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Interaction between fungicide spray timing, brown rust development and yield in winter rye

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Summary

Fungicide treatments were evaluated as one, two and three-spray programmes on the winter rye variety Rapid, drilled on 24 September 1997 on the loamy sand soil at Colney, Norwich. Treatment application dates were 14 April 1998 (GS 32), 8 May (GS 47-51) and 20 May (GS 59-61), with the two-spray treatments being applied on 14 April and 8 May. Brown rust was already present in the crop when the first treatments were applied on 14 April and it continued to develop as the season progressed. When assessed on 29 May, a mean value of 36.3% of the area of leaves 1, 2 and 3 was affected by brown rust on untreated crop. All treatments significantly reduced disease levels, many having less than 5% infection. On 16 June, brown rust had increased to 49.3% on untreated crop, with the best control following the inclusion of Amistar either alone or in mixture when an 8 May application was included in the programme. Where no fungicide was applied, the crop produced a yield of 5.59 t/ha, with responses ranging from 0.32 t/ha (two applications of Alto 100SL at 0.8 l/ha) to 3.00 t/ha (two applications of Amistar + Corbel at 1.0 + 0.5 l/ha). The inclusion of Amistar in the fungicide programme always produced a good yield response.

Object

To assess the impact of spray timing on disease development and yield and evaluate the comparative activity of fungicides

Method

<i>Site</i>	New Found Farm, Colney, Norwich
<i>Soil type and series</i>	Loamy sand
<i>Variety</i>	Rapid
<i>Treatments</i>	Details of treatments are given in Tables 1 & 2
<i>Sowing date</i>	25 September 1997
<i>Husbandry</i>	The crop followed rye, all applications as farm crop except fungicide, field details as outlined in Appendix
<i>Trial design</i>	Randomised block with four replicates
<i>Analysis</i>	ANOVA with LSD's quoted at P = 0.05
<i>Plot size</i>	12 m x 2.1 m with buffers
<i>Application</i>	Treatments (see Tables 1 & 2) were applied on 14 April (GS 32), 8 May (GS 47-51) and 20 May (GS 59-61) in 200 l/ha water as a medium spray using F110-03 nozzles
<i>Experiment diary</i>	See Appendix
<i>Deviations from protocol</i>	<ul style="list-style-type: none"> • 2nd treatment timing applied at GS 47-51 (target GS 39) • 3rd treatment timing applied at GS 59-61 (target GS 55)

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Results

Table 1. Brown rust and green leaf area (% leaf area) and grain yield (t/ha at 85% dm)

Treatments (product l/ha)	Brown rust L1-3 on 29 May	Brown rust L1-3 on 16 June	Green leaf L1-3 on 2 July	Yield (t/ha at 85% dm)
1. Untreated	36.3	49.3	0.0	5.59
<i>Two-spray fungicide programmes, GS 32 + 47-51</i>				
2. Alto 100SL (0.8)	10.3	34.0	4.5	5.91
3. Opus (1.0)	9.5	32.8	5.5	6.08
4. Folicur (1.0)*	5.5	30.5	5.5	6.35
5. Amistar (1.0)	1.3	5.8	55.8	8.14
6. Amistar (0.5)	3.4	9.5	50.0	7.47
7. Corbel (1.0)*	4.1	30.3	1.0	6.56
8. Landmark (1.0)	4.0	20.8	15.3	7.01
9. Folicur + Corbel (1.0 + 0.5)*	1.4	11.0	22.5	7.11
10. Amistar + Corbel (1.0 + 0.5)	0.6	3.3	66.3	8.59
11. Amistar + Corbel (0.5 + 0.5)	1.6	5.3	47.0	7.81
12. Landmark + Corbel (1.0 + 0.5)	1.1	5.3	16.8	7.70
13. Amistar + Folicur (0.5 + 0.5)	1.4	7.5	53.8	8.14
<i>Timing element, Amistar + Corbel (1.0 + 0.5)</i>				
14. GS 32 (14 April)	6.5	41.3	0.0	6.19
15. GS 47-51 (8 May)	2.5	5.8	59.3	7.61
16. GS 47-51 + 59-61 (20 May)	0.6	0.8	79.8	8.22
17. GS 32 + 47-51 + 59-61	0.1	0.1	75.8	8.43
LSD	2.40	6.91	10.10	0.759
SE per plot (48 df)±	1.68	4.84	7.07	0.531
CV (%)	31.7	28.1	21.5	7.3

* These were the only products currently approved for use on rye after GS 32. The grain from the other plots was destroyed.

Table 2. Active ingredients of commercial products used

Product	Active ingredients (ai)	g ai/l or % w/w	Formulation
Alto 100SL	cyproconazole	250	SC
Amistar	azoxystrobin	250	SC
Corbel	fenpropimorph	750	EC
Folicur	tebuconazole	250	EW
Landmark	epoxiconazole + kresoxim-methyl	125 + 125	SC
Opus	epoxiconazole	125	SC

- The crop followed rye and was drilled on 25 September 1997.
- When the first fungicides were applied on 14 April 1998, brown rust was already present in the crop with up to 20% of the area of the third expanded leaf affected. The disease continued to develop as the season progressed and assessments on untreated crop at the subsequent spray timings are held on file.
- A full assessment (a composite value of leaves 1, 2 and 3) was made on 29 May when 36.3% brown rust was recorded on untreated crop (Tables 1 and A1). All treatments significantly reduced disease levels many of them having less than 5% infection.

- At a later assessment on 16 June, brown rust had increased to 49.3% on untreated plots (Tables 1 and A1). Whilst all treatments were significantly reducing brown rust infection, the best control followed the inclusion of Amistar either alone or in a mixture when an 8 May application was included in the programme.
- Green leaf assessments on 16 June, 2 and 10 July showed that by 2 July, no green leaf remained on untreated crop (Tables 1 and A1). At this assessment, treatments giving good control of brown rust had retained the most green leaf (over 70% from the best programmes). This benefit was maintained at the last assessment.
- At harvest, considerable brackling was recorded where no fungicide had been applied, but this was significantly reduced by all the programmes (Table A2).
- Where no fungicide was applied, the crop produced a yield of 5.59 t/ha (Tables 1 and A2). Most treatments significantly increased yield, with responses ranging from 0.32 t/ha (two applications of Alto 100SL at 0.8 l/ha) to 3.00 t/ha (two applications of Amistar + Corbel at 1.0 + 0.5 l/ha at Gs 32 and GS 47-51). The inclusion of Amistar in the fungicide programme always produced a relatively good yield response.
- Where no fungicide was applied, a specific weight of 74.1 kg/hl was recorded (Table A2). There were no significant effects of treatment.

Further details

Other experiment details and results are presented in the appendix.

Field details

Applications to crop

Experiment diary

Method

Results

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

Table A2 Brackling (0-5 score), grain yield (t/ha) and specific weight (kg/hl)

Field details

Site	New Found Farm, Colney, Norwich			
Field reference	Block 4			
Crop	Winter rye			
Variety	Rapid			
Previous crop	1997 Rye 1996 Rye			
Soil type and series	Loamy sand			
Soil analysis	pH	P	K	Mg
July 1998	8.0	1+	1	0+
Seed rate	300 seeds/m ²			
Date sown	25 September 1997			
Cultivations	9 September 1997	Ploughed and pressed		

Applications to crop

Precise treatments remain confidential but they are held on file. Appropriate treatments were applied to give a good commercial level of control of weeds, pests and crop growth and of crop nutrition.

Experiment diary

Date	GS	Treatments applied or action
25 September 1997	-	Trial drilled using Oyjord plot drill
14 April 1998	32	1 st fungicide application as per treatment list. Weather conditions cloudy and cool (8°C)
8 May	47-51	2 nd fungicide application as per treatment list. Weather conditions cloudy and warm (19°C)
20 May	59-61	3 rd fungicide application as per treatment list. Weather conditions cloudy and warm (23°C)
29 May	69-71	Assessment of brown rust on leaves 1-3
16 June	73	Assessment of brown rust and green leaf area on leaves 1-3
2 July	77-83	Assessment of green leaf area on leaves 1-3
10 July	85	Assessment of green leaf area on leaves 1-3
5 August		Assessment of brackling Trial harvested using Sampo 2010 "M" plot combine

Spray and assessment methods for cereal trials

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

Plot layout

Plots were sown at 500 seeds/m² 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 half of the buffer at each side. For harvest purposes, plot length was reduced to 9.0 m.

Overall treatments

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

Spraying details

Treatments were applied using a CO₂ 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

Brackling was assessed on a scale of 1-5 as the plot area affected by stems which had buckled or bent over sharply at a point (normally a node) at least one-third up the stem from its base where 1 = no brackling and 5 = severe brackling.

Foliar disease and green leaf area

Foliar disease (brown rust) and green leaf area were determined by the following method. A standard was established and assessments were made from the end of each plot and the appropriate values recorded.

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 by taking a 200 g sample, oven drying for 40 hours at 100-102°C and weighing at ambient temperature.

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 Farn-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.

Tables of results

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

Treatment	Brown rust	Brown rust	GLA	GLA	GLA
-	L1-3	L1-3	L1-3	L1-3	L1-3
Unit	%	%	%	%	%
Date	29/05/1998	16/06/1998	16/06/1998	02/07/1998	10/07/1998
1	36.3	49.3	32.8	0.0	0.0
2	10.3	34.0	54.5	4.5	0.3
3	9.5	32.8	48.5	5.5	0.3
4	5.5	30.5	57.0	5.5	0.5
5	1.3	5.8	85.8	55.8	11.8
6	3.4	9.5	82.3	50.0	9.0
7	4.1	30.3	54.8	1.0	0.0
8	4.0	20.8	69.3	15.3	1.3
9	1.4	11.0	78.5	22.5	0.3
10	0.6	3.3	94.0	66.3	22.8
11	1.6	5.3	86.3	47.0	8.5
12	1.1	5.3	87.0	16.8	1.8
13	1.4	7.5	82.5	53.8	11.5
14	6.5	41.3	40.0	0.0	0.0
15	2.5	5.8	88.0	59.3	13.8
16	0.6	0.8	95.3	79.8	45.3
17	0.1	0.1	98.0	75.8	33.5
LSD (P=0.05)	2.40	6.91	10.31	10.10	11.00
SE per plot (48 df)±	1.68	4.84	7.22	7.07	7.70
CV (%)	31.7	28.1	9.9	21.5	81.7

Table A2 *Brackling (1-5 score)*, grain yield (t/ha at 85% dm) and specific weight (kg/hl)*

Treatment	Brackling*	Grain yield at 85% dm	Specific weight
-	0-5	t/ha	kg/hl
Unit	05/08/1998	05/08/1998	
Date			
1	4.0	5.59	74.1
2	3.3	5.91	73.1
3	3.3	6.08	74.3
4	3.0	6.35	74.9
5	3.0	8.14	74.8
6	3.0	7.47	74.9
7	3.0	6.56	74.6
8	3.0	7.01	74.2
9	3.0	7.11	74.4
10	3.0	8.59	74.1
11	3.3	7.81	74.8
12	3.0	7.70	74.5
13	3.0	8.14	74.9
14	3.3	6.19	74.8
15	3.0	7.61	74.0
16	3.0	8.22	73.5
17	3.0	8.43	73.9
LSD (P=0.05)	0.43	0.759	NS
SE per plot (48 df)±	0.3	0.531	0.94
CV (%)	9.72	7.3	1.3

* Brackling score (1-5) where 1 = no brackling and 5 = severe brackling