)   |
|  | Parable (Zeneca)   |
| fosamine ammonium                              | Krenite (Du Pont)  |
|  | <i>Note: stocks in existence at time of writing, but manufacture has ceased.</i> |
| glufosinate-ammonium                           | Challenge (AgrEvo)   |
|  | Harvest (AgrEvo)   |
|  | Headland Sword (Headland)  |
| glyphosate                                     | Barbarian (Barclay)  |
|  | Barclay Gallup (Barclay)   |
|  | Barclay Gallup Amenity (Barclay)   |
|  | Clayton Glyphosate (Clayton)   |
|  | Clayton Swath (Clayton)  |
|  | Glyfos (Cheminova)   |
|  | Glyphogan (PBI)  |
|  | Glyphosate 360 (Top Farm)  |
|  | Hilite (Nomix-Chipman) – CDA formulation   |
|  | Helosate (Helm)  |
|  | Outlaw (Barclay)   |
|  | Portman Glyphosate 360 (Portman)   |
|  | Roundup (Monsanto)   |
|  | Roundup (AgrEvo)   |
|  | Roundup Biactive (Monsanto)  |
|  | Roundup Biactive Dry (Monsanto)  |
|  | Roundup Pro Biactive (Monsanto)  |
|  | Stacato (Unicrop)  |
|  | Stefes Glyphosate (Stefes)   |
|  | Stefes Kickdown 2 (Stefes)   |
| Stetson (Monsanto)                             |  |
| Stirrup (Nomix-Chipman) – CDA formulation      |  |

|             |                                  |
|-------------|----------------------------------|
|             | Typhoon 360 (Chiltern)           |
| imazapyr    | Arsenal 50F (Nomix-Chipman)      |
| isoxaben    | Gallery 125 (DowElanco)          |
|             | Flexidor 125 (DowElanco)         |
| paraquat    | Barclay Total (Barclay)          |
|             | Gramoxone 100 (Zeneca/AgrEvo)    |
|             | Scythe LC (Cyanamid)             |
| propyzamide | Headland Judo (Headland)         |
|             | Kerb Flo (PBI Rohm + Haas)       |
|             | Kerb 50W (PBI, Rohm + Haas)      |
|             | Kerb Granules (PBI, Rohm + Haas) |
| triclopyr   | Garlon 4 (DowElanco)             |
|             | Timbrel (DowElanco)              |
|             | Chipman Garlon 4 (Nomix-Chipman) |

***Products with full farm forestry label approval***

| <i>Active ingredient</i> | <i>Product (manufacturer)</i> |
|--------------------------|-------------------------------|
| propaquizafop            | Falcon 100 (Cyanamid)         |
|                          | Shogun 100 EC (Ciba-Geigy)    |

***Products with forestry off-label approval***

| <i>Active ingredient</i> | <i>Product (manufacturer)</i> |
|--------------------------|-------------------------------|
| clopyralid               | Dow Shield (DowElanco)        |

***Products with farm forestry off-label approval***

| <i>Active ingredient</i> | <i>Product (manufacturer)</i> |
|--------------------------|-------------------------------|
| cyanazine                | Fortrol (Cyanamid)            |
| fluazifop-p-butyl        | Fusilade 5 (Zeneca)           |
|                          | Fusilade 250 EW (Zeneca)      |
| metazachlor              | Butisan S (BASF)              |
| pendimethalin            | Stomp (Cyanamid)              |

Full details of the method of use for products containing these active ingredients can be found in Forestry Commission Field Book 8. Additional products made available for use under the long-term off-label arrangements covering farm forestry and short rotation coppice are detailed in Field Book 14 (Willoughby and Clay, 1996).

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