MORLEY RESEARCH CENTRE

Interaction between fungicide spray timing, rust development and yield of winter rye, 1999

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Summary

A range of triazole and morpholine fungicides was applied with and without the strobilurin Amistar. Fungicides were applied GS 32 and GS 55 with most plots being sprayed at both stages. Low levels of mildew *(Erysiphe graminis)* were recorded early in the season but this was rapidly overtaken by severe brown rust *(Puccinia recondita)*. All treatments reduced brackling at harvest but Amistar appeared to be the most effective.

Fungicide treatment resulted in yield increases of up to 3.02 t/ha over the untreated which yielded 4.76 t/ha. Amistar alone applied twice at 1.0 l/ha resulted in a yield of 7.61 t/ha and this was not significantly improved by the addition of 0.5 l/ha of Corbel. Applications of half doses of Amistar with half doses of Corbel or Folicur resulted in yields of 7.02 and 7.13 t/ha respectively. Specific weight from the untreated plots was 76.5 kg/hl and this was increased to 76.6-77.9 by treatment.

Object

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

Trial manager D B Stevens.

Site New found Farm, Colney Lane, Norwich (loamy sand).

Variety Esprit

Method

The trial was sown at 300 seeds/m² on 1 October 1998 using an Oyjord plot drill to sow plots with an effective width of 2.1 m and length of 12.0 m that was reduced to a harvest length of 9.0 m. Each harvest plot was separated from the next by a buffer of similar size to avoid fungicide treatments affecting adjoining plots. The treatments in Table 1 were applied at the dates and growth stages shown. Disease was recorded on untreated plots at the time of fungicide treatment and a detailed assessment of all plots was made on 28 May. Green leaf area remaining on the top three leaves was recorded on 26 June. There was no lodging but brackling was recorded before harvest on 1 August. All work was carried out according to the Standard Operating Procedures of Morley Research Centre.

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* Not for publication without the Directors consent. This report deals with only one year so any conclusions given are provisional.

Table 1. *Treatments applied and growth stage*

Treatment	Dose (l/ha)	Proposed GS	GS at application	Date of Application
1. Untreated	-	-	-	-
Two-spray programmes, GS 32 + 55				
2. Alto 240SL	0.33	32 + 39	32 + 55	15 April + 6 May
3. Folicur	1.0	32 + 39	32 + 55	15 April + 6 May
4. Folicur	0.5	32 + 39	32 + 55	15 April + 6 May
5. Amistar	1.0	32 + 39	32 + 55	15 April + 6 May
6. Amistar	0.5	32 + 39	32 + 55	15 April + 6 May
7. Corbel	1.0	32 + 39	32 + 55	15 April + 6 May
8. Amistar + Array	0.5 + 1.0	32 + 39	32 + 55	15 April + 6 May
9. Folicur + Corbel	1.0 + 0.5	32 + 39	32 + 55	15 April + 6 May
10. Amistar + Corbel	1.0 + 0.5	32 + 39	32 + 55	15 April + 6 May
11. Amistar + Corbel	0.5 + 0.5	32 + 39	32 + 55	15 April + 6 May
12. Amistar + Folicur	1.0 + 0.5	32 + 39	32 + 55	15 April + 6 May
13. Amistar + Folicur	0.5 + 0.5	32 + 39	32 + 55	15 April + 6 May
Timing of Amistar + Folicur (0.5 + 0.5)				
14. Amistar + Folicur	0.5 + 0.5	32	32	15 April
15. Amistar + Folicur	0.5 + 0.5	39	55	6 May

Active ingredients of the fungicides used are shown in Table 2.

Table 2. *Active ingredients of commercially available products*

Product	Active ingredient (g ai/l)
Alto 240SL	cyproconazole (240)
Amistar	azoxystrobin (250)
Array	spiroxamine + tebuconazole (400 + 100)
Corbel	fenpropimorph (750)
Folicur	tebuconazole (250)

Results and discussion

Plant establishment and growth

Although the loose soil resulted in drilling slightly deeper than the target of 25-40 cm, emergence did not appear to have been delayed and establishment was good. When counted on 2 December there were 203 plants/m^2.

Disease control and green leaf area

Periodic assessments of disease on the untreated plots (Table 3) show that brown rust was the dominant disease on Esprit. Traces of mildew were present early in the season but this was soon overtaken by the brown rust.

Table 3. *Periodic observations of disease on untreated (% infection)*

Date	Growth stage	Leaf	Disease	Esprit
15 April	32	2	B rust	3.3
		2	Mildew	Trace
28 April	39-51	3	B rust	3.0
		4	B rust	10.0
		3	Mildew	0.0
		4	Mildew	0.0
6 May	55	1	B rust	0.0
		2	B rust	1.0
		3	B rust	3.5
		4	B rust	8.0
		5	B rust	18.0
		2	Mildew	0.0
		3	Mildew	0.0
		4	Mildew	0.0
		5	Mildew	0.0

When a detailed assessment of all plots was made on 28 May brown rust was very active on each of leaves 2, 3 and 4 as shown in Table 4. At this time there was 8.7 % rust on leaf 2 but all plots that had received two applications of fungicide that included Amistar had less than 1.0% infection. The lower leaves had much more disease but control by Amistar was still good and even 0.5 l/ha provided better protection than the best of the triazoles at the full dose. Corbel provided similar control to that achieved by Folicur.

Table 4. *Brown rust on leaves 2, 3 and 4 on 28 May (% leaf area infected)*

Treatment	Dose (l/ha)	Leaf 2	Leaf 3	Leaf 4
1. Untreated	-	8.7	25.0	44.0
Two-spray programmes, GS 32 + 55				
2. Alto 240SL	0.33	3.2	13.3	26.0
3. Folicur	1.0	2.3	6.8	16.7
4. Folicur	0.5	6.3	18.0	32.3
5. Amistar	1.0	0.0	0.4	6.0
6. Amistar	0.5	0.3	4.5	9.5
7. Corbel	1.0	1.7	6.8	16.0
8. Amistar + Array	0.5 + 1.0	0.0	0.1	2.1
9. Folicur + Corbel	1.0 + 0.5	0.7	2.7	6.7
10. Amistar + Corbel	1.0 + 0.5	0.0	0.0	3.2
11. Amistar + Corbel	0.5 + 0.5	0.2	1.2	4.7
12. Amistar + Folicur	1.0 + 0.5	0.0	0.2	1.5
13. Amistar + Folicur	0.5 + 0.5	0.1	1.3	8.0
Timing of Amistar + Folicur (0.5 + 0.5)				
14. GS 32	0.5 + 0.5	3.5	9.0	16.7
15. GS 55	0.5 + 0.5	1.2	5.7	12.3
LSD		1.53	4.28	6.40
SE per plot (40 df)		±0.93	±2.59	±3.88
CV (%)		58.2	47.4	33.2

LSD = least significant difference at 95% probability

Mildew infection was very low except where Amistar had been used alone (Table 5). On these plots the control of brown rust only appears to have allowed some progress of mildew.

The green leaf area mirrored the disease control and on 26 June all green tissue had been destroyed on the untreated Esprit. Less than 10.0% GLA remained on plots that had received only a triazole or Corbel but 22.5% remained where Folicur + Corbel had been used (T 9). The single early treatment of Amistar + Folicur had only 3.8% GLA while there was 53.3% following the late treatment.

Table 5. *Mildew infection on leaf 3 on 28 May and green leaf area (GLA) on top three leaves on 26 June (% leaf area)*

Treatment	Dose (l/ha)	Mildew L 3, 28 May	GLA L 1-3, 26 June
1. Untreated	-	0.0	0.0
Two-spray programmes, GS 32 + GS 55			
2. Alto 240SL	0.33	0.0	4.0
3. Folicur	1.0	0.0	6.0
4. Folicur	0.5	0.0	3.0
5. Amistar	1.0	1.0	67.8
6. Amistar	0.5	0.4	47.5
7. Corbel	1.0	0.0	6.3
8. Amistar + Array	0.5 + 1.0	0.0	70.3
9. Folicur + Corbel	1.0 + 0.5	0.0	22.5
10. Amistar + Corbel	1.0 + 0.5	0.0	77.8
11. Amistar + Corbel	0.5 + 0.5	0.0	48.0
12. Amistar + Folicur	1.0 + 0.5	0.2	79.5
13. Amistar + Folicur	0.5 + 0.5	0.0	56.3
Timing of Amistar + Folicur (0.5 + 0.5)			
14. GS 32	0.5 + 0.5	0.0	3.8
15. GS 55	0.5 + 0.5	0.0	53.3
LSD		0.48	9.08
SE per plot (40 df)		±0.29	±6.42
CV (%)		206.8	16.5

Brackling, grain yield and specific weight

There was brackling of 33.8% of tillers on untreated plots as the crop matured (Table 6). This was significantly reduced by all treatments with Amistar treatments resulting in the greatest reduction.

All treatments resulted in significant yield increases of up to 3.02 t/ha. Single treatments at GS 32 or GS 55 resulted in yield improvements but the later treatment gave more than twice the benefit of the earlier treatment. When two applications were applied the highest yield followed the use of Amistar + Corbel (1.0 + 0.5) but Amistar (1.0) or Amistar + Folicur were not significantly different.

Table 6. *Brackling (% tillers) on 1 August, grain yield (t/ha at 85% dm) and specific weight (kg/hl)*

Treatment	Dose (l/ha)	Brackling (%)	Yield (t/ha)	Spec. wt. (kg/hl)
1. Untreated	-	33.8	4.76	76.5
Two-spray programmes, GS 32 + GS 55				
2. Alto 240SL	0.33	21.8	5.74	77.1
3. Folicur	1.0	18.0	5.78	77.3
4. Folicur	0.5	25.8	5.20	76.6
5. Amistar	1.0	10.0	7.61	77.1
6. Amistar	0.5	13.0	6.85	77.8
7. Corbel	1.0	17.5	5.77	77.6
8. Amistar + Array	0.5 + 1.0	19.3	7.06	77.7
9. Folicur + Corbel	1.0 + 0.5	13.5	6.49	77.3
10. Amistar + Corbel	1.0 + 0.5	8.8	7.78	77.5
11. Amistar + Corbel	0.5 + 0.5	11.0	7.02	77.6
12. Amistar + Folicur	1.0 + 0.5	12.5	7.72	77.8
13. Amistar + Folicur	0.5 + 0.5	13.8	7.13	77.5
Timing of Amistar + Folicur (0.5 + 0.5)				
14. GS 32	0.5 + 0.5	19.3	5.60	76.7
15. GS 55	0.5 + 0.5	13.8	6.83	77.9
LSD		6.38	0.502	0.83
SE per plot (40 df)		±4.51	±0.355	±0.59
CV (%)		31.5	5.4	0.8

A number of partners for Amistar at a reduced dose of 0.5 l/ha were tested but they all fell short of the full dose of Amistar and resulted in yields just over 7.0 t/ha compared to the best yield at 7.78 t/ha. Of the products other than Amistar, there was little difference in yield between Alto 240SL, Folicur and Corbel. The best treatments resulted in significant improvements in specific weight but the untreated value of 76.5 kg/hl was surprisingly good and the highest value was 77.9 kg/hl.

Field details

Site	Morley Research Centre, land at Colney Lane, Norwich
Field reference	Block 5, New Found Farm
Crop	Winter rye
Variety	Esprit
Previous crop	1998 Winter barley 1997 Spring barley 1996 Sugar beet 1995 Winter rye
Soil type	Loamy sand

Soil analysis	pH	P	K	Mg
Aug 1996	8.1	2+	1	1

Seed	Commercial C2 stock	
Seed rate	300 seeds/m²	
Date sown	1 October 1998	

Nutrients applied	Rate (kg/ha)	
10 March 1999	38 N	18 S
14 April	80 N	
10 May	40 N	
Total nitrogen	158	

Cultivations	9 September 1998	Ploughed and pressed

Applications to crop

Date	Item	Rate/ha
16 November1998	Cyperkill 10 (cypermethrin, 100) Ardent (diflufenican + trifluralin, 40 + 400)	250 ml 1.5 l
10 March 1999	Double Top (26% N, 12% S)	148 kg
20 March	Chlormequat 70 (chlormequat, 700) + Quantum (tribenuron-methyl, 50%)	2.5 l 10 g
14 April	Urea (46% N)	174 kg
29 April	Terpal (2-chloroethylphosphonic acid + mepiquat chloride, 155 + 305) + wetter	1.75 l
10 May	Extran (34.5% N)	116 kg

Experiment diary

Date	Treatments applied or action
1 October 1998	Plots sown at 300/m² using disc coultered Oyjord plot drill. Seed bed very loose but contained adequate moisture and was satisfactory.
2 December	Plant counts (GS 21-22).
8 February 1999	Crop inspected. Weeds dying, some mildew evident particularly in CST 48 and 49.
26 March	Crop inspected. Mildew evident in CST 48. Brown rust developing on lower leaves of Esprit but not yet seen on CST varieties.
15 April	First application of fungicides and record of disease on untreated plots (GS 32)
28 April	Check growth stage and progress of trial (GS 37-45). Treated plots still fairly clean but brown rust now on all untreated plots except CST 48.
6 May	Second application of fungicides and record of disease on untreated plots (GS 55).
28 May	Assessment of brown rust on each of leaves 2, 3 and 4 and mildew on leaf 3 (GS 65).
26 June	Assessment of green leaf area remaining on top three leaves, whole plot method (GS75).
1 August	Brackling recorded and trial harvested

Method

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

Plot layout

Plots were sown at the required seed rate using an Oyjord drill. The drilled plots were 12m long and 1.56m wide from outside row to outside row (14 rows at 12.0cm 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 2.10m, which was used for harvest yield calculations. For harvest purposes, plot length was reduced to 9.0m.

Overall treatments

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

Agronomic factors

Plant population was determined by making one count of a 30.5 x 30.5cm quadrat in every plot.

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.

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 or 1000 grain weight) were carried out.

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