

PROJECT REPORT

To:
Horticultural Development Council
Bradbourne House
East Malling
Kent
ME19 6DZ

**To investigate safe and effective herbicides for
weed control in onions and leeks**

(FV257)

January 2005

Commercial – In Confidence

CONTRACT REPORT

Title: To investigate safe and effective herbicides for weed control in onions and leeks

Client: Horticultural Development Council
Bradbourne House
East Malling
Kent ME19 6DZ

Project No.: FV257

Project
Leader: Julian Davies

Project
Location: Stockbridge Technology Centre Ltd
Cawood, Selby,
North Yorkshire,
YO8 3TZ

Project
Coordinator: Mr D O'Connor, Allium and Brassica Centre

Date
Commenced: March 2004

Date
Completed: 30 August 2004

Report date: January 2005

Key words: Onions, leeks, herbicides, weed control, crop safety, phytotoxicity

Distribution: HDC (3 copies)
Mr D O'Connor, Allium & Brassica Centre (1 copy)
STC File and Archive (2 copies)

Whilst reports issued under the auspices of the HDC are prepared from the best available information, neither the authors or the HDC can accept any responsibility for inaccuracy or liability for loss, damage or injury from the application of any concept or procedure discussed.

© 2005 Horticultural Development Council
No part of this publication may be reproduced in any form or by any means without prior permission from the HDC

Authentication

The results and conclusions in this report are based on two experiments. The conditions under which the work was carried out and the results have been reported with detail and accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations.

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.

Signature Date.....

J S Davies
Project Leader
Agronomy Services
Stockbridge Technology Centre Ltd

CONTENTS

Page

GROWER SUMMARY

Headlines	5
Background and expected deliverables	5
Summary of project and main conclusions	5
Financial benefits	7
Action points for growers	7

SCIENCE SECTION

Introduction	8
Objectives	8
Details	8
Results	12
Discussion	17
Conclusions	18
Recommendations	18
Acknowledgements	19

GROWER SUMMARY

Headlines

This work has demonstrated to the EU that action is being taken on behalf of UK growers to find alternatives to replace herbicides currently permitted via Essential Use derogations.

Through this study two new herbicides have been identified as safe to the 2 allium crops and are now being investigated for progress through the approval process.

Background and expected deliverables

Many of the current herbicides approved on horticultural crops were not supported in Rounds 2 and 3 of the EU Review programme. Even if a specific ai continues to be supported and achieves Annex I listing (the EU positive list of Approved ai's) specific products or uses of products may disappear at the re-registration phase as manufacturers prioritise their efforts.

Approval for unsupported active substances were revoked on 25 July 2003. However, the European Commission granted derogations for 'Essential Uses' of prometryn, cyanazine and sodium monochloroacetate in onions and leeks until 31 December 2007 on condition that alternatives were sought.

The CSL survey of pesticide usage (Defra), showed that in 2003 prometryn was used on 2,263 ha of onions and leeks and cyanazine on 11,957 ha. After 2007 the loss of these important actives will present the allium industry with a major challenge in terms of weed control unless alternative products can be found.

The aim of this project therefore is:

- a. to provide a crop safety or 'phytotoxicity' screen to identify alternative herbicides which can be used safely on onions and leeks
- b. to allow the industry to demonstrate to the EU that action has been taken to find alternatives to replace these 'Essential Use' herbicides
- c. to identify suitable products that could be considered for new SOLAs

Summary of project and main conclusions

Onions and leeks were drilled on a commercial site on 21 March and 27 April respectively and treated with a range of herbicides either pre-emergence or at various stages after emergence (post-crook - 2 true leaf stage) to determine their relative crop safety. The herbicides evaluated as pre-emergence treatments included Stomp 400 + aclonifen (1.5 l/ha + 2.0 l/ha), which was compared with standard Ramrod + Stomp 400 (9.0 l/ha + 1.0 l/ha). Standard Ramrod + Stomp 400 (9.0 l/ha + 1.0 l/ha) was applied pre-emergence of all the post-emergence programmes. The post-emergence treatments following standard pre-emergence treatment were Boxer (florasulam) applied at 25ml/ha post-crook, 1 true leaf and 2 true leaf stage, Boxer at 50ml/ha at 1 true leaf or at 2 true leaf stage, or at 100ml/ha at the 2 true leaf stage. Some treatments received a Totril +Stomp + Pyramin mix at the 1 true leaf stage

followed by Boxer and Boxer + Starane or Bifenox at 1.0l/ha at the 2 true leaf stage. The treatments were applied to both crops in 300 l/ha water.

Plant stand was recorded for the pre-emergence treatment application. There was no effect on the germination of the onions but Stomp + aclonifen reduced plant stand for the leeks, and caused slight stunting in onions.

The main weeds present on the untreated control were field pansy, fumitory, fat hen, black-bindweed, groundsel and knotgrass. In the leeks there was a serious problem with weed beet and also volunteer potatoes with the latter removed by hand. Weed control where the standard pre-emergence treatments were applied was very good and better than for the Stomp + aclonifen. The main weakness of Stomp + aclonifen was groundsel, for Stomp + propachlor, field pansy and charlock – neither tank-mix controlled fumitory.

The efficacy of Boxer and Fox (bifenox) on weed species were not clearly identified because they were used in programmes with other herbicides.

For onions the use of Boxer at 25ml/ha at post-crook reduced crop vigour and this effect was still slightly visible 2 months later. Applications of Boxer at 25 and 50ml/ha at the one true leaf stage were safer with only transitional yellowing which only lasted for 14 days. Boxer applied at 25, 50 and 100ml/ha (the cereal dose rate) at the second true leaf stage did not affect plant vigour. Tank mixes of Boxer at 25ml/ha plus Totril at 200ml/ha at one true leaf stage caused some severe distortion and stunting. Tank mixes of Boxer at 25ml/ha with Starane at 400ml/ha at the second true leaf stage was safer and did not affect plant vigour. Fox (bifenox) applied at 1.0l/ha at the second true leaf stage produced a kink in some leaves but was also safe. Boxer failed to control fumitory or fat-hen. None of the treatments provided effective control of fumitory, but the use of the Totril/Stomp/Pyramin mix at the first true leaf stage following standard residual application gave partial fumitory control and overall the cleanest plots.

For leeks the use of Boxer at 25ml/ha at post-crook reduced crop vigour and this effect was still visible 1 month later. Applications of Boxer at 25 and 50ml/ha at the one true leaf stage were safer. Boxer applied at 25, 50 and 100ml/ha at the second true leaf stage did not affect plant vigour. Tank mixes of Boxer at 25ml/ha plus Totril at 200ml/ha at one true leaf stage was safe, but with Starane at 400ml/ha at the second true leaf stage there was slight twisting of the foliage. Fox (bifenox) applied at 1.0l/ha at the second true leaf stage caused severe scorch of the leaf margins. Boxer was effective on weed beet but not on fumitory. None of the treatments provided effective control of fumitory, but the use of the Totril/Stomp/Pyramin mix at the first true leaf stage following standard residual application gave partial fumitory control and overall the cleanest plots. Boxer applied at the post-crook or first true leaf stage gave the best control of the weed beet.

Financial benefits

As a result of the wide-ranging EU pesticide review programme growers will lose a number of the key herbicides required for weed control in allium crops. This primary study ought to be of considerable practical and financial benefit to the UK industry as it identifies the relative crop safety of two potential alternative products. Further work is required to identify the safest crop growth stage and the optimal timing to maximise weed control before any alternative products can be approved for use.

Action points for growers

- Growers need to familiarise themselves with the likely impact of the EU Review programme in order to review their current weed control strategy for onion and leeks.
- Pre-emergence tank-mix Stomp + aclonifen was not as safe on drilled onions and leeks as standard Stomp + Ramrod, and the aclonifen reduced plant stand in leeks. However it is approved in France for onions grown from sets, and may be worth further investigation – residues data are available.
- This primary study reported here has identified that Boxer (florasulam) appears to be safe (non-phytotoxic) on onions and leeks when used after the post-crook stage and that Fox (bifenox) is safe when used at the second true leaf stage for onions. For leeks Fox was less safe and further work is required to identify safer rates and timing.
- Oxyfluorfen, used in onions in Southern Europe is worth evaluation although it might not be available for a few years.
- It is likely that an Off-Label approval application will be required for any alternative product and 2 years residues data may be required for this.

Status of the new herbicides used in this project (as at December 2004)

<i>Product name</i>	<i>a.i. and formulation</i>	<i>Marketing company</i>	<i>EC Review of a.i.</i>	<i>Approval other crops</i>	<i>Residue data onions?</i>
(Challenge in France)	aclonifen (600 g/L SC)	Bayer CropScience	supported	No UK approval, France registered onion sets not drilled	France
Fox	bifenox 500g/L SC	Makhteshim	supported	UK cereals, applied for SOLA oilseed rape	Possibly Germany
Boxer	florasulam 50g/L SC	Dow AgroSciences	Annex 1	UK cereals	None

SCIENCE SECTION

Introduction

Onion and leek growers will lose prometryn and cyanazine after 2007, both herbicides are foliar and residual soil-acting. Effective herbicides are needed to control the full spectrum of weeds including volunteers from previous crops such as potatoes. Preliminary trials by Dow (with Boxer) and Makhteshim (Fox) suggested that these might be safe in onions. Both herbicides are foliar acting but have no residual activity. Some suggestions for trials were drawn to the attention of BOPA. Consultation was carried out with crop specialists to approve a list of proposed treatments.

The results from these studies will be used to demonstrate that alternatives to the herbicides with derogations for 'Essential Use' in onion and leeks are being sought so that these Essential Uses can continue until the end of 2007. Trials in 2004, sited within commercial crops in Nottinghamshire evaluated the experimental products for efficacy against various weed species and crop safety with a view to On- or Off-Label Approval on the crops.

A list of 13 treatments including a range of products applied at different rates was drawn up by the BOPA and these were applied to a commercial onion and leek crop either pre-emergence or up to the 2 true leaf stage depending on the herbicide. All treatments were applied as a single pass. The treated crop was monitored regularly for any evidence of crop damage (phytotoxicity), delays in plant growth with an option for harvest at crop maturity if required. Weed control was also monitored.

Objectives

- To identify safe and effective herbicide programmes for onions and leeks
- To compare a range of rates and timings of new herbicides for their effectiveness on a range of weed species and to determine effects on crop growth and development
- To monitor the effects on the crop and then to harvest the trials if considered appropriate
- To make recommendations on whether any treatments should be taken forward into the SOLA programme
- To report the results to growers and also allow them to view the trials

Details

Study Location

Both studies were undertaken at Edwinstowe, Nottinghamshire by kind permission of Naish Farms Ltd. The trials were sited within commercial crops grown on a sandy loam soil.

Treatments

The following treatments were drawn up by BOPA members and applied to both crops at the appropriate crop growth stage. All were applied in 300l/ha water.

Treatment		Pre emergence	Post emergence		
No	Herbicides		Post-crook	1 true leaf	2 true leaf
1	Untreated				
2	Standard pre emergence	A	-	-	-
3	Stomp + aclonifen	1.5l + 2.0l	-	-	-
4	Boxer (florasulam)	A	-	25ml	-
5	Boxer (florasulam)	A	25ml	-	-
6	Boxer x 2	A	-	25ml	25ml
7	Boxer	A	-	50ml	-
8	Boxer	A	-	-	50ml
9	Boxer	A	-	-	100ml
10	Boxer + Totril	A	-	25ml + 200ml	-
11	Totril mix followed by Boxer	A	-	B	50ml
12	Totril mix followed by Boxer + Starane	A	-	B	25ml+400ml
13	Totril mix followed by Bifenox	A	-	B	1.0l

A = Standard pre emergence as propachor @ 9.0l/ha + pendimethalin @ 1.0l/ha

B = Totril mix: Stomp @ 0.8l/ha + Pyramin @ 400g/ha + Totril @ 0.15l/ha

Study Details

Onions were drilled on 21 March and leeks were drilled on 27 April with four rows per 2m bed.

The treatment timings are shown in the table below.

Table 1. Treatment dates and crop growth stage - onions.

Treatment	Date (s)	Crop stage
1. Untreated	-	-
2. Standard pre emergence	23 March	pre emergence
3. Stomp + aclonifen	23 March	pre emergence
4. Boxer @ 25ml 1 TL	14 May	1 true leaf
5. Boxer @ 25ml post crook	28 April	post-crook
6. Boxer @25ml 1 and 2 TL	14 + 25 May	1 and 2 true leaf
7. Boxer @ 50ml 1 TL	14 May	1 true leaf
8. Boxer @ 50ml 2 TL	25 May	2 true leaf
9. Boxer @100ml 2 TL	25 May	2 true leaf
10. Boxer + Totril @ 1 TL	14 May	1 true leaf
11. Totril mix followed by Boxer @ 50ml 2TL	25 May	2 true leaf
12. Totril mix followed by Boxer + Starane @ 25ml+400ml 2TL	25 May	2 true leaf
13. Totril mix followed by Bifenox @ 1.0L 2TL	25 May	2 true leaf

Treatments 2, 4-13 received standard pre-emergence application of Ramrod and Stomp on 23 March.

Totril mix applied to treatments 11-13 on 14 May.

Table 2. Treatment dates and crop growth stage - leeks.

Treatment	Date (s)	Crop stage
1. Untreated	-	-
2. Standard pre emergence	28 April	pre emergence
3. Stomp + aclonifen	28 April	pre emergence
4. Boxer @ 25ml 1 TL	4 June	1 true leaf
5. Boxer @ 25ml post crook	25 May	post-crook
6. Boxer @25ml 1 and 2 TL	4 June + 21 June	1 and 2 true leaf
7. Boxer @ 50ml 1 TL	4 June	1 true leaf
8. Boxer @ 50ml 2 TL	21 June	2 true leaf
9. Boxer @100ml 2 TL	21 June	2 true leaf
10. Boxer + Totril @ 1 TL	4 June	1 true leaf
11. Totril mix followed by Boxer @ 50ml 2TL	21 June	2 true leaf
12. Totril mix followed by Boxer + Starane @ 25ml+400ml 2TL	21 June	2 true leaf
13. Totril mix followed by Bifenox @ 1.0L 2TL	21 June	2 true leaf

Treatments 2, 4-13 received standard pre-emergence application of Ramrod and Stomp on 28 April.

Totril mix applied to treatments 11-13 on 4 June.

Treatments were applied using a gas pressurised Oxford precision sprayer fitted with a 1.8 m boom with 4 nozzles (F110/0.80/3) operated at 2 bar pressure to give fine spray quality. Treatments were carefully scheduled to allow leaf wax to develop after any persistent rain.

Each plot was 8 m long x 1 bed width (2.0m) with 3 replicates of each treatment. There were a total of 39 plots for each crop.

Records/Assessments

The following records and assessments were undertaken following application of the various experimental treatments, the results of which are reported below.

- Crop emergence and vigour comparing pre-emergence treatments
- Plant vigour after post-emergence applications
- Observations and notes on any phytotoxicity symptoms
- Observations and notes on weed control achieved

Results

Onions

The emergence of the crop was good and very uniform across the whole trial area.

Plant stand per plot row were recorded on the untreated, Standard and Stomp + aclonifen treatments. The results are presented in Table 3.

Table 3. Plant counts for pre-emergence treatments on 14 May (number of plants/m of row).

Treatment	Plants/m row
Untreated	18.2
Standard (Ramrod + Stomp)	18.6
Stomp + aclonifen	17.5

Plant counts were similar for the untreated control, Standard (Ramrod + Stomp) and where Stomp + aclonifen were used.

The results for the plant vigour/size assessments are presented in Table 4.

Table 4. Plant vigour/size (1=very poor/small plants: 10=excellent/large plants).

Treatment	14/5	25/5	12/6	17/6	6/7
1. Untreated	7	7	5.2	8	1.7
2. Standard pre emergence	7	7.3	9	10	9.2
3. Stomp + aclonifen	7	6.7	8.3	9	8.7
4. Boxer @ 25ml 1 TL	7	5	8.5	8.3	8.8
5. Boxer @ 25ml post-crook	3.7	5.3	7.7	7	7.7
6. Boxer @ 25ml 1 and 2 TL	7	6	8.7	8.7	9
7. Boxer @ 50ml 1 TL	7	6.3	7.5	8.3	8
8. Boxer @ 50ml 2 TL	7	7	8.6	8	9.2
9. Boxer @ 100ml 2 TL	7	6.3	8.3	7.3	8.8
10. Boxer + Totril @ 1 TL	7	4.7	8	6.3	8.5
11. Totril mix followed by Boxer @ 50ml 2TL	7	7.2	8	7.3	9.5
12. Totril mix followed by Boxer + Starane @ 2TL	7	7.3	8.3	8.3	9.8
13. Totril mix followed by Bifenox @ 1.0L 2TL	7	6.7	8.5	9	9.3

Plant vigour was reduced where Boxer was applied at the post-crook stage. By 12 June, 18 days after the second true leaf stage treatments had been applied there were only minimal effects on plant vigour. By 6 July plant vigour was lower for some treatments due to weed competition.

The effects of the treatments on weed control are summarised in Tables 5 and 6.

Table 5. Weed cover (%).

Treatment	14/5	25/5	25/5	4/6	12/6	17/6#	6/7
1. Untreated	30	60	60	97	93	83	100
2. Standard pre emergence	2	3	3	18	45	5	47
3. Stomp + aclonifen	3	3	3	15	26	25	55
4. Boxer @ 25ml 1 TL	3.3	3.7	3.7	23	33	3.7	33
5. Boxer @ 25ml post-crook	3	4	4	27	35	8.3	47
6. Boxer @ 25ml 1 and 2 TL	2.3	3	3	22	22	2.3	17
7. Boxer @ 50ml 1 TL	3.3	4.7	4.7	38	35	2.7	16
8. Boxer @ 50ml 2 TL	2.3	3.3	3.3	27	22	5	25
9. Boxer @ 100ml 2 TL	3.7	8.3	8.3	42	55	1.7	8
10. Boxer + Totril @ 1 TL	2.7	3	3	18	32	2.7	12
11. Totril mix followed by Boxer @ 50ml 2TL	1.7	1.3	1.3	7.3	6	<1	1.7
12. Totril mix followed by Boxer + Starane @ 2TL	3	3	3	8.3	7	<1	1.7
13. Totril mix followed by Bifenox @ 1.0L 2TL	3.7	4	4	6.7	7	<1	1.3

after fumitory had been removed on 17 June.

Effective residual weed control was maintained until late May when weed growth rapidly increased. Weed populations, particularly for fumitory was variable across the trial. The effects of the Boxer on weed control were not very clear as the Totril mix applied at the one true leaf stage provided very effective weed control and suppressed fumitory.

Table 6. Effects on various weed species in early June.

Treatment	Weeds remaining
1. Untreated	BW, CL, KG, GS, FP, FH, FUM, SP
2. Standard pre emergence	BW, FP, FH, FUM, CL, GS, SP
3. Stomp + aclonifen	FH, FUM, GS, FP, KG, CL, BW
4. Boxer @ 25ml 1 TL	FP, FUM, BW
5. Boxer @ 25ml post-crook	BW, FUM, FH, FP, RS, CL
6. Boxer @ 25ml 1 and 2 TL	FH, FUM, AMG, FP
7. Boxer @ 50ml 1 TL	FH, FUM, FP, KG
8. Boxer @ 50ml 2 TL	FH, FUM, FP, BW, KG, AMG
9. Boxer @ 100ml 2 TL	FH, FUM, AMG
10. Boxer + Totril @ 1 TL	BW, FUM, FH, RS, FP
11. Totril mix followed by Boxer @ 50ml 2TL	FH, FP, FUM
12. Totril mix followed by Boxer + Starane @ 2TL	FUM
13. Totril mix followed by Bifenox @ 1.0L 2TL	FH, FUM

AMG= Annual meadow grass, CL=Cleavers, GS=Groundsel, FP=Field pansy, BW=Black bindweed, FH=Fathen, FUM= Fumitory, SP=Speedwell, RS=Redshank

Overall, the weed spectrum present was excellent and provided testing conditions. The most prominent weeds across all the replicates included fumitory, field pansy and red shank. The dose rate of Stomp was too low to control knotgrass in treatments 2 and 3.

The surrounding commercial crop was very weed free but crop vigour was poorer compared to all the treatments in this trial.

Leeks

The emergence of the crop was good and very uniform across the whole trial area, except for the Stomp + aconifen treatment.

Plant stand per plot row were recorded for the standard and Stomp + aconifen treatments. The results are presented in Table 7.

Table 7. Plant counts for pre-emergence treatments on 21 June (number of plants/m of row).

Treatment	Plants/m row
Standard (Ramrod + Stomp)	14
Stomp + aconifen	6

The Stomp + aconifen treatments reduced seedling emergence compared to the standard tank mix of Ramrod and Stomp.

The results for the plant vigour/size assessments are presented in Table 8.

Table 8. Plant vigour/size (1=very poor/small plants: 10=excellent/large plants).

Treatment	17/6	21/6	6/7	27/7
1. Untreated	6	8	-	-
2. Standard pre emergence	6	8.7	8.5	9
3. Stomp + aclonifen	5	7.3	8.5	9
4. Boxer @ 25ml 1 TL	6	8.7	9.2	9
5. Boxer @ 25ml post-crook	4.5	6.7	8.8	9
6. Boxer @ 25ml 1 and 2 TL*	6	7.7	8.8	9
7. Boxer @ 50ml 1 TL	6	7	8.8	9
8. Boxer @ 50ml 2 TL	6	9	8.8	9
9. Boxer @ 100ml 2 TL	6	7.7	8.3	9
10. Boxer + Totril @ 1 TL	6	7.3	8.3	9
11. Totril mix followed by Boxer @ 50ml 2TL	6	7.7	9	9
12. Totril mix followed by Boxer + Starane @ 2TL	6	8.3	8.8	8.5
13. Totril mix followed by Bifenox @ 1.0L 2TL	6	8.3	7.5	7.5

8. Second application was not applied with bifenox at 1.0l applied by mistake

Plant vigour was reduced where Boxer was applied at the post-crook stage and where Stomp + aclonifen was used after drilling. In early July vigour was reduced where Bifenox was applied on 21 June at the 2 true leaf stage with severe scorch of the leaf margins. This effect was still visible in late July.

The effects of the treatments on weed control are summarised in Tables 9 and 10.

Table 9. Weed cover (%).

Treatment	4/6	17/6	21/6	6/7 ⁽¹⁾	6/7 ⁽²⁾	27/7 ⁽¹⁾	27/7 ⁽²⁾
8. Untreated	12.3	63	92	100	100	100	86
2. Standard pre emergence	5	23	50	67	36	90	73
3. Stomp + aclonifen	8.3	35	52	57	40	95	67
4. Boxer @ 25ml 1 TL	<5	15	17	42	28	97	82
5. Boxer @ 25ml post-crook	<5	5	22	47	28	99	91
6. Boxer @ 25ml 1 and 2 TL*	<5	15	22	7	2	65	43
7. Boxer @ 50ml 1 TL	<5	5	7	20	20	92	88
8. Boxer @ 50ml 2 TL	<5	45	65	60	33	97	81
9. Boxer @ 100ml 2 TL	<5	37	48	52	34	95	89
10. Boxer + Totril @ 1 TL	<5	5	60	20	10	97	86
11. Totril mix followed by Boxer @ 50ml 2TL	<5	8	13	14	5	73	55
12. Totril mix followed by Boxer + Starane @ 2TL	<5	7	12	10	4	83	54
13. Totril mix followed by Bifenox @ 1.0L 2TL	<5	13	23	12	3	48	27

⁽¹⁾ all weeds ⁽²⁾ weeds excluding weed beet

* Second application was not applied with bifenox at 1.0l applied by mistake

Boxer applied at the post-crook or one true leaf stage gave enhanced control of weeds, particularly weed beet. By late July the trial was severely affected by weeds with only the Bifenox treatment showing any promise.

Table 10. Effects on various weed species.

Treatment	Weeds remaining
1. Untreated	FH, FUM, FP, KG, WB
2. Standard pre emergence	BW, WB, FH, FP, FUM, KG, SP
3. Stomp + aclonifen	FP, WB, FUM, BW, FH
4. Boxer @ 25ml 1 TL	FP, FUM, FH, WB
5. Boxer @ 25ml post-crook	FH, FP, FUM, WB, BW
6. Boxer @ 25ml 1 and 2 TL*	FP, FUM, FH, WB
7. Boxer @ 50ml 1 TL	FH, FP, FUM
8. Boxer @ 50ml 2 TL	FUM, FP, WB, BW
9. Boxer @ 100ml 2 TL	BW, FUM, WB, FH, FP, SP
10. Boxer + Totril @ 1 TL	FUM, FP, WB
11. Totril mix followed by Boxer @ 50ml 2TL	FUM, WB, FP
12. Totril mix followed by Boxer + Starane @ 2TL	FUM, WB, FP, BW
13. Totril mix followed by Bifenox @ 1.0L 2TL	FUM, FP, WB, FH, GS

GS=Groundsel, FP=Field pansy, FUM= Fumitory, WB= weed beet, BW=Black bindweed, FH=Fathen, SP=Speedwell, RS=Redshank

* Second application was not applied with bifenox at 1.0l applied by mistake

Weed control was significantly poorer than had been achieved in the onion trial. The prolonged wet weather had encouraged weed development plus the presence of the weed beet resulted in the trial being over-run with weeds. Even the use of the standard residual programme followed by the Totril/Stomp/Pyramin mix was not as effective as it had been in the onions for suppressing weed growth.

Discussion

Onion and leek growers will face a challenge to control certain weeds, particularly Fumitory, when prometryn is no longer available.

These trials have provided some information on crop safety for some possible alternatives. Further testing is required to ensure grower confidence and to minimise potential damage to the crop by inappropriate rates or timings.

The numbers of weeds and the weed spectrum present in the onion trial was very good and included most of the target species. Unfortunately for the leeks there was an abundance of volunteer weed beet, which affected the vigour of the crop and resulted in the trial being abandoned before reaching crop maturity.

Boxer at 25ml/ha applied post-crook – damaging to both crops with effects still visible after 4 weeks. Gave good control of the emerged weeds on the leeks.

Boxer at 25ml and 50ml/ha applied at one true leaf – safer to both crops than when applied at post-crook. Gave effective control of the weed beet in the leeks.

Boxer at 25ml/ha at one and two true leaf stage – two applications on onions were safe but there was a reduction in leek crop vigour after the first application. Gave effective control of the weed beet in the leeks. Where bifenoX had been applied by mistake to the leeks the scorch symptoms were also present.

Boxer at 50ml/ha at one or two true leaf stage – two applications on onions were safe but there was more of an effect on the leeks with a reduction in crop vigour. Gave more effective control of the weed beet in the leeks at the earlier application probably due to the size of the weed beet.

Boxer at 100ml/ha at two true leaf stage – reduced plant vigour on both crops for about 2 weeks.

Boxer at 25ml/ha + Totril (one true leaf) or Starane (two true leaf) – slight reduction in plant vigour for the leeks with some leaf twisting for the Starane.

BifenoX at 1.0l/ha at two true leaf stage – appeared safe on onions although it caused a kink in some onion leaves. It did not appear to be safe in leeks and caused severe scorch on the leaf margins. This effect was still visible after 5 weeks.

Another herbicide oxyfluorfen (product Goal in Spain) was suggested at the time of planning the trials but Crop Protection Companies indicated that it would not be supported in Northern Europe for any crop. However, this situation may change after 2008 and work on the crop safety should be considered.

Conclusions

1. Stomp + aclonifen applied pre-emergence in these studies adversely affected plant stand for the leeks. Stomp + aclonifen provided poorer weed control than where Ramrod + Stomp had been used. The main weakness of Stomp + aclonifen was groundsel, for Stomp + propachlor it was field pansy and charlock . Neither tank-mix controlled fumitory.
2. Boxer and bifenox are foliar-acting and have no residual activity. Neither controlled fumitory at the dose rates used. Boxer gave the best control of weed beet, and in cereals it controls oilseed rape and mayweeds not found on the trial sites.
3. Boxer applied at 25ml at the post-crook stage reduced plant vigour with effects still visible after 2 months for onions and for six weeks for the leeks.
4. Boxer applied at 25 and 50ml at the first or second true leaf stage, or 100ml at the second true leaf stage caused slight yellowing of the leaves for a short period, but were all considered safe for both onions and leeks.
5. Fox (bifenox) applied at the second true leaf was safe on onions but caused severe scorch on leaf margins for the leeks.
6. Boxer + Starane applied at the second true leaf stage caused some twisting of the foliage for leeks.
7. Boxer applied at 25 and 50ml/ha at the one true leaf stage gave effective control of the weed beet in the leeks. The benefits of including Boxer in herbicide programmes for onions requires further work as weed pressure was low during May due to the effectiveness of the residual programme.
8. The most effective herbicide programmes were the standard residual programme followed by Totril + Pyramin + Stomp applied at the first true leaf stage as this reduced the numbers of Fumitory.
9. For the onions all of the treatments had less effect on the vigour of the crop than the programme used on the surrounding crop but weed control including Fumitory was very good in the commercial crop.

Recommendations

Further work should be considered to ensure adequate crop safety in a different season for both crops. The most promising treatments could be included in residue trials to support potential submissions for off-label approvals. The potential of bifenox on leeks should be investigated further to determine the persistence of the scorch. Oxyfluorfen a new active ingredient for the UK but widely used in S. Europe should also be evaluated.

Acknowledgements

This work was funded by the Horticultural Development Council and the support of the onion industry through the HDC Vegetable Panel and members of the British Onion Producers Association and is gratefully acknowledged. A special thanks to Mr D O'Connor for undertaking the role of HDC project coordinator, to Mr A Richardson of the Allium and Brassica Centre for providing assistance and to Naish Farms Ltd for hosting the trials. Also to Ms Cathy Knott for providing guidance and support with the short-listing of candidate products and interpretation of the results.