



Forestry Commission

Field Book 14

Herbicides for Farm Woodlands and Short Rotation Coppice

Ian Willoughby and David Clay



1996 Edition

Front Cover, Background: Weeds compete for moisture and nutrients, and hence reduce tree growth and survival. However some vegetation cover can be beneficial for amenity or wildlife, particularly between weed free spots, and when trees become established. This 3-year-old poplar would still benefit from spot weeding. (41440)

Inset, top: A normal agricultural sprayer adapted by the addition of a short boom on the rear of the sprayer. The use of short treeshelters allows non-selective broad-spectrum herbicides to be used, but may prove costly in high density woodlands designed for rapid establishment and quality timber production. (40156)

Inset, bottom: This new planting of ash has been kept weed free through the use of appropriate residual herbicides. Complete weed control of these 2m x 2m spaced trees has been practised to maximise early tree survival and growth. Note the profuse weed growth on untreated areas to the margins. (I. Willoughby)

Back Cover, Left: Tractor mounted boom sprayers are a cheap method of applying broad spectrum herbicides pre-planting, or more selective products post-planting. (38974)

Back Cover, Right: A healthy ash transplant with a 1m spot kept weed free through the use of herbicides. (39251)

Forestry Commission

Field Book 14

Herbicides for Farm Woodlands and Short Rotation Coppice

by Ian Willoughby

*Forestry Commission
Research Division*

and David Clay

*Avon Vegetation Research
P.O. Box 1033
Nailsea
Bristol
BS19 2FH*

LONDON: HMSO

© Crown copyright 1996

Applications for reproduction should be made to HMSO, The Copyright Unit,
St Clements, 2-16 Colegate, Norwich NR3 1BQ

ISBN 0 11 710336 5

FDC 414:441:236.1:307

Keywords: *Herbicides, Farm forestry*

Abstract

This publication gives information about the use of herbicides in farm woodlands and short rotation coppice. Recommendations are given for suitable herbicides for a range of crop and weed species.

Disclaimer

This publication 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 Field Book.

Enquiries relating to this publication should be addressed to:

The Research Communications Officer
Forestry Commission Research Division
Alice Holt Lodge, Wrecclesham
Farnham, Surrey GU10 4LH

Contents

1. Introduction	1
2. Approval status	2
Full approval	2
Specific off-label approval	2
Long-term off-label arrangements	3
3. Approved products	5
Product mode of action	5
Methods of application	5
Table 1 – Summary of approved products and their uses	6–9
Timing	10
General	10
Pre-emergent herbicides	11
Foliar-acting herbicides	12
4. Crop tolerance	14
Table 2 – Tree species screened for herbicide tolerance	14
Table 3 – Crop tolerance	15–16
5. Weed susceptibility	17
Table 4 – Susceptibility of common arable weeds to selective pre-emergent farm forestry herbicides	18–21
Table 5 – Susceptibility of common arable weeds to selective post-emergent farm forestry herbicides	22–25
6. Herbicide mixtures	26
Table 6 – Farm forestry herbicide tank mixes (all herbicides at approved rates)	27
7. Further reading	28
8. Appendix – Notices of approval (specific off-labels)	29
– Long-term off-label arrangements	58

2 Approval status

Under the Control of Pesticides Regulations 1986, all pesticides, including herbicides, used in farm woodlands must be approved by the Pesticides Safety Directorate of MAFF for that use. Approval may be full, with a label recommendation, or may be off-label as explained below.

Full approval

Products with full on-label or specific off-label approval for use in forestry, **CAN** be used in farm woodlands and short rotation coppice. The reverse **DOES NOT** apply.

The only herbicides with approval for use in forestry that are treated in detail in this publication are atrazine (Atlas Atrazine/Unicrop Flowable Atrazine), isoxaben (Gallery/Flexidor) and propyzamide (Kerb) because they are useful in mixes with other products in farm woodland situations. Glyphosate and glufosinate ammonium are contact herbicides that are included for comparison because of their broad spectrum of activity.

Propaquizafop (Shogun/Falcon) has full-label approval for use in farm forestry.

Specific off-label approval

In some instances the Pesticides Safety Directorate will issue specific off-label approval for existing products, which may be of importance for a minor use such as forestry, but where anticipated sales volumes are not sufficient to persuade manufacturers to carry out the research and development required to obtain full-label approval. In these cases, all applications are made at the user's own risk, and all conditions of use detailed on the product label must still be complied with. In addition, users must obtain a copy of the off-label approval document itself, and comply with all conditions of use therein. Copies of all specific off-label approvals referred to in this Field

Book are included in the Appendix. Specific off-label approvals relate to individual products, not to active ingredients. It is not permissible to substitute an alternative product with the same active ingredient.

Products with specific off-label approval:

Clopyralid (Dow Shield) – specific off-label approval for use in forestry.

Metazachlor (Butisan S), cyanazine (Fortrol), fluazifop-p-butyl (Fusilade 250EW) and pendimethalin (Stomp) – specific off-label approval for use in farm forestry.

Atrazine (Unicrop Flowable Atrazine) has a specific off-label approval extending its use to broadleaved trees – the full label approval is only for coniferous trees.

Long-term off-label arrangements

In addition to the two main types of approval, namely full on-label and specific off-label approval, certain fields of use may be covered by long-term off-label arrangements, which are valid until 31 December 1999.

The long-term arrangements grant off-label approval to certain fields of use, rather than to specific products. The same basic principles as specific off-label approval apply, namely users must comply with all label conditions of use as well as additional off-label restrictions, and all applications are made at the user's own risk.

Fields of use

The following extensions of use are permitted under the long-term arrangements:

- Herbicides with full or provisional label approval for use on cereals, may be used in the first five years of establishment of new farm woodlands (including short rotation energy coppice), on land previously under arable cultivation or improved grassland (as defined in the Woodland Grant Scheme).

- Herbicides with full or provisional label approval for use on cereals, oil-seed rape, sugar beet, potatoes, peas and beans, may be used in the first year of regrowth following cutting in short rotation energy coppice, on land previously under cultivation or improved grassland (as defined in the Woodland Grant Scheme).

Conditions of use

As well as the usual good working practices required of users, certain **additional** conditions **MUST** be complied with when applying pesticides under the long-term off-label arrangements – these are detailed in the appendix.

Practical implications

The long-term off-label arrangements should allow a wider range of products to be used in the initial years after planting. Farm managers may be familiar with many of them and already using the same products over different agricultural crops. However, the Forestry Commission Research Division can only offer guidance on those products that have been found to be effective and safe to trees, in small-scale trials programmes. Consequently, only those herbicides for which the Forestry Commission has made additional specific off-label applications are detailed in this publication.

The following additional products may be of use in short rotation coppice situations only: cycloxydim (Laser), lenacil (Venzar), metamilon (Goltix WG), napropamide (Devrinol) and simazine (Unicrop Flowable Simazine). Amitrole (Weedazol) may be of use in farm forestry and short rotation coppice situations. Table 1 summarises the approved products, the approval status, mode of action, method and rate of application.

3 Approved products

Product mode of action

The products detailed in Table 1 may be divided into three main modes of action:

a. Residual herbicides

Pendimethalin, lenacil, isoxaben, napropamide and simazine are most active on weeds pre-emergence, and have very little if any activity on established weeds.

b. Residual/foliar acting herbicides

Metamitron, atrazine, cyanazine, metazachlor and propyzamide are mainly pre-emergent herbicides, but they do have activity on some weeds post-emergence, either through foliar or root uptake. Only propyzamide is likely to control mature weeds effectively – see weed susceptibility, Table 5, for maximum growth stages of weeds that can be controlled.

c. Foliar acting herbicides

Amitrole, clopyralid, cycloxdim, fluazifop-p-butyl, glufosinate ammonium, glyphosate and propaquizafop are foliar acting herbicides which are applied to emerged weeds. They must be applied at the correct stage of growth to obtain maximum effect (see Table 5), and are unlikely to have any significant residual or pre-emergent effect.

Methods of application

All the products in Table 1 may be applied through hand-held or mechanised applicators, except for fluazifop-p-butyl (Fusilade), which may **ONLY** be applied through mechanised sprayers.

Hand-held applications are most appropriate when trees are unguarded, when directed sprays avoiding shoots are required to avoid crop damage. Mechanised applications are likely to be cheaper, and it may be possible to make use of existing

Table 1 Summary of approved products and their uses

Active ingredient (amount in product)	Product	Manufac.	Field of use			Approval status	Mode of action	Method of application	Product rate	Maximum number of applications per year
			Forestry	Farm forestry	Farm forestry Years 1-5					
Amitrole (225g/l)	Weedazol TL	Bayer		✓	✓	LTOA - farm forestry	Foliar	Hand-held and mechanised	20.0 l/ha	-
Atrazine (500g/l)	Unicrop Flowable Atrazine***	Unicrop	✓	✓	✓	Forestry label approval Off-label approval for broadleaved trees	Residual pre-emergent/ foliar	Hand-held and mechanised	5-13.5 l/ha	Max total to be applied 13.5 l/ha per year
Clopyralid (200g/l)	Dow Shield	Dow-Elanco	✓	✓	✓	Forestry off-label	Foliar	Hand-held and mechanised	1.0 l/ha	2
Cyanazine (500g/l)	Fortrol	Cyanamid	✓	✓	✓	Farm forestry off-label	Residual pre-emergent/ foliar	Hand-held and mechanised	4.0 l/ha	1
Cycloxdim (200g/l)	Laser **	BASF			✓	LTOA - Short rotation coppice	Foliar	Hand-held and mechanised	2.25 l/ha	2
Fluazifop-p-butyl 250EW (250g/l)	Fusilade 250EW	Zeneca	✓	✓	✓	Farm forestry off-label	Foliar	Mechanised only	1.5 l/ha	2

Table 1 Summary of approved products and their uses - (contd.)

Active ingredient (amount in product)	Product	Manufac.	Field of use			Approval status	Mode of action	Method of application	Product rate	Maximum number of applications per year
			Forestry	Farm forestry	Farm forestry 1-5 years					
Glufosinate ammonium (150g/l)	Challenge/ Harvest	Hoechst/ AgroEvo	✓	✓	✓	Forestry label approval	Foliar	Hand-held and mechanised	3.0-5.0 l/ha	-
Glyphosate (360g/l)	Roundup Pro Blactive *	Monsanto*	✓	✓	✓	Forestry label approval	Foliar	Hand-held and mechanised	1.5-5.0 l/ha	-
Isoxaben (125g/l)	Gallery 125/ Flexidor 125	Dow Elanco	✓	✓	✓	Forestry label approval	Residual pre-emergent	Hand-held and mechanised	2.0 l/ha	2
Lenacil (440g/l)	Venzar Flowable/ Vizor**	DuPont			✓	LTOA- Short rotation coppice	Residual pre-emergent	Hand-held and mechanised	4.0-5.0 l/ha 1.1-2.0 kg/ha	1
Metamitron (70%w/w)	Gollix WG**	Bayer			✓	LTOA - Short rotation coppice	Residual pre-emergent/ foliar	Hand-held and mechanised	5.0 kg/ha	1
Metazachlor (500g/l)	Butisan S	BASF	✓	✓	✓	Farm forestry off-label	Residual pre-emergent/ foliar	Hand-held and mechanised	2.5 l/ha	3

Table 1 Summary of approved products and their uses – (contd.)

Active ingredient (amount in product)	Product	Manufac.	Field of use			Approval status	Mode of action	Method of application	Product rate	Maximum number of applications per year
			Forestry	Farm forestry	Farm forestry 1-5 years after coppice rotation					
Napro-pamide (450g/l)	Devrinol	Rhone Poulenc Agriculture			✓	LTOA – Short rotation coppice	Residual pre-emergent	Hand-held and mechanised	2.1 l/ha	1
Pendimethalin (400g/l)	Cyanamid Stomp 400SC		✓		✓	Farm forestry off-label	Residual pre-emergent	Hand-held and mechanised	5.0 l/ha	1
Propa-quizatop (100g/l)	Falcon Shogun 100EC	Cyanamid Ciba	✓		✓	Farm forestry label approval	Foliar	Hand-held and mechanised	0.7–1.5 l/ha	Maximum total applied to be 2.0 l/ha per year
Propyz-amide (400g/l, 50%w/w, 4%w/w)	Kerb Flowable/Kerb 50W/Kerb Granules***	P.B.I./Rohm & Haas	✓	✓	✓	Forestry label approval	Residual pre-emergent/foliar	Hand-held and mechanised	3.75 l/ha 3.0 kg/ha 38.0 kg/ha	1
Simazine (500g/l)	Unicrop Flowable/Simazine**	Unicrop			✓	LTOA – Short rotation coppice	Residual pre-emergent	Hand-held and mechanised	1.1–2.2 l/ha	1

Note:* The following additional glyphosate products have full on label approval for use in forestry and farm forestry:

Barbarian	360 g/litre glyphosate (Barclay)
Barclay Gallup	360 g/litre glyphosate (Barclay)
Barclay Gallup Amenity	360 g/litre glyphosate (Barclay)
Clayton Glyphosate	360 g/litre glyphosate (Clayton)
Clayton Swath	360 g/litre glyphosate (Clayton)
Glyfonex	360 g/litre glyphosate (Danagri)
Glyphos	360 g/litre glyphosate (Cheminova)
Glyphogan	360 g/litre glyphosate (PBI)
Glyphosate-360	360 g/litre glyphosate (Top Farm)
Helosate	360 g/litre glyphosate (Helm)
Hilite	144 g/litre glyphosate (Nomix-Chipman) – CDA formulation
Outlaw	360 g/litre glyphosate (Barclay)
Portman Glyphosate 360	360 g/litre glyphosate (Portman)
Roundup	360 g/litre glyphosate (Schering/AgrEvo)
Roundup	360 g/litre glyphosate (Monsanto)
Roundup Pro Biactive	360 g/litre glyphosate (Monsanto)
Roundup Biactive Dry	42.6% w/w glyphosate (Monsanto)
Stacato	360 g/litre glyphosate (Unicrop)
Stefes Glyphosate	360 g/litre glyphosate (Stefes)
Stetson	360 g/litre glyphosate (Monsanto)
Stefes Kickdown 2	360 g/litre glyphosate (Stefes)
Stirrup	144 g/litre glyphosate (Nomix-Chipman) – CDA formulation

These products may have different conditions of use - refer to the product label.

** The following additional products, with the same active ingredients as indicated in the Table, are approved for use under the long-term off-label arrangements for short rotation coppice. These products may have different conditions of use - refer to the product label.

cycloxiidim	–	Stratos (BASF)
lenacil	–	Stefes lenacil (Stefes)
metamitron	–	Stefes 7G (Stefes)
		Stefes Metamitron (Stefes)
		Tripart Accendo (Tripart)
simazine	–	Ashlade Simazine (Ashlade)
		Atlas Simazine (Atlas)
		Gesatop 500SC (Ciba Agric)
		Gesatop 50WP (Ciba Agric)
		MSS Simazine 50FL (Mirfield)

*** The following products also have full label approval for use in forestry:

Atlas atrazine	500 g/litre atrazine (Atlas)
Atrazol	500g/litre atrazine (Sipcam)
Headland Judo	400g/litre propyzamide (Headland)
Headland Sword	150g/litre glufosinate ammonium (Headland)

agricultural sprayers. Plantations need to be designed to allow sprayer access, either through wide (2.8 metres plus) space between rows, or wider spacing at intervals to allow access of boom sprayers which can extend over rows of closer spaced trees. The use of treeshelters can make the application of non-selective herbicides easier. Further guidance on applicators is given in Forestry Commission Field Book 8 and Forestry Commission Technical Development Branch Technical Information Note 8/94.

Timing

General

Precise weeding regimes will depend on many factors such as crop species, weed species, site type, cultivation practice, etc. However a general regime for a lowland ex-arable site may be as follows:

1. Before any cultivation, clear any established weeds through the use of a broad spectrum contact herbicide.
2. If cultivation takes place, aim for a firm fine tilth for the effective use of residual herbicides.
3. Apply residual herbicides as overall or directed sprays immediately after planting to weed free sites.
4. During the growing season, repeat applications of residual/foiar or selective foliar acting herbicides to emerging weeds. In general, it is important to apply these products to **young weeds** before they become large and established. Alternatively, use directed sprays of broad spectrum herbicides to clear large established weeds.
5. Aim to clear up the site at the end of the growing season with applications of broad spectrum herbicides, if necessary directed away from crop species.
6. Repeat the regime (steps 3 to 5) in subsequent years until the crop trees are established and the dominant form of vegetation on the site, normally for a minimum of 3 years after planting.

Pre-emergent herbicides

Pre-emergent herbicides should be applied immediately after the trees have been planted, to weed-free sites prior to bud-burst. Subject to crop tolerance (see Table 3) most can be applied as an overall or directed spray. With poplar and willow cuttings, apply as soon as rain has consolidated soil around the cuttings (sets) as an overall or directed spray. If used in subsequent years, these herbicides should be applied to bare soil in early spring before weed emergence.

The propyzamide products Kerb 50W and Kerb Flowable should be applied from 1 October to 31 January, north of a line from Aberystwyth to London, and from 1 October to 31 December south of this line, and on peat or peaty gley soils. Kerb Granules should be applied from 1 October to the end of February, north of a line from Aberystwyth to London, and from 1 October to the end of January south of this line, and on peat or peaty gley soils.

Napropamide should be applied before the end of February, and isoxaben before the end of March.

For those products only approved for use after cut-back of short rotation coppice, apply prior to bud-burst, prior to weed germination, as an overall or directed spray.

If applied correctly these products may give weed control well into the growing season. Usually a mixture or sequence of products will be required, chosen according to the weed species present. In general, metamitron, metazachlor, atrazine and cyanazine have somewhat less effective residual properties than lenacil, napropamide, pendimethalin, simazine, isoxaben or propyzamide, having an effective life of about 12 weeks. Repeated applications of metazachlor and metamitron are permitted, but they should take place before weeds have passed the growth stage when they are susceptible.

For all these products it is important that rain follows application to move the herbicide into the top 2–3 cm of the soil. If these residual herbicides are applied to dry soil, and little or no rain follows application, weed control is likely to be poor.

Applications will be most effective when made to a firm, fine tilth. If the soil has large clods at the time of herbicide application, these may weather and crumble, exposing untreated soil and allowing prolific weed growth.

Foliar acting herbicides

The timing of application of foliar acting herbicides will be determined by the growth stage of the target weed (see Table 5). Applications may be made as overall or directed sprays. Dormant trees may be oversprayed by products such as fluazifop-p-butyl, cycloxdim and clopyralid. Overall sprays using these products may be safe when trees are actively growing (see Table 3) but it is advisable to avoid newly flushed trees, before new growth has hardened in the spring. When clopyralid is applied overall there may be some transient twisting of needles and young shoots, and cupping of leaves, but this will soon be outgrown.

Directed sprays of broad spectrum herbicides offer the least risk of crop damage and allow the use of higher product rates to control difficult weeds. However, in small-scale trials, sprays of glufosinate ammonium at 5 litres/ha have been shown to be safe for application over most broadleaved species (including willow and poplar cuttings), provided that the trees are deeply dormant. Glufosinate ammonium is at present (early 1996) only approved for use between 1 March and 30 September.

Glyphosate at 1.5 litres/ha can be used over dormant conifers. Results on broadleaves have been variable and it is advisable to use directed applications wherever possible.

Glyphosate is translocated more readily than glufosinate ammonium, so it will give better control of deeply rooted weed species. Conversely, accidental crop contamination from glufosinate ammonium through spray drift or applicators on to damaged bark is less likely to result in damage to the whole tree, and so is a safer treatment for in-season applications.

Amitrole should generally be used as a directed spray. However, in short rotation coppice overall applications of 20 litres/ha of product from 1 week after cutting, prior to bud burst, is well

tolerated, although temporary yellowing of emerging shoots may occur. Applications made at higher rates are likely to reduce height growth and survival significantly, particularly with willow.

In general, applications of foliar acting herbicides should be avoided during periods of bright sunlight or high temperatures, as this can lead to scorching of tree foliage. If applications are necessary in mid-summer, they should be made in the evening, to allow the maximum delay between applications and the occurrence of bright sunlight and high temperatures. Rainfall shortly after spraying will seriously reduce the efficacy of all these products – consult the product label for details of the minimum rain free period required.

Applications of **ANY** herbicide to waterlogged ground, or to trees under stress from factors such as drought, should be avoided, as there is a greater risk of herbicide damage in these situations.

4 Crop tolerance

The herbicides listed in Table 1 are tolerated by the coniferous and broadleaved species listed in Table 2, when applied as detailed in Table 3. Information on products without full on-label approval is based upon small-scale research experiments. Users should determine the approval status of products before using them, and conduct their own limited field trials of new herbicides before adopting them on a commercial scale.

Table 2 Tree species screened for herbicide tolerance

Conifers	Broadleaves	Short rotation coppice
Sitka spruce	Oak	Poplar (sets)
Norway spruce	Ash	Willow (sets)
Douglas fir	Sycamore	
Noble fir	Beech	
Corsican pine	Wild cherry	
Western red cedar	Birch	
Japanese larch	Alder	
Scots pine	Sweet chestnut	
	Norway maple	
	Poplar (sets)*	
	Willow (sets)	

*A 'set' is a complete unrooted shoot. These were the stock type used in the poplar and willow herbicide screens.

Table 3 Crop tolerance

Active ingredient	Product	Trees dormant			Trees post-flushing		
		Conifers	Broadleaves	Short rotation coppice	Conifers	Broadleaves	Short rotation coppice
Amitrole	Weedazol TL	D	D	✓ ⁴	D	D	D
Atrazine	Unicrop Flowable Atrazine	✓ ⁵	✓ ⁶	✓ ⁶	✓ ⁵	X	X
Clopyralid	Dow Shield	✓	✓	✓	✓	✓	✓
Cyanazine	Fortrol	✓	✓	✓	✓	D	D
Cycloxdim	Laser	X	X	✓	X	X	✓
Fluazifop-p-butyl	Fusilade 250EW	✓	✓	✓	✓	✓	✓
Glufosinate ammonium	Challenge/Harvest	D	✓ ⁷	✓ ⁷	D	D	D
Glyphosate	Roundup Pro Biactive	✓ ³	D	D	D	D	D
Isoxaben	Gallery 125/ Flexidor 125	✓	✓	✓	✓	✓	✓
Lenacil	Venzar Flowable	X	X	✓	X	X	✓
Metamitron	Goltix WG	X	X	✓	X	X	D
Metazachlor	Butisan S	✓	✓	✓	✓ ¹	✓	✓
Napropamide	Devrinol	X	X	✓	X	X	✓ ²
Pendimethalin	Stomp 400SC	✓	✓	✓	✓	✓	✓
Propaquizafop	Falcon/ Shogun 100EC	✓	✓	✓	✓	✓	✓
Propyzamide	Kerb Flowable/ Kerb 50W/	✓	✓	✓	✓ ²	✓ ²	✓ ²
Simazine	Kerb Granules Unicrop Flowable Simazine	X	X	✓	X	X	✓

CROP TOLERANCE

Notes:

- For the purposes of this table, treat larch as a broadleaved tree
 - Trees will be at their most sensitive immediately after flushing. Herbicide application should not be made before new needles/leaves have hardened.
 - In Forestry Commission trials, the treatments listed as safe to overspray trees post-flushing were found to have no significant effect on height or survival of the crop species listed. However, there may be some transient foliage damage. Where condition of foliage is particularly important, such as in Christmas trees, overall post-flushing applications are not recommended.
- ✓ = Herbicides can be used as an overall or directed spray.
- D = Herbicides should only be used as a directed spray.
- X = Herbicides are unapproved and must not be used.
- ✓¹ = In FC trials where metazachlor was applied to pine in active growth (e.g. candles fully extended but needles not fully hardened) damage was observed. The damage symptoms were distortion, browning and loss of needles from the tender new growth. On a few plants the growing tip was killed, but on most plants the main stem (or candle) remained healthy but devoid of needles. Terminal buds were set as normal.
- ✓² = By the time trees have flushed it is usually too late to achieve effective weed control using napropamide or propyzamide.
- ✓³ = Sitka spruce, Norway spruce, Scots pine, Corsican pine, lodgepole pine, western red cedar and Lawson cypress will tolerate overall sprays at 1.5 l/ha PROVIDED TREES ARE DORMANT - i.e. STEM ELONGATION HAS CEASED, LEADER GROWTH HAS HARDENED, AND BUDS ARE TIGHTLY CLOSED.
- ✓⁴ = See text. Overall spray after cutting, before regrowth, is well tolerated.
- ✓⁵ = All the major forest species are tolerant of overall applications except Norway spruce, western hemlock and larch, which are sensitive during the growing season and should only be treated before bud burst.
- ✓⁶ = All broadleaves are sensitive when in leaf, and should only be treated before the start of bud burst in the spring, at 6.5 l/ha. For both conifers and broadleaves, do not apply to badly planted trees, or those under stress, in poor health, or on light calcareous or sandy soils, or on reclaimed sites with poor soil structure.
- ✓⁷ = Broadleaves will tolerate overall sprays at 5 l/ha PROVIDED TREES ARE DEEPLY DORMANT - i.e. STEM ELONGATION HAS CEASED, LEADER GROWTH HAS HARDENED, BUDS ARE TIGHTLY CLOSED, AND LEAVES HAVE BEEN SHED.

5 Weed susceptibility

The susceptibility of commonly occurring weeds to the herbicides listed in Table 1 are given in Tables 4 and 5. These tables are based on information supplied with product labels, and on limited Forestry Commission experience. In practice weeds may vary in susceptibility to a particular application for the reasons outlined in the earlier section on mode of action. Users are advised to make small-scale trials of products they are unfamiliar with before deciding to adopt them on a commercial scale.

Table 4 Susceptibility of common arable weeds to selective pre-emergent farm forestry herbicides

Weeds	Pre-emergent herbicides									
	atrazine	cyanazine	isoxaben	lencil	metribolon	metazachlor	napropamide	pendimethalin	propyzamide	suzatine
American willowherb										
Bents	S			S	MS	S	S	S	S	
Bitter cress, hairy			S	S	S	S	MS			
Bittersweet										
Black bindweed	MS	S		S	MR	MS	MS	S	MS	
Black grass	S	MS		R	MR	S	MS	S	S	
Black nightshade	S			MS		R	S	S		
Brome, barren		S				MS				
Buttercup, corn	R		S		MS		S	S		MR
Buttercup, creeping					MS					
Canary grass, awned										
Chamomile, corn	S	S	S	S		S	S	S	S	S
Chamomile, stinking	S	S	S	S		S	S	S	S	S
Charlock	S	S	S	S	MS	MR	R			
Chickweed, common	S	S	S	S	S	S	S	S	S	S
Cleavers	MR	MR	MS	R	R	MS	S*	S	MR	MR
Clover (from seed)					S					
Cocksfoot	MR								S	
Common couch	MR								S	
Crane's-bill, cut-leaved							S			MR
Creeping bent (watergrass)	S								S	
Creeping soft grass	MR		R						S	
Crested dog's tail									S	
Curled dock					S				S	

Table 4 Susceptibility of common arable weeds to selective pre-emergent farm forestry herbicides

Weeds	Pre-emergent herbicides									
	atrazine	cyanazine	isoxaben	tenacil	metamifron	metazachlor	napropamide	pendimethalin	propyzamide	simazine
Dead-nettle, henbit	S	S	S		MS	S	S	S	S	S
Dead-nettle, red	S	S	S	MS	MS	S	S	S	S	S
Dead-nettle, white	S	S	S	MS	S			S		
Dock, broadleaved									S	
Established perennials	MR	R	R							
False oat grass	S	MS	S	S	S	MS	S	S	S	S
Fat-hen	S	MS	S	S	S			S	S	S
Fescues	MS							S	S	S
Fescue, meadow	MS							S	S	S
Field horsetail								S	S	S
Fleabane, common						MS				
Fool's parsley		MR			S					
Forget-me-not, field	S	S	S		S	S		S	S	S
Foxglove									R	MS
Fumitory, common	MS	MS	S	S	MS	R	S	S	MS	S
Gromwell, field										
Groundsel	S	S	S	MS	S	S	S	S	S	S
Hemp-nettle, common	S	S	S	R	MR	MR	S	S	S	MR
Knotgrass	MR	MS	S	S	S	R	MS	S	S	S
Marigold, corn	S	S	S	S	S	S	R	S	S	S
Mat grass										
Mayweed, scented	S	S	S	S	S	S	S	S	S	S
Mayweed, scentless	S	S	S	S	S	S	S	S	S	S
Meadow foxtail										
Meadow grass, annual	S	S	R	S	S	S	S	S	S	S
Meadow grass, rough	S	S	R	S	S	S	S	S	S	MR

Table 4 Susceptibility of common arable weeds to selective pre-emergent farm forestry herbicides

Weeds	Pre-emergent herbicides									
	atrazine	cyanazine	isoxaben	tenalix	metamifon	metazachlor	napropamide	pendimethalin	propazine	simazine
Meadow grass, smooth	MS		R						S	MR
Mustard, white	S	S				MR			S	S
Mustard, black	S	S				MR			S	S
Nettle, small	S	MS	S	MS	S	MS	S	S	S	S
Nightshade, black	S	S	S	R	MR	S	S	S	S	MS
Orache, common	MS	S	S	S	S	S	S	S	S	MS
Pale persicaria	MS	S	S	S	MS	MS	MS	S	S	MS
Pansy, field	MS	MS	S	R	S	MR	MS	S	S	MS
Pansy, wild						MR				
Parsley piert	S	S	S			S				S
Pimpernel, scarlet	S	S	S	S	MR	S				S
Pineapple weed	S	S	S	S		R				S
Poppy, common	S	S	S	S	S	S				S
Purple moor grass	R	S	S	S	S	S			S	S
Radish, wild	S	S	S	S	MR					S
Redshank	MS	S	S	S	MS	MS	S	S	S	MS
Rosebay willowherb	R	S	S	S				R	S	MS
Rye grasses	S	S				S		S	S	MS
Sedges								MS		
Sheep's sorrel	MR									
Shepherd's purse	S	S	S	S	S	S	S	S	S	S
Soft brome	S	S	S	MR	S	S	S	S	S	MS
Speedwell, common	S	S	S	MR	S	S	S	S	S	MR
Speedwell, germander	S	S	S	R	MS	S	S	S	S	MS
Speedwell, ivy-leaved	S	S	S	R		S	S	S	S	MS
Speedwell, grey	S	S	S	MR		S	S	S	S	MR

Table 4 Susceptibility of common arable weeds to selective pre-emergent farm forestry herbicides

Weeds	Pre-emergent herbicides									
	atrazine	cyanazine	isoxaben	lencil	metamiton	metazachlor	napropamide	pendimethalin	propyzamide	sinoxazine
Speedwell, green	S	S	S	MR		S	S	S	MR	
Speedwell, wall	S	S	S	S		S	S		MS	
Spurrey, corn	MS			S		MS	S		MS	
Sweet vernal grass	S				S			S	S	
Timothy	S					S				S
Thale cress										
Thistle, smooth sow				S		S	S		S	
Tufted hair grass	MR							S		
Vetches (from seed)									MR	
Volunteer cereals	MS					MR	MS	S		
Volunteer oilseed rape		S				R	S*	S		
Wavy hair grass	S									
Wild carrot					S					
Wild oat	MS			R	R	MR	S	S	MS	
Wood small reed								S		
Yellow oat grass								S		
Yorkshire fog	S						S	S		

Key

- S - susceptible
 MS - moderately susceptible
 MR - moderately resistant
 R - resistant
 - - not tested
 * - plants arising from deep-germinating seeds may not be controlled

Table 5 Susceptibility of common arable weeds to post-emergent farm forestry herbicides

Weeds	Post-emergent herbicides												
	antiole [®]	atrazine	clpyralid	cyanazine	cycloxdim	fluzilop [®]	fluzilop [®] -p-butyl	glufosinate [®] ammonium*	glyphosate [®]	metamitron	metazachlor	propachlorop	propyznate [®]
Bents	S	FT		FT	4ETL	S	S	S				S	
Bitter cress, hairy	S					S	S	S				MS	MS
Bittersweet	MS					MS	S	S				MS	MS
Black bindweed	S	50mm	2ETL	100mm		S	S	S	MR	MR	2ETL	FT	S
Black grass	S	FT		2ETL	FT	S	S	S	MR	MR			MS
Black nightshade	S	100mm		2ETL	FT	S	S	S					S
Brome, barren	S					S	S	S	MSC	MSC			S
Buttercup, corn	S	R				S	S	S	MSC	MSC			MS
Buttercup, creeping	MS					S	S	S					
Canary grass, awned	MS					MS	S	S					
Chamomile, corn	S	100mm				S	S	S					
Chamomile, stinking	S	100mm	2ETL			S	S	S	MSC	MSC			
Charlock	S	100mm		6ETL		S	S	S	MSC	MSC	4ETL		S
Chickweed, common	S	100mm		100mm		S	S	S	C	R			R
Cleavers	S					S	S	S	C	C			MR
Clover (from seed)	S	MR	2ETL			S	S	S					
Cocksfoot	S					S	S	S	S				
Coltsfoot	S		MS6ETL#			S	S	S	S			3ETL	S
Common couch	S	3ETL		FT	4ETL	S	S	S	S				
Crane's-bill, cut-leaved	S					S	S	S			C		S
Creeping bent (watergrass)	S	3ETL		FT	4ETL	MS	S	S					S
Creeping soft grass	S	MR		FT	4ETL	MS	S	S					MS
Crested dog's tail	S					S	S	S					S
Curled dock	S					S	S	S					MS
Dead-nettle, henbit	S	100mm		100mm		S	S	S	MSC	MSC	2ETL		
Dead-nettle, red	S	100mm		100mm		S	S	S	MSC	MSC			
Dead-nettle, white	S	100mm		100mm		S	S	S					

Table 5 Susceptibility of common arable weeds to post-emergent farm forestry herbicides

Weeds	Post-emergent herbicides											
	amitrol ^a	atrazine	copryalid	cyanazine	cycloxdim	fluzilop-p-butyl	glufosinate-ammonium ^a	glyphosate	metazifluron	metazachlor	propaquizafop	propyzamide ^b
Dock, broadleaved	S						S	C				MS
Established perennials	MS						S					S
False oat grass	S						S	MSC				MS
Fat-hen	S	100mm		2ETL			S					S
Fescues	S	MS					S					S
Fescue, meadow	S	MS					S					S
Field horsetail	MS					MS	S					MS
Flabane, common	S						S					S
Fool's parsley	MS			1ETL			S	C				S
Forget-me-not, field	S	100mm		4ETL			S	C	2ETL			R
Foxglove	MS					MS	S					R
Fumitory, common	S	50mm		1ETL			S	MSC				
Gromwell, field	S	100mm		1ETL			S	MSC	2ETL			
Groundsel	S		6ETL	1ETL			S	MSC				
Hemp-nettle, common	S		100mm				S					MS
Knotgrass	S		MS2ETL	1ETL			S	MSC				
Marigold, corn	S	100mm	6ETL				S	C	2ETL			
Mayweed, scented	S	100mm	6ETL	2ETL			S	C	4ETL			
Mayweed, scentless	S	100mm	6ETL	2ETL			S	C	4ETL			
Meadow foxtail	S						S					S
Meadow grass, annual	S	FT		FT			S	MSC	2ETL	3ETL		S
Meadow grass, rough	S	S		FT			S					S
Meadow grass, smooth	S	MS					S					S
Mustard, white	S	100mm		6ETL			S					
Mustard, black	S	100mm		6ETL			S					MS
Nettle, small	S	100mm		100mm			S	C				MS
Nightshade, black	S	100mm		100mm			S	MR				MS

Table 5 Susceptibility of common arable weeds to post-emergent farm forestry herbicides

Weeds	Post-emergent herbicides										
	amtriole	atrazine	clopyralid	cyanazine	cycloxdim	fluzilop-p	fluzilop-p +trifl-p	glifosinate ammonium	glyphosate	metazachlor	propyzachlor
Orache, common	S	50mm	MS2ETL	1ETL			S	S	C		
Pale perisparia	S	50mm	MS2ETL	2ETL			S	S	MSC		
Pansy, field	S			1ETL			S	S	MSC		
Pansy, wild	S						S	S			
Parsley pierf	S	100mm		1ETL			S	S	MR	4ETL	
Pimpernel, scarlet	S	100mm		100mm			S	S			
Pineapple weed	S	100mm					S	S			
Poppy, common	S	100mm	6ETL				S	S			
Purple moor grass	MS	R					MS	S	C		S
Radish, wild	S	50mm		100mm			S	S	MSC		MS
Redshank	S	50mm	MS2ETL	100mm			S	S	MSC		R
Rosebay willowherb	MS	50mm					MS	S		FT	MS
Rye grasses	S	3ETL		3ETL		FT	S	S			S
Sedges	MS						MS	S			MS
Sheep's sorrel	S						S	S			MS
Shepherd's purse	S	50mm		100mm			S	S	C		R
Soft brome	S						S	S			S
Speedwell, common	S	100mm		100mm			S	S	C		MS
Speedwell, germander	S	100mm		100mm			S	S		2ETL	MS
Speedwell, ivy-leaved	S	100mm		100mm			S	S	MSC	2ETL	MS
Speedwell, grey	S	100mm		100mm			S	S		2ETL	
Speedwell, green	S	100mm		100mm			S	S		2ETL	
Speedwell, wall	S	100mm		100mm			S	S		2ETL	
Spurry, corn	S	50mm					S	S	C		S
Sweet vernal grass	S	S					S	S			S
Timothy	S						S	S			S
Thale cress	MS						MS	S			S

Table 5 Susceptibility of common arable weeds to post-emergent farm forestry herbicides

Weeds	Post-emergent herbicides										
	amitrole [®]	atrazine	glyphosate	clopyralid	cyanazine	cycloxdim	fluzilop-p-butyl	glyphosate ammonium [*]	metazachlor	propaquizafop	propyzamide
Thistle, creeping	S			MS250mm#			S				
Thistle, perennial sow	S			MS250mm#			S				
Thistle, smooth sow	S			6ETL			S				
Thistle, spear	MS			MS250mm#			MS				
Trefoils (from seed)	S		MR	2ETL			S			S	
Tufted hair grass	S			2ETL			MS				
Veitches (from seed)	MS		FT		FT	FT	S		FT	S	
Volunteer cereals	S						S				
Volunteer oilseed rape	S				FT	FT	S			S	
Wavy hair grass	S		S				MS				
Wild carrot	S		FT			FT	S		FT	S	
Wild oat	S						S			S	
Wood small reed	MS						MS			S	
Yellow oat grass	MS						S			S	
Yorkshire fog	S		S				S			S	

Key: Post-emergent growth stage of weeds (latest at which controlled):

- C cotyledon
 ETL - number of expanded true leaves
 ETLs - number of expanded true leaves (suppression only)
 mm - diameter or height of weeds
 Fbv - flower bud visible
 FT - fully tillered
 S - susceptible at all growth stages
 MS - moderately susceptible at all growth stages
 MR - moderately resistant at all growth stages
 R - resistant
 † - not tested
 - all weed susceptibilities for propyzamide post emergence are for fully established weeds
- Ø - amitrole will give a degree of control over most annual weeds present at application. Weed susceptibilities shown in this table are for fully established weeds.
 # - control with a programme of an application at 0.5 l/ha followed by one of 1.0 l/ha 3-4 weeks later
 * - in addition to the weeds listed, most species will be damaged by applications of glyphosate ammonium at 5.0 l/ha if they are actively growing, although repeated applications may be required to achieve a total kill of deep rooted species
 \$ - in addition to the weeds listed, most species will be controlled by applications of glyphosate at 5.0 l/ha if they are actively growing.

6 Herbicide mixtures

Products which do not contain anti-cholinesterase ingredients (no anti-cholinesterase compounds are listed in this Field Book), can be used in tank mixes of two or more herbicides provided that all the conditions of use for all of the products to be used are complied with.

In agricultural situations, control of the wide range of weeds found on arable sites is commonly achieved using tank mixtures of herbicides. The application of tank mixes may be appropriate during tree establishment to cope with different mixtures of weeds and because of the absence of crop competition.

Results of trials carried out during 1989 and 1990 at a number of sites in southern Britain indicate that the herbicide mixtures listed in Table 6 are tolerated by the coniferous and broadleaved species listed in Table 2 when applied as overall sprays before bud-burst in spring. Propaquizafop was not subject to Forestry Commission trials - entries are based upon the manufacturer's data.

Table 6 Farm forestry herbicide tank mixes (all herbicides at approved rates)

Cyanazine	clopyralid isoxaben pendimethalin
Isoxaben	clopyralid cyanazine metazachlor propyzamide pendimethalin
Lenacil	metazachlor pendimethalin propyzamide
Metamitron	metazachlor
Metazachlor	clopyralid isoxaben lenacil metamitron pendimethalin propyzamide simazine
Pendimethalin	cyanazine isoxaben lenacil metazachlor propyzamide
Propaquizafop	clopyralid metazachlor
Propyzamide	clopyralid cyanazine isoxaben lenacil metazachlor pendimethalin
Simazine	metazachlor

Note: Mixtures of herbicides in the left column, with those listed to their right, were found to be safe. However, unless such mixes are specifically listed on the product label, they are made at the user's own risk.

Users **MUST ALWAYS** read the instructions on the herbicide product label, and follow the safety precautions and instructions therein relating to its use.

7 Further reading

Further detailed guidance on the use of herbicides can be found in:

WILLOUGHBY, I. and DEWAR, J. (1995). *Use of herbicides in the forest*. 4th edition. Forestry Commission Field Book 8. HMSO, London.

DRAKE-BROCKMAN, G.R. (1994). *An introduction to the use of tractor-mounted sprayers in farm woodland*. Technical Development Branch Information Note 8/94. Forestry Commission, Edinburgh. (Available only from: Technical Development Branch, Forestry Commission, Ae Village, Dumfries DG1 1QB).