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PRACTICAL SECTION FOR GROWERS

Objectives and background

Observations at HRI East Malling (Vasek, 1986) indicated that some soil-acting residual herbicides used in field-grown trees can have a negative effect on rootstock growth and subsequent bud-take. However, only a limited number of herbicides were used and a number of newer herbicides have come into use since these results were reported. Most of the tree species in the East Malling trials are known to be relatively difficult to bud and it was not known if this effect would apply to moderate- or easy-to-bud species as well.

The objective of this work is to study and quantify the effect of individual herbicides on rootstock growth, bud-take and subsequent maiden growth in the first year of the study. In the second year the effect of herbicide programmes and mixtures is being studied. A secondary objective is the provision of information on the weed control achieved by the different programmes.

Summary and results

In 1997/8 a range of single herbicide treatments were each applied three times (after planting rootstocks, after budding and after heading back) on two sites to six different species. Records were taken of weed control, visual phytotoxicity, growth increment at budding, bud-take and maiden growth. This was followed by a another similar trial in 1998/9 in which a range of herbicide mixtures were applied to the same tree species.

Weed control

The predominant weeds in the trial were mayweed, groundsel, fat hen, knotgrass and oil seed rape. The best weed control from single treatments was obtained with Bolero, Simazine, Ronstar Liquid and Lenacil. Devrinol, Kerb Flo and Sovereign were less effective as single treatments.

The best tank mixtures of herbicide for weed control were Ronstar Liquid + Sovereign, Ronstar Liquid + Kerb Flo and Simazine + Butisan S + Kerb Flo.

Table 1: Single Treatments: Summary of weed control - 1997/8

Treatment	Weed control **** (0-10% weed cover) *** (11-19% weed cover) ** (20-39% weed cover) * (40%+ weed cover)
1. Untreated control	*
2. Bolero @ 0.5 l/ha	****
3. Butisan S @ 2.5 l/ha	***
4. Devrinol @ 9.0 l/ha	***
5. Flexidor 125 @ 2.0 l/ha	**
6. Kerb Flo @ 2.1 l/ha	**

Cont/d...

Treatment	Weed control **** (0-10% weed cover) *** (11-19% weed cover) ** (20-39% weed cover) * (40%+ weed cover)
7. Ronstar liquid @ 4.0 l/ha	****
8. Simazine @ 1.7 l/ha	****
9. Sovereign @ 3.3 l/ha	***
10. Stefes Lenacil @ 1.7 kg/ha	****
11. Butisan S @ 5.0 l/ha	****
12. Flexidor 125 @ 4.0 l/ha	**
13. Kerb Flo @ 4.2 l/ha	**
14. Simazine @ 3.4 l/ha	****
15. Stefes Lenacil @ 3.4 l/ha	****

Table 2: Mixture treatments: Summary of weed control - 1998/9

Treatment	Weed control **** (0-10% weed cover) *** (11-19% weed cover) ** (20-39% weed cover) * (40%+ weed cover)
1. Untreated control	*
2. Bolero @ 0.5 l/ha	****
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	****
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	***
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	****
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	***
7. Ronstar Liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	****
9. Sovereign @ 3.3 l/ha + Ronstar Liquid @ 4.0 l/ha	****
10. Stefes Lenacil @1.7 kg/ha + Butisan S @ 2.5 l/ha	***
11. Butisan S @ 5.0 l/ha	**
12. Flexidor 125 @ 4.0 l/ha	**
13. Kerb Flo @ 4.2 l/ha	**
14. Simazine @ 3.4 l/ha	****
15. Stefes Lenacil @ 3.4 l/ha	*

Phytotoxicity, bud-take and growth records

The main phytotoxicity symptoms were from Bolero causing a chlorosis and bleaching of lower leaves on most species in both years. The plants grew away by the end of the season. *Prunus* tended to be most affected as it was at bud burst or early leaf when the spring herbicides were applied. Ronstar Liquid alone and in mixtures caused a foliar scorch when applied to *Prunus* post bud burst - this damage was severe in 1998 causing plant losses, a number of other species also had slight lower leaf scorch and bark discolouration. Apart from *Prunus* the damage was not significant. Butisan S and Flexidor 125 caused slight scorch when used in mixtures with other herbicides, but no significant damage was caused. Simazine and Lenacil alone and in mixtures caused severe chlorosis to *Tilia* and *Prunus* at East Malling, but Simazine damage did not result in significantly reduced growth.

Herbicide effects on growth were not consistent between sites or years. There was an indication that Lenacil had effect on growth of *Prunus* and *Tilia* and Kerb Flo at the higher rate on *Tilia*. In most cases where growth increment or bud-take was reduced it appeared to be an indirect effect of poorer weed control e.g. in Kerb Flo treated plots, rather than a direct effect of herbicide on growth. Particularly at the Notcutts site, the untreated control had the poorest growth and bud-take in spite of regular clean up sprays of contact herbicides and hoeing.

Table 3: Single treatments: Summary of growth records - 1997/8

Treatment	**Phytotoxicity (- nil, * some, ** moderate, *** severe)**						**Growth increment (* 0-5%, ** 6-10%,*** 11-20%, **** >20%)**							
	Acer	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*	*Acer*	*Fraxinus*	*Malus*	*Prunus*		*Sorbus*	*Tilia*	
										Notcutt	*EMRS*		*Notcutt*	*EMRS*
1. Untreated control							*	*	**	***	****	*	*	**
2. Bolero 0.5 l/ha	*	-	*	**	*	**	***	**	**	***	****	***	***	**
3. Butisan S 2.5 l/ha	-	-	-	*	-	-	***	**	**	****	****	****	***	***
4. Devrinol 9.0 l/ha	-	-	-	-	-	-	**	**	*	***	***	**	**	**
5. Flexidor 125 2.0 l/ha	-	-	-	-	-	-	***	**	**	***	****	**	**	**
6. Kerb Flo 2.1 l/ha	-	-	-	-	-	-	***	*	**	***	****	**	**	**
7. Ronstar liquid 4.0 l/ha	-	-	-	-	-	-	***	**	**	***	***	**	***	**
8. Simazine 1.7 l/ha	-	-	-	*	-	-	***	**	**	****	***	***	***	**
9. Sovereign 3.3 l/ha	-	-	-	-	-	-	***	*	***	***	****	**	**	**
10. Stefes Lenacil 1.7 kg/ha	-	-	-	-	-	-	***	**	**	***	***	***	**	**
11. Butisan S 5.0 l/ha	-	-	-	-	-	-					***			**
12. Flexidor 125 4.0 l/ha	-	-	-	-	-	-					****			*
13. Kerb Flo 4.2 l/ha	-	-	-	-	-	-					****			***
14. Simazine 3.4 l/ha	-	-	-	*	-	**					****			**
15. Stefes Lenacil 3.4 l/ha	-	-	-	*	-	-					***			**

Table 4: Single treatments: Summary of bud-take and maiden growth 1997/8

Treatment	Bud take * 0-39%, ** 40-59%, *** 60-79%, **** 80-100%								Maiden height (m.) * <1m, ** 1-1.19m,*** 1.2-1.39m, ****>1.4m							
	Acer	*Fraxinus*	*Malus*	*Prunus* Notcutt	*Prunus* EMRS	*Sorbus*	*Tilia* Notcutt	*Tilia* EMRS	*Acer*[1]	*Fraxinus*	*Malus*	*Prunus* Notcutt	*Prunus* EMRS	*Sorbus*	*Tilia* Notcutt	*Tilia* EMRS
1. Untreated control	*	*	*	***	****	****	*	****		**	*	**	***	***	**	*
2. Bolero 0.5 l/ha	*	****	**	***	***	****	****	****		***	**	***	***	***	***	**
3. Butisan S 2.5 l/ha	*	***	**	****	****	****	****	****		**	*	**	****	**	***	**
4. Devrinol 9.0 l/ha	*	***	*	***	***	****	***	****		**	***	**	***	***	***	**
5. Flexidor 125 2.0 l/ha	*	****	*	**	****	****	***	****		***	**	**	****	***	***	**
6. Kerb Flo 2.1 l/ha	*	***	*	****	***	***	***	***		**	*	****	****	***	***	*
7. Ronstar liquid 4.0 l/ha	*	***	**	**	****	****	****	****		**	**	*	****	***	****	**
8. Simazine 1.7 l/ha	*	***	**	***	****	****	****	****		***	**	***	****	***	***	***
9. Sovereign 3.3 l/ha	*	**	**	***	****	***	***	****		***	**	***	****	**	****	**
10. Stefes Lenacil 1.7 kg/ha	*	***	**	***	****	****	***	****		***	**	**	****	***	****	**
11. Butisan S 5.0 l/ha	*				****			****					****			**
12. Flexidor 125 4.0 l/ha	*				****			****					***			**
13. Kerb Flo 4.2 l/ha	*				***			****					****			*
14. Simazine 3.4 l/ha	*				****			****					****			**
15. Stefes Lenacil 3.4 l/ha	*				****			****					****			**

Table 5 : Mixture treatments: Summary of growth records - 1998/9

Treatment	**Phytotoxicity (- nil, * some, ** moderate, *** severe)**						**Growth increment (* 0-5%, ** 6-10%,*** 11-20%, **** >20%)**							
	Acer	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*	*Acer*	*Fraxinus*	*Malus*	*Prunus* Notcutt	*Prunus* EMRS	*Sorbus*	*Tilia* Notcutt	*Tilia* EMRS
1. Untreated control							***	****	**	****	****	***	***	**
2. Bolero 0.5 l/ha	*	-	*	**	*	**	***	****	**	****	****	**	***	**
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	*	-	*	*	*	*	***	****	**	****	****	***	***	***
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	-	-	-	-	-	*	***	***	***	****	***	***	***	**
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	-	-	-	*	-	*	**	***	***	****	****	***	***	***
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	-	-	-	*	-	*	***	***	****	****	****	***	***	**
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	*	*	*	***	*	*	***	***	***	****	***	**	****	**
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1/ha ha	*	-	-	*	-	*	***	***	***	****	***	**	***	**
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	*	*	*	***	*	*	**	***	***	****	****	***	****	**
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	-	*	-	***	-	**	***	***	***	****	***	***	***	**
11. Butisan S 5.0 l/ha	-	-	-	-	-	-					***			**
12. Flexidor 125 4.0 l/ha	-	-	-	*	-	*					****			*
13. Kerb Flo 4.2 l/ha	-	-	-	-	-	-					****			**
14. Simazine 3.4 l/ha	-	-	-	***	-	***					****			**
15. Stefes Lenacil 3.4 l/ha	-	-	-	**	-	**					***			**

Table 6: Mixture treatments: Summary of bud-take and maiden growth - 1998/9

Treatment	Bud take * 0-39%, ** 40-59%, *** 60-79%, **** 80-100%								Maiden height (m.) * <1m, ** 1-1.19m,*** 1.2-1.39m, ****>1.4m							
	Acer	*Fraxinus*	*Malus*	*Prunus* Notcutt	*Prunus* EMRS	*Sorbus*	*Tilia* Notcutt	*Tilia* EMRS[1]	*Acer*	*Fraxinus*	*Malus*	*Prunus* Notcutt	*Prunus* EMRS	*Sorbus*	*Tilia* Notcutt	*Tilia* EMRS[1]
1. Untreated control	*	***	**	**	*	****	****		****	**	*	***	*	*	***	
2. Bolero 0.5 l/ha	*	****	**	***	**	****	****		****	**	**	**	*	*	***	
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	*	****	***	***	**	****	****		****	**	*	****	**	*	***	
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	*	****	**	***	**	****	****		****	**	*	****	*	*	**	
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	*	****	***	**	***	****	****		****	**	*	***	**	*	***	
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	*	****	**	****	*	****	****		****	*	*	***	*	*	**	
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	*	***	***	*	*	****	****		****	**	**	*	**	*	***	
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1/ha ha	*	****	**	***	***	***	****		****	**	**	****	**	*	***	
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	*	****	***	*	**	****	****		****	**	*	***	**	*	**	
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	*	****	**	***	**	****	****		****	**	**	***	**	*	***	
11. Butisan S 5.0 l/ha					**								**			
12. Flexidor 125 4.0 l/ha					*								**			
13. Kerb Flo 4.2 l/ha					*								*			
14. Simazine 3.4 l/ha					***								**			
15. Stefes Lenacil 3.4 l/ha					*								**			

[1] No result due to winter loss

Action points for growers

- Ensure weed free conditions during the crucial budding phase.

- The following herbicide combinations provided particularly effective weed control with minimal damage providing they were used pre bud burst:

  Ronstar Liquid + Sovereign,
  Ronstar Liquid + Kerb Flo
  Simazine (low rate) + Butisan S + Kerb Flo

- Ronstar Liquid should be used pre bud burst to avoid damage to soft growth.

- Bolero has potential for excellent weed control but should only be applied when the trees are fully dormant.

Practical and financial anticipated benefits

This trial has indicated a number of herbicides, alone or in combination, that can be used safely and effectively during the rootstock and maiden year of budded tree production. So far it appears that effect of these herbicides on tree growth is small when compared with the growth reduction and consequent reduction in bud-take that can result from allowing even a small amount of weed to develop during the budding period.

With a move towards the use of cultivations rather than herbicides for weed control there is a risk that growers could underestimate the consequences of allowing weed cover to develop during the budding period. Such an effect could result in reductions of bud-take of up to 60% compared with the best herbicide treatment.

Note: With the wide range of crops grown and the sensitivity of some of this material to herbicides, it is possible that crop damage can occur from time to time. The information in this report should be regarded as a guide rather than a definitive recommendation as any off-label use of pesticides is entirely at the risk of the user.

SCIENCE SECTION

Introduction

Observations at HRI East Malling (Vasek, 1986) indicated that some soil-acting residual herbicides used in field-grown trees can have a negative effect on rootstock growth and that subsequent bud-take can be even more adversely affected. However, only a limited number of herbicides were used and a number of newer herbicides have come into use since these results were reported. Most of the tree species in the East Malling trials are known to be relatively difficult to bud and it was not known if this effect would apply to moderate- or easy-to-bud species as well.

Poor bud-take is an expensive problem for the industry. If the use of inappropriate herbicides is contributing to the problem, guidance on safer herbicides will enable growers to achieve a better bud-take, improve maiden quality and directly increase profitability

Currently, growers are unsure about the safety of herbicides, leading some to rely more on cultivations and hand-work. This is known to be expensive and can itself lead to a loss of quality by root damage or weed competition. Better guidance on crop tolerance should enable growers to use safer herbicides with more confidence.

The objective in year one was to study and quantify the effect of individual herbicides on rootstock growth, bud-take and subsequent maiden growth. In the second year, the effect of herbicide programmes and mixtures was studied. A secondary objective is the provision of information on the weed control achieved by the different programmes.

MATERIALS AND METHODS

Herbicide treatments

Year 1 (1997 planting)

Notcutts Nursery site - Suffolk
Soil type: medium sandy loam soil

1. Untreated control (weeds removed by hoeing or contact herbicide after each recording)
2. Bolero (diflufenican 200g/l /terbuthylazine 400g/l) @ 0.5 l/ha
3. Butisan S (metazachlor 500g/l) @ 2.5 l/ha
4. Devrinol (napropamide 450g/l) @ 9.0 l/ha
5. Flexidor 125 (isoxaben 125g/l) @ 2.0 l/ha
6. Kerb Flo (propyzamide 400g/l) @ 2.1 l/ha
7. Ronstar Liquid (oxadiazon 250g/l) @ 4.0 l/ha
8. Gesatop (simazine 500g/l) @1.7 l/ha
9. Sovereign 400 (pendimethalin 400g/l) @ 3.3 l/ha
10. Stefes Lenacil (lenacil 80% w/w) @1.7 kg/ha

HRI East Malling Site
Soil type: fine sandy loam soil

In addition to the above, the following double rate treatments were applied:

11. Butisan S (metazachlor) @ 5.0 l/ha
12. Flexidor 125 (isoxaben) @ 4.0 l/ha
13. Kerb Flo (propyzamide) @ 4.2 l/ha
14. Gesatop (simazine) @ 3.4 l/ha
15. Stefes Lenacil (lenacil) @ 3.4 kg/ha

Year 2 (1998 planting)

Notcutts Nursery site - Suffolk
Soil type - Medium sandy loam

1. Untreated control (weeds removed by hoeing or contact herbicide after each recording)

2. Bolero (diflufenican/terbuthylazine) @ 0.5 l/ha

3. Butisan S (metazachlor) @ 2.5 l/ha + Flexidor 125 (isoxaben) @ 2.0 l/ha

4. Devrinol (napropamide) @ 9.0 l/ha + Flexidor 125 (isoxaben) @ 2.0 l/ha

5. Sovereign 400 (pendimethalin) @ 3.3 l/ha + Flexidor 125 (isoxaben) @ 2.0 l/ha

6. Kerb Flo (propyzamide) @ 2.1 l/ha + Flexidor 125 (isoxaben) @ 2.0 l/ha

7. Ronstar Liquid (oxadiazon) @ 4.0 l/ha + Kerb Flo (propyzamide) @ 2.1 l/ha

8. Gesatop (simazine) @ 1.7 l/ha + Butisan S (metazachlor) @ 2.5 l/ha + Kerb Flo (propyzamide) @ 2.1 l/ha

9. Sovereign 400 (pendimethalin) @ 3.3 l/ha + Ronstar Liquid (oxadiazon) @ 4.0 l/ha

10. Stefes Lenacil (lenacil) @ 1.7 kg/ha + Butisan S (metazachlor) @ 2.5 l/ha

HRI East Malling Site

Soil type - fine sandy loam

In addition to the above, the following double rate treatments were applied:

11. Butisan S (metazachlor) @ 5.0 l/ha

12. Flexidor 125 (isoxaben) @ 4.0 l/ha

13. Kerb Flo (propyzamide) @ 4.2 l/ha

14. Gesatop (simazine) @ 3.4 l/ha

15. Stefes Lenacil (lenacil) @ 3.4 kg/ha

All treatments were applied in 500 l/ha water, immediately after planting the rootstocks, repeated at the same rates after budding, and immediately after heading back the following spring.

Treatment dates

Year 1

	After planting	After budding	After heading back
Notcutts Nurseries	15-25 April 1997	23-24 October 1997	17-24 March 1998
HRI East Malling	16 April 1997	9 September 1997	2 March 1998

Year 2

	After planting	After budding	After heading back
Notcutts Nurseries	14-29 May 1998	26 October - 11 November 1998	10-17 March 1999
HRI East Malling	7 May 1998	29 September 1998	17-18 March 1999

In addition, contact herbicides were applied as directed sprays to all treatments on the following occasions:

Notcutts Nurseries, 1997 trial, 11 July 1997, 10 October 1997, 16 July 1998
1998 trial, 16 July 1998, 16 October 1998, August 1999, November 1999

East Malling, Both trials, after each recording.

An additional overall nursery treatment was made to the Notcutts Trial 1997 planted site in early February 1998 - Butisan 2.5 l/ha + Flexidor 125 1.0 l/ha + Kerb Flo 2.75 l/ha.

Budding: East Malling, 26 August 1997, 12 August 1998
Notcutts Nurseries, early August 1997 & 1998.

Tree species

Notcutts Nurseries

Prunus Kanzan on *P.* Colt rootstock
Acer Crimson Sentry on *A. platanoides* rootstock
Sorbus Sheerwater Seedling on *S.aucuparia* rootstock
Tilia x euchlora on *T.cordata* rootstock
Malus Tschonowskii on *M. domestica* rootstock
Fraxinus Westhof Glorie on *F.excelsior* rootstock

HRI East Malling

Tilia x euchlora on *T.cordata* rootstock
Prunus Sargentii on *P.*Colt rootstock

Trial Design and Analysis of Results

East Malling
The trial was a four replicate, two treatment factor, split-plot design. The main treatment factor was tree species (*Tilia, Prunus*), with each tree species plot split into 15 herbicide treatment sub-plots. Each main plot consisted of 30m of double row of rootstock containing 150 trees. Each sub-plot consisted of 2m of double row of rootstock containing 10 trees.

Notcutts Nurseries
The trial was a three replicate, two treatment factor, split-plot design. The main treatment factor was tree species (*Acer, Fraxinus, Malus, Prunus, Sorbus*), with each tree species plot split into 10 herbicide treatment sub-plots. Each main plot consisted of 40m of single row of rootstock containing 100 trees. Each sub-plot consisted of 4m of single row of rootstock containing 10 trees.

Details of statistical analyses performed on the results are given in Appendix 1.

Assessments

Weed control was assessed by estimating the % ground area (total sample area per plot - $4m^2$) covered by weeds on 2 occasions. Growth increment was determined by measuring stem girth at 7.5 cm from ground level on 2 occasions (pre-budding and after tie removal).

RESULTS AND DISCUSSION

Weed control: Year 1

In 1997 single products were used in both trials so any weakness in the weed control spectrum was quite apparent. At the Notcutts site the predominant weeds were common mayweed, fat hen, common orache, oilseed rape, field pansy and speedwell. Simazine, Ronstar Liquid, and Stefes Lenacil gave the best weed control followed by Bolero and Butisan S. Kerb Flo and Devrinol were less effective. Kerb Flo failed to give good control of mayweed and Devrinol failed to control oilseed rape.

At the East Malling site in 1997, the predominant weeds were mayweed, groundsel, fat hen, knotgrass and annual meadow grass. Weed control from the treatments was generally less effective at this site, which had a greater weed pressure. Treatments 11-15 at this site were high rate applications of Butisan S, Flexidor 125, Kerb Flo, Simazine and Stefes Lenacil, included primarily to test for phytotoxicity. Not surprisingly some of these treatments were also the most effective for weed control, particularly higher rate Simazine, Stefes Lenacil and Butisan S. Of the normal rate treatments (2-10), the most effective were Stefes Lenacil, Simazine, Bolero and Ronstar Liquid. Devrinol, Kerb Flo, Flexidor 125 and Sovereign were less effective mainly because of failure to control mayweed adequately.

Taking both sites into account, Simazine, Ronstar Liquid and Stefes Lenacil were the most effective treatments.

Table 7: Percentage weed cover - Notcutts Nurseries 1997 planting

Treatment	Assessment date	
	4/6/97	**19/12/97**
1. Untreated control	44.0	64.7
2. Bolero @ 0.5 l/ha	0.1	4.3
3. Butisan S @ 2.5 l/ha	0.4	5.1
4. Devrinol @ 9.0 l/ha	2.4	10.2
5. Flexidor 125 @ 2.0 l/ha	2.1	7.3
6. Kerb Flo @ 2.1 l/ha	7.8	27.8
7. Ronstar liquid @ 4.0 l/ha	0.5	0.7
8. Simazine @ 1.7 l/ha	0	0.4
9. Sovereign @ 3.3 l/ha	1.8	9.1
10. Stefes Lenacil @ 1.7 kg/ha	2.0	2.3
SED	*1.90*	*5.43*
DF	*107*	*108*
P	*<0.001*	*<0.001*

(See Appendix 1 Tables 23-30 for statistical analysis and further data)

Table 8: Percentage weed cover - HRI East Malling 1997 planting

Treatment	Assessment date	
	18/6/97-1/7/97	1-7/12/97
1. Untreated control	89.2	4.6
2. Bolero 0.5 l/ha	35.5	0.1
3. Butisan S 2.5 l/ha	47.4	0.4
4. Devrinol 9.0 l/ha	57.7	2.1
5. Flexidor 125 2.0 l/ha	79.6	2.6
6. Kerb Flo 2.1 l/ha	80.9	1.7
7. Ronstar liquid 4.0 l/ha	37.3	0.7
8. Simazine 1.7 l/ha	22.0	0.5
9. Sovereign 3.3 l/ha	64.4	1.2
10. Stefes Lenacil 1.7 kg/ha	19.8	0.2
11. Butisan S 5.0 l/ha	17.2	0.6
12. Flexidor 125 4.0 l/ha	71.5	1.3
13. Kerb Flo 4.2 l/ha	75.9	1.8
14. Simazine 3.4 l/ha	14.8	0.2
15. Stefes Lenacil 3.4 l/ha	13.1	0.1
SED	*5.90*	*1.12*
DF	*84*	*84*
P	*<0.001*	*<0.001*

Weed control: Year 2

In 1998, tank mixtures were used to test the effects on crop growth and bud-take. These mixtures were also designed to combine the relative strengths of the individual products to give a broader range of weed control.

At the Notcutts site, the predominant weeds were again mayweed, fat hen, orache, oilseed rape, and field pansy, but in addition black bindweed, hedge mustard and sow thistle - the latter was the predominant weed in the autumn. The most effective treatments were Stefes Lenacil + Butisan S, Bolero and Ronstar Liquid + Sovereign. Butisan S + Flexidor 125, Sovereign + Flexidor 125, Ronstar Liquid + Kerb Flo and Simazine + Butisan S + Kerb Flo all gave good results in the spring, but because of a delay in applying the post budding treatment, autumn weed control was poorer.

At the East Malling site in 1998, the predominant weeds were fat hen, mayweed, groundsel and black nightshade. The most effective treatments were Ronstar Liquid + Sovereign, Ronstar Liquid + Kerb Flo, Simazine and Simazine + Butisan S + Kerb Flo. The Flexidor 125 mixtures with Butisan S, Devrinol, Kerb Flo or Sovereign treatments were moderately effective in the spring, but more effective in the autumn.

Taking both sites into account, the most effective treatment was Ronstar Liquid + Sovereign.

Table 9: Percentage weed cover - Notcutts Nurseries 1998 planting

Treatment	Assessment date	
	10/7/98	**15/10/98**
1. Untreated control	53.1	28.7
2. Bolero 0.5 l/ha	1.6	1.3
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	0.9	13.2
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	6.0	14.1
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	0.4	16.9
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	5.1	24.8
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	0	13.7
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	0.1	12.4
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	0	2.8
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	0.3	1.0

Table 10: Percentage weed cover - HRI East Malling 1998 planting

Treatment	Assessment date	
	1-7/7/98	**13/10/98**
1. Untreated control	100^{f}	3.6
2. Bolero 0.5 l/ha	35.8^{bc}	1.3
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	18.8^{ab}	0.7
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	36.1^{bc}	0.2
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	12.2^{ab}	0.3
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	38.6^{bc}	0.4
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	6.3^{a}	1.7
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	8.7^{a}	2.6
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	0.4^{a}	0.8
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	52.0^{cd}	0.6
11. Butisan S 5.0 l/ha	69.0^{de}	1.3
12. Flexidor 125 4.0 l/ha	59.8^{cd}	0.4
13. Kerb Flo 4.2 l/ha	74.1^{def}	0.9
14. Simazine 3.4 l/ha	4.3^{a}	1.6
15. Stefes Lenacil 3.4 l/ha	93.0^{ef}	1.0
sed	*11.62*	*
df	*84*	*
p	*<0.001*	*

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05)

*(*This data was not considered suitable for ANOVA analysis due to the large number of zero records)*

Phytotoxicity symptoms

Bolero- caused the most widespread phytotoxicity at both sites and in both years. Symptoms were a bleaching and chlorosis of lower leaves with occasional pink colouration. The symptoms were most pronounced on *Prunus* and *Tilia* with *Malus*, *Sorbus* and *Acer* less affected. To some extent the damage was related to the degree of bud development when sprayed. In the 1998 Notcutts trial some leafing out had occurred at the time of spraying after planting and damage was greater. Although the damage was visually obvious, in most cases the plants grew away by the end of the season.

Ronstar Liquid - has a strong contact action. In 1997 at the Notcutts site the *Prunus* was just beyond bud burst when sprayed, leaf was initially scorched but regrew. In 1998 at the same site spraying was delayed and the rootstocks were at early leaf stage. This foliage was scorched and the trees did not recover. The other species at Notcutts and at East Malling were largely unaffected by the Ronstar Liquid treatments including tank mixtures with Kerb Flo and Sovereign. Some bark discoloration was noted at East Malling on *Tilia* and *Prunus* in 1998 from the tank mixture treatments, and there was slight scorch to lower leaves on *Acer, Fraxinus, Sorbus* and *Malus* at the Notcutts site. No long term damage was caused to these.

Butisan S - has a slight contact action, less severe than Ronstar liquid. As noted above, the Prunus were not quite dormant when sprayed at the Notcutts site. No damage was caused in 1997 at either site. In 1998 when the trees were more advanced in growth and tank mixtures were used there was a slight scorch or blotching on the foliage from some of the tank mixtures (see below), the bark discolouration on Tilia was only noted at East Malling.

Phytotoxicity of Butisan S when used in mixtures with:

	Flexidor 125	**Simazine + Kerb Flo**	**Lenacil**
Acer	Lower leaf scorch	Lower leaf scorch	-
Fraxinus	-	-	Slightly smaller
Malus	Slight scorch	-	-
Prunus	-	Slightly smaller/ scorch	Severe stunting/ scorch
Sorbus	Slight scorch	-	-
Tilia	Bark discolouration	Bark discolouration	Severe scorch Bark discoloration Dieback

In 1999 slight chlorosis was noted on maiden growth of *Prunus* following the application of a Butisan S + Flexidor 125 mixture.

Devrinol - did not cause any phytotoxicity symptoms when applied alone in 1997. When used in tank mixtures in 1998 with Flexidor 125, some dieback occurred on *Tilia* at East Malling but no damage occurred at Notcutts site.

Flexidor 125 - did not cause phytotoxicity at either site in 1997 when the product was used alone. When used with various tank mix partners in 1998 and 1999 slight damage occurred on some subjects when tank mixed with Butisan S (see above). At East Malling only, slight dieback and bark discolouration on Tilia occurred with all tank mixes and double rate product. Slight scorch was noted on Prunus at East Malling only, from tank mixes with Kerb Flo or Sovereign or double rate product.

Kerb Flo - no damage occurred when the product was used alone even at double rate. Some damage occurred with tank mixtures as discussed above.

Simazine - did not cause any damage at the Notcutts site, but at East Malling it caused chlorosis on *Prunus* and *Tilia* (higher rate only) in 1997 and scorch and dieback on both subjects at the higher rate in 1998. No further damage occurred to maiden growth in 1999.

Stefes Lenacil - Caused chlorosis to *Prunus* at East Malling and dieback or stunting when tank mixed with Butisan S at the lower rate. *Tilia* was also affected with chlorosis at the higher rate only. No damage occurred in 1999.

Growth measurements during budding

In 1997 at the Notcutts site trees in the untreated control plots generally had the smallest growth increment (Table 11), this may be due to the higher levels of weed in these plots. The most tree growth was noted in the Simazine, Sovereign, Lenacil, and Butisan S plots. The least growth was noted in plots with the poorest weed control; the untreated control, Devrinol and Kerb, and also in *Prunus* treated with Ronstar liquid or Flexidor. In 1998 at the Notcutts site (Table 12) trees in the untreated control plots had better growth - there was less weed pressure over the budding period. The most growth was noted in the Lenacil + Butisan S, Bolero, Sovereign + Ronstar Liquid (Malus, Sorbus and Tilia only) and Simazine + Butisan S + Kerb Flo plots but these differences were not statistically significant.

In 1997 at East Malling (Table 13) the Simazine low rate, Butisan and Lenacil high rates appeared to cause reduced growth on *Prunus*, Devrinol and Flexidor 125 high rate caused reduced growth on *Tilia*, but overall (Table 32) no treatment significantly reduced growth compared with the control. In 1998 (Tables 14, 33) plots treated with Ronstar Liquid + Kerb Flo, Simazine and Sovereign + Flexidor had better growth than the control. Although Lenacil and Kerb Flo high rate treatments appeared to cause some growth reduction differences were not statistically significantly different from the control.

Table 11: % Girth Increment - Notcutts Nurseries 1997 planting
Recorded 8/97 - 10/97

Treatment	*Acer*	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*
1. Untreated control	8.5	-1.1	7.6	12.2	3.0	4.1
2. Bolero 0.5 l/ha	11.3	8.2	7.4	18.0	12.6	16.2
3. Butisan S 2.5 l/ha	10.6	6.5	9.9	19.2	10.7	17.4
4. Devrinol 9.0 l/ha	7.1	5.2	4.7	14.6	9.2	9.4
5. Flexidor 125 2.0 L/ha	11.5	9.2	8.1	19.4	8.9	5.9
6. Kerb Flo 2.1 l/ha	12.9	1.1	6.0	12.3	7.7	5.8
7. Ronstar liquid 4.0 l/ha	13.3	6.0	7.5	14.8	8.0	14.4
8. Simazine 1.7 l/ha	15.5	7.7	9.6	21.3	12.0	13.5
9. Sovereign 3.3 l/ha	13.4	3.2	10.6	19.5	9.9	7.2
10. Stefes Lenacil 1.7 kg/ha	13.5	9.6	9.3	19.8	10.4	9.2

(For statistical analysis see Appendix 1 Table 7)

Table 12: % Girth Increment - Notcutts Nurseries 1998 planting
Recorded 8/98-10/98

Treatment	*Acer*	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*
1. Untreated control	14.5	24.9	9.0	42.1	13.1	15.4
2. Bolero 0.5 l/ha	12.6	24.3	7.8	52.5	9.5	19.4
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	12.5	22.9	10.0	46.7	12.2	14.7
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	11.4	16.5	15.8	47.0	11.2	14.8
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	7.8	17.2	15.7	39.8	11.1	11.7
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	12.1	14.7	27.1	39. 7	15.5	15.2
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	12.6	11.4	15.2	44.9	9.0	20.2
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	15.6	15.9	12.0	55.2	7.2	18.9
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	8.9	15.6	17.8	32.9	12.3	21.0
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	17.2	17.1	11.8	50.4	12.3	17.5
	NS	*NS*	*NS*	*NS*	*NS*	*NS*

ns = non significant at the 5% level

Table 13: % Girth Increment - HRI East Malling 1997 planting
Recorded 20/8/97-21/10/97

Treatment	*Prunus*	*Tilia*
1. Untreated control	23.0	8.0
2. Bolero 0.5 l/ha	20.0	7.9
3. Butisan S 2.5 l/ha	21.8	11.4
4. Devrinol 9.0 l/ha	19.4	6.2
5. Flexidor 125 2.0 l/ha	20.2	10.7
6. Kerb Flo 2.1 l/ha	27.2	8.3
7. Ronstar liquid 4.0 l/ha	18.3	7.3
8. Simazine 1.7 l/ha	17.9	7.3
9. Sovereign 3.3 l/ha	21.4	8.1
10. Stefes Lenacil 1.7 kg/ha	18.8	9.0
11. Butisan S 5.0 l/ha	16.2	9.1
12. Flexidor 125 4.0 l/ha	20.5	5.9
13. Kerb Flo 4.2 l/ha	24.4	10.2
14. Simazine 3.4 l/ha	24.1	8.6
15. Stefes Lenacil 3.4 l/ha	17.0	7.9

(For statistical analysis see Appendix 1 Table 31)

Table 14: % Girth Increment - HRI East Malling 1998 planting
Recorded 3/8/98-9/10/98

Treatment	*Prunus*	*Tilia*
1. Untreated control	5.6	5.0
2. Bolero 0.5 l/ha	15.6	9.4
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	11.1	0.9
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	12.1	5.6
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	15.1	14.5
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	9.0	-0.6
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	21.4	16.0
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	18.9	8.0
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	10.9	14.5
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	12.2	4.7
11. Butisan S 5.0 l/ha	6.5	2.6
12. Flexidor 125 4.0 l/ha	7.9	2.5
13. Kerb Flo 4.2 l/ha	8.0	-2.5
14. Simazine 3.4 l/ha	22.6	10.1
15. Stefes Lenacil 3.4 l/ha	5.3	0.1

(For statistical analysis see Appendix 1 Table 33)

Bud-take

There were significant differences in bud-take between treatments at the Notcutts site in 1997 (Tables 15, 34). Bud-take in the untreated controls was low across all species except *Sorbus*, possibly as a result of weed competition. Bud-take in *Acer* was very low in all treatments in both years and *Verticillium* wilt caused losses in 1999. There was an indication of lower bud-take in *Fraxinus* from the Sovereign treatment, in *Tilia*, *Malus* and *Sorbus* from Kerb Flo, and in *Prunus* from Flexidor 125 and Ronstar Liquid. Overall, bud-take was highest from the Butisan S and Simazine treatments (Table 34). In 1998 (Tables 16, 35) differences were less obvious, although the untreated controls tended to give the lower bud-take results. Treatments containing Ronstar liquid also gave lower bud-take results, no doubt due to damage to the rootstocks, particularly *Prunus*, which were coming into leaf when sprayed in March 1998.

Although there were no significant differences in bud- take between treatments at the East Malling site in 1997 (Table 17) the lowest bud-take on *Prunus* was from the Devrinol treatment and on *Tilia* from the Kerb Flo lower rate treatment. Considerable winter damage occurred to the *Tilia* plots in 1998/99. In 1998 bud-take was disapointingly low and variable on all plots. There were some significant differences in bud-take between treatments, but no treatments were significantly different from the untreated control. Surprisingly, the simazine treatments gave the highest bud-takes. The high rate Flexidor treatment gave the lowest bud-take although this was not significantly different from the control.

Table 15: % Bud-take - Notcutts Nurseries 1997 planting

Treatment	*Acer*	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*
1. Untreated control	7	20	0	73	90	27
2. Bolero 0.5 l/ha	3	80	53	70	87	80
3. Butisan S 2.5 l/ha	7	70	57	80	93	83
4. Devrinol 9.0 l/ha	0	73	30	70	90	67
5. Flexidor 125 2.0 l/ha	3	87	40	50	90	77
6. Kerb Flo 2.1 l/ha	13	70	10	87	70	60
7. Ronstar liquid 4.0 l/ha	13	77	47	50	87	90
8. Simazine 1.7 l/ha	13	77	50	70	93	90
9. Sovereign 3.3 l/ha	7	53	50	67	77	73
10. Stefes Lenacil 1.7 kg/ha	13	73	57	67	93	73

(For statistical analysis see Appendix 1 Table 34)

Table 16: % Bud-take - Notcutts Nurseries 1998 planting

Treatment	Acer	Fraxinus	Malus	Prunus	Sorbus	Tilia
1. Untreated control	7	67	50	57[abc]	90	83
2. Bolero 0.5 l/ha	3	87	43	63[bc]	90	93
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	23	90	77	67[c]	83	83
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	13	87	50	77[c]	100	97
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	13	87	63	57[abc]	87	100
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	10	83	53	80[c]	80	80
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	0	70	73	30[a]	83	90
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	17	80	50	73[c]	73	93
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	3	83	67	33[ab]	83	87
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	7	87	57	73[c]	97	80
P-value	*NS*	*NS*	*NS*	*0.02*	*NS*	*NS*
d.f.				*18*		
s.e.d				*14*		

ns = non significant at the 5% level - for further statistical analysis of all species combined see Appendix 1 Table 35

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05)

Table 17: % Bud Take - HRI East Malling 1997 planting

Treatment	*Prunus*	*Tilia*
1. Untreated control	90	98
2. Bolero 0.5 l/ha	78	93
3. Butisan S 2.5 l/ha	80	90
4. Devrinol 9.0 l/ha	73	95
5. Flexidor 125 2.0 l/ha	88	83
6. Kerb Flo 2.1 l/ha	78	85
7. Ronstar liquid 4.0 l/ha	83	90
8. Simazine 1.7 l/ha	80	95
9. Sovereign 3.3 l/ha	85	83
10. Stefes Lenacil 1.7 kg/ha	80	85
11. Butisan S 5.0 l/ha	88	90
12. Flexidor 125 4.0 l/ha	90	85
13. Kerb Flo 4.2 l/ha	75	85
14. Simazine 3.4 l/ha	80	93
15. Stefes Lenacil 3.4 l/ha	83	90
ns = non significant at the 5% level	*ns*	*ns*

Table 18: % Bud Take - HRI East Malling 1998 planting

Treatment	*Prunus*	*Tilia**
1. Untreated control	32^{abcde}	
2. Bolero 0.5 l/ha	52^{bcde}	
3. Butisan S 2.5 l/ha	47^{bcde}	
4. Devrinol 9.0 l/ha	55^{cde}	
5. Flexidor 125 2.0 l/ha	65^{e}	
6. Kerb Flo 2.1 l/ha	22^{abc}	
7. Ronstar liquid 4.0 l/ha	27^{abcd}	
8. Simazine 1.7 l/ha	67^{e}	
9. Sovereign 3.3 l/ha	42^{abcde}	
10. Stefes Lenacil 1.7 kg/ha	55^{cde}	
11. Butisan S 5.0 l/ha	47^{bcde}	
12. Flexidor 125 4.0 l/ha	7^{a}	
13. Kerb Flo 4.2 l/ha	20^{abc}	
14. Simazine 3.4 l/ha	62^{de}	
15. Stefes Lenacil 3.4 l/ha	17^{ab}	
P- value	*0.004*	
d.f	*42*	
s.e.d.	*15.8*	

* Winter losses severely affected all *Tilia* plots
Duncans multiple range test: figures in the same column followed by a common letter are not significantly different ($P<0.05$)

Maiden height

Differences in maiden height were significant at East Malling in 1998 (Tables 18, 37). Most herbicide treatments produced more maiden height on *Tilia* than the control, but growth was reduced following the Kerb Flo treatments. Many of the herbicide treatments produced more maiden height on *Prunus* than the control, but treatments Bolero and Flexidor 125 (high rate), were shorter. In 1998 (Table 22) none of the trreatments were significantly different from the control

Although differences in maiden height were not significant at the Notcutts site in 1998 (Table 19), there was an indication of slightly reduced height on *Prunus* and *Fraxinus* from Ronstar Liquid treatment. For *Prunus* this effect was repeated in 1999 where one of the Ronstar treatments gave a reduced height following late application in the spring.

Table 19: Maiden height (m) - Notcutts Nurseries 1997 planting Recorded 11/98

Treatment	*Acer**	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*
1. Untreated control		1.19	*	1.10	1.25	1.16
2. Bolero 0.5 l/ha		1.27	1.08	1.24	1.32	1.37
3. Butisan S 2.5 l/ha		1.11	0.99	1.17	1.16	1.31
4. Devrinol 9.0 l/ha		1.18	1.20	1.09	1.20	1.32
5. Flexidor 125 2.0 l/ha		1.21	1.18	1.02	1.23	1.38
6. Kerb Flo 2.1 l/ha		1.12	0.96	1.59	1.26	1.35
7. Ronstar liquid 4.0 l/ha		1.04	1.07	0.95	1.26	1.48
8. Simazine 1.7 l/ha		1.23	1.06	1.33	1.22	1.39
9. Sovereign 3.3 l/ha		1.24	1.02	1.26	1.18	1.47
10. Stefes Lenacil 1.7 kg/ha		1.30	1.06	1.10	1.27	1.40
		ns	*ns*	*ns*	*ns*	*ns*

ns = non significant at the 5% level
* Insufficient bud-take for recording

Table 20: Maiden height (m) - Notcutts Nurseries 1998 planting Recorded 28/9/99

Treatment	*Acer*	*Fraxinus*	*Malus*	*Prunus*	*Sorbus*	*Tilia*
1. Untreated control	2.71	1.16	0.97	1.34[b]	0.58	1.21
2. Bolero 0.5 l/ha	1.81	1.16	1.00	1.17[b]	0.57	1.31
3. Butisan S 2.5 l/ha + Flexidor 125 2.0 l/ha	2.07	1.08	0.82	1.45[bc]	0.54	1.38
4. Devrinol 9.0 l/ha + Flexidor 125 2.0 l/ha	2.44	1.07	0.88	1.46[bc]	0.59	1.15
5. Sovereign 3.3 l/ha + Flexidor 125 2.0 l/ha	2.13	1.12	0.99	1.31[b]	0.56	1.33
6. Kerb Flo 2.1 l/ha + Flexidor 125 2.0 l/ha	1.85	0.97	0.98	1.32[b]	0.57	1.19
7. Ronstar liquid 4.0 l/ha + Kerb Flo 2.1 l/ha	2.19	1.06	1.15	0.75[a]	0.59	1.35
8. Simazine 1.7 l/ha + Butisan S 2.5 l/ha + Kerb Flo 2.1 l/ha	1.93	1.14	1.00	1.66[c]	0.54	1.38
9. Sovereign 3.3 l/ha + Ronstar liquid 4.0 l/ha	2.19	1.08	0.98	1.21[b]	0.60	1.16
10. Stefes Lenacil 1.7 kg/ha + Butisan S 2.5 l/ha	2.53	1.16	1.02	1.29[b]	0.52	1.37
P-value	*n.s*	*n.s*	*n.s*	*<0.001*	*n.s*	*n.s*
d.f.				*16*		
s.e.d				*0.133*		

ns = non significant at the 5% level - for further statistical analysis of all species combined see Appendix 1 Table 36
Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05)

Table 21: Maiden Height (m) - HRI East Malling 1997 planting
Recorded 9/10/98

Treatment	*Prunus*	*Tilia*
1. Untreated control	1.34	0.99
2. Bolero 0.5 l/ha	1.23	1.13
3. Butisan S 2.5 l/ha	1.60	1.16
4. Devrinol 9.0 l/ha	1.38	1.13
5. Flexidor 125 2.0 l/ha	1.48	1.06
6. Kerb Flo 2.1 l/ha	1.40	0.84
7. Ronstar liquid 4.0 l/ha	1.53	1.18
8. Simazine 1.7 l/ha	1.53	1.20
9. Sovereign 3.3 l/ha	1.56	1.15
10. Stefes Lenacil 1.7 kg/ha	1.61	1.19
11. Butisan S 5.0 l/ha	1.63	1.18
12. Flexidor 125 4.0 l/ha	1.27	1.04
13. Kerb Flo 4.2 l/ha	1.41	0.85
14. Simazine 3.4 l/ha	1.43	1.19
15. Stefes Lenacil 3.4 l/ha	1.41	1.18

(For statistical analysis see Appendix 1 Table 37.)

Table 22: Maiden Height (m) - HRI East Malling 1998 planting
Recorded 30/9/99

Treatment	*Prunus*	*Tilia**
1. Untreated control	0.95^{bcd}	
2. Bolero 0.5 l/ha	0.89^{abc}	
3. Butisan S 2.5 l/ha	1.16^{d}	
4. Devrinol 9.0 l/ha	0.95^{bcdc}	
5. Flexidor 125 2.0 l/ha	1.03^{bcd}	
6. Kerb Flo 2.1 l/ha	0.86^{ab}	
7. Ronstar liquid 4.0 l/ha	1.14^{d}	
8. Simazine 1.7 l/ha	1.04^{bcd}	
9. Sovereign 3.3 l/ha	1.12^{cd}	
10. Stefes Lenacil 1.7 kg/ha	1.08^{bcd}	
11. Butisan S 5.0 l/ha	1.02^{bcd}	
12. Flexidor 125 4.0 l/ha	1.14^{d}	
13. Kerb Flo 4.2 l/ha	0.71^{a}	
14. Simazine 3.4 l/ha	1.02^{bcd}	
15. Stefes Lenacil 3.4 l/ha	1.07^{bcd}	
P- value	*0.007*	
d.f	*41*	
s.e.d.	*0.099*	

* Winter losses severely affected all Tilia plots
Duncans multiple range test: figures in the same column followed by a common letter are not significantly different ($P<0.05$)

CONCLUSIONS

1. Although some visual phytotoxicity was recorded, particularly from Bolero at both sites and Lenacil and Simazine at the East Malling site, there was no consistent effect on growth or bud-take of the six tree species.

2. Where trees had been allowed to break bud at the Notcutts site prior to spraying there was contact damage on Prunus from the use of Ronstar Liquid and mixtures containing Ronstar Liquid. Although this did not affect growth during budding in 1997, bud-take was reduced. Further damage occurred on the 1998 plantings.

3. In most cases where growth increment or bud-take was reduced, it appeared to be an indirect effect of poorer weed control rather than a direct effect of herbicide on growth.

4. The best weed control from single treatments was obtained with Simazine, Ronstar Liquid and Lenacil. Devrinol, Kerb Flo and Sovereign were less effective as single treatments.

5. The best herbicide mixtures for weed control were Ronstar Liquid + Sovereign, Ronstar Liquid + Kerb Flo and Simazine + Butisan S + Kerb Flo.

GLOSSARY OF PLANT NAMES

Annual meadow grass	*Poa annua* L.
Black bindweed	*Polygonum convolvulus* L.
Black nightshade	*Solanum nigrum* L.
Canadian fleabane	*Erigeron canadensis* L. (syn *Conyza canadensis* (L.) Cronq.
Charlock	*Sinapsis arvensis* L.
Cleavers	*Galium aparine* L.
Common chickweed	*Stellaria media* (L.) Vill.
Common orache	*Atriplex patula* L.
Common poppy	*Papaver rhoeas* L.
Common sowthistle	*Sonchus oleraceus* L.
Common speedwell	*Veronica officinalis* L.
Common knot grass	*Polygonum aviculare* L.
Creeping thistle	*Cirsium arvense* (L.) Scop.
Dandelion	*Taraxacum officinale* Weber
Dock	*Rumex* spp.
Fat hen	*Chenopodium album* L.
Field pansy	*Viola arvensis* Murray
Field penny cress	*Thlaspi arvense* L.
Groundsel	*Senecio vulgaris* L.
Hairy bitter cress	*Cardamine hirsuta* L.
Mayweed scentless	*Tripleurospermum inodorum* L. Vaarama,
Mayweed rayless	*Matricaria matricarioides* (Less.) Porter
Red shank	*Polygonum persicaria* L.
Scarlet pimpernel	*Anagallis arvensis* L.
Shepherds-purse	*Capsella bursa-pastoris* (L.) Medicus
Small nettle (Annual)	*Urtica urens* L.
Willowherbs	*Epilobium* spp.

REFERENCE

Vasek J., (1986) Rep. E. Malling Res. Stn for 1985

APPENDIX 1

Statistical analysis and additional data

Table 9

There were a large number of zeroes in the data, nevertheless the data were explored using the whole plots for a given tree species and a Friedman's analysis was conducted and all but Acer (10/7/98) and Fraxinus (15/10/98) etc. were statistically significantly different at the 5% level. Additionally, multiple range tests were carried out in this exploration of the data (Siegel, S. and Castellan Jnr, N. J.1988) and no pairwise comparisons (or as appropriate) were considered significant at the 5% level when an ANOVA gave a significant treatment difference. These was probably due in part to the size of the critical value of the test statistic needed to counter the very large probability of finding a significant difference by chance due to the very high number of treatment combinations.

REFERENCE

Siegel, S. and Castellan Jnr, N. J. (1988) Nonparametric statistics for the behavioural sciences. Second Edition. McGraw-Hill Book Company, London, pp174-181.

Table 23: Percentage weed cover - Notcutts Nurseries 1997 planting
Arcsine transform values

Treatment	Assessment date	
	4/6/97	**19/12/97**
1. Untreated control	41.14^{e}	53.26^{e}
2. Bolero 0.5 l/ha	0.32^{a}	3.79^{abc}
3. Butisan S 2.5 l/ha	2.03^{ab}	4.43^{abc}
4. Devrinol 9.0 l/ha	6.69^{c}	11.82^{bc}
5. Flexidor 125 2.0 l/ha	4.87^{bc}	12.79^{c}
6. Kerb Flo 2.1 l/ha	12.9^{d}	28.05^{d}
7. Ronstar liquid 4.0 l/ha	2.1^{ab}	1.89^{ab}
8. Simazine 1.7 l/ha	0^{a}	1.49^{a}
9. Sovereign 3.3 l/ha	4.83^{bc}	11.94^{bc}
10. Stefes Lenacil 1.7 kg/ha	5.14^{bc}	5.88^{abc}
SED	*1.648*	*4.46*
DF	*107*	*108*
P	*<0.001*	*<0.001*

An arcsine transformation was used to make the data appropriate for analaysis. The residuals plot was not quite appropriate due principally to the presence of zero values.

There were also significant diferences between tree species plots presumably due to weed distribution

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05)

Example of anova analysis for split plot design (4/6/97 recording)

```
Variate: %wc_totarc

Source of variation      d.f.(m.v.)      s.s.       m.s.     v.r.  F pr.

Block.Wplot stratum
Block                         2          314.42     157.21    1.76  0.221
Factor1                       5         2961.32     592.26    6.64  0.006
Residual                     10          891.77      89.18    0.91

Block.Wplot.Splot stratum
Factor2                       9        96868.59   10763.18  110.06  <.001
Factor1.Factor2              45         9598.63     213.30    2.18  <.001
Residual                    107(1)     10463.50      97.79    3.29

Block.Wplot.Splot.Reps stratum
                            537(3)     15957.27      29.72

Total                       715(4)    136895.72
```

Table 24: Percentage weed cover 4/6/97 - Notcutts Nurseries 1997 planting

Treatment	Black bindweed	Fat hen	Field pansy	Groundsel	Mayweed	Oilseed Rape	Orache
1. Untreated control	0.6	6.1	0.7	1.1	20.8	1.2	4.0
2. Bolero @ 0.5 l/ha	0	0	0	0.1	0	0	0
3. Butisan S @ 2.5 l/ha	0	0	0	0	0	0.5	0
4. Devrinol @ 9.0 l/ha	0.2	0.1	0	1.2	0.3	1.3	0
5. Flexidor 125 @ 2.0 l/ha	0.1	0.1	0.1	1	0.6	0	0
6. Kerb Flo @ 2.1 l/ha	0	0.1	0	0.2	7.1	0.4	0.3
7. Ronstar liquid @ 4.0l/ha	0	0	0	0.1	0.1	0.3	0
8. Simazine @ 1.7 l/ha	0	0	0	0	0	0	0
9. Sovereign @ 3.3 l/ha	0	0	0	0.2	1.3	0	0
10. Stefes Lenacil @ 1.7 kg/ha	0	0.6	0.2	0.1	0	0.1	0

This data was not considered suitable for statistical analysis because of the variability of weed species distribution

Table 25: Weed species 19/12/97 - Notcutts Nurseries, 1997 planting

Treatment	Predominant Weeds
1. Untreated control	Mayweed, fat hen, Speedwell, Field pansy,Groundsel
2. Bolero @ 0.5 l/ha	Mayweed, Speedwell, Fat hen, Orache
3. Butisan S @ 2.5 l/ha	Mayweed, Fat hen
4. Devrinol @ 9.0 l/ha	Mayweed, Fat hen, Field pansy
5. Flexidor 125 @ 2.0 l/ha	Knotgrass, Mayweed, Fat hen
6. Kerb Flo @ 2.1 l/ha	Mayweed, Groundsel, Fat hen
7. Ronstar liquid @ 4.0 l/ha	
8. Simazine @1.7 l/ha	Groundsel
9. Sovereign @ 3.3 l/ha	Knotgrass, Mayweed
10. Stefes Lenacil @ 1.7 kg/ha	Speedwell, Knotgrass, Mayweed, Fat hen

Table 26: % Weed cover by species, recorded 6/97 - East Malling 1997 planting

Treatment	Knotgrass	Mayweed	Groundsel	Fat hen	Others
1. Untreated control	3.59	37.4	31.4	22.9	4.92
2. Bolero @ 0.5 l/ha	1.56	5.2	26.5	2.5	0.23
3. Butisan S @ 2.5 l/ha	1.25	10.9	16.5	18.8	0.94
4. Devrinol @ 9.0 l/ha	5.31	43.0	8.4	1.5	0.86
5. Flexidor 125 @ 2.0 l/ha	7.19	39.2	18.9	10.5	6.41
6. Kerb Flo @ 2.1 l/ha	0.34	28.9	36.4	10.9	6.72
7. Ronstar liquid @ 4.0 l/ha	6.17	7.2	20.1	0.0	4.45
8. Simazine @ 1.7 l/ha	0.16	1.1	19.3	0.2	1.25
9. Sovereign @ 3.3 l/ha	0.00	25.5	39.1	0.0	0.08
10.Stefes Lenacil @ 1.7 kg/ha	0.47	0.0	4.9	14.1	0.23
11.Butisan S @ 5.0 l/ha	6.80	2.3	0.9	5.6	0.39
12.Flexidor 125 @ 4.0 l/ha	9.20	39.6	10.5	4.7	6.56
13.Kerb Flo @ 4.2 l/ha	0.00	40.4	26.6	9.5	1.02
14.Simazine @ 3.4 l/ha	2.19	0.0	12.3	0.0	0.00
15.Stefes Lenacil @ 3.4 l/ha	0.23	0.0	11.9	0.0	0.94
P-value[1]	0.051	<.001	<.001	<.001	0.002
d.f.	14	14	14	14	14
s.e.d.[1]	4.259	5.22	5.14	5.09	3.560
Residual plot [1]	U	B	A	U	U

A = acceptable, B =borderline, U = unacceptable. NS = non-significant at 0.05 level.

[1] ANOVA using arcsine transformation: applies to sub-plot factor. Main plot and interaction with sub-plot factor were all non-significant at 0.05 level.

Table 27: % Weed cover by species, recorded 12/97 - East Malling 1997 planting

Treatment	Meadow Grass	Groundsel	Chickweed	Seedling/others	Mayweed
1. Untreated control	1.83	0.38	1.64	0.63	0.14
2. Bolero @ 0.5 l/ha	0.05	0.00	0.00	0.00	0.00
3. Butisan S @ 2.5 l/ha	0.02	0.02	0.00	0.38	0.00
4. Devrinol @ 9.0 l/ha	0.11	0.23	0.94	0.70	0.05
5. Flexidor 125 @ 2.0 l/ha	1.80	0.34	0.06	0.39	0.02
6. Kerb Flo @ 2.1 l/ha	0.16	0.66	0.05	0.67	0.20
7. Ronstar liquid @ 4.0 l/ha	0.02	0.03	0.61	0.08	0.00
8. Simazine @ 1.7 l/ha	0.02	0.05	0.00	0.28	0.00
9. Sovereign @ 3.3 l/ha	0.02	0.83	0.00	0.31	0.02
10.Stefes Lenacil @ 1.7 kg/ha	0.00	0.00	0.00	0.20	0.00
11.Butisan S @ 5.0 l/ha	0.03	0.08	0.00	0.48	0.00
12. Flexidor 125 @ 4.0 l/ha	0.84	0.08	0.02	0.30	0.13
13. Kerb Flo @ 4.2 l/ha	0.11	0.67	0.14	0.81	0.08
14. Simazine @ 3.4 l/ha	0.05	0.05	0.00	0.11	0.00
15. Stefes Lenacil @ 3.4 L/ha	0.03	0.05	0.00	0.06	0.00
P-value[1]	<.001	<.001	<.001	<.001	<.001
d.f.	14	14	14	14	14
s.e.d.[1]	0.877	0.893	0.983	0.887	0.452
Residual plot [1]	A	B	U	B	U

A = acceptable, B =borderline, U = unacceptable. NS = non-significant at 0.05 level.

[1] ANOVA using arcsine transformation: applies to sub-plot factor. Main plot and interaction with sub-plot factor were nearly all non-significant at 0.05 level. Main plot factor significant(arcsine data; p=0.037,df =1, s.e.d. = 0.433).

Table 28: % Weed cover by species, recorded 6/98 - Notcutts Nurseries 1998 planting

Treatment	Black Bindweed	Fat Hen	Maywee d	Orache	Oilseed Rape	Groundsel	Field Pansy	Hedge mustard	Knot grass	Sow-Thistl e	Redshank	Willow herb	Speedwel l
1. Untreated control	17.7	25.1	11.1	3.5	15.7	0.8	2.5	6.5	2	2	1	.5	1.4
2. Bolero @ 0.5 l/ha	1	3	0	0	0	0	0	0	0	0	0	0	0
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	1.8	1	0	0.5	0	0	0	0	0	0	0	0	0
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	8	2	0	0	0	0	2	0	0	0	0	0	0
5. Sovereign @ 3.3 l/ha + Flexidor 125 @2.0 l/ha	0.1	0	2	2	0	0	0	0	0	0	0.2	0	0
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	1.4	9.9	1.3	.7	0	.5	0	0	0	0.1	0	0	0
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	0	0	1	0	1	0	0	0	0	0	0	0	0
8. Simazine @ 1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 l/ha	0	0	0	0	0.1	0	0	2	0	0	0	0	0
9. Sovereign @ 3.3 l/ha + Ronstar liquid @ 4.0 l/ha	0	0	0.2	0	0	0	0	0	0	0	0	0	0
10. Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	10.3	40.0	5.0	0	0	0.1	0	2.0	0	0	0	0	0

This data was not considered suitable for statistical analysis because of the variability of weed species distribution

Table 29: % Weed cover by species, recorded 6/98 - East Malling 1998 planting

Treatment	Groundsel	Mayweed	Annual meadow grass	Black nightshade	Other
1. Untreated control	0.11	0.06	0.16	3.25	0.13
2. Bolero @ 0.5 l/ha	0.16	0.19	0.66	0.25	0
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	0.34	0.09	0.11	0.11	0
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	0.22	0	0	0	0
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	0.17	0	0.02	0.06	0.05
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	0.47	0	0	0	0
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	0.69	0.02	1.02	0	0
8. Simazine @1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 l/ha	0.88	0.08	1.61	0	0
9. Sovereign @ 3.3 l/ha + Ronstar Liquid @ 4.0 l/ha	0.73	0	0.02	0	0
10.Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	0.53	0	0.06	0	0
11.Butisan S @ 5.0 l/ha	1.03	0.03	0.2	0	0.02
12.Flexidor 125 @ 4.0 l/ha	0.41	0	0	0	0.05
13. Kerb Flo @ 4.2 l/ha	1.02	0.02	0	0	0
14. Simazine @ 3.4 l/ha	0.61	0.3	0.59	0.03	0
15. Stefes Lenacil @ 3.4 l/ha	0.25	0.09	0.61	0	0.03

This data was not considered suitable for statistical analysis because of the variability of weed species distribution

Table 30: % Weed cover by species, recorded 10/98 - East Malling 1998 planting

Treatment	Fat Hen	Knotgrass	Mayweed	Groundsel	Other
1. Untreated control	65.3	0.2	7.7	0	0
2. Bolero @ 0.5 l/ha	44.7	0	0	0.2	0
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	0	2.2	0	0.2	0
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	5.66	0	5.9	0.7	0.2
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	0	0	7	0	1.6
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	9.69	0	6.9	0	0
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	0	0	0.2	1.1	0
8. Simazine @ 1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 L/ha	1.56	0	0	0	0
9. Sovereign @ 3.3 l/ha + Ronstar liquid @ 4.0 l/ha	0	0	0.6	0.8	0
10. Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	46.9	1.3	0.6	0.3	0
11. Butisan S @ 5.0 l/ha	42.7	0	1.3	0	0
12. Flexidor 125 @ 4.0 l/ha	31.6	2.7	4.7	0	0
13. Kerb Flo @ 4.2 l/ha	51.9	0	8.9	0	0
14. Simazine @ 3.4 l/ha	9.06	0	0	0.2	0
15. Stefes Lenacil @ 3.4 l/ha	44.4	0	16	0	0

This data was not considered suitable for statistical analysis because of the variability of weed species distribution

Table 31: % Girth Increment - Notcutts 1997 planting
Combined result of all tree species

Treatment	Duncan code letter(s)	% Difference in tree diameter
1. Untreated control	a	5.7
2. Bolero @ 0.5 l/ha	cd	12.3
3. Butisan S @ 2.5 l/ha	cd	12.4
4. Devrinol @ 9.0 l/ha	abc	8.4
5. Flexidor 125 @ 2.0 l/ha	bcd	10.5
6. Kerb Flo @ 2.1 l/ha	ab	7.6
7. Ronstar liquid @ 4.0 l/ha	bcd	10.7
8. Simazine @ 1.7 l/ha	d	13.3
9. Sovereign @ 3.3 l/ha	bcd	10.6
10. Stefes Lenacil @ 1.7 kg/ha	cd	12.0
		SED = 1.859
		DF = 108
		p = 0.001

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the Block.wplot.split stratum.

Table 32: % Girth Increment - HRI East Malling 1997 planting
Combined result of *Prunus* and *Tilia*

Treatment	Duncan code letter(s)	%difference in tree diameter
1. Untreated control	abc	15.5
2. Bolero @ 0.5 l/ha	abc	14.0
3. Butisan S @ 2.5 l/ha	bc	16.6
4. Devrinol @ 9.0 l/ha	ab	12.8
5. Flexidor 125 @ 2.0 l/ha	abc	15.5
6. Kerb Flo @ 2.1 l/ha	c	17.7
7.Ronstar liquid @ 4.0 l/ha	ab	12.8
8. Simazine @ 1.7 l/ha	a	12.6
9. Sovereign @ 3.3 l/ha	abc	14.8
10.Stefes Lenacil @ 1.7 kg/ha	abc	13.9
11. Butisan S @ 5.0 l/ha	ab	12.7
12. Flexidor 125 @4.0 l/ha	ab	13.2
13. Kerb Flo @ 4.2 l/ha	c	17.3
14. Simazine @ 3.4 l/ha	abc	16.4
15. Stefes Lenacil @3.4l/ha	a	12.5
		SED = 1.687
		DF = 84
		p = 0.008
Prunus	-	20.7
Tilia	-	8.4
		SED = 0.930
		DF = 3
		p<0.001
Interaction terms between the two treatment factors (tree species / herbicide) were non-significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.

Table 33: % Girth Increment - HRI East Malling 1998 planting
Combined result of *Prunus* and *Tilia*

Treatment	Duncan code letter(s)	%difference in tree diameter
1. Untreated control	abc	5.3
2. Bolero @ 0.5 l/ha	bcdef	12.5
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	abcd	6.0
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	abcde	8.8
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	ef	14.8
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	a	4.2
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	f	18.7
8. Simazine @1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 l/ha	def	13.2
9. Sovereign @ 3.3 l/ha + Ronstar Liquid @ 4.0 l/ha	cdef	12.7
10. Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	abcde	8.4
11. Butisan S @ 5.0 l/ha	a	4.5
12. Flexidor 125 @ 4.0 l/ha	ab	5.2
13. Kerb Flo @ 4.2 l/ha	a	2.8
14. Simazine @ 3.4 l/ha	f	16.3
15. Stefes Lenacil @ 3.4 l/ha	a	2.7
		SED = 3.295
		DF = 84
		p = <0.001
Interaction terms between the two treatment factors (tree species / herbicide) were non-significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.

Table 34: % Bud Take - Notcutts 1997 planting
Combined result of all species

Treatment	Duncan code letter(s)	% Bud-take
1. Untreated control	a	42
2. Bolero @ 0.5 l/ha	bc	74
3. Butisan S @ 2.5 l/ha	c	77
4. Devrinol @ 9.0 l/ha	bc	66
5. Flexidor 125 @ 2.0 l/ha	bc	69
6. Kerb Flo @ 2.1 l/ha	b	59
7. Ronstar liquid @4.0 l/ha	bc	70
8. Simazine @ 1.7 l/ha	c	76
9. Sovereign @ 3.3 l/ha	bc	64
10. Stefes Lenacil @1.7 kg/ha	bc	73
		SED = 6.8
		DF = 90
		p = <0.001
Interaction terms between the two treatment factors (tree species / herbicide) were also significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.

Table 35: % Bud Take - Notcutts 1998 planting
Combined result of all species

Treatment	Duncan code letter(s)	% Bud-take
1. Untreated control	a	59
2. Bolero @ 0.5 l/ha	ab	63
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	b	71
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	b	71
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	ab	68
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	ab	64
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	a	58
8. Simazine @1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 l/ha	ab	64

9. Sovereign @ 3.3 l/ha + Ronstar Liquid @ 4.0 l/ha	ab	59
10. Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	ab	67
		SED = 4.93
		DF = 108
		p = 0.085
Interaction terms between the two treatment factors (tree species / herbicide) were also significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.

Table 36: Mean tree height - Notcutts 1998 planting
Combined result of all species

Treatment	Duncan code letter(s)	Tree height (m.)
1. Untreated control	e	1.32
2. Bolero @ 0.5 l/ha	ab	1.17
3. Butisan S @ 2.5 l/ha + Flexidor 125 @ 2.0 l/ha	abcd	1.22
4. Devrinol @ 9.0 l/ha + Flexidor 125 @ 2.0 l/ha	bcde	1.26
5. Sovereign @ 3.3 l/ha + Flexidor 125 @ 2.0 l/ha	abcde	1.24
6. Kerb Flo @ 2.1 l/ha + Flexidor 125 @ 2.0 l/ha	a	1.15
7. Ronstar liquid @ 4.0 l/ha + Kerb Flo @ 2.1 l/ha	ab	1.17
8. Simazine @1.7 l/ha + Butisan S @ 2.5 l/ha + Kerb Flo @ 2.1 l/ha	cde	1.28
9. Sovereign @ 3.3 l/ha + Ronstar Liquid @ 4.0 l/ha	abc	1.19
10. Stefes Lenacil @ 1.7 kg/ha + Butisan S @ 2.5 l/ha	de	1.32
		SED = 0.0458
		DF = 92
		p = <0.001
Interaction terms between the two treatment factors (tree species / herbicide) were also significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.

Table 37: Mean tree height - HRI East Malling 1997 planting
Combined result of *Prunus* and *Tilia*

Treatment	Duncan code letter(s)	Height (m)
1. Untreated control	ab	1.16
2. Bolero @ 0.5 l/ha	ab	1.18
3. Butisan S @ 2.5 l/ha	de	1.38
4. Devrinol @ 9.0 l/ha	bc	1.25
5. Flexidor 125 @ 2.0 l/ha	bcd	1.27
6. Kerb Flo @ 2.1 l/ha	a	1.12
7. Ronstar liquid @ 4.0 l/ha	cde	1.35
8. Simazine @ 1.7 l/ha	cde	1.36
9. Sovereign @ 3.3 l/ha	cde	1.35
10.Stefes Lenacil @ 1.7 kg/ha	e	1.40
11.Butisan S @ 5.0 l/ha	e	1.41
12.Flexidor 125 @ 4.0 l/ha	ab	1.16
13.Kerb Flo @ 4.2 l/ha	a	1.13
14.Simazine @ 3.4 l/ha	cde	1.31
15.Stefes Lenacil @ 3.4 l/ha	cde	1.30
		SED = 0.05199
		DF = 84
		p = <0.001
Interaction terms between the two treatment factors (tree species / herbicide) were also significant at the 5% level.		

Duncans multiple range test: figures in the same column followed by a common letter are not significantly different (P<0.05). The multiple range test has been carried out using the mean-square residual error term and the Block.wplot.split stratum.