ADAS

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Project Title: LEEKS: FUNGICIDES AND DISEASE FORECASTING FOR THE CONTROL OF RUST

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AUTHENTICATION

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

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ACTION FOR GROWERS

Continue to use existing programmes and apply fungicides at the first signs of rust.

In 1992 and 1993 treatments were applied according to the Burchill Forecasting Model developed at HRI-Wellesbourne. Despite numerous infection periods identified by the Burchill Forecasting Model in the early autumn, rust did not develop to any extent at any of the sites. This was very disappointing and clearly the model was not of value.

In 1995, newer fungicides (previously developed for cereals) were evaluated and outstanding control was achieved by Alto and Folicur treatments.

The activity of Folicur was confirmed in glasshouse tests (Dr Roy Kennedy FV102 report) whereby Folicur could be applied up to seven days after infection and still maintain almost complete control. Alto was not evaluated in Dr Kennedy's experiments. Dr Kennedy found that the most effective currently approved product in controlling rust infection was Tilt although Bayleton (tested as its field equivalent Bayfidan) was not used in the glasshouse studies over the same concentration range. Corbel was relatively ineffective in controlling rust when applied after infection had occurred.

It is anticipated that approval will be sought by the marketing companies for the use of Alto and Folicur on leeks.

SUMMARY

In 1991, fungicides were applied at the first signs of rust (apart from Trimanzone which was applied approximately six weeks earlier) and all gave good control of moderate rust at both sites tested - Halsall, Lancashire and Wallingford, Oxfordshire. No appreciable differences between fungicide treatments were observed at Halsall in December. At Wallingford the last fungicide spray was applied in late October and when the experiment was assessed pre-harvest, in March, good control had been obtained especially with Tilt at 1l/ha, Bayfidan 0.5l/ha plus Corbel 0.5l/ha and Trimanzone 3.0 kg/ha.

In the 1992 and 1993 seasons, treatments were applied either at the first appearance of rust or according to the Burchill Forecasting Model. Despite numerous infection periods being identified by the Burchill Forecasting Model in the early autumn, rust did not develop to any extent at any of the sites. This was very disappointing and clearly the model was not of value. All these experiments had very low levels of rust despite being sited in high risk rust areas and little information was obtained regarding fungicide efficacy.

In 1995, a range of fungicides which had been identified in 1994 were compared. Moderate incidence of rust developed. For all fungicides, apart from Sanction which gave very poor control, curative sprays applied at the first signs of rust performed better than preventative sprays. Outstanding control was achieved by Alto and Folicur. When compared to the Tilt standard, there was no effect on yield of fungicide, programme or their interaction.

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INTRODUCTION

Leek rust caused by the fungus *Puccinia allii* is an important disease of leeks in the UK. To meet the demand for high quality produce, free of blemishes, a wide range of cultivars with a limited degree of rust resistance are available. However, cultivar resistance to rust cannot be completely relied upon. In the intensive leek growing areas, leeks at various growth stages occupy the land for twelve months of the year and rust inoculum is maintained by the "green bridge". Experiments in the past have demonstrated the value of routine high volume sprays of triadimefon (Bayleton) plus wetter for disease control, yield and quality (Jones, 1985a). Fortnightly applications of manganese zinc ethylene bis-dithiocarbamate with ferbam (Trimanzone) or triademefon every two or three weeks gave good control of rust. This work also showed that fenpropimorph (Mistral or Corbel) has given excellent rust control with applications at three weekly intervals. In addition, limited work showed that propiconazole (Tilt) gave outstanding rust control (Jones, 1985b), and this is now one of the standard fungicide treatments for rust control. Tilt has the added advantage that it offers protection against Heterosporium leaf blotch.

An outline of the work is as follows.

In 1991, the objective was to evaluate fungicides and fungicide mixtures, the latter at lower dose rates, for rust control at two sites, one in Lancashire and one in the Thames Valley.

Dr Roy Burchill of HRI-Wellesbourne developed a model for forecasting leek rust infection. **In 1992 and 1993**, fungicide treatments were applied as two programmes; a) every 3 weeks after the first incidence of rust, and b) after the first infection period identified by the Burchill Forecasting Model, repeated after every subsequent infection period with a minimum of 3 weeks interval between sprays. A Delta-T Logger was used to monitor and record weather data for use with the Burchill Forecasting model to identify infection periods.

Experiments were carried out in 1992 in Lancashire and the Thames Valley, and in 1993 in Lancashire only. It was intended to have a site at Quadring in Lincolnshire in 1993, but it was not possible to apply fungicides due to excessively wet ground, although meteorological data were collected for use with the forecasting model.

In 1994, an experiment was carried out at the VEGEX site at the ADAS Siltland Centre near Holbeach, Lincolnshire, in lieu of the aborted experiment at Quadring, Lincolnshire. This experiment aimed to evaluate some of the more recently developed cereal fungicides for the control of leek rust

to be applied either as protectants or as eradicants. This site was drilled with the cultivar Winter Derrick which grew very slowly so it was decided to re-plant with the cultivar Albana. Despite irrigation this also grew very slowly due to the hot, dry weather and the experiment was abandoned after the first set of treatments had been applied and no assessments were made.

In 1995, the 1994 experiment to evaluate some of the more recently developed cereal fungicides for control of leek rust applied either as protectants or as eradicants, was repeated successfully at New York, Lincolnshire.

MATERIALS AND METHODS

Experiments in 1991.

Experiments were carried out at Halsall, Lancashire and at Wallingford, Oxfordshire.

A comparison of fungicides was made at the two sites to evaluate single fungicide products and also fungicide mixtures at lower dose rates.

Treatment details:

1. Untreated control
2. Tilt 1.0 l/ha
3. Tilt 0.5 l/ha
4. Corbel 1.0 l/ha
5. Tilt 0.5 l/ha + Corbel 0.5 l/ha
6. Tilt 0.25 l/ha + Corbel 0.5 l/ha
7. Bayfidan 0.5 l/ha
8. Bayfidan 0.5 l/ha + Corbel 0.5 l/ha
9. Bayfidan 0.25 l/ha + Corbel 0.5 l/ha
10. Trimanzone 3.0 kg/ha

All fungicide treatments were applied in 600 litres of water/ha using an OPS CO_2 pressurised knapsack sprayer using 03-F80 nozzles at 200kPa.

Halsall

Treatments 2-9 were applied every three weeks after the first signs of rust. Treatment 10 was applied every two weeks from early July.

Wallingford

Treatments 2-9 were applied every three weeks after first signs of rust. Treatment 10 was applied on 5 occasions from late July.

Application dates are given in Appendix I.

Assessment methods

At both sites, 10 plants were selected at random from each plot and percentage area affected with rust estimated using ADAS Disease Assessment Key 1.3.1 as a guide. Yield was measured from a harvest area per plot of 2m x 0.75 m at Wallingford and 3m x 0.75m at Halsall.

Experiments in 1992.

Experiments were carried out at Halsall, Lancashire and at Wallingford, Oxfordshire.

In 1992, fungicide treatments were applied at either the first signs of rust, or in response to infection periods identified by the Burchill Forecasting Model.

Treatment details:

1.	Untreated control	
2.	Tilt 1.0 l/ha	)
3.	Corbel 1.0 l/ha	)
4.	Tilt 0.25l/ha + Corbel 0.5 l/ha	) Applied every three weeks
5.	Bayfidan 0.5 l/ha	) after first signs of rust
6.	Bayfidan 0.25 l/ha + Corbel 0.5 l/ha	)
7.	Trimanzone 3.0 kg/ha	)
8.	Tilt 1.0 l/ha	)
9.	Corbel 1.0 l/ha	) Applied after every infection period
10.	Tilt 0.25 l/ha + Corbel 0.5 l/ha	) with a minimum of 3 weeks between
11.	Bayfidan 0.5 l/ha	) sprays
12.	Bayfidan 0.25l/ha + Corbel 0.5l/ha	)

Halsall

All fungicide treatments were applied in 600 litres of water/ha.

Wallingford

Trimanzone was applied in 1000 litres of water/ha. All other treatments were applied in 600 litres of water/ha.

Fungicides were applied using an OPS CO_2 pressurised knapsack sprayer using 03-F80 nozzles at 200kPa.

Application dates are given in Appendix II.

Assessment methods

At both sites, levels of rust were assessed by selecting 10 plants at random from the central rows. Percentage leaf area affected with rust was estimated using ADAS Disease Assessment Key 1.3.1. Yield was measured from a harvest area per plot of 2m x 0.75 m at Wallingford and 3m x 0.75m at Halsall.

Experiments in 1993.

Experiments were carried out at Burscough, Lancashire and at Quadring, Lincolnshire.*

Treatment details:

1.	Untreated control	
2.	Tilt 1.0 l/ha	)
3.	Corbel 1.0 l/ha	)
4.	Tilt 0.25l/ha + 0.5 l/ha	) Applied every three weeks
5.	Bayfidan 0.5 l/ha	) after first signs of rust
6.	Bayfidan 0.25 l/ha + Corbel 0.5 l/ha	)
7.	Trimanzone 3.0 kg/ha	)
8.	Tilt 1.0 l/ha	) Applied after every infection
9.	Corbel 1.0 l/ha	) period with a minimum of 3
10.	Tilt 0.25 l/ha + Corbel 0.5 l/ha	) weeks between sprays
11.	Bayfidan 0.5 l/ha	)
12.	Bayfidan 0.25 l/ha + Corbel 0.5 l/ha	)

All treatments were applied in 600 litres of water/ha. Fungicides were applied using an OPS CO_2 pressurised knapsack sprayer using 03-F80 nozzles at 200 kPa.

Application dates are given in Appendix III.

*At the Quadring site, no treatments were applied due to excessively wet ground conditions but rainfall, temperature, relative humidity and leaf wetness were monitored and these data sent to HRI-Wellesbourne for infection periods to be identified. Rust was present at low levels but no detailed assessments were made.

Assessment methods

Rust was assessed as in the previous year, but on 20 plants per plot. Harvest area was 3m x 0.75m per plot.

Experiment in 1994.

An experiment was set up in 1994 at the VEGEX site at the ADAS Siltland Crop Centre, Holbeach St Marks, Lincolnshire. Only the first set of treatments was applied (see Appendix IV) and the experiment was discontinued. However, some limited comparisons between treatments were made and this information was used to formulate treatments for the 1995 experiment.

Experiment in 1995.

One experiment was carried out at New York, Lincolnshire.

Treatment details:

Preventative			Curative	
1)	Corbel*	4 x 1 l	7) Corbel *	4 x 1 l
2)	Tilt**	3 x 1 l	8) Tilt **	3 x 1 l
3)	Tilt*	4 x 0.5 l	9) Tilt **	1 x 1 l followed by 2 x 0.5 l
4)	Sanction*	4 x 0.4 l	10) Sanction **	1 x 0.5 l followed by 2 x 0.25 l
5)	Alto*	4 x 0.4 l	11) Alto**	1 x 0.8 l followed by 2 x 0.4 l
6)	Folicur*	4 x 0.5 l	12) Folicur**	1 x 1 l followed by 2 x 0.5 l

* = 4 applications applied at 3 week intervals

** = 3 applications applied at 3 week intervals

Preventative treatments were applied prior to rust being present in the crop.

Curative treatments were applied when rust was found on at least 10% of plants at 0.1% leaf area affected.

Fungicides were applied using an MDM CO_2 pressurised knapsack sprayer with 02-F80 nozzles at 200kPa. All fungicide treatments were applied in 400 litres of water/ha.

Application dates are given in Appendix V.

Assessment methods

Rust was assessed using the whole plant method (Davies & Bachmann, unpublished) on a total of 20 plants per plot (5 plants from the centre 2 rows of each bed). Disease incidence and severity were assessed prior to each spray application, 21 days after the last spray and at harvest. An assessment of *Stemphylium* spp. was made on 22 November. Harvest area was 8m x 0.75m per plot.

Experimental design and statistical analyses

Experiments in 1991 to 1993 were arranged as a randomised block design with four replicates. In 1995 the experiment was arranged as a 2 x 5 factorial plus untreated control with four replicates. Treatments were compared to the Tilt standard using analysis of variance. Standard errors of differences between means are quoted when probability $P \leq 0.5$. NS = not significant, $P > 0.05$.

RESULTS

1991.

At Halsall Lancs., fortnightly sprays of Trimanzone commenced on 14 July. Leek rust was first recorded on 3 September when the occasional pustule was seen across the experiment area. Rust incidence gradually increased on the unsprayed plots until early October after which it substantially increased. A considerable loss of green leaf area was recorded at harvest.

At Halsall, all fungicide treatments controlled rust from October onwards. At the pre-harvest assessment in early December (table 1) all treatments had reduced rust and increased green leaf area compared with the untreated.

At Wallingford, rust incidence, even in the unsprayed controls, remained very low throughout the autumn and winter and no differences between treatments were apparent during this period. However, rust developed during late winter and a pre-harvest assessment was made on 12 March (table 1). All treatments gave control of rust apart from Bayfidan at 0.5 l/ha and Bayfidan at 0.25 l/ha + Corbel 0.5 l/ha. The least disease was recorded in the Tilt 1.0 l/ha, Bayfidan 0.5 l/ha + Corbel 0.5 l/ha and Trimanzone treatments. There was no effect of treatment on green leaf area pre-harvest.

Table 1. Effect of treatment on mean % rust per plant, and % green leaf area assessments (pre-harvest) Halsall and Wallingford.

	Halsall 2 Dec. 1991		Wallingford 12 March 1992	
Treatment	% Rust	% GLA*	% Rust	% GLA*
1 Unsprayed control	15.67	40.0	22.7	70.2
2 Tilt at 1 l /ha	0.20	69.0	2.6	74.3
3 Tilt at 0.5 l /ha	2.80	60.8	8.4	73.4
4 Corbel at 1 l /ha	0.91	67.5	13.1	65.8
5 Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	0.18	71.0	11.3	72.5
6 Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	0.58	68.8	7.7	74.0
7 Bayfidan at 0.5 l /ha	0.68	67.2	30.2	70.1
8 Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	0.16	72.0	4.6	73.1
9 Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	0.26	69.0	15.2	70.9
10 Trimanzone at 3 kg /ha	0.23	72.3	3.2	72.6
SED	1.310	2.56	3.80	NS
% CV (16df)	32.5	2.3	16.5	95.0

* Green leaf area.

1992.

At Halsall, leek rust was first noted on 3 September. In spite of recording numerous infection periods (Appendix II) rust incidence remained low throughout the autumn (table 2).

At Wallingford, despite finding rust on 19 August, and recording numerous infection periods thereafter, (Appendix II) rust incidence remained low throughout (table 2).

Table 2. Effect of treatment on mean % rust (pre-harvest) at Halsall and Wallingford.

Treatment	Mean % rust per plant	
	Halsall 1 Dec.	Wallingford 9 Dec.
1 Unsprayed control	1.56	0.05
Routine after rust found		
2 Tilt	0.00	0.10
3 Corbel	0.04	0.05
4 Tilt + Corbel	0.05	0.12
5 Bayfidan	0.27	0.07
6 Bayfidan + Corbel	0.14	0.05
7 Trimanzone	0.16	0.01
After infection periods		
8 Tilt	0.01	0.17
9 Corbel	0.25	0.16
10 Tilt + Corbel	0.02	0.25
11 Bayfidan	0.35	0.05
12 Bayfidan + Corbel	0.02	0.03
SED	0.119	0.110
CV% (22df)	60.8	142.0

1993.

At Burscough, Lancs. leek rust was first noted on 16 August. Despite recording numerous infection periods (Appendix III) rust levels remained low throughout the autumn until harvest in December. Details of early season foliar assessments and yield assessments are also given in Appendix III.

From September onwards, all fungicide treatments reduced the severity of rust, although Trimanzone did not perform as well as other treatments. At the pre-harvest assessment on 2 December, reductions in rust severity were achieved by most treatments with no disease recorded in treatments 2 (Tilt applied after rust found), 3 (Corbel applied after rust found), 4 (Tilt + Corbel applied after rust found) and 12 (Bayfidan + Corbel applied after infection periods) - table 3. Heterosporium leaf blotch was reduced by all treatments, with the least seen in treatments which included Tilt. There was no effect of treatment on yield. (Appendix III).

Table 3. Effect of treatment on pre-harvest foliar assessments at Burscough (2 December).

Treatment	% Rust	% Heterosporium
1 Unsprayed control	2.07	11.10
Routine after rust found		
2 Tilt	0.00	3.17
3 Corbel	0.00	5.27
4 Tilt + Corbel	0.00	3.90
5 Bayfidan	0.07	5.77
6 Bayfidan + Corbel	0.01	6.03
7 Trimanzone	0.47	5.17
After infection periods		
8 Tilt	0.10	6.30
9 Corbel	0.02	5.67
10 Tilt + Corbel	0.07	6.30
11 Bayfidan	0.01	7.63
12 Bayfidan + Corbel	0.00	7.73
SED	0.241	1.125
CV% (22df)	26.4	22.8

1995.

At New York, Lincs. rust was first recorded on 28 August and developed steadily during the autumn (Appendix V). There was no interaction between treatments and programme on the incidence or severity of rust (table 4).

Table 4. Effect of fungicide treatment and programme interaction on the mean percentage incidence and severity of rust pre-harvest (2 December).

Fungicide	Mean % rust incidence		Mean % rust severity	
	Preventative	Curative	Preventative	Curative
Untreated	48.75		0.0932	
Corbel	47.50	21.25	0.0691	0.0075
Tilt (standard)	45.00	23.75	0.0619	0.0109
Tilt	52.50	31.25	0.0719	0.0250
Sanction	65.00	56.25	0.1761	0.1434
Alto	28.75	2.50	0.0382	0.0015
Folicur	22.50	1.25	0.0380	0.0006
SED	NS		NS	
CV% (33df)	40.3		117.7	

The least disease was found was in the Alto and Folicur treated plots (table 5). Sanction had no effect on rust incidence or severity.

Table 5. Effect of fungicide on mean percentage incidence and severity of rust pre-harvest.

Fungicide	Mean % rust incidence	Mean % rust severity
Corbel	34.38	0.038
Tilt (standard)	34.38	0.036
Tilt	41.88	0.048
Sanction	60.63	0.160
Alto	15.63	0.020
Folicur	11.88	0.019
SED	6.680	0.0299
CV% (33df)	40.3	111.7

The curative treatments reduced the incidence and severity of rust compared to the preventative treatments (table 6).

Table 6. Effect of treatment on mean percentage severity and incidence of rust pre-harvest.

Treatment programme	Mean % rust incidence	Mean % rust severity
Preventative	43.54	0.076
Curative	22.71	0.031
SED	3.857	0.0173
CV% (33df)	40.3	111.7

DISCUSSION

In 1991, fungicides were applied at the first signs of rust (apart from Trimanzone which was applied earlier) and all treatments gave good control of moderate rust levels at both sites. No appreciable differences between fungicide treatments were observed at Halsall in December. At Wallingford, the last fungicide spray was applied in late October and when the experiment was assessed in March, pre-harvest, good control was obtained especially with Tilt at 1l/ha (confirming the earlier work of Jones 1985b), Bayfidan 0.5l plus Corbel 0.5l/ha and Trimanzone.

In the following two years treatments were applied according to the first appearance of rust or to the Burchill Forecasting Model. Despite numerous infection periods being identified by the Burchill Forecasting Model in the early autumn, rust did not develop to any extent at any of the sites. This was very disappointing and clearly the model was not of value. All these experiments had very low levels of rust and little information was obtained regarding fungicide efficacy despite being sited in high rust risk areas.

The experiment at Quadring in 1993 was repeated in 1994 as no fungicides could be applied due to wet soil conditions.

The experiment design in 1994 was changed in view of the ineffectiveness of the forecasting model and more recently introduced cereal rust fungicides were compared. However, the experiment was abandoned as the drilled crop and the subsequent transplanted crop were too backward at the end of the summer for a 'commercial' crop to develop.

In 1995, the experiment was successively completed when the range of fungicides identified in 1994 was compared. Moderate incidence of rust developed. Curative sprays applied at first signs of rust

performed better than preventative sprays for all fungicides apart from Sanction which gave very poor control. Outstanding control was achieved by Alto and Folicur treatments. There was no effect (when compared to the Tilt standard) of fungicide, programme or their interaction, on yield.

The activity of Folicur was confirmed in glasshouse tests (Dr Roy Kennedy FV102 report) whereby Folicur [and Anvil (hexaconazole) not tested in the field as no samples were available] could be applied up to seven days after infection had occurred and still maintain almost complete control. Alto was not evaluated in Dr Kennedy's experiments but the field experiment suggested that it performed similarly to Folicur. Dr Kennedy found that the most effective currently approved product in controlling rust infection was Tilt although Bayleton (tested as its field equivalent Bayfidan) was not used in the glasshouse studies over the same concentration range. Corbel was relatively ineffective in controlling rust when applied after infection had occurred. Sanction performed relatively well in glasshouse tests but it was ineffective in the field experiment at New York in 1995.

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Appendix I **1991 Experiment**

1.1 Application dates of treatments.

HALSALL		WALLINGFORD	
	Treatment		Treatment
July 14	10	July 7	10
July 26	10	August 16	10
August 8	10	September 10	2-10
August 20	10	September 30	2-10
September 3	10	September 20	2-10
September 5	2-9		
September 19	10		
September 30	2-9		
October 2	10		
October 15	10		
October 21	2-9		
October 28	10		
November 14	2-10		

1.2 Effect of treatment on mean % rust severity - Halsall 1991.

Treatment	Mean % rust per plant			
	5 Sept.	2 Oct.	28 Oct.	18 Nov.
1 Unsprayed control	0.03	1.68	8.53	12.03
2 Tilt at 1 l /ha	0.01	0.03	0.17	0.11
3 Tilt at 0.5 l /ha	0.03	0.27	1.29	1.39
4 Corbel at 1 l /ha	0.00	0.09	0.33	0.41
5 Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	0.01	0.01	0.05	0.08
6 Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	0.03	0.08	0.19	0.23
7 Bayfidan at 0.5 l /ha	0.02	0.07	0.24	0.26
8 Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	0.03	0.03	0.10	0.12
9 Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	0.02	0.04	0.16	0.11
10 Trimanzone at 3 kg /ha	0.00	0.02	0.05	0.08
SED	NS	0.092	0.512	0.135
%CV(18df)	40.0	52.6	39.9	32.9

All treatments reduced rust compared with the untreated control after September.

1.3 Effect of treatment on mean plot yield for each size grade at harvest- Halsall 1991.

	Treatment	Yield of leeks (kg/plot) in each size grade					Mean weight per plant(g)
		<10mm	10-25mm	25-35mm	>35mm	Total	
1	Unsprayed control	0.02	2.84	3.85	0.58	7.29	111
2	Tilt at 1 l /ha	0.04	1.48	4.79	2.67	8.98	130
3	Tilt at 0.5 l /ha	0.02	1.85	5.10	1.41	8.37	116
4	Corbel at 1 l /ha	0.03	1.66	4.14	1.75	7.57	121
5	Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	0.01	1.89	5.20	1.84	8.94	125
6	Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	0.03	1.59	5.00	2.46	9.08	146
7	Bayfidan at 0.5 l /ha	0.03	2.50	4.28	0.88	7.69	108
8	Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	0.03	1.64	4.35	2.18	8.19	127
9	Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	0.02	1.58	4.81	1.77	8.18	121
10	Trimanzone at 3 kg /ha	0.00	1.07	3.95	3.52	8.55	146
SED		NS	NS	NS	0.709	NS	NS
CV%(18df)		105.2	34.5	19.3	45.6	9.1	12.8

No differences in yield were recorded except in the >35 mm size grade where yield increases by treatments 2, 6 and 10 were recorded.

1.4 Effect of treatment on the number of plants in each size grade at harvest - Halsall 1991.

	Treatment	Mean No. of plants in each size grade				
		<10mm	10-25mm	25-35mm	>35mm	Total
1	Unsprayed control	2.0	33.7	27.3	2.7	65.7
2	Tilt at 1 l /ha	3.3	23.7	31.3	11.7	70.0
3	Tilt at 0.5 l /ha	1.0	28.7	36.3	6.3	72.3
4	Corbel at 1 l /ha	2.0	22.3	31.3	8.0	63.7
5	Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	2.3	28.0	34.7	8.0	73.0
6	Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	3.0	18.3	31.3	11.3	64.0
7	Bayfidan at 0.5 l /ha	2.7	34.0	28.7	6.7	72.0
8	Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	2.7	21.7	30.7	9.7	64.7
9	Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	2.0	23.7	33.7	8.7	68.0
10	Trimanzone at 3 kg /ha	0.3	17.3	26.0	15.0	58.7
SED		NS	NS	NS	NS	NS
CV%(18df)		98.5	37.9	20.8	46.0	16.6

There was no effect of treatment on the mean number of plants in the various size grades.

1.5 Effect of treatment on mean plot yield (kg) for each size grade at harvest - Wallingford 1991.

	Treatment	Yield of leeks (kg) in each size grade		
		10-25 mm	25-35 mm	>35 mm
1	Unsprayed control	0.00	0.41	1.40
2	Tilt at 1 l /ha	0.07	0.35	1.40
3	Tilt at 0.5 l /ha	0.00	0.24	1.70
4	Corbel at 1 l /ha	0.03	0.29	1.20
5	Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	0.05	0.37	1.10
6	Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	0.08	0.69	1.50
7	Bayfidan at 0.5 l /ha	0.08	0.34	0.80
8	Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	0.02	0.66	1.60
9	Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	0.00	0.19	1.70
10	Trimanzone at 3 kg/ha	0.07	0.14	1.90
SED		0.050	0.292	NS
CV% (18df)		184.9	97.3	108.4

Compared with the untreated control there was no effect of fungicide treatment on yield.

1.6 Effect of treatment on the mean number of plants in each size grade - Wallingford 1991.

	Treatment	Mean No of plants in each size grade		
		10-25 mm	25-35 mm	>35 mm
1	Unsprayed control	0.0	11.8	11.5
2	Tilt at 1 l /ha	3.7	12.5	10.8
3	Tilt at 0.5 l /ha	0.0	7.4	12.5
4	Corbel at 1 l /ha	7.0	11.8	12.1
5	Tilt at 0.5 l /ha + Corbel at 0.5 l /ha	12.0	13.0	13.7
6	Tilt at 0.25 l /ha + Corbel at 0.5 l /ha	4.3	13.4	11.4
7	Bayfidan at 0.5 L /ha	6.6	13.0	12.9
8	Bayfidan at 0.5 l /ha + Corbel at 0.5 l /ha	3.5	11.0	12.5
9	Bayfidan at 0.25 l /ha + Corbel at 0.5 l /ha	0.0	12.8	12.2
10	Trimanzone at 3 kg/ha	3.4	7.6	12.3
SED		3.00	3.20	1.30
CV% (18df)		92.2	33.8	13.3

Compared with the untreated, more plants were recorded in the 10-25mm size grade following treatment with Corbel at 1 l /ha and with Tilt at 0.5 l /ha + Corbel at 0.5 l /ha, but there was no effect of fungicides on shank width in the other size grades.

Appendix II **1992 Experiment**

2.1 Application dates of treatments

HALSALL		WALLINGFORD	
	Treatments		Treatments
August 18 a	8-12	August 19	2-7
September 5	2-7	August 21 a*	8-12
September 23 b	8-12	October 13 b*	2-12
September 25	2-7	November 3 c*	2-12
October 20	2-7		
October 29 c	8-12		

a = applied in response to infection periods on 13 - 19 August
b = applied in response to infection periods on 28 - 29 September
c = applied in response to infection periods on 18 - 19 October

a* = applied in response to infection periods on 18-22 August
b* = applied in response to infection periods on 3-4 October
c* = applied in response to infection periods on 25 & 27 October

2.2 Infection periods Halsall

August	7,9,10,11,12,16,26,27,29
September	2,8,11,12,18,19,20,21,22,25,27,30
October	3,4,18,19,21,22,25,27
November	7,9,11,15,16,21,22

2.3 Infection periods Wallingford

August	8,9,14,15,16,18-22,24-30
September	2,4,6,14-16,18-21,23,24,26,27,28,30
October	1,2,4,11,13,15,18,21,22,23,26,27,28,30
November	2 (recordings ceased after 2 November)

2.4 Effect of treatment on mean % rust per plant - Halsall 1992

Treatment	Mean % rust per plant		
	19 Oct.	24 Nov.	1 Dec.
1 Unsprayed control	0.24	0.21	1.56
Routine after rust found			
2 Tilt	0.00	0.00	0.00
3 Corbel	0.01	0.05	0.04
4 Tilt + Corbel	0.00	0.01	0.05
5 Bayfidan	0.01	0.28	0.27
6 Bayfidan + Corbel	0.00	0.03	0.14
7 Trimanzone	0.05	0.12	0.16
After infection periods			
8 Tilt	0.00	0.01	0.01
9 Corbel	0.02	0.06	0.25
10 Tilt + Corbel	0.02	0.00	0.02
11 Bayfidan	0.02	0.13	0.35
12 Bayfidan + Corbel	0.01	0.02	0.02
SED	0.022	0.0	0.115
CV% (22df)	69.3	84.7	60.8

Rust levels remained low throughout the autumn until harvest in December.

2.5 Effect of treatment on mean plot yield (kg) for each size grade at harvest - Halsall 1992

Treatment	Yield of leeks (kg) in each size grade					Mean
	<10mm	10-25mm	25-35mm	>35mm	Total	weight(g)
1 Unsprayed control	0.02	0.96	3.33	2.43	6.74	110
Routine after rust found						
2 Tilt	0.03	1.49	3.65	1.96	7.13	106
3 Corbel	0.03	2.00	4.05	1.88	7.96	99
4 Tilt + Corbel	0.01	1.46	4.17	1.55	7.19	101
5 Bayfidan	0.02	1.28	4.11	1.79	7.20	104
6 Bayfidan + Corbel	0.01	1.29	3.72	2.86	7.88	113
7 Trimanzone	0.01	1.22	4.31	1.99	7.53	121
After infection periods						
8 Tilt	0.00	1.19	3.91	2.18	7.28	117
9 Corbel	0.02	1.77	3.89	2.33	8.01	107
10 Tilt + Corbel	0.01	1.27	3.74	2.16	7.18	108
11 Bayfidan	0.02	1.71	4.04	1.81	7.58	100
12 Bayfidan + Corbel	0.01	1.69	4.60	1.90	8.20	111
SED	NS	NS	NS	NS	NS	NS
CV%(22df)	95.2	35.0	26.9	39.1	13.3	12.3

There was no effect of treatment on the yield of plants in the various size grades.

2..6 Effect of treatment on the No. of plants in each size grade at harvest - Halsall 1992.

Treatment	No of plants in each size grade				
	<10mm	10-25mm	25-35mm	>35mm	Total
1 Unsprayed control	1.7	20.7	27.0	12.3	61.7
Routine after rust found					
2 Tilt	2.0	28.0	29.3	9.0	68.3
3 Corbel	4.5	41.6	32.7	5.9	84.7
4 Tilt + Corbel	0.7	29.7	33.3	8.0	71.7
5 Bayfidan	3.7	26.7	31.0	8.3	69.7
6 Bayfidan + Corbel	1.0	26.3	29.0	13.3	69.6
7 Trimanzone	0.7	24.9	33.8	9.1	68.5
After infection periods					
8 Tilt	0.0	22.7	29.7	10.3	62.7
9 Corbel	2.0	34.0	29.0	10.7	75.7
10 Tilt + Corbel	1.0	25.3	29.7	10.7	66.7
11 Bayfidan	2.0	32.3	33.7	9.0	77.0
12 Bayfidan + Corbel	1.0	30.0	34.3	8.3	73.6
SED	NS	NS	NS	NS	NS
CV% (22df)	117.8	29.2	21.2	38.0	15.2

There was no effect of treatment on the mean number of plants in the various size grades.

2.7 Effect of treatment on mean % plant weight in each size grade - Halsall 1992

Treatment	% Weight in each size grade			
	<10mm	10-25mm	25-35mm	>35mm
1 Unsprayed control	0.3	14.3	49.4	36.0
Routine after rust found				
2 Tilt	0.4	20.9	51.4	27.3
3 Corbel	0.3	24.5	50.2	25.0
4 Tilt + Corbel	0.2	20.6	57.4	21.8
5 Bayfidan	0.4	18.1	56.7	24.8
6 Bayfidan + Corbel	0.1	16.5	47.2	36.2
7 Trimanzone	0.2	16.2	57.1	26.5
After infection periods				
8 Tilt	0.0	16.6	53.3	26.5
9 Corbel	0.3	21.9	47.4	30.4
10 Tilt + Corbel	0.1	17.5	52.2	30.2
11 Bayfidan	0.3	22.1	52.9	24.7
12 Bayfidan + Corbel	0.1	20.0	55.5	24.4
SED	NS	NS	NS	NS
CV%(22df)	99.5	27.8	16.6	41.8

There was no effect of treatment on the yield of plants in the various size grades.

2.8 Effect of treatment on mean % rust per plant - Wallingford 1992.

Treatment	Mean % rust per plant		
	13 Oct.	3 Nov.	9 Dec.
1 Unsprayed control	0.07	0.15	0.05
Routine after rust found			
2 Tilt	0.14	0.18	0.10
3 Corbel	0.02	0.02	0.05
4 Tilt + Corbel	0.10	0.14	0.12
5 Bayfidan	0.01	0.03	0.07
6 Bayfidan + Corbel	0.01	0.02	0.05
7 Trimanzone	0.02	0.04	0.01
After infection periods			
8 Tilt	0.21	0.11	0.17
9 Corbel	0.37	0.18	0.16
10 Tilt + Corbel	0.05	0.06	0.25
11 Bayfidan	0.02	0.01	0.05
12 Bayfidan + Corbel	0.01	0.01	0.03
SED	0.09	0.08	0.11
CV% (22df)	124.7	134.9	142.0

Despite finding rust in the plots on 19 August, and the recording of numerous infection periods thereafter, the incidence of rust remained low throughout the duration of the experiment. Differences between treatments in disease and yield compared with the untreated control, were not significant.

2.9 Effect of treatment on mean plot (kg) yield in each size grade and mean plant weight - Wallingford 1992

Treatment	Yield of leeks (kg) in each size grade				Mean plant weight (kg)
	<10mm	10-25mm	26-35mm	>35mm	
1 Unsprayed control	0.0820	0.223	0.271	0.1425	0.193
Routine after rust found					
2 Tilt	0.030	0.211	0.452	0.307	0.175
3 Corbel	0.031	0.230	0.397	0.341	0.192
4 Tilt + Corbel	0.083	0.127	0.444	0.345	0.193
5 Bayfidan	0.083	0.153	0.387	0.377	0.212
6 Bayfidan + Corbel	0.099	0.106	0.361	0.434	0.210
7 Trimanzone	0.079	0.148	0.406	0.346	0.217
After infection periods					
8 Tilt	0.012	0.184	0.357	0.447	0.209
9 Corbel	0.010	0.154	0.375	0.461	0.206
10 Tilt + Corbel	0.045	0.153	0.375	0.427	0.199
11 Bayfidan	0.091	0.161	0.356	0.392	0.207
12 Bayfidan + Corbel	0.023	0.175	0.264	0.538	0.228
SED	0.048	0.064	0.086	0.077	0.018
CV% (22df)	105.4	46.1	28.3	23.3	11.0

Compared with Tilt applied after rust was found, increased yields were recorded in the >35mm category with Corbel and Bayfidan + Corbel treatments applied after infection periods. Also there was an increase in the mean plant weight following Bayfidan, with Trimanzone treatments applied after rust was found and with Bayfidan + Corbel treatment after infection periods.

Appendix III **1993 Experiment**

3.1 Application dates of treatments

BURSCOUGH		QUADRING
Treatments		
August 16	2-7	
September 1 a	8-12	
September 6	2-7	
September 27	2-7	NO TREATMENTS APPLIED
September 28 b	8-12	
October 19	2-7	
October 23 c	8-12	
November 10	2-7	
November 18 d	8-12	
November 30	2-7	

a = Applied in response to infection period from 9-21 August

b = Applied in response to infection period from 22-25 September

c = Applied in response to infection period from 20 October

d = Applied in response to infection period from 12-14 November

3.2 Infection periods Burscough

August 19, 21, 22, 26, 27, 28, 29, 30, 31

September 1, 4, 8, 9, 12, 15, 21, 22, 23, 24, 25, 26, 29, 30

October 2, 3, 4, 5, 6, 7, 8, 10, 12, 20

November 6, 7, 8, 9, 10, 11, 12, 14

3.3 Infection periods Quadring

August 23 - no data available

September 12, 14, 22, 24, 27, 29,

October 5, 6, 8, 9, 11, 13,17, 19, 26

3.4 Effect of treatment on rust 16 August - 18 November - Burscough 1993.

Treatment	Mean % Rust							
	16 Aug.	1 Sept.	6 Sept.	27 Sept.	19 Oct.	23 Oct.	10 Nov.	18 Nov.
1	Trace	0.10	0.12	1.65	2.90	2.90	2.12	2.12
2	-	-	0.00	0.00	0.01	-	0.02	-
3	-	-	0.01	0.02	0.06	-	0.03	-
4	-	-	0.00	0.00	0.00	-	0.00	-
5	-	-	0.01	0.04	0.07	-	0.04	-
6	-	-	0.01	0.00	0.03	-	0.06	-
7	-	-	0.11	1.28	0.80	-	0.64	-
8	-	-	-	0.12	-	0.12	-	0.04
9	-	-	-	0.07	-	0.13	-	0.01
10	-	-	-	0.04	-	0.11	-	0.07
11	-	-	-	0.05	-	0.31	-	0.05
12	-	-	-	0.08	-	0.13	-	0.15

No statistical analysis is shown as very low levels of rust were observed and data were still skewed despite transformation.

From late September onwards, all fungicide treatments reduced the severity of rust.

3.5 Pre-harvest assessments of white tip and green leaf area (2 December) - Burscough 1993.

Treatment	% White Tip	% Green leaf
1	1.30	49.2
2	2.07	60.6
3	1.57	56.9
4	2.03	56.0
5	1.20	59.6
6	1.63	54.6
7	0.87	58.4
8	1.33	55.2
9	2.00	59.3
10	1.33	55.2
11	1.50	57.8
12	1.47	58.9
SED	NS	NS
CV% (22df)	32.0	6.6

There was no effect of treatment on white tip or green leaf area retention.

3.6 Effect of treatment on yield - Burscough 1993.

Treatment	Yield (kg) in each size grade				
	< 10 mm	10-25 mm	25-35 mm	> 35 mm	Total
1	0.12	1.46	1.57	0.86	4.01
2	0.07	1.29	2.09	0.34	3.79
3	0.08	1.57	2.28	0.80	4.73
4	0.10	1.43	2.12	0.68	4.33
5	0.06	1.12	1.86	0.81	3.85
6	0.07	1.44	1.48	0.73	3.72
7	0.07	1.55	2.39	0.76	7.78
8	0.10	1.29	2.31	0.84	4.54
9	0.11	1.41	2.16	0.99	4.66
10	0.08	1.20	2.39	0.91	4.58
11	0.09	1.37	2.10	0.81	4.37
12	0.08	1.50	2.26	0.53	4.37
SED	NS	NS	NS	NS	NS
CV% (22df)	60.9	29.3	24.4	73.5	17.3

There was no effect of treatment on yield.

3.7 Effect of treatment on % weight in each size grade - Burscough 1993.

Treatment	% Weight in each size grade			
	<10 mm	10-25 mm	25-35 mm	>35 mm
1	2.7	38.7	39.6	19.0
2	1.9	33.4	55.5	9.2
3	1.8	33.4	48.8	16.0
4	2.8	37.6	47.4	12.2
5	1.7	29.5	47.5	21.3
6	2.0	38.3	39.8	19.9
7	1.3	32.0	51.0	15.7
8	2.8	28.7	51.6	16.9
9	2.3	31.5	46.4	19.8
10	1.9	27.3	52.1	18.7
11	2.0	32.3	48.2	17.5
12	2.0	35.6	51.8	10.6
SED	NS	NS	NS	NS
CV% (22df)	62.3	35.3	17.4	64.3

There was no effect of treatment on % weight in each grade.

Appendix IV **1994 Experiment**

ADAS Siltland Crop Centre, Lincs.

4.1 Treatment details:

1. Untreated control
2. Corbel 1.0 l/ha
3. Tilt 1.0 l/ha
4. Sanction 0.25l/ha + Corbel 0.5 l/ha
5. Folicur 0.5 l/ha
6. Tilt 0.25 l/ha + Corbel 0.5 l/ha
7. Sanction 3.0 kg/ha
8 Folicur 0 l/ha

The experiment was abandoned in late September and not taken to harvest. Fungicide treatments were applied in 400 litres of water/ha applied using an MDM CO_2 pressurised knapsack sprayer with 02- F80 nozzles at 200kPa. However, treatments were only applied on the first spray date.

Appendix V **1995 experiment**

5.1 Application dates of treatments.

Preventative treatments		Curative treatments	
July 17	)	August 29	) Applied when rust
August 8	) Applied prior to rust	September 21	) found on at least
August 29	) being present in crop	November 11	) 10 % plants at
September 21	)	November 2	) 0.1% leaf area affected

5.2 Effect of fungicide and programme on mean percentage incidence of rust - New York 1995

Fungicide	Mean % rust incidence					
	21 Sept.		11 Oct.		2 Nov.	
Untreated	32.5		62.5		91.25	
	Preventative	Curative	Preventative	Curative	Preventative	Curative
Corbel	7.50	12.50	26.25	36.25	57.5	36.25
Tilt (Std)*	5.00	16.25	28.75	40.00	66.25	40.00
Tilt	8.75	8.75	40.00	58.75	80.00	58.75
Sanction	5.00	10.00	41.25	78.75	87.50	78.75
Alto	0.00	1.25	5.00	2.50	41.25	2.50
Folicur	1.25	1.25	3.75	5.00	27.50	5.00
SED	NS		NS		NS	
CV% (33df)	88.1		42.2		38.8	

*Standard treatment

There was no interaction between treatments and programme at any date.

5.3 Effect of fungicide on mean percentage incidence of rust - New York 1995

Fungicide	Mean % rust incidence		
	21 Sept.	11 Oct.	2 Nov.
Corbel	10.00	30.00	46.88
Tilt (Std)*	10.63	40.00	53.13
Tilt	8.75	35.63	69.37
Sanction	7.50	44.38	83.12
Alto	0.63	5.63	21.87
Folicur	1.25	5.00	16.25
SED	2.845	5.647	9.403
CV% (33df)	88.1	42.2	38.8

*Standard treatment

The lowest % incidence of rust at all dates was in the Alto and Folicur treatments. On 2 November the mean % rust incidence was greater in the Sanction treatment compared to the Tilt standard treatment.

5.4 Effect of programme on mean percentage incidence of rust - New York 1995.

Programme	Mean % rust incidence		
	21 Sept.	11 Oct.	2 Nov.
Preventative	4.58	24.17	60.00
Curative	8.33	29.37	36.88
SED	1.643	NS	5.429
CV% (33df)	88.1	42.2	38.8

On 21 September, the preventative treatments reduced rust incidence compared to the curative treatments. On 2 November, the curative treatments reduced rust incidence compared to the preventative treatments.

5.5 Effect of fungicide and programme on mean percentage severity of rust - New York 1995

Fungicide	Mean % rust severity					
	21 Sept.		11 Oct.		2 Nov.	
Untreated	0.2612		0.235		0.5589	
	Preventative	Curative	Preventative	Curative	Preventative	Curative
Corbel	0.0009	0.0089	0.020	0.025	0.0945	0.0500
Tilt (Std)*	0.0054	0.0781	0.015	0.113	0.4650	0.0875
Tilt	0.0083	0.0086	0.023	0.025	0.2050	0.0975
Sanction	0.0006	0.0089	0.097	0.058	0.3750	0.4275
Alto	0.0000	0.0001	0.005	0.008	0.0545	0.0003
Folicur	0.0001	0.0001	0.005	0.008	0.0238	0.0010
SED	NS		NS		NS	
CV%(33df)	369.3		153.9		167.3	

*Standard treatment

There was no interaction between treatments and programme on any date.

5.6 Effect of fungicide and programme on mean percentage severity of rust - New York 1995

Fungicide	Mean % rust severity		
	21 Sept.	11 Oct.	2 Nov.
Corbel	0.0049	0.023	0.073
Tilt (Std)*	0.0418	0.064	0.276
Tilt	0.0084	0.024	0.151
Sanction	0.0048	0.078	0.401
Alto	0.0001	0.006	0.027
Folicur	0.0001	0.006	0.012
SED	NS	0.0256	0.1311
CV% (33df)	369.3	153.9	167.3

*Standard treatment

The mean % rust severity decreased between 21 September and 11 October on the Alto and Folicur treatments when compared with the Tilt standard treatment.

5.7 Effect of fungicide and programme on mean percentage severity of rust - New York 1995

Treatment programme	Mean % rust severity		
	21 Sept.	11 Oct.	2 Nov.
Preventative	0.0025	0.028	0.203
Curative	0.0175	0.039	0.111
SED	NS	NS	NS
CV% (33df)	369.3	153.9	167.3

There was no effect of programme on rust severity.

5.8 Effect of treatment on mean percentage incidence and severity of *Stemphylium* spp. on 16 November - New York 1995

Fungicide	Mean % *Stemphylium* spp.			
	incidence		severity	
	Preventative	Curative	Preventative	Curative
Corbel	4.25	6.25	0.060	0.056
Tilt (Std)*	9.75	2.25	0.090	0.028
Tilt	11.75	5.50	0.207	0.036
Sanction	16.50	10.75	0.175	0.207
Alto	12.50	3.75	0.257	0.010
Folicur	13.50	7.50	0.200	0.132
SED	NS		NS	
CV% (33df)	63.0		89.0	

*Standard treatment

The untreated control plots were not assessed for *Stemphylium* spp.

There was no significant interaction between treatments and programme on the mean % incidence or severity of *Stemphylium* spp.

5.9 Effect of fungicide on mean percentage incidence and severity of *Stemphylium* spp. on 16 November - New York 1995

Fungicide	Mean % *Stemphylium* spp.	
	incidence	severity
Corbel	5.25	0.058
Tilt (Std)*	6.00	0.059
Tilt	8.63	0.122
Sanction	13.63	0.191
Alto	8.13	0.134
Folicur	10.50	0.167
SED	2.74	NS
CV% (33df)	63.0	89.0

*Standard treatment

The untreated control plots were not assessed for *Stemphylium* spp.

Compared with the Tilt standard, there was no effect of other fungicides on the mean % incidence of *Stemphylium* spp. apart from an increase following the Sanction treatment only, but the mean % severity of *Stemphylium* spp. was not affected by any treatment.

5.10 Effect of treatment programme on mean percentage incidence and severity of *Stemphylium* spp. on 16 November - New York 1995

Treatment programme	Mean % incidence	Mean % severity
Preventative	11.38	0.165
Curative	6.00	0.078
SED	1.58	0.031
CV% (33df)	63.0	89.0

Curative treatments reduced both the mean % incidence and severity of *Stemphylium* compared to the preventative treatments

5.11 Effect of treatment on Total yield t/ha, marketable yield t/ha and mean plant weights (kg) - New York 1995.

Fungicide	Treatment programme	Total Fresh Yield	Marketable yield excl. Fusarium infected plants	Marketable yield incl. Fusarium infected plants	Fresh weight per plant	Marketable weight per plant excluding Fusarium infected plants	Marketable weight per plant including Fusarium infected plants
Untreated		34.00	7.72	9.85	0.220	0.093	0.092
Corbel	Preventative	52.43	16.74	18.85	0.325	0.132	0.131
	Curative	56.23	15.25	19.33	0.321	0.129	0.129
Tilt (Std)*	Preventative	51.88	13.95	17.12	0.310	0.119	0.120
	Curative	66.77	18.52	21.16	0.337	0.136	0.134
Tilt	Preventative	55.06	14.35	16.76	0.309	0.123	0.123
	Curative	58.36	16.38	19.84	0.313	0.127	0.126
Sanction	Preventative	51.24	13.68	16.04	0.305	0.120	0.118
	Curative	60.15	17.81	19.48	0.343	0.138	0.138
Alto	Preventative	52.03	15.23	17.42	0.309	0.125	0.126
	Curative	52.47	12.22	16.00	0.321	0.123	0.124
Folicur	Preventative	62.19	16.58	20.12	0.337	0.133	0.134
	Curative	54.96	16.30	19.54	0.332	0.142	0.142
SED		NS	1.92	NS	0.028	NS	0.007
Corbel		54.33	15.99	19.09	0.323	0.131	0.130
Tilt (Std)*		59.32	16.23	19.14	0.323	0.128	0.127
Tilt		56.71	15.36	18.30	0.311	0.125	0.125
Sanction		55.70	15.75	17.76	0.324	0.129	0.128
Alto		52.25	13.73	16.71	0.315	0.124	0.125
Folicur		58.57	16.44	19.83	0.335	0.138	0.138
SED		NS	NS	NS	NS	NS	NS
	Preventative	54.14	15.09	17.72	0.316	NS	0.125
	Curative	58.16	16.08	19.22	0.328	0.132	0.132
SED		NS	NS	NS	NS	0.003	NS
CV%		12.2	17.5	15.4	5.6	8.4	8.0

There was no effect (when compared to the Tilt standard*) of fungicide, programme or their interaction on yield.

Appendix VI SITE AND CROP DETAILS

1991

	Halsall, Lancs.	Wallingford, Oxon.
Soil texture:	Loamy sand	Sandy loam
Cultivar:	Argenta	Winter Derrick
Design:	Randomised block, 3 replicates	Randomised block, 3 replicates
Plot size:	7.0m x 1.5m	7.0 m x 1.68 m
Fertiliser	Standard farm practice	
Herbicide:	Standard farm practice	
Insecticide:	Standard farm practice	
Harvest area:	3.0m x 0.75m	3.0 m x 0.9 m
Harvest date:	2 December 1991	12 March 1992

1992

	Halsall, Lancs.		Wallingford, Oxon.
Soil texture:	Loamy Sand		Sandy loam
Soil analysis:	P index	5	
	K index	2	
	Mg index	2	
	pH	6.4	
Cultivar:	Gloriana		Winter Derrick
Design:	Randomised block, 3 replicates		Randomised block , 3 replicates
Plot size:	7.0 m x 1.5 m		7.0m x 1.68m
Fertiliser	Standard farm practice		
Herbicide:	Standard farm practice		
Insecticide:	Standard farm practice		
Harvest area:	3.0 m x 0.75 m		3.0 x 0.9m
Harvest date:	4 December 1992		12 December 1992

1993 Burscough, Lancs.

Soil texture:	Loamy Sand	
Soil analysis:	P Index	3
	K Index	1
	Mg Index	2
	pH	7.7
	OM %	3.1
Cultivar:	Gloriana	
Design:	Randomised block, 3 replicates	
Plot size:	7.0 m x 1.5 m	
Fertiliser	Standard farm practice	
Herbicide:	Standard farm practice	
Insecticide:	Standard farm practice	
Harvest area:	3.0 m x 0.75 m	
Harvest date:	4 December 1993	

1995 New York, Lincs.

Soil texture:	Sandy Loam	
Soil analysis:	P Index	3
	K Index	1
	Mg Index	2
	pH	7.0
	OM %	2.1
Cultivar:	Pancho	
Design:	Randomised block, 3 replicates	
Plot size:	5.0 m x 4 beds (4 rows per bed)	
Planting date	7 May 1995 (345 modules)	
Fertiliser	Base: 10% N, 4% P, 18% K, 6.5 % Mg (11 cwt/ac)	
	Top Dressing: 34.5% N (2 cwt/ac)	
Herbicide:	Alicep Totril 17 August 1995	
Insecticide:	cypermethrin 31 July 1995	
Harvest date:	2 December 1995	
Irrigation:	17 May, 3 June, 21 June, 9 July, 16 August 1995.	