CONTRACT REPORT
PROJECT FV 166

LEEKS:
CONTROL OF ANNUAL MEADOW GRASS (Poa annua)

FINAL REPORT

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Authentication:

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Disclaimer

The products and rates used in this work are not necessarily approved for use on leeks and references to them in this report should not be taken as recommendations. Before using any crop protection chemical, the product label or relevant off-label document should always be consulted and the instructions followed. In the event of doubt the chemical supplier or a competent adviser should be consulted.

Relevance to growers and practical application

Application

Control of annual meadow grass (AMG) *(Poa annua)* in drilled leeks can be difficult. Pre-emergence herbicides have a limited and short term effect, particularly on organic soils, and the range of herbicides available for use on leeks is small. Graminicides with specific activity against Annual Meadow Grass are not available to UK growers and Falcon, currently approved on onions but not leeks, has only a marginal effect when used alone. Using information gained from glasshouse screening trials at HRI Kirton in 1994 a range of herbicide combinations was tested in the field in 1995 and 1996 to examine both annual meadow grass and broad leaf weed control.

Summary

The work demonstrated that pre emergence residual herbicides are essential to achieve control of both annual meadow grass and broad leaf weeds. When applied from the post crook growth stage, a programme of 4 applications of Gesagard 50WP (ranging from 0.3 kg/ha to 0.5 kg/ha) + Totril (ranging from 0.25 l/ha to 0.3 l/ha) at approximately 10 day intervals gave the best control of both grass and other weeds but at the expense of plant vigour and counts. Good broad leafed weed and AMG control was combined with better crop safety with a) Falcon used at full rate (1.5 l/ha) following a Fortrol + Totril programme, b) Atlas Red followed by Fortrol + Totril c) CIPC + Nortron followed by Fortrol + Totril, and d) to a lesser extent a 4 spray programme of Kerb 50W + Totril and Sovereign 400SC + Totril.

The Sovereign 400SC + Totril programme combined excellent broad leafed weed control with crop safety. The results from the 2 years of this trial will provide much valuable information on weed control strategies in drilled leeks to growers and their consultants.

Introduction and review of 1995 results

Pre-emergence herbicides applied to drilled crops only have a short term and limited effect on organic soils, and are unreliable on other soils when there is inadequate soil moisture. Contact herbicides are ineffective when applied to AMG which is larger than the second true leaf stage. Commonly used contacts have little effect on Annual Meadow Grass, and can be damaging to the crop. Earlier HDC funded trials on weed control in onions and work in 1994 using the 'spray race' facilities at HRI Kirton identified a number of herbicides which might be suitable for this application, either alone or in combination. These materials were incorporated into field trials in 1995 both at HRI Kirton (mineral soil) and on an organic soil in Lancashire. During 1996, this range of herbicides was modified in the light of the previous years' results and these were again tested on an organic moss soil in Lancashire and a mineral soil site in Lincolnshire.

In the first year of this project a range of repeat low dose post emergence herbicide treatments were applied to plots either with pre-emergence herbicide (Ramrod plus CIPC40 on the organic soil; Sovereign plus Ramrod on the mineral silt soil) or without pre-emergence treatment. An Arresin+Totril combination gave excellent control of both Annual Meadow Grass and broad-leaved weeds at both sites but at the expense of crop safety. At the mineral soil site a Kerb+Totril combination gave excellent control of both broad-leaved weeds and Annual Meadow Grass even in the absence of pre-emergence treatments, whilst at the moss site this combination proved to be reasonably effective and was safe to the crop. The Fortrol+Totril combination, standard on organic soils, was only effective against Annual Meadow Grass at early growth stages, reflecting commercial experience. Grass control was disappointing from all other combinations, including those containing the graminicide Falcon at 0.5 l/ha. The Sovereign+Totril combination was ineffective as a post emergence application on grass, but was very effective for broad leaf weed control on the mineral soil. The trial

confirmed the effectiveness of pre-emergence treatments to prevent early grass and weed emergence.

Experimental Section

Materials and methods

Cultural details

1. Organic soil site.

Seeds of the leek cultivar Farinto (Nunhems), a winter maturing variety, were drilled on 1 April at a rate of 400,000 per ha in a highly organic Moss soil at East Crantum Farm, Southport. Four rows were drilled on each 1.83 m wide bed. The nutrient status of the soil following a spring barley was pH 5.9, P_2O_5 index = 5, K_2O index = 1, Mg index = 4. A base dressing of 100 kg N, 50 kg P, 240 kg K_2O per ha was applied during seedbed preparation. A further 100 kg N/ha was applied during the life of the crop. The site was chosen especially for it history of high Annual Meadow Grass population.

2. Mineral soil site.

Seeds of the cultivar Carlton F1 (Nunhems), an early maturing type, were sown on 4 April on 0.5m rows at a rate of 280,000 per ha into a sandy silt loam at Willow Farm, Dogdyke near New York, Lincolnshire. A base dressing of 150 kg/ha K_2O and 60 kg/ha Mg was applied to soil with P_2O_5 index 5, K_2O index 1 and Mg index 1. At drilling a liquid fertiliser of 250 l/ha 7:20: (NPK) was applied. Top dressings of nitrogen amounted to 240 kg N/ha.

Experimental design

A split block design with three replicates was used at each site. The pre emergence treatments were allocated to blocks, and within each block the post emergence herbicide regimes were randomised.

Treatments

The pre-emergence treatments were applied according to soil type:

1. Organic soil site: Ramrod (propachlor) 13 l/ha + CIPC (chlorpropham) 4.2 l/ha

2. Mineral soil site: Ramrod 9 l/ha + Sovereign 400 SC (pendimethalin) 1.65 l/ha

Both were applied as a tank mix in 400 l/ha water on 3 April (1) and the 10 April (2).

Post emergence treatments, the same at both sites, were applied as four low dose applications beginning shortly after the post-crook growth stage and then at approximately 10 day intervals.

Post emergence treatments:

Treatment	Spray No	
1	1	Pyramin DF 0.4 kg/ha + Sovereign 400SC 0.825 l/ha
	2	Pyramin DF 0.4 kg/ha + Sovereign 400SC 0.825 l/ha
	3	Pyramin DF 0.4 kg/ha + Sovereign 400SC 0.825 l/ha
	4	Pyramin DF 0.4 kg/ha + Sovereign 400SC 1.65 l/ha
2	1	Fortrol 0.25 l/ha + Totril 0.25 l/ha
	2	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	3	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	4	Fortrol 0.3 l/ha + Totril 0.3 l/ha
3	1	Gesagard 50WP 0.3 kg/ha
	2	Gesagard 50WP 0.5 kg/ha
	3	Gesagard 50WP 0.5 kg/ha
	4	Gesagard 50WP 0.8 kg/ha
4	1	Ashlade CP 2.5 l/ha + Nortron 0.5 l/ha
	2	Ashlade CP 2.5 l/ha + Nortron 0.5 l/ha
	3	Ashlade CP 2.5 l/ha + Nortron 0.5 l/ha
	4	Ashlade CP 2.5 l/ha + Nortron 0.5 l/ha
5	1	Atlas Red 4.2 l/ha
	2	Fortrol 0.25 l/ha + Totril 0.25 l/ha
	3	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	4	Fortrol 0.3 l/ha + Totril 0.3 l/ha
6	1	CIPC 1 l/ha + Nortron 0.5 l/ha
	2	CIPC 1 l/ha + Nortron 0.5 l/ha
	3	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	4	Fortrol 0.3 l/ha + Totril 0.3 l/ha
7	1	Gesagard 50WP 0.3 kg/ha + Totril 0.25 l/ha
	2	Gesagard 50WP 0.5 kg/ha + Totril 0.25 l/ha
	3	Gesagard 50WP 0.5 kg/ha + Totril 0.3 l/ha
	4	Gesagard 50WP 0.5 kg/ha + Totril 0.3 l/ha
8	1	Kerb 0.7 kg/ha + Totril 0.25 l/ha

	2	Kerb 0.7 kg/ha + Totril 0.3 l/ha
	3	Kerb 0.7 kg/ha + Totril 0.3 l/ha
	4	Kerb 0.7 kg/ha + Totril 0.3 l/ha
9	1	Sovereign 400SC 0.825 l/ha + Totril 0.25 l/ha
	2	Sovereign 400SC 0.825 l/ha + Totril 0.3 l/ha
	3	Sovereign 400SC 0.825 l/ha + Totril 0.3 l/ha
	4	Sovereign 400SC 1.65 l/ha + Totril 0.3 l/ha
10	1	Fortrol 0.25 l/ha + Totril 0.25 l/ha
	2	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	3	Fortrol 0.3 l/ha + Totril 0.3 l/ha
	4	Falcon 1.5 l/ha + Totril 0.3 l/ha
11		Untreated Control

All treatments were applied in 250 l/ha water using a hand held Oxford Precision sprayer. The application dates were as follows:-

1. Organic soil site: 8 May, 18 May, 29 May, 7 June
2. Mineral soil site: 30 May, 13 June, 25 June, 9 July

In both cases the first application date target of post crook stage was achieved.

Assessments

Assessments were made of percentage weed and grass cover a) after each spray, b) 1 week after the last spray and c) 1 month after the last spray. The weed species present and their percentage cover were also noted at the last two assessments. Leek vigour scores were taken as well as a final plant count. An assessment of crop yields was made on 10 September at the Lincolnshire mineral soil site, but only on blocks receiving pre emergence treatments. The leeks were weight graded into <15mm, 15-35mm, 35mm+ shank diameter grades and unmarketable, graded down due to pest and disease damage. No yield assessments were made on the organic soil site.

Results and Discussion

Soil and weather conditions after drilling and up to late May were generally cool and dry: many ground frosts were recorded at both sites during the first half of May. These conditions

delayed crop development. Thereafter conditions were relatively good for crop and weed growth.

Due to the dry conditions and the late emergence of the crop on the mineral soil, post emergence applications were not as effective as might have been expected. As a consequence those plots receiving no pre-emergence herbicide were smothered in weed by the middle of June.

A high natural population of AMG was present on the organic soil site whereas on the mineral soil AMG populations were lower.

Broad leaf weed control

Table 1 shows the percentage weed cover at three assessment dates for the various post emergence treatments, on plots receiving the pre emergence herbicide on the organic soil site. Broad leaf weed (BLW) cover gradually increased over time, and in the least effective treatments smothered the crop (100% cover) at the last assessment dates. By the 7 June there were significant differences between the post emergence treatments, with Fortrol + Totril then Falcon, the Atlas Red the Fortrol + Totril, Gesagard + Totril providing very good control and Kerb + Totril and Sovereign + Totril good control. Most of these treatments retained their edge by the 5 July when most treatments did well apart from Pyramin + Sovereign, Gesagard and Ashlade + Nortron which provided no weed control. Where the effect of the post emergence treatments are averaged over all levels of pre emergence (Table 2), the above observations are less distinct.

On the mineral site, Fortrol + Totril and the Gesagard + Totril proved effective at controlling BLW. The application of a pre emergence spray significantly reduced the number of broad leaf weeds, and this effect persisted through to the last assessment date (Table 4).

Annual meadow grass

Careful interpretation is needed when comparing the effect of the post emergence treatments on AMG. On the organic soil, where broad leaf weed control was poor there was smothering of the AMG. Table 1 shows that the AMG control with the Fortrol + Totril alone was poor, but the addition of the Falcon reduced the AMG. The other treatments combining good control of BLW and AMG were Gesagard + Totril, Atlas Red followed by Fortrol + Totril , CIPC + Nortron followed by Fortrol + Totril and to a lesser extent Kerb + Totril and Sovereign + Totril. These observations are also reflected in Table 2. The AMG control is significantly better when a pre emergence treatment is applied. This effect continues until the 5 July when the BLW smothered the AMG. On the mineral site pre emergence treatments worked well. Post emergence treatments of CIPC + Nortron followed by Fortrol + Totril, Gesagard + Totril and the Kerb + Totril treatments had lower AMG ground cover than some other treatments whilst giving some BLW control.

Plant numbers and crop vigour

Plant numbers at the mid season assessment were significantly lower where no pre emergence was applied (Table 6). There were no difference between the post emergence treatments on the mineral site. On the organic soil site, plant numbers were very low on the untreated and Ashlade + Nortron treated plots due to weed competition. The Gesagard only, Atlas Red followed by Fortrol + Totril, the CIPC + Nortron followed by Fortrol + Totril and the Sovereign + Totril had the highest plant numbers. The Gesagard + Totril produced the lowest plant numbers (Table 5).

As with the plant numbers, the absence of a pre emergence treatment significantly reduced the crop vigour (Table 8). These assessments took place 3 weeks after the plant counts, and on the organic soil site showed that the Kerb + Totril, the Fortrol + Totril and the Sovereign + Totril all had high vigour scores. Of those treatments with good BLW control, the Gesagard + Totril produced low vigour plants: all other low scores were a reflection of weed competition. On the mineral soil there was far less variation between the treatments but the

Pyramin + Sovereign and Gesagard scored low, whilst the Gesagard + Totril and the Fortrol + Totril scored high.

Yield

Yields were only be recorded at the mineral site and the results are presented in Table 9.

The highest yields were produced from treatment 5, Atlas Red followed by Fortrol + Totril, treatment 2, the Fortrol + Totril, and treatment 7 the Gesagard + Totril treated plots. The lowest yields were from the untreated plots whilst treatment 6, CIPC + Nortron followed by Fortrol + Totril, treatment 10, Fortrol + Totril and Falcon + Totril and treatment 8, Kerb + Totril also gave a low yield.

In the >35mm size grade the untreated, treatment 6 CIPC + Nortron followed by Fortrol + Totril and treatment 3, Gesagard gave a low yield. In this grade, all other treatments had significantly higher yields than the untreated.

In the smallest size grade, <15mm, the untreated and treatment 6 were again both significantly different from the other treatments, giving higher yields.

Table 1: Organic site, effect of post emergence treatments on weed and AMG control at three assessment dates, where a pre emergence herbicide was applied.

Post emergence treatment	Weed Cover %						AM Grass Cover %					
	18/5		7/6		5/7		18/5		7/6		5/7	
1 Pyramin+Sovereign	5	(2.21)	14	(3.70)	93	(9.64)	0.04	(0.21)	1.7	(1.28)	6.6	(2.57)
2 Fortrol+Totril	2	(1.52)	0.7	(0.82)	12	(3.40)	0.04	(0.21)	2.7	(1.63)	12.0	(3.46)
3 Gesagard	4	(1.90)	9	(3.05)	91	(9.55)	0.01	(0.11)	2.1	(1.46)	2.2	(1.49)
4 Ashlade+Nortron	5	(2.16)	24	(4.89)	100	(10.0)	0.01	(0.11)	0.7	(0.82)	0.0	(0.00)
5 Atlas Red, Fortrol+Totril	3	(1.82)	1	(0.94)	24	(4.85)	0.02	(0.15)	1.2	(1.08)	3.8	(1.96)
6 CIPC+Nortron, Fortrol+Totril	5	(2.30)	6	(2.54)	13	(3.54)	0.06	(0.25)	1.0	(0.94)	5.2	(2.27)
7 Gesagard+Totril	2	(1.52)	0	(0.53)	9	(2.99)	0.01	(0.11)	2.2	(1.49)	3.6	(1.90)
8 Kerb+Totril	5	(2.21)	2	(1.52)	22	(4.64)	0.01	(0.11)	1.2	(1.09)	4.0	(1.99)
9 Sovereign+Totril	4	(1.90)	1	(0.80)	11	(3.39)	0.04	(0.21)	1.5	(1.24)	5.9	(2.43)
10 Fortrol+Totril , Falcon+Totril	3	(1.63)	1	(0.72)	22	(4.65)	0.01	(0.11)	3.0	(1.73)	4.3	(2.07)
11 Untreated	7	(2.60)	81	(9.02)	100	(10.0)	0.10	(0.33)	0.7	(0.81)	0.0	(0.00)
SED (40 df)		(0.53)		(0.79)		(1.14)		(0.13)		(0.38)		(0.70)
LSD (5%)		(1.07)		(1.60)		(2.30)		(0.27)		(0.77)		(1.40)

Note: Analysis performed on square root transformation, in parentheses.

Table 2: Organic site, effect of post emergence treatments on weed and AMG control at three assessment dates, average of both pre emergence and nil pre emergence plots

Post emergence treatment	Weed Cover %						AM Grass Cover %					
	18/5		7/6		5/7		18/5		7/6		5/7	
1 Pyramin+Sovereign	17	(4.14)	34	(5.83)	65	(8.05)	0.2	(0.46)	6	(2.44)	6	(2.38)
2 Fortrol+Totril	5	(2.26)	2	(1.46)	17	(4.07)	0.3	(0.51)	10	(3.23)	40	(6.35)
3 Gesagard	11	(3.30)	29	(5.37)	92	(9.60)	0.2	(0.41)	8	(2.87)	5	(2.15)
4 Ashlade+Nortron	13	(3.61)	53	(7.27)	100	(10.0)	0.2	(0.43)	2	(1.24)	0	(0.00)
5 Atlas Red, Fortrol+Totril	8	(2.83)	3	(1.80)	32	(5.62)	0.1	(0.38)	4	(2.11)	20	(4.50)
6 CIPC+Nortron, Fortrol+Totril	17	(4.09)	21	(4.59)	18	(4.22)	0.2	(0.45)	6	(2.35)	28	(5.31)
7 Gesagard+Totril	5	(2.18)	1	(0.81)	29	(5.41)	0.2	(0.43)	9	(3.01)	31	(5.55)
8 Kerb+Totril	9	(3.08)	10	(3.11)	35	(5.95)	0.1	(0.38)	6	(2.52)	21	(4.62)
9 Sovereign+Totril	11	(3.25)	5	(2.25)	18	(4.24)	0.2	(0.48)	8	(2.86)	33	(5.73)
10 Fortrol+Totril , Falcon+Totril	5	(2.14)	1	(1.17)	40	(6.29)	0.2	(0.44)	11	(3.31)	18	(4.27)
11 Untreated	24	(4.89)	90	(9.51)	100	(10.0)	0.2	(0.47)	0	(0.40)	0	(0.00)
SED (40 df)		(0.38)		(0.56)		(0.81)		(0.09)		(0.27)		(0.490)
LSD (5%)		(0.76)		(1.13)		(1.63)		(0.19)		(0.54)		(0.99)

Note: Analysis performed on square root transformation, in parentheses.

Table 3: Mineral soil site, effect of post emergence treatments on weed and AMG control where pre emergence applied.

Post emergence treatment	Weed Cover %						AM Grass Cover %					
	28/5		21/6		1/7		28/5		21/6		1/7	
1 Pyramin+Sovereign	7	(2.55)	27	(5.22)	49	(6.99)	1.0	(1.0)	1.7	(1.28)	3.3	(1.82)
2 Fortrol+Totril	4	(2.08)	11	(3.29)	29	(5.42)	0.5	(0.7)	0.7	(0.81)	5.9	(2.44)
3 Gesagard	5	(2.16)	24	(4.94)	45	(6.72)	0.5	(0.7)	0.7	(0.81)	1.9	(1.39)
4 Ashlade+Nortron	5	(2.16)	19	(4.37)	40	(6.32)	1.0	(1.0)	1.9	(1.38)	10.0	(3.09)
5 Atlas Red, Fortrol+Totril	5	(2.24)	19	(4.41)	35	(5.88)	1.0	(1.0)	0.8	(0.91)	2.4	(1.55)
6 CIPC+Nortron, Fortrol+Totril	8	(2.78)	45	(6.72)	66	(8.10)	0.1	(0.3)	0.7	(0.81)	0.7	(0.81)
7 Gesagard+Totril	5	(2.24)	13	(3.60)	25	(4.98)	0.5	(0.7)	2.4	(1.55)	0.9	(0.94)
8 Kerb+Totril	7	(2.55)	24	(4.89)	44	(6.66)	0.5	(0.7)	0.1	(0.33)	0.8	(0.91)
9 Sovereign+Totril	10	(3.24)	22	(4.65)	39	(6.23)	0.5	(0.7)	0.2	(0.47)	2.0	(1.41)
10 Fortrol+Totril , Falcon+Totril	7	(2.55)	24	(4.90)	35	(5.93)	0.2	(0.5)	0.1	(0.33)	3.8	(1.96)
11 Untreated	6	(2.47)	40	(6.29)	68	(8.23)	0.5	(0.7)	1.0	(1.00)	0.3	(0.58)
SED (40 df, * 20 df)		(0.535)		(*0.993)		(*0.856)		(0.378)		(0.483)		(0.651)
LSD (5%)		(1.08)		(2.07)		(1.79)		(0.760)		(0.98)		(1.32)

Note: Analysis performed on square root transformation, in parentheses.

Table 4: Effect of pre emergence treatments on weed control at both sites

NB. Assessments for organic site - a. 18/5, b. 7/6, c. 5/7; mineral site a. 28/5, 21/6, 1/7

Pre emergence treatment	Weed Cover %						AM Grass Cover %					
assessment date	a		b		c		a		b		c	
Organic Site												
None	21	(4.53)	28	(5.26)	53	(7.30)	0.50	(0.71)	12.7	(3.56)	3.30	(1.83)
Ramrod + CIPC	4	(1.98)	7	(2.60)	37	(6.06)	0.02	(0.17)	1.51	(1.23)	31.4	(5.60)
SED (2 df)		(0.255)		(0.129)		(0.435)		(0.064)		(0.142)		(0.169)
LSD (5%)		(0.52)		(0.26)		(0.88)		(0.13)		(0.29)		(0.34)
Mineral Site												
None	61	(7.82)	-		-		0.09	(0.30)	1.30	(1.14)	0.14	(0.38)
Ramrod + Sovereign	6	(2.45)	-		-		0.50	(0.71)	0.77	(0.88)	2.40	(1.54)
SED (2 df)		(0.203)						(0.921)		(0.289)		(0.246)
LSD (5%)		(0.41)						(1.86)		(0.58)		(0.50)

Note: Analysis performed on square root transformation, in parentheses.

Table 5: The effect of post emergence treatments on plant numbers, average of both pre emergence and nil pre emergence plots

Post emergence treatment	Organic site 17/6		Mineral site 17/7	
1 Pyramin+Sovereign	16	(4.00)	12	(3.49)
2 Fortrol+Totril	13	(3.59)	15	(3.85)
3 Gesagard	18	(4.23)	12	(3.51)
4 Ashlade+Nortron	6	(2.51)	15	(3.92)
5 Atlas Red, Fortrol+Totril	17	(4.18)	13	(3.66)
6 CIPC+Nortron, Fortrol+Totril	20	(4.53)	14	(3.75)
7 Gesagard+Totril	10	(3.19)	17	(4.09)
8 Kerb+Totril	15	(3.93)	13	(3.65)
9 Sovereign+Totril	17	(4.12)	12	(3.48)
10 Fortrol+Totril , Falcon+Totril	12	(3.41)	14	(3.77)
11 Untreated	1	(1.14)	14	(3.70)
SED (40 df)		(0.353)		(0.455)
LSD (5%)		(0.71)		(0.92)

Table 6: Effect of pre emergence treatments on plant numbers

Pre emergence treatment	Organic site 17/6		Mineral site 17/7	
None	9	(3.05)	12	(3.41)
Pre emergence applied	16	(4.01)	16	(4.02)
SED (2 df)		(0.069)		(0.127)
LSD (5%)		(0.14)		(0.26)

Table 7: The effect of post emergence treatments on leek vigour scores (0-10, 0 = poor): organic site average of both nile & pre emergence treatments; mineral site average of pre emergence only.

Post emergence treatment	Organic site 5/7	Mineral site 6/8
1 Pyramin+Sovereign	4.8	5.3
2 Fortrol+Totril	7.8	7.3
3 Gesagard	3.2	5.3
4 Ashlade+Nortron	0.0	6.0
5 Atlas Red, Fortrol+Totril	7.5	6.7
6 CIPC+Nortron, Fortrol+Totril	7.3	5.7
7 Gesagard+Totril	4.7	7.0
8 Kerb+Totril	8.0	6.0
9 Sovereign+Totril	7.7	6.3
10 Fortrol+Totril , Falcon+Totril	7.0	6.3
11 Untreated	0.0	5.7
SED (40 df)	1.25	0.71
LSD (5%)	2.51	1.47

Table 8: Effect of pre emergence treatments on leek vigour scores (0-10)

Pre emergence treatment	Organic site 5/7	Mineral site 6/8
None	4.1	-
Pre emergence applied	6.5	-
SED (2 df)	0.16	-
LSD (5%)	0.69	-

Table 9: Mineral site, effect of post emergence treatment on plot yield (t/ha), where pre emergence treatment applied.

Post emergence treatment	Size grade (mm)			
	<15	15-35	>35	Total
1 Pyramin+Sovereign	2.16	14.5	21.1	38.4
2 Fortrol+Totril	2.64	21.1	28.8	52.6
3 Gesagard	1.48	19.8	15.5	37.6
4 Ashlade+Nortron	1.56	16.3	28.7	47.0
5 Atlas Red, Fortrol+Totril	2.43	24.0	31.3	58.2
6 CIPC+Nortron, Fortrol+Totril	3.95	10.1	17.0	31.6
7 Gesagard+Totril	2.05	16.1	34.8	53.1
8 Kerb+Totril	2.20	12.3	22.1	36.9
9 Sovereign+Totril	1.10	15.9	27.9	45.4
10 Fortrol+Totril , Falcon+Totril	2.73	11.8	21.4	36.3
11 Untreated	5.68	13.8	5.2	24.7
SED (20 df)	1.15	7.35	9.32	9.77
LSD (5%)	2.41	15.33	19.44	20.38

Note: total yield also includes unmarketable (not shown here)

Weed species

The species present on the site were ranked as follows:

Weed		Organic site	Mineral site
Annual meadow grass	*Poa annua*	1	6
Black bindweed	*Fallopia convolvulus*	4	7
Fat hen	*Chenopdium album*	9	2
Redshank	*Polygonum persicaria*	2	-
Pale persicaria	*Polygonum lapathifolium*	5	-
Small nettle	*Urtica urens*	3	4
Knotgrass	*Polygonum aviculare*	8	1
Field pansy	*Viola arvensis*	7	3
Chickweed (common)	*Stellaria media*	6	-
Groundsel	*Senecio vulgaris*	10	-
Shepherd's Purse	*Capsella bursa pastoris*	11	9
Prickly Sow thistle	*Sonchus asper*	12	-
Ryegrass	*Lolium perenne*	15	-
Mayweed	*Matricaria spp.*	13	5
Fumitory	*Fumaria officinalis*	14	8

Comments on control are as follows: Annual Meadow Grass was not completely controlled by any one treatment but the treatments a) with Falcon, b) Gesagard + Totril, c) Atlas Red followed by Fortrol + Totril , d) CIPC + Nortron followed by Fortrol + Totril and to a lesser extent e) Kerb + Totril and f) Sovereign + Totril, all reduced AMG cover. Chickweed was controlled by most treatments. Knotgrass was not completely controlled by any treatment, especially on the mineral soil where it established very quickly. Fat Hen and nettle were controlled by most treatments, with Gesagard + Totril particularly effective on Fat Hen. Redshank and nettle were the most vigorous weeds on the organic soil. Redshank was not adequately controlled by Pyramin + Sovereign or Ashlade + Nortron. The other treatments

containing Totril generally controlled the polygonum weeds and nettles. Field Pansy was not controlled by the Gesagard only treatment, and was only partly controlled by Gesagard + Totril and Ashlade + Nortron.

The presence of knotgrass in many of the mineral soil plots this year is indicative that the pre emergence spray was not very effective. The higher numbers of knotgrass compared to last year provided severe test for the post emergence treatments, none of which were completely effective against this weed.

Comments on each post-emergence treatment are given below:

Pyramin + Sovereign

This combination was expected to give some control of Annual Meadow Grass but did not at the rates used. There was insufficient contact effect in this trial and as a result overall weed control was very poor.

Fortrol+Totril

Overall weed control was good but there was little effect on Annual Meadow Grass, (only the tiniest seedlings were scorched). Unlike 1995, there was no evidence that this combination was dangerous to young leeks.

Gesagard

Gesagard on its own does not have sufficient contact effect to knock out most weeds. Field Pansy, notably, was untouched. Despite Gesagard reducing leek vigour at the mineral site, plant numbers were high especially on the organic site.

Ashlade + Nortron

Although in theory these products should have an effect on AMG, insufficient contact effect on other weeds at the rates used meant that this combination provided very poor overall weed control.

Atlas Red, followed by Fortrol + Totril

This programme controlled AMG relatively well unlike the Fortrol + Totril only combination, indicating the early post emergence effect of the Atlas Red. The Fortrol + Totril applications later in the programme took care of most other weeds although other combinations proved better. Crop safety was good.

CIPC+Nortron, followed by Fortrol + Totril

The theory behind this programme was similar to the one above: an early application with products with known activity against AMG followed by strong contact herbicides for other weeds. This combination had a good effect on AMG at both sites and was one of the better ones for the broad leaf weeds. Crop safety was good.

Gesagard + Totril

The combination had an excellent effect on broad leaf weeds with the exception of field pansy. AMG control was also very good but there is concern regarding crop safety in the rates and timings used in this trial as the plant numbers and vigour were adversely effected.

Kerb + Totril

Only mediocre effect on broad leaf weeds and AMG but, as in 1995, appearing to be better on mineral soils for AMG control. Safe to the crop.

Sovereign + Totril

Although not particularly good at controlling AMG, this mixture shows potential for general weed control, even on organic soil. The combination had excellent crop safety.

Fortrol + Totril, followed by Falcon + Totril

Here the late application of Falcon at full rate had a significant effect on reducing AMG, with the 3 preceding Fortrol + Totril treatments taking care of most broad leaf weeds until the last spray, where the absence of the Fortrol reduced its effectiveness.

Many of the results point to the importance of controlling AMG at early growth stages. The use of the Falcon may have been more effective at an earlier application date: the spray race work in 1994 showed that it was safe at 1.0 l/ha at the leek post crook growth stage.

Conclusions

1. Successful application of pre emergence residual herbicides is an essential pre requisite for control of later emerging weeds on all soil types. Annual meadow grass control is strongly influenced by the application of pre emergence herbicides, showing that it is control of the grass in its early growth stages that is important.
2. Early post emergence contact effect on young AMG is important, as shown by several treatments using products, albeit at relatively low rate, with known activity against the grass (e.g. CIPC, Nortron, Kerb and Atlas Red) followed by strong contact mixtures to knock out the vigorous broad leaf weeds.
3. A programme based on Gesagard + Totril proved to have good control over both AMG and the other weeds, although at the expense of some crop safety. This combination may be useful at later growth stages, using a 'kinder' mix at post crook.
4. Other treatments combining good control of broad leaf weeds and AMG were where Falcon was used at full rate, Atlas Red followed by Fortrol + Totril , CIPC + Nortron followed by Fortrol + Totril and to a lesser extent Kerb + Totril and Sovereign + Totril
5. For broad leaf weeds the Sovereign + Totril programme combined excellent weed control and crop safety.
6. This work has provided much valuable information in understanding the best weed control strategies to adopt in drilled leeks. In addition the results point to candidates for inclusion in the SOLA programme.

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Appendix 1

Active ingredients and approvals

Product	*Active ingredient*	*Approval status*
Pyramin DF	65 w/w chloridazon	Off label for leeks up to 2 true leaves 0349/93, only 1 application approved
Sovereign 400SC	400 g/1 pendimethalin	Off label for onions, full label pre emergence on leeks and off label 0759/95 post emergence on leeks
Fortrol	500 g/1 cyanazine	Provisional Label approval for 1 application on organic soils
Totril	225 g/1 ioxynil	Label approval
Nortron	200 g/1 ethofumesate	Off label use for onions only
Ashlade CP	86:400 g/1 chloridazon/propachlor	Off label post emergence on leeks OLA 0081/92
Atlas Red	200 g/l chlorpropham + cresylic acid + 50 g/l fenuron	Label approval
CIPC	400 g/1 chlorpropham	Label approval but not for post emergence use
Gesagard 50WP	50% w/w prometryn	Off label post emergence on leeks OLA 0054/92, 1 application approved
Kerb 5OW	50% w/w propyzamide	None for alliums
Falcon	100 g/1 propaquizafop	Full label approval for bulb onions, approval pending for leeks

Note: Every attempt was made to ensure accuracy at the time of writing but the approval situation of any chemical should be checked before use.