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18 Lavant Street
Petersfield
GU32 3EW

ADAS Contract Manager: C Speller
ADAS Arthur Rickwood
Mepal
Ely
Cambs CB6 2BA
Tel: 0354 692531

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Bulb Onions: Control of Volunteer Potatoes

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Commercial - In Confidence

ADAS

PRINCIPAL WORKER

Julian Davies BSc Horticultural Advisor (author of report)

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.

C.S.Speller ..... Date 12.2.92

Colin Speller Contract Manager

Report authorised by:

.....

S W Perkins Esq
HDC Account Manager
Block B
Government Buildings
Brooklands Avenue
Cambridge CB2 2DR
Tel: 0223 455752

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BULB ONIONS: CONTROL OF VOLUNTEER POTATOES

Summary

Onions cv Hyton were drilled on 26 February and a uniform population of potatoes cv Maris Piper planted within the crop to simulate volunteers. Herbicide programmes containing Dow Shield, Dosaflo, Fortrol, Starane 2 and Totril began on 20 May at the first true leaf of the onions and continued until 20 June when the onions were at the third true leaf stage. On 6 June there was severe leaf twisting following two applications of Starane 2, particularly where wetting agents had been included. Applications of Totril alone or mixed with Fortrol were safer to the onions but were not so effective in controlling the vigour of the potatoes compared to where Starane 2 had been used. By 25 July the potatoes on most of the treatments had recovered to some extent except where either Starane 2 had been applied on three occasions or where an application of Dosaflo on 11 June followed Totril, or where Dow Shield had been applied on 20 June following Starane and Totril. These treatments remained the most effective by 16 August. At harvest all herbicide programmes had reduced the yield compared to the hand weeded control. The best treatments were either Starane 2 at 0.5 or 0.75 l/ha applied on three occasions from the first true leaf stage, or Dosaflo at 3.0 l/ha following two applications of Totril at 0.7 and 1.4 l/ha. All of these programmes controlled potato vigour yet produced good yields of high quality bulbs, but none are currently permitted for use. Of the approved programmes the safest and most effective regime comprised two applications of Totril at 0.7 then 1.4 l/ha followed by Starane at 1.0 on 11 June.

Particularly effective potato control was achieved using a single application of Dow Shield in programmes with Totril or Totril and Fortrol and Starane. However, some reduction in yield of large onions was recorded which showed the risk associated with using this product. Where two sequential application of Dow Shield were made there was a considerable reduction in marketable yield.

Note that only two applications of Starane 2 are currently permitted under the off-label approval, and that Dosaflo is not approved for use on onions.

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Objective

To evaluate recently approved (off-label) Starane 2 in programmes with standard broad-leaved herbicides for their effect on both the onions and on potatoes established at known population to represent "volunteers".

Introduction

The problem of volunteer potatoes in vegetable crops is on the increase and is particularly evident in weakly competitive crops such as onions. The off-label approval of Starane 2 gained in 1990 offered growers a potential solution but this chemical is known to severely affect onion foliage. This trial, now in its second year, is designed to compare low rates of Starane 2 applied from the first true leaf stage with higher rates applied at later growth stages following standard broad-leaved herbicides. The addition of chemical wetting agents is also being evaluated. Dosaflo, which is not currently approved for use on onions, has also been included due to its effectiveness in controlling potatoes.

Materials and Methods

Site

The experiment was conducted on House Ground field at ADAS Arthur Rickwood, Mepal, Ely, Cambridgeshire. The soil type was a loamy peat 90 cm deep with 33% organic matter over Fen clay (Adventurers' Shallows).

Treatments

	First application (20 May)	Second application (30 May)	Third application (11 June)	Fourth application (20 June)
1.	Untreated control			
2.	Hand weeded control			
3.	Starane 2 0.5 l/ha	Starane 2 0.5 l/ha	Starane 2 0.5 l/ha	
4.	Starane 2 0.75 l/ha	Starane 2 0.75 l/ha	Starane 2 0.75 l/ha	
5.	Starane 2 0.5 l/ha + Agral	Starane 2 0.5 l/ha + Agral	-	
6.	Starane 2 0.5 l/ha + Actipron	Starane 2 0.5 l/ha + Actipron	-	
7.	Starane 2 0.5 l/ha + Ethokem	Starane 2 0.5 l/ha + Ethokem	-	
8.	Starane 2 0.75 l/ha + Agral	Starane 2 0.75 l/ha + Agral	-	
9.	Starane 2 0.75 l/ha + Actipron	Starane 2 0.75 l/ha + Actipron	-	
10.	Starane 2 0.75 l/ha + Ethokem	Starane 2 0.75 l/ha + Ethokem	-	
11.	Starane 0.5 l/ha + Totril 0.7 l/ha	Starane 0.5 l/ha + Totril 0.7 l/ha	Starane 1.0 l/ha	
12.	Totril 0.7 l/ha	Totril 0.7 l/ha	Starane 0.75 l/ha	
13.	Totril 0.7 l/ha	Totril 0.7 l/ha	Starane 1.0 l/ha	
14.	Totril 0.7 l/ha	Totril 1.4 l/ha	Starane 0.75 l/ha	
15.	Totril 0.7 l/ha	Totril 1.4 l/ha	Starane 1.0 l/ha	

16.	Totril 0.7 l/ha	-	Starane 0.75 l/ha	
17.	Totril 0.7 l/ha	Starane 0.75 l/ha	Starane 1.0 l/ha	
18.	Totril 0.7 l/ha	Totril 0.7 l/ha	Totril 0.7 l/ha	
	Fortrol 0.7 l/ha	Fortrol 0.7 l/ha	Fortrol 0.7 l/ha	
19.	Totril 0.35 l/ha	Totril 0.35 l/ha	Totril 0.35 l/ha	
	Fortrol 0.35 l/ha	Fortrol 0.35 l/ha	Fortrol 0.35 l/ha	
20.	Totril 0.7 l/ha	-	Starane 1.0 l/ha	Dow Shield 0.5 l/ha
21.	Totril 0.7 l/ha	-	Starane 1.0 l/ha	Dow Shield 0.5 l/ha
	Fortrol 0.7 l/ha			
22.	Totril 0.7 l/ha	-	Dow Shield 0.5 l/ha	Dow Shield 0.5 l/ha
23.	Totril 0.7 l/ha	Totril 1.4 l/ha	Dosaflo 2.0 l/ha	
24.	Totril 0.7 l/ha	Totril 1.4 l/ha	Dosaflo 3.0 l/ha	

Notes Wetting Agents

1 Agral was added at a rate of 1.0 l/1000 l of water

2 Actipron was added at a rate of 5.0 l/250 l of water

3 Ethokem was added at a rate of 10 l/1000 l of water

Treatment application

All treatments were applied in 250 l/ha water using a hand-held Oxford Precision sprayer with Teejet 8002 nozzles at 2 bar pressure. Special experimental permits allowed the testing of Dosaflo as there is no approval for the use of this chemical on onions.

The weather at the time of treatment application is detailed in Appendix V.

Husbandry

Onions cv Hyton were drilled on 26 February. On 15 March potatoes cv Maris Piper were planted by hand to achieve a uniform density of 'volunteers'.

The first treatments commenced at the first true leaf stage, the second applications made 10 days later, with the final applications made either on 11 June, when the crop was at the 2-3 true leaf stage, or on 20 June, at the third true leaf stage, as appropriate to control potato re-growth.

The hand weeded control plots were hoed on both 21 May and 12 June. The whole trial (except treatment 1) was hoed on 9 July to remove all weeds except the potatoes so as to minimise competition which could have influenced the yield and quality at harvest.

The trial was harvested at the 90% foliage fall over stage and loaded into store. After drying and curing the onions were removed from store and graded on 8 November.

Assessments

1. Onion and potato vigour were assessed on 6 June.
2. Potato stem number was recorded on 25 July.
3. Onion and potato vigour and potato stem number were recorded on 16 August.
4. Plant populations and yield at harvest.

Design and statistical analysis

The trial was a randomised block with four replicates. Each plot consisted of a 1.68 m bed and was 6 m in length (10.08 m^2), with four rows per bed.

All the data were subjected to analysis of variance.

Results

Plant Establishment and Vigour

The onions emerged well in late March with, on average, 53 plants/m^2 when recorded in mid May. The potatoes emerged in late April with an average of 29 plants per plot, close to the target of 3 plants/m^2.

The vigour of the onions and potatoes was assessed on 6 June between the second and third herbicide applications. The results shown in Table 1 have been averaged where the applications to date have been the same.

Table 1. Onion and potato vigour on 6 June.

	Treatments to date	Onion Vigour (0-10)*	Potato vigour (0-10)#
1	Untreated	6.5	7.5
2	Hand weeded	7.0	0
3	Starane @ 0.5 x 2	5.3	4.3
4	Starane @ 0.75 x 2	5.0	5.5
5	Starane @ 0.5 + Agral x 2	4.3	4.3
6	Starane @ 0.5 + Actipron x 2	4.3	4.0
7	Starane @ 0.5 + Ethokem x 2	4.0	4.5
8	Starane @ 0.75 + Agral x 2	3.8	4.3
9	Starane @ 0.75 + Actipron x 2	4.0	4.0
10	Starane @ 0.75 + Ethokem x 2	4.0	4.0
11	Starane @ 0.5 + Totril @ 0.7 x 2	4.8	4.3
12,13	Totril @ 0.7 x 2	6.3	5.8
14,15,23,24	Totril @ 0.7, Totril @ 1.4	6.3	5.4
16,20,22	Totril @ 0.7 x 1	7.3	7.2
17	Totril @ 0.7, Starane @ 0.75	6.0	5.3
18	Totril + Fortrol @ 0.7 x 2	5.3	5.5
19	Totril + Fortrol @ 0.35 x 2	6.3	6.5
21	Totril + Fortrol @ 0.7	6.8	7.0
Mean		5.6	5.2
CV %		11	9
SED (69 df)		0.44	0.33
LSD (@ 5%)		0.87	0.65

* Onions
0 = dead
3 = leaves prostrate
5 = leaves green, curled and twisted
9 = slight leaf tipping
10 = vigorous and healthy

\# Potatoes
0 = dead
3 = yellow and severely stunted
5 = green and severely stunted
7 = green, slight twisting
10 = vigorous and flowering

The vigour of the onions ranged from very good to poor. The early applications of Starane 2 at both 0.5 and 0.75 l/ha caused severe leaf twisting and resulted in the plants being laid flat on the ground, particularly where wetters had been added (treatments 5-10). The application of the Totril plus Fortrol mixture with both products at 0.7 l/ha at the first leaf stage and then repeated 10 days later also significantly reduced plant vigour compared to the hand weeded control.

The vigour of the potatoes remained high where only one herbicide application had been made at the first leaf stage, but was reduced where two applications had been made. The application of Starane 2 at the first leaf stage, then repeated 10 days later significantly reduced the vigour of the potatoes. The plants were twisted and stunted, particularly where wetters had been added resulting in enhanced activity. The addition of Starane 2 with Totril (treatment 11) on two occasions also reduced the vigour of the potatoes.

Further vigour assessments were taken on 25 July and these are detailed in Appendix IV. The vigour of the potatoes had been significantly reduced following the application of Dosaflo at 3 l/ha on 11 June (treatment 24) and also where Starane had been applied on 11 June followed by Dow Shield on 20 June (treatments 20 and 22). Those treatments which involved applying Starane 2 at low rates from the first leaf stage on three occasions (treatments 3 and 4) also significantly reduced potato vigour. However, where Starane 2 had been applied with wetters on two occasions the potato plants were still green and, although stunted, looked vigorous.

The final vigour assessments were taken on 16 August prior to harvest, Table 2.

Table 2. Onion and potato vigour on 16 August.

Treatments	Onion Vigour (0-10)	Potato vigour (0-10)
1 Untreated	2.5	8.3
2 Hand weeded	10.0	2.3
3 Starane @ 0.5 x 3	9.5	4.0
4 Starane @ 0.75 x 3	9.8	3.5
5 Starane @ 0.5 + Agral x 2	10.0	7.8
6 Starane @ 0.5 + Actipron x 2	9.8	8.0
7 Starane @ 0.5 + Ethokem x 2	9.8	8.3
8 Starane @ 0.75 + Agral x 2	9.8	7.3
9 Starane @ 0.75 + Actipron x 2	9.8	7.4
10 Starane @ 0.75 + Ethokem x 2	9.8	9.0
11 Starane @ 0.5 + Totril @ 0.7 x 2, Starane @ 1.0	10.0	6.5
12 Totril @ 0.7 x 2, Starane @ 0.75	9.8	7.3
13 Totril @ 0.7 x 2, Starane @ 1.0	10.0	8.3
14 Totril @ 0.7, Totril @ 1.4, Starane 0.75	9.8	7.0
15 Totril @ 0.7, Totril @ 1.4, Starane @ 1.0	9.0	5.3
16 Totril 0.7, -, Starane @ 0.75	9.5	5.5
17 Totril 0.7, Starane @ 0.75, Starane @ 1.0	9.5	5.3
18 Totril + Fortrol @ 0.7 x 3	9.5	6.8
19 Totril + Fortrol @ 0.35 x 3	9.5	5.3
20 Totril @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	9.3	1.5
21 Totril + Fortrol @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	10.0	3.3
22 Totril @ 0.7, -, Dow Shield @ 0.5 x 2	7.8	5.0
23 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 2.0	10.0	8.5
24 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 3.0	9.8	3.8
Mean	9.3	6.0
CV %	8	32
SED (69 df)	0.51	1.37
LSD (@ 5%)	1.00	2.71

The vigour of the onions was excellent except for the untreated control and where Dow Shield has been applied on 11 and 20 June. The vigour of the potatoes was still high for treatments 12, 13, 14 despite the use of Starane 2 on 11 June following earlier applications of Totril. The use of Dosaflo at 2 l/ha did not completely control the vigour of the potatoes, whereas excellent control was achieved at 3 l/ha.

Yield

The trial was harvested on 29 August and graded out of store on 8 November. The results are given in Table 3.

Table 3. Plant populations and yield at harvest.

Treatments	Plants/m²	Yield (t/ha) Total	>40	>50	>60
1 Untreated	22	6.3	3.6	1.7	0.8
2 Hand weeded	52	62.0	61.2	57.7	40.0
3 Starane @ 0.5 x 3	46	53.0	52.4	49.0	30.7
4 Starane @ 0.75 x 3	49	50.0	49.1	45.4	26.2
5 Starane @ 0.5 + Agral x 2	47	45.6	44.9	39.0	18.8
6 Starane @ 0.5 + Actipron x 2	49	45.8	45.0	39.8	19.3
7 Starane @ 0.5 + Ethokem x 2	49	43.6	42.1	35.1	15.3
8 Starane @ 0.75 + Agral x 2	44	44.8	43.7	39.5	20.7
9 Starane @ 0.75 + Actipron x 2	46	46.0	45.2	40.8	20.6
10 Starane @ 0.75 + Ethokem x 2	50	46.4	45.3	39.6	18.3
11 Starane @ 0.5 + Totril @ 0.7 x 2, Starane @ 1.0	50	43.8	42.7	36.1	13.7
12 Totril @ 0.7 x 2, Starane @ 0.75	52	51.6	50.7	44.2	22.6
13 Totril @ 0.7 x 2, Starane @ 1.0	45	49.2	48.0	44.0	26.9
14 Totril @ 0.7, Totril @ 1.4, Starane 0.75	47	46.0	45.0	40.5	20.0
15 Totril @ 0.7, Totril @ 1.4. Starane @ 1.0	46	49.2	48.4	40.1	22.1
16 Totril 0.7, -, Starane @ 0.75	46	46.6	46.0	40.8	21.7
17 Totril 0.7, Starane @ 0.75, Starane @ 1.0	47	46.0	45.2	39.6	22.5
18 Totril + Fortrol @ 0.7 x 3	48	46.7	45.6	39.6	17.9
19 Totril + Fortrol @ 0.35 x 3	50	47.7	46.9	42.0	21.8
20 Totril @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	48	46.2	45.0	40.0	22.1
21 Totril + Fortrol @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	50	52.6	51.8	46.7	27.4
22 Totril @ 0.7, -, Dow Shield @ 0.5 x 2	41	35.7	34.2	29.3	14.9
23 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 2.0	47	55.6	54.9	49.0	26.3
24 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 3.0	48	52.4	51.8	47.2	27.9
Mean	46	46.4	45.4	40.3	21.6
CV %	16	23	14	14	15
SED (69 df)	5.4	4.46	4.35	4.34	3.52
LSD (@ 5%)	10.7	8.83	8.61	8.59	6.97

The mean plant population at harvest was 46 plants/m² with a significant reduction only recorded for the untreated control. The mean total yield

was 46.4 t/ha with all treatments significantly ($P<0.05$) reducing the yield compared to the hand weeded control except programme 23 where two applications of Totril were followed by Dosaflo at 2 l/ha. This was also the case for the yield over 40 mm category.

The yield of bulbs over 50 mm ranged from 1.7 t/ha to 57.7 t/ha. All treatments yielded significantly ($P<0.05$) lower than the handweeded control. The application of Dow Shield on two occasions (22) substantially reduced the yield to 29.3 t/ha, and those treatments where Starane 2 plus wetters had been applied also produced below average yields. The best treatments appeared to be either Starane 2 at 0.5 or 0.75 l/ha on three occasions (3, 4) or where Dosaflo at 2 or 3 l/ha had been applied on 11 June, following a Totril programme (23, 24).

The yield of bulbs over 60 mm was on average 21.6 t/ha. All treatments yielded significantly ($P<0.05$) lower than the hand weeded control. Lower than average yields were recorded following the use of Starane 2 plus wetters (5-10), Dow Shield on two occasions (22) and a tank mix of Starane 2 plus Totril on two occasions followed by Starane 2 in early June (11).

Bulb Quality

The quality of the bulbs was very good and similar for all treatments, with less than 2.2% of defects which were mainly rotten onions or bulbs with a poor skin finish.

Progeny tuber viability

At harvest daughter tubers were collected from each treatment. These will be stored in a temperature controlled store over the winter and assessed for viability in the spring.

Discussion

Starane 2 on three occasions (treatments 3 and 4)

The application of Starane 2 at either 0.5 or 0.75 l/ha at the first leaf stage and repeated 10 days later caused a significant reduction in the vigour of the onions in early June but they had recovered well by August. The vigour of the potatoes was significantly reduced using these regimes, particularly following a third application on 11 June whereby the potatoes remained stunted until harvest. The three applications of Starane caused the potato plants to lie close to the ground and, although green, they did not compete with the crop to any great extent. At harvest, these two treatments yielded well.

Starane 2 plus wetting agents (treatments 5 to 10)

The addition of wetting agents with the Starane 2 caused an even greater reduction in onion vigour than where Starane 2 alone had been applied. This was particularly visible where Starane 2 at 0.75 l/ha had been used with the wetters. The control of the potatoes was good early on in the season but by late July the plants had recovered, particularly where Ethokem had been added. At harvest the total yields and plant populations were similar to other herbicide treatments but the yield of bulbs over 60 mm was lower.

Starane 2 plus Totril (treatment 11)

The tank mix of Starane 2 and Totril on two occasions followed by Starane 2 on 11 June reduced the early vigour of both the onions and the potatoes. At harvest the total yield was below average with a lower yield in the over 60 mm size grade compared to where Starane 2 had not been applied with the Totril.

Delayed application of Starane 2 (treatments 12 to 19)

The application of Totril or Totril plus Fortrol in late May appeared to be safer to the onions than Starane 2 but had less effect on the potatoes. There was an improvement in the control of potato vigour where Starane 2

had been applied on 11 June following earlier applications of Totril and Totril plus Fortrol, particularly where a rate of 1.0 l/ha had been used rather than 0.75 l/ha. The late use of Starane did not reduce the yield of onions at harvest.

Late use of Dow Shield (treatments 20 to 22)

The application of Dow Shield at the third leaf stage following either Totril or Totril plus Fortrol then Starane 2 was very effective in controlling the vigour of the potatoes. Two applications of Dow Shield following Totril at the first leaf stage (22) considerably reduced the vigour of the potatoes. However, this treatment also caused damage to the onions and, at harvest, significantly reduced the total yield.

Late application of Dosaflo (treatments 23 and 24)

The application of Dosaflo on 11 June following two applications of Totril gave excellent control of the potatoes with the lowest number of surviving plants at harvest. In addition, the total yield of onions was high with a high proportion in the larger size grade. The 3.0 l/ha rate of Dosaflo gave better control of the potatoes whilst not significantly reducing onion yield.

Conclusions

1. Starane 2 caused severe stunting of the potatoes but, unless applied on three occasions at the rates used, did not satisfactorily control their vigour.

2. Although Starane 2 caused severe twisting of the onion leaves, the plants grew out of it and produced relatively high yields of large good quality bulbs at harvest.

3. The addition of wetting agents with the Starane 2 resulted in a yield reduction. Their use from the second true leaf rather than from the first true leaf stage might lessen this yield reduction.

4. The application of Starane 2 in early June following the use of Totril or Totril and Fortrol was safer to the onions and controlled potato growth.

5. Dow Shield was very effective for controlling the potatoes but even with one application some loss in yield of large onions was recorded when compared with the safest effective programmes. When two sequential applications were made a large loss in yield of marketable onions was observed.

6. Dosaflo at 3 l/ha in early June following two applications of Totril gave excellent control of the potatoes with no reduction in crop yield. At present there is no approval for the use of Dosaflo on onions.

Recommendations

1. This trial has shown that Starane 2 has an important role in controlling the vigour of the potatoes. More information is required on its performance particularly when applied from the second true leaf stage which might lessen the risk of crop damage compared with its earlier use.

2. These experimental treatments should be evaluated on a mineral soil type.

3. Dosaflo gave excellent control of the potatoes when used following Totril. It offered scope for good potato control whilst giving little or no reduction in onion yield compared with the other, harsher volunteer potato control regimes.

4. An integrated control programme involving control of volunteer potatoes in a preceding crop should be investigated.

Storage of data

The raw data will be stored at ADAS Arthur Rickwood, Mepal, Ely, Cambridgeshire for a period of 10 years. The Horticultural Development Council will be consulted before the disposal of the data.

Appendix I

Field	House Ground	
Previous cropping	1990 Sugar beet 1989 Winter wheat 1988 Winter wheat	
Crop diary		
Cultivation	20 December	ploughed
	25 February	power harrowed
Husbandry	26 February	drilled with Stanhay drill
	15 March	potatoes planted by hand
	21 May	Treatment 1 hand weeded
	12 June	Treatment 1 hand weeded
	9 July	all trial hoed for annual meadow grass and thistle <u>but</u> not potatoes
Insecticides	26 February	1.4 kg/ha ai carbofuran as 28 kg/ha cp Yaltox applied at drilling
	31 July	7.5 ml/ha ai deltamethrin as 300 ml/ha cp Decis in 1000 l/ha water (onion thrip control)
Herbicides	18 March	4.32 kg/ha ai propachlor + 2.24 kg/ha ai chlorpropham + 0.6 kg/ha ai paraquat as 9 l/ha cp Ramrod Flo + 5.6 l/ha cp CIPC 40 + 3 l/ha cp Gramoxone in 600 l/ha water
	12 April	0.45 kg/ha ai chlorbufam + 0.56 kg/ha chloridazon as 2.25 kg/ha cp Alicep in 450 l/ha water
	24 April	as above
	20 May	treatments applied as appropriate
	30 May	treatments applied as appropriate
	11 June	treatments applied as appropriate
	20 June	treatments applied as appropriate
Fungicides	21 June	1.0 kg/ha chlorothalonil as 2 l/ha cp Bravo + 280 ml/ha cp Bond in 200 l/ha water
	19 July	as above
Fertiliser	4 December	80 kg/ha P_2O_5 + 120 kg/ha K_2O
	4 April	40 kg/ha
	7 May	40 kg/ha

Trace elements	29 April	9 kg/ha $MnSO_4$ in 280 l/ha water
	28 May	9 kg/ha $MnSO_4$ in 280 l/ha water
	14 June	9 kg/ha $MnSO_4$ in 280 l/ha water
	28 June	9 kg/ha $MnSO_4$ in 280 l/ha water
	17 July	9 kg/ha $MnSO_4$ in 280 l/ha water
Irrigation	19 July	25 mm
	7 August	25 mm
Harvest	29 August	
Graded out of store	8 November	

Appendix II

Ingredients of commercial products used in the trial.

Product	Active ingredient
Dow Shield	0.5 l/ha contains 100 g/ha ai clopyralid
Dosaflo	2.0 l/ha contains 1.0 kg/ha ai metoxuron 3.0 l/ha contains 1.5 kg/ha ai metoxuron
Fortrol	0.35 l/ha contains 175 g/ha ai cyanazine 0.7 l/ha contains 350 g/ha ai cyanazine
Starane 2	0.5 l/ha contains 100 g/ha ai fluroxypyr 0.75 l/ha contains 150 g/ha ai fluroxypyr 1.0 l/ha contains 200 g/ha ai fluroxypyr
Totril	0.35 l/ha contains 80 g/ha ai ioxynil 0.7 l/ha contains 160 g/ha ai ioxynil

Appendix III

Table of treatments.

	First true leaf stage								Second true leaf stage				
	First				Second (10 days later)				Third (a further 12 days later)				
	S	T	F	Wetter	S	T	F	Wetter	S	T	F	DS	Dosaflo
Number													
1	Untreated												
2	Hand weeded as appropriate												
3	0.5				0.5				0.5				
4	0.75				0.75				0.75				
5	0.5			Agral	0.5			Agral					
6	0.5			Actipron	0.5			Actipron					
7	0.5			Ethokem	0.5			Ethokem					
8	0.75			Agral	0.75			Agral					
9	0.75			Actipron	0.75			Actipron					
10	0.75			Ethokem	0.75			Ethokem					
11	0.5	0.7			0.5	0.7			1.0				
12		0.7				0.7			0.75				
13		0.7				0.7			1.0				
14		0.7				1.4			0.75				
15		0.7				1.4			1.0				
16		0.7							0.75				
17		0.7			0.75				1.0				
18		0.7	0.7			0.7	0.7			0.7	0.7		
19		0.35	0.35		0.35	0.35				0.35	0.35		
20		0.7							1.0			0.5*	
21		0.7	0.7						1.0			0.5*	
22		0.7										0.5**	
23		0.7				1.4							2.0
24		0.7				1.4							3.0

Notes S = Starane; T = Totril; F = Fortrol; DS = Dow Shield
Agral @ 1 l/1000 l/water * at third leaf stage
Actipron @ 5 l/ha ** also repeated at third leaf stage
Ethokem @ 10 l/1000 l/water

Appendix IV

Potato stem number and vigour on 25 July and potato leaf cover on 16 August.

Treatments	No. of Potato stem	Potato vigour (0-10)	Potato leaf cover (%)	(angle transformation)
1 Untreated	30	8.0	90.0	(71.9)
2 Hand weeded	0	0.8	1.5	(5.0)
3 Starane @ 0.5 x 3	11	2.8	2.5	(7.8)
4 Starane @ 0.75 x 3	9	2.8	3.0	(8.5)
5 Starane @ 0.5 + Agral x 2	17	6.5	21.2	(25.9)
6 Starane @ 0.5 + Actipron x 2	14	5.0	32.5	(34.3)
7 Starane @ 0.5 + Ethokem x 2	25	8.0	48.7	(44.4)
8 Starane @ 0.75 + Agral x 2	14	5.8	26.2	(30.0)
9 Starane @ 0.75 + Actipron x 2	16	5.5	18.0	(25.2)
10 Starane @ 0.75 + Ethokem x 2	23	6.5	25.7	(29.4)
11 Starane @ 0.5 + Totril @ 0.7 x 2, Starane @ 1.0	17	5.8	23.2	(27.0)
12 Totril @ 0.7 x 2, Starane @ 0.75	18	4.5	25.0	(29.7)
13 Totril @ 0.7 x 2, Starane @ 1.0	17	5.3	19.0	(25.3)
14 Totril @ 0.7, Totril @ 1.4, Starane 0.75	20	4.8	18.7	(24.2)
15 Totril @ 0.7, Totril @ 1.4, Starane @ 1.0	13	3.8	9.0	(17.1)
16 Totril 0.7, -, Starane @ 0.75	22	4.0	12.7	(19.0)
17 Totril 0.7, Starane @ 0.75, Starane @ 1.0	16	4.8	13.5	(18.0)
18 Totril + Fortrol @ 0.7 x 3	10	4.0	12.0	(18.6)
19 Totril + Fortrol @ 0.35 x 3	11	6.0	26.7	(30.5)
20 Totril @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	18	2.5	1.5	(5.0)
21 Totril + Fortrol @ 0.7, -, Starane @ 1.0, Dow Shield @ 0.5	16	2.8	4.5	(11.9)
22 Totril @ 0.7, -, Dow Shield @ 0.5 x 2	24	5.8	38.7	(38.2)
23 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 2.0	7	5.0	10.0	(18.1)
24 Totril @ 0.7, Totril @ 1.4, Dosaflo @ 3.0	5	3.3	3.7	(9.4)
Mean	15	4.7	20.3	(23.9)
CV %	34	29		(37)
SED (69 df)	3.66	0.97		(6.31)
LSD (@ 5%)	7.25	1.92		(12.89)

Appendix V

Weather conditions at spraying.

20 May	Very cloudy at time of spraying with a gentle breeze. 7 hours of sunshine.
21 May	A calm day, warmer than 20 May with 9.8 hours of sunshine.
22 May	Breezy and lower temperatures than 21 May but with 11 hours of sunshine.
30 May	Generally a calm, cold dull day with no sunshine.
31 May	Cloudy and cold with no sunshine.
1 June	Cloudy, breezy and cold with only 2.5 hours of sunshine.
11 June	Generally a breezy day, quite cold with only 3.7 hours of sun.
12 June	Warm but fairly breezy with 7.6 hours of sunshine.
13 June	Cloudy at first but with 7.7 hours of sunshine but not as warm as 12 June.
20 June	A fairly warm, still day with 6.7 hours of sunshine.
21 June	Quite warm but with only 3.9 hours of sunshine.
22 June	Breezy but warm with 7.1 hours of sunshine.

Contract between ADAS (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

PROPOSAL

1. TITLE OF PROJECT **Contract No: FV 54c**

BULB ONIONS: CONTROL OF VOLUNTEER POTATOES

2. BACKGROUND AND COMMERCIAL OBJECTIVE

Volunteer potatoes have become one of the most serious problems in onion production across the whole range of soil types where potatoes are grown. In 1990 the Arthur Rickwood EHF undertook a trial for HDC to obtain information on the use of fluroxypyr (as Starane 2) for control of volunteer potatoes (towards obtaining off label approval). In discussion with leading commercial onion growers, Andrew Greenfield (ADAS) and Bill Bond (HRI - Wellesbourne), and following a small adjacent observation study, it was concluded that there may well be safer and more effective treatments than Starane 2 to overcome this problem. Other herbicides and tank mixes could offer an alternative armoury against this pernicious weed. It is proposed that a range of treatments be trialled to ascertain the best chemical options when compared with hand hoeing (NB spot application of glyphosate are not permitted in this crop). In the 1990 trial Starane 2 used from the second true leaf stage of the crop appeared fairly safe, but there was evidence of the chemical being damaging when used earlier, at the first true leaf stage. The optimum rate and timing of Starane 2 will be determined.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

The incidence of volunteer potatoes in onion crops is on the increase. Farmers can deal with the problem within the onion crop only by hand hoeing (£some £150/ha). If the grower could apply up to 2 l/ha of Starane 2 (perhaps as 3 low rate applications) the cost would be £30/ha and there would be no need to find extra labour. The financial benefit to the onion industry is £420,000 assuming all fields affected to a greater or lesser extent. Starane 2 has additional weed control advantages (eg cleavers, knotgrass). It may be that other chemicals or tank mixes could be applied which would be more effective against volunteer potatoes than Starane 2 yet at a similarly attractive or even lower cost.

4. SCIENTIFIC/TECHNICAL TARGET OF WORK

To identify efficacious, safe and cost-effective programmes of chemical control of volunteer potatoes in an onion crop.

5. CLOSELY RELATED WORK COMPLETED OR IN PROGRESS

Preliminary work has been done at Arthur Rickwood EHF to identify the best ways of using Starane 2 in the herbicide programme. Other potentially useful herbicides have also been identified from other MAFF-funded herbicide trials, and from field observation. The Sugar Beet Research and Education Committee are sponsoring a major study on integrated control of potatoes in sugar beet at ADAS EHF's commencing in November 1990. Any information gained that is of benefit to the onion crop will be used, although it is recognised that the two crops have few herbicides in common.

6. DESCRIPTION OF THE WORK

Potatoes cv Maris Piper would be hand planted in a crop of onions to simulate a volunteer population of about $3/m^2$. The potatoes would be controlled from the first true leaf stage of the onions using a range of broad leaved herbicide programmes aiming to keep the plots weed free. Some suggested herbicides treatments are:-

1. Unweeded control

2. Hand weeded control

3. Starane 2 @ 0.5 l/ha at first leaf, 7 days later and at second leaf stage

4. Starane 2 @ 0.75 l/ha at first leaf, 7 days later and at second leaf stage

5. Totril @ 0.7 l/ha at first leaf stage and 7 days later and Starane 2 @ 0.75 l/ha at second leaf stage

6. Totril @ 0.7 l/ha at first leaf stage and 7 days later and Starane 2 @ 1.0 l/ha at second leaf stage

7. Totril @ 0.7 l/ha at first leaf stage, Totril @ 1.4 l/ha after 7 days and Starane 2 @ 0.75 l/ha at second leaf stage

8. Totril @ 0.7 l/ha at first leaf stage, Totril @ 1.4 l/ha after 7 days and Starane 2 @ 1.0 l/ha at second leaf stage

9. Totril @ 0.7 l/ha + Fortrol @ 0.7 l/ha at first leaf stage, repeated 7 days later and at second leaf stage

10. Totril @ 0.35 l/ha + Fortrol @ 0.35 l/ha at first leaf stage, repeated 7 days later and at second leaf stage

11. Totril @ 0.7 l/ha at first leaf stage, Starane 2 @ 0.75 l/ha at second leaf stage

12. Totril @ 0.7 l/ha at first leaf stage, Starane 2 @ 1.0 l/ha at second leaf stage, Dow Shield @ 0.5 l/ha at third leaf stage

13. Totril @ 0.7 l/ha at first leaf stage, Dow Shield @ 0.5 l/ha at second leaf stage and repeated at third leaf stage

14. Totril @ 0.7 l/ha + Fortrol @ 0.7 l/ha at first true leaf stage, Starane 2 @ 1.0 l/ha at second true leaf, Dow Shield @ 0.5 l/ha at third leaf stage

15. Starane 2 @ 0.5 l/ha + Agral at first true leaf stage and repeated 7 days later

16. Starane 2 @ 0.5 l/ha + Actipron at first true leaf stage and repeated 7 days later

17. Starane 2 @ 0.5 l/ha + Frigate at first true leaf stage and repeated 7 days later

18. Starane 2 @ 0.75 l/ha + Agral at first true leaf stage and repeated 7 days later

19. Starane 2 @ 0.75 l/ha + Actipron at first true leaf stage and repeated 7 days later

20. Starane 2 @ 0.75 l/ha + Frigate at first true leaf stage and repeated 7 days later

21. Totril @ 0.7 l/ha at first leaf stage, Totril @ 1.4 l/ha after 7 days and Dosaflo @ 2.0 l/ha at second leaf stage

22. Totril @ 0.7 l/ha at first leaf stage, Totril @ 1.4 l/ha after 7 days and Dosaflo @ 3.0 l/ha at second leaf stage

7. COMMENCEMENT DATE AND DURATION

February 1991
First year's data completed by January 1992. (An interim report of weed control effects will be provided in August 1991.)

8. COSTS

Cost £5500 in a one year study.

9. STAFF RESPONSIBILITIES

Experiment Leader - Sally R Runham
Contract Manager - C S Speller

10. PAYMENT

On each quarter day the Council will pay the Contractor in accordance with the following schedule:

Quarter/Year	1991	1992
1	915	460
2	1375	-
3	1375	-
4	1375	-

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor (s)

Signature M. J. Guff

Position R&D Manager

Date 21/5/91

Signed for the Contractor (s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position CHIEF EXECUTIVE

Date 17.5.91