Title: WB23-05502 Fungicide timing response monitoring in winter barley at Morley

Trial Code: WB23-05502
Centre and (Trial Site): Morley
Crop: Winter Barley
Variety: Craft
Report Author: Nathan Morris

Objective:

To record and monitor the yield responses to each of the component spray timings within a fungicide spray programme on winter barley.

Background:

This is the 14th year of operation for this trial series and forms an invaluable part of the dataset on fungicide performance. This trial is mirrored with a winter wheat trial (05501) performing a similar function. This work is sponsored through The Morley Agricultural Foundation (TMAF) as part of the NIAB Morley Long Term Studies (LoTS) programme. The trial uses the winter barley variety Craft, a two-row malting winter barley that displays a strong yield response when comparing untreated to fungicide-treated crops and is a preferred variety with maltsters and brewers in Norfolk and East Anglia. Craft displays moderately high resistance to mildew, brown rust, rhynchosporium and net blotch; scoring 6, 7, 6 and 5 respectively (according to the 2023-24 AHDB Recommended List). Previous years have shown disease score levels in the field to be variable, depending on the seasonal pressure.

Summary:

Unlike in previous years in this trial series, disease pressure was substantial, with observed net blotch early in the season at GS25. The use of a T3 alone resulted in a negative yield response, yielding less than the standard program (T1 + T2). Overall, the standard program (T1 + T2), produced the highest yield with 7.15 t/ha and the greatest yield response with 0.35 t/ha, compared to untreated. Excluding season 2022, this confers with the annual observed trends that a two-spray fungicide programme (at traditional T1 + T2 timings) is responsible for most of the yield uplift in barley.

Treatments:

Table 1: Treatment list with description and comments.

Treatments	Growth stage timing of application				Comment
	GS25	GS31-32	G39	GS61	
1	-	-	-	-	Untreated
2	-	Siltra Xpro 0.6l/ha	-	-	T1 only
3	-	Siltra Xpro 0.6l/ha	Siltra Xpro 0.4l/ha	-	T1 + T2
4	Proline 275 0.25 l/ha	Siltra Xpro 0.6l/ha	Siltra Xpro 0.4l/ha	-	Spring T0 + T1 + T2
5	-	Siltra Xpro 0.6l/ha	Siltra Xpro 0.4l/ha	Proline 275 0.25 l/ha	T1 + T2 + T3
6	-	Revystar XE 0.6 l/ha	Revystar XE 0.4 l/ha	Proline 275 0.25 l/ha	T1 + T2* + T3

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Table 2: Products and active ingredients.

Product	Active ingredient and concentration
Proline 275	Prothioconazole 275 g/l
Revystar XE	Fluxapyroxad 47.5 g/l and mefentrifluconazole 100 g/l
Siltra Xpro	Bixafen 60 g/l and prothioconazole 200 g/l

Results

Net blotch was the principal disease observed in 2023, unlike in previous years where disease pressure has been significantly lower. Notably, GS25 had a high level of net blotch observations (Table 3). The dry weather slowed spread up through the canopy, such that observed levels of net blotch at the GS39 assessment were confined to leaf 4 and leaf 3, with no net blotch observed on the flag leaf at GS77. Ramularia or brown rust was not visually observed in the trial. Green leaf area (GLA) was maintained in leaf 2 and 3 but the untreated and T1+T2*+T3 saw a small reduction in GLA on leaf 4.

Table 3. Mean disease scores (n=3 plots per treatment).

Growth Stage	GS 25											
Disease	Net blotch %											
Treatment	Untreated			T1+T2			T1+T2+T3			T1+T2*+T3		
Leaf	5	6	7	5	6	7	5	6	7	5	6	7
Average disease score	0.3	1.7	4.3	0.0	2.3	1.7	0.0	2.3	3.3	0.0	2.0	3.7
Growth Stage	GS 39											
Disease	Net blotch %											
Treatment	Untreated			T1+T2			T1+T2+T3			T1+T2*+T3		
Leaf	2	3	4	2	3	4	2	3	4	2	3	4
Average disease score	0.0	0.7	3.3	0.0	0.7	1.0	0.0	0.7	1.7	0.7	1.0	4.0
Growth Stage	GS 39											
Disease	GLA %											
Treatment	Untreated			T1+T2			T1+T2+T3			T1+T2*+T3		
Leaf	2	3	4	2	3	4	2	3	4	2	3	4
Average disease score	99	99	97	99	99	99	99	99	99	99	98	97

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Table 4: Yield (t/ha) of Craft at Morley in 2023, with details of each treatment programme and growth stage timing of application.

Treatment	Growth stage timing of application				Comment	Average Yield t/ha
	GS25	GS31	GS39	GS61		
1	Untreated	-	-	-	Untreated	**6.80** ± 0.14
2	-	Siltra Xpro 0.6 l/ha	-	-	T1 only	**6.99** ± 0.24
3	-	Siltra Xpro 0.6 l/ha	Siltra Xpro 0.4 l/ha	-	T1 + T2	**7.15** ± 0.17
4	Proline 275 0.25 l/ha	Siltra Xpro 0.6 l/ha	Siltra Xpro 0.4 l/ha	-	Spring T0 + T1 + T2	**7.06** ± 0.17
5	-	Siltra Xpro 0.6 l/ha	Siltra Xpro 0.4 l/ha	Proline 275 0.25 l/ha	T1 + T2 + T3	**7.05** ± 0.14
6	-	Revystar XE 0.6 l/ha	Revystar XE 0.4 l/Ha	Proline 275 0.25 l/ha	T1 + T2* + T3	**6.63 ± 0.14**

Figure 1: Yield (t/ha) ± SE for Craft at Morley in 2023.

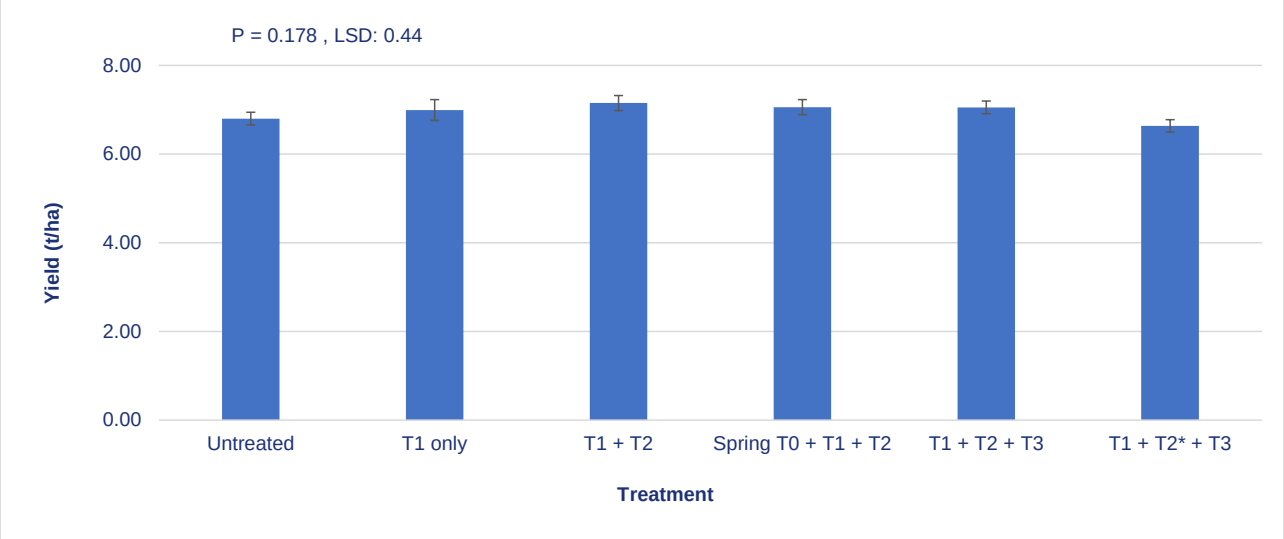

Table 5: Component yield responses (t/ha) for Craft.

Comparison	Yield Response (t/ha)
Benefit of T0 alone	-0.09
Benefit of T1 alone	0.19
Benefit of T2 alone	0.16
Benefit of T1+T2 (Standard programme)	0.35
Benefit of T3 alone where Siltra Xpro was used at T2	-0.10
Benefit of T3 alone where Revystar XE was used at T2	-0.52

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Table 4 and Figure 1 display the yield results for each treatment programme. There were no significant differences between treatment yields. Untreated plots yielded an average of 6.80 t/ha, and the largest yield increase was observed with a T1+T2 programme, yielding 7.15 t/ha. Table 5 displays the yield responses to individual components of the fungicide programme. Using a 2 spray programme (at traditional T1+T2 timings) induced the highest yield response of 0.35 t/ha, whereas a T3 spray, where either after Siltra Xpro or Revystar XE used at T2, resulted in a negative response.

Table 6: Multi-year fungicide yield response 2008 – 2023 at Morley. Previous years' trials have selected winter barley varieties with moderate to high fungicide responses.

Harvest	Timing				
	Autumn T0	Spring T0	T1 + T2	T3	3 spray vs 2 spray programme
2008	0.05	0.10	1.75	No data	
2011	0.00	0.08	0.37	0.00	
2012	0.65	0.73	0.34	0.36	
2013	0.01	0.00	0.51	0.33	
2014	0.12	0.27	1.87	0.53	
2015	0.47	0.49	0.35	0.67	
2016	0.00	0.04	1.24	0.56	
2017	0.00	0.13	1.73	0.36	
2018	0.05	0.08	2.29	0.32	0.31
2019	0.10	0.30	1.48	0.16	0.06
2020	-	0.10	0.20	0.10	0.10
2021	-	0.11	0.38	0.32	0.32
2022	-	0.28	-0.22	0.33	0.31
2023	-	-0.09	0.35	-0.31	0.24
Mean Response		*0.19*	*0.90*	*0.27*	*0.14*

Compared with the mean yield response across the fourteen-year trial period, the 2023 yield response was relatively low (Table 6). In 2023, there was a -0.09 t/ha yield response to a spring T0 alone, a 0.35 t/ha response to the addition of a T1 + T2, and a -0.31 t/ha response to a T3.

Molecular detection of foliar pathogens

Net Blotch

Cultures of net blotch (*Pyrenophora teres* f. *teres*) were isolated from 50 leaf samples taken from three untreated plots within the fungicide trial. DNA was extracted from these cultures via CTAB extraction and amplified using polymerase chain reaction (PCR). The products of these reactions were then imaged on an agarose gel, along with controls and compared to the known DNA band sizes of either the net form of net blotch or spot form of net blotch (*Pyrenophora teres* f. *maculata*). Using this methodology, it was determined which form of net blotch was present within the trial at different growth stages.

In 2023, three individual untreated plots within the fungicide trial were compared for the presence of both *forma speciales* of net blotch (Figure 2). All three growth stages showed disease presence as did all three plots. Most disease was present in the GS25 samples, and the disease levels were reduced at GS31 and reduced further at GS39. GS39 shows no disease presence in one of the replicate plots, this is not to say the pathogen was not present at these stages within the plot, just not detected in the molecular screen. These results confer with the visual disease scoring described earlier in the report.

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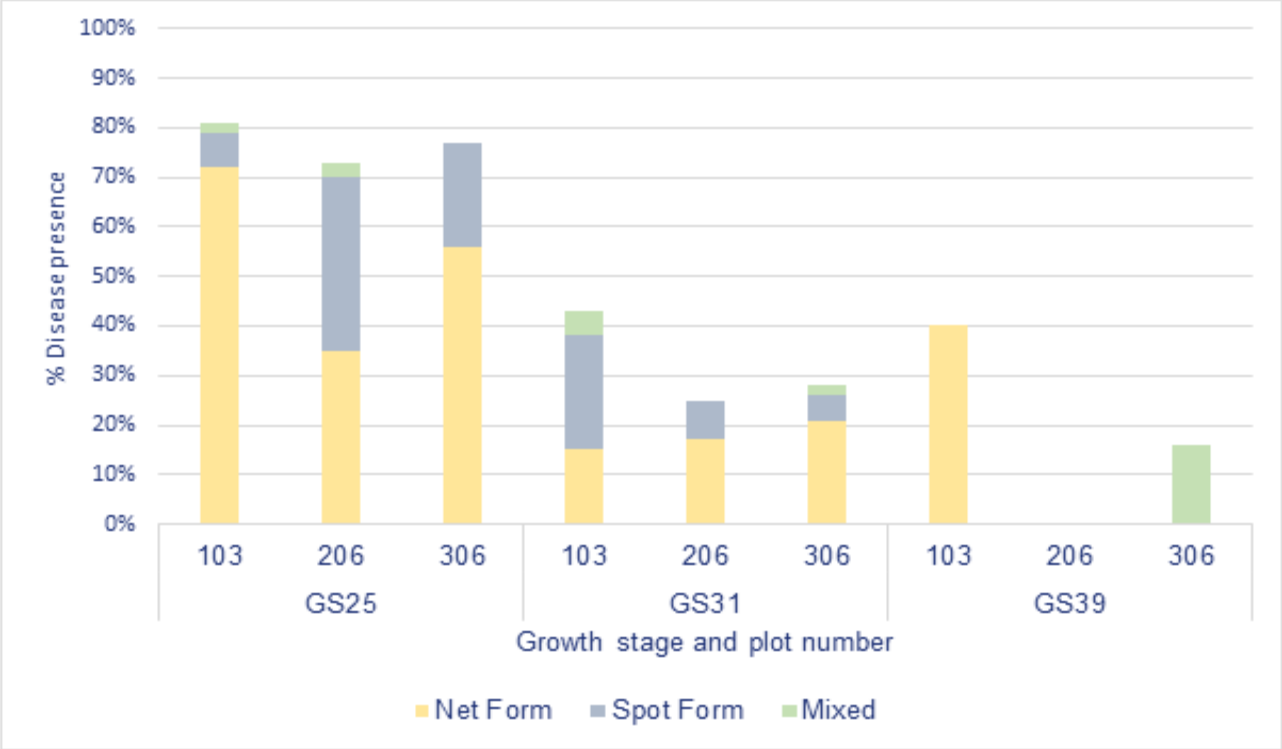
The net form of net blotch was the most common form; however, the spot form was observed at GS25 and GS31. There are also samples that show a mix of both *forma speciales* (spot and net forms) present at all three growth stages.

From these results, it can be inferred that both forms of net blotch were present within the untreated plots of the trial from GS25 through to GS39.

Figure 2: Net blotch presence in untreated plots in 2023.



Ramularia

50 leaves from each treatment were tested from three different growth stages, GS31, GS39 and GS59. From these leaves, the DNA of *Ramularia collo-cygni* was extracted and a quantitative measurement of the presence of ramularia (ng fungal DNA/mg of leaf tissue) was determined using quantitative polymerase chain reaction (qPCR). Using these concentrations, statistical analysis was conducted to determine if there was any significant difference in the presence and amount of Ramularia in leaf tissue, between growth stages or treatments.

The statistical analysis found no significant difference between growth stages or treatments for the presence and amount of Ramularia in leaf tissue (Table 7). Although ramularia was present throughout the trial, the levels were low. When paired with the visual assessment data, it can be inferred that the 2023 season had low levels of ramularia which showed no significant results.

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Table 7: Concentration of Ramularia in trial

Treatment	Growth stage	Ramularia concentration (ng/mg of leaf tissue)
1	31	2.6
	39	9.3
	59	2.6
2	39	1.4
	59	0.6
3	39	9.5
	59	1.4
4	39	2.7
	59	1.4
5	39	0.3
	59	6
6	39	0.7
	59	0.8

Appendix

Field details

Trial Code	WB23-05502
Trial Centre	Morley
Trial Location	Rachal's
Crop	Winter barley
Previous Crop	Winter wheat
Soil Texture	Sandy clay loam
Soil Series	Ashley
Soil Analysis	pH 7.4, P 11 mg/l, K 88mg/l, Mg 39 mg/l
Soil Mineral Nitrogen	0-30cm 16 kgN/ha, 30-60cm 7 kgN/ha, 60-90cm 4 kgN/ha
Total N/ha applied	99 kgN/ha
Drill Date	06/10/22
Seed Rate	315 seed/m^2
Drilled Plot Dimensions	2m x 12m
Replicates	3
Harvest Date	17/07/23

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