

Project title: Salad Onion - Evaluation of Tank-mixes for Post-emergence Annual Weed Control on Mineral Soils

Report: Final Report (November 1997).

Project Number: FV 165.

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Location: 1994: HRI Kirton.
1995: Vale of Evesham. (Aborted)
1996: Gravesend, Kent.
1997: Wallingford, Oxon.

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PRACTICAL SECTION FOR GROWERS

Scope and Objectives of Project

The purpose of the project is to develop a range of post-emergence herbicide mixtures as a sequence to provide a second line of defence in the event of pre-emergence herbicide failures. In 1994 a large number of potential mixtures of herbicides were screened in single applications for crop safety only using spray technology at HRI Kirton

A range of the safer treatments was selected for trialing in a field grown commercial crop as a single application only. The field trial planned for 1995 was aborted due to absence of weeds and poor crop emergence but a successful experiment was conducted in 1996 still using single applications only.

In 1997 a second field trial was undertaken to test the safety and efficacy of 14 sequential low dose tank mixtures. These treatments were based mainly on the most promising mixtures from the previous work but also included some additional materials discussed at the Annual Project Review Meeting.

The 1997 trial also tested interactions with a standard pre-emergence residual herbicide applied at drilling to half of the total area. The materials used were mainly currently approved for use in salad onions, either full label recommendation or Off-label approval, but two non-approved herbicides, Lentagran and Semeron, were also included.

Application of the treatments was made when the onions had just reached the 1½ leaf stage, considerably earlier than the normal application stage for contact herbicides in this crop.

Summary of Results

Crop Safety

36 treatments and a water control were evaluated using spray race technology at HRI Kirton in 1994 and results were reported separately that year, (FV 165 1994). A number of the safer treatments were subsequently selected for field trialing which was carried out as single treatments only in 1996.

In 1996 only one treatment, (Lentagran + Semeron), caused any phytotoxic effect to the crop when applied at the 1½ true leaf stage. The symptoms consisted of leaf tipping of the first true leaf but this effect subsequently disappeared as growth progressed.

In 1997 the sequential treatments all caused a slight leaf tip scorch, more severe for those containing Semeron. As in 1996 the symptoms disappeared and the crop was of good commercial quality on all plots at the time of crop maturity.

These trials produced no evidence to show that using a recognised residual pre-emergence herbicide mix at drilling in any way affected the safety of the subsequent contact treatments tested.

The only adverse effect on crop recorded in either year has been a temporary reduction in the leaf quality at a very early stage subsequently outgrown by the crop. Loss of vigour or checks to growth have not been observed

Weed Control

Overall weed control scores are shown in Table II (page 6); Figures III & IV (Pages 13 & 14) of this report set out the weed species fully controlled by the 1997 sequential treatments. Table IV shows the results where no residual herbicide treatment was used at drilling and this data shows that Trt 11 (Semeron/Totril + Totril/Basagran) controlled the widest range of weed species but Trt3 (Totril/Basagran +Totril/Basagran) is also effective. This effect was achieved on weeds of at least 4 true leaves and generally larger.

TABLE I: CROP SAFETY SCORES 1997

TREATMENT	CROP SCORE 19 June	CROP SCORE 23 July
1. Gesagard / Nortron +Totril /Basagran	7.2	8.2
2. Gesagard / Nortron +Totril /Nortron	7.3	8.0
3. Totril / Basagran +Totril / Basagran	6.5	8.0
4. Totril / Basagran +Totril / Nortron	7.2	7.7
5. Totril / Nortron +Totril / Basagran	7.2	8.8
6. Totril / Nortron +Totril / Nortron	7.7	8.3
7. Dow Shield / Nortron +Totril / Basagran	7.5	7.7
8. Dow Shield/ Nortron +Totril / Nortron	7.7	7.6
9. Dow Shield / Starane +Totril / Basagran	7.3	7.5
10. Dow Shield / Starane+Totril / Nortron	7.7	7.6
11. Semeron/ Totril +Totril / Basagran	6.3	8.0
12. Semeron/ Totril +Totril / Nortron	6.8	7.8
13. Lentagran/ Semeron +Totril / Basagran	6.0	8.3
14. Lentagran/ Semeron +Totril / Nortron	6.5	7.8
15. Unweeded control	9.0	0.0
MEAN	7.2	7.40
lsd	0.83	1.37

Crop vigour incorporating leaf quality scored 0 - 9, (0 = crop loss, 9 = no crop damage)

TABLE II: WEED CONTROL SCORES 1997

TREATMENT	WEED CONTROL SCORE	WEED CONTROL SCORE
	19 June	23 July
1. Gesagard / Nortron +Totril /Basagran	6.3	7.0
2. Gesagard / Nortron +Totril /Nortron	5.8	5.8
3. Totril / Basagran +Totril / Basagran	6.3	5.2
4. Totril / Basagran +Totril / Nortron	6.0	6.2
5. Totril / Nortron +Totril / Basagran	7.0	7.5
6. Totril / Nortron +Totril / Nortron	5.0	5.7
7. Dow Shield / Nortron +Totril / Basagran	4.7	5.7
8. Dow Shield/ Nortron +Totril / Nortron	3.0	2.8
9. Dow Shield / Starane +Totril / Basagran	4.8	4.2
10. Dow Shield / Starane+Totril / Nortron	4.2	4.5
11. Semeron/ Totril +Totril / Basagran	8.0	7.2
12. Semeron/ Totril +Totril / Nortron	7.0	7.7
13. Lentagran/ Semeron +Totril / Basagran	7.7	7.2
14. Lentagran/ Semeron +Totril / Nortron	7.3	8.0
15. Unweeded control	0.2	0.0
MEAN	5.60	5.60
lsd	1.37	2.07

Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

Action Points for Growers

This project indicates that certain mixtures of reduced rate contact herbicides can be safely applied to healthy well waxed salad onions at the 1½ true leaf stage.

Of the approved materials tested, Totril + Basagran as a repeat low dose treatment has been safe and effective in 1997.

In 1996 Dow Shield + Starane, as a single application was safe and very effective against large bindweed and clover. In 1997 this treatment was not as effective as sensitive weed species were absent.

The potential for Semeron as a constituent of low rate mixtures on salad onions has been shown in both years. At present this material has no form of approval on this crop and pursuit of an Off-label Approval should be seriously considered.

Practical and Financial Anticipated Benefits

Results of this project show that in the event of a residual herbicide failure, good weed control can be achieved by the early application of a low dose contact herbicide programme appropriate to the weed species present.

Due to the lack of commercial experience of these treatments omission of the normal residual herbicide application is not advised. Should extended commercial use prove full reliability of these treatments there is potential for cost saving by reducing the reliance on more expensive residual herbicide programmes.

EXPERIMENTAL SECTION

Introduction

Reliability of annual weed control in salad onions can be compromised by a number of field factors, particularly the following.

- a. reduced performance of residual herbicides because of dry soil surface, incorrect timing, and uneven seed beds.
- b. uneven crop emergence delaying application of foliar herbicides.
- c. presence of weed species resistant to current weed control regimes.

Existing recommendations for foliar acting herbicides alone and in mixtures on salad onions tend to restrict their use to a relatively advanced crop stage, typically 2-3 true leaves, by which time some weeds are often too large to be fully controlled.

The purpose of this experiment was to test a range of mixtures of label recommended and off-label approved materials at an earlier than recommended crop stage for crop safety and efficacy. A small number of materials not currently approved for use on salad onions were also included in the treatments tested.

Weed species notified as difficult to control at the post emergence stage with existing programmes:-

Annual meadow grass
Mayweed species
Field Pansy
Cleavers
Sun spurge

Fools Parsley
Knotgrass
Fumitory
Oil seed rape volunteers

Materials and method

Treatments (all rates as commercial product per hectare, applied in 500 litres water/ha)

	First Application (9/6/97)	Follow-up Application (13/6/97)
1.	Gesagard 300g + Nortron 2.0L	Totril 300ml + Basagran 1.0L
2.	Gesagard 300g + Nortron 2.0L	Totril 300ml + Nortron 2.0L
3.	Totril 300ml + Basagran 1.0L	Totril 300ml + Basagran 1.0L
4.	Totril 300ml + Basagran 1.0L	Totril 300ml + Nortron 2.0L
5.	Totril 300ml + Nortron 2.0L	Totril 300ml + Basagran 1.0L
6.	Totril 300ml + Nortron 2.0L	Totril 300ml + Nortron 2.0L
7.	Dow Shield 250ml + Nortron 2.0L	Totril 300ml + Basagran 1.0L
8.	Dow Shield 250ml + Nortron 2.0L	Totril 300ml + Nortron 2.0L
9.	Dow Shield 250ml + Starane 300ml	Totril 300ml + Basagran 1.0L
10.	Dow Shield 250ml + Starane 300ml	Totril 300ml + Nortron 2.0L
11.	Semeron 850g + Totril 300ml	Totril 300ml + Basagran 1.0L
12.	Semeron 850g + Totril 300ml	Totril 300ml + Nortron 2.0L
13.	Lentagran 1.25kg + Semeron 850g	Totril 300ml + Basagran 1.0L
14.	Lentagran 1.25kg + Semeron 850g	Totril 300ml + Nortron 2.0L
15.	Unweeded control	

Due to the trial layout, 8 spare plots were available. In order to test a slightly later application of the mixture these were treated as follows:-

A-H. Totril 300mls + Basagran 1.0L Lentagran 1.25kg + Semeron 850g

Design and layout

Randomised block design, 5 row beds at 1.83m centres. Half the site was treated pre-emergence with 3kg/ha Dacthal tank mixed with 9L/ha Ramrod with the remaining half receiving no such treatment. In each section the treatments were replicated 3 times, making 6 replicates for the whole experiment.

Assessments

Crop vigour incorporating leaf quality scored 0 - 9, (0 = crop loss, 9 = no crop damage)

Leaf quality scored 0 - 9 (0 = leaf destruction, 9 = no adverse effects)

Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

List of weed species controlled by treatment. Scored 0-4

(0 = weed absent, 1 = no effect, 2 & 3 = intermediate control, 4 = total control)

Assessments were made on two dates as listed below.

Site

Messrs W C Emmett and Sons Ltd, Wilton Farm, Little Marlow, Marlow, Bucks.
Trial located at Severalls Farm, Wallingford, on fine sandy loam soil of the Sutton series.

Experimental procedure and crop diary

The site was marked out and cv. White Winter Bunching drilled 17 April 1997 into a fine dry seed bed. Rainfall of 19mm fell on 26 April and a further 20 mm between 5 and 8 May. First emergence was noted on 7 May.

By 9 June, most of the crop had reached 1½ true leaf stage, the intended spraying stage, with the crop generally in the 1¼ - 1¾ true leaf stage, and the first treatments were applied on this date in warm sunny conditions with a slight breeze.

The weed species and approximate sizes in the residual treated plots (nos. 1-45) were:-

Fools Parsley	4 true leaves (t.l.)
Common Fumitory	2-3" high
Black Nightshade	3-4 t.l., 1" high
Groundsel	2" high
Sun spurge	1,5" high
Redshank	7 t.l., 3" high

Small numbers of the following were also present:-

Mayweed
Fat Hen
Field pansy
Shepherd's purse

Generally the weed cover at the date of the first spraying was about 10% on the residual treated plots. Much greater weed cover was noted in the no-residual plots, ranging between 40 and 80% due to a combination of higher numbers and larger weed size.

The follow-up sprays were applied on 13 June, 4 days later, in similar weather conditions.

The first assessment was made on 19 June to record crop safety and weed control and these assessments were repeated on 23 July.

A Two-way Analysis of Variance was carried out on the data recorded in this experiment using the PC based statistics program, Minitab.

RESULTS

Crop Safety

1st Assessment: 19 June 1997.

All treatments caused a check to the growth of the crop with some tipping compared to the untreated control. Treatments 3, (Totril/Basagran + Totril/Basagran), 11, (Semeron/Totril + Totril/Basagran), 13, (Lentagran/Semeron + Totril/Basagran) and 14, (Lentagran/Semeron + Totril/Nortron), caused significantly more damage than the others, with 13 being the most damaging.

2nd Assessment: 23 July 1997.

By this date all the onions had fully recovered with new leaf growth and the loss of the old leaf as normally anticipated. The crop from all treatments was of acceptable commercial quality and fully met commercial market specifications. The control plots were overwhelmed by weeds and not possible to assess for crop safety.

Weed Control (Overall)

All treatments at both assessments gave significantly better weed control than the untreated control plots.

At the first assessment date five treatments gave high levels of weed control, an efficacy index at the time of more than 80%, (Trts. 5, 11, 12, 13 and 14). Of these five, with the exception of 11, the treatments that had received the residual herbicides at drilling gave the higher scores. Treatment 11 achieved a high score irrespective of whether a residual herbicide was applied or not.

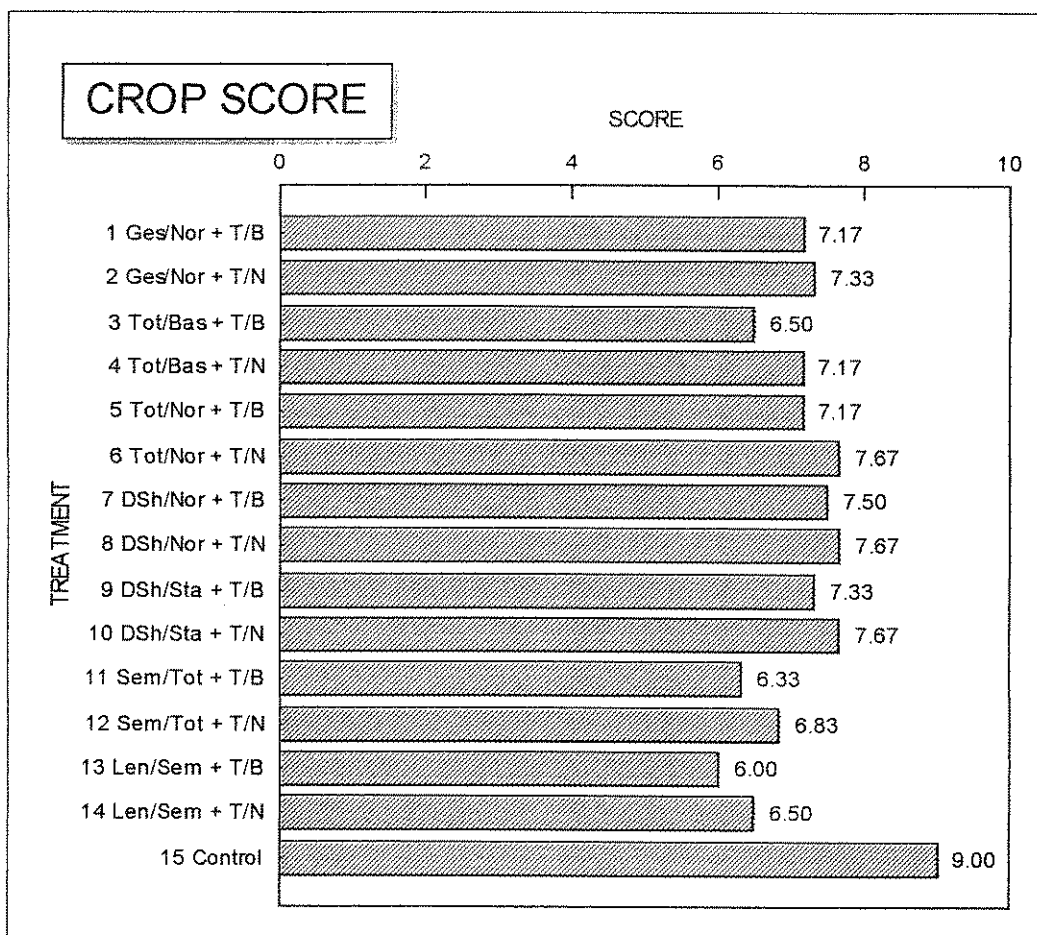
At the second assessment, five weeks later, there had been no reduction in the overall standard of weed control. Again treatments 5, 11, 12, 13 and 14 gave the most effective result and the benefit of the residual applications was still evident. Additionally, treatment 4 gave a high score where a residual herbicide was used but was poor in its absence.

Effect of Residual herbicides.

Figures V and VI below indicate the difference between the two sections of the trial and the areas with and without residual herbicide applied. In most cases the weed control achieved was better where a residual herbicide was applied at drilling prior to the treatments.

It should be noted that of these most effective treatments mentioned above, four included Semeron in the first application at the 1½ leaf stage, (Nos. 11-14), and are therefore not currently approved for use on onions.

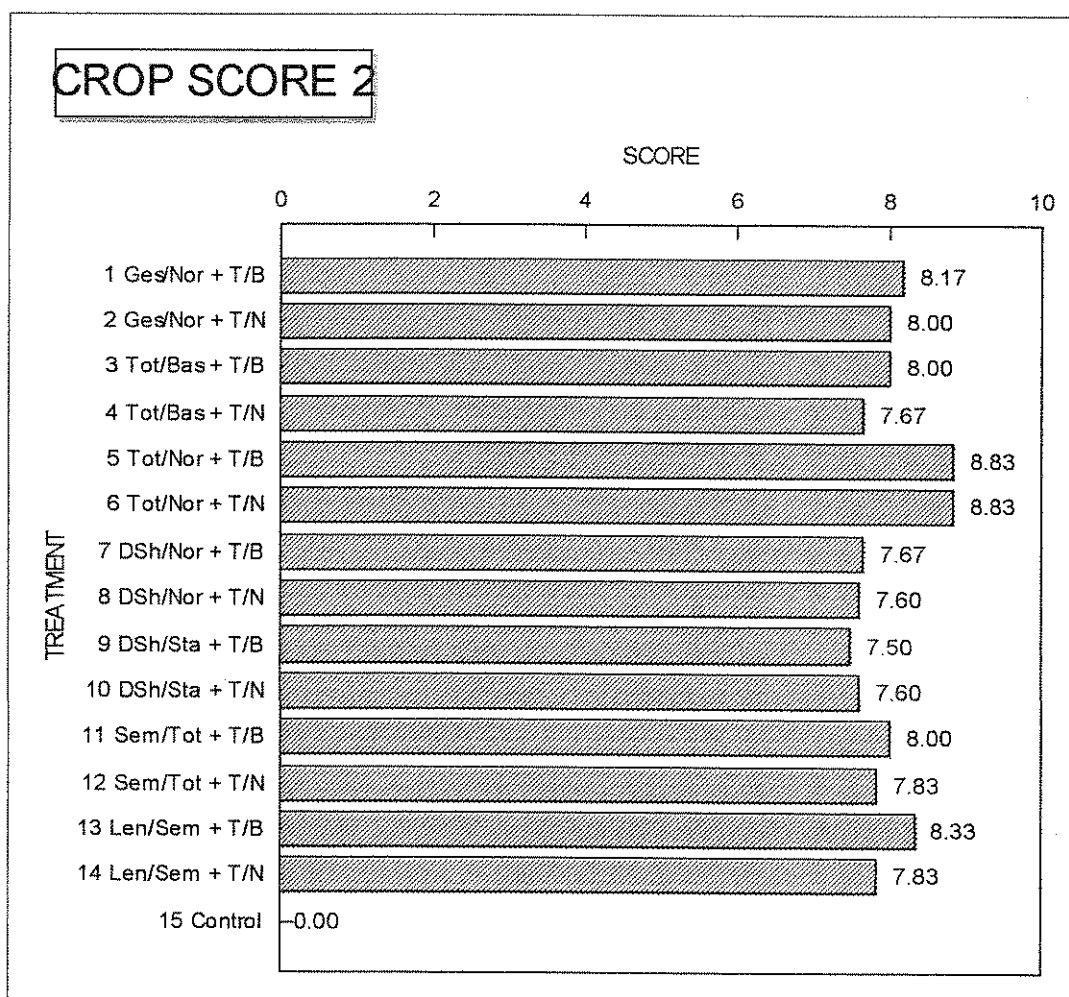
Figure I: Crop Safety Score: First Assessment



Crop vigour incorporating leaf quality scored 0 - 9, (0 = crop loss, 9 = no crop damage)

- | | | |
|-----|----------------------------------|------------------------------|
| 1. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. | Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. | Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. | Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. | Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
| 10. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Nortron 2.0L |
| 11. | Semeron 850g + Totril 300ml | Totril 300ml + Basagran 1.0L |
| 12. | Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. | Unweeded control | |

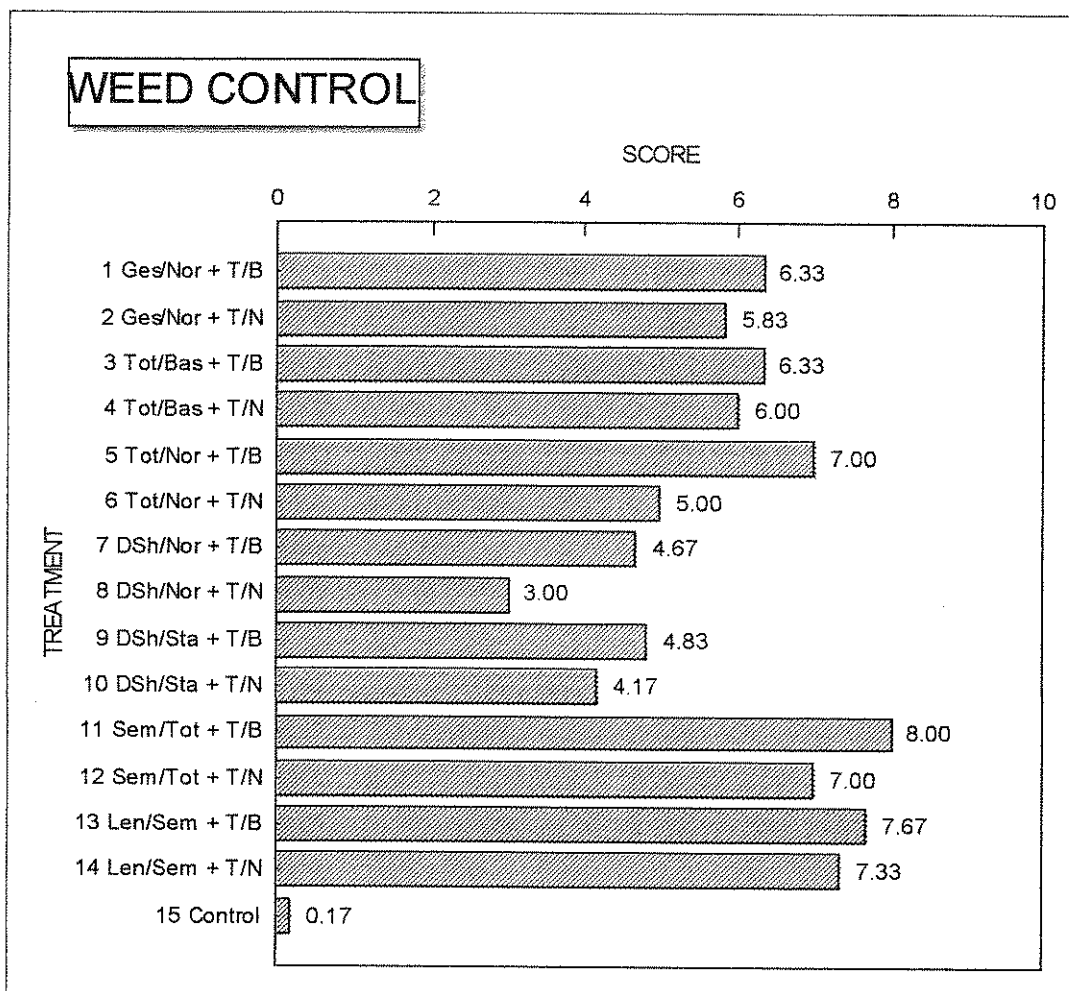
Figure II: Crop Safety Score: Second Assessment.



Crop vigour incorporating leaf quality scored 0 - 9, (0 = crop loss, 9 = no crop damage)

- | | |
|--------------------------------------|------------------------------|
| 1. Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
| 10. Dow Shield 250ml + Starane 300ml | Totril 300ml + Nortron 2.0L |
| 11. Semeron 850g + Totril 300ml | Totril 300ml + Basagran 1.0L |
| 12. Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. Unweeded control | |

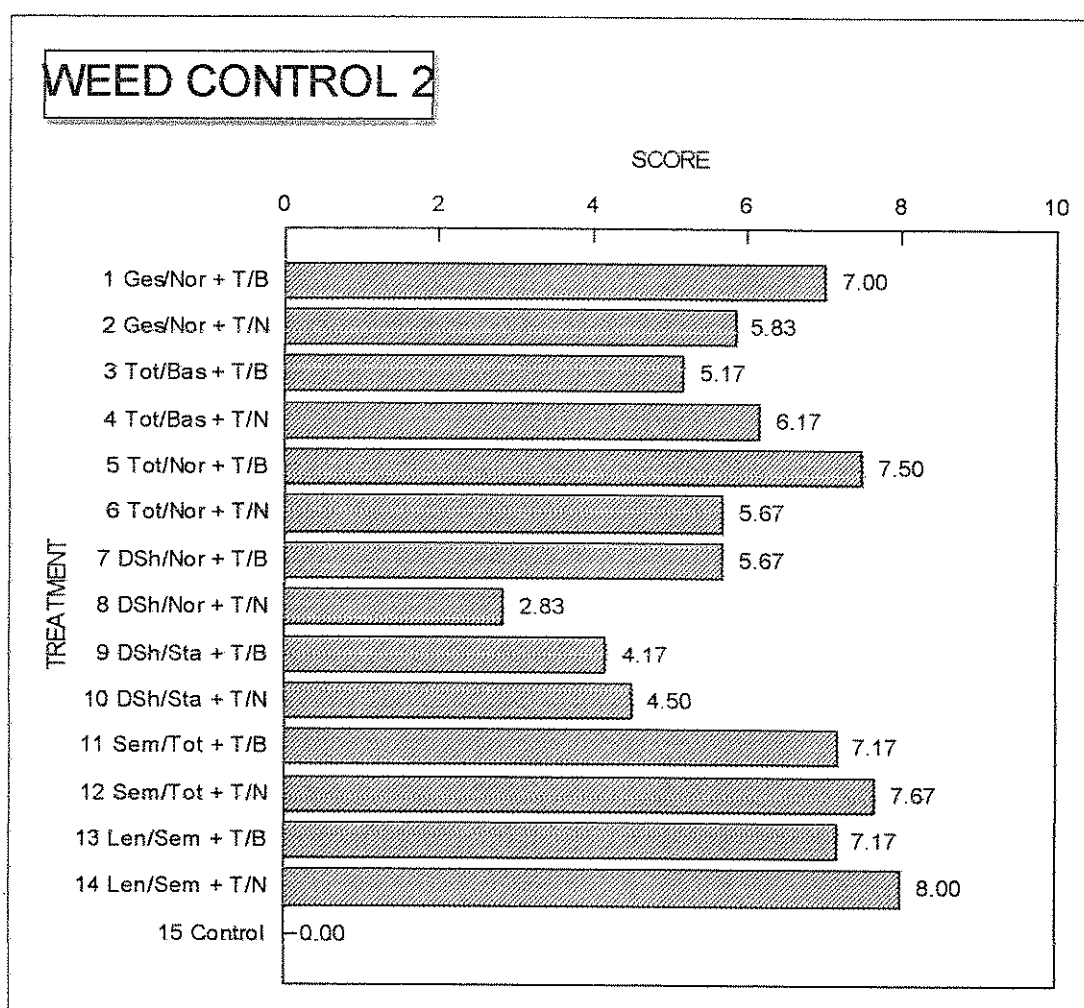
Figure III: Weed Control 1st Assessment



Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

- | | | |
|-----|----------------------------------|------------------------------|
| 1. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. | Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. | Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. | Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. | Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
| 10. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Nortron 2.0L |
| 11. | Semeron 850g + Totril 300ml | Totril 300ml + Basagran 1.0L |
| 12. | Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. | Unweeded control | |

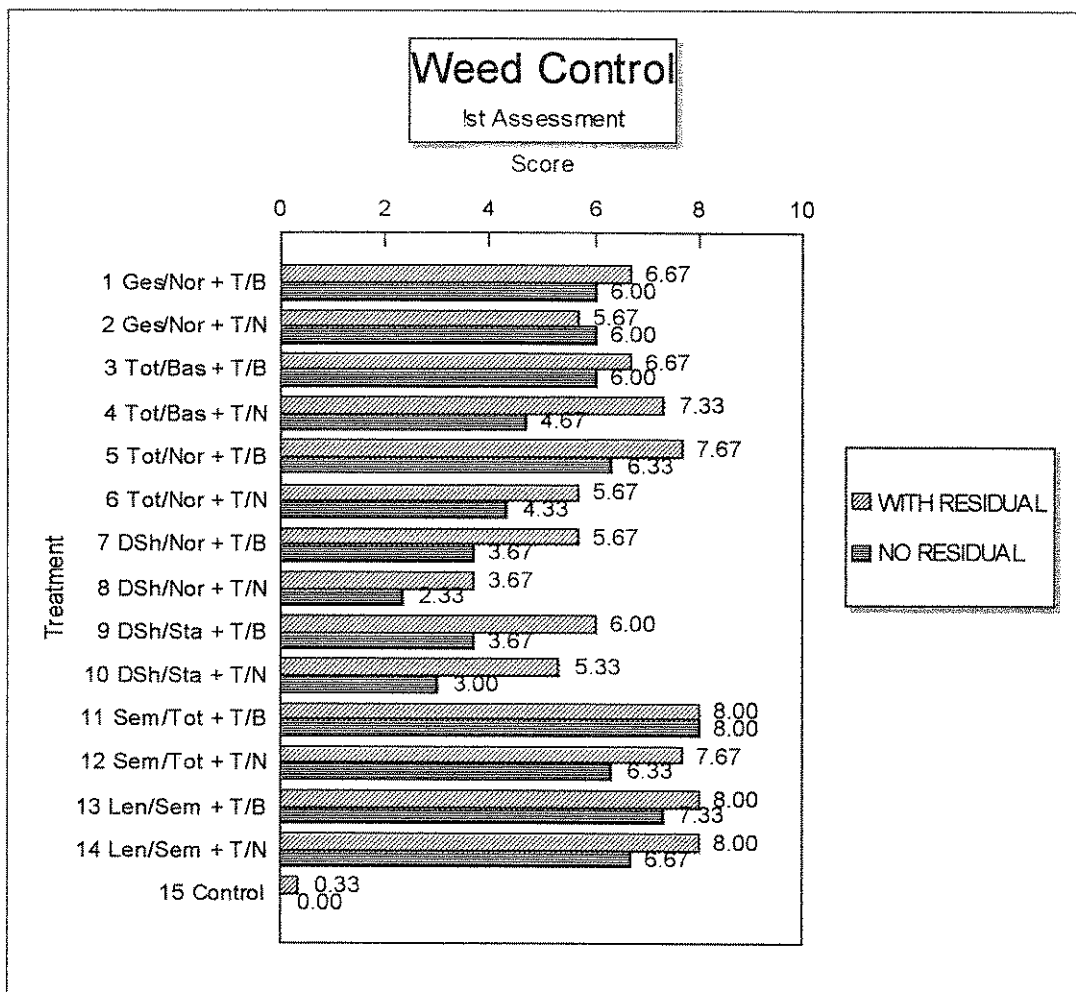
Figure IV: Weed Control 2nd assessment



Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

- | | | |
|-----|----------------------------------|------------------------------|
| 1. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. | Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. | Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. | Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. | Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
| 10. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Nortron 2.0L |
| 11. | Semeron 850g + Totril 300ml | Totril 300ml + Basagran 1.0L |
| 12. | Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. | Unweeded control | |

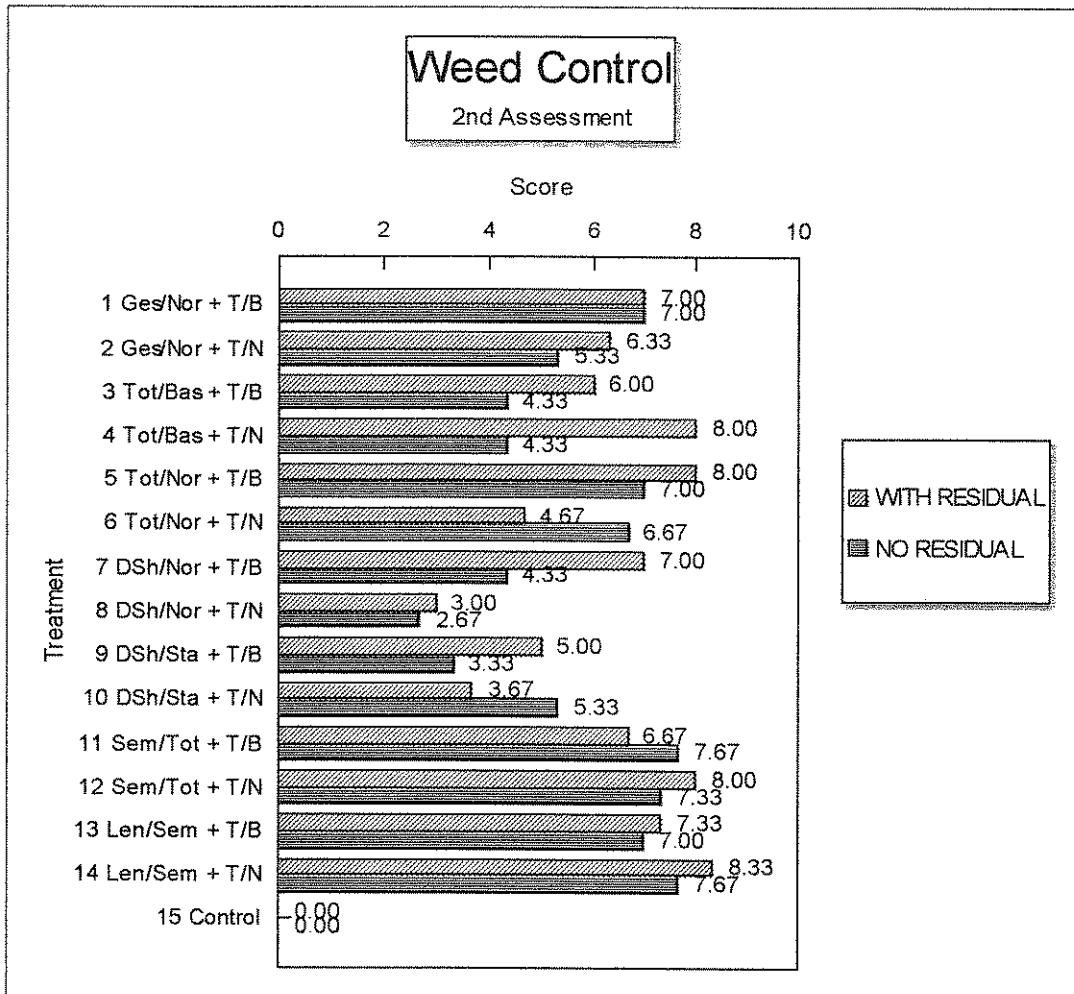
Figure V: Weed Control 1st Assessment: Effect of Residual Herbicide



Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

- | | |
|--------------------------------------|------------------------------|
| 1. Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
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| 11. Semeron 850g + Totril 300ml | Totril 300ml + Basagran 1.0L |
| 12. Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. Unweeded control | |

Figure VI: Weed Control 2nd Assessment: Effect of Residual Herbicide



Weed control efficacy scored 0 - 9 covering both weed numbers and size, and giving an index of the competitive effect of the weed present.

- | | | |
|-----|----------------------------------|------------------------------|
| 1. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 2. | Gesagard 300g + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 3. | Totril 300ml + Basagran 1.0L | Totril 300ml + Basagran 1.0L |
| 4. | Totril 300ml + Basagran 1.0L | Totril 300ml + Nortron 2.0L |
| 5. | Totril 300ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 6. | Totril 300ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 7. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Basagran 1.0L |
| 8. | Dow Shield 250ml + Nortron 2.0L | Totril 300ml + Nortron 2.0L |
| 9. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Basagran 1.0L |
| 10. | Dow Shield 250ml + Starane 300ml | Totril 300ml + Nortron 2.0L |
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| 12. | Semeron 850g + Totril 300ml | Totril 300ml + Nortron 2.0L |
| 13. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Basagran 1.0L |
| 14. | Lentagran 1.25kg + Semeron 850g | Totril 300ml + Nortron 2.0L |
| 15. | Unweeded control | |

Sensitivity of Weed Species to Treatments Tested.

At the first assessment date records were taken of the sensitivity of each weed species present on the trial site to the treatment range.

Scores were made on a 0-4 scale, where 0 = weed absent on the plot, 1 = no effect, 2 = slight effect, 3 = severe effect and 4 = total control.

The following Tables III & IV indicate which treatments gave total kill or nearly so of the range of weed species present on the trial site.

TABLE III: WEED SPECIES KILLED OR NEARLY KILLED BY TREATMENTS (All 6 Reps)

	Redshank	Fools parsley	Common fumitory	Sun spurge	Groundsel	Shepherds purse	Black n'tshade	Mayweed	Fathen	Field pansy	Total No.
1 Gesagard/Nortron + Totril/Basagran	S	*				*	S	*	*		2
2 Gesagard/Nortron + Totril/Nortron						S	*		S		2
3 Totril/Basagran+ Totril/Basagran	S	S			*	S	S	S			5
4 Totril/Basagran+ Totril/Nortron		S				*		S			2
5 Totril/Nortron+ Totril/Basagran	*	S				S	*	S			3
6 Totril/Nortron+ Totril/Nortron						*	S				1
7 Dow Shield/Nortron + Totril/Basagran	*						*				0
8 Dow Shield/Nortron + Totril/Nortron											0
9 Dow Shield/Starane + Totril/Basagran											0
10 Dow Shield/Starane + Totril/Nortron											0
11 Semeron/Totril + Totril/Basagran	S	S			*	*	*	S	S		4
12 Semeron/Totril + Totril/Nortron		*				*	*		S		1
13 Lentagran/Semeron + Totril/Basagran	S	S	*			*	*	S	S		4
14 Lentagran/Semeron + Totril/Nortron	*	*	*			S	*		S		2
A-H Totril/Basagran + Lentagran/Semeron	*	*	*	*		*	S	S	S		3

S = complete kill (score 4), * = some killed but some survivors (score > 3.5)

TABLE IV: WEED SPECIES KILLED OR NEARLY KILLED BY TREATMENTS (Reps 4-6, no residual)

	Redshank	Fools parsley	Common fumitory	Sun spurge	Groundsel	Shepherds purse	Black n'tshade	Mayweed	Fathen	Field pansy	Total No.
1 Gesagard/Nortron + Totril/Basagran	S	*				*	S	S	*		3
2 Gesagard/Nortron + Totril/Nortron	*		*			S	S		S		3
3 Totril/Basagran+ Totril/Basagran	S	S			*	S	S	S	*		5
4 Totril/Basagran+ Totril/Nortron		S						S			2
5 Totril/Nortron+ Totril/Basagran	S	S				S	S	S			5
6 Totril/Nortron+ Totril/Nortron	*					*	S				1
7 Dow Shield/Nortron + Totril/Basagran	*					*	*				0
8 Dow Shield/Nortron + Totril/Nortron											0
9 Dow Shield/Starane + Totril/Basagran											0
10 Dow Shield/Starane + Totril/Nortron											0
11 Semeron/Totril + Totril/Basagran	S	S			S	S	S	S	S		7
12 Semeron/Totril + Totril/Nortron	*						S		S		2
13 Lentagran/Semeron + Totril/Basagran	S	S	S			*	*		S	*	4
14 Lentagran/Semeron + Totril/Nortron	S		*			S	S		S		4
A-H Totril/Basagran + Lentagran/Semeron	S	S	*	*		*	S	S	S	*	5

S = complete kill (score 4), * = some killed but some survivors (score > 3.5)

Key to weed species in Table IV

Discussion

The purpose of the project is to develop a range of sequential low-dose mixtures of post-emergence contact herbicides to provide a second line of defence in the event of pre-emergence herbicide failures, and a series of simple two-stage sequences of treatments were tested in the field. The treatments were chosen from the best performing mixtures in the 1996 experiment following discussion at the subsequent review meeting.

It was agreed to treat half the site with a standard pre-emergence residual herbicide in order to test crop safety in as near a commercial situation as possible, and also to repeat the treatments on an area where no residual had been applied so as to test to the limit the weed control efficacy. The trial thus consisted of two areas, each of 15 treatments replicated three times, making a total of six replications and 90 plots in total.

Crop Safety

Even though the salad onion crop was healthy and well-waxed at the time of application of the treatments, they all caused a slight leaf tip scorch when assessed on the 19 June, six days after application of the second sprays. A higher degree of leaf scorch was recorded on Trts. 11-14, all containing Semeron, but by 23 July, 40 days after the second application these symptoms had disappeared, new leaves appearing without symptoms and first leaves dying off as the crop grew away normally. The crop from all treatments was assessed as being of good, commercially acceptable quality by this second assessment date.

This result is consistent with 1996 in which Ramrod alone was used as the pre-emergence residual herbicide, and all treatments were found to be safe. In 1997 the residual treatment on the one half of the trial site of half the normal rate of Dacthal and full rate of Ramrod was safe and had no effect on crop safety and quality.

Efficacy

In 1997, mixtures containing Dow Shield and Starane were the least effective, in contrast to 1996. This was due to the absence of weed species sensitive to these herbicides, notably black-bindweed which was the dominant species in 1996 but absent in 1997. The weed species that were present (see page 10) are not well controlled by these materials.

Based on the weed control efficacy data shown in Figures III - VI, the remaining mixtures were all effective to varying degrees, but five treatments were particularly good when assessed on 23 July.

Totril/Nortron + Totril/Basagran (Trt 5) and the reverse sequence (Trt 4) were effective when used in conjunction with the pre-emergence residual, but were less effective without, particularly Trt 4.

The highest levels of weed control in the absence of a residual herbicide resulted from those treatments containing Semeron. Semeron/Totril + Totril/Basagran (Trt 11), was the best treatment without residual and efficacy was actually less following the residual herbicide. Lentagran/Semeron + Totril/Nortron (Trt 14), was the most effective treatment with residual, being very similar to Trt 11 where residual was not used.

The residual herbicide slightly enhanced the effect of the Semeron mixtures, though without the residual herbicide, these treatments still gave the best weed control, particularly Trts 11 and 14 which recorded the highest scores. Where residual herbicides have failed in commerce, Semeron mixtures may well offer the best prospect of achieving good weed control, depending on the weed species present.

The overall efficacy of any individual treatment will depend on the weed species present on the relevant plots. It is a feature of field trials of this type that weed distribution over the site is random and variable. For example, in this trial sun spurge, *Euphorbia helioscopia*, was distributed in patches and therefore individual plot scores could be reduced even though most other weed species were controlled. For this reason the data contained in the above Tables III & IV may be a more accurate indication of the efficacy of any given treatment as it identifies those mixtures capable of giving full control of the weed species present.

Table III sets out the susceptibility of weeds to the treatments in all six replicates, including those with and without the residual herbicide at drilling. On this evidence the repeated low dose Totril/Basagran, Trt 3, killed the widest range of weeds. Treatments 11 (Semeron/Totril + Totril/Basagran) and 13 (Lentagran/Semeron + Totril/Basagran), were also highly effective as they achieved a near kill on a wider range of weeds including difficult species such as common fumitory.

Table IV shows weed species killed or nearly killed on the three replicates that received no pre-emergence residual herbicide at drilling. In this half of the trial Trt 11 (Semeron/Totril + Totril/Basagran), killed the widest range of weeds followed by Trt 3 (repeated low dose Totril/Basagran) and Trt 5 (Totril/Nortron + Totril/Basagran). It was noted that the contact treatments were more active in this half of the trial compared with the outcome for the trial as a whole. This may be due to some interaction with the residual herbicide applied at drilling, as previously noted, weed size and cover at spraying were much greater where no residual was used. However the exact reasons for this apparent improved weed control are not at present fully understood.

Because of the trial layout, eight plots (A - H) were spare and available for an extra replicated but non-randomised treatment discussed at the review meeting but withdrawn from the main trial. This consisted of Totril/Basagran + Lentagran/Semeron, ie. Treatment 13 in reverse.

The results from this extra observation treatment were very similar to the main trial in terms of crop safety, but may have caused slightly less leaf tipping, probably as a result of the slightly later application of Lentagran/Semeron. Efficacy of weed control was as good as the treatments in the main trial but the range of weeds controlled was no greater than that controlled by Trt 13 (Lentagran/Semeron + Totril/Basagran).

In this trial the authors recorded for the first time individual weed species totally controlled by each treatment in addition to recording the overall score for weed control. This data (Tables III & IV), should enable growers to select safe treatments appropriate to the weed spectrum on their farms.

CONCLUSIONS

A different and wider spectrum was present in 1997 compared with 1996 with large numbers of redshank, common fumitory, black nightshade, sun spurge, groundsel and fool's parsley. Smaller numbers of mayweed, fat-hen, field pansy and shepherd's purse were also present.

The application of the pre-emergence residual herbicide did not increase the risk of damage by the contact treatments.

The application of two low rate tank mixes four days apart starting at the 1½ leaf stage was safe to the crop. Most treatments caused a slight transient leaf tipping when observed six days after the second spray application of the sequence. This effect had disappeared by the second assessment date, 34 days later, when the onions were all commercially acceptable and would have met normal market specifications.

Weed number and size was generally lower where the residual pre-emergence herbicide was used at drilling.

Of the approved treatments tested, repeated low dose Totril/Basagran, Trt 3, killed 5 of the 10 weed species present and severely checked another two. This treatment is used already to a certain extent in commercial practice.

The treatment which killed the widest range of weeds was Semeron/Totril + Totril/Basagran, 7 out of the 10 species present being fully controlled. This result was achieved in the absence of the pre-emergence residual.

Observation plots of Totril/Basagran + Lentagran/Semeron also appeared to be safe but no more effective than any of the other main treatments.

The best treatment in terms of the weed control score and range of weed species controlled was Semeron/Totril + Totril/Basagran, the Semeron mixtures all giving excellent control of fat hen. Semeron appears to have potential as a safe and effective herbicide for salad onion growers. A SOLA application should be considered. The herbicide may also have a place in the armoury for bulb onion growers.

The layout of Tables III & IV is designed to assist growers in selecting suitable treatments for the weed species in their own crops.

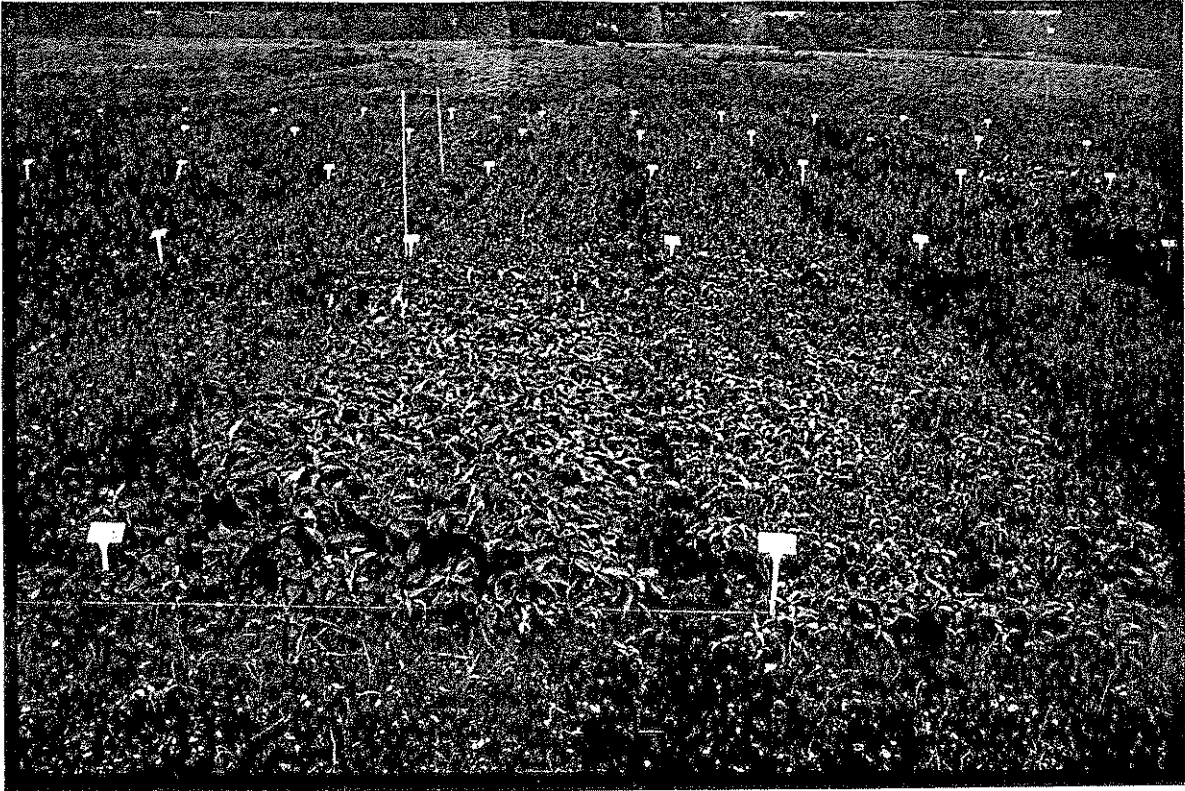
Dow Shield/Starane did not repeat the success of the 1996 field trial because sensitive weed species such as black bindweed were not present. However this treatment is worth considering where susceptible weed species occur.

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APPENDIX

Photograph I: Overall view showing extent of weed cover on Control treatment 6 days after spraying. Plots behind this row received no residual herbicide.



Photograph II: Treatment 11 (Semeron/Totril + Totril/Basagran) showing leaf tipping 6 days after spraying



Photograph III

Treatment I1 showing recovery from leaf tipping 34 days after Photograph II.



Photograph IV:

Plot E (Totril/Basagran + Seneron/Lentagran) without residual showing crop at maturity.

