

## MORLEY RESEARCH CENTRE

### Interaction between fungicide spray timing, rust development and yield of winter rye, 1997

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#### Summary

A range of traditional conazole and new strobilurin fungicides was applied at various timings either alone or with the addition of Corbel (fenpropimorph) to a crop of Amando winter rye. A series of single, two and three-spray Folicur (tebuconazole) programmes was also tested. Amistar (azoxystrobin) was shown to be a step forward in the control of brown rust in rye, able to maintain green leaf area longer and reduce brackling more than any other treatment. This was mirrored in excellent yield increases, of up to 2.84 t/ha over the untreated yield of 4.14 t/ha.

#### Object

To assess the interaction between fungicide spray timing, rust development and yield and evaluate the comparative activity of fungicides.

#### Method

A range of traditional conazole and new strobilurin fungicides was applied at various timings either alone or with the addition of Corbel (fenpropimorph at 375 g ai/ha) to a crop of Amando winter rye in a randomised block with four replicates.

The trial was sown on 10 October 1996 at a rate of 300 seeds per m<sup>2</sup>, on a loamy sand site at New Found Farm, Colney. Plants were counted on 5 November. The trial received normal farm inputs of nitrogen and growth regulator. Lodging and brackling was assessed when the trial was harvested on 6 August 1997.

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\*Not for publication without the Director's consent. This report deals primarily with only one year's work, so any conclusions given are provisional.

Fungicides (as shown in Table 1) were applied to appropriate plots on 9 April (GS 31), 3 May (GS 45-49) and 25 May (GS 59). All foliar fungicide applications were applied in 200 l/ha water using F110-03 nozzles on a 4 m boom.

Assessments of brown rust (*Puccinia recondita*) on the untreated crop were made at each spray date. Brown rust on leaf 1 was assessed on 17 June (GS 69-71). Green leaf area (GLA) was recorded on leaves 1 and 2 together on 10 July (GS 81). Plot layout and experiment method followed Morley standard operating procedures. Details of active ingredients of the commercially available products used are provided in Table 2.

Table 1. *Details of treatments applied*

**Treatments (product l/ha)**

1 Untreated

*Two-spray fungicide programmes, GS 31 + 45-49*

2 Alto 100SL (0.8)  
 3 NAS 155  
 4 Folicur (1.0)  
 5 Amistar (1.0)  
 6 NAS 178  
 7 Corbel (1.0)  
 8 NAS 179  
 9 Corbel + Alto 100SL, (0.5 + 0.8)  
 10 Corbel + NAS 155  
 11 Corbel + Folicur (0.5 + 1.0)  
 12 Corbel + Amistar (0.5 + 1.0)  
 13 Corbel + NAS 179

*Timing element (Folicur only, 1.0)*

14 GS 31  
 15 GS 45-49  
 16 GS 31 + 45-49  
 17 GS 45-49 + GS 59  
 18 GS 31 + GS 45-49 + GS 59

Table 2. *Active ingredients of commercially available products*

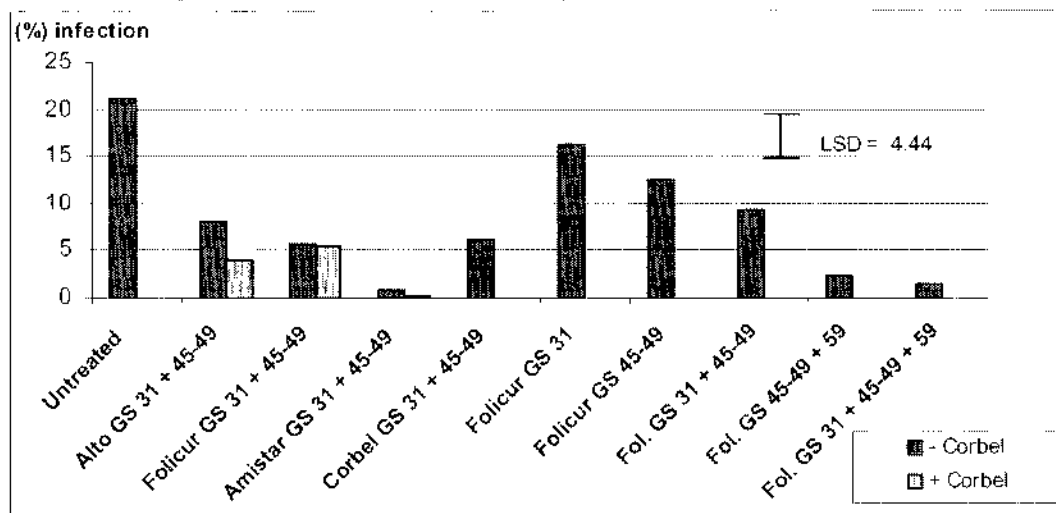
Product	Active ingredient (g ai/l)
Alto 100SL	cyproconazole (100)
Folicur	tebuconazole (250)
Amistar	azoxystrobin (250)
Corbel	fenpropimorph (750)

## Results and discussion

### Foliar disease and persistence of green leaf area

Brown rust was present on the lower leaves when the GS 31 and 45-49 treatments were applied. When the final treatments were applied on 25 May (GS 59) brown rust symptoms were found on all leaf layers, 1, 2.5, 4 and 10% infection on leaves 1 to 4 of the untreated crop respectively. When all plots were assessed, on 17 June (GS 69-71) brown rust affected 21.3% of leaf 1 of the untreated crop (Figure 1). All treatments resulted in significant control of rust.

Figure 1. *Brown rust infection of leaf 1 on 17 June 1997 (%)*

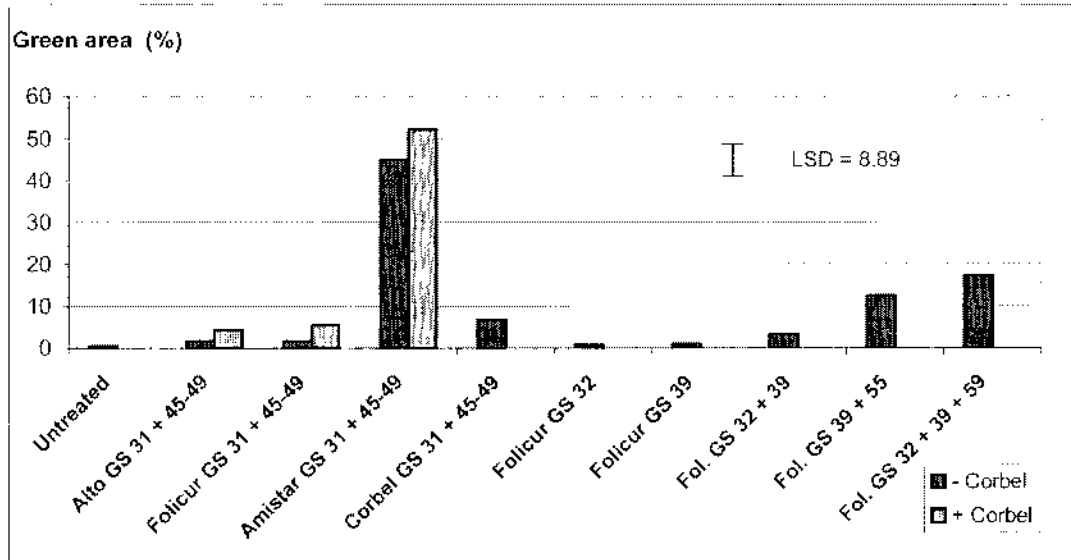


Timing was a significant factor in the disease control obtained by Folicur treatments. Single applications gave poor control, barely significant by 17 June when applied at GS 31. Crop treated at GS 45-49 and 59 had less brown rust than plots treated at GS 31 and 45-49 (2.25 and 9.25% respectively). A three spray programme of Folicur at GS 31, 45-49 and 59 restricted the development of brown rust to 1.5% on the flag leaf.

The addition of Corbel to the two spray programmes tended to give slightly better brown rust control, but this was only significantly improved when added to Alto 100SL, (4% compared to 8%). Amistar gave outstanding control of brown rust, 0.9% when used alone in a two spray programme and only 0.3% when mixed with 0.5 l/ha Corbel. Two sprays of Amistar gave better rust control than three sprays of Folicur.

The levels of rust were reflected in loss of green leaf later in the season. When assessed on 10 July (Figure 2), only 0.5% of the top two leaves of the untreated crop remained green. Again, the addition of Corbel tended to enhance the performance of the two spray programmes but the difference was not statistically significant. Application of Folicur at GS 45-49 and 59 was again more effective than when applied at GS 31 and 45-49. Where a three-spray Folicur programme was used 17.3% of leaves 1 and 2 remained green but Amistar was a great improvement on these results, with 45 and 52.5% GLA remaining when used alone and mixed with Corbel respectively.

Figure 2. Green area on leaves 1 and 2 on 10 July 1997(%)

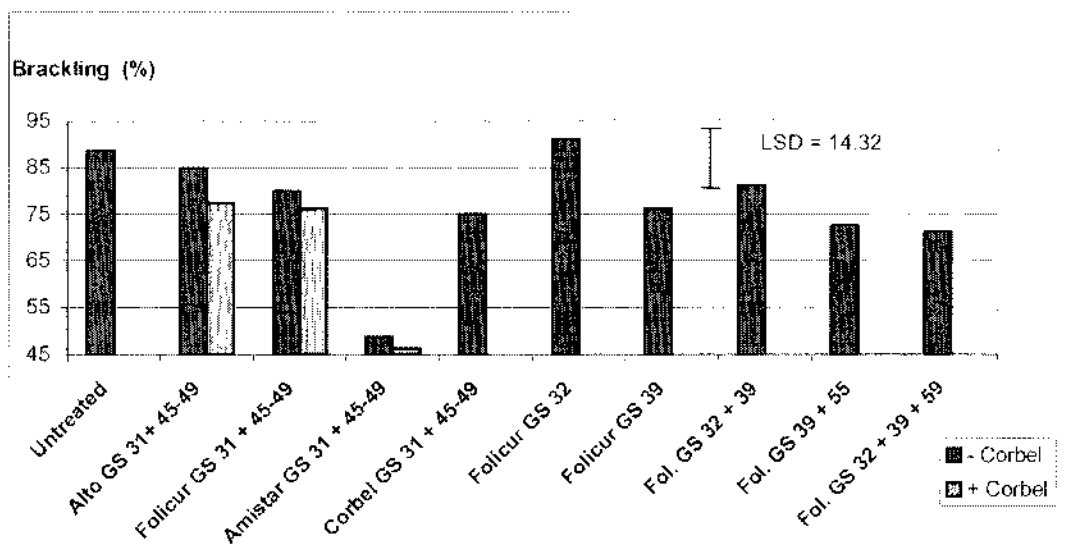


**Brackling and lodging**

Levels of brackling and lodging were assessed when the trial was harvested on 6 August. Though some lodging was recorded, levels were low and there was no difference between treatments.

Brackling was affected by some treatments (Figure 3), the highest levels were recorded on untreated and crop receiving Follicur at GS 31 (88.7 and 91.2% respectively). Most treatments gave only a small reduction in brackling. Once again the trend was for Corbel to enhance the two spray programmes slightly. Brackling on crop treated with Amistar was considerably less than any other treatment, possibly due to fusarium control in the lower stem or nodes, though no assessment of stem base disease was carried out in this trial.

Figure 3. Brackling on 6 August 1997 (%)



### Grain yield and quality

The untreated crop yielded 4.14 t/ha. Significant increases in yield were recorded from all treatments (Table 3). Further yield increases were observed from each delay in timing of Folicur application. There was a small yield benefit from adding a GS 31 application to the later two spray Folicur programme (GS 45-49 and 59), however a similar yield was obtained by mixing Corbel with an early two spray Folicur programme (GS 31 and 45-49).

Due to its excellent ability to reduce brown rust and maintain green area on rye, Amistar produced a large increase in grain yield, mixing with Corbel gave no added yield increase. Adding Corbel to the Alto and NAS 179 programmes did increase yield.

Specific weight was recorded as 70.9 kg/hl on the untreated crop. There were no significant differences between any treatments.

Table 3. *Grain yield and specific weight*

Treatments	Yield (t/ha at 85% dm)	Specific weight (kg/hl)
1 Untreated	4.14	70.9
<i>Two-spray fungicide</i>		
2 Alto 100SL (0.8)	5.04	71.5
3 NAS 155	5.13	-
4 Folicur (1.0)	5.35	71.6
5 Amistar (1.0)	6.98	71.7
6 NAS 178	5.57	-
7 Corbel (1.0)	5.35	71.6
8 NAS 179	5.46	-
9 Corbel + Alto 100SL, (0.5 + 0.8)	5.50	72.0
10 Corbel + NAS 155	5.37	-
11 Corbel + Folicur (0.5 + 1.0)	5.61	72.1
12 Corbel + Amistar (0.5 + 1.0)	6.94	72.6
13 Corbel + NAS 179	5.84	-
<i>Timing element (Folicur only, 1.0)</i>		
14 GS 31	4.55	71.1
15 GS 45-49	4.80	71.5
16 GS 31 + 45-49	5.08	71.6
17 GS 45-49 + GS 59	5.41	71.7
18 GS 31 + GS 45-49 + GS 59	5.66	71.8
LSD	0.295	NS
SE per plot (51 df)	± 0.208	± 0.84
CV (%)	3.8	1.2

## Conclusions

This trial demonstrates that Amistar is a major step forward in the control of brown rust in rye. Two sprays of this new strobilurin fungicide maintained green area and reduced brackling far more effectively than any of the other programmes tested, including three sprays of Folicur.

Where conventional conazoles were used, though rarely of statistical significance, there was a trend for the addition of Corbel to improve disease control and yield. In the series of Folicur programmes tested, two applications at flag leaf and ear spray contributed more to yield than when the programme was applied at 1st node and flag leaf, despite disease being present in the crop at the time of the first spray. Combining these into a three spray sequence gave better disease control but was still less effective than two applications of Amistar.

## Appendix

The following information is presented as an appendix, which is available on request.

Field details

Method

Experiment diary

Results

Table A1 . Brown rust and green leaf area (%)

Table A2 . Lodging and brackling at harvest (%)

**Field details**

<b>Site</b>	New Found Farm, Colney			
<b>Field reference</b>	Block III			
<b>Crop</b>	Rye			
<b>Variety</b>	Amando			
<b>Previous crop</b>	1996 Linseed 1995 Sugar beet 1994 Rye 1993 Spring barley 1992 Rye			
<b>Soil type</b>	Loamy sand (Burlingham series)			
<b>Soil analysis</b>	pH	P	K	Mg
26 January 1994	8.4	2.0	0.0	0.0
<b>Drilling date</b>	10 October 1996			
<b>Seed treatment</b>	Panoctine (guazatine) + New Kotol (gamma-HCH)			
<b>Seed rate</b>	300 seeds/m <sup>2</sup>			
<b>Nutrients applied (kg/ha)</b>	<b>N</b>	<b>P</b>	<b>K</b>	
27 February		60	60	
2 March	40			
17 April	<u>112</u>			
<b>Total N</b>	<b><u>152</u></b>			

**Applications to crop**

<b>Date</b>	<b>GS</b>	<b>Item (g ai/l)</b>	<b>Dose/ha</b>
27 February 1997	23	Payne fertiliser (24% N: 24% S)	250 kg
2 March	24	Kemira Double Top fertiliser (27% N: 12% S)	145 kg
10 March	25	Stefes CCC 720 (chlormequat, 720) + Ally (metsulfuron-methyl, 20%) + Duplosan (mecaprop-p, 600)	2.0 l 20 g 2.0 l
17 April	32	Kemira Nitro Top (34.5% N)	325kg
1 May	45	Terpal (2-chloroethylphosphonic acid + mepiquat chloride, 155 + 305) + non ionic wetter	0.5 l 40 ml



## Method

This is an abbreviated version of the standard operating procedures used at Morley Research Centre.

### Plot layout

Plots were sown at 300 seeds/m<sup>2</sup> with an Oyjord drill. The drilled plots were 12 m long and 1.56 m wide from outside row to outside row (14 rows at 12.0 cm spacing). Plots were separated by a buffer of the same size with a 54 cm gap between successive plots and buffers. This gave an effective plot width of 2.10 m, which was used for harvest yield calculations. Treatments were applied to the plot and to part of the buffer at each side. For harvest purposes, plot length was reduced to 9m.

### Overall treatments

Overall treatments such as fertiliser, insecticides, herbicides, and growth regulators were applied across all plots with farm machinery using wheelings, 24 m apart.

### Spraying details

Treatments were applied using a CO<sub>2</sub> powered backpack sprayer, utilising 'Cornelius' vessels and a 4 m boom (eight nozzles at 0.5 m spacings) with Lurmark F110-03 nozzles at 2 bar pressure, to give 200 l/ha spray volume at 1.6 m/s forward speed.

### Agronomic factors

Overall plant population was determined by making 50 counts of a 30.5 x 30.5 cm quadrat at random across the site.

### Foliar disease and green leaf

Foliar disease of a particular leaf or leaf layer was determined by the following method. A standard (based on the appropriate key from the ADAS manual of disease assessment keys, 1976) was agreed between two experienced assessors and plots were assessed by walking along the gap between the harvest area and the buffer, examining the plot from both sides. The crop was examined at intervals and an appropriate disease level was agreed at the end of each plot.

Green leaf area was determined by the following method. A standard was agreed between two people and the green leaf area was assessed from one end of each plot by one person whilst another recorded the appropriate values. Green area was assessed on each leaf by one person whilst another recorded the appropriate values.

### Harvest details

Plots were harvested using a Sampo 2010 combine which was modified for plot work and used electronic weighing (Novatech M864 Loadmeter). Trials were harvested by replicate.

### Post harvest determinations

Moisture content was determined using a Burrows digital moisture computer. A minimum of two samples were tested from each plot, with a tolerance of 0.2% required between samples.

The grain samples were pre-cleaned using a Rational sample cleaner to remove any chaff or straw before further assessments (specific weight) were carried out.

Specific weight was determined using a Farm-Tec Easi-Lab chondrometer and electronic balance. A minimum of two samples was tested from each plot, with a tolerance of 2.0 g required between samples.

### Experiment diary

<b>Date</b>	<b>Treatments applied or action</b>
10 October 1996	Trial drilled to plan, drilling depth 50 mm in a ploughed and pressed seedbed with a very fine tilth
5 November	Population counts GS 12 (179 plants-m <sup>2</sup> )
9 April 1997	First sprays applied at GS 31 (target GS 32)
3 May	Second sprays applied at GS 45-49 (target GS 39)
25 May	Third sprays applied at GS 59 (target GS 55)
17 June	Brown rust assessed on leaf 1 (whole plot score)
10 July	Green leaf area assessed on leaves 1 and 2 (whole plot score)
6 August	Lodging and brackling recorded. Trial harvested.

## Results

Table A1. *Brown rust and green leaf area (%)*

Treatments	Brown rust on leaf 1 17 June	GLA on leaves 1 and 2 10 July
Untreated	21.3	0.5
<i>Two-spray fungicide</i>		
Alto 100SL (0.8)	8.0	1.8
Folicur (1.0)	5.8	1.8
Amistar (1.0)	0.9	45.0
Corbel (1.0)	6.3	6.8
Corbel + Alto 100SL, (0.5 + 0.8)	4.0	4.5
Corbel + Folicur (0.5 + 1.0)	5.5	5.5
Corbel + Amistar (0.5 + 1.0)	0.3	52.5
<i>Timing element (Folicur only, 1.0)</i>		
GS 31	16.3	0.8
GS 45-49	12.5	1.0
GS 31 + 45-49	9.3	3.3
GS 45-49 + GS 59	2.3	12.5
GS 31 + GS 45-49 + GS 59	1.5	17.3
LSD	4.44	8.89
SE per plot (51 df)	± 3.13	± 6.26
CV (%)	46.2	64.9

Table A2. Lodging and brackling at harvest (%)

Treatments	Lodging	Brackling
Untreated	2.5	88.7
<i>Two-spray fungicide</i>		
Alto 100SL (0.8)	2.5	85.0
Folicur (1.0)	2.0	80.0
Amistar (1.0)	1.3	48.7
Corbel (1.0)	2.5	75.0
Corbel + Alto 100SL, (0.5 + 0.8)	3.8	77.5
Corbel + Folicur (0.5 + 1.0)	2.5	76.2
Corbel + Amistar (0.5 + 1.0)	3.8	46.2
<i>Timing element (Folicur only, 1.0)</i>		
GS 31	2.5	91.2
GS 45-49	2.5	76.2
GS 31 + 45-49	3.8	81.2
GS 45-49 + GS 59	0.0	72.5
GS 31 + GS 45-49 + GS 59	3.8	71.2
LSD	NS	14.32
SE per plot (51 df)	± 2.62	± 10.09
CV (%)	103	13.4