Project title:	Improving Quality and Extending the Season for Late UK Leeks
Project number:	FV387a
Project leader:	David Norman, Precision Agronomy Ltd
Report:	Annual Report, October 2012
Previous report:	FV387
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Date project commenced:	01 December, 2011
Date project completed (or expected completion date):	30 November, 2013

DISCLAIMER

The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with 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

AUTHENTICATION

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

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GROWER SUMMARY

Headline

Maleic Hydrazide applied as the product 'Fazor', gave a highly significant reduction of bolting in late leeks produced under UK conditions. The technique as evaluated here has the potential to extend the production season of UK by 3-4 weeks, significantly reducing the dependence on leek imports, mainly from Spain, during May and June.

Background

The season for UK leeks starts with harvest at the end of June using transplant plants produced under glass and then transplanted outside under crop covers, the season then runs through until late April/early May in the following year. The crops for the latest part of the season are direct field drilled in the previous May for harvest up until late April/early May the following year. The season finishes usually because the old season crop runs to seed (bolts) making it unacceptable for the market.

In many similar biennial crops such as onions, carrots and parsnips the use of a sprout suppressant reduces bolting and re-growth to allow a longer marketing season. The use of these sprout suppressants also offers improvements in quality and shelf life for late season produce. The use of such materials has not been investigated in leeks previously and hence this study was proposed by the British Leek Growers Association. Maleic hydrazide is currently not approved for use in leeks in the UK.

Figure 1. Leeks bolting in the field trial

Summary

‘Fazor’ (maleic hydrazide) show excellent promise for extending the season of UK leeks. This can be achieved from a by reduction in bolting, the main cause of the loss of quality at the end of the UK leek season. In addition to reducing bolting ‘Fazor’ has other beneficial effects on leek quality by reducing softness and telescoping, both of which are important quality defects at the end of the UK season. There does, however, need to be caution in the use of this product, should it become approved, as application too early can cause leeks to become too short and fat, application too late, after bolting has occurred does not have any beneficial effects.

Financial Benefits

Using this technique could extend the leek season by up to four weeks, potentially allowing year long supply of British leeks to consumers when used with the correct storage. Given that the total value of leek production in the UK is currently worth £35,000,000 this could add a further £3,000,000 worth of production value to this figure.

Action Points

This study has confirmed that the application window for maleic hydrazide on leeks is during March, as spring re-growth resumes after the winter dormant period. This technique has only been tested on one variety and it is likely that varieties with slightly different maturity characteristics will vary with their timing requirement.

We also need to know how the technique can be integrated with cold storage to further extend the UK season of production. The use of maleic hydrazide is likely to result in an exceedance of the current maximum residue level (mrl) for leeks as the use is not an approved use and the mrl is set at a low rate to reflect this. Once the timing and rates have been confirmed therefore, residue studies will be required to submit data to allow an increase of the mrl, to comparable levels with other crops where the active is in approved use. Following this increase in mrl an application for an off-label approval could be submitted.

SCIENCE SECTION

Introduction

Currently the UK supplies home grown leeks from around the 1st July until the end of April the following year, with cold storage increasing the length of supply by a few weeks into May.

The main factor which stops field harvesting in late April/early May is the development of the seed head within the plant – bolting. If bolting could be reduced or controlled, UK leeks could be marketed for an extra 3-4 weeks, reducing dependence imports and increasing UK late season production. Previous studies have looked into the effects of temperature, day length and transplanting on leek bolting (Weibe, 1994; Wurr, *et al*, 1999) but none so far have looked into the effects of applying growth regulators to reduce and delay the occurrence of bolting.

The total value of UK leek production is around £35,000,000 (source Defra hort. Stats 2009). Extending home production by 4 weeks could add £2-2.5 million gross output for UK leek growers and expand production from 1,800ha to 2,000ha.

In addition to season extension, the quality of late produced leeks could be improved as the use of growth regulators improves shelf life and keeping quality. This characteristic is already in commercial use on onions, carrots, parsnips and potatoes.

Growth regulators are currently used in UK onions to reduce sprouting, improve quality and shelf life, increasing the season of production. The same is also true of carrots and parsnips, increasing the season and improving product quality. Retailers have become mostly accepting of the use of growth regulators when used in a measured, limited time period and in a careful and responsible way.

The current range of crops, in which there is commercial use of growth regulators, do so to retain dormancy. The timing of application of growth regulators is therefore clearly at the point just before the onset of dormancy. Leeks are physiologically quite different from onions or carrots in that they are never truly physiologically dormant under UK growing conditions as they are field harvested green throughout the Winter and therefore the potential timing for the use of sprouting regulators under UK conditions is unclear and requires detailed investigation.

In the earlier project FV387 three products were tested, including maleic hydrazide, mepiquat chloride and Trinexapac-ethyl. The first project demonstrated that maleic hydrazide was the best active tested and that Autumn applications were at a too early timing, with Spring applications performing the best. Therefore this follow on project was design to refine the timing of the Spring application, test the rate of application and examine how the technique could be integrated with storage and different varieties to provide the maximum benefit.

Materials and methods

Experimental design

The trial was carried out at field Hub 70, Hubbersteads farm, Upware, Cambridgeshire (OS grid reference: TL 546681). The soil in this field is an organic clay loam. The crop was direct drilled using natural seed and a precision commercial air drill on the 7th May 2011.

The experiment comprised of two treatments applied at eight different timings, 16 treatments in total. This gave seventeen plots per replicate, including an untreated control. There were three replicates to the experiment, giving a total of fifty one plots. Each plot measured 2m by 6m.The variety used was Harston, known for its bolting susceptibility.

Treatments

The treatments were two rates of maliec hydrazide (60%w/w) as the product 'Fazor' at 8.0kg/ha or 4.0kg/ha product respectively (see table 1). Treatments were due to be applied at eight timings, two in February, four in March, and two in April (see tables below). The treatments were applied with a precision 2M Azo plot sprayer.

Table 1: The treatments used in the trial

Treatments	Hectare rates			Water l/ha
	Product	Rate	unit	
1	Fazor 8.0 T1	8000	gm	400
2	Fazor 4.0 T1	4000	gm	400
3	Fazor 8.0 T2	8000	gm	400
4	Fazor 4.0 T2	4000	gm	400
5	Fazor 8.0 T3	8000	gm	400

Treatments		Hectare rates		Water l/ha
6	Fazor 4.0 T3	4000	gm	400
7	Fazor 8.0 T4	8000	gm	400
8	Fazor 4.0 T4	4000	gm	400
9	Fazor 8.0 T5	8000	gm	400
10	Fazor 4.0 T5	4000	gm	400
11	Fazor 8.0 T6	8000	gm	400
12	Fazor 4.0 T6	4000	gm	400
13	Fazor 8.0 T7	8000	gm	400
14	Fazor 4.0 T7	4000	gm	400
15	Fazor 8.0 T8	8000	gm	400
16	Fazor 4.0 T8	4000	gm	400
17	Untreated	0		400

Table 2: Treatment application details

Treatment	Date & Time	Operator	Temp °C	Wind speed (mph)& direction	Cloud cover
T1-T2	07/02/2012 1400 - 1420	P Hammond	2	6, NW	40%
T3-T4	21/02/2012 1130 – 1145	P Hammond	11	14, NE	20%
T5-T6	06/03/2012 1345 – 1400	P Hammond	8	3, N	100%
T7-T8	12/03/2012 1445 – 1500	P Hammond	9	5, S	100%
T9-T10	21/03/2012 1245 – 1300	P Hammond	16	3, NE	10%
T11-T12	28/03/2012 0945 – 1000	P Hammond	10	1, NE	0%
T13-T14	05/04/2012 0945 – 1000	P Hammond	6	10, SW	80%
T15-T16	16/04/2012 0955 – 1010	P Hammond	6	4, S	90%

Assessments

The crop was harvested on the 4th May 2012; at the same time the surrounding field crop was being harvested. Assessments on yield and bolting were carried out. Before harvest the mean plant height for each plot was measured. For the yield assessments three meter lengths of each of the two centre rows of each plot were hand lifted and loose leek specification trimmed to 30cm length by professional leek harvesters provided by Allpress Farms Ltd. The leeks were weighed and counted by Precision Agronomy staff, to obtain the gross yield and average leek plant weight. Further to this bolt lengths were measures for each plant at harvest. Samples from each plot of 25 leeks per plot, 75 leek plants per treatment, were sent to NIAB, Cambridge for shelf-life testing where they were put into the shelf life room at 4°C. The samples were kept in plastic bags and then put in crates which were wrapped and covered in plastic to keep the humidity up around the leeks. Bolt lengths were also measured from 10 new plants from each plot 14 days after the harvest date.

Samples were assessed by NIAB staff after 7 days. The following measures were recorded: count of leeks which had telescoped (converted to a percentage), sum of telescoping length in cm (converted to per plant), count of leeks with re-growth of roots, 1-9 score of overall sample for softness (1=soft, 9 =firm), and count of leeks obviously bolted (converted to a percentage).

Samples were re-bagged and covered to maintain humidity levels and returned into cold storage for a further 7 days. The following measures were recorded 14 days after harvest: sum of telescoping length in cm (converted to per plant), a 1-9 score of overall sample for softness (1=soft, 9 =firm) and the mean bolt length per leek. The bolt length was assessed by cutting leeks in half along their length and the bolt length measured.

Residue Testing

A sub-sample of six treated leeks from a selection of treatments were taken at the point of harvest in the field, in final trimmed form and sent to Eclipse at Chatteris for maleic hydrazide residue testing.

Table 3: Residue results

Treatment Number	Treatment Date	Treatment Rate Kg/ha	Result
T3	21/02/12	8	4.8
T4	21/02/12	4	1.2
T7	12/03/12	8	7.4
T8	12/03/12	4	4.9
T11	28/03/12	8	14.0
T12	28/03/12	4	5.8
T15	16/04/12	8	7.0
T16	16/04/12	4	1.8

The current mrl for maleic hydrazide on leeks is 0.2, it is set at a low level because the use has no approval. In related crops where there is approval such as onions the mrl is set a more realistic rate

Table 4: MRL's for Maleic Hydrazide in some Vegetable Crops

Crop	Use Approved	MRL Set
Leeks	No	0.2
Onions	Yes, label	15
Garlic	Yes, SOLA	15
Shallots	Yes, SOLA	15
Carrots	Yes, SOLA	30
Parsnips	Yes, SOLA	30
Potatoes	Yes, label	50

All of the treatments would have resulted in an mrl above the current level of 0.2 for leeks. The 0.2 is set as a default level for most crops where there is no approval. If it was raised to the same level as in approved crops such as onion, shallot or garlic then all applications would have resulted in residues below the mrl. If the application rate were the same as in onions with the same 7 day PHI then the residue level is likely to be under 10, however an mrl of 15 would cover all likely situations.

Results

All treatments, except T15 and 16, both 'Fazor' 4kg/ha and 'Fazor' 8kg/ha at the last application date, showed significantly smaller bolt lengths compared to the untreated control ($P<0.001$).

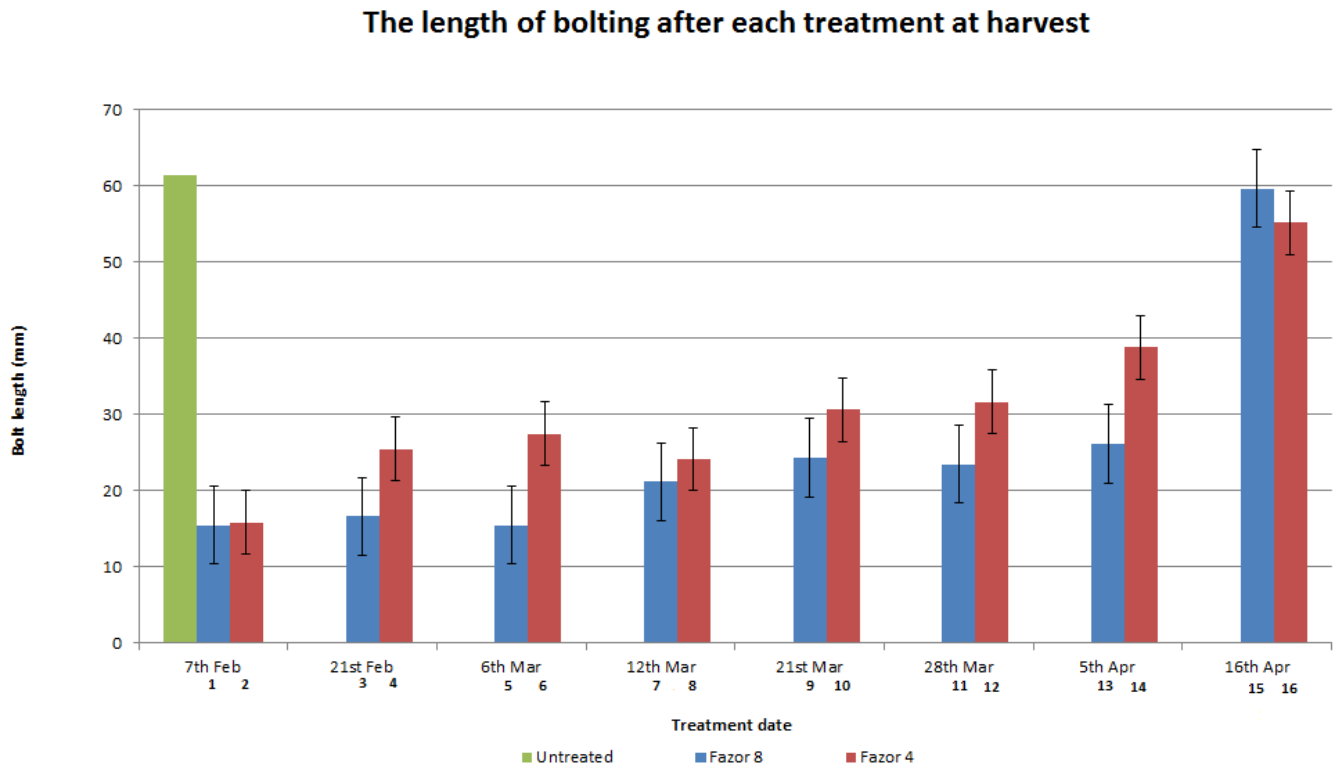


Fig 1: The length of bolting after each treatment.

Treatments 10, 11, 12 and 13 were also significantly lower than treatments 15 and 16 (the end two) ($P<0.001$). Treatments 1 to 9 were also significantly lower than treatments 14,15 and 16 ($P<0.001$). Treatment 14 also gave a significantly shorter average bolt length than treatment 15 although at a lower confidence level ($P<0.01$).

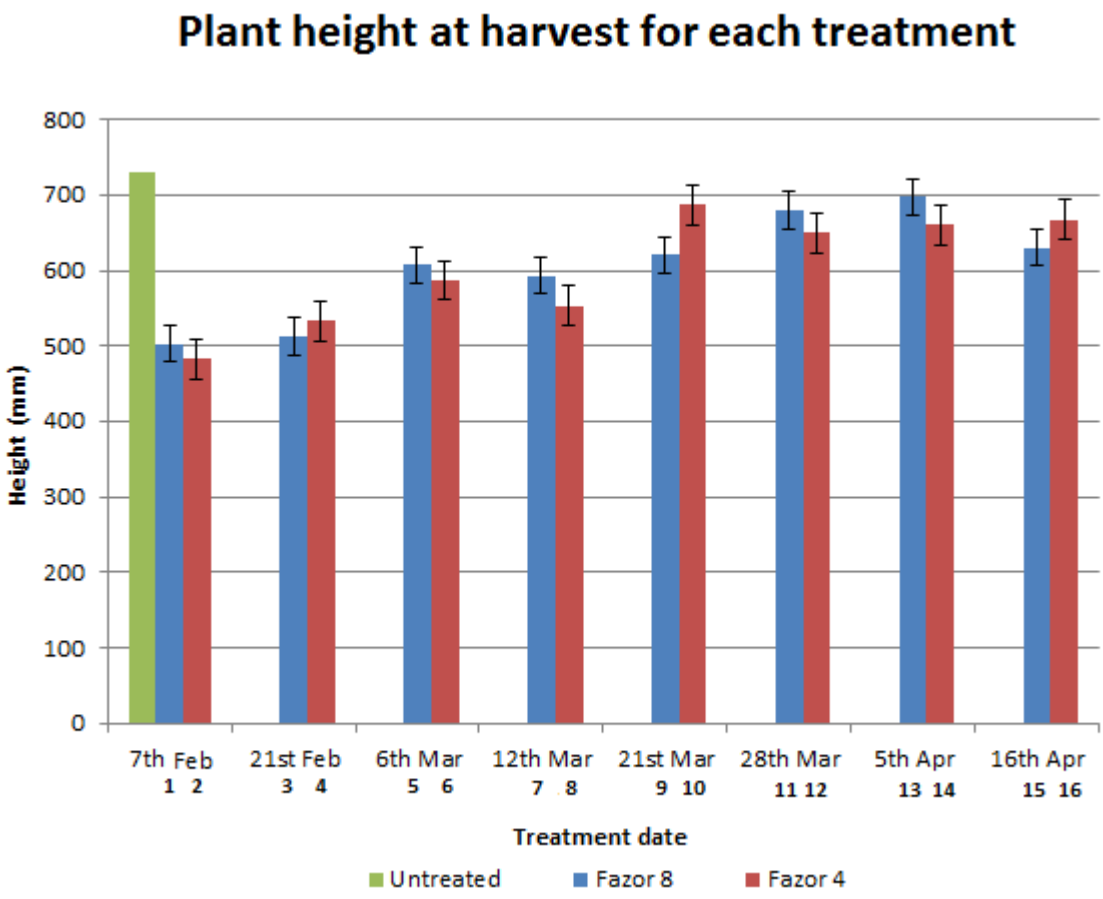


Fig. 2: The plant height at harvest for each of the treatments.

The above graph shows the trend that plant height increased with later application dates of both doses of 'Fazor'. Treatments 1, 2, 3, 4 and 8 all produced plants significantly shorter than the untreated control (P<001). Treatment 10, 11 and 13 also have significantly taller plants than treatments 1, 2 and 3 (P<0.01). Treatments 14 and 16 also gave significantly taller plants than treatment 2 (P<0.01).

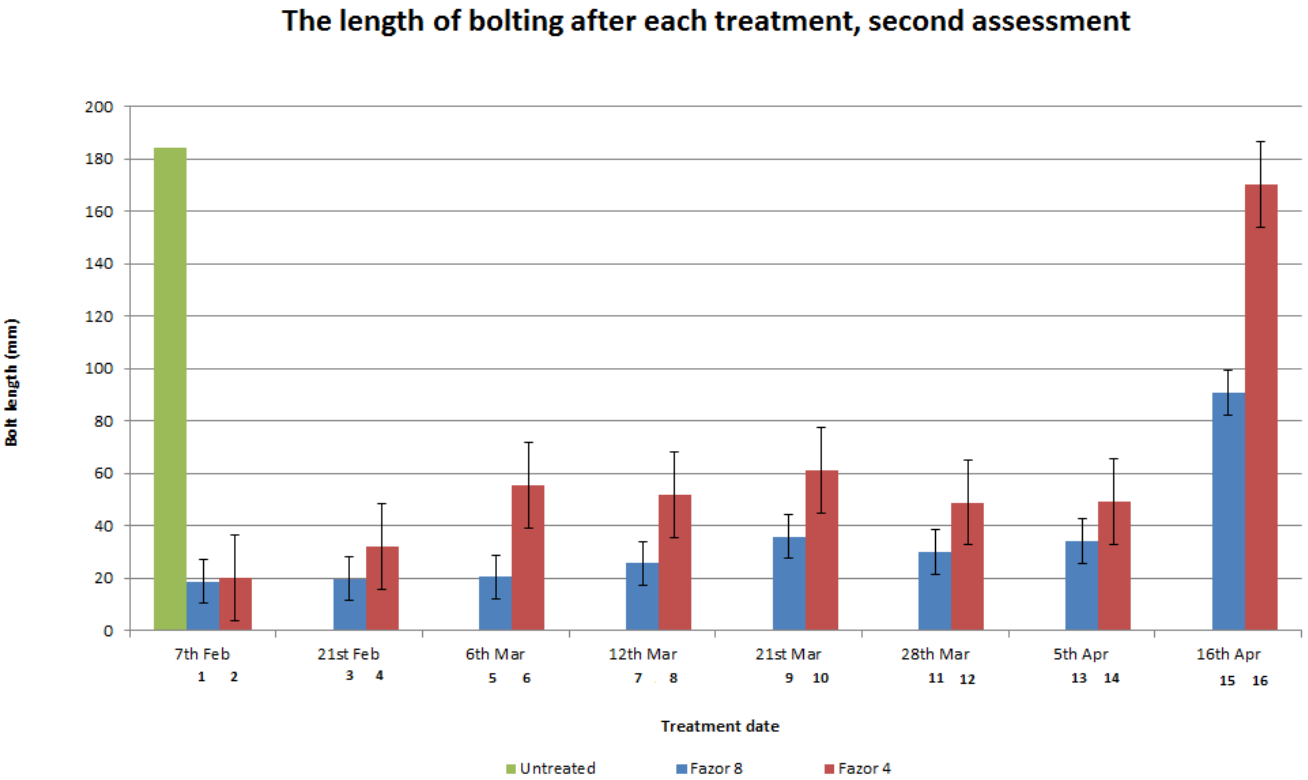


Fig 3: The bolt lengths at the second field assessment 14 days after normal harvest.

All treatments except T16 had significantly shorter bolt lengths than the untreated (P<0.001). T15 showed significantly longer bolt lengths than all other 'Fazor' 8 treatments but only the two early 'Fazor' 4 treatments in February (P<0.001). T16 showed significantly longer bolt lengths than all other treatments (P<0.001) and was not significantly different from the control.

Table 5: The plant heights for each of the treatments

Date	**7th Feb.**		**21st Feb.**		**6th Mar**		**12th Mar**	
Timing	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**
Rep 1	480	490	500	480	590	550	500	570
Rep 2	500	480	500	540	590	620	700	520
Rep 3	530	480	540	580	640	590	580	570
Total	1510	1450	1540	1600	1820	1760	1780	1660
Average	503	483	513	533	607	587	593	553

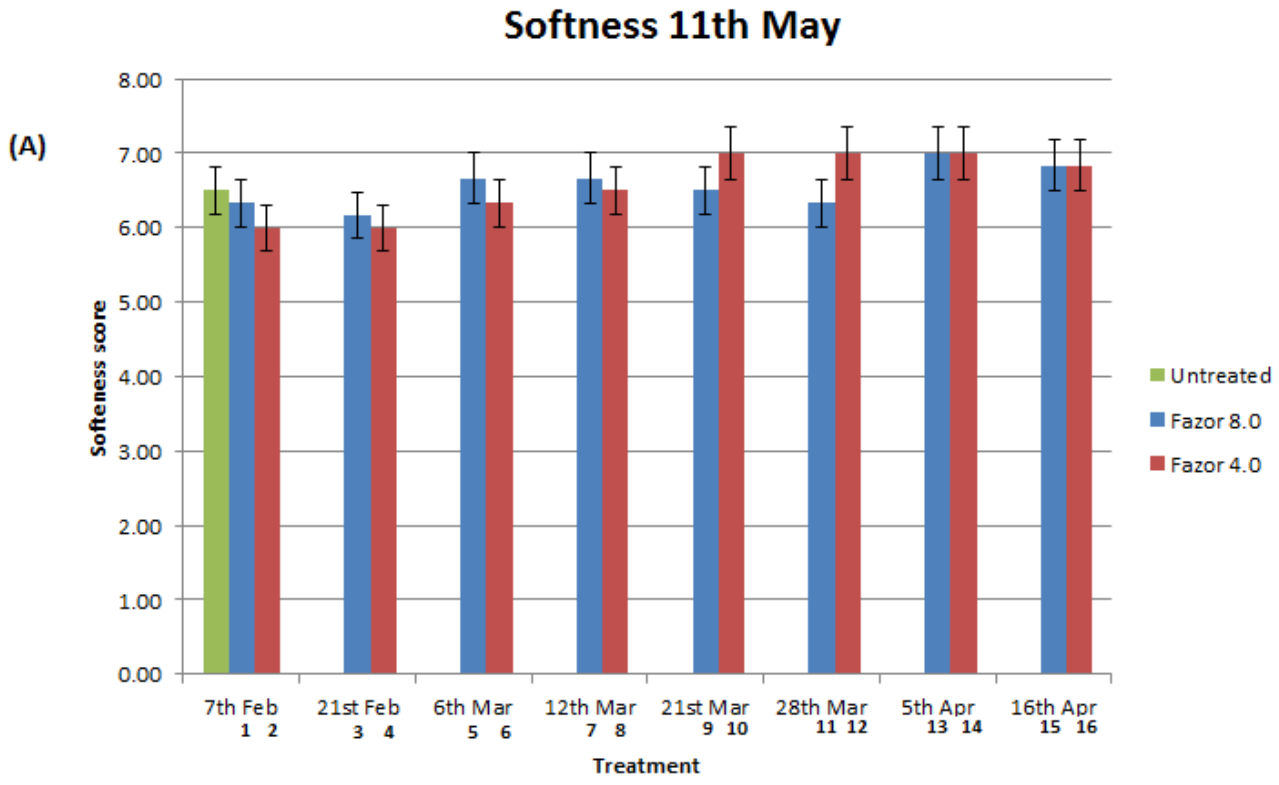
Table 5(cont): The plant heights for each of the treatments

21st Mar		**28th Mar**		**5th Apr**		**16th Apr**		**untreated**
T9	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**
590	630	620	670	640	700	620	690	740
650	750	660	620	690	650	600	640	650
620	680	760	660	760	630	670	670	800
1860	2060	2040	1950	2090	1980	1890	2000	2190
620	687	680	650	697	660	630	667	730

Shelf life assessments (NIAB):

Table 6: The results of the first shelf life assessments on the 11th May 20120.

Dose	Date of application	Treatment No.	telescoping /plant cm	softness 1-9 (1=soft)	% bolters
Fazor 8.0	07-Feb	T1	0.00	6.33	0.00
Fazor 4.0	07-Feb	T2	0.04	6.00	0.00
Fazor 8.0	21-Feb	T3	0.00	6.17	0.00
Fazor 4.0	21-Feb	T4	0.03	6.00	0.00
Fazor 8.0	06-Mar	T5	0.00	6.67	0.00
Fazor 4.0	06-Mar	T6	0.00	6.33	0.00
Fazor 8.0	12-Mar	T7	0.01	6.67	0.00
Fazor 4.0	12-Mar	T8	0.01	6.50	0.00
Fazor 8.0	21-Mar	T9	0.03	6.50	0.00
Fazor 4.0	21-Mar	T10	0.01	7.00	0.00
Fazor 8.0	28-Mar	T11	0.01	6.33	0.00
Fazor 4.0	28-Mar	T12	0.00	7.00	0.00
Fazor 8.0	05-Apr	T13	0.05	7.00	0.00
Fazor 4.0	05-Apr	T14	0.01	7.00	0.00
Fazor 8.0	16-Apr	T15	0.05	6.83	0.00
Fazor 4.0	16-Apr	T16	0.01	6.83	0.00
Untreated	-	T17	0.05	6.50	0.00



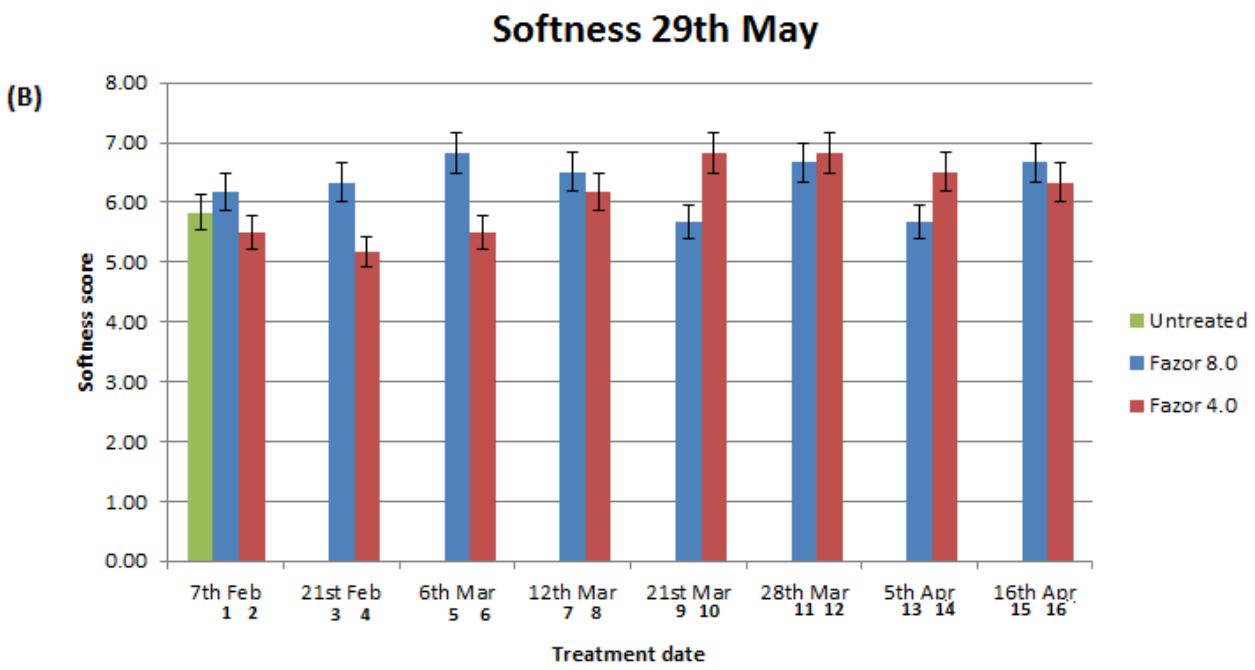


Fig 4: The softness assessment results taken at two dates: 11th May (A) and 29th May (B).

This shelf life assessment showed the trend that later application dates gave firmer leeks (lower score equals firmer leeks). The earlier treatments 2 and 4 produced the softest leeks

and these were significantly softer than treatments 5, 7,10,12,13,14,15,16. Treatments 1, 6 and 11 were significantly softer than 10, 12, 13 and 14

The second softness assessment showed a slightly different pattern to the first. Here 'Fazor' 8 shows slightly firmer leeks at earlier assessment dates whereas 'Fazor' 4 still showed softer leeks at an earlier application date. Treatment 4 gave the softest leeks here, which were significantly softer than 1,3,5,7,8,10,11,12,14,15 and 16. Treatments 2 and 6 have leeks significantly softer than 5, 7,10,11,12,14,15.Treatments 9 and 13 gave leeks significantly softer than 5,10,11,12 and 15. Treatments 5 and T10 also gave significantly firmer leeks than the untreated control.

Table 7: The results of the second shelf life assessment on the 29th May 2012.

Dose	Date of application	Treatment No.	telescoping /plant cm	softness 1-9 (1=soft)	% bolters
Fazor 8.0	07-Feb	T1	0.20	6.17	0.09
Fazor 4.0	07-Feb	T2	0.25	5.50	0.43
Fazor 8.0	21-Feb	T3	0.03	6.33	0.15
Fazor 4.0	21-Feb	T4	0.52	5.17	1.40
Fazor 8.0	06-Mar	T5	0.16	6.83	0.51
Fazor 4.0	06-Mar	T6	0.71	5.50	1.76
Fazor 8.0	12-Mar	T7	0.27	6.50	0.55
Fazor 4.0	12-Mar	T8	0.43	6.17	1.27
Fazor 8.0	21-Mar	T9	0.79	5.67	1.27
Fazor 4.0	21-Mar	T10	0.45	6.83	1.57
Fazor 8.0	28-Mar	T11	0.49	6.67	1.63
Fazor 4.0	28-Mar	T12	0.45	6.83	2.65
Fazor 8.0	05-Apr	T13	0.92	5.67	2.64
Fazor 4.0	05-Apr	T14	0.71	6.50	2.80
Fazor 8.0	16-Apr	T15	0.69	6.67	4.51
Fazor 4.0	16-Apr	T16	1.00	6.33	4.41
Untreated	-	T17	0.92	5.83	6.07

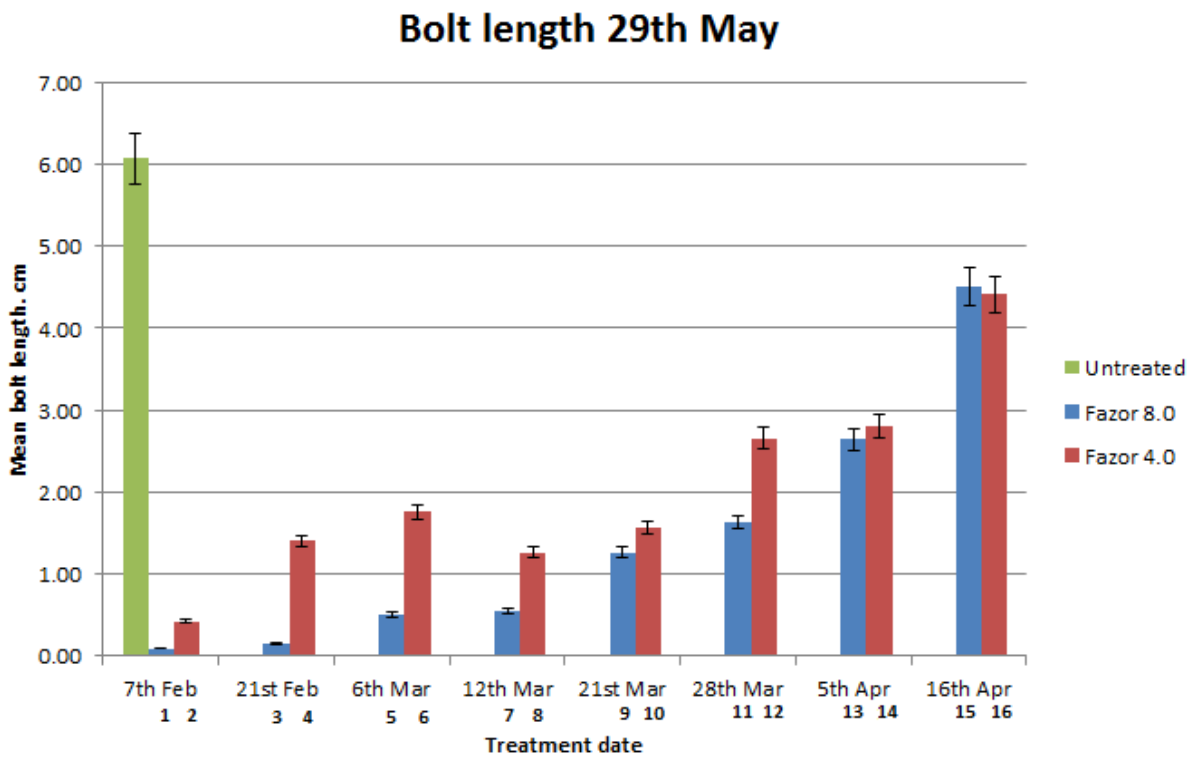


Fig 5: The results of the bolting assessment made at the second shelf life assessment.

Bolting shelf life results: All treatments performed significantly better than the untreated control (fig 4, table 3). All other treatments also showed significantly smaller bolt lengths than treatments 15 and 16. 'Fazor 8' gives lower bolt lengths than 'Fazor 4' at all application dates except the last. There is a clear trend showing that the earlier these treatments are applied the lower the bolting length. 'Fazor 8' showed significant improvements in bolt length over 'Fazor 4' at applications on 21/2 6/3 and 28/3.

The first shelf life assessment regarding telescoping showed the earlier the treatment was applied the lower the levels of telescoping. Treatments 13 and 15 gave same amount as untreated control. This was significantly more than treatments 1, 3,5,6,7,8,10,11,12,14 and 16. Treatment 2 also showed significantly more telescoping than treatments 1, 3,5,6,12.

At the second assessment the same pattern appeared as the first shelf life assessment - the earlier the treatment was applied the lower the levels of telescoping. Treatments 13 showed the longest telescoping which was significantly higher than treatments 1,2,3,5,7,8. Treatment 6 and 14 also showed significantly more telescoping than treatments 3 and 5. T9 also showed high levels of telescoping - significantly higher than treatments 1, 2,3,5,7.

Discussion

The two bolting assessments made in the field showed that earlier treatment dates showed lower levels of bolting. Further to this the higher application rate of 'Fazor' gave a smaller bolt length compared to the lower application rate at almost all application timings. At the second in-field assessment the applications of 'Fazor' 4kg/ha from the 6th March onwards were not significantly different to the last application of 'Fazor' 8kg/ha. This suggests that 'Fazor' 8kg/ha is giving better bolting reduction at any date up until the start of April compared to 'Fazor' 4kg/ha.

The plant heights at harvest, however, showed that the earliest applications gave slightly shorter plants. This trade off was also apparent after shelf life tests. The bolting assessment made here showed that the later applications showed significantly longer bolt lengths than those made at the beginning of the season and, again, at all treatment dates except the last 'Fazor' 8kg/ha showed smaller bolt lengths than 'Fazor' 4kg/ha. The applications made on the 21st March appear to the tipping point. After this date applications, particularly of 'Fazor' 4kg/ha, did not appear to control bolting as well as earlier applications did.

There was a stronger pattern in the first softness assessment than the second, where earlier applications gave softer leeks with the two February applications of 'Fazor' 4kg/ha giving the softest leeks. At the second softness assessment the earlier applications of 'Fazor' 4kg/ha also gave the softest leeks. Earlier applications of 'Fazor' 8kg/ha showed slightly firmer leeks than at the earlier softness assessment.

It appears, therefore, that there is a still a trade-off between bolting control and leek quality. The earlier timings give the best control of bolting but also softer, shorter plants. 'Fazor' 8kg/ha also appears to perform better than 'Fazor' 4kg/ha at both bolting control and shelf life assessments at this application timing. The timings of the 'Fazor 8' applications on the 6th March and the 12th of March seem to provide the best compromise.

Conclusions

'Fazor' (maleic hydrazide) shows excellent promise for extending the season of UK leeks. This can be achieved from a reduction in bolting, the main cause of the loss of quality at the end of the UK leek season. In addition to reducing bolting 'Fazor' has other beneficial effects on leek quality by reducing softness and telescoping, both of which are important quality defects at the end of the UK season. There does, however, need to be caution in the use of this product, should it become approved, as application too early can cause leeks

to become too short and fat, application too late, after bolting has occurred does not have any beneficial effects. All the trials have been carried out on one variety Harston, known to be susceptible to bolting. If this technique were used on a variety less susceptible to bolting then the potential for season extension is likely to be even greater. If the use of 'Fazor' is combined with a bolt resistant variety and cold storage then you could potentially have all year round UK leek production. The potential value of this to the industry would be huge, in the order of £3,000,000 per annum.

Knowledge and Technology Transfer

This is a two year project; the results will be presented to the UK Leek Growers Association and their 2012 winter meeting, a decision will then be made on the continuation of the project for the final year.

Glossary

Bolting

The appearance of a flower stalk in the centre of the plant, this particularly occurs with biennial plants such as alliums in the second season of growth.

Softness

A good quality leek should have a firm straight shank, a soft or flabby shank is unacceptable

Telescoping

Re-growth of the leaf sheath tops after trimming causing the tops of the leek to form a pyramid shape rather than be flat.

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Appendix 1
Treatment Plan Layout

PA -HDC FV387a Leek PGR's Allpress Farms

11	2	7	1	16	8	4	14	17	6	9	3	15	5	10	12	13
9	7	5	11	17	13	15	12	3	14	16	2	6	1	4	8	10
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Treatments		Hectare rates		Water l/ha	Single Plot Rates			Three Rep Rates	
	Product	Rate	unit		mlplot	WaterlPlot		mlsl+sps	waterlSings
1	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T1								
2	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T1								
3	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T2								
4	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T2								
5	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T3								
6	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T3								
7	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T4								
8	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T4								
9	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T5								
10	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T5								
11	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T6								
12	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T6								
13	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T7								
14	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T7								
15	Fazor 8.0	8000	ml	400	9.6	0.48		28.8	1.44
	T8								
16	Fazor 4.0	4000	ml	400	4.8	0.48		14.4	1.44
	T8								
17	Untreated	0		400	0	0.48		0	1.44

T1	WK 8
Operator	P Hammond
Date	22/02/2012
Time	1400 - 1430
Temp	2
Wind Speed	5
Wind direction	NW
Cloud cover	40%

T2	WK 9
Operator	P Hammond
Date	01/03/2012
Time	1130 - 1145
Temp	11
Wind Speed	14
Wind direction	NN
Cloud cover	20%

Crop	Leeks
Variety	
Drill/Plant date	
Field Name	
Farm Name	
Nr. Town	
County	
DB Ref:	

T3	WK 10
Operator	P Hammond
Date	08/03/2012
Time	1345 - 1400
Temp	8
Wind Speed	3
Wind direction	N
Cloud cover	100%

T4	WK 11
Operator	P Hammond
Date	15/03/2012
Time	1445 - 1500
Temp	9
Wind Speed	5
Wind direction	S
Cloud cover	100%

T5	WK 12
Operator	P Hammond
Date	21/03/2012
Time	1345 - 1300
Temp	16
Wind Speed	3
Wind direction	NN
Cloud cover	10%

T6	WK 13
Operator	P Hammond
Date	28/03/2012
Time	0945 - 1000
Temp	10
Wind Speed	1
Wind direction	NN
Cloud cover	10%

T7	WK 14
Operator	P Hammond
Date	05/04/2012
Time	0945 - 1000
Temp	9
Wind Speed	10
Wind direction	SW
Cloud cover	80%

T8	WK 15
Operator	P Hammond
Date	18/04/2012
Time	0900 - 1010
Temp	9
Wind Speed	1
Wind direction	S
Cloud cover	90%