3.3.6 Photosynthetically active radiation interception and photosynthetically active radiation use efficiency

3.3.6.1 Photosynthetically active radiation use efficiency

Radiation use efficiency (RUE) was measured at the East Yorkshire and Kent sites from 2001 to 2003. Values ranged between 1.71 and 2.63 g MJ^{-1} and there were no consistent or significant seed rate or fungicide treatment effects, though varietal effects were not tested (data not shown).

3.3.6.2 Cumulative photosynthetically active radiation interception m^{-2}

3.3.6.2.1 2000/01

3.3.6.2.1.1 East Yorkshire

Between 7th February and 28th March, 107 MJ m^{-2} of photosynthetically active radiation was intercepted by the crop, averaging across all treatments (Figure 3.3.24). Cumulative radiation interception continued to increase through the season, until by harvest, 727 MJ m^{-2} PAR had been intercepted. Neither seed rate nor fungicide treatment had any significant effect on PAR interception at any point in the season, though the higher seed rate intercepted more radiation at all sampling points.

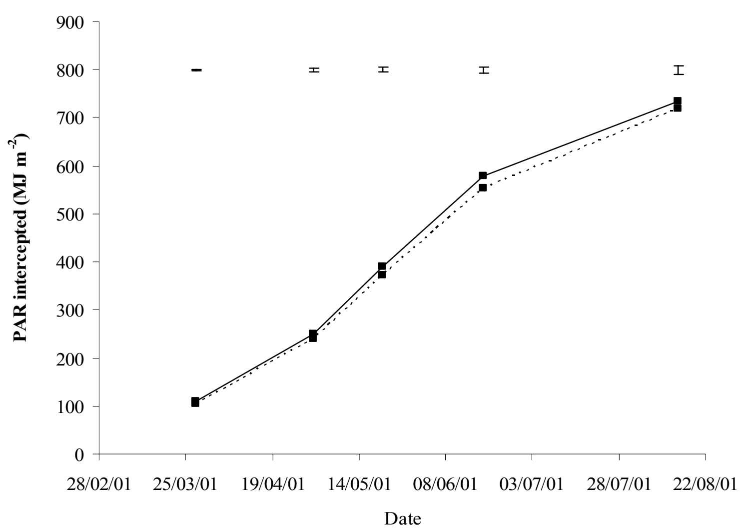

Figure 3.3.24 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}) and East Yorkshire, 2000/01, from 7th February to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.2.1.2 Kent

Between 12th February and 3rd April, 42 MJ m^{-2} PAR had been intercepted by the crop, averaging across all treatments (Figure 3.3.25). There then followed a period of rapid increase from early May until early June, when cumulative PAR intercepted was 670 MJ m^{-2}. The rate of increase then levelled off until at harvest (1st August), a total of 815 MJ m^{-2} PAR had been intercepted, averaged across treatments. Increasing seed rate increased radiation interception at all sampling times in the season, significantly so on 7th May and 28th May (p=0.026 and 0.019 respectively). When looking at PAR intercepted between sampling points, as opposed to cumulative PAR through the season, seed rate also intercepted more PAR on 2nd July (p=0.013; data not shown). Fungicide treatments had no significant effect at any point in the season, nor were there any significant treatment interactions.

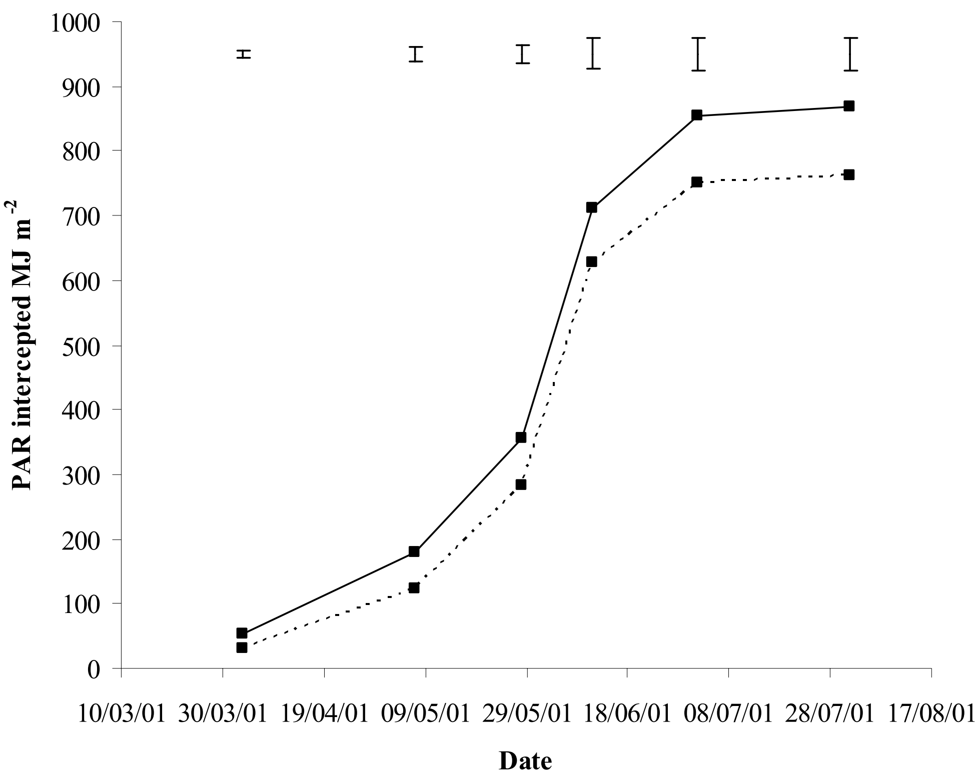

Figure 3.3.25 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}) at the Kent site, 2000/01, from 12th February to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10, except 2nd July d.f =9 and 1st August d.f. = 8).

3.3.6.2.2 2001/02

3.3.6.2.2.1 East Yorkshire

Between 4th March and 22nd April, 227 MJ m^{-2} PAR was intercepted, averaged across all treatments (Figure 3.3.26). A rapid period of increase followed until by mid-June, 637 MJ m^{-2} PAR had been intercepted. The rate of increase in cumulative PAR decreased from mid-June to harvest, where at total of 760 MJ m^{-2} PAR had been intercepted. Increasing seed rate increased intercepted PAR significantly at all sampling points, though these increases were only small ($p<0.05$). Additional spring fungicides increased intercepted PAR on 22nd April, 20th May and 18th June ($p=0.009$, 0.018 and 0.03 respectively), by around 10 MJ m^{-2} compared to the control treatment. There were no significant interactions between seed rate and fungicide treatments.

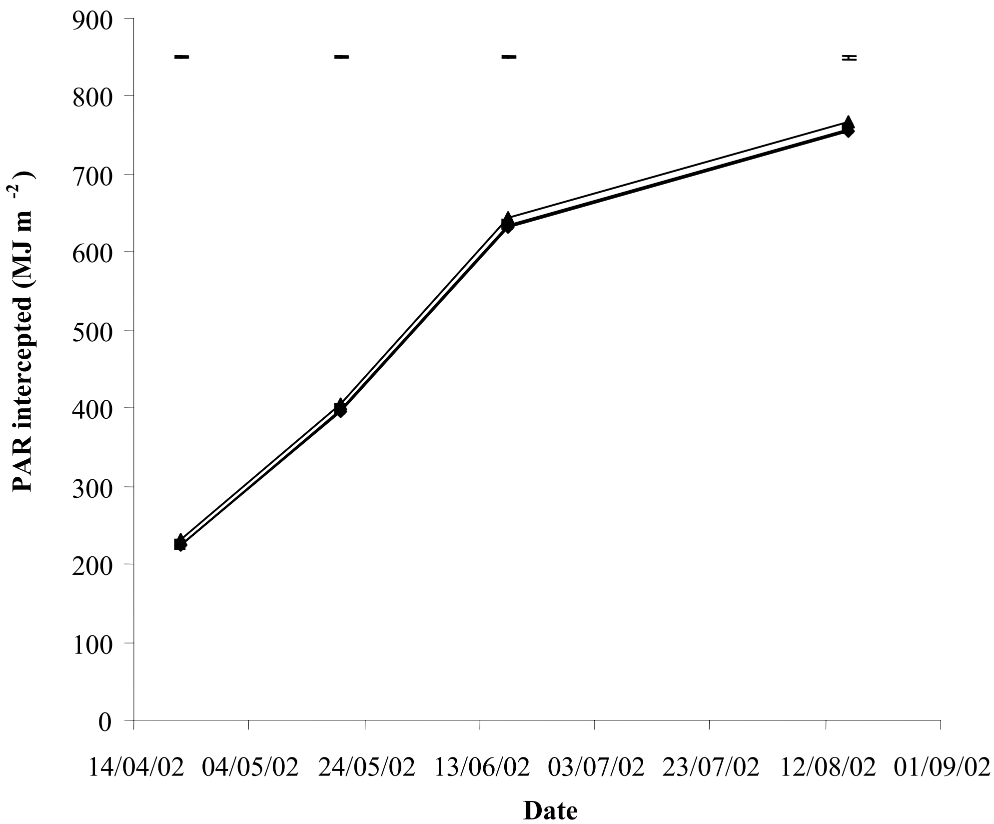

Figure 3.3.26 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}), East Yorkshire 2001/02, from 12th February to harvest, with standard fungicide treatments (■), standard plus additional autumn fungicide (♦) and standard plus additional spring fungicide (▲).. Error bars are SEDs for comparing fungicide treatment means (d.f. = 10).

3.3.6.2.2.2 Kent

Cumulative intercepted PAR between 11th March and 15th April averaged 162 MJ m^{-2} averaged across treatments (Figure 3.3.27). This increased rapidly through May until mid-June, and then more steadily until harvest, where a total of 780 MJ m^{-2} PAR had been intercepted. Increasing seed rate increased PAR intercepted significantly at all sampling points, by around 10 MJ m^{-2} ($p<0.05$). Fungicide treatments had no significant effect on cumulative PAR interception, though additional autumn or additional spring fungicides tended to result in greater PAR interception compared to the control, of around 10 MJ m^{-2} with additional spring fungicide by pre-harvest. There were no significant treatment interactions.

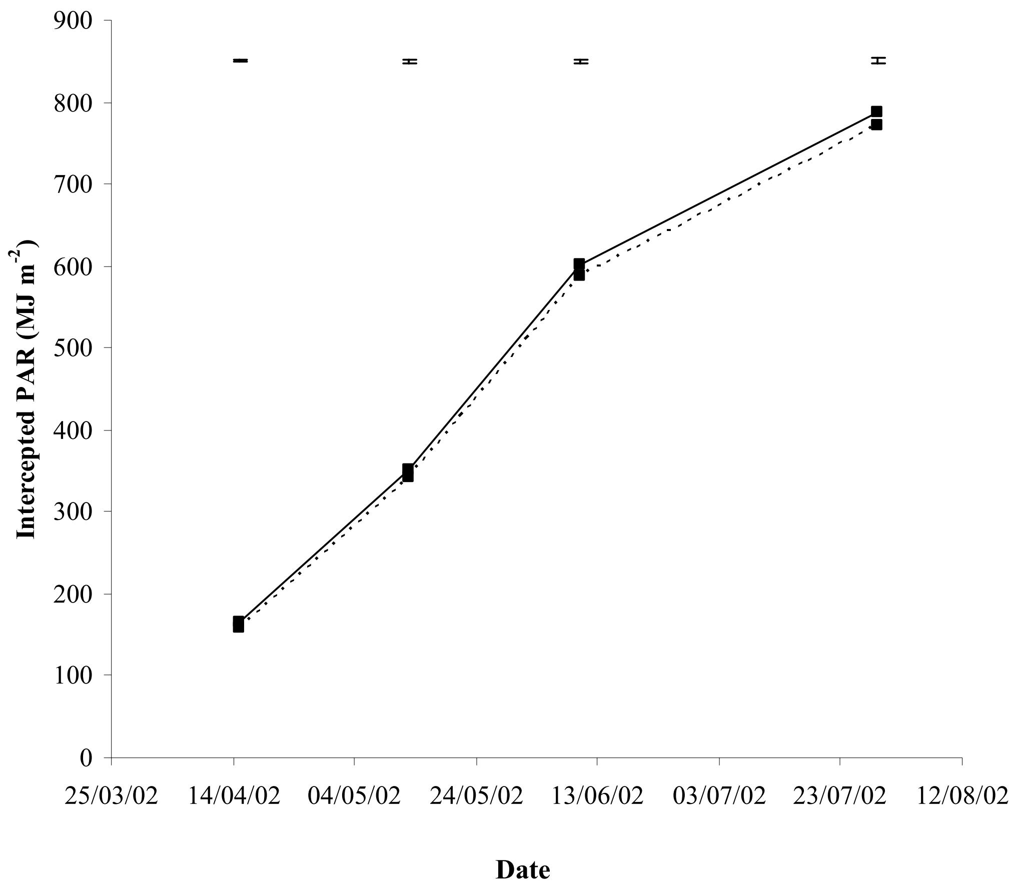

Figure 3.3.27 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}) at the Kent site, 2001/02, from 11th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.2.3 2002/03

3.3.6.2.3.1 East Yorkshire

Cumulative PAR intercepted between 17th March and 14th April was 62 MJ m^{-2} averaged across treatments. There was then a rapid increase in cumulative intercepted PAR until mid-June, when the rate of increase eased a little, until at harvest 663 MJ m^{-2} PAR had been intercepted (Figure 3.3.28). Increasing seed rate increased PAR interception significantly ($p<0.001$) at all sampling points, until at harvest plots sown at 200 seeds m^{-2} had intercepted an additional 40 MJ m^{-2} PAR compared to plots sown at 100 seeds m^{-2}. Fungicide treatment had no significant effect at any of the sampling points, nor were there any significant treatment interactions.

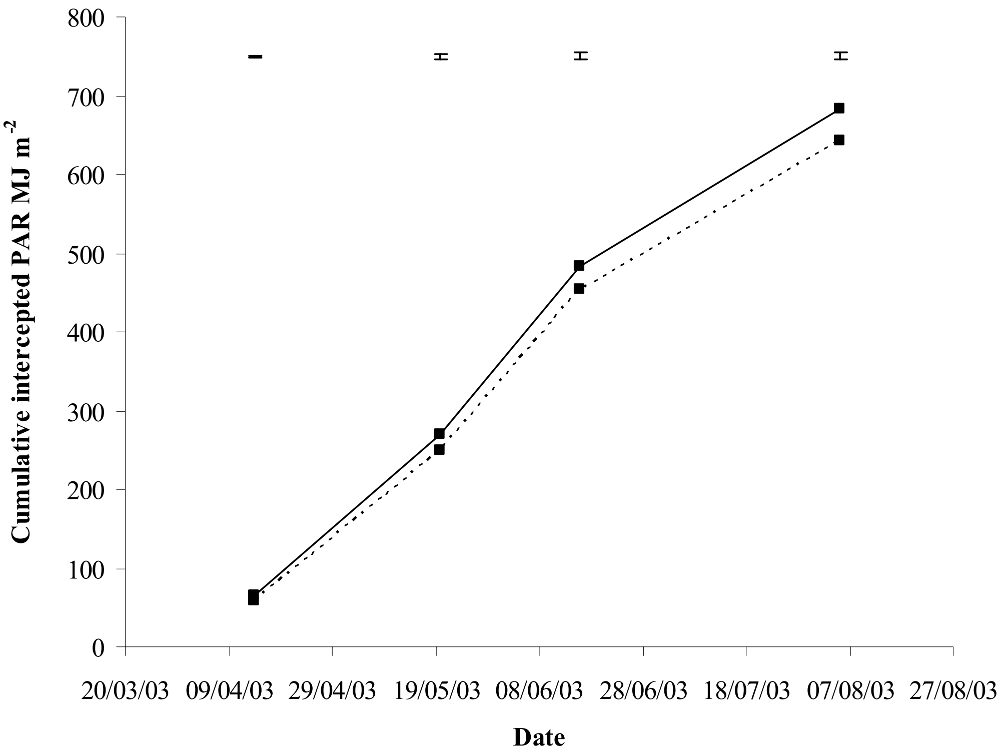

Figure 3.3.28 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}), East Yorkshire 2002/03, from 17th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.2.3.2 Kent

Between 24th March and 7th April, 64 MJ m^{-2} PAR was intercepted, averaged across treatments. There was a rapid increase in cumulative PAR intercepted from this point up to mid-June, when the rate of increase slackened, until at harvest 734 MJ m^{-2} PAR had been intercepted (Figure 3.3.29). Cumulative intercepted PAR was generally higher at 200 seeds m^{-2}, but increases were not statistically significant. There were no significant fungicide or treatment interaction effects.

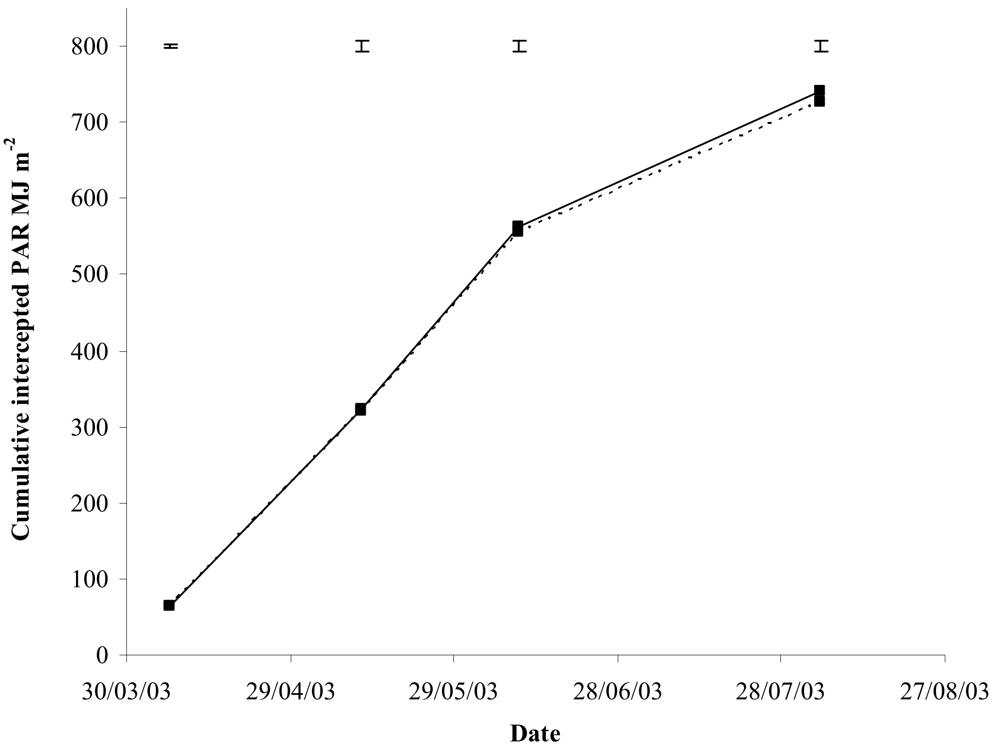

Figure 3.3.29 Cumulative photosynthetically active radiation (PAR) interception (MJ m^{-2}), Kent 2002/03, from 24th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.2.4 Radiation interception – summary

Increasing seed rate tended to increase PAR interception, but these increases were generally only small, even if statistically significant. Only at the Kent site in the 2000/01 season were there substantial absolute increases in PAR interception at the higher seed rate, of over 100 MJ m^{-2}, though perversely this increase was not statistically significant (p=0.068). The largest significant increases were seen at the East Yorkshire site in 2002/03, of 40 MJ m^{-2} by harvest. Fungicide effects were only seen in the 2001/02 season, where additional spring, and to a lesser extent additional autumn fungicides slightly increased PAR interception. There were no seed rate or fungicide treatment interactions.

3.3.6.3 Photosynthetically active radiation interception per shoot

3.3.6.3.1 2000/01

3.3.6.3.1.1 East Yorkshire

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 7th February, rose from 0.14 MJ on 28th March to 1.22 MJ on 14th August, just before harvest (Figure 3.3.30). More PAR was intercepted per shoot at the lower seed rate at all sampling times ($p<0.006$). Additional spring fungicide apparently increased PAR intercepted per shoot on 1st May compared to the other fungicide treatments ($p=0.023$), but this was not observed at other sampling dates. There were no significant seed rate/fungicide treatment interactions.

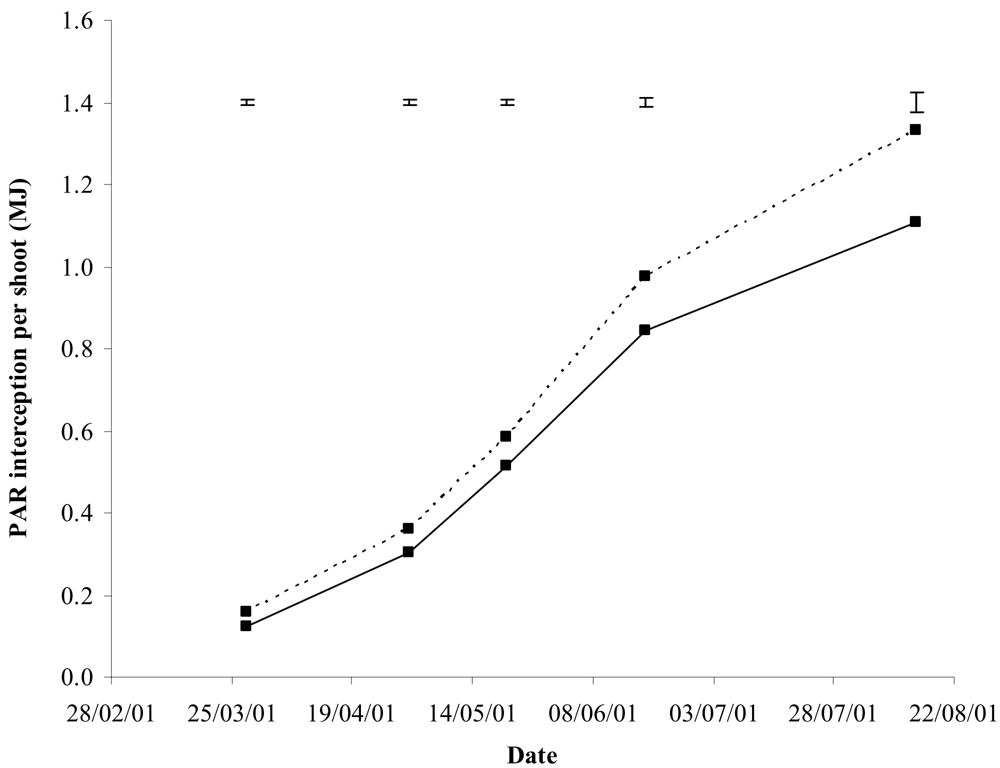

Figure 3.3.30 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ), East Yorkshire 2000/01, from 28th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.3.1.2 Kent

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 12th February, rose from 0.08 MJ on 28th March to 1.91 MJ on 1st August, just before harvest (Figure 3.3.31). PAR interception per shoot was increased at the lower seed rate at all sampling times, significantly so on 28th May, 2nd July and 1st August ($p=0.038$, 0.004 and <0.001 respectively). Additional autumn fungicide apparently decreased PAR intercepted per shoot on 1st August compared to the standard fungicide regime ($p<0.001$), but this was not observed at any other sampling dates. At 100 seeds m^{-2} the standard fungicide regime intercepted significantly more PAR per shoot than the other two fungicide treatments, but at 200 seeds m^{-2}, additional spring fungicide reduced PAR intercepted per shoot compared to the standard or additional autumn fungicide regimes ($p=0.002$).

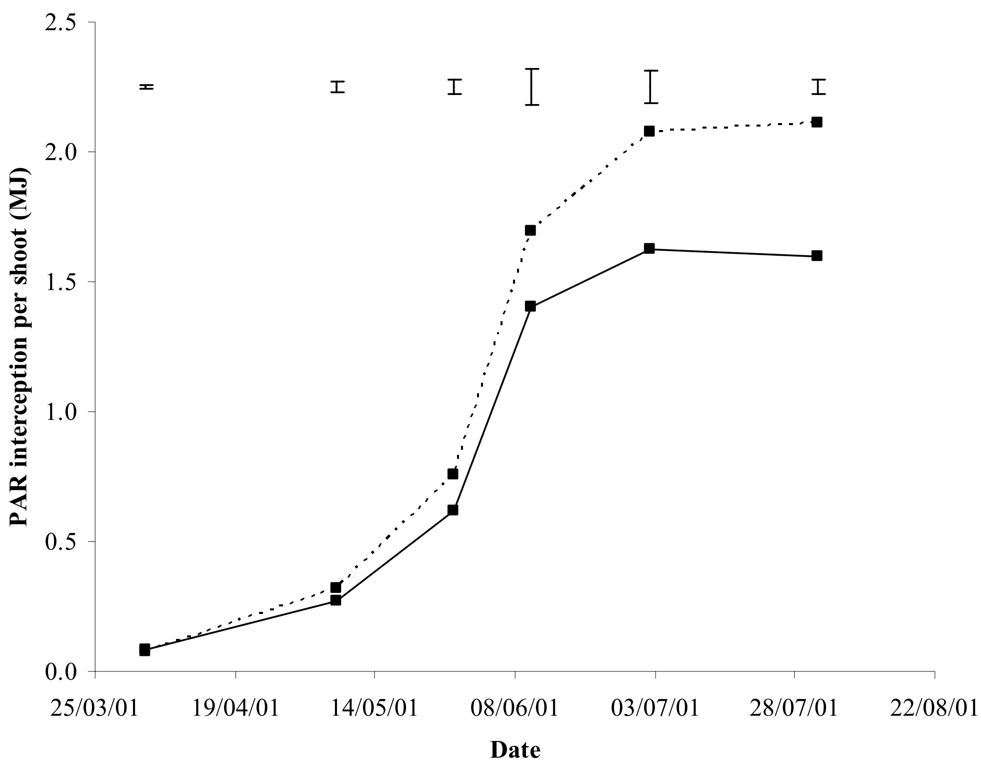

Figure 3.3.31 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ) at the Kent site, 2000/01, from 12th February to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10, except 2nd July d.f =9 and 1st August d.f. = 8).

3.3.6.3.2 2001/02

3.3.6.3.2.1 East Yorkshire

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 4th March, rose from 0.30 MJ on 22nd April to 1.29 MJ on 16th August, just before harvest (Figure 3.3.32). Increasing seed rate from 100 to 200 seeds m^{-2} resulted in significantly less PAR interception per shoot at the lower seed rate at all sampling times ($p<0.05$). Additional spring and additional autumn fungicides increased PAR intercepted per shoot on 18th June and 16 August compared to the standard fungicide regime ($p=0.043$ and 0.014 respectively),. There were no significant seed rate/fungicide treatment interactions.

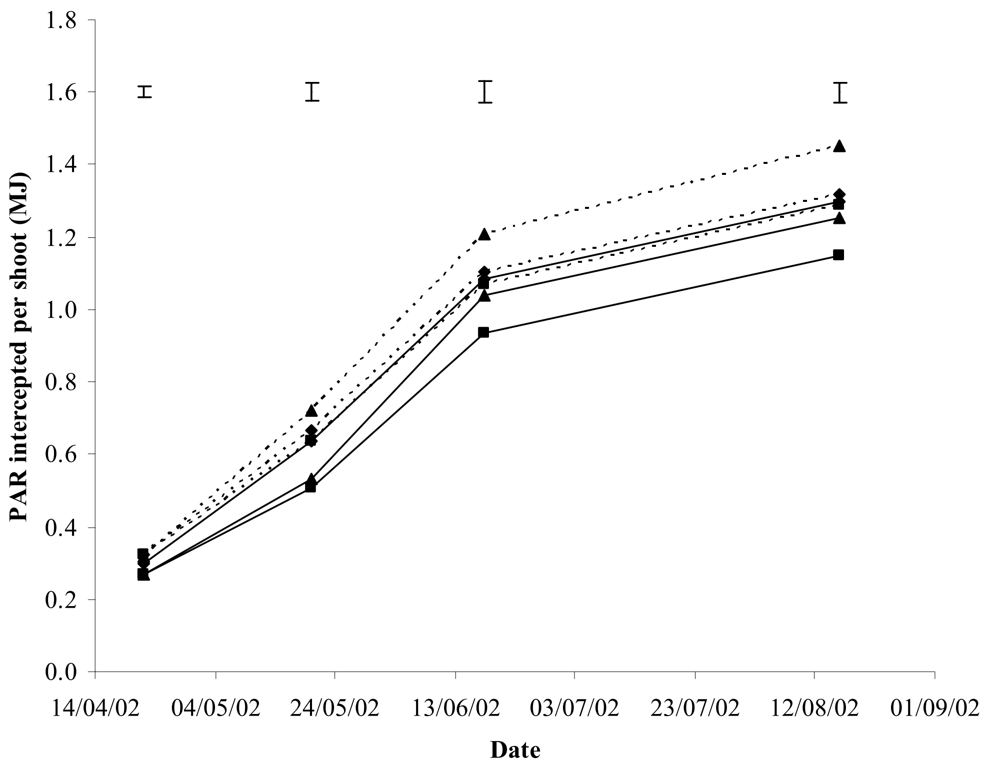

Figure 3.3.32 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ), East Yorkshire 2000/01, from 4th March to harvest. Treatments are sowing rate at 100 (dashed lines) and 200 (solid lines) seeds m^{-2}, with standard fungicide treatments (■), standard plus additional autumn fungicide (♦) and standard plus additional spring fungicide (▲). Error bars are SEDs for comparing fungicide/seed rate treatment combinations (d.f. = 10).

3.3.6.3.2.2 Kent

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 11th March, rose from 0.21 MJ on 15th April to 1.22 MJ on 29th July, just before harvest (Figure 3.3.33). Varying seed rate had no effect, nor were there any significant fungicide effects. However, on 15th April, at 100 seeds m^{-2}, additional autumn fungicides significantly increased PAR interception per shoot compared to the other fungicide treatments (p=0.026), but this effect was not seen at 200 seeds m^{-2}. This effect was not observed at any of the other sampling dates.

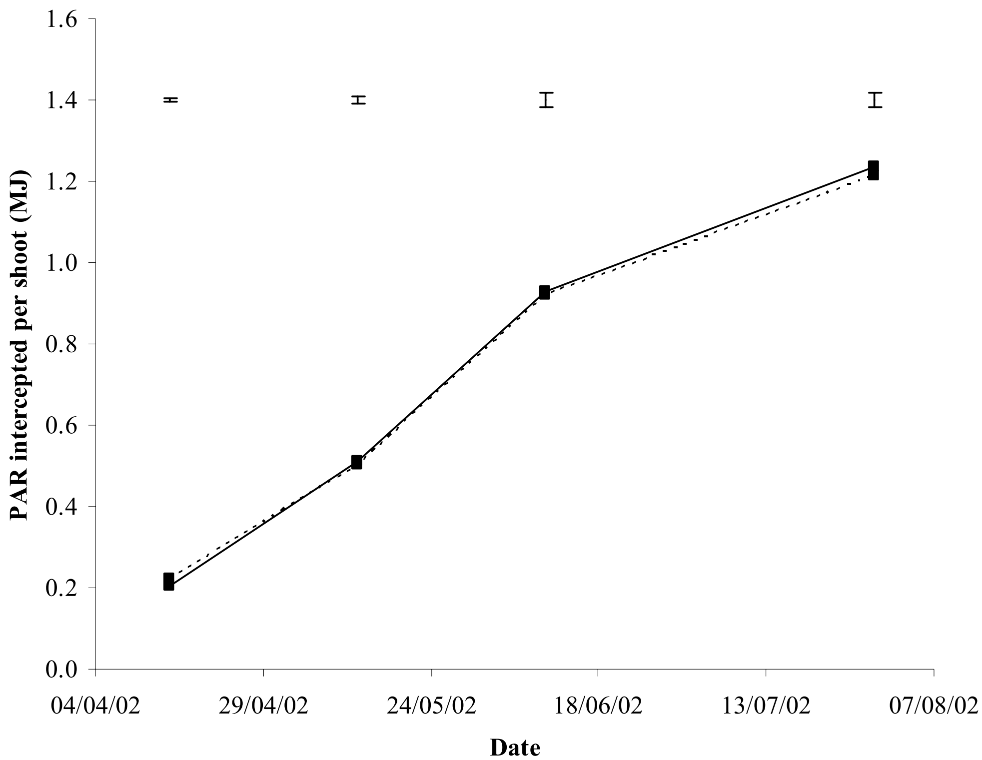

Figure 3.3.33 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ) at the Kent site, 2001/02, from 11th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.3.3 2002/03

3.3.6.3.3.1 East Yorkshire

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 17th March, rose from 0.10 MJ on 14th April to 1.62 MJ on 5th August, just before harvest (Figure 3.3.34). PAR interception per shoot was significantly increased at the lower seed rate at all sampling times ($p<0.05$). Additional autumn fungicide increased PAR intercepted per shoot on 16th June compared to the other fungicide treatments ($p=0.021$), non significant increases were observed on other sampling dates with the exception of the 14th April sampling. On 16th June and 5th August additional autumn fungicides significantly increased PAR interception per shoot compared to other fungicide treatments at 100 seeds m^{-2} ($p=0.022$ and 0.021 respectively), but had no effect at 200 seeds m^{-2}.

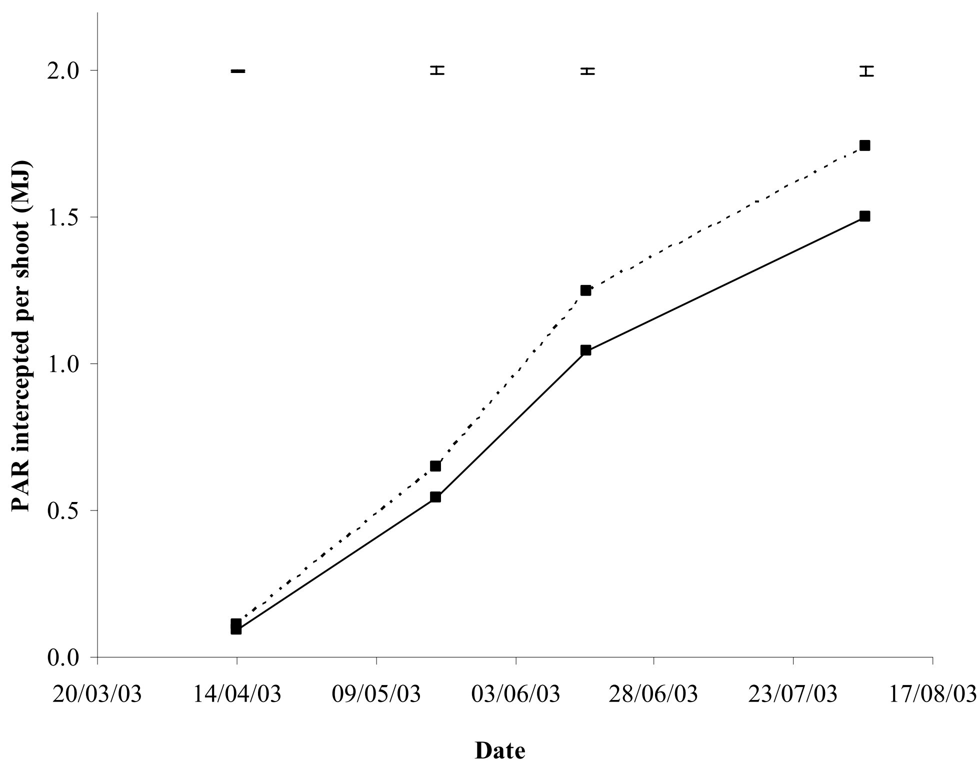

Figure 3.3.34 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ), East Yorkshire 2002/03, from 17th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.3.3.2 Kent

Photosynthetically active radiation (PAR) interception per shoot, averaged across treatments from 24th March, rose from 0.09 MJ on 7th April to 1.27 MJ on 4th August, just before harvest (Figure 3.3.35). At the reduced seed rate PAR interception per shoot was increased, significantly so at all sampling times except 12th May ($p<0.05$). There were no significant fungicide effects, nor were there any significant treatment interactions.

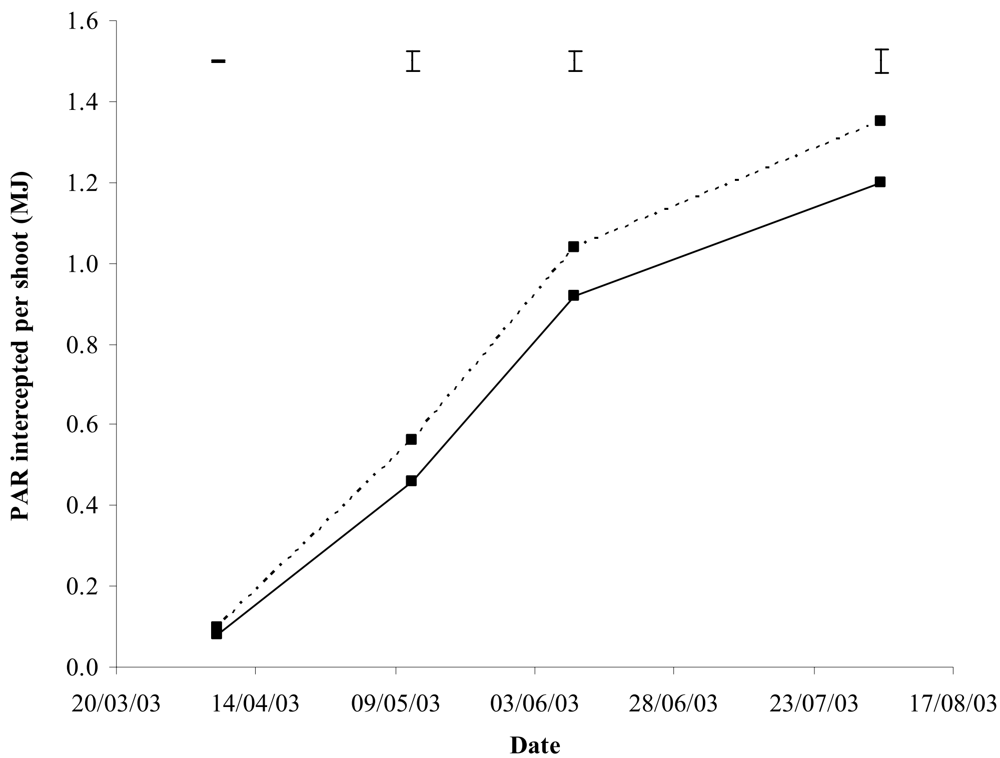

Figure 3.3.35 Cumulative photosynthetically active radiation (PAR) interception per shoot (MJ) at the Kent site, 2002/03, from 24th March to harvest, at 100 (dashed line) and 200 (solid line) seeds m^{-2}. Error bars are SEDs for comparing seed rate means (d.f. = 10).

3.3.6.3.4 Photosynthetically active radiation interception per shoot - summary

Decreasing seed rate generally led to consistent and significant increases in PAR intercepted per shoot. Additional autumn fungicides increased PAR interception per shoot at only two site/season combinations (East Yorkshire, 2001/02 and 2002/03), whereas additional spring fungicides increased this variate at only a single site/season combination (East Yorkshire, 2001/02). There were no consistent treatment interactions.

3.3.7 Total dry biomass matter accumulation

3.3.7.1 1999/2000

No measurements of biomass are available for this season.

3.3.7.2 2000/01

3.3.7.2.1 East Yorkshire

In October, averaging across seed rate and fungicide treatments, total biomass in Claire was 0.26 t ha^{-1}. This rose only slowly through the winter, until by March there was 0.96 t ha^{-1} dry matter. There was then a period of rapid biomass accumulation, until by June, 14.83 t ha^{-1} dry matter had been accumulated (Figure 3.3.36). Increasing seed rate significantly increased biomass at all sampling points ($p<0.05$) except in June. Fungicide had no significant effects, nor were there any treatment interactions.

At pre-harvest, 20.91 t ha^{-1} dry matter had been accumulated (Table 3.3.87). Increasing seed rate significantly increased dry matter accumulation ($p<0.001$) by around 1 t ha^{-1}. Consort had the highest biomass, but this was only weakly significant compared to Claire ($p=0.052$). There were also suggestions that additional spring, additional autumn and spring and early T1 fungicides increased total biomass, but these effects were only weakly significant ($p=0.053$). There were no significant treatment interactions.

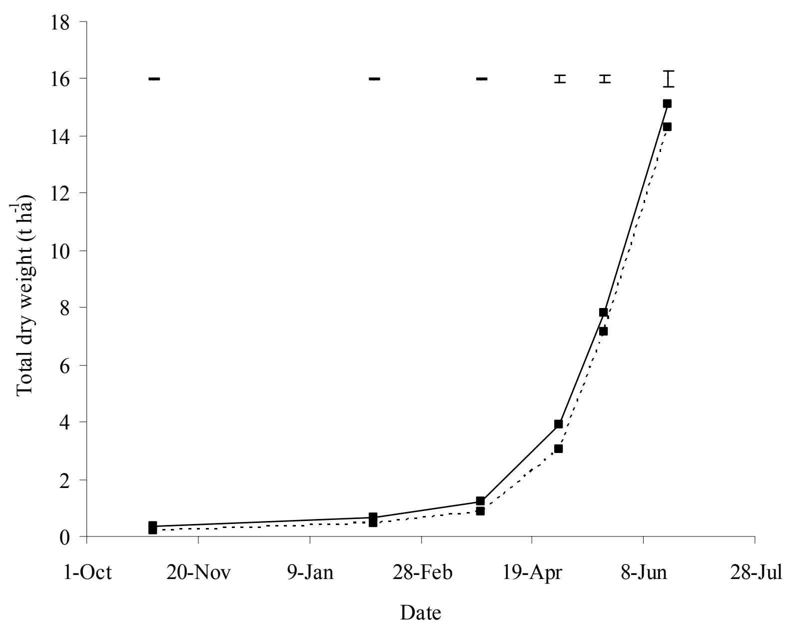

Figure 3.3.36 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, East Yorkshire 2000-01. Error bars are SEDs for comparing seed rate means (d.f. = 10 except in October when d.f. = 8).

Table 3.3.87 Total biomass accumulation immediately preharvest at East Yorkshire, 2000/01. Fungicide treatments are: 1 - standard T1, T2 and T3 applications; 2 – standard plus additional autumn fungicide; 3 – standard plus additional spring fungicide; 4 – standard plus additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3 applications.

		Fungicide Treatment					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	19.10	17.98	21.21	20.90	19.64	19.77
	200	20.74	20.30	22.01	22.26	20.85	21.23
	Mean	19.92	19.14	21.61	21.72	20.25	20.53
Consort	**100**	21.36	20.14	21.22	21.00	21.31	21.01
	200	20.50	21.55	22.26	22.24	21.20	21.55
	Mean	20.93	20.84	21.74	21.62	21.25	21.28
Equinox	**100**	19.57	20.98	20.41	20.35	20.51	20.36
	200	20.41	21.39	21.82	20.73	23.43	21.56
	Mean	19.90	21.19	21.12	20.54	21.97	20.94
Mean	**100**	20.01	19.70	20.95	20.75	20.49	20.38
	200	20.55	21.08	22.03	21.74	21.83	21.45
Overall Mean		20.27	20.39	21.49	21.26	21.16	20.91

	P	SED	
Rate	<0.001	0.28	
Variety	0.052	0.34	
Fungicide	0.053	0.44	
Rate*variety	0.293	0.47	
Rate*fungicide	0.974	0.62	
Variety*fungicide	0.181	0.76	
Rate*variety*fungicide	0.458	1.08	56 df

3.3.7.2.2 Kent

In November, averaging across seed rate and fungicide treatments, total biomass in Claire was 0.31 t ha^{-1}. This rose only slowly through the winter, until by April there was 1.07 t ha^{-1} dry matter. There was then a period of rapid biomass accumulation, until by July, 16.59 t ha^{-1} dry matter had been accumulated (Figure 3.3.37). Increasing seed rate significantly increased biomass in February (p=0.001), April (p=0.013), early May (p=0.005) and late May (p=0.039). Additional spring fungicides apparently decreased total biomass by 1.14 t ha^{-1} at the June sampling (p=0.023). In June, at 100 seeds m^{-2} additional autumn fungicides increased total biomass by 2.13 t ha^{-1} whereas at 200 seeds additional spring fungicides decreased total biomass by 3.25 t h compared to the standard fungicide regime (p=0.003).

By preharvest, total accumulated biomass had reached 17.70 t ha^{-1}, averaging across seed rate, variety and fungicide treatments (Table 3.3.88). Increasing seed rate significantly increased total dry weight (p=0.003) by 0.55 t ha^{-1}. Claire had more accumulated dry matter than Consort or Equinox (p=0.001). Averaging across seed rate and varietal treatments, fungicide treatments had no significant effects, though the standard fungicide regime had the lowest accumulated biomass, and treatments with additional autumn fungicides had the highest. Additional autumn fungicides increased total dry matter at 100 seeds m^{-2} in Claire and Consort, and at 200 seeds m^{-2} in Equinox (p=0.025). Treatment with additional spring or early T1 fungicides increased dry matter in Claire at 100 seeds m^{-2}, and in Equinox at 200 seeds m^{-2}. Additional autumn and spring fungicides together increased total biomass only in Claire at 100 seeds m^{-2} (p=0.025).

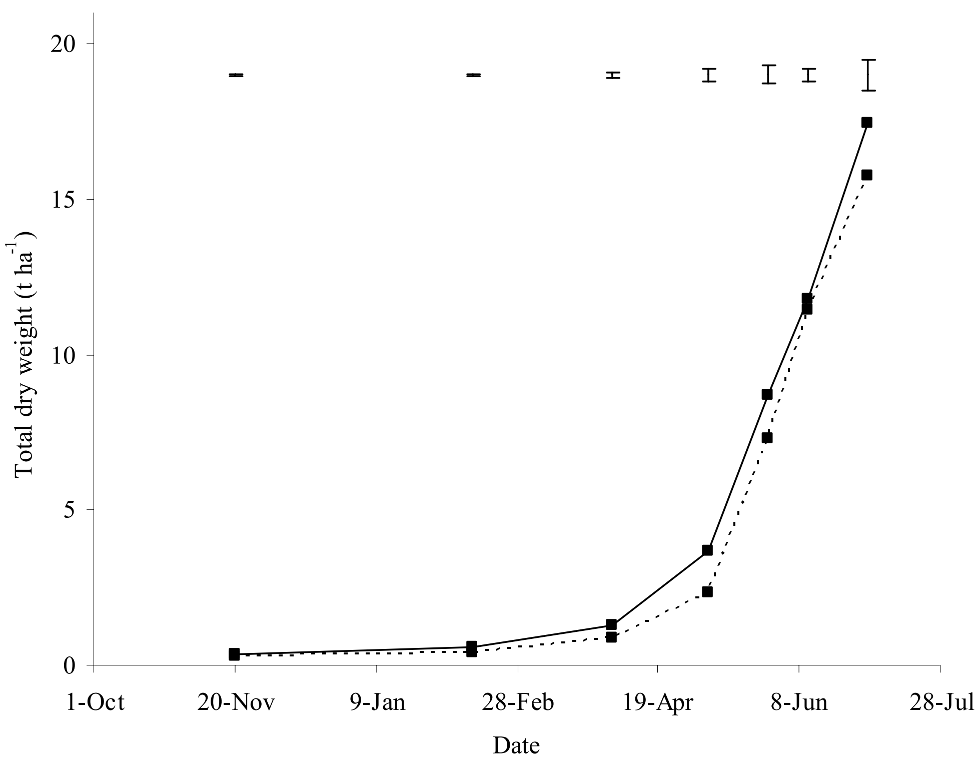

Figure 3.3.37 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, Kent 2000-01. Error bars are SEDs for comparing seed rate means (d.f. = 10).

Table 3.3.88 Total biomass accumulation immediately preharvest at Kent, 2000/01. Fungicide treatments are: 1 - standard T1, T2 and T3 applications; 2 – standard plus additional autumn fungicide; 3 – standard plus additional spring fungicide; 4 – standard plus additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3 applications.

		Fungicide					
Seed rate	Variety	1	2	3	4	5	Mean
100	Claire	14.30	19.01	18.91	17.54	21.11	**18.18**
	Consort	16.10	19.50	18.40	17.79	14.98	**17.35**
	Equinox	16.62	15.60	18.06	18.15	15.22	**16.73**
	Mean	**15.67**	**18.04**	**18.46**	**17.83**	**17.10**	**17.42**
200	Claire	19.02	21.04	16.33	17.81	16.71	**18.18**
	Consort	18.73	17.49	16.56	19.53	16.51	**17.76**
	Equinox	14.14	18.87	19.31	15.24	22.28	**17.97**
	Mean	**17.29**	**19.14**	**17.40**	**17.53**	**18.50**	**17.97**
Seed rate mean	Claire	16.66	20.03	17.62	17.68	18.91	**18.18**
	Consort	17.41	18.50	17.48	18.66	15.74	**17.56**
	Equinox	15.38	17.24	18.69	16.69	18.75	**17.35**
Overall mean		**16.48**	**18.59**	**17.93**	**17.68**	**17.80**	**17.70**

	P-value	SED
Rate	0.003	0.323
Variety	0.001	0.396
Fungicide	0.192	0.511
Rate*Variety	0.846	0.56
Rate*Fungicide	0.863	0.723
Variety*Fungicide	0.066	0.886
Rate*Variety*Fungicide	0.025	1.253

3.3.7.2.3 Bedfordshire

Total accumulated dry matter immediately preharvest was 12.76 t ha^{-1} (Table 3.3.89). Increasing seed rate from 100 to 200 seeds m^{-2} increased dry matter by 1.73 t ha^{-1} ($p<0.001$). There were no significant varietal or fungicide treatment effects, nor were there any significant treatment interactions.

Table 3.3.89 Total biomass accumulation immediately preharvest, Bedfordshire 2000/01. Fungicide treatments are: 1 - standard T1, T2 and T3 applications; 2 – standard plus additional autumn fungicide; 3 – standard plus additional spring fungicide; 4 – standard plus additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3 applications.

Seeds m^{-2}	Fungicide treatment	Variety: Claire	Consort	Equinox	Mean
100	**1**	11.26	11.06	11.78	**11.37**
	2	13.83	9.33	11.91	**11.69**
	3	13.47	12.88	10.33	**12.23**
	4	10.99	11.56	11.49	**11.35**
	5	13.29	11.94	13.35	**12.86**
	Mean	**12.57**	**11.35**	**11.77**	**11.90**
200	**1**	14.17	14.24	13.99	**14.13**
	2	14.41	13.62	15.63	**14.55**
	3	13.62	13.45	12.33	**13.13**
	4	13.97	12.14	13.20	**13.10**
	5	13.10	13.17	13.41	**13.23**
	Mean	**13.85**	**13.32**	**13.71**	**13.63**
Mean	**1**	12.71	12.65	12.88	**12.75**
	2	14.12	11.47	13.77	**13.12**
	3	13.55	13.16	11.33	**12.68**
	4	12.48	11.85	12.34	**12.23**
	5	13.20	12.56	13.38	**13.04**
Overall Mean		**13.21**	**12.34**	**12.74**	**12.76**

	P	**SED**	
Rate	<0.001	0.41	
Variety	0.234	0.51	
Fungicide	0.675	0.65	
Rate*variety	0.748	0.72	
Rate*fungicide	0.237	0.93	
Variety*fungicide	0.375	1.13	
Rate*variety*fungicide	0.752	1.60	58 d.f.

3.3.7.2.4 Gloucestershire

Immediately preharvest, total biomass accumulated averaged 15.20 t ha^{-1} across all treatments (Table 3.3.90). Increasing seed rate increased biomass by 0.92 t ha^{-1} (p=0.002). Dry matter accumulation of Claire was greater than Consort (p=0.011), but was not significantly greater than that of Equinox. There were no statistically significant main effects of fungicide treatment. There were some statistically significant seed rate/variety/fungicide interaction effects (0.035) but these did not show any logical pattern and were probably not real effects.

Table 3.3.90 Total biomass accumulation immediately preharvest, Gloucestershire 2000/01. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide Treatments					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	15.86	15.46	15.26	14.85	15.05	**15.30**
	200	15.14	16.42	16.64	17.23	15.00	**16.08**
	Mean	**15.50**	**15.94**	**15.95**	**16.04**	**15.02**	**15.69**
Consort	**100**	13.67	14.21	12.99	13.87	14.90	**13.93**
	200	15.21	15.35	15.64	14.69	15.50	**15.28**
	Mean	**14.44**	**14.78**	**14.32**	**14.28**	**15.20**	**14.60**
Equinox	**100**	14.61	13.90	16.61	15.09	14.56	**14.95**
	200	15.59	15.24	13.91	16.17	17.25	**15.63**
	Mean	**15.10**	**14.57**	**15.26**	**15.63**	**15.91**	**15.29**
Mean	**100**	14.71	14.52	14.95	14.60	14.84	**14.73**
	200	15.31	15.67	15.40	16.03	15.92	**15.67**
Overall Mean		**15.01**	**15.10**	**15.18**	**15.32**	**15.38**	**15.20**

	P	SED	
Rate	0.002	0.29	
Variety	0.011	0.35	
Fungicide	0.926	0.46	
Rate*variety	0.595	0.50	
Rate*fungicide	0.808	0.64	
Variety*fungicide	0.568	0.79	
Rate*variety*fungicide	0.035	1.12	58 df

3.3.7.2.5 2000/01 Summary

Increasing seed rate increased end of season biomass at all sites, by around 1 t ha^{-1} averaged across all sites. Significant increases were also observed at earlier points in the season. Claire had the highest accumulated biomass at the end of the season in two out of four sites. Fungicide effects were rarely statistically significant, and not consistent across sites.

3.3.7.3 2001/02

3.3.7.3.1 East Yorkshire

Averaging across seed rate and fungicide treatments in Claire, total dry matter accumulated in early March was 2.14 t ha^{-1}. This increased rapidly, until by mid-June this figure was 17.93 t ha^{-1} (Figure 3.3.38). Increasing seed rate significantly increased dry matter at the March (p=0.001), April (p=0.026) and May (p=0.001) sampling times. Fungicide treatments had no significant effect, nor were there any significant treatment interactions.

Immediately preharvest, accumulated dry matter averaged across seed rate, varietal and fungicide treatments was 22.0 t ha^{-1} (Table 3.3.91). Increasing seed rate increased total biomass by 1 t ha^{-1} (p<0.001). Claire had greater biomass than Consort (p=0.031), but increases above Equinox were not significant. However, varietal differences were not seen at 200 seeds m^{-2} (p=0.01). There were no significant fungicide or other interaction effects.

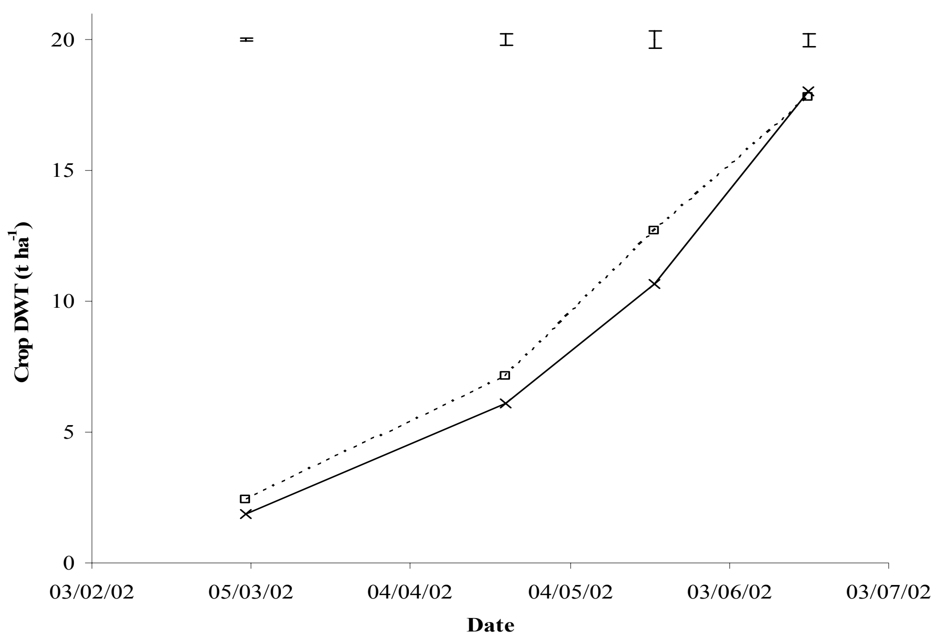

Figure 3.3.38 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, East Yorkshire 2001/02. Error bars are SEDs for comparing seed rate means (d.f. = 10).

Table 3.3.91 Total biomass accumulation immediately preharvest at East Yorkshire, 2001/02. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	22.3	23.5	22.4	22.8	21.6	**22.5**
	Consort	21.0	20.7	21.0	21.9	20.3	**21.0**
	Equinox	20.4	19.9	21.0	22.6	21.4	**21.1**
Mean		**21.2**	**21.4**	**21.5**	**22.5**	**21.1**	**21.5**
200	Claire	22.3	22.1	23.0	22.3	22.0	**22.3**
	Consort	21.4	22.6	22.5	23.3	20.9	**22.1**
	Equinox	22.3	22.7	22.8	23.4	23.3	**22.9**
Mean		**22.0**	**22.5**	**22.8**	**23.0**	**22.1**	**22.5**
S.R. Mean	**Claire**	22.3	22.8	22.7	22.5	21.8	**22.4**
	Consort	21.2	21.6	21.8	22.6	20.6	**21.6**
	Equinox	21.3	21.3	21.9	23.0	22.4	**22.0**
Overall mean		21.6	21.9	22.1	22.7	21.6	**22.0**

	P-value	**SED**	
Rate	<0.001	0.261	
Variety	0.031	0.32	
Fungicide	0.058	0.413	
Rate*Variety	0.01	0.452	
Rate*Fungicide	0.886	0.584	
Variety*Fungicide	0.351	0.715	
Rate*Variety*Fungicide	0.735	1.011	58 d.f.

3.3.7.3.2 Kent

Total biomass accumulated in Claire by March was 2.2 t ha^{-1}, averaging across seed rate and fungicide treatments. By April this figure had risen to 4.6 t ha^{-1}, and in May and June the figures were 9.9 and 16.9 t ha^{-1} respectively (Figure 3.3.39). Increasing seed rate increased dry matter accumulation in March (p=0.034) and April (p=0.025). By June however, total biomass was the same for both seed rates. Fungicide treatments had no significant effect at any point in the season, nor were there any significant treatment interactions.

Immediately preharvest, total dry matter accumulated was 20.28 t ha^{-1} averaging across all treatments (Table 3.3.92). Seed rate had no significant effect; Claire had significantly more biomass than Equinox, which in turn had significantly greater biomass than Consort ($p<0.001$). Additional spring and additional autumn and spring fungicides significantly increased total biomass compared to the standard fungicide regime ($p<0.001$). There were no significant treatment interactions.

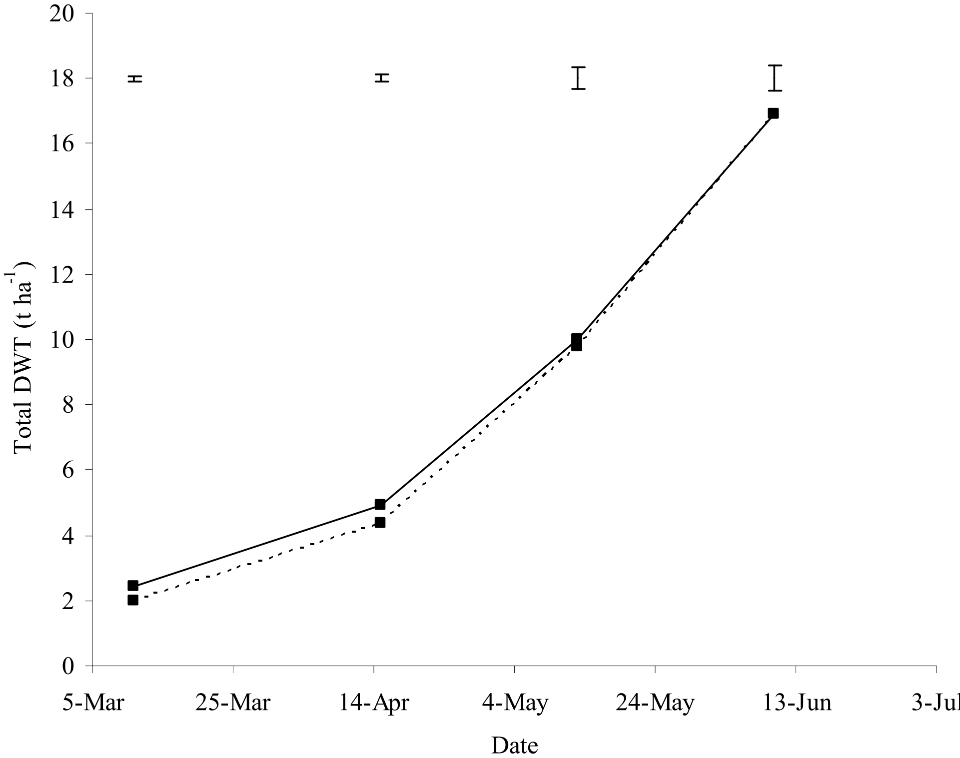

Figure 3.3.39 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, Kent 2001/02. Error bars are SEDs for comparing seed rate means (d.f. = 10).

Table 3.3.92 Total biomass accumulation immediately preharvest, Kent 2001/02. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

Seeds m^{-2}	Fungicide treatment	Variety Claire	Consort	Equinox	Mean
100	**1**	20.73	18.45	18.95	**19.38**
	2	21.11	17.14	19.01	**19.08**
	3	21.56	21.20	23.51	**22.09**
	4	23.15	20.71	21.60	**21.82**
	5	19.86	18.30	19.10	**19.09**
	Mean	**21.28**	**19.16**	**20.43**	**20.29**
200	**1**	21.40	18.86	18.91	**19.73**
	2	19.70	18.56	19.08	**19.12**
	3	21.20	20.27	21.43	**20.97**
	4	22.23	21.62	21.62	**21.82**
	5	20.91	18.82	19.36	**19.70**
	Mean	**21.09**	**19.63**	**20.08**	**20.27**
Mean	**1**	21.07	18.66	18.93	**19.55**
	2	20.41	17.85	19.04	**19.10**
	3	21.38	20.74	22.47	**21.53**
	4	22.69	21.17	21.61	**21.82**
	5	20.39	18.56	19.23	**19.39**
Overall Mean		**21.19**	**19.39**	**20.26**	**20.28**

	P	**SED**	
Rate	0.936	0.33	
Variety	<0.001	0.41	
Fungicide	<0.001	0.52	
Rate*variety	0.565	0.57	
Rate*fungicide	0.532	0.74	
Variety*fungicide	0.467	0.91	
Rate*variety*fungicide	0.886	2.18	58 d.f.

3.3.7.3.3 Bedfordshire

Immediately preharvest total dry matter accumulated was 26 t ha^{-1} averaging across treatments (Table 3.3.93). Seed rate did not significantly affect this figure, nor did fungicide treatment. Consort had significantly less biomass than either Claire or Equinox (p=0.011). There were no significant treatment interactions.

Table 3.3.93 Total biomass accumulation immediately preharvest, Bedfordshire, 2001/02. Fungicide treatments are: 1 - standard T1, T2 and T3 applications; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	27.37	25.97	27.07	25.60	26.41	**26.48**
	Consort	23.43	25.88	24.20	27.43	25.16	**25.22**
	Equinox	25.10	26.64	25.42	26.83	26.85	**26.17**
100 mean		**25.30**	**26.17**	**25.56**	**26.62**	**26.14**	**25.96**
200	Claire	25.36	30.37	26.64	26.91	25.55	**26.97**
	Consort	22.55	26.28	24.05	26.26	24.36	**24.70**
	Equinox	26.87	25.47	26.42	27.60	25.79	**26.43**
200 mean		**24.93**	**27.37**	**25.71**	**26.93**	**25.23**	**26.03**
S.R. Mean	Claire	26.36	28.17	26.86	26.26	25.98	**26.72**
	Consort	22.99	26.08	24.13	26.85	24.76	**24.96**
	Equinox	25.99	26.06	25.92	27.22	26.32	**26.30**
Ocerall mean		**25.11**	**26.77**	**25.63**	**26.77**	**25.68**	**26.00**

	P	**SED**
Rate	0.877	0.48
Variety	0.011	0.59
Fungicide	0.122	0.76
Rate*variety	0.672	0.84
Rate*fungicide	0.708	1.08
Variety*fungicide	0.446	1.32
Rate*variety*fungicide	0.502	1.87

3.3.7.3.4 Gloucestershire

Immediately preharvest total dry matter accumulated was 20.4 t ha^{-1}, averaging across treatments (Table 3.3.94). Increasing seed rate increased total biomass by 1.4 t ha^{-1} (p=0.003). Consort had significantly less biomass than either Claire or Equinox (p=0.001). There were no significant fungicide effects when averaged across seed rate and varietal treatments, but at 200 seeds m^{-2}, treatments with additional spring fungicide had significantly more biomass than the standard fungicide regime (p=0.021). There were no other treatment interactions.

Table 3.3.94 Total biomass accumulation immediately preharvest, Gloucestershire, 2001/02. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	22.3	19.7	22.1	17.5	18.9	**20.1**
	Consort	19.4	16.5	19.9	18.4	19.9	**18.8**
	Equinox	19.8	20.0	21.2	20.6	19.5	**20.2**
100 mean		**20.5**	**18.7**	**21.0**	**18.8**	**19.4**	**19.7**
200	Claire	20.5	21.4	22.4	23.4	22.0	**21.9**
	Consort	18.1	21.0	21.8	21.0	18.2	**20.0**
	Equinox	18.7	22.4	22.9	21.0	21.6	**21.3**
200 mean		**19.1**	**21.6**	**22.3**	**21.8**	**20.6**	**21.1**
S.R. Mean	**Claire**	21.4	20.5	22.2	20.4	20.5	**21.0**
	Consort	18.8	18.7	20.8	19.7	19.0	**19.4**
	Equinox	19.2	21.2	22.0	20.8	20.6	**20.8**
Overall mean		**19.8**	**20.1**	**21.7**	**20.3**	**20.0**	**20.4**

	P-value	**SED**
Rate	0.003	0.449
Variety	0.01	0.550
Fungicide	0.075	0.709
Rate*Variety	0.762	0.777
Rate*Fungicide	0.021	1.003
Variety*Fungicide	0.846	1.229
Rate*Variety*Fungicide	0.24	1.738

3.3.7.3.5 Northumberland

Immediately preharvest total dry matter accumulated was 16.3 t ha^{-1}, averaging across treatments (Table 3.3.95). Increasing seed rate increased total biomass by 1.5 t ha^{-1} (p=0.001). There were no significant varietal or fungicide effects nor were there any treatment interactions.

Table 3.3.95 Total biomass accumulation immediately preharvest, Northumberland, 2001/02. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	17.2	13.7	17.2	15.1	14.6	15.5
	Consort	13.9	16.1	14.0	16.8	16.9	**15.5**
	Equinox	14.5	14.6	17.2	17.0	14.8	**15.6**
100 mean		**15.2**	**14.8**	**16.2**	**16.3**	**15.4**	**15.6**
200	Claire	18.0	15.0	17.1	16.7	17.0	**16.7**
	Consort	16.3	18.5	16.8	17.9	18.3	**17.6**
	Equinox	19.2	15.7	15.9	16.3	18.2	**17.1**
200 mean		**17.8**	**16.4**	**16.6**	**17.0**	**17.8**	**17.1**
S.R. Mean	Claire	17.6	14.3	17.2	15.9	15.8	**16.1**
	Consort	15.1	17.3	15.4	17.3	17.6	**16.6**
	Equinox	16.8	15.2	16.6	16.7	16.5	**16.3**
Overall mean		**16.5**	**15.6**	**16.4**	**16.6**	**16.6**	**16.3**

	P-value	SED	
Rate	0.001	0.412	
Variety	0.84	0.504	
Fungicide	0.22	0.651	
Rate*Variety	0.14	0.713	
Rate*Fungicide	0.45	0.921	
Variety*Fungicide	0.102	1.128	
Rate*Variety*Fungicide	0.399	1.595	58 d.f.

3.3.7.3.6 2001/02 summary

At both sites where total dry matter was measured through the season, biomass at the lower seed rate was smaller than that at the higher rate early in the season, but by the end of the season these differences had disappeared. However, by preharvest, in three out of five sites increasing seed rate increased biomass by over 1 t ha^{-1}. Significant fungicide effects were few, but at the Kent site, and the Gloucestershire site at 200 seeds m^{-2}, additional spring fungicides did increase biomass compared to the control. Consort tended to have the lowest biomass of the three varieties examined, whereas Claire tended to have the highest. There were no treatment interactions that were consistent across sites.

3.3.7.4 2002/03

3.3.7.4.1 East Yorkshire

Total dry weight in March for Claire was 1.38 t ha^{-1}, averaging across treatments, increasing to 2.99, 8.45 and 14.54 t ha^{-1} in April, May and June respectively (Figure 3.3.40). Increasing seed rate significantly increased biomass at all sampling points ($p<0.001$), the disparity between seed rates increasing in absolute terms as the season progressed, but decreasing in proportionate terms. There were no significant fungicide or treatment interaction effects.

At preharvest, total biomass averaged across all treatments was 18.5 t ha^{-1} (Table 3.3.96). Increasing seed rate increased biomass by 1.3 t ha^{-1} ($p<0.001$). Consort had significantly less biomass than Claire or Equinox ($p<0.001$). Fungicide treatments had no significant effects when averaged across seed rate or varietal treatments, but at 200 seeds m^{-2} additional autumn and spring fungicides increased biomass ($p=0.05$), whereas at 100 seeds m^{-2} there was no significant effect. There were no other significant treatment interactions.

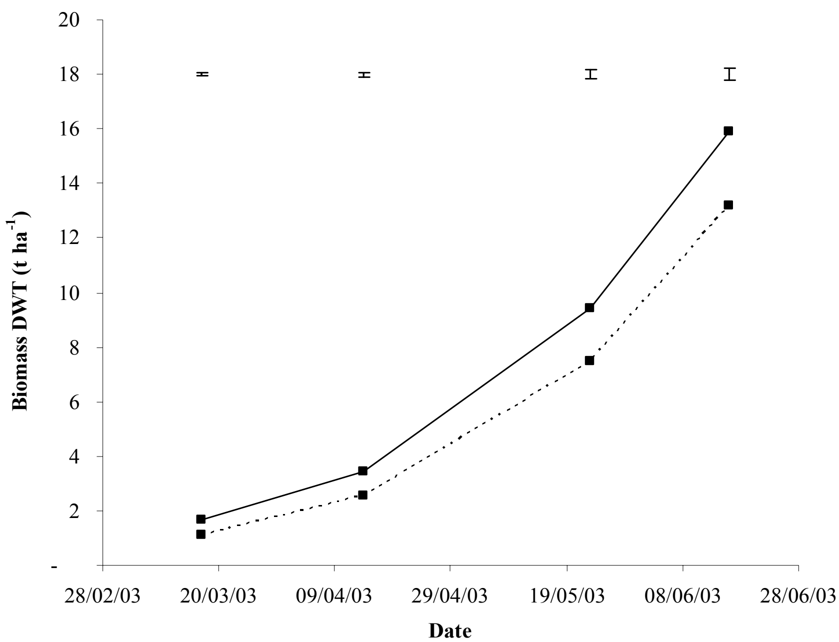

Figure 3.3.40 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, East Yorkshire 2002/03. Error bars are SEDs for comparing seed rate means (d.f. = 10).

Table 3.3.96 Total biomass accumulation immediately preharvest at East Yorkshire, 2002/03. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seeds m^{-2}	Variety	1	2	3	4	5	Mean
100	Claire	20.2	18.0	17.8	18.3	18.3	**18.5**
	Consort	16.6	15.1	17.5	17.4	19.1	**17.1**
	Equinox	17.5	17.7	17.7	18.5	18.3	**17.9**
100 mean		**18.1**	**16.9**	**17.7**	**18.0**	**18.6**	**17.9**
200	Claire	19.3	20.0	18.1	21.2	21.1	**19.9**
	Consort	17.5	19.0	17.9	19.3	17.7	**18.3**
	Equinox	19.0	20.5	19.8	19.7	18.4	**19.5**
200 mean		**18.6**	**19.8**	**18.6**	**20.1**	**19.1**	**19.2**
S.R. Mean	Claire	19.7	19.0	17.9	19.7	19.7	**19.2**
	Consort	17.1	17.0	17.7	18.3	18.4	**17.7**
	Equinox	18.3	19.1	18.8	19.1	18.3	**18.7**
Mean		**18.4**	**18.4**	**18.1**	**19.1**	**18.8**	**18.5**
			p-value	SED			
	Rate		<0.001	0.30			
	Variety		<0.001	0.37			
	Fungicide		0.28	0.47			
	Rate*variety		0.84	0.52			
	Rate*fungicide		0.05	0.67			
	Variety*fungicide		0.32	0.82			
	Rate*variety*fungicide		0.15	1.16	58 d.f.		

3.3.7.4.2 Kent

Total dry weight in March for Claire was 1.79 t ha^{-1}, averaging across treatments, increasing to 2.57, 9.14 and 16.04 t ha^{-1} in April, May and June respectively (Figure 3.3.41). Increasing seed rate significantly increased biomass in March and April (p=0.005 and 0.01 respectively), the disparity between seed rates decreasing. There were no significant fungicide or treatment interaction effects.

At preharvest, total biomass averaged across all treatments was 21.1 t ha^{-1} (Table 3.3.97). Increasing seed rate increased biomass by 1 t ha^{-1} (p=0.002). Consort had significantly less biomass than Claire or Equinox (p=0.002). Fungicide treatments had no significant effects. At 100 seeds m^{-2} Equinox had significantly greater biomass than Claire or Consort (p=0.02), whereas at 200 seeds m^{-2} Claire had the highest biomass, though this was significantly different only to Consort. There were no other significant treatment interactions.

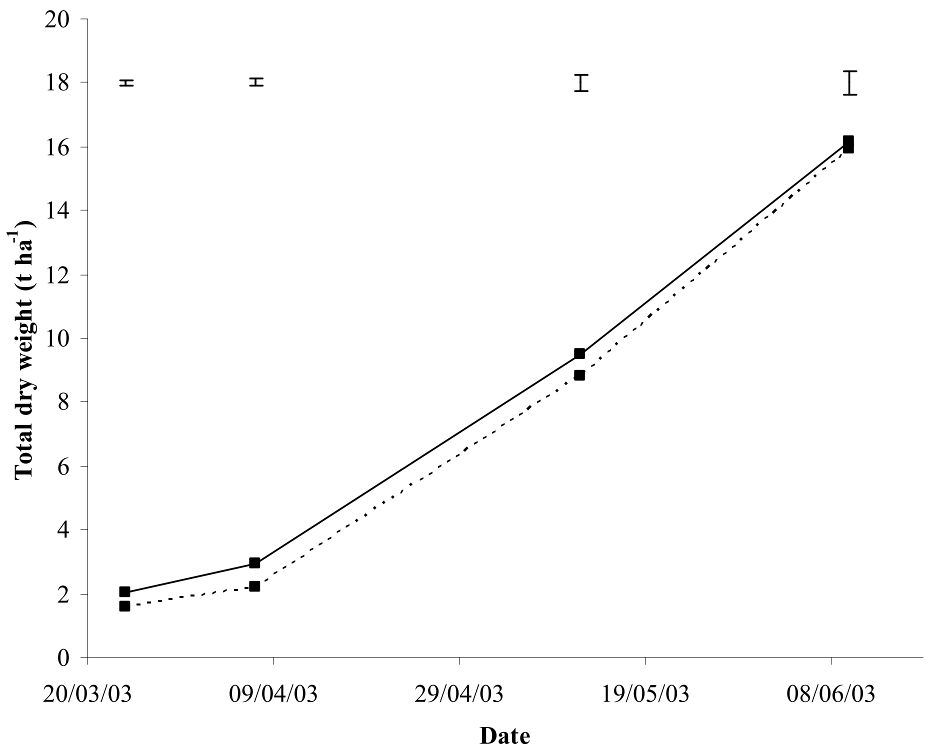

Figure 3.3.41 Total biomass dry weight accumulation (t ha^{-1}) over the growing season at 100 (dashed line) and 200 (solid line) seeds m^{-2}, Kent 2002/03. Error bars are SEDs for comparing seed rate means (d.f. = 10).

Table 3.3.97 Total biomass accumulation immediately preharvest at Kent, 2002/03. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	20.4	20.7	20.6	19.8	20.4	**20.4**
	Consort	19.5	21.3	18.5	19.7	20.0	**19.8**
	Equinox	21.8	22.6	21.5	20.9	21.2	**21.6**
100 Mean		**20.6**	**21.5**	**20.2**	**20.2**	**20.6**	**20.6**
200	Claire	23.6	21.9	23.5	21.9	21.2	**22.4**
	Consort	20.8	20.5	21.0	20.7	21.1	**20.8**
	Equinox	19.5	22.0	22.8	22.3	21.1	**21.5**
200 Mean		**21.3**	**21.5**	**22.4**	**21.6**	**21.1**	**21.6**
S.R. Mean	Claire	22.0	21.3	22.0	20.9	20.8	**21.4**
	Consort	20.2	20.9	19.8	20.2	20.6	**20.3**
	Equinox	20.7	22.3	22.1	21.6	21.2	**21.6**
Mean		**20.9**	**21.5**	**21.3**	**20.9**	**20.8**	**21.1**
			p-value	SED			
Rate			0.002	0.299			
Variety			0.002	0.367			
Fungicide			0.556	0.473			
Rate*variety			0.020	0.519			
Rate*fungicide			0.154	0.669			
Variety*fungicide			0.374	0.820			
Rate*variety*fungicide			0.516	1.160	58 d.f.		

3.3.7.4.3 Bedfordshire

At preharvest, total biomass averaged across all treatments was 19.6 t ha^{-1} (Table 3.3.98). Increasing seed rate increased biomass by 0.5 t ha^{-1}, but this was not statistically significant. Consort had significantly less biomass than Equinox, which in turn had less biomass than Claire (p=0.003). Fungicide treatments had no significant effects, nor were there any significant treatment interactions.

Table 3.3.98 Total biomass accumulation immediately preharvest, Bedfordshire 2002/03. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	19.8	19.7	19.7	21.0	20.2	**20.1**
	Consort	18.2	19.7	17.7	18.4	18.6	**18.5**
	Equinox	18.4	20.8	18.3	19.2	20.4	**19.4**
100 Mean		**18.8**	**20.1**	**18.5**	**19.5**	**19.7**	**19.3**
200	Claire	20.4	21.2	19.4	21.7	19.2	**20.4**
	Consort	19.5	19.0	18.3	19.5	19.4	**19.1**
	Equinox	19.8	19.7	21.3	20.4	18.1	**19.9**
200 Mean		**19.9**	**20.0**	**19.7**	**20.5**	**18.9**	**19.8**
S.R. Mean	Claire	20.1	20.5	19.5	21.4	19.7	**20.2**
	Consort	18.8	19.3	18.0	18.9	19.0	**18.8**
	Equinox	19.1	20.3	19.8	19.8	19.3	**19.6**
Overall mean		**19.3**	**20.0**	**19.1**	**20.0**	**19.3**	**19.6**

	p-value	SED	
Rate	0.163	0.32	
Variety	0.003	0.39	
Fungicide	0.216	0.51	
Rate*variety	0.946	0.56	
Rate*fungicide	0.215	0.72	
Variety*fungicide	0.796	0.88	
Rate*variety*fungicide	0.308	1.24	58 d.f.

3.3.7.4.4 Gloucestershire

Total biomass at preharvest averaged across all treatments was 17.6 t ha^{-1} (Table 3.3.99). Increasing seed rate increased biomass by 0.6 t ha^{-1} (p=0.008). Claire had significantly more biomass than Consort or Equinox (p=0.001). Additional spring or additional autumn and spring fungicides significantly increased total biomass (p=0.01) compared to the standard fungicide regime and treatments with additional autumn or early T1 fungicides. There were no significant treatment interactions.

Table 3.3.99 Total biomass accumulation immediately preharvest, Gloucestershire 2002/03. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	19.3	16.7	17.5	17.4	17.3	**17.6**
	Consort	17.2	16.5	17.4	16.4	17.9	**17.1**
	Equinox	15.9	16.1	18.0	18.3	16.9	**17.0**
100 Mean		**17.4**	**16.5**	**17.7**	**17.4**	**17.4**	**17.3**
200	Claire	18.3	18.3	18.9	19.6	18.8	**18.8**
	Consort	16.0	17.5	17.8	18.7	16.7	**17.3**
	Equinox	17.0	17.2	18.5	18.4	16.7	**17.6**
200 Mean		**17.1**	**17.6**	**18.4**	**18.9**	**17.4**	**17.9**
S.R. Mean	Claire	18.8	17.5	18.2	18.5	18.0	**18.2**
	Consort	16.6	17.0	17.6	17.6	17.3	**17.2**
	Equinox	16.4	16.6	18.3	18.4	16.8	**17.3**
Mean		**17.3**	**17.0**	**18.0**	**18.2**	**17.4**	**17.6**
			p-value	SED			
	Rate		0.008	0.23			
	Variety		0.001	0.28			
	Fungicide		0.010	0.37			
	Rate*variety		0.282	0.40			
	Rate*fungicide		0.070	0.52			
	Variety*fungicide		0.197	0.63			
	Rate*variety*fungicide		0.222	0.90	58 d.f.		

3.3.7.4.5 Northumberland

Total biomass at preharvest averaged across all treatments was 21.2 t ha^{-1} (Table 3.3.100). Increasing seed rate increased biomass by 0.6 t ha^{-1} ($p<0.001$). There were no significant varietal, seed rate, fungicide or treatment interaction effects.

Table 3.3.100 Total biomass accumulation immediately preharvest, Northumberland 2002/03. Fungicide treatments are: 1 - standard T1, T2 and T3 regime; 2 – with additional autumn fungicide; 3 – with additional spring fungicide; 4 – with additional autumn and spring fungicides; 5 – early T1 application, standard T2 and T3.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	21.3	20.4	20.3	20.8	19.4	**20.5**
	Consort	19.7	20.2	22.1	20.0	21.2	**20.6**
	Equinox	19.0	20.5	19.4	20.9	20.9	**20.1**
100 Mean		**20.0**	**20.3**	**20.6**	**20.6**	**20.5**	**20.4**
200	Claire	22.3	21.7	23.3	23.3	23.3	**22.8**
	Consort	21.7	22.0	22.6	21.6	21.4	**21.9**
	Equinox	21.0	21.7	21.4	21.3	21.0	**21.3**
200 Mean		**21.7**	**21.8**	**22.4**	**22.1**	**21.9**	**22.0**
S.R. Mean	Claire	21.8	21.1	21.8	22.1	21.3	**21.6**
	Consort	20.7	21.1	22.3	20.8	21.3	**21.2**
	Equinox	20.0	21.1	20.4	21.1	21.0	**20.7**
Overall mean		**20.8**	**21.1**	**21.5**	**21.3**	**21.2**	**21.2**

	p-value	SED	
Rate	<0.001	0.390	
Variety	0.168	0.478	
Fungicide	0.852	0.617	
Rate*variety	0.399	0.676	
Rate*fungicide	0.998	0.872	
Variety*fungicide	0.794	1.068	
Rate*variety*fungicide	0.779	1.511	58 d.f.

3.3.7.4.6 2002/03 summary

Similar to 2001/02, biomass at the higher seed rate was greater early in the season, but as the season progressed disparities between the seed rates became less, either in proportionate or absolute terms. At harvest however, increased seed rate resulted in higher biomass of between 0.5 – 1.0 t ha^{-1}. Consort tended to have the lowest biomass levels, whereas Claire and Equinox ranked highest depending on site. Fungicide treatments generally had no significant effects, but in some cases additional spring fungicides increased biomass production. There were no consistent treatment interactions across sites.

3.3.7.5 Total dry matter accumulation – summary

Seed rate effects tended to be greatest early on in the season, and become smaller as the season progressed. However, in most sites at harvest, increasing seed rates had greater biomass in the region of 1 t ha^{-1}. Consort tended to have the lowest biomass production, and Claire the highest. Fungicide effects were small, though additional spring fungicides allowed increased biomass production in some cases. There were no consistent treatment interactions across sites or seasons.

3.3.8 Lodging

3.3.8.1 1999/00

3.3.8.1.1 East Yorkshire

Lodging averaged 74.4% across varietal and seed rate treatments on 13th July (Figure 3.3.42). Increasing seed rate from 100 to 200 to 400 seeds m^{-2} increased lodging from 51.9 to 80.4 to 90.8 respectively ($p<0.001$). Averaging across seed rates, Riband had the lowest percentage lodging (45.6%), significantly lower than all but Weston ($p<0.001$). Savannah had the highest percentage lodging (92.2%), significantly higher than all but Milestone, Claire, Eclipse, Chaucer and Napier. There were significant interactions between seed rate and varietal treatments ($p<0.001$). There were no significant differences between varieties in lodging at the 400 seeds m^{-2} seed rate. Varietal rankings at 100 and 200 seeds m^{-2} were the same as those when values were averaged across seed rate treatments. At 200 seeds m^{-2} Riband had significantly less lodging than all other varieties, whereas Savannah had significantly more lodging than Equinox, Riband, Buchan and Weston. At 100 seeds m^{-2} however, lodging in Riband was not significantly lower than Weston, Buchan and Equinox; Savannah was still the highest lodger, significantly so compared to all but Claire, Eclipse, Chaucer and Napier.

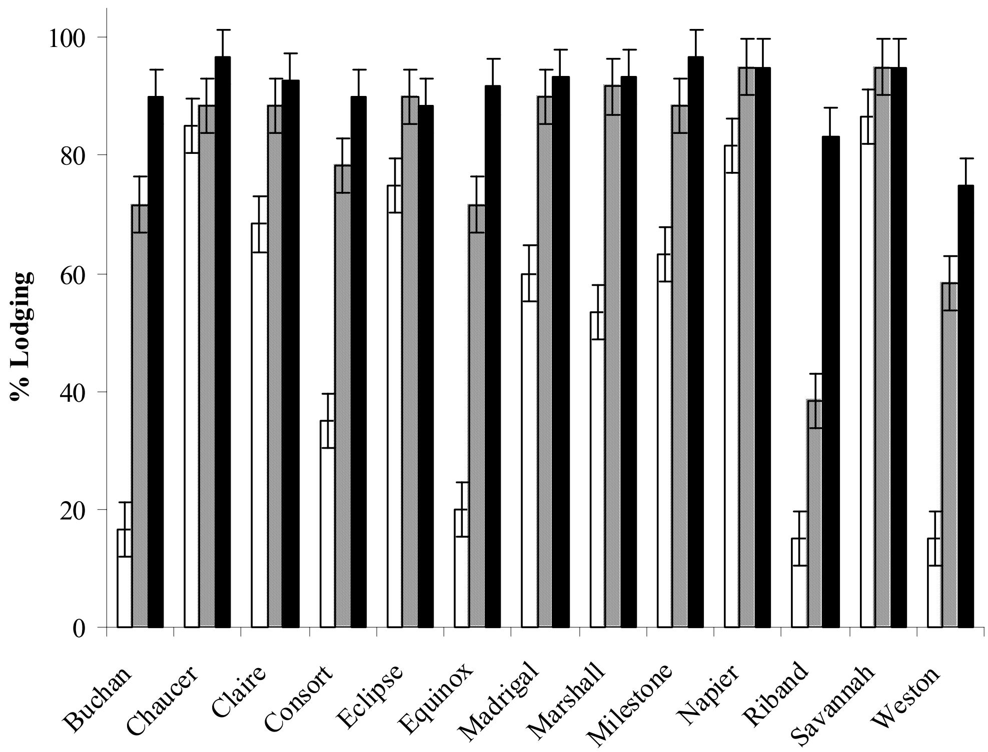

Figure 3.3.42 Percentage lodging on 13th July 2000 in 13 different varieties at 100 (white bars), 200 (cross hatched bars) and 400 (black bars) seeds m^{-2}, East Yorkshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 76).

3.3.8.1.2 Kent

Lodging averaged 29% across all treatments (Figure 3.3.43) on 7th August. As seed rate increased from 100 to 250 to 350 seeds m^{-2}, so lodging increased from 9 to 31 to 48 percent respectively. Increases between 250 and 350 seeds m^{-2} were not significant, those between 100 and 250 seeds m^{-2} were ($p<0.001$). Buchan had the lowest lodging, at four percent, significantly lower than all varieties other than Eclipse, Claire, Weston and Milestone ($p=0.008$), whereas Napier had the highest lodging, at 52%, significantly higher than all but Chaucer, Savannah and Equinox ($p=0.008$). There were no significant interactions between seed rate and varietal treatments.

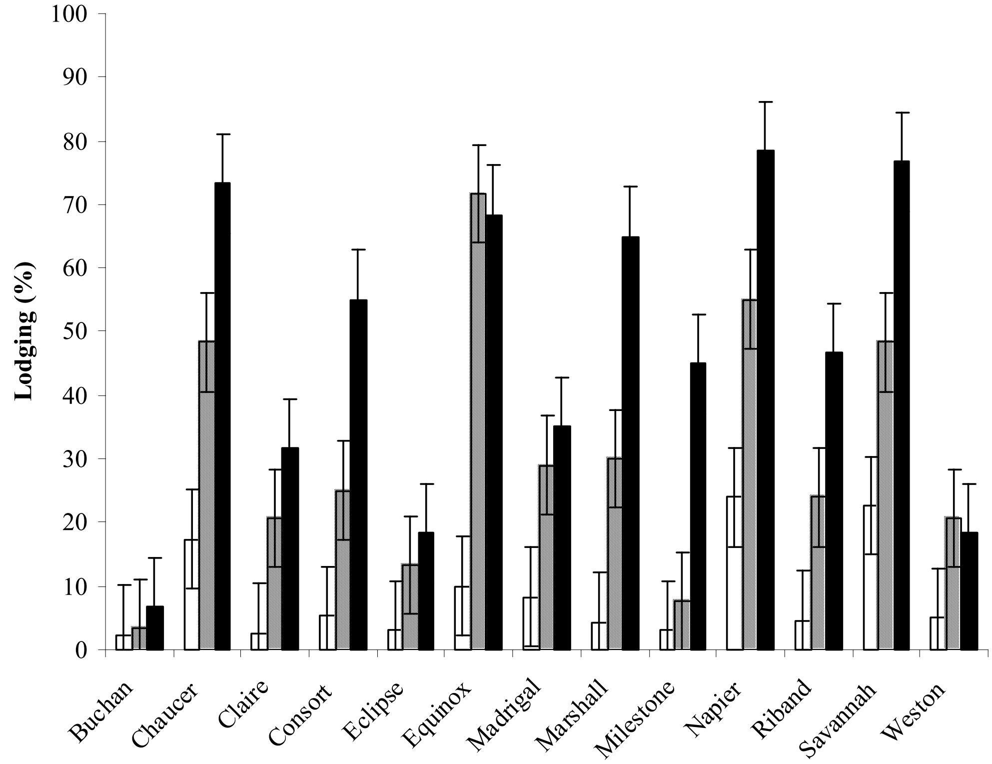

Figure 3.3.43 Percentage lodging on 13th July 2000 in 13 different varieties at 100 (white bars), 250 (cross hatched bars) and 350 (black bars) seeds m^{-2}, Kent, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 76).

3.3.8.1.3 Bedfordshire

Averaged across all treatments, 35% lodging was observed (Figure 3.3.44). Significant increases in lodging were observed at as seed rate was increased from 100 to 250 to 400 seeds m^{-2} giving respective lodging values of 6%, 41% and 58% ($p<0.001$). Buchan had the lowest lodging, showing no lodging at all at any of the seed rates. Lodging values for Buchan were significantly lower than all varieties other than Weston, which had significantly lower lodging than Chaucer, Marshall, Consort, Napier and Savannah ($p<0.001$). Savannah had the highest lodging values, at 60% averaged across seed rates. This value was significantly higher than that of all varieties other than Chaucer, Marshall, Consort and Napier ($p<0.001$). There were no seed rate/variety interactions.

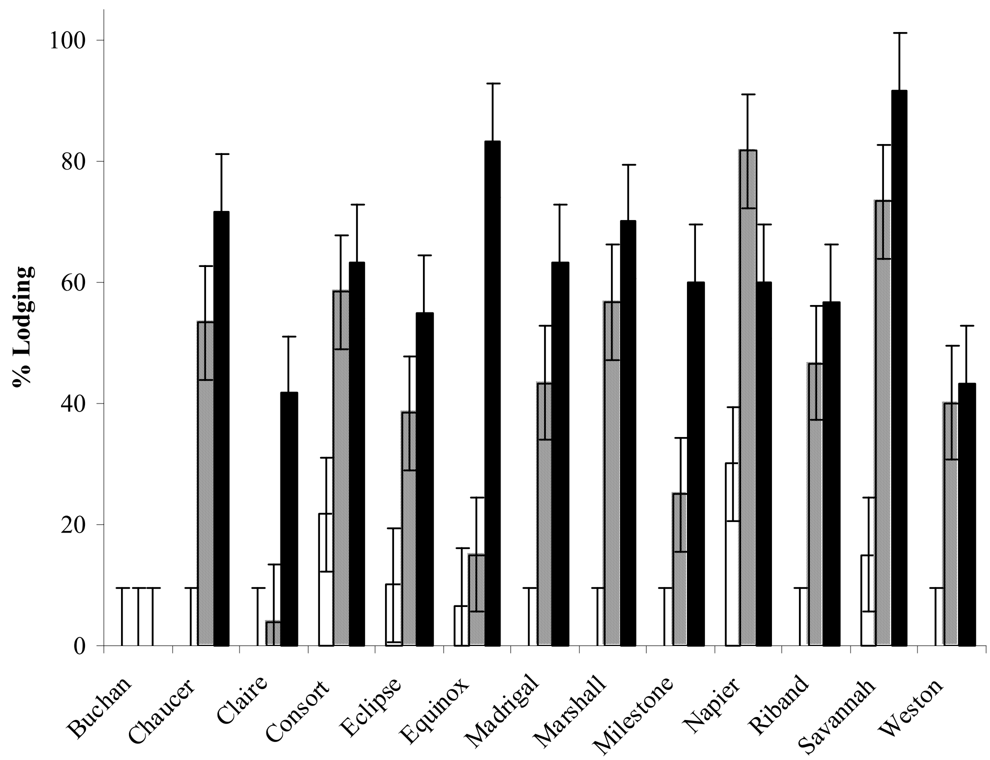

Figure 3.3.44 Percentage lodging at harvest in 13 different varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Bedfordshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 76).

3.3.8.1.4 Gloucestershire

Lodging averaged 35% across all treatments. Lodging increased significantly at each seed rate increase from 100 to 250 to 400 seeds m^{-2}, with respective values of 3, 39 and 63% ($p<0.001$). Averaged across seed rates, Buchan had the lowest lodging (six percent), significantly lower than all varieties other than Claire, Riband and Weston ($p<0.001$); these varieties had significantly lower lodging scores than all but Madrigal and Consort. Napier had the highest lodging, at 59%, significantly higher than all but Milestone, Eclipse, Equinox, Savannah and Chaucer ($p<0.001$). All these varieties, plus Marshall, had significantly higher lodging than Riband, Claire, Weston and Buchan ($p<0.001$). There were no significant treatment interactions.

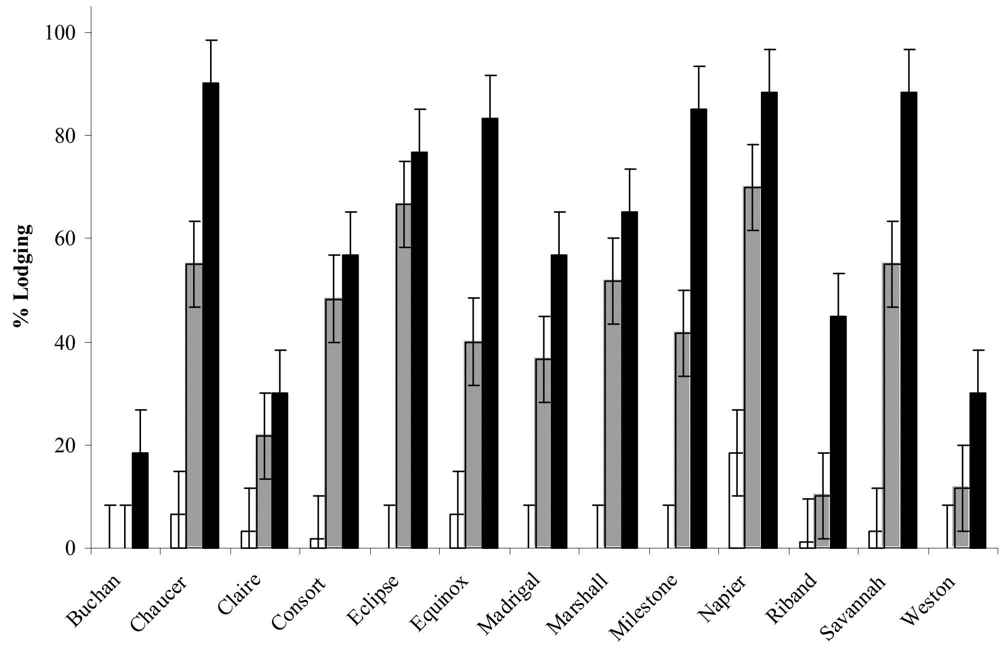

Figure 3.3.45 Percentage lodging on 27th July 2000 in 13 different varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Gloucestershire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 76).

3.3.8.1.5 1999/2000 Summary

Lodging increased significantly as seed rate increased at all sites. These increases were generally larger when comparing the lowest seed rate (100 seeds m^{-2}) with the medium rate (200 or 250 seeds m^{-2}) than when comparing the medium rate with the high rate (350 or 400 seeds m^{-2}). Buchan, Riband and Weston tended to have low lodging values, whereas Savannah, Napier and Chaucer tended to have higher lodging values. Varieties generally ranked similarly at all seed rates.

3.3.8.2 Following seasons (2001-03)

No lodging was observed at any of the sites in these seasons.

3.3.9 Grain yield and yield components

3.3.9.1 Combine yield

All combine yields are quoted at 15% moisture content.

3.3.9.1.1 1999/2000

3.3.9.1.1.1 East Yorkshire

Combine yield averaged 9.63 t ha^{-1} across all treatments (Table 3.3.101). Decreasing seed rate significantly increased yield from 8.64 to 9.77 and 10.49 t ha^{-1} at 400, 200 and 100 seeds m^{-2} respectively ($p<0.001$). Claire was the highest yielding variety, yielding significantly more than all other varieties with the exception of Eclipse, Buchan and Marshall ($p<0.001$). Savannah was the lowest yielding variety overall, having significantly less yield than all varieties other than Napier. Rankings were slightly different at different seed rates, with Buchan being the highest yielder at 100 seeds m^{-2}, Claire at 200 seeds m^{-2} and Eclipse at 200 seeds m^{-2} ($p=0.01$). Yield responses in all varieties to decreases in seed rate from 400 to 100 were significant, but Claire, Marshall, Riband, Madrigal and Consort showed no significant response to changing seed rate from 200 to 100 seeds m^{-2} ($p=0.01$). Milestone and Savannah showed no response to decreasing seed rate from 400 to 200 seeds m^{-2} ($p=0.01$).

Table 3.3.101 Combine yields (t ha^{-1}) at 85% dry weight, East Yorkshire 1999/2000.

Variety	Seeds m^{-2} 100	200	400	Mean
Buchan	11.18	10.32	8.89	**10.13**
Chaucer	10.41	9.32	7.65	**9.13**
Claire	11.10	10.66	9.35	**10.37**
Consort	10.29	10.11	8.43	**9.61**
Eclipse	11.14	10.33	9.53	**10.33**
Equinox	10.51	9.66	8.66	**9.61**
Madrigal	10.62	9.92	8.69	**9.74**
Marshall	10.65	10.29	9.08	**10.01**
Milestone	10.71	9.08	9.40	**9.73**
Napier	9.74	8.68	7.36	**8.59**
Riband	9.99	10.60	9.02	**9.87**
Savannah	9.24	8.06	7.40	**8.24**
Weston	10.78	10.03	8.80	**9.87**
Mean	**10.49**	**9.77**	**8.64**	**9.63**
		P	SED	
	Rate	<0.001	0.1001	
	Variety	<0.001	0.2084	
	Rate*variety	0.01	0.361	76 d.f.

3.3.9.1.1.2 Kent

Yields averaged 7.97 t ha^{-1} across all treatments (Table 3.3.102). Decreasing seed rate increased yield, from 7.35 t ha^{-1} at 350 seeds m^{-2} to 7.87 and 8.69 t ha^{-1} at 200 and 100 seeds m^{-2} ($p<0.001$). Averaging across seed rate treatments, Eclipse ranked the highest, yielding 9.27 t ha^{-1}, significantly more than all other varieties except Claire ($p<0.001$). Equinox yielded the lowest at 6.87 t ha^{-1}, significantly lower than all the other varieties except Madrigal or Chaucer ($p<0.001$). Eclipse and Equinox retained their respective ranking positions at all seed rates, though intermediate rankings changed with different seed rates, Savannah tended to do better at lower seed rates compared with other varieties, where as Buchan did better at higher seed rates. Responses to seed rates also varied according to varietal choice ($p=0.047$). Buchan, Riband, Marshall, Weston, Madrigal and Chaucer did not show significantly increased yields as seed rates were reduced from 250 to 100 seeds m^{-2}. Only Marshall, Weston, Chaucer and Savannah showed any significant response to reducing seed rate from 350 to 250 seeds m^{-2}, whereas all but Buchan significantly increased yields as seed rate was reduced from 350 to 100 seeds m^{-2} ($p=0.047$).

Table 3.3.102 Combine yields (t ha^{-1}) at 85% dry weight, Kent 1999/2000.

	Seeds m^{-2}			
Variety	**100**	**250**	**350**	**Mean**
Buchan	8.86	8.20	8.38	**8.48**
Chaucer	7.62	7.16	6.43	**7.07**
Claire	9.52	8.56	8.29	**8.79**
Consort	8.87	8.03	7.61	**8.17**
Eclipse	9.88	9.06	8.86	**9.27**
Equinox	7.57	6.83	6.21	**6.87**
Madrigal	7.87	7.19	6.68	**7.25**
Marshall	9.42	8.75	7.88	**8.68**
Milestone	8.97	8.16	7.79	**8.31**
Napier	8.81	7.31	6.65	**7.59**
Riband	8.47	8.03	7.57	**8.02**
Savannah	9.03	7.28	6.24	**7.52**
Weston	8.05	7.76	6.90	**7.57**
Mean	**8.69**	**7.87**	**7.35**	**7.97**
		P	**SED**	
	Rate	<0.001	0.097	
	Variety	<0.001	0.202	
	Rate*variety	0.047	0.3498	76 d.f.

3.3.9.1.1.3 Bedfordshire

Yields averaged 10.4 t ha^{-1} across treatments. Decreasing seeds m^{-2} led to increases in yield from 9.6 t ha^{-1} at 400 seeds m^{-2} to 10.5 and 11.2 t ha^{-1} at 250 and 100 seeds m^{-2} respectively ($p<0.001$). Averaged across seeds treatments, Marshall yielded higher than all other varieties at 11.4 t ha^{-1}, significantly compared to all but Claire, Buchan and Milestone ($p<0.001$). Chaucer was the lowest ranked variety, having significantly lower yields than all varieties other than Savannah. Chaucer ranked lowest at 100 and 400 seeds m^{-2}, but Savannah ranked lowest at 250 seeds m^{-2}. There were also differences in the top ranked variety at different seed rates, with Marshall maintaining top rank at 100 seeds m^{-2}, but losing out to Buchan at 250 seeds m^{-2} and Claire at 400 seeds m^{-2}. Buchan seemed to do poorly relative to other varieties at 100 seeds m^{-2}, whereas Weston performed poorly at 100 and 250 seeds m^{-2} but did comparatively well at 400 seeds m^{-2}. Napier and Savannah were varieties that did relatively well at 100 seeds m^{-2}, but performed poorly in contrast to other varieties at 250 and 400 seeds m^{-2}. Only Savannah and Napier showed significant increases in yield as seed rate was reduced from 250 to 100 seeds m^{-2}, whereas only Eclipse, Riband, Napier and Chaucer showed yield responses as seed rate decreased from 400 to 250 seeds m^{-2} (p=0.005). All but Claire, Buchan and Weston showed significant yield increases when comparing yields at 400 seeds m^{-2} to those at 100 seeds m^{-2}; these three varieties showed no significant responses to seed rate.

Table 3.3.103 Combine yields (t ha^{-1}) at 85% dry weight, Bedfordshire 1999/2000.

	Seeds m^{-2}			
Variety	**100**	**250**	**400**	**Mean**
Buchan	10.5	11.4	11.0	**11.0**
Chaucer	10.3	9.3	7.8	**9.1**
Claire	11.7	11.3	11.1	**11.4**
Consort	11.2	10.2	9.1	**10.2**
Eclipse	11.2	11.2	9.6	**10.7**
Equinox	10.5	10.4	9.3	**10.1**
Madrigal	11.2	10.5	10.0	**10.6**
Marshall	12.1	11.4	10.7	**11.4**
Milestone	11.7	11.1	10.0	**10.9**
Napier	11.7	10.0	8.8	**10.2**
Riband	11.1	10.7	9.5	**10.5**
Savannah	11.9	8.7	7.9	**9.5**
Weston	10.9	10.0	10.1	**10.3**
Mean	**11.2**	**10.5**	**9.6**	**10.4**
		P	**SED**	
Seed rate		<0.001	0.1678	
Variety		<0.001	0.3493	
Seed rate*variety		0.005	0.605	76 df

3.3.9.1.1.4 Gloucestershire

Averaged across treatments, yield was 7.3 t ha^{-1}. Reducing the seed rate increased yield from 6.2 t ha^{-1} at 400 seeds m^{-2} to 7.5 and 8.2 t ha^{-1} at 250 and 100 seeds m^{-2} respectively (p<0.001). Averaged across seed rate treatments, Claire had the highest yield, significantly more than all varieties other than Buchan, Eclipse and Marshall (p<0.001). Chaucer yielded the lowest of the varieties, significantly lower than all but Savannah, Consort and Napier (p<0.001). When looking at rankings for individual seed rates, Chaucer was the lowest ranked variety for all but the 400 seeds m^{-2} treatment, where Napier was the lowest yielder; Claire was the highest yielding variety at 250 and 400 seeds m^{-2}, but Eclipse was highest ranked at 100 seeds m^{-2}. Buchan performed poorly relative to other varieties at 100 seeds m^{-2} compared to its ranking at 250 and 400 seeds m^{-2}, as did Riband. Napier and Savannah performed better compared to other varieties at 100 seeds m^{-2} than at 250 and 400 seeds m^{-2}. Milestone did comparatively worse at 400 seeds m^{-2}. Only Napier's yield increased significantly in response to decreases in seed rate from 250 to 100 seeds m^{-2}, whereas Riband, Equinox, Milestone, Savannah and Napier responded to decreases from 400 to 250 seeds m^{-2} (p=0.029). All varieties except Claire, Buchan, Madrigal and Riband responded to decreases in seed rate from 400 to 100 seeds m^{-2}. Both Claire and Buchan failed to show any significant response to seed rate.

Table 3.3.104 Combine yields (t ha^{-1}) at 85% dry weight, Gloucestershire 1999/2000.

	Seeds m^{-2}			
Variety	**100**	**250**	**400**	**Mean**
Buchan	8.6	8.6	8.2	**8.5**
Chaucer	6.9	5.9	5.2	**6.0**
Claire	9.1	8.8	8.3	**8.7**
Consort	7.4	6.7	6.0	**6.7**
Eclipse	9.3	8.2	7.1	**8.2**
Equinox	7.8	7.3	5.8	**6.9**
Madrigal	7.9	7.4	6.9	**7.4**
Marshall	8.8	7.7	7.2	**7.9**
Milestone	8.5	7.7	5.4	**7.2**
Napier	8.6	6.5	3.3	**6.1**
Riband	7.1	7.8	6.1	**7.0**
Savannah	8.1	7.2	5.1	**6.8**
Weston	8.0	7.5	6.6	**7.4**
Mean	**8.2**	**7.5**	**6.2**	**7.3**

	P	**SED**	
Seed rate	<0.001	0.1994	
Variety	<0.001	0.4152	
Seed rate*variety	0.029	0.7191	76 df

3.3.9.1.1.5 1999/2000 Summary

Decreasing seed rate led to significant increases in yield at all sites. Claire, Eclipse, Buchan and Marshall were the higher yielding varieties, whereas Savannah, Napier, Equinox, Consort and Chaucer tended to yield the lowest. There were some differences in varietal response to seed rate, Claire and Buchan seemed relatively insensitive to seed rate compared to other varieties, but Napier, Savannah and Chaucer showed strong responses at most sites. There was some difference in rankings at different seed rates, though generally the higher yielding varieties had the highest yields at all seed rates. Buchan did relatively better at higher seed rates, whereas Napier and Savannah did better at lower seed rates compared to other varieties. Yield responses to seed rate appeared to be more sensitive when comparing 400 or 350 seeds m^{-2} with 250 or 200 seeds m^{-2} than when comparing the latter seed rates with yields at 100 seeds m^{-2}.

3.3.9.1.2 2000/01

3.3.9.1.2.1 East Yorkshire

Yield averaged across all treatments was 11.6 t ha^{-1} (Figure 3.3.46). Increasing seed treatment from 100 to 200 seeds m^{-2} increased yield from 11.1 to 12.0 t ha^{-1} respectively ($p<0.001$). Claire yielded significantly lower than Consort or Equinox ($p<0.001$). There were no significant fungicide or treatment interaction effects.

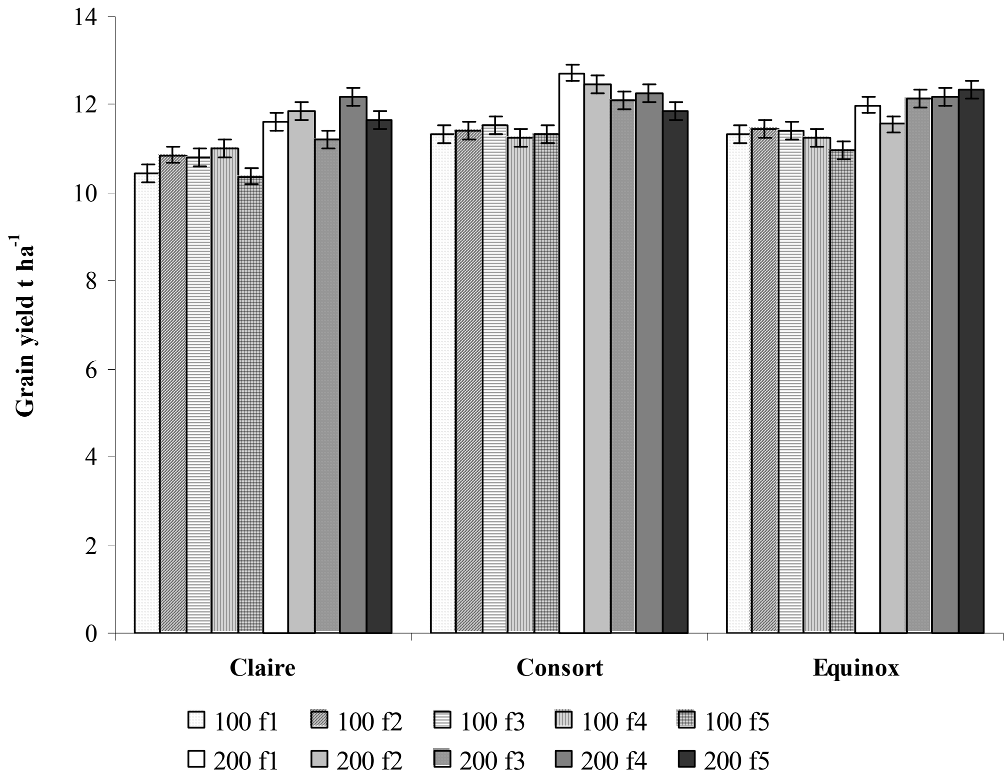

Figure 3.3.46 Combine yields (t ha^{-1}) at 15% moisture content, East Yorkshire 2000/01. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.2.2 Kent

Combine yield averaged across treatments was 9.1 t ha^{-1} (Figure 3.3.47). Increasing seed rate from 100 to 200 seeds m^{-2} increased yield from 8.8 to 9.4 t ha^{-1} respectively (p=0.017). Claire significantly out yielded Consort and Equinox (p<0.001). There were no significant fungicide or treatment interaction effects.

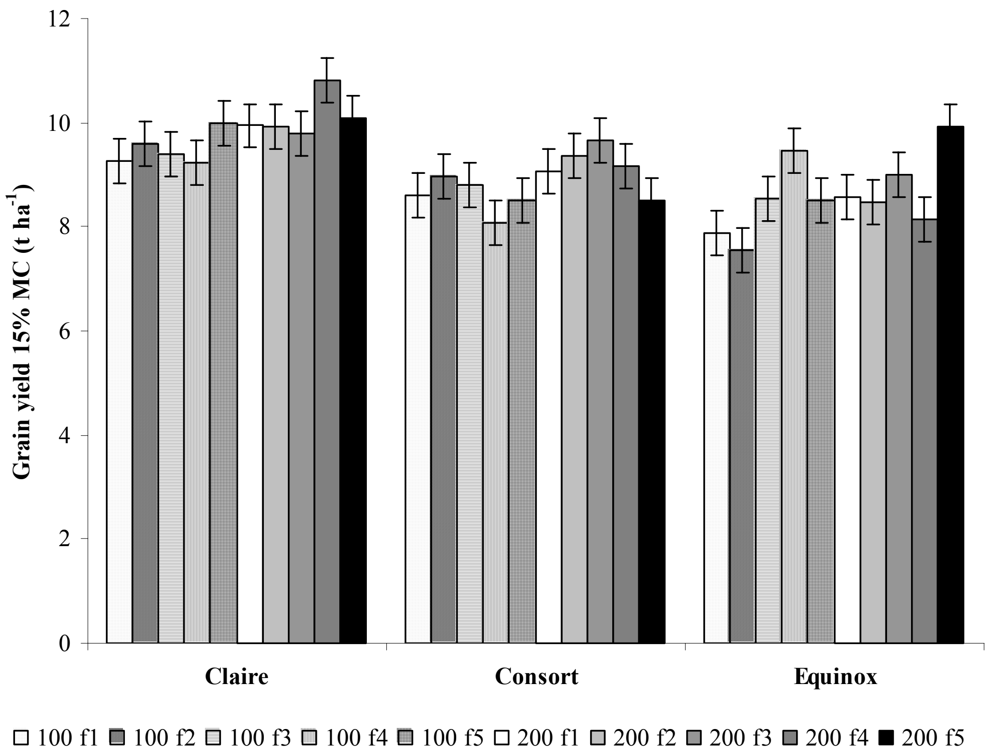

Figure 3.3.47 Combine yields at 15% moisture content, Kent 2000/01. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.2.3 Bedfordshire

Averaged across treatments, combine yield at 15% moisture was 6.5 t ha^{-1} (Figure 3.3.48). Yield increased from 5.9 to 7.1 t ha^{-1} as seed rate increased from 100 to 200 seeds m^{-2} (p<0.001). Yields of Claire were higher than those of Equinox, which in turn were higher than those of Consort (p<0.001). None of the non-standard fungicide treatments yielded significantly more than the standard fungicide treatment, but additional autumn fungicides increased yields when compared with treatments with additional spring fungicides or early T1 applications (p=0.047). At 100 seeds m^{-2} additional autumn fungicides increased yield compared to the standard fungicide treatments, whereas at 200 seeds m^{-2} treatments with additional spring fungicides had lower yields than the standard fungicide regime (p=0.023). There were no other significant treatment interactions.

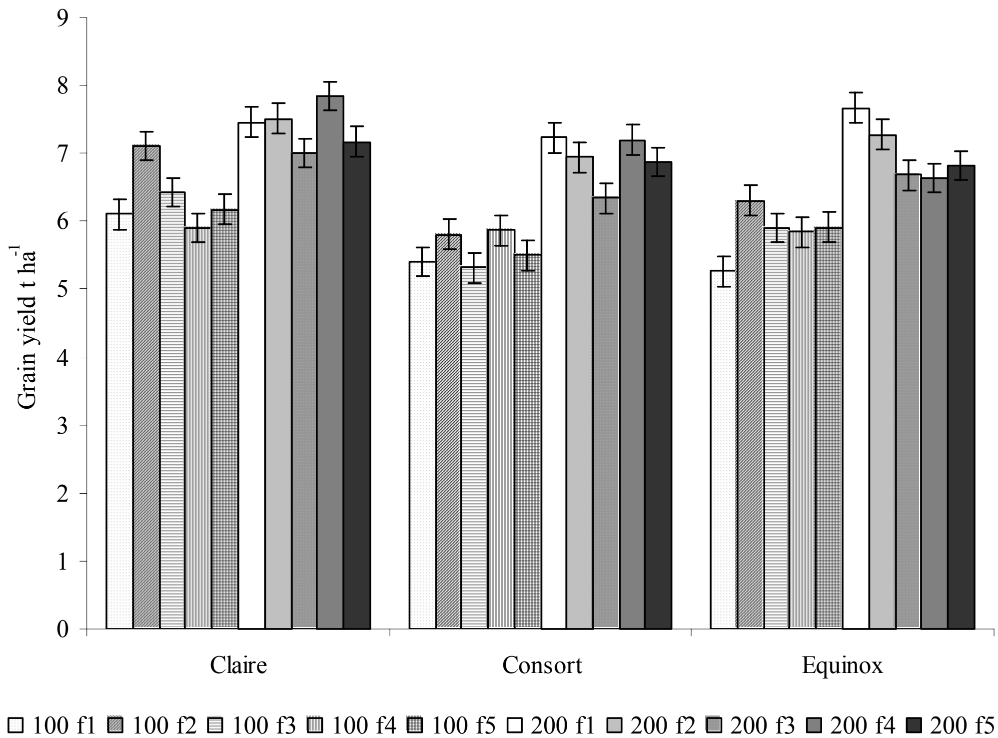

Figure 3.3.48 Combine yields at 15% moisture content, Bedfordshire 2000/01. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (57 d.f.).

3.3.9.1.2.4 Gloucestershire

Combine yield averaged across treatments was 9.2 t ha^{-1} (Figure 3.3.49). Increasing seed rate from 100 to 200 seeds m^{-2} increased yield from 9.0 to 9.4 t ha^{-1} respectively ($p<0.001$). Claire and Consort had yielded greater, at 9.3 and 9.4 t ha^{-1} respectively than Equinox at 8.9 t ha^{-1} ($p<0.001$). There were no significant fungicide effects. Claire and Consort both showed increased yield in response to increasing seed rate, but Equinox did not (p=0.049). There were no other significant treatment interactions.

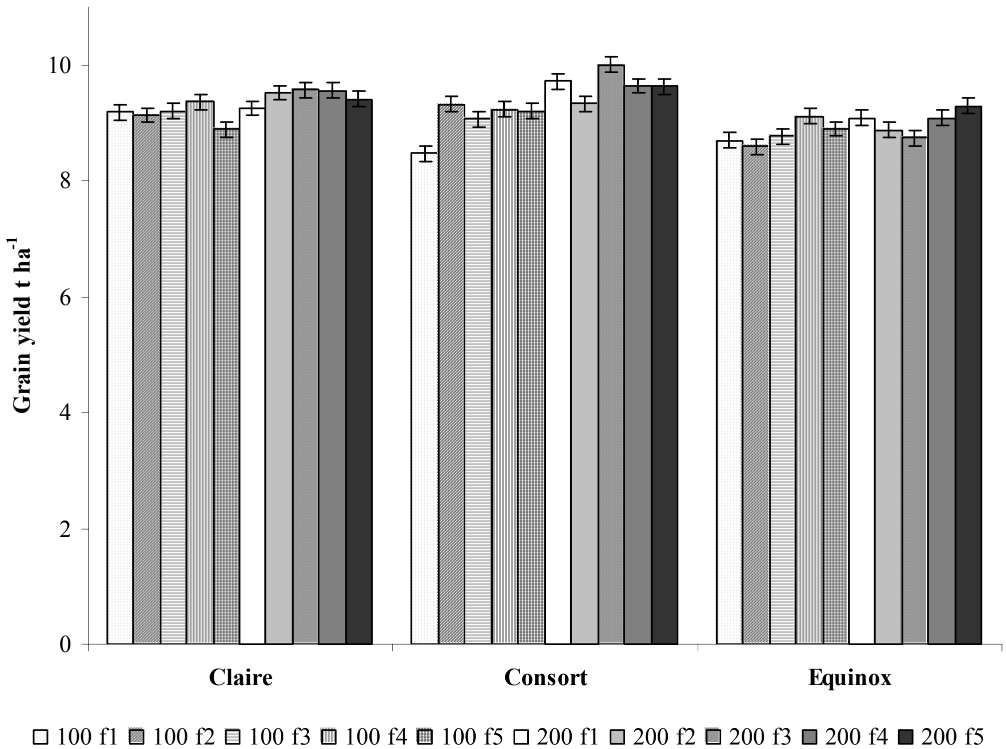

Figure 3.3.49 Combine yields at 15% moisture content, Gloucestershire 2000/01. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.2.5 2000/01 Summary

Increasing seed rate increased yield at all sites. Extent of the response varied quite considerable, from 1.2 t ha^{-1} at the Bedfordshire site, to 0.4 t ha^{-1} at the Gloucestershire site. In three out of four sites Claire gave the highest yields, and Equinox the lowest. There were no consistent fungicide effects across sites, and any significant effects were small. There were no consistent treatment interactions.

3.3.9.1.3 2001/02

3.3.9.1.3.1 East Yorkshire

Averaged across treatments, combine yields were 12.6 t ha^{-1}. Increasing seed rate from 100 to 200 seeds m^{-2} increased yield from 12.5 to 12.7 t ha^{-1} respectively (p=0.023). There were no significant varietal effects.

Averaging across seed rate and variety treatments, yields were significantly increased compared to the standard fungicide regime (12.3 t ha^{-1}) where additional spring fungicides (12.6 t ha^{-1}), additional autumn and spring fungicides (13.0 t ha^{-1}), and early T1 (12.7 t ha^{-1}) treatments were applied ($p<0.001$). Equinox showed increased yields averaged across fungicide treatments where seed rate was increased from 100 to 200 seeds m^{-2}, but Claire and Consort were not significantly affected by seed rate ($p=0.01$). Yields of Consort were apparently unaffected by fungicide treatment when averaged across seed rate treatments, but Claire showed increased yields compared to the control where additional autumn and spring fungicides had been applied together, and in the early T1 treatment; Equinox showed significant responses to additional spring and additional autumn and spring fungicides ($p=0.002$). There were no other significant treatment interactions.

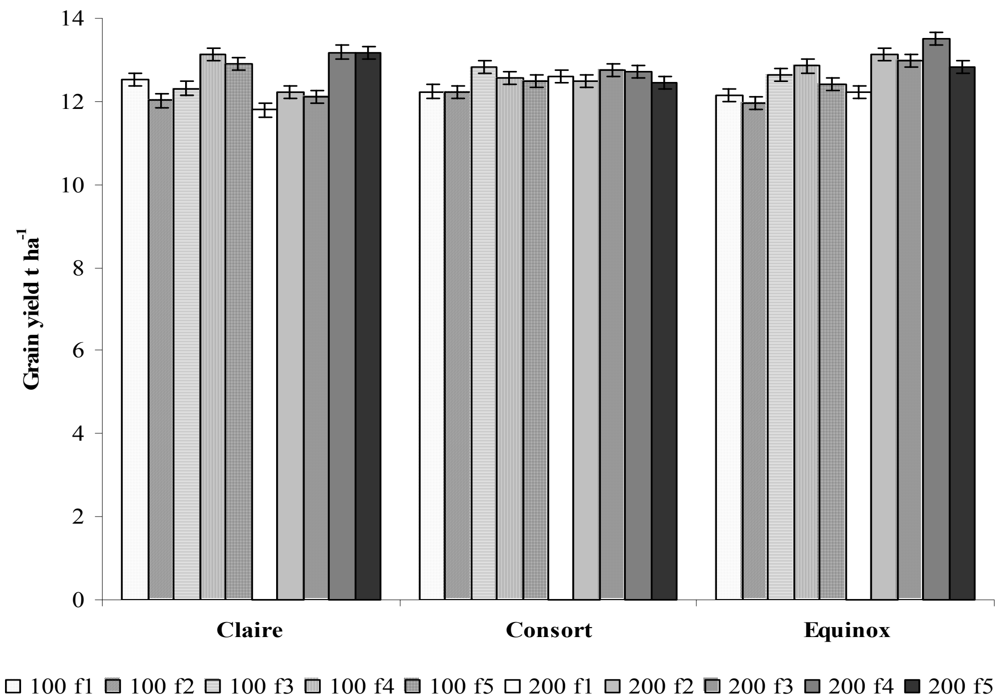

Figure 3.3.50 Combine yields at 15% moisture content, East Yorkshire 2001/02. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.3.2 Kent

Combine yield averaged across treatments was 9.4 t ha^{-1}(Figure 3.3.51). Yield increased from 9.3 to 9.5 t ha^{-1} as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p=0.01$). Claire yielded significantly higher at

10.3 t ha^{-1} than Consort or Equinox at 9.0 and 8.8 t ha^{-1} respectively ($p<0.001$). Averaging across varieties and seed rates, yield with the standard fungicide regime was 8.8 t ha^{-1}; application of additional spring fungicides, or additional autumn and spring fungicides increased yield to 10.4 t ha^{-1} ($p<0.001$). This was also observed when looking at fungicide effects in individual varieties averaged across seed rate treatments, although Claire only showed a significant increase in yield above the control when spring fungicides alone were applied, not where both spring and autumn fungicides were applied together ($p<0.001$). There were no varietal differences where autumn and spring fungicides had been applied, and only Consort was significantly lower in yield than Claire where spring fungicides had been applied. In all other fungicide treatments, varietal rankings were the same as when averaged across seed rate and fungicide treatments ($p<0.001$). There were no other significant treatment interactions.

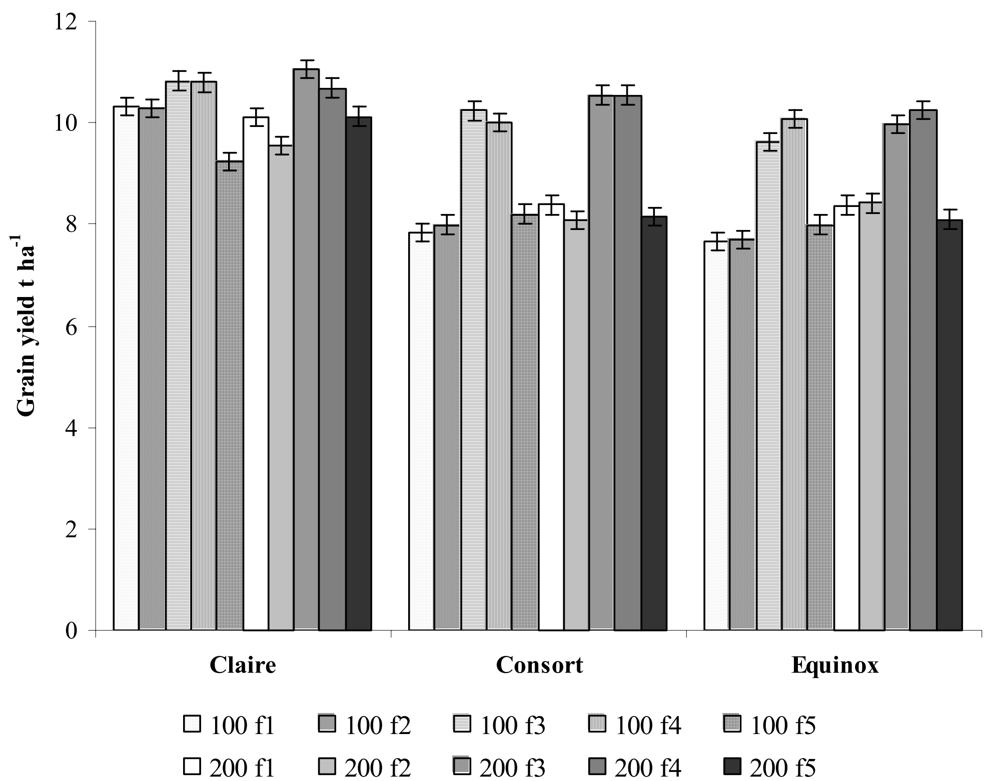

Figure 3.3.51 Combine yields at 15% moisture content, Kent 2001/02. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.3.3 Bedfordshire

Combine yield averaged 12.2 t ha^{-1} across treatments (Figure 3.3.52). Yield was slightly increased at the higher seed rate, but not significantly so. Claire had the lowest yield of the three varieties, but differences were not statistically significant. Where additional autumn and spring fungicides were applied yield was 0.3 t ha^{-1} higher than the control fungicide treatment yield of 12.1 t ha^{-1}, though this was not statistically significant. There were no significant treatment interactions.

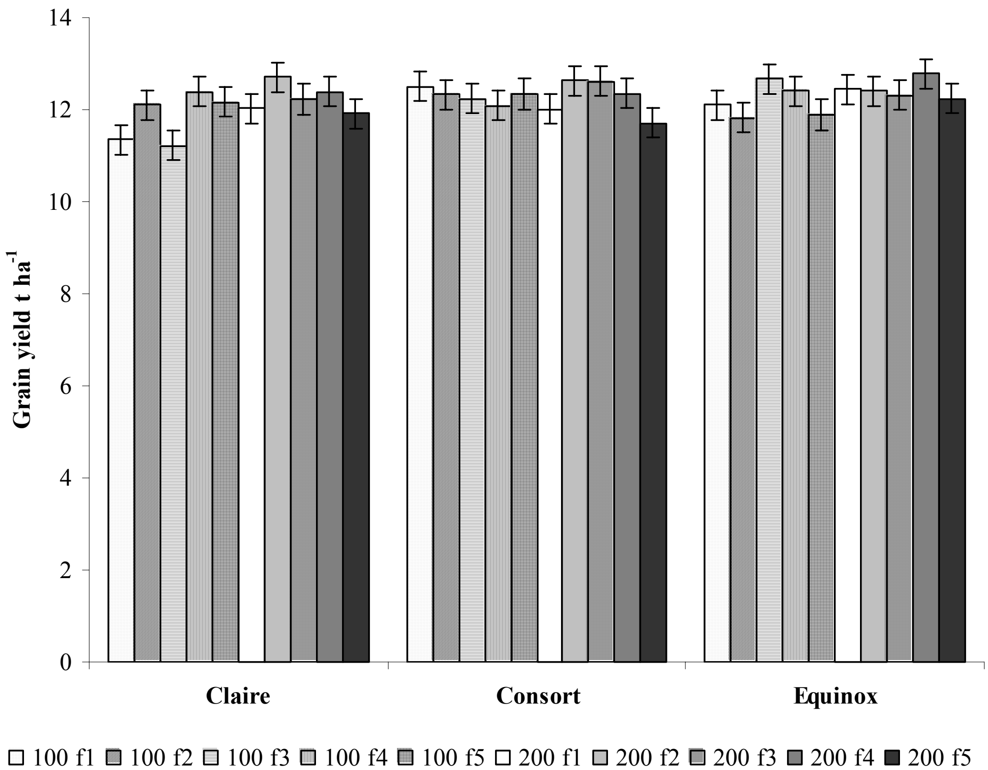

Figure 3.3.52 Combine yields at 15% moisture content, Bedfordshire 2001/02. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (57 d.f.).

3.3.9.1.3.4 Gloucestershire

Averaged across treatments, combine yields were 12.1 t ha^{-1} (Figure 3.3.53). Increasing seed rate increased yield from 11.7 to 12.5 t ha^{-1} at 100 and 200 seeds m^{-2} respectively ($p<0.001$). Averaged across fungicide and seed rate treatments Claire, at 12.4 t ha^{-1}, out yielded Equinox, at 12.1 t ha^{-1}, which in turn out yielded Consort, at 11.7 t ha^{-1} ($p<0.001$). Additional spring fungicides, and additional applications of both autumn and spring fungicides, significantly increased yields to 12.3 t ha^{-1} compared to the standard fungicide regime treatment yields of 11.9 t ha^{-1} (p=0.001). Additional autumn fungicides on their own or early T1 fungicide treatments had no significant effects relative to the standard fungicide treatment. At 200 seeds m^{-2} there was no significant yield increase in response to fungicide treatment compared to the standard fungicide regime in Claire and Consort, but additional spring fungicides and additional autumn and spring fungicides did increase yield in Equinox (p=0.006). At 100 seeds m^{-2} additional spring fungicides increased yield only in Equinox, and additional autumn and spring fungicides increased yields only in Consort, whereas in Claire, only additional autumn fungicides significantly increased yields (p=0.006).

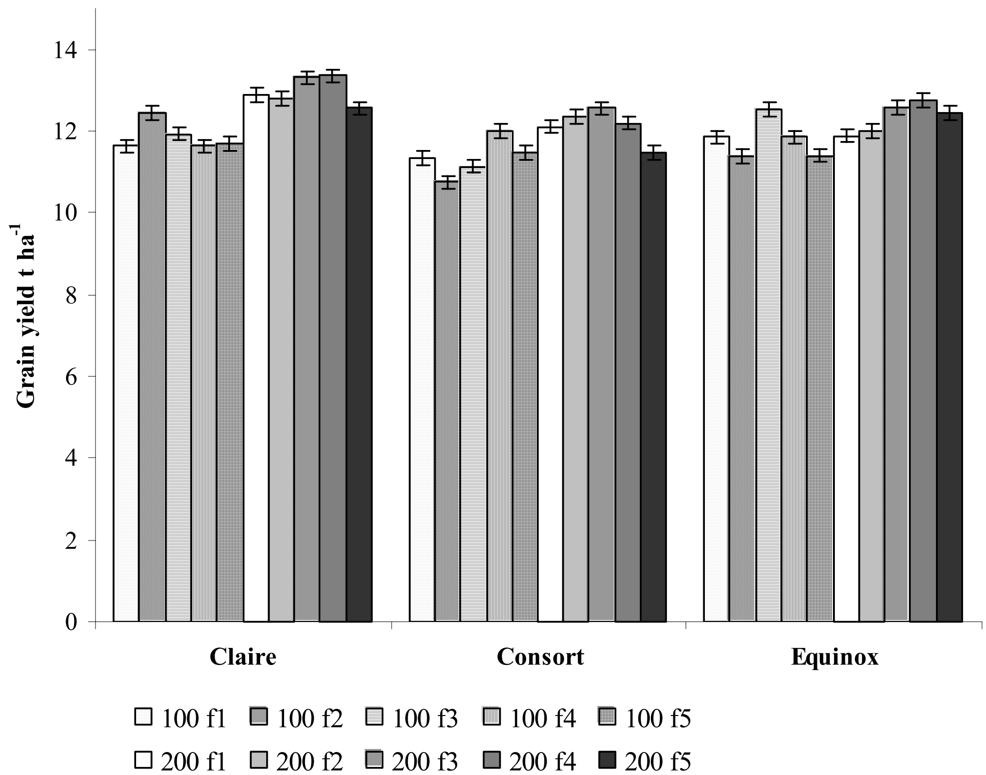

Figure 3.3.53 Combine yields at 15% moisture content, Gloucestershire 2001/02. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.3.5 Northumberland

Combine yields were 9.4 t ha^{-1} averaged across all treatments. Increasing seed rate from 100 to 200 seeds m^{-2} increased yield from 8.5 to 10.2 t ha^{-1} (p<0.001). Equinox, at 8.9 t ha^{-1} yielded significantly lower than

Claire and Consort, at 9.5 and 9.7 t ha^{-1} respectively ($p<0.001$). Averaging across varieties and seed rates, yield in the standard fungicide treatment was 9.4 t ha^{-1}. None of the other fungicide treatments increased yield above this significantly. However, plots treated with additional spring fungicides and those receiving early T1 applications yielded significantly less than those receiving both additional autumn and spring fungicides ($p=0.007$). There were no significant treatment interactions.

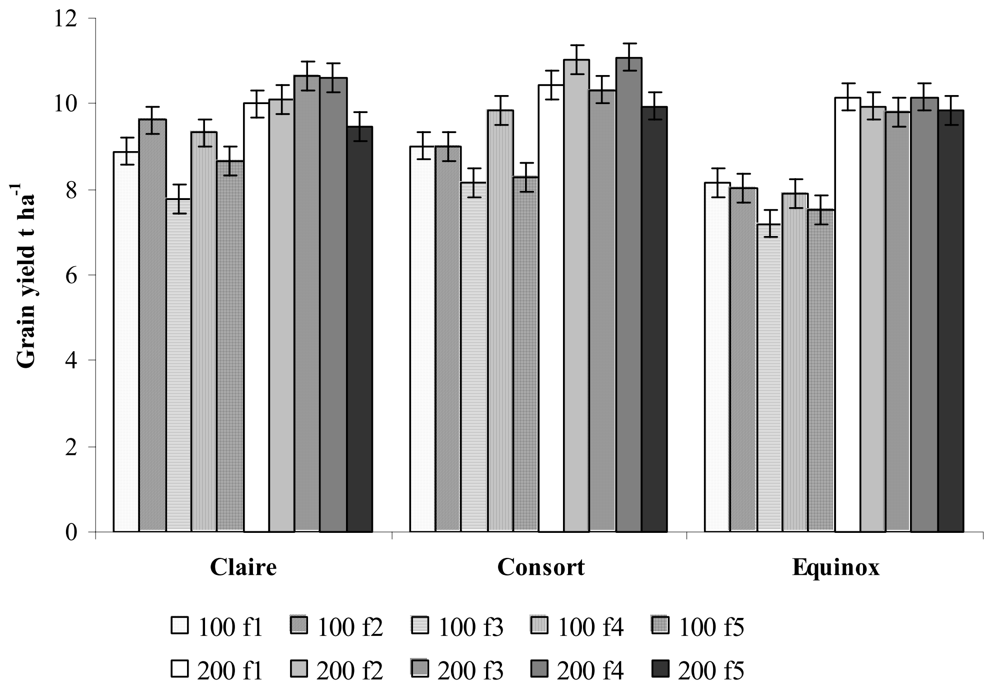

Figure 3.3.54 Combine yields at 15% moisture content, Northumberland 2001/02. Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.3.6 2001/02 Summary

Increasing seed rates increased yield at all sites. Seed rate increases were quite small at the Bedfordshire, Kent and East Yorkshire sites (around 0.2 t ha^{-1}), but at the Gloucestershire and Northumberland sites increases of 0.8 and 1.7 t ha^{-1} respectively were observed. Claire generally had the highest yields, while Equinox generally had the lowest. In general, treatment with additional spring fungicides, or additional autumn and spring fungicides, led to significant increases in yield. Responses to these fungicide treatments were much greater at the Kent site (1.6 t ha^{-1}) than the other sites (0.3 t ha^{-1}). There were no consistent treatment interactions across sites.

3.3.9.1.4 2002/03

3.3.9.1.4.1 East Yorkshire

Combine yields averaged 8.6 t ha^{-1} across all treatments (Figure 3.3.55). Yields increased from 8.3 to 8.9 t ha^{-1} as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Averaging across seed rate and fungicide treatments, yields of Claire, at 9.2 t ha^{-1}, were higher than Equinox, at 8.3 t ha^{-1}, which in turn were higher than those of Consort, at 8.1 t ha^{-1} ($p<0.001$). Treatments with additional autumn and spring fungicides yielded 8.8 t ha^{-1}, significantly more than treatments with the standard fungicide regime, at 8.5 t ha^{-1} ($p=0.028$). Other fungicide treatments had no significant effect. There were no significant treatment interactions.

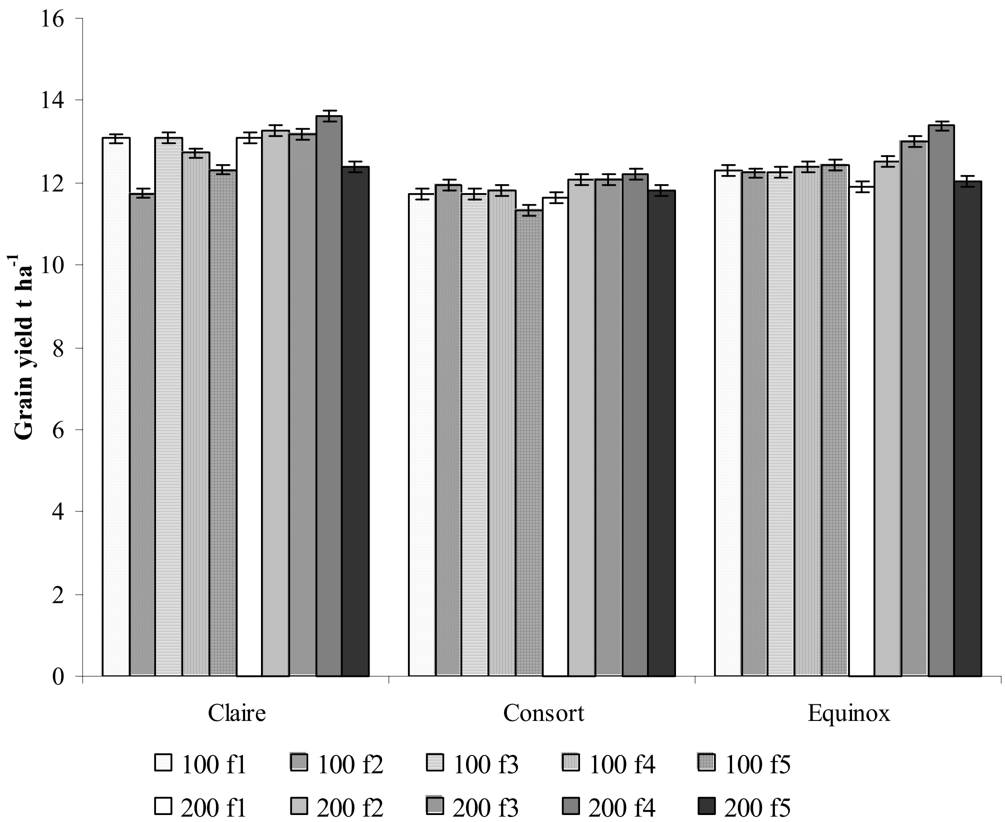

Figure 3.3.55 Combine yields at 15% moisture content, East Yorkshire 2002./03 Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.4.2 Kent

Combine yields of 12.4 t ha^{-1} were observed at the Kent site in 2003, when averaged across all treatments (Figure 3.3.56). As seed rate increased from 100 to 200 seeds m^{-2}, so yield increased from 12.2 to 12.6 t ha^{-1} respectively ($p<0.001$). Claire yielded highest, at 12.8 t ha^{-1} followed by Equinox at 12.5 t ha^{-1}, and Consort yielded lowest, at 11.9 t ha^{-1} ($p<0.001$). Averaging across varietal and seed rate treatments, additional spring, or additional autumn and spring fungicides led to yields of 12.6 and 12.7 t ha^{-1} respectively representing a significant increases on treatments with the standard fungicide regime at 12.3 t ha^{-1} ($p<0.001$). Additional autumn fungicides on their own, or early T1 fungicide treatments had no significant effect. When looking at individual seed rates, additional spring and additional autumn and spring fungicides only increased yields compared to the control treatment when sown at 200 seeds m^{-2}; they were ineffective at 100 seeds m^{-2} ($p=0.018$). There were no other significant treatment interactions.

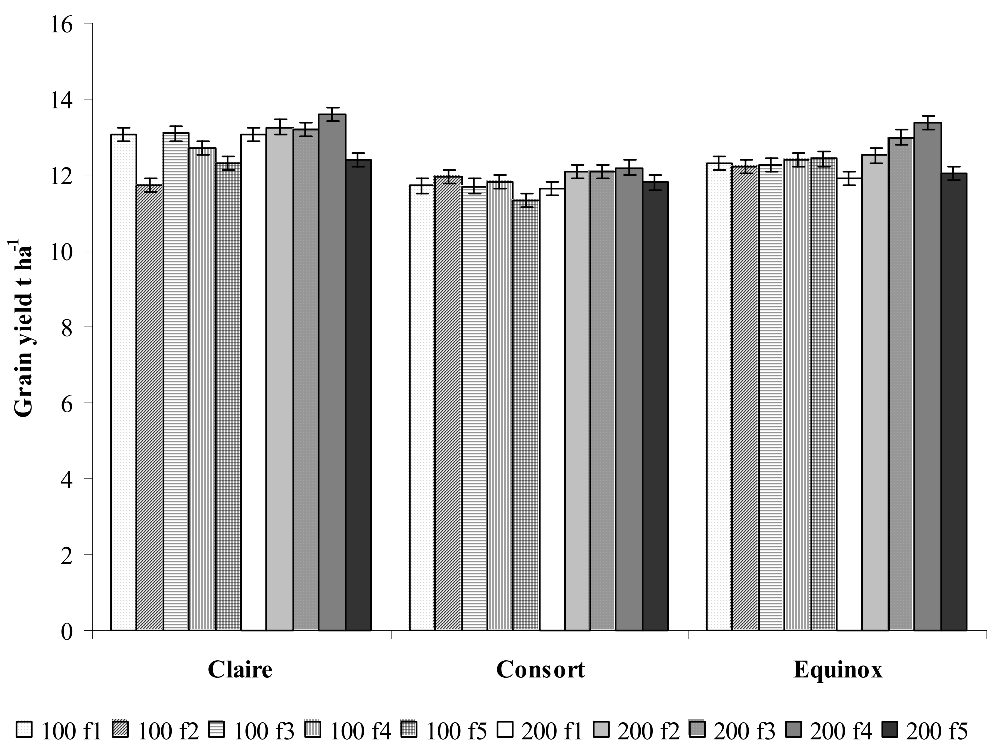

Figure 3.3.56 Combine yields at 15% moisture content, Kent 2002./03 Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.4.3 Bedfordshire

Combine yields averaged 11.9 t ha^{-1} across all treatments (Figure 3.3.57). Yields increased from 11.7 to 12.1 t ha^{-1} as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$), when averaged across variety and fungicide treatments. When looking at varietal means, Claire, at 12.3 t ha^{-1}, significantly out yielded Equinox, at 11.8 t ha^{-1}, which in turn was higher than Consort, at 11.5 t ha^{-1} ($p<0.001$). There were no significant fungicide effects, nor were there any significant interactions.

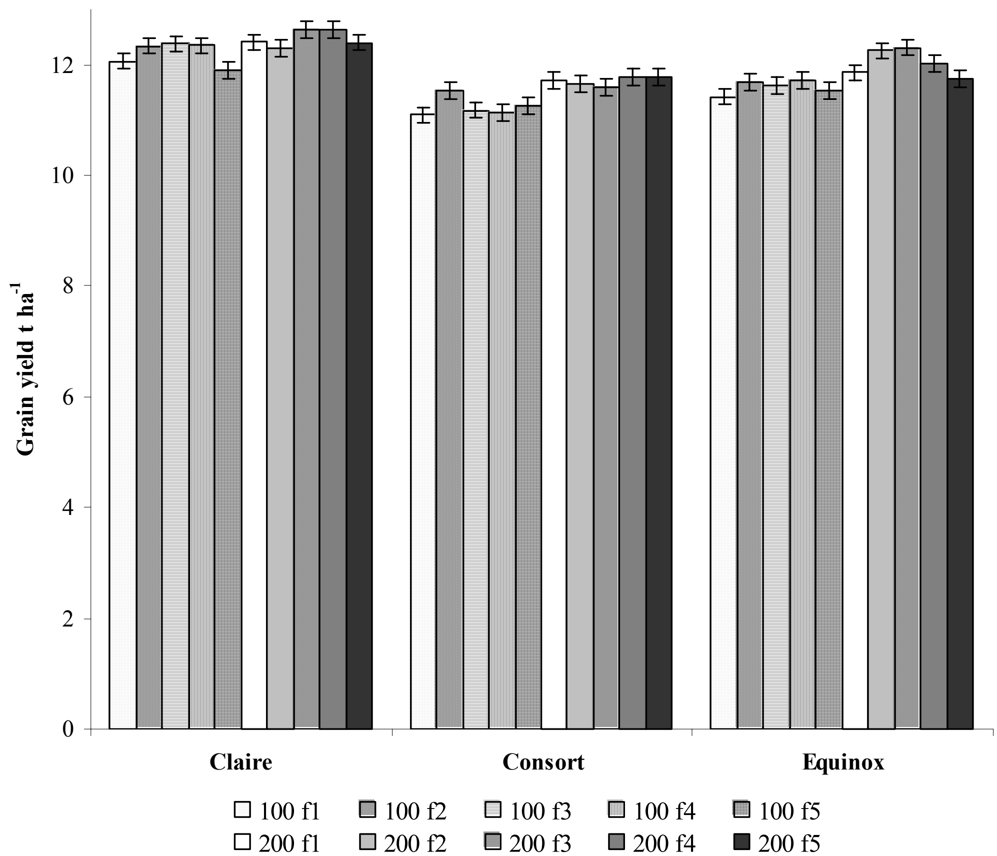

Figure 3.3.57 Combine yields at 15% moisture content, Bedfordshire 2002./03 Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.4.4 Gloucestershire

Combine yields averaged 11.1 t ha^{-1} (Figure 3.3.58). As seed rates increased from 100 to 200 seeds m^{-2}, yields increased from 10.9 to 11.4 t ha^{-1} respectively ($p<0.001$). Yields of Claire, averaging 11.7 t ha^{-1} across seed rate and fungicide treatments, were significantly greater than those of Equinox and Consort, at 10.9 and 10.8 t ha^{-1} respectively ($p<0.001$). Yields of 11.3 and 11.4 t ha^{-1} were observed for treatments with additional spring, or additional autumn and spring fungicides respectively, averaging across seed rate and varietal treatments. These were significantly higher than figures for the standard fungicide regime, which averaged 11.1 t ha^{-1} ($p<0.001$); other fungicide treatments had no effect. Varietal rankings observed when averaging across seed rate and fungicide treatments were maintained when looking at rankings at 100 seeds m^{-2}, however, at 200 seeds m^{-2}, although Claire was still the highest yielder, Equinox showed a statistically significant increase in yield over Consort ($p=0.005$). When looking at fungicide effects in different varieties, only Equinox showed any significant response to additional spring and additional autumn and spring fungicide applications ($p=0.002$). There were no other significant treatment interactions.

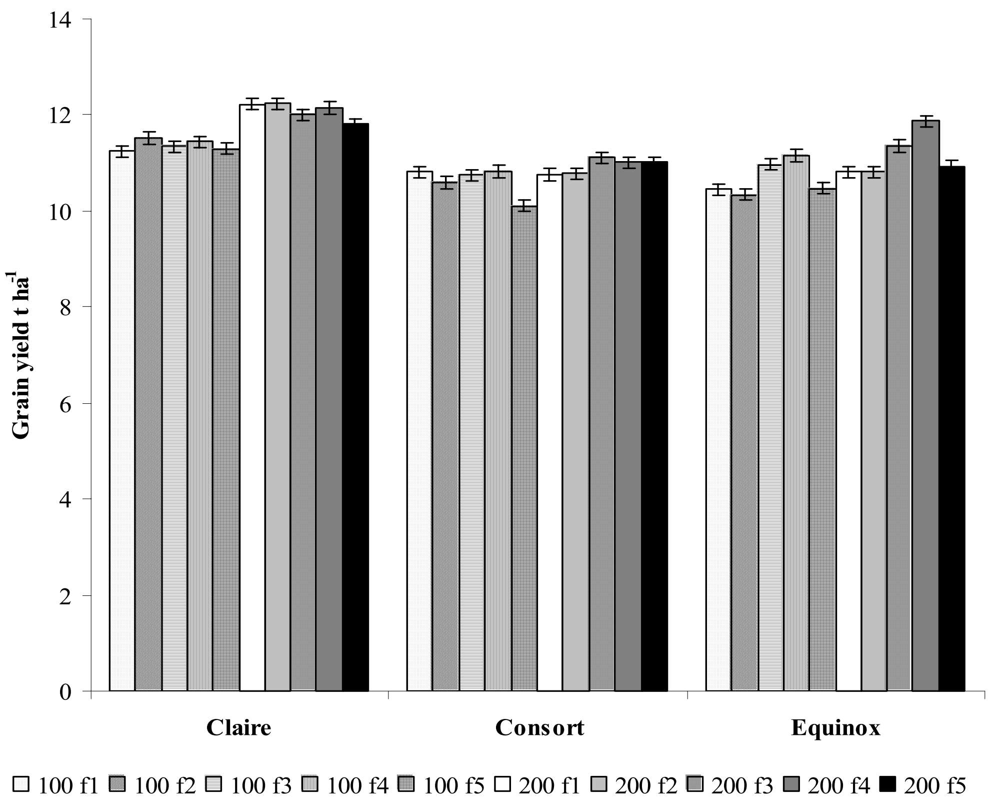

Figure 3.3.58 Combine yields at 15% moisture content, Gloucestershire 2002./03 Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.4.5 Northumberland

Combine yields averaged 11.1 t ha^{-1} across treatments (Figure 3.3.59). Yields increased from 10.9 to 11.3 t ha^{-1} as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Averaged across seed rate and fungicide treatments, Claire yielded the highest at 11.5 t ha^{-1}, higher than Consort at 11.2 t ha^{-1}, which in turn was higher than Equinox at 10.7 t ha^{-1} ($p<0.001$). Fungicide treatment had no significant effect on yield, nor were there any significant treatment interactions.

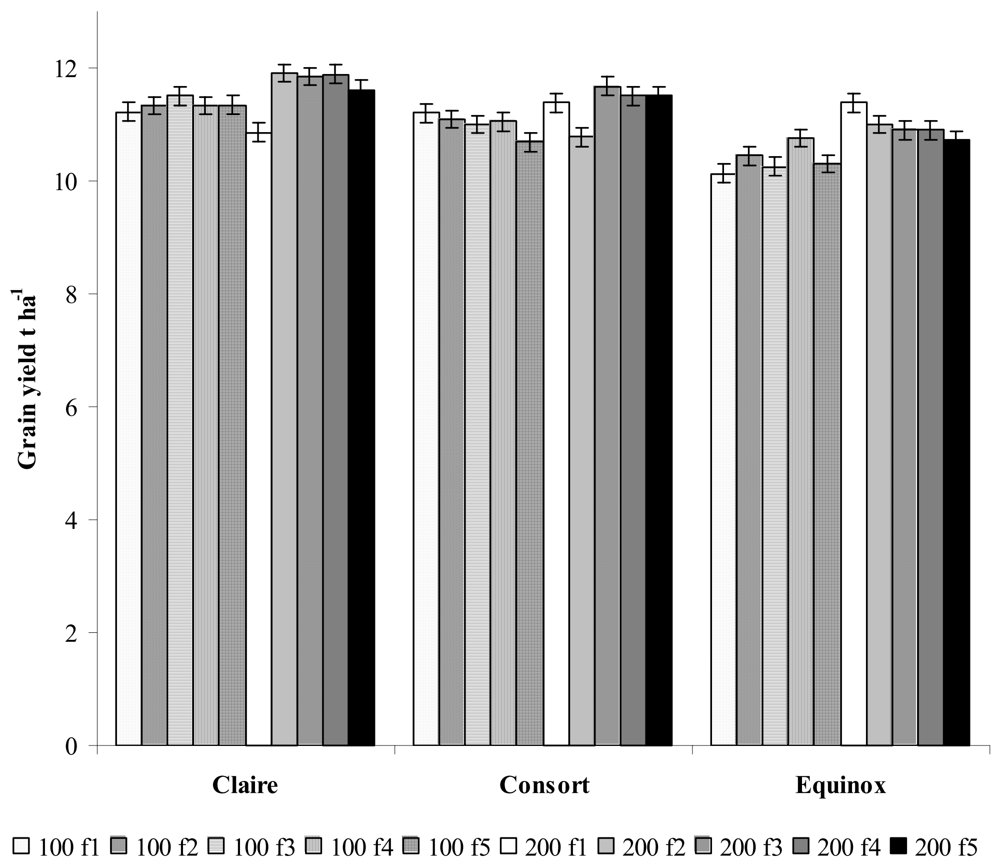

Figure 3.3.59 Combine yields at 15% moisture content, Northumberland 2002./03 Legend codes are 100 or 200 seeds m^{-2} (100 or 200), standard fungicide application (f1), additional autumn fungicides (f2), additional spring fungicides (f3), additional autumn and spring fungicides (f4) and early T1 application (f5). Error bars are SEDs for comparing individual seed treatment/variety/fungicide treatments (58 d.f.).

3.3.9.1.4.6 2002/03 Summary

Higher seed rates resulted in significantly higher yields at all sites, of around 0.4 t ha^{-1}. Claire was the highest yielding variety at all sites, Equinox was generally the mid-yielding variety, with Consort having the lowest yield at most sites. There were significant effects of fungicide treatment at three out of the five sites. Additional autumn and spring fungicides significantly increased yield by around 0.3 t ha^{-1} at the East Yorkshire, Kent and Gloucestershire sites. Additional spring fungicides on their own also significantly increased yields by approximately the same extent at the Kent and Gloucestershire sites. There were no significant treatment interactions that were consistent across sites.

3.3.9.1.5 Combine yield - summary

In three years out of four a higher seed rate led to statistically significant increases in yield. These increases could as high as 1.7 t ha^{-1}, but generally were around 0.4 t ha^{-1}. In the first year of this study however, all sites showed large and significant declines in yield as seed rate increased, approximately in the order of 1 t ha^{-1} as seed rate was doubled from 100 to 200 (or 250) and then to 400 (or 350) seeds m^{-2}.

Across all sites and seasons, Claire came out as a high yielder, whereas Consort and Equinox yielded lower, particularly Consort.

Efficacy of fungicide treatments varied widely across sites and years. In the 2000/01 season fungicide treatments had no effect. In the 2001/02 season, additional spring fungicides, or additional autumn and spring fungicides, significantly increased yields in three out of five sites. The extent of response varied with site, with the Kent site showing a 1.6 t ha^{-1} response, other sites showing only a 0.3 t ha^{-1} increase. In 2002/03 response to additional spring and additional spring and autumn fungicides were more consistent across sites, but smaller overall at around 0.3 t ha^{-1} at three out of five sites. Interestingly perhaps, the two sites that showed no response to fungicide treatment in the 2001/02 season, Bedfordshire and Northumberland, were the same two sites that had no response in the 2002/03 season.

Statistically significant treatment interactions were observed, but these were not consistent within years or sites.

3.3.9.2 Harvest index

3.3.9.2.1 1999/2000

No measurements of harvest index are available for the 1999/2000 season.

3.3.9.2.2 2000/01

3.3.9.2.2.1 East Yorkshire

A harvest index (HI) of 0.57 was recorded at this site, averaged across treatments (Table 3.3.105). HI decreased as seed rate increased, but differences were not significant. Claire had a significantly lower HI than either Consort or Equinox ($p<0.001$). Fungicide treatment had no significant effect, nor were there any significant treatment interactions.

Table 3.3.105 Harvest index of three varieties sown at two different rates with five different fungicide regimes, East Yorkshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatment					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	0.55	0.65	0.53	0.49	0.54	**0.55**
	200	0.54	0.53	0.52	0.51	0.52	**0.53**
	Mean	**0.55**	**0.59**	**0.53**	**0.51**	**0.53**	**0.54**
Consort	**100**	0.60	0.59	0.60	0.59	0.59	**0.59**
	200	0.58	0.57	0.57	0.57	0.59	**0.58**
	Mean	**0.59**	**0.59**	**0.59**	**0.58**	**0.59**	**0.59**
Equinox	**100**	0.56	0.59	0.58	0.57	0.58	**0.57**
	200	0.57	0.57	0.56	0.59	0.57	**0.57**
	Mean	0.56	0.58	0.57	0.58	0.57	**0.57**
Mean	**100**	0.57	0.61	0.57	0.55	0.57	**0.57**
	200	0.56	0.56	0.55	0.56	0.56	**0.56**
Overall Mean		**0.57**	**0.58**	**0.56**	**0.55**	**0.56**	**0.57**

	P	SED	
Rate	0.07	0.008	
Variety	<0.001	0.010	
Fungicide	0.153	0.013	
Rate*variety	0.586	0.014	
Rate*fungicide	0.253	0.018	
Variety*fungicide	0.157	0.022	
Rate*variety*fungicide	0.505	0.031	54 d.f.

3.3.9.2.2.2 Kent

Averaging across treatments, HI was 0.52 at the Kent site in this year (Table 3.3.106). Increasing seed rate decreased HI from 0.53 to 0.52 at 100 and 200 seeds m^{-2} respectively (p=0.006). Equinox had significantly higher HI than Claire or Consort (p<0.001). Treatment with additional autumn fungicides significantly increased HI compared to all other fungicide treatments (p=0.044). There were no significant treatment interactions.

Table 3.3.106 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Kent 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

	Fungicide	Variety			
Seeds m^{-2}	**treatment**	**Claire**	**Consort**	**Equinox**	**Mean**
100	**f1**	0.52	0.52	0.53	**0.52**
	f2	0.55	0.55	0.55	**0.55**
	f3	0.53	0.52	0.55	**0.53**
	f4	0.52	0.50	0.53	**0.52**
	f5	0.53	0.54	0.55	**0.54**
	Mean	**0.53**	**0.53**	**0.54**	**0.53**
200	**f1**	0.50	0.53	0.54	**0.52**
	f2	0.50	0.52	0.55	**0.52**
	f3	0.45	0.52	0.52	**0.50**
	f4	0.50	0.51	0.54	**0.52**
	f5	0.52	0.52	0.53	**0.52**
	Mean	**0.50**	**0.52**	**0.54**	**0.52**
Mean	**f1**	0.51	0.52	0.54	**0.52**
	f2	0.53	0.54	0.55	**0.54**
	f3	0.49	0.52	0.54	**0.52**
	f4	0.51	0.50	0.54	**0.52**
	f5	0.53	0.53	0.54	**0.53**
Overall Mean		**0.51**	**0.52**	**0.54**	**0.52**

	P	**SED**	
Rate	0.006	0.005	
Variety	<0.001	0.006	
Fungicide	0.044	0.008	
Rate*variety	0.146	0.009	
Rate*fungicide	0.114	0.012	
Variety*fungicide	0.676	0.014	
Rate*variety*fungicide	0.194	0.020	51 d.f.

3.3.9.2.2.3 Bedfordshire

Harvest index averaged across treatments was 0.51 (Table 3.3.107). There was a slight decrease in HI from 0.52 to 0.51 as seed rate increased from 100 to 200 seeds m^{-2} respectively, but these decreases were not significant. Claire had a slightly higher HI than either Consort or Equinox, but differences were not significant. Fungicide treatments had no significant effect, nor were there any significant interactions.

Table 3.3.107 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Bedfordshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

Seeds m^{-2}	Fungicide treatment	Variety: Claire	Consort	Equinox	Mean
100	**1**	0.53	0.50	0.51	**0.51**
	2	0.53	0.52	0.50	**0.51**
	3	0.51	0.52	0.53	**0.52**
	4	0.52	0.51	0.52	**0.52**
	5	0.53	0.52	0.51	**0.52**
	Mean	**0.52**	**0.51**	**0.51**	**0.52**
200	**1**	0.56	0.51	0.51	**0.53**
	2	0.51	0.48	0.50	**0.50**
	3	0.50	0.51	0.50	**0.50**
	4	0.49	0.49	0.50	**0.50**
	5	0.51	0.50	0.52	**0.51**
	Mean	**0.51**	**0.50**	**0.51**	**0.51**
Mean	**1**	0.55	0.50	0.51	**0.52**
	2	0.52	0.50	0.50	**0.51**
	3	0.51	0.52	0.51	**0.51**
	4	0.51	0.50	0.51	**0.51**
	5	0.52	0.51	0.52	**0.52**
Overall Mean		**0.52**	**0.51**	**0.51**	**0.51**

	P	**SED**	
Rate	0.072	0.005	
Variety	0.097	0.006	
Fungicide	0.224	0.008	
Rate*variety	0.719	0.009	
Rate*fungicide	0.157	0.011	
Variety*fungicide	0.340	0.014	
Rate*variety*fungicide	0.764	0.020	58 d.f.

3.3.9.2.2.4 Gloucestershire

Harvest index averaged 0.54 averaged across treatments (Table 3.3.108). Seed rate did not have any significant effects. Consort had significantly higher HI than either Claire or Equinox ($p<0.001$). The different fungicide treatments had no significant effects, nor were there any significant treatment interactions.

Table 3.3.108 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Gloucestershire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatments					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	0.53	0.55	0.53	0.52	0.53	**0.53**
	200	0.53	0.54	0.53	0.52	0.53	**0.53**
	Mean	**0.53**	**0.54**	**0.53**	**0.52**	**0.53**	**0.53**
Consort	**100**	0.56	0.56	0.55	0.55	0.56	**0.56**
	200	0.58	0.54	0.54	0.59	0.56	**0.56**
	Mean	**0.57**	**0.55**	**0.55**	**0.57**	**0.56**	**0.56**
Equinox	**100**	0.55	0.53	0.54	0.51	0.54	**0.53**
	200	0.54	0.52	0.53	0.52	0.54	**0.53**
	Mean	0.54	0.52	0.53	0.52	0.54	**0.53**
Mean	**100**	0.55	0.54	0.54	0.53	0.54	**0.54**
	200	0.55	0.53	0.53	0.55	0.54	**0.54**
Overall Mean		**0.55**	**0.54**	**0.54**	**0.54**	**0.54**	**0.54**

	P	SED	
Rate	0.959	0.004	
Variety	<0.001	0.005	
Fungicide	0.527	0.007	
Rate*variety	0.624	0.008	
Rate*fungicide	0.127	0.010	
Variety*fungicide	0.140	0.012	
Rate*variety*fungicide	0.722	0.017	58 df

3.3.9.2.2.5 2000/01 Summary

As seed rate increased, HI generally decreased, though these decreases were very small, and rarely of statistical significance. Claire generally had the lowest HI, but again, differences were small and not always statistically significant. There were no significant fungicide effects or treatment interactions.

3.3.9.2.3 2001/02

3.3.9.2.3.1 East Yorkshire

HI averaged 0.54 across all treatments (Table 3.3.109). There was a slight decrease in HI as seed rate increased, but this was not statistically significant. Claire had a lower HI than either Consort or Equinox (p=0.013). There were no statistically significant fungicide effects or treatment interactions.

Table 3.3.109 Harvest index of three varieties sown at two different rates with five different fungicide regimes, East Yorkshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	**Claire**	0.51	0.52	0.54	0.51	0.55	**0.53**
	Consort	0.55	0.53	0.56	0.55	0.54	**0.55**
	Equinox	0.54	0.53	0.54	0.55	0.56	**0.54**
Mean		**0.53**	**0.53**	**0.55**	**0.54**	**0.55**	**0.54**
200	**Claire**	0.53	0.54	0.53	0.52	0.54	**0.53**
	Consort	0.55	0.53	0.54	0.53	0.54	**0.54**
	Equinox	0.54	0.53	0.52	0.54	0.54	**0.54**
Mean		**0.54**	**0.53**	**0.53**	**0.53**	**0.54**	**0.53**
S.R. Mean	**Claire**	0.52	0.53	0.54	0.52	0.54	**0.53**
	Consort	0.55	0.53	0.55	0.54	0.54	**0.54**
	Equinox	0.54	0.53	0.53	0.54	0.55	**0.54**
Overall mean		**0.53**	**0.53**	**0.54**	**0.53**	**0.54**	**0.54**

	P-value	SED	
Rate	0.078	0.00334	
Variety	0.013	0.00409	
Fungicide	0.082	0.00528	
Rate*Variety	0.356	0.00578	
Rate*Fungicide	0.062	0.00746	
Variety*Fungicide	0.073	0.00914	
Rate*Variety*Fungicide	0.958	0.01293	58 d.f.

3.3.9.2.3.2 Kent

Harvest index averaged 0.42 across treatments (Table 3.3.110). Seed rate and varietal treatments had no statistically significant effect, nor were there any significant treatment interactions. Treatment with additional spring, or additional autumn and spring fungicides significantly increased HI (p<0.001) compared to the standard fungicide regime. Additional autumn fungicides on their own, or early application of T1 fungicides had no significant effect.

Table 3.3.110 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Kent 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

	Fungicide	Variety			
Seeds m^{-2}	**treatment**	**Claire**	**Consort**	**Equinox**	**Mean**
100	**1**	0.40	0.40	0.41	**0.40**
	2	0.41	0.39	0.39	**0.40**
	3	0.44	0.44	0.42	**0.43**
	4	0.43	0.46	0.43	**0.44**
	5	0.43	0.41	0.41	**0.42**
	Mean	**0.42**	**0.42**	**0.41**	**0.42**
200	**1**	0.42	0.40	0.40	**0.41**
	2	0.41	0.40	0.40	**0.40**
	3	0.42	0.46	0.43	**0.44**
	4	0.44	0.46	0.45	**0.45**
	5	0.43	0.43	0.40	**0.42**
	Mean	**0.42**	**0.43**	**0.42**	**0.42**
Mean	**1**	0.41	0.40	0.41	**0.40**
	2	0.41	0.40	0.39	**0.40**
	3	0.43	0.45	0.43	**0.44**
	4	0.43	0.46	0.44	**0.44**
	5	0.43	0.42	0.40	**0.42**
Overall Mean		**0.42**	**0.42**	**0.41**	**0.42**
			P	**SED**	
		Rate	0.228	0.005	
		Variety	0.161	0.006	
		Fungicide	<0.001	0.008	
		Rate*variety	0.799	0.009	
		Rate*fungicide	0.904	0.011	
		Variety*fungicide	0.315	0.013	
		Rate*variety*fungicide	0.747	0.019	58 d.f.

3.3.9.2.3.3 Bedfordshire

HI averaged 0.49 across treatments (Table 3.3.111). There was a small decrease as seed rate increased, but this was not significant. There were no significant varietal, fungicide or treatment interaction effects.

Table 3.3.111 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Bedfordshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

	Fungicide	Variety			
Seeds m^{-2}	**treatment**	**Claire**	**Consort**	**Equinox**	**Mean**
100	**f1**	0.54	0.49	0.48	**0.50**
	f2	0.49	0.48	0.49	**0.49**
	f3	0.50	0.51	0.49	**0.50**
	f4	0.49	0.50	0.51	**0.50**
	f5	0.51	0.50	0.49	**0.50**
	Mean	**0.51**	**0.49**	**0.49**	**0.50**
200	**f1**	0.50	0.53	0.52	**0.52**
	f2	0.49	0.50	0.42	**0.47**
	f3	0.42	0.47	0.51	**0.47**
	f4	0.51	0.50	0.49	**0.50**
	f5	0.49	0.49	0.48	**0.49**
	Mean	**0.48**	**0.50**	**0.48**	**0.49**
Mean	**f1**	0.52	0.51	0.50	**0.51**
	f2	0.49	0.49	0.46	**0.48**
	f3	0.46	0.49	0.50	**0.48**
	f4	0.50	0.50	0.50	**0.50**
	f5	0.50	0.49	0.49	**0.49**
Overall Mean		**0.49**	**0.50**	**0.49**	**0.49**

	P	**SED**	
Rate	0.201	0.008	
Variety	0.750	0.010	
Fungicide	0.132	0.013	
Rate*variety	0.417	0.014	
Rate*fungicide	0.326	0.018	
Variety*fungicide	0.501	0.022	
Rate*variety*fungicide	0.145	0.031	58 d.f.

3.3.9.2.3.4 Gloucestershire

Averaged across treatments, HI was 0.53 (Table 3.3.112). Increasing seed rate slightly decreased HI, though not significantly. There were no significant effects of varietal or fungicide treatments, nor were there any significant treatment interactions.

Table 3.3.112 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Gloucestershire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.52	0.54	0.52	0.50	0.54	**0.52**
	Consort	0.53	0.52	0.53	0.55	0.53	**0.53**
	Equinox	0.53	0.53	0.53	0.53	0.53	**0.53**
Mean		**0.53**	**0.53**	**0.53**	**0.52**	**0.53**	**0.53**
200	Claire	0.52	0.52	0.52	0.53	0.53	**0.52**
	Consort	0.53	0.53	0.53	0.52	0.53	**0.53**
	Equinox	0.51	0.52	0.52	0.53	0.52	**0.52**
Mean		**0.52**	**0.52**	**0.52**	**0.53**	**0.53**	**0.52**
S.R. Mean	**Claire**	0.52	0.53	0.52	0.51	0.54	**0.52**
	Consort	0.53	0.52	0.53	0.53	0.53	**0.53**
	Equinox	0.52	0.52	0.53	0.53	0.53	**0.52**
Overall mean		**0.52**	**0.53**	**0.52**	**0.52**	**0.53**	**0.53**

	P-value	SED	
Rate	0.082	0.003	
Variety	0.346	0.004	
Fungicide	0.789	0.005	
Rate*Variety	0.275	0.005	
Rate*Fungicide	0.73	0.007	
Variety*Fungicide	0.329	0.008	
Rate*Variety*Fungicide	0.088	0.012	58 d.f.

3.3.9.2.3.5 Northumberland

HI averaged 0.47 across treatments (Table 3.3.113). There was no significant effect of seed rate treatment. Claire had significant lower HI than Consort or Equinox (p=0.019). However, at 100 seeds m^{-2} Equinox had significantly lower HI than Consort, whereas the HI of Claire was not significantly different from either other variety (p=0.004). Claire apparently had a lower HI at 200 seeds m^{-2}, whereas Equinox had a larger HI at the higher seed rate (p=0.004). There were no other significant treatment interactions, nor were there any significant fungicide effects.

Table 3.3.113 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Northumberland 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seed rate	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.47	0.47	0.50	0.44	0.45	**0.47**
	Consort	0.48	0.49	0.48	0.52	0.50	**0.49**
	Equinox	0.42	0.47	0.45	0.47	0.46	**0.45**
Mean		**0.46**	**0.48**	**0.48**	**0.48**	**0.47**	**0.47**
200	Claire	0.43	0.41	0.46	0.41	0.40	**0.42**
	Consort	0.49	0.45	0.49	0.50	0.51	**0.49**
	Equinox	0.49	0.47	0.52	0.48	0.48	**0.49**
Mean		**0.47**	**0.44**	**0.49**	**0.47**	**0.46**	**0.47**
S.R. Mean	Claire	0.45	0.44	0.48	0.42	0.43	**0.45**
	Consort	0.49	0.47	0.49	0.51	0.50	**0.49**
	Equinox	0.45	0.47	0.48	0.48	0.47	**0.47**
Overall mean		**0.46**	**0.46**	**0.48**	**0.47**	**0.47**	**0.47**

	P-value	SED	
Rate	0.572	0.00937	
Variety	0.019	0.01148	
Fungicide	0.48	0.01482	
Rate*Variety	0.004	0.01624	
Rate*Fungicide	0.695	0.02096	
Variety*Fungicide	0.43	0.02567	
Rate*Variety*Fungicide	0.544	0.03631	58 d.f.

3.3.9.2.3.6 2001/02 Summary

Increasing seed rate generally decreased HI, though these decreases were small and non-significant. Varietal effects were small, but Claire tended to have the lowest HI of the three varieties. Statistically significant fungicide effects were seen only at the Kent site. Any treatment interactions were not consistent across sites.

3.3.9.2.4 2002/03

3.3.9.2.4.1 East Yorkshire

HI averaged 0.53 across treatments (Table 3.3.114). Increasing seed rate decreased HI only slightly, and was not statistically significant. Consort had lower HI than either Claire or Equinox (p=0.01). There were no significant fungicide effects or treatment interactions.

Table 3.3.114 Harvest index of three varieties sown at two different rates with five different fungicide regimes, East Yorkshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.55	0.56	0.56	0.57	0.55	**0.56**
	Consort	0.53	0.48	0.53	0.55	0.47	**0.51**
	Equinox	0.55	0.54	0.54	0.55	0.54	**0.54**
Mean		**0.54**	**0.53**	**0.55**	**0.56**	**0.52**	**0.54**
200	Claire	0.54	0.54	0.51	0.54	0.54	**0.54**
	Consort	0.52	0.52	0.53	0.54	0.54	**0.53**
	Equinox	0.53	0.53	0.54	0.52	0.52	**0.53**
Mean		**0.53**	**0.53**	**0.53**	**0.53**	**0.54**	**0.53**
S.R. Mean	Claire	0.55	0.55	0.54	0.56	0.55	**0.55**
	Consort	0.53	0.50	0.53	0.54	0.51	**0.52**
	Equinox	0.54	0.54	0.54	0.54	0.53	**0.54**
Mean		**0.54**	**0.53**	**0.54**	**0.54**	**0.53**	**0.53**

	p-value	SED	
Rate	0.400	0.007	
Variety	0.010	0.008	
Fungicide	0.510	0.011	
Rate*variety	0.063	0.012	
Rate*fungicide	0.317	0.015	
Variety*fungicide	0.699	0.019	
Rate*variety*fungicide	0.754	0.026	58 d.f.

3.3.9.2.4.2 Kent

Averaged across all treatments, HI was 0.49 (Table 3.3.115). Neither seed rate nor fungicide treatment significantly affected HI, nor were there any significant treatment interactions. HI of Consort was significant lower than that of Equinox (p=0.001).

Table 3.3.115 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Kent 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.47	0.51	0.48	0.49	0.50	**0.49**
	Consort	0.48	0.48	0.48	0.47	0.49	**0.48**
	Equinox	0.50	0.49	0.51	0.52	0.50	**0.50**
Mean		**0.48**	**0.49**	**0.49**	**0.49**	**0.50**	**0.49**
200	Claire	0.46	0.48	0.48	0.49	0.48	**0.48**
	Consort	0.49	0.48	0.48	0.48	0.47	**0.48**
	Equinox	0.53	0.48	0.49	0.49	0.49	**0.50**
Mean		**0.49**	**0.48**	**0.48**	**0.48**	**0.48**	**0.49**
S.R. Mean	Claire	0.47	0.50	0.48	0.49	0.49	**0.49**
	Consort	0.48	0.48	0.48	0.47	0.48	**0.48**
	Equinox	0.51	0.48	0.50	0.50	0.50	**0.50**
Mean		**0.49**	**0.49**	**0.49**	**0.49**	**0.49**	**0.49**

	p-value	SED	
Rate	0.193	0.004	
Variety	0.001	0.005	
Fungicide	0.988	0.007	
Rate*variety	0.618	0.007	
Rate*fungicide	0.299	0.009	
Variety*fungicide	0.112	0.011	
Rate*variety*fungicide	0.417	0.016	58 d.f.

3.3.9.2.4.3 Bedfordshire

Harvest index averaged 0.54 across all treatments (Table 3.3.116). Sowing at the higher seed rate decreased HI (p=0.003). Claire had significantly lower HI than either Consort or Equinox (p<0.001). There were no significant fungicide effects, nor were there any significant treatment interactions.

Table 3.3.116 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Bedfordshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.54	0.53	0.53	0.54	0.53	**0.53**
	Consort	0.54	0.55	0.55	0.53	0.55	**0.54**
	Equinox	0.55	0.54	0.54	0.55	0.55	**0.55**
Mean		**0.55**	**0.54**	**0.54**	**0.54**	**0.54**	**0.54**
200	Claire	0.52	0.53	0.53	0.51	0.53	**0.52**
	Consort	0.54	0.54	0.54	0.54	0.53	**0.54**
	Equinox	0.55	0.54	0.54	0.54	0.54	**0.54**
Mean		**0.53**	**0.53**	**0.54**	**0.53**	**0.53**	**0.53**
S.R. Mean	Claire	0.53	0.53	0.53	0.52	0.53	**0.528**
	Consort	0.54	0.54	0.54	0.54	0.54	**0.540**
	Equinox	0.55	0.54	0.54	0.55	0.54	**0.543**
Mean		**0.54**	**0.54**	**0.54**	**0.53**	**0.54**	**0.54**

	p-value	SED	
Rate	0.003	0.0024	
Variety	<.001	0.0029	
Fungicide	0.555	0.0037	
Rate*variety	0.534	0.0041	
Rate*fungicide	0.600	0.0053	
Variety*fungicide	0.520	0.0065	
Rate*variety*fungicide	0.103	0.0091	58 d.f.

3.3.9.2.4.4 Gloucestershire

Harvest index was 0.51 averaging across all treatments (Table 3.3.117). Seed rate had no effect on HI, neither did any of the fungicide treatments. Equinox had significantly increased HI compared to Claire, which in turn had a larger HI than Consort (p<0.001). Consort showed significantly reduced HI at 200 seeds m^{-2} compared to that at 100 seeds m^{-2} (p=0.014). There were no other significant treatment interactions.

Table 3.3.117 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Gloucestershire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.52	0.52	0.51	0.50	0.50	**0.51**
	Consort	0.51	0.50	0.49	0.50	0.51	**0.50**
	Equinox	0.53	0.49	0.52	0.54	0.51	**0.52**
Mean		**0.52**	**0.50**	**0.51**	**0.51**	**0.50**	**0.51**
200	Claire	0.52	0.50	0.51	0.52	0.52	**0.51**
	Consort	0.49	0.48	0.47	0.49	0.47	**0.48**
	Equinox	0.51	0.53	0.52	0.55	0.52	**0.52**
Mean		**0.51**	**0.50**	**0.50**	**0.52**	**0.50**	**0.51**
S.R. Mean	Claire	0.52	0.51	0.51	0.51	0.51	**0.51**
	Consort	0.50	0.49	0.48	0.49	0.49	**0.49**
	Equinox	0.52	0.51	0.52	0.54	0.51	**0.52**
Mean		**0.51**	**0.50**	**0.50**	**0.52**	**0.50**	**0.51**
			p-value	SED			
	Rate		0.305	0.004			
	Variety		<.001	0.005			
	Fungicide		0.134	0.006			
	Rate*variety		0.014	0.007			
	Rate*fungicide		0.381	0.009			
	Variety*fungicide		0.224	0.011			
	Rate*variety*fungicide		0.283	0.015	58 d.f.		

3.3.9.2.4.5 Northumberland

Averaged across treatments, HI was 0.53 (Table 3.3.118). Increasing seed rate decreased HI from 0.53 to 0.52 at 100 and 200 seeds m^{-2} respectively (p=0.01). Consort had significantly greater HI than Claire or Equinox (p<0.001). There were no fungicide effects, nor were there any significant treatment interactions.

Table 3.3.118 Harvest index of three varieties sown at two different rates with five different fungicide regimes, Northumberland 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	0.52	0.54	0.52	0.54	0.53	**0.53**
	Consort	0.53	0.56	0.55	0.54	0.56	**0.55**
	Equinox	0.50	0.52	0.52	0.53	0.52	**0.52**
Mean		**0.52**	**0.54**	**0.53**	**0.53**	**0.54**	**0.53**
200	Claire	0.51	0.51	0.50	0.50	0.51	**0.51**
	Consort	0.53	0.55	0.55	0.53	0.55	**0.54**
	Equinox	0.51	0.52	0.51	0.51	0.52	**0.52**
Mean		**0.52**	**0.53**	**0.52**	**0.51**	**0.52**	**0.52**
S.R. Mean	Claire	0.51	0.53	0.51	0.52	0.52	**0.52**
	Consort	0.53	0.55	0.55	0.53	0.55	**0.54**
	Equinox	0.51	0.52	0.51	0.52	0.52	**0.52**
Mean		**0.52**	**0.53**	**0.52**	**0.52**	**0.53**	**0.53**

	p-value	SED	
Rate	0.01	0.004	
Variety	<.001	0.005	
Fungicide	0.074	0.006	
Rate*variety	0.101	0.006	
Rate*fungicide	0.449	0.008	
Variety*fungicide	0.604	0.010	
Rate*variety*fungicide	0.993	0.015	58 d.f.

3.3.9.2.4.6 2002/03 Summary

Increasing seed rate generally led to a decrease in HI, however, these decreases were usually small and not statistically significant. Consort generally had a lower HI than Claire or Equinox, but at one site it had significantly greater HI than the other two varieties. Fungicide treatment had no significant effect, and there were no consistent treatment interactions.

3.3.9.2.5 Harvest Index - summary

Harvest index tended to decrease as seed rate increased. However, these decreases were generally small and not significant. In two out of three years Claire tended to have lower HIs than Consort or Equinox, but in the 2002/03 season, Consort tended to have the lowest HI. Significant fungicide effects were seen only in one site season combination out of the 14 available. No treatment interactions were observed that were consistent across sites and seasons.

3.3.9.3 Grains per ear

3.3.9.3.1 1999/2000

3.3.9.3.1.1 East Yorkshire

Grains ear^{-1} averaged 38.2 across all treatments (Figure 3.3.60). Sowing at 100 seeds m^{-2} gave 43.0 grains ear^{-1}, significantly more than the 37.7 and 22.9 grains ear^{-1} measured at 200 and 400 seeds m^{-2} respectively (p=0.002). However, differences between 200 and 400 seeds m^{-2} were not statistically significant. Consort had the highest grains ear^{-1} at 41.7, significantly higher those of Claire or Equinox, at 36.9 and 35.9 grains ear^{-1} respectively (p=0.028). There were no significant interactions between seed rate and variety treatments.

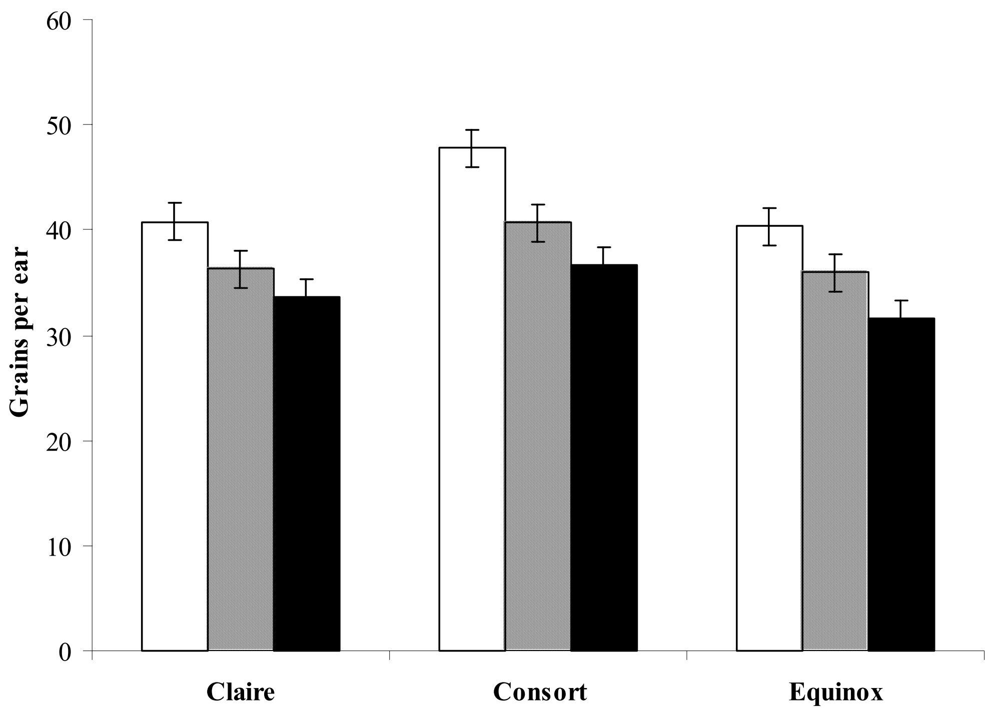

Figure 3.3.60 Grains per ear immediately preharvest in three varieties at 100 (white bars), 200 (cross hatched bars) and 400 (black bars) seeds m^{-2}, East Yorkshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.3.1.2 Kent

No measurements of grains per ear were made at the Kent site in this season.

3.3.9.3.1.3 Bedfordshire

Grains ear^{-1} averaged 43.1 across all treatments (Figure 3.3.61). Increasing seed rate decreased grains ear^{-1} from 48.7 at 100 seeds m^{-2} to 43.0 at 250 seeds m^{-2} to 37.4 at 400 seeds m^{-2} ($p<0.001$). Equinox had the highest grains ear^{-1}, followed by Claire and then Consort, but varietal differences were not statistically significant. Treatment interactions were not significant.

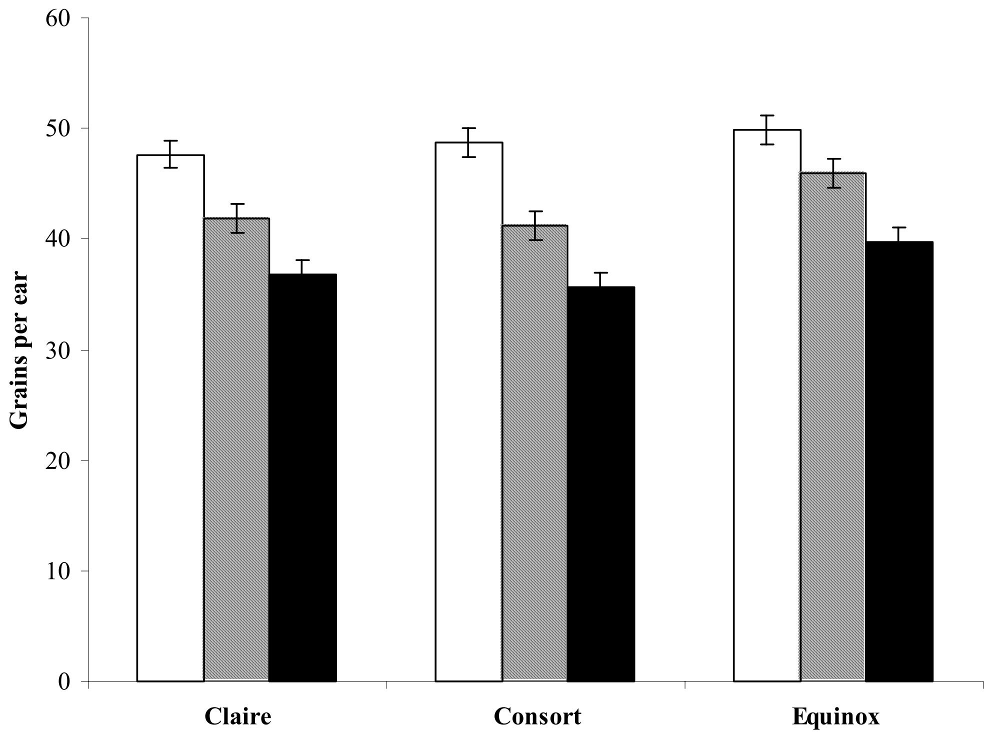

Figure 3.3.61 Grains per ear immediately preharvest in three varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Bedfordshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.3.1.4 Gloucestershire

Averaged across treatments, 40.9 grains ear^{-1} were measured at the Gloucestershire site. Increasing seed rate from 100 to 250 seeds m^{-2} decreased grains ear^{-1} from 44.1 to 39.2 grains ear^{-1} respectively ($p=0.041$), but differences between grains ear^{-1} at 250 and 400 seeds m^{-2} were not significant. Grains ear^{-1} in Equinox, at

45.2, were significantly greater than those in Claire or Consort, at 39.5 and 38.0 grains ear^{-1} respectively (p=0.006). There were no significant interactions between seed rate and varietal treatments.

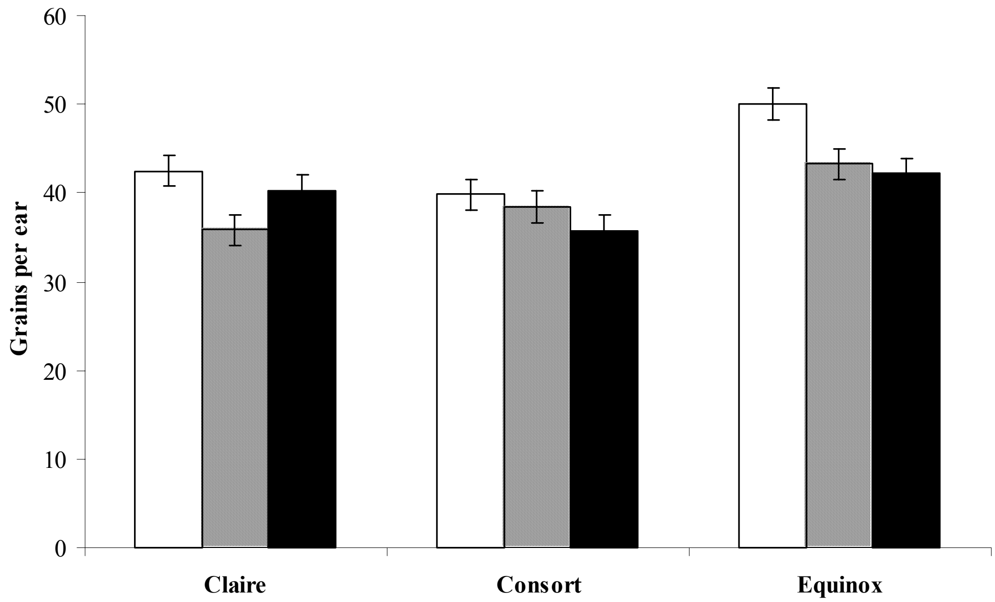

Figure 3.3.62 Grains per ear immediately preharvest in three varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Gloucestershire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.3.1.5 1999/2000 Summary

Grains ear^{-1} decreased significantly as seed rate increased at all sites. However, decreases in grains ear^{-1} seemed to be greater when comparing 100 to 200 or 250 seeds m^{-2} than when comparing 200 or 250 to 400 seeds m^{-2}. There were no consistent differences in variety across sites.

3.3.9.3.2 2000/01

3.3.9.3.2.1 East Yorkshire

Grains ear^{-1} averaged 44.3 across all treatments (Table 3.3.119). Increasing seed rate from 100 to 200 seeds m^{-2} decreased grains ear^{-1} from 47.0 to 41.4 respectively (p<0.001). Consort had significantly more grains ear^{-1} than Equinox, which in turn had significantly more than Claire (p<0.001). There were no significant fungicide effects, nor any significant treatment interactions.

Table 3.3.119 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatment					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	45.1	42.7	42.4	35.6	41.5	**41.5**
	200	36.3	38.3	36.1	35.0	35.6	**36.3**
	Mean	**40.7**	**40.5**	**39.3**	**35.3**	**38.5**	**38.9**
Consort	**100**	51.8	52.6	54.0	50.8	49.5	**51.8**
	200	46.8	43.7	44.3	46.5	46.1	**45.5**
	Mean	**49.3**	**50.4**	**49.2**	**48.7**	**47.8**	**49.1**
Equinox	**100**	46.8	48.2	49.6	46.8	47.8	**47.8**
	200	44.0	41.4	40.2	45.1	41.2	**42.4**
	Mean	**45.7**	**44.8**	**44.9**	**46.0**	**44.5**	**45.2**
Mean	**100**	47.9	47.8	48.7	44.4	46.3	**47.0**
	200	42.4	41.1	40.2	42.2	41.0	**41.4**
Overall Mean		**45.2**	**44.7**	**44.5**	**43.3**	**43.6**	**44.3**

	P	SED	
Rate	<0.001	0.64	
Variety	<0.001	0.79	
Fungicide	0.488	1.02	
Rate*variety	0.934	1.12	
Rate*fungicide	0.088	1.44	
Variety*fungicide	0.463	1.76	
Rate*variety*fungicide	0.677	2.49	54 df

3.3.9.3.2.2 Kent

Averaged across treatments there were 53.0 grains ear^{-1} at the Kent site. Grains ear^{-1} were significantly reduced from 56.8 to 49.1 as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Consort had significantly reduced grains ear^{-1} compared to Claire and Equinox ($p=0.019$); differences between Claire and Equinox were not significant. This varietal ranking was maintained when looking at 100 seeds m^{-2}, but there were no significant varietal differences at 200 seeds m^{-2} ($p=0.026$). There were no significant fungicide effects, nor any other significant treatment interactions.

Table 3.3.120 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicde					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	58.8	64.1	64.3	55.2	54.5	**59.4**
	Consort	48.0	53.8	55.2	54.8	59.0	**54.1**
	Equinox	59.5	57.9	55.4	55.1	57.2	**57.0**
100 Mean		**55.4**	**58.6**	**58.3**	**55.0**	**56.9**	**56.8**
200	Claire	48.5	48.8	46.2	44.9	49.2	**47.5**
	Consort	49.1	49.4	47.2	47.1	47.4	**48.0**
	Equinox	52.8	55.7	50.3	53.5	47.2	**51.9**
200 mean		**50.1**	**51.3**	**47.9**	**48.5**	**47.9**	**49.1**
S.R. Mean	Claire	53.6	56.4	55.2	50.0	51.9	**53.4**
	Consort	48.5	51.6	51.2	50.9	53.2	**51.1**
	Equinox	56.2	56.8	52.9	54.3	52.2	**54.5**
Grand Mean		**52.8**	**54.9**	**53.1**	**51.8**	**52.4**	**53.0**

	P	**SED**	
Rate	<0.001	0.96	
Variety	0.019	1.17	
Fungicide	0.280	1.51	
Rate*variety	0.026	1.65	
Rate*fungicide	0.442	2.14	
Variety*fungicide	0.260	2.62	
Rate*variety*fungicide	0.180	3.70	51 d.f.

3.3.9.3.2.3 Bedfordshire

Grains ear^{-1} averaged 43.4 across all treatments (Table 3.3.121). Increasing seed rate from 100 to 200 seeds m^{-2} decreased grains ear^{-1} from 44.9 to 41.8 respectively (p=0.006). Claire had significantly more grains ear^{-1} than Equinox, which in turn had significantly more than Consort (p<0.001). There were no significant fungicide or treatment interaction effects.

Table 3.3.121 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	49.2	50.5	49.1	51.0	50.6	**50.1**
	Consort	39.3	38.6	44.7	37.5	46.9	**41.4**
	Equinox	44.5	39.3	42.5	45.2	45.0	**43.3**
100 Mean		**44.3**	**42.8**	**45.4**	**44.6**	**47.5**	**44.9**
200	Claire	52.6	44.9	42.8	41.3	45.4	**45.4**
	Consort	38.9	35.4	37.3	37.1	35.3	**36.8**
	Equinox	42.5	45.9	45.4	38.9	43.3	**43.2**
200 Mean		**44.7**	**42.1**	**41.8**	**39.1**	**41.4**	**41.8**
S.R. Mean	Claire	50.9	47.7	45.9	46.2	48.0	**47.7**
	Consort	39.1	37.0	41.0	37.3	41.1	**39.1**
	Equinox	43.5	42.6	43.9	42.1	44.2	**43.2**
Overall mean		**44.5**	**42.4**	**43.6**	**41.8**	**44.4**	**43.4**

	P	**SED**	
Rate	0.006	1.07	
Variety	<0.001	1.31	
Fungicide	0.385	1.69	
Rate*variety	0.159	1.85	
Rate*fungicide	0.256	2.39	
Variety*fungicide	0.843	2.93	
Rate*variety*fungicide	0.236	4.14	57 d.f.

3.3.9.3.2.4 Gloucestershire

Averaged across treatments, 54.0 grains ear^{-1} were observed at the Gloucestershire site (Table 3.3.122). Grains ear^{-1} decreased from 55.4 to 52.6 as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Claire had significantly higher grains ear^{-1} than Consort, which had significantly more than Equinox ($p<0.001$). The standard fungicide treatment and the fungicide treatment with additional autumn and spring fungicides (fungicide treatments one and four respectively) had significantly greater grains ear^{-1} than the fungicide treatments with additional autumn fungicides only or additional spring fungicides only (treatments two and three respectively, p=0.04). There were no significant treatment interactions.

Table 3.3.122 Grains ear^{-1} preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatments					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	60.0	60.1	58.1	61.7	58.0	**59.6**
	200	55.2	56.5	54.4	59.2	55.9	**56.3**
	Mean	**57.6**	**58.3**	**56.3**	**60.5**	**57.0**	**57.9**
Consort	**100**	56.9	53.2	53.0	54.6	54.6	**54.4**
	200	53.5	50.9	50.8	53.6	53.4	**52.4**
	Mean	**55.2**	**52.0**	**51.9**	**54.1**	**54.0**	**53.4**
Equinox	**100**	59.1	47.5	52.2	50.6	51.1	**52.1**
	200	51.1	48.0	48.5	50.2	48.4	**49.2**
	Mean	55.1	47.7	50.4	50.4	49.8	**50.7**
Mean	**100**	58.6	53.6	54.4	55.6	54.5	**55.4**
	200	53.3	51.8	51.2	54.3	52.6	**52.6**
Overall Mean		**56.0**	**52.7**	**52.8**	**55.0**	**53.6**	**54.0**

	P	SED	
Rate	<0.001	0.772	
Variety	<0.001	0.946	
Fungicide	0.040	1.221	
Rate*variety	0.779	1.338	
Rate*fungicide	0.475	1.727	
Variety*fungicide	0.251	2.115	
Rate*variety*fungicide	0.972	2.991	58 df

3.3.9.3.2.5 2000/01 Summary

Increasing seed rate significantly decreased grains ear $^{-1}$ at all sites. Varietal rankings varied with site, but Claire and Consort tended to rank higher than Equinox. Significant fungicide effects were seen at only one site, and these were not likely to be real effects. There were no consistent treatment interactions.

3.3.9.3.3 2001/02

3.3.9.3.3.1 East Yorkshire

Grains ear^{-1} averaged 47.3 across all treatments (Table 3.3.123). As seed rate increased from 100 to 200 seeds m^{-2}, grains ear^{-1} decreased from 49.7 to 44.9 ($p<0.001$). Claire had significantly lower grains ear^{-1} than Consort or Equinox (p=0.002). Early application of T1 fungicides (treatment five) significantly increased grains ear^{-1} when compared to all other fungicide regimes except where additional spring fungicides had been applied (treatment three), which in turn had significantly higher grains ear^{-1} than fungicide treatments with additional autumn, or additional autumn and spring fungicides (treatments two and four respectively, p=0.002). At 100 seeds m^{-2}, additional spring fungicides, or an early T1 treatment significantly increased grains ear^{-1} compared to the standard fungicide regime, whereas at 200 seeds m^{-2}, additional autumn and spring fungicides resulted in significantly lower grains ear^{-1} compared to standard and early T1 fungicide regimes (p=0.014). There were no other significant treatment interactions.

Table 3.3.123 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	43.1	46.2	51.3	43.0	51.4	**47.0**
	Consort	51.0	49.5	53.4	52.1	50.5	**51.3**
	Equinox	49.2	46.4	53.3	53.6	51.9	**50.9**
100 Mean		**47.7**	**47.4**	**52.7**	**49.6**	**51.3**	**49.7**
200	Claire	44.2	44.3	44.4	41.7	46.4	**44.2**
	Consort	47.9	43.0	45.6	45.0	47.7	**45.8**
	Equinox	46.5	44.6	43.8	40.7	48.1	**44.8**
200 Mean		**46.2**	**44.0**	**44.6**	**42.5**	**47.4**	**44.9**
S.R. Mean	**Claire**	43.7	45.2	47.9	42.4	48.9	**45.6**
	Consort	49.5	46.2	49.5	48.6	49.1	**48.6**
	Equinox	47.8	45.5	48.6	47.1	50.0	**47.8**
Overall mean		**47.0**	**45.7**	**48.6**	**46.0**	**49.3**	**47.3**

	P-value	SED	
Rate	<0.001	0.665	
Variety	0.002	0.815	
Fungicide	0.002	1.052	
Rate*Variety	0.099	1.153	
Rate*Fungicide	0.014	1.488	
Variety*Fungicide	0.273	1.822	
Rate*Variety*Fungicide	0.287	2.577	58 d.f.

3.3.9.3.3.2 Kent

Averaged across treatments, grains ear^{-1} was 39.5 at the Kent site (Table 3.3.124). Grains ear^{-1} decreased as seed rate increased, but these decreases were not statistically significant. Equinox had less grains ear^{-1} than Claire or Consort ($p<0.001$). Grains ear^{-1} showed slight increases where additional spring, additional autumn and spring, or early T1 fungicide treatments had been applied, but these were not significant. There were no significant treatment interactions.

Table 3.3.124 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	38.0	40.6	42.8	42.9	46.7	**42.2**
	Consort	38.8	38.7	44.0	43.2	42.2	**41.4**
	Equinox	38.8	33.9	36.2	39.3	36.5	**36.9**
100 mean		**38.5**	**37.7**	**41.0**	**41.8**	**41.8**	**40.2**
200	Claire	42.5	40.9	41.3	39.1	42.4	**41.2**
	Consort	39.6	39.5	42.5	40.0	41.3	**40.6**
	Equinox	34.8	34.5	35.1	37.2	32.7	**34.8**
200 Mean		**38.9**	**38.3**	**39.6**	**38.8**	**38.8**	**38.9**
S.R, Mean	**Claire**	40.2	40.7	42.0	41.0	44.5	**41.7**
	Consort	39.2	39.1	43.3	41.6	41.8	**41.0**
	Equinox	36.8	34.2	35.6	38.2	34.6	**35.9**
Overall mean		**38.7**	**38.0**	**40.3**	**40.3**	**40.3**	**39.5**

	P	**SED**	
Rate	0.078	0.72	
Variety	<0.001	0.88	
Fungicide	0.131	1.13	
Rate*variety	0.718	1.24	
Rate*fungicide	0.325	1.90	
Variety*fungicide	0.211	1.96	
Rate*variety*fungicide	0.735	2.77	58 d.f.

3.3.9.3.3.3 Bedfordshire

Grains ear^{-1} averaged 46.5 across all treatments (Table 3.3.125). As seed rate increased from 100 to 200 seeds m^{-2}, so grains ear^{-1} decreased from 48.4 to 44.6 ($p<0.001$). Claire had more grains ear^{-1} than Consort or Equinox ($p=0.011$). Averaging across seed rate and varietal treatments, there were no significant fungicide effects. However, looking at individual varieties, Claire and Consort showed no significant effects of fungicide treatments, but in Equinox, additional spring fungicides significantly increased grains ear^{-1} compared to the treatment with additional autumn fungicides ($p=0.025$). There were no other significant treatment interactions.

Table 3.3.125 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	50.2	50.2	53.5	50.3	52.6	**51.4**
	Consort	43.7	45.7	45.7	47.0	46.7	**45.8**
	Equinox	46.1	45.3	52.6	49.8	47.0	**48.2**
100 Mean		**46.7**	**47.1**	**50.6**	**49.0**	**48.8**	**48.4**
200	Claire	46.9	46.6	39.1	48.1	45.4	**45.2**
	Consort	43.0	49.0	42.3	44.8	43.3	**44.5**
	Equinox	47.1	36.7	47.3	44.4	44.4	**44.0**
200 Mean		**45.7**	**44.1**	**42.9**	**45.8**	**44.4**	**44.6**
S.R. Mean	**Claire**	48.5	48.4	46.3	49.2	49.0	**48.3**
	Consort	43.4	47.4	44.0	45.9	45.0	**45.1**
	Equinox	46.6	41.0	50.0	47.1	45.7	**46.1**
Overall Mean		**46.2**	**45.6**	**46.8**	**47.4**	**46.6**	**46.5**

	P	**SED**	
Rate	<0.001	0.852	
Variety	0.011	1.043	
Fungicide	0.738	1.347	
Rate*variety	0.072	1.476	
Rate*fungicide	0.164	1.905	
Variety*fungicide	0.025	2.333	
Rate*variety*fungicide	0.295	3.300	58 d.f.

3.3.9.3.3.4 Gloucestershire

Averaged across all treatments, 57.8 grains ear^{-1} were observed at the Gloucestershire site (Table 3.3.126). Grains ear^{-1} decreased from 60.6 to 54.9 as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Equinox had significantly less grains ear^{-1} than Claire or Consort ($p=0.004$). Fungicide treatments had no significant effect, nor were there any significant treatment interactions.

Table 3.3.126 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	58.5	65.1	57.5	61.1	62.5	**60.9**
	Consort	61.5	61.8	63.0	67.7	58.6	**62.5**
	Equinox	57.3	57.5	58.8	60.0	58.8	**58.5**
100 Mean		**59.1**	**61.4**	**59.8**	**62.9**	**60.0**	**60.6**
200	Claire	56.3	54.7	56.2	55.7	59.2	**56.4**
	Consort	56.5	54.0	54.2	54.3	57.7	**55.3**
	Equinox	51.7	52.3	51.9	54.8	54.2	**53.0**
200 Mean		**54.8**	**53.7**	**54.1**	**54.9**	**57.0**	**54.9**
S.R. Mean	**Claire**	57.4	59.9	56.8	58.4	60.8	**58.7**
	Consort	59.0	57.9	58.6	61.0	58.2	**58.9**
	Equinox	54.5	54.9	55.4	57.4	56.5	**55.7**
Overall mean		**57.0**	**57.5**	**56.9**	**58.9**	**58.5**	**57.8**

	P-value	SED	
Rate	<0.001	0.828	
Variety	0.004	1.014	
Fungicide	0.431	1.309	
Rate*Variety	0.412	1.434	
Rate*Fungicide	0.301	1.851	
Variety*Fungicide	0.749	2.267	
Rate*Variety*Fungicide	0.433	3.206	58 d.f.

3.3.9.3.3.5 Northumberland

Grains ear^{-1} averaged 42.7 across all treatments (Table 3.3.127). Increasing seed rate from 100 to 200 seeds m^{-2} decreased grains ear^{-1} from 45.5 to 39.9 respectively ($p=0.003$). Consort had significantly higher grains ear^{-1} than Claire or Equinox ($p<0.001$). Additional spring fungicides, or additional autumn and spring fungicides increased grains ear^{-1}, but these increases were not significant compared to the standard fungicide regime. There were no significant treatment interactions.

Table 3.3.127 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Northumberland 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	40.4	47.0	52.9	38.2	40.2	**43.8**
	Consort	50.4	49.5	49.1	58.6	47.1	**50.9**
	Equinox	34.6	41.2	44.8	43.5	44.5	**41.7**
Mean		**41.8**	**45.9**	**49.0**	**46.8**	**43.9**	**45.5**
200	Claire	35.2	33.8	37.0	33.2	34.3	**34.7**
	Consort	45.7	39.0	48.1	49.2	50.6	**46.5**
	Equinox	41.5	35.4	43.2	37.8	34.6	**38.5**
Mean		**40.8**	**36.1**	**42.7**	**40.1**	**39.8**	**39.9**
S.R. Mean	**Claire**	37.8	40.4	45.0	35.7	37.3	**39.2**
	Consort	48.0	44.2	48.6	53.9	48.8	**48.7**
	Equinox	38.1	38.3	44.0	40.7	39.6	**40.1**
Overall mean		**41.3**	**41.0**	**45.9**	**43.4**	**41.9**	**42.7**

	P-value	SED	
Rate	0.003	1.676	
Variety	<0.001	2.052	
Fungicide	0.493	2.65	
Rate*Variety	0.147	2.903	
Rate*Fungicide	0.552	3.747	
Variety*Fungicide	0.187	4.589	
Rate*Variety*Fungicide	0.964	6.490	58 d.f.

3.3.9.3.3.6 2001/02 Summary

Increasing seed rate decreased grains ear^{-1} at all sites, and significantly so at four out of five sites. There were no consistent varietal rankings across sites, but Claire and Consort tended to have more grains ear^{-1} than Equinox. Treatments with additional spring fungicides, or additional autumn and spring fungicides allowed small increases in grains ear^{-1} at some sites, but they were not statistically significant. The early T1 fungicide treatment significantly increased grains ear^{-1} at the East Yorkshire site. Significant treatment interactions were observed, but these were not consistent across sites.

3.3.9.3.4 2002/03

3.3.9.3.4.1 East Yorkshire

Grains ear^{-1} averaged 52.7 across all treatments (Table 3.3.128). Grains ear^{-1} decreased from 55.3 to 50.0 as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Claire had the most grains ear^{-1}, significantly more than Equinox, which in turn had significantly more than Consort ($p<0.001$). This ranking was maintained at both seed rates, but at 200 seeds m^{-2} only differences between Claire and Consort were statistically significant ($p=0.023$). There were no significant fungicide effects, nor any other significant treatment interactions.

Table 3.3.128 Grains ear^{-1} preharvest at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	58.2	59.0	61.7	64.1	59.6	**60.5**
	Consort	49.6	42.3	50.2	52.2	50.8	**49.0**
	Equinox	57.6	56.4	54.3	57.6	55.6	**56.3**
Mean		**55.1**	**52.6**	**55.4**	**58.0**	**55.3**	**55.3**
200	Claire	53.8	51.9	51.1	53.1	53.9	**52.8**
	Consort	42.7	47.2	47.0	48.6	49.4	**47.0**
	Equinox	51.1	49.9	51.7	47.5	51.4	**50.3**
Mean		**49.2**	**49.7**	**49.9**	**49.8**	**51.6**	**50.0**
S.R. Mean	Claire	56.0	55.4	56.4	58.6	56.8	**56.6**
	Consort	46.2	44.7	48.6	50.4	50.1	**48.0**
	Equinox	54.3	53.2	53.0	52.6	53.5	**53.3**
Mean		**52.2**	**51.1**	**52.7**	**53.9**	**53.5**	**52.7**

	p-value	SED	
Rate	<0.001	0.84	
Variety	<0.001	1.03	
Fungicide	0.235	1.33	
Rate*variety	0.023	1.46	
Rate*fungicide	0.299	1.88	
Variety*fungicide	0.574	2.31	
Rate*variety*fungicide	0.394	3.26	58 d.f.

3.3.9.3.4.2 Kent

Averaged across treatments there were 42.6 grains ear^{-1} at the Kent site (Table 3.3.129). As seed rate increased from 100 to 200 seeds m^{-2}, grains ear^{-1} decreased from 43.8 to 41.4 respectively (p=0.005). Equinox had the most grains ear^{-1}, and along with Claire had significantly more than Consort (p=0.002). There were no significant fungicide or treatment interaction effects.

Table 3.3.129 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	41.2	47.4	43.3	42.4	46.9	**44.2**
	Consort	41.9	39.7	40.6	44.5	43.2	**42.0**
	Equinox	44.2	42.3	46.2	49.1	44.7	**45.3**
Mean		**42.4**	**43.1**	**43.4**	**45.4**	**44.9**	**43.8**
200	Claire	38.9	45.7	40.3	41.6	41.9	**41.7**
	Consort	42.2	39.1	40.1	37.5	37.9	**39.4**
	Equinox	46.0	40.7	43.2	43.0	43.8	**43.3**
Mean		**42.3**	**41.8**	**41.2**	**40.7**	**41.2**	**41.4**
S.R. Mean	Claire	40.0	46.5	41.8	42.0	44.4	**42.9**
	Consort	42.0	39.4	40.4	41.0	40.5	**40.7**
	Equinox	45.1	41.5	44.7	46.1	44.3	**44.3**
Mean		**42.4**	**42.5**	**42.3**	**43.0**	**43.1**	**42.6**
			p-value	SED			
Rate			0.005	0.813			
Variety			0.002	0.995			
Fungicide			0.953	1.285			
Rate*variety			0.936	1.407			
Rate*fungicide			0.407	1.817			
Variety*fungicide			0.064	2.225			
Rate*variety*fungicide			0.778	3.147	58 d.f.		

3.3.9.3.4.3 Bedfordshire

Grains ear^{-1} averaged 50.5 across all treatments (Table 3.3.130). Grains ear^{-1} decreased from 52.5 to 48.4 as seed rate increased from 100 to 200 seeds m^{-2} respectively ($p<0.001$). Consort had significantly less grains ear^{-1} than Claire or Equinox ($p<0.001$). There were no significant fungicide effects, nor any significant treatment interactions.

Table 3.3.130 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	55.3	53.3	55.6	55.4	52.7	**54.5**
	Consort	50.0	48.1	51.9	47.4	49.5	**49.4**
	Equinox	50.9	53.3	55.9	53.8	54.2	**53.6**
100 Mean		**52.1**	**51.6**	**54.5**	**52.2**	**52.1**	**52.5**
200	Claire	51.3	48.7	50.7	47.9	48.9	**49.5**
	Consort	45.7	46.2	45.5	45.3	45.9	**45.7**
	Equinox	50.2	49.9	51.4	49.4	49.6	**50.1**
200 Mean		**49.1**	**48.3**	**49.2**	**47.5**	**48.1**	**48.4**
S.R. Mean	Claire	53.3	51.0	53.2	51.7	50.8	**52.0**
	Consort	47.9	47.1	48.7	46.3	47.7	**47.5**
	Equinox	50.5	51.6	53.6	51.6	51.9	**51.9**
Overall mean		**50.6**	**49.9**	**51.8**	**49.9**	**50.1**	**50.5**

	p-value	SED	
Rate	<0.001	0.56	
Variety	<0.001	0.68	
Fungicide	0.133	0.88	
Rate*variety	0.545	0.97	
Rate*fungicide	0.744	1.25	
Variety*fungicide	0.672	1.53	
Rate*variety*fungicide	0.740	2.16	58 d.f.

3.3.9.3.4.4 Gloucestershire

Averaged across treatments there were 44.7 grains ear^{-1} at the Gloucestershire site (Table 3.3.131). As seed rate increased from 100 to 200 seeds m^{-2}, grains ear^{-1} decreased from 46.3 to 43.0 respectively ($p<0.001$). Consort had significantly less grains ear^{-1} than either Claire or Equinox ($p<0.001$); Equinox had the most grains ear^{-1}. There were no significant fungicide or treatment interaction effects.

Table 3.3.131 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	52.9	54.9	47.9	47.2	46.9	**50.0**
	Consort	44.0	41.7	35.9	39.5	42.6	**40.7**
	Equinox	50.6	43.3	49.1	50.8	47.9	**48.3**
Mean		**49.2**	**46.6**	**44.3**	**45.8**	**45.8**	**46.3**
200	Claire	46.5	42.9	45.4	47.6	49.1	**46.3**
	Consort	38.0	36.6	33.4	39.5	33.0	**36.1**
	Equinox	45.2	45.3	47.7	49.8	45.3	**46.7**
Mean		**43.2**	**41.6**	**42.1**	**45.6**	**42.5**	**43.0**
S.R. Mean	Claire	49.7	48.9	46.7	47.4	48.0	**48.1**
	Consort	41.0	39.1	34.6	39.5	37.8	**38.4**
	Equinox	47.9	44.3	48.4	50.3	46.6	**47.5**
Mean		**46.2**	**44.1**	**43.2**	**45.7**	**44.1**	**44.7**
			p-value	SED			
Rate			<0.001	0.899			
Variety			<0.001	1.101			
Fungicide			0.176	1.421			
Rate*variety			0.368	1.557			
Rate*fungicide			0.267	2.010			
Variety*fungicide			0.242	2.462			
Rate*variety*fungicide			0.196	3.482	58 d.f.		

3.3.9.3.4.5 Northumberland

Grains ear^{-1} averaged 52.4 across all treatments (Table 3.3.132). Grains ear^{-1} decreased from 56.1 to 48.8 as seed rate increased from 100 to 200 seeds m^{-2} respectively (p<0.001). Equinox, had significantly lower grains ear^{-1} than Claire or Consort (p=0.016); Claire had the most grains ear^{-1}. This ranking was maintained at 100 seeds m^{-2}, though differences between Consort and Equinox were non-significant, at 200 seeds m^{-2} however there were no significant differences (p=0.036). There were no significant fungicide effects, nor any other significant treatment interactions.

Table 3.3.132 Grains ear^{-1} immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Northumberland 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	56.4	61.6	54.5	61.5	60.5	**58.9**
	Consort	55.6	56.4	58.6	51.9	58.3	**56.2**
	Equinox	52.9	53.8	53.6	54.2	51.7	**53.2**
100 Mean		**55.0**	**57.2**	**55.6**	**55.9**	**56.8**	**56.1**
200	Claire	51.1	47.3	47.2	45.8	49.6	**48.2**
	Consort	47.4	50.9	52.1	49.0	52.1	**50.3**
	Equinox	49.4	46.7	47.3	46.6	49.2	**47.8**
200 Mean		**49.3**	**48.3**	**48.9**	**47.1**	**50.3**	**48.8**
S.R. Mean	Claire	53.8	54.4	50.8	53.7	55.0	**53.5**
	Consort	51.5	53.6	55.4	50.4	55.2	**53.2**
	Equinox	51.1	50.2	50.5	50.4	50.4	**50.5**
Overall mean		**52.1**	**52.8**	**52.2**	**51.5**	**53.6**	**52.4**

	p-value	SED	
Rate	<0.001	0.909	
Variety	0.016	1.113	
Fungicide	0.680	1.437	
Rate*variety	0.036	1.574	
Rate*fungicide	0.732	2.032	
Variety*fungicide	0.489	2.488	
Rate*variety*fungicide	0.531	3.519	58 d.f.

3.3.9.3.4.6 2002/03 Summary

Increasing seed rate significantly reduced grains ear^{-1} at all sites. Varietal rankings were not consistent across sites, though Equinox tended to have the most grains ear^{-1}, and Consort the lowest. Fungicide treatment had no significant effect at any site. There was some evidence that varietal rankings were dependant on seed rate, but changes in rankings with changes in seed rates were not consistent.

3.3.9.3.5 Grains per ear - summary

Grains ear^{-1} was significantly decreased as seed rate increased in the majority of site/season combinations. Varietal effects were inconsistent across sites and seasons, though Claire and Consort tended to have more grains ear^{-1} than Equinox, though this was reversed in the 2002/03 season. Some fungicide effects were seen in the 2001/02 season, but these effects were small and non-significant. There were no consistent treatment interaction effects.

3.3.9.4 Thousand grain weight

All thousand grain weights are dry weights, and taken from preharvest quadrat samples.

3.3.9.4.1 1999/2000

3.3.9.4.1.1 East Yorkshire

Thousand grain weight (TGW) averaged across all treatments, was 40.4 g at the East Yorkshire site (Figure 3.3.63). Increasing seed rate significantly decreased TGW, from 42.5 to 41.1 and 37.6 g at 100, 200 and 400 seeds m^{-2} respectively ($p=0.01$). Equinox, with a TGW of 48.8 g, had significantly larger grains than those of Claire and Consort, with TGWs of 36.7 and 36.4 respectively ($p<0.001$). There were no significant interactions between seed rate and varietal treatments.

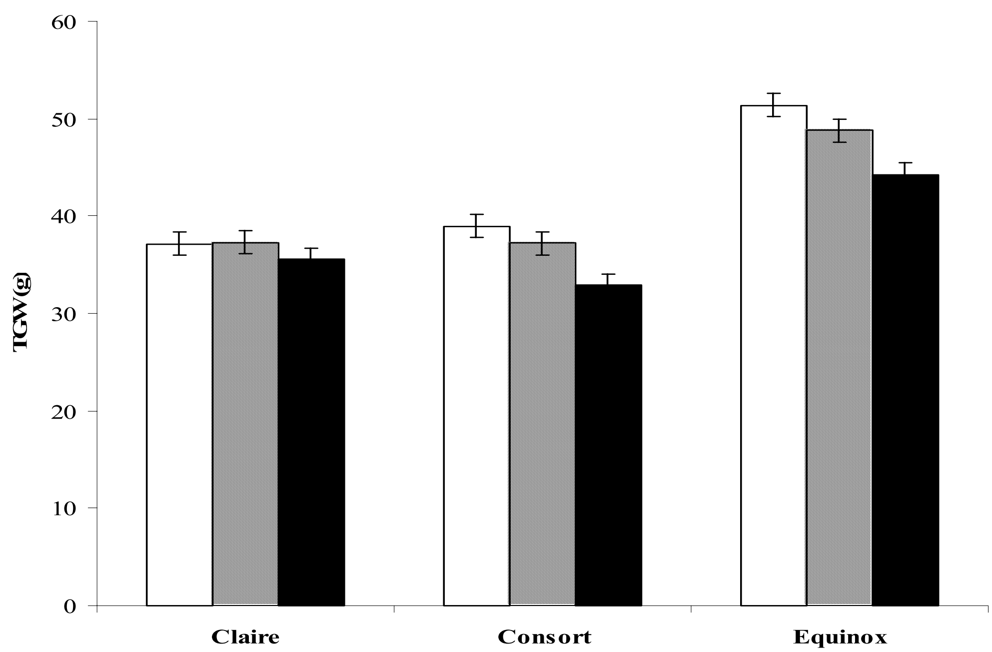

Figure 3.3.63 Thousand grain weight (TGW, g) immediately preharvest in three varieties at 100 (white bars), 200 (cross hatched bars) and 400 (black bars) seeds m^{-2}, East Yorkshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.4.1.2 Kent

No measurements of thousand grain weight were made at the Kent site in this season.

3.3.9.4.1.3 Bedfordshire

Thousand grain weight (TGW) averaged 40.3 g across all treatments (Figure 3.3.64). As seed rate increased from 100 to 250 to 400 seeds m^{-2}, so TGW decreased from 45.0 to 39.1 to 36.7 g respectively ($p<0.001$). There were no significant varietal effects or treatment interactions.

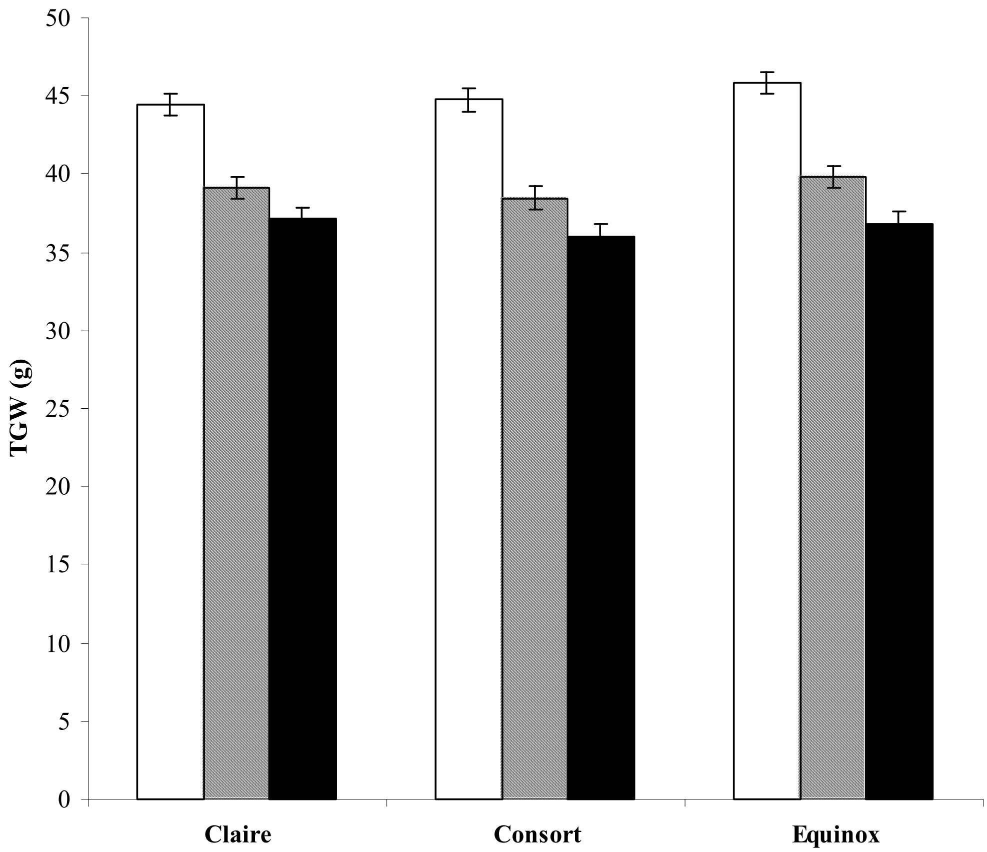

Figure 3.3.64 Thousand grain weight (TGW, g) immediately preharvest in three varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Bedfordshire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.4.1.4 Gloucestershire

Averaged across treatments, TGW was 41.7 g at the Gloucestershire site (Figure 3.3.65). TGW at 100 seeds m^{-2}, at 44.0 g was significantly greater than TGWs at 250 and 400 seeds m^{-2} (40.9 and 40.4 g respectively, p=0.02). Claire had a TGW of 44.4 g, averaged across seed rates, significantly higher than corresponding figures for Consort and Equinox, at 40.9 and 39.9 g respectively (p<0.001). There were no significant treatment interactions.

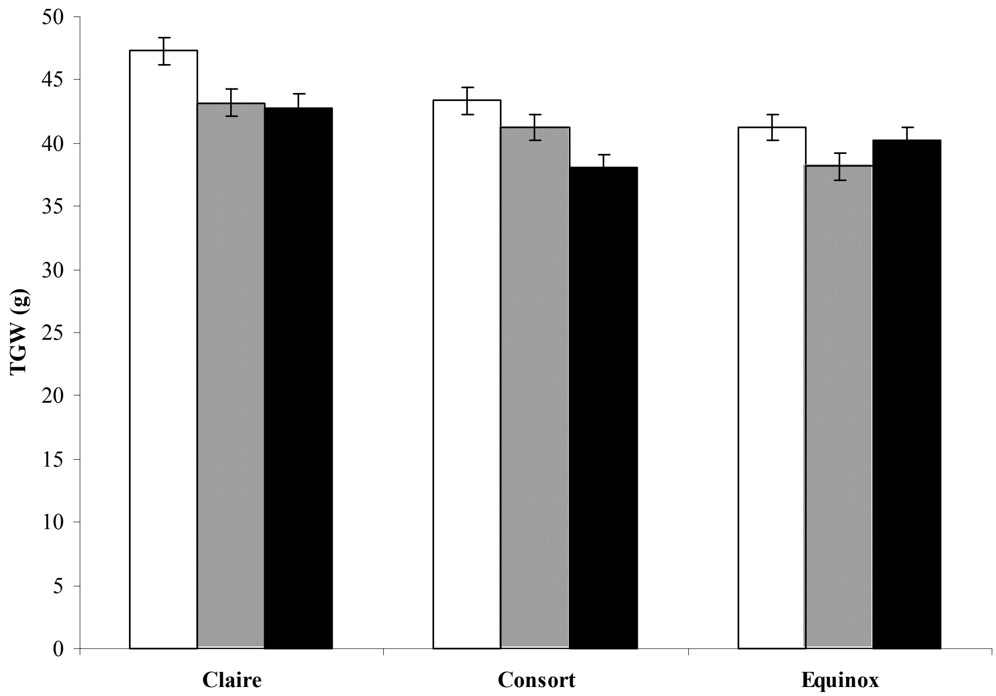

Figure 3.3.65 Thousand grain weight (TGW, g) immediately preharvest in three varieties at 100 (white bars), 250 (cross hatched bars) and 400 (black bars) seeds m^{-2}, Gloucestershire, 1999/2000. Error bars are SEDs for comparing seed rate/variety combinations (d.f. = 16).

3.3.9.4.1.5 1999/2000 Summary

Thousand grain weight decreased significantly as seed rate increased at all sampled sites. There were no consistent differences in variety across sites, nor were there any significant interactions between seed rate and varietal treatments. Similar values of TGW were obtained from the three sites sampled.

3.3.9.4.2 2000/01

3.3.9.4.2.1 East Yorkshire

Thousand grain weight averaged 54.6 g across all treatment combinations (Table 3.3.133). Increasing seed rate from 100 to 200 seeds m^{-2} significantly decreased TGW (p<0.001). Equinox had the largest TGW, significantly greater than Claire, which in turn had significantly greater TGW than Consort (p<0.001).

Averaging across seed rate and varietal treatments there were no significant effects of fungicide treatment, however, only treatments with additional autumn, or additional autumn and spring fungicides showed significant decreases in TGW as seed rate was increased (p=0.025). There were no other significant treatment interactions.

Table 3.3.133 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatment					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	53.2	54.6	54.7	57.1	54.9	**54.9**
	200	51.9	51.2	51.1	51.4	53.7	**51.9**
	Mean	**52.6**	**52.9**	**52.9**	**53.7**	**54.3**	**53.3**
Consort	**100**	53.3	53.0	52.5	52.1	53.2	**52.8**
	200	53.1	50.7	51.0	49.9	52.0	**51.3**
	Mean	**53.2**	**52.4**	**51.8**	**51.0**	**52.6**	**52.2**
Equinox	**100**	57.6	58.6	59.5	59.8	59.7	**59.0**
	200	58.7	57.7	59.1	54.1	59.1	**57.8**
	Mean	**58.2**	**58.2**	**59.3**	**56.9**	**59.4**	**58.4**
Mean	**100**	54.7	55.4	55.5	56.3	55.9	**55.6**
	200	54.6	53.2	53.7	51.8	54.9	**53.7**
Overall Mean		**54.6**	**54.4**	**54.6**	**54.0**	**55.4**	**54.6**

	P	SED	
Rate	<0.001	0.43	
Variety	<0.001	0.52	
Fungicide	0.379	0.68	
Rate*variety	0.162	0.74	
Rate*fungicide	0.025	0.96	
Variety*fungicide	0.305	1.17	
Rate*variety*fungicide	0.877	1.65	55 df

3.3.9.4.2.2 Kent

Thousand grain weight averaged 48.9 g across all treatment combinations (Table 3.3.134). Increasing seed rate from 100 to 200 seeds m^{-2} slightly but significantly decreased TGW ($p<0.001$). Equinox had the largest TGW, significantly greater than Consort, which in turn had significantly greater TGW than Claire ($p<0.001$). There were no significant fungicide or treatment interaction effects.

Table 3.3.134 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	47.2	46.8	46.0	45.3	49.2	**46.9**
	Consort	49.3	49.5	51.1	48.7	49.7	**49.6**
	Equinox	51.7	53.0	54.1	52.5	52.1	**52.7**
100 Mean		**49.4**	**49.8**	**50.4**	**48.8**	**50.3**	**49.7**
200	Claire	43.1	44.0	43.3	44.7	47.0	**44.4**
	Consort	51.7	48.9	48.6	47.8	46.9	**48.8**
	Equinox	52.4	49.6	52.0	50.5	50.9	**51.1**
200 Mean		**49.1**	**47.5**	**48.0**	**47.7**	**48.3**	**48.1**
S.R. Mean	**Claire**	45.2	45.4	44.7	45.0	48.1	**45.7**
	Consort	50.5	49.2	49.9	48.3	48.3	**49.2**
	Equinox	52.0	51.3	53.0	51.5	51.5	**51.9**
Overall Mean		**49.2**	**48.6**	**49.2**	**48.2**	**49.3**	**48.9**

	P	**SED**	
Rate	<0.001	0.434	
Variety	<0.001	0.531	
Fungicide	0.469	0.686	
Rate*variety	0.314	0.751	
Rate*fungicide	0.503	0.970	
Variety*fungicide	0.074	1.188	
Rate*variety*fungicide	0.446	1.679	58 d.f.

3.3.9.4.2.3 Bedfordshire

Across all treatments, TGW averaged 45.9 g (Table 3.3.135). Increasing seed rate from 100 to 200 seeds m^{-2} reduced TGW significantly (p<0.001). Averaged across seed rates and fungicide treatments, TGW of Claire was significantly lower than those of Consort or Equinox (p<0.001). There were no significant effects of fungicide treatment, nor were there any significant treatment interactions.

Table 3.3.135 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	44.8	44.4	43.8	43.8	45.8	**44.5**
	Consort	48.1	50.1	46.6	47.0	49.4	**48.2**
	Equinox	47.6	48.6	49.3	49.0	49.7	**48.8**
100 Mean		**46.8**	**47.7**	**46.6**	**46.6**	**48.3**	**47.2**
200	Claire	39.5	41.5	41.6	41.2	41.1	**41.0**
	Consort	47.6	44.8	46.7	47.5	49.1	**47.2**
	Equinox	46.7	44.8	43.9	45.4	46.3	**45.4**
200 Mean		**44.6**	**43.7**	**44.1**	**44.7**	**45.5**	**44.5**
S.R. Mean	**Claire**	42.1	43.0	42.7	42.5	43.4	**42.8**
	Consort	47.8	47.4	46.7	47.3	49.3	**47.7**
	Equinox	47.2	46.7	46.6	47.2	48.0	**47.1**
Overall Mean		**45.7**	**45.7**	**45.3**	**45.7**	**46.9**	**45.9**

	P	**SED**	
Rate	<0.001	0.522	
Variety	<0.001	0.639	
Fungicide	0.328	0.825	
Rate*variety	0.117	0.904	
Rate*fungicide	0.733	1.167	
Variety*fungicide	0.994	1.429	
Rate*variety*fungicide	0.392	2.021	58 d.f.

3.3.9.4.2.4 Gloucestershire

Thousand grain weight averaged 44.8 g across all treatment combinations (Table 3.3.136). Increasing seed rate from 100 to 200 seeds m^{-2} slightly but significantly decreased TGW (p=0.007). Equinox had the largest TGW, significantly greater than Consort, which in turn had significantly greater TGW than Claire (p<0.001). There were no significant fungicide or treatment interaction effects.

Table 3.3.136 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2000/01. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide Treatments					
Variety	**Rate**	**1**	**2**	**3**	**4**	**5**	**Mean**
Claire	**100**	41.0	44.2	42.6	41.6	42.2	**42.3**
	200	41.5	42.8	41.7	41.2	40.5	**41.6**
	Mean	**41.3**	**43.5**	**42.1**	**41.4**	**41.3**	**41.9**
Consort	**100**	46.5	46.6	44.7	44.4	45.7	**45.6**
	200	44.2	44.9	44.4	45.2	46.2	**45.0**
	Mean	**45.3**	**45.8**	**44.5**	**44.8**	**45.9**	**45.3**
Equinox	**100**	48.9	48.3	48.6	46.7	48.4	**48.2**
	200	47.0	45.6	45.9	45.0	47.8	**46.3**
	Mean	48.0	46.9	47.2	45.8	48.1	**47.2**
Mean	**100**	45.5	46.4	45.3	44.2	45.4	**45.4**
	200	44.3	44.4	44.0	43.8	44.8	**44.3**
Overall Mean		**44.9**	**45.4**	**44.6**	**44.0**	**45.1**	**44.8**

	P	SED	
Rate	0.007	0.39	
Variety	<0.001	0.48	
Fungicide	0.217	0.62	
Rate*variety	0.347	0.68	
Rate*fungicide	0.741	0.87	
Variety*fungicide	0.377	1.07	
Rate*variety*fungicide	0.863	1.51	58 df

3.3.9.4.2.5 2000/01 Summary

Thousand grain weights were reduced significantly by increasing seed rates at all sites, though absolute reductions were not always large. Equinox tended to have the largest TGW, and Claire the smallest. There were no significant fungicide effects at any of the sites, and no significant treatment interaction effects that were consistent across sites. East Yorkshire had the highest TGWs.

3.3.9.4.3 2001/02

3.3.9.4.3.1 East Yorkshire

Across all treatments, TGW averaged 47.5 g (Table 3.3.137). Increasing seed rate from 100 to 200 seeds m^{-2} had no significant effect on TGW. Averaged across seed rates and fungicide treatments, TGW of Equinox was significantly higher than those of Claire or Consort ($p<0.001$). There were no significant effects of fungicide treatment, nor were there any significant treatment interactions.

Table 3.3.137 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	**Claire**	47.0	46.9	47.0	46.5	47.0	**46.9**
	Consort	46.1	46.6	46.1	46.4	46.6	**46.4**
	Equinox	49.4	48.7	49.4	50.2	50.8	**49.7**
100 Mean		**47.5**	**47.4**	**47.5**	**47.7**	**48.1**	**47.7**
200	**Claire**	46.7	46.6	46.7	45.4	47.3	**46.5**
	Consort	46.3	46.1	46.3	45.0	45.1	**45.8**
	Equinox	49.3	48.7	49.2	52.9	49.7	**50.0**
200 Mean		**47.4**	**47.1**	**47.4**	**47.8**	**47.4**	**47.4**
S.R. Mean	**Claire**	46.8	46.8	46.8	46.0	47.1	**46.7**
	Consort	46.2	46.3	46.2	45.7	45.9	**46.1**
	Equinox	49.3	48.7	49.3	51.6	50.3	**49.8**
Overall mean		**47.5**	**47.3**	**47.4**	**47.8**	**47.8**	**47.5**

	P-value	SED	
Rate	0.353	0.38	
Variety	<0.001	0.465	
Fungicide	0.958	0.601	
Rate*Variety	0.241	0.658	
Rate*Fungicide	0.946	0.85	
Variety*Fungicide	0.175	1.041	
Rate*Variety*Fungicide	0.731	1.472	58 d.f.

3.3.9.4.3.2 Kent

Thousand grain weight averaged 39.1 g across all treatment combinations (Table 3.3.138). Increasing seed rate from 100 to 200 seeds m^{-2} slightly decreased TGW, but not significantly so. Equinox had significantly greater TGW than Claire or Consort ($p<0.001$). Treatments with additional spring fungicides, or additional autumn and spring fungicides had significantly higher TGWs than treatments given just the standard fungicide regime ($p<0.001$). There were no significant treatment interaction effects.

Table 3.3.138 Thousand grain weight preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 – additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	34.3	35.1	38.7	37.4	36.2	**36.3**
	Consort	33.0	32.7	40.4	40.5	33.9	**36.1**
	Equinox	42.3	43.8	49.9	48.9	42.6	**45.5**
100 Mean		**36.5**	**37.2**	**43.0**	**42.3**	**37.6**	**39.3**
200	Claire	34.8	34.3	36.6	37.1	35.1	**35.6**
	Consort	33.5	33.0	38.6	39.7	34.7	**35.9**
	Equinox	44.1	40.0	50.1	49.4	43.2	**45.4**
200 Mean		**37.5**	**35.8**	**41.8**	**42.1**	**37.6**	**38.9**
S.R. Mean	**Claire**	34.5	34.7	37.6	37.3	35.6	**36.0**
	Consort	33.3	32.8	39.5	40.1	34.3	**36.0**
	Equinox	43.2	41.9	50.0	49.1	42.9	**45.4**
Overall Mean		**37.0**	**36.5**	**42.4**	**42.2**	**37.6**	**39.1**

	P	**SED**	
Rate	0.411	0.444	
Variety	<0.001	0.544	
Fungicide	<0.001	0.703	
Rate*variety	0.815	0.770	
Rate*fungicide	0.448	0.994	
Variety*fungicide	0.018	1.217	
Rate*variety*fungicide	0.766	1.721	58 d.f.

3.3.9.4.3.3 Bedfordshire

Across all treatments, TGW averaged 47.3 g (Table 3.3.139). Increasing seed rate from 100 to 200 seeds m^{-2} had no significant effect on TGW. Averaged across seed rates and fungicide treatments, TGW of Equinox was significantly higher than that of Consort, which was significantly greater than that of Claire ($p<0.001$). This ranking was maintained at both seed rates, but at 100 seeds m^{-2} TGW Consort was not significantly lower than of Equinox, but TGW of Claire was still significantly lower than these two varieties ($p=0.012$). There were no significant effects of fungicide treatment, nor were there any other significant treatment interactions.

Table 3.3.139 Thousand grain weight preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	45.3	45.5	45.7	46.0	45.2	**45.5**
	Consort	46.7	47.1	48.9	48.4	47.6	**47.7**
	Equinox	48.6	48.1	48.2	50.1	48.6	**48.7**
100 Mean		**46.9**	**46.9**	**47.6**	**48.2**	**47.1**	**47.3**
200	Claire	45.6	43.4	44.9	45.3	44.6	**44.8**
	Consort	46.1	47.4	48.0	46.6	47.4	**47.1**
	Equinox	52.5	49.6	48.7	50.5	49.1	**50.1**
200 Mean		**48.0**	**46.8**	**47.2**	**47.5**	**47.0**	**47.3**
S.R. Mean	**Claire**	45.4	44.4	45.3	45.6	44.9	**45.1**
	Consort	46.4	47.2	48.5	47.5	47.5	**47.4**
	Equinox	50.5	48.8	48.5	50.3	48.8	**49.4**
Overall Mean		**47.4**	**46.8**	**47.4**	**47.8**	**47.1**	**47.3**

	P	**SED**	
Rate	0.962	0.312	
Variety	<0.001	0.382	
Fungicide	0.336	0.494	
Rate*variety	0.012	0.541	
Rate*fungicide	0.393	0.698	
Variety*fungicide	0.113	0.855	
Rate*variety*fungicide	0.676	1.210	58 d.f.

3.3.9.4.3.4 Gloucestershire

Thousand grain weight averaged 46.8 g across all treatment combinations (Table 3.3.140). Increasing seed rate from 100 to 200 seeds m^{-2} did not significantly affect TGW. Equinox had the largest TGW, significantly greater than Claire, which in turn had significantly greater TGW than Consort ($p<0.001$). There were no significant fungicide or treatment interaction effects.

Table 3.3.140 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	46.9	46.1	46.9	41.8	46.8	**45.7**
	Consort	45.0	41.1	45.0	45.2	44.6	**44.2**
	Equinox	51.1	50.2	51.1	50.7	50.7	**50.8**
100 Mean		**47.7**	**45.8**	**47.7**	**45.9**	**47.4**	**46.9**
200	Claire	46.0	45.1	46.0	46.9	44.2	**45.6**
	Consort	43.7	44.2	43.7	44.9	44.1	**44.1**
	Equinox	49.3	50.5	51.6	49.5	50.6	**50.3**
200 Mean		**46.3**	**46.6**	**47.1**	**47.1**	**46.3**	**46.7**
S.R. Mean	**Claire**	46.4	45.6	46.4	44.4	45.5	**45.7**
	Consort	44.3	42.7	44.3	45.1	44.3	**44.1**
	Equinox	50.2	50.4	51.4	50.1	50.6	**50.5**
Overall mean		**47.0**	**46.2**	**47.4**	**46.5**	**46.8**	**46.8**

	P-value	SED	
Rate	0.962	0.396	
Variety	<.001	0.485	
Fungicide	0.433	0.626	
Rate*Variety	0.351	0.686	
Rate*Fungicide	0.169	0.886	
Variety*Fungicide	0.278	1.085	
Rate*Variety*Fungicide	0.07	1.534	58 d.f.

3.3.9.4.3.5 Northumberland

Thousand grain weight averaged across all treatments, was 43.0 g at the Northumberland site (Table 3.3.141). Increasing seed rate significantly increased TGW, from 41.6 to 44.3 at 100 and 200 seeds m^{-2} respectively (p=0.003). Equinox, had significantly higher TGW than that of Claire or Consort (p<0.001). The increase in TGW with increasing seed rate was significant only with Consort and Equinox, not with Claire (p=0.05). There were no significant fungicide effects or treatment interactions.

Table 3.3.141 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Northumberland 2001/02. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	44.0	40.5	44.0	38.5	39.1	**41.2**
	Consort	37.3	38.4	37.3	41.4	42.9	**39.5**
	Equinox	43.3	45.5	43.3	43.9	44.8	**44.2**
100 Mean		**41.5**	**41.5**	**41.5**	**41.3**	**42.3**	**41.6**
200	Claire	42.9	38.9	42.9	39.2	42.0	**41.2**
	Consort	41.7	42.5	41.7	43.3	44.1	**42.7**
	Equinox	48.3	49.6	47.2	49.9	50.3	**49.1**
200 Mean		**44.3**	**43.7**	**43.9**	**44.1**	**45.5**	**44.3**
S.R. Mean	**Claire**	**43.4**	**39.7**	**43.4**	**38.8**	**40.5**	**41.2**
	Consort	39.5	40.5	39.5	42.4	43.5	**41.1**
	Equinox	45.8	47.6	45.3	46.9	47.6	**46.6**
Overall mean		**42.9**	**42.6**	**42.7**	**42.7**	**43.9**	**43.0**

	P-value	**SED**
Rate	0.003	0.78
Variety	<0.001	0.955
Fungicide	0.263	1.233
Rate*Variety	0.05	1.35
Rate*Fungicide	0.432	1.743
Variety*Fungicide	0.835	2.135
Rate*Variety*Fungicide	0.738	3.02

3.3.9.4.3.6 2001/02 Summary

Thousand grain weights at the Kent and Northumberland sites were lower than those at the other sites. Increasing seed rate generally had no significant effect on TGW, though at the Northumberland site significant increases were seen at the higher seed rate. Equinox tended to have the highest TGWs. Fungicide treatments had no significant effects except at the Kent site where additional spring or additional autumn and spring fungicides significantly increased TGW. There were no significant treatment interactions that were consistent across sites.

3.3.9.4.4 2002/03

3.3.9.4.4.1 East Yorkshire

Thousand grain weight averaged 44.7 g across all treatment combinations (Table 3.3.142). Increasing seed rate from 100 to 200 seeds m^{-2} slightly but significantly decreased TGW (p=0.02). Equinox had significantly greater TGW than Claire, which in turn had significantly higher TGW than Consort (p<0.001). There were no significant fungicide or treatment interaction effects.

Table 3.3.142 Preharvest thousand grain weight at two different sowing rates in three varieties under five different fungicide regimes, East Yorkshire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	45.0	44.7	45.6	44.9	45.5	**45.1**
	Consort	44.4	40.5	43.2	44.0	42.7	**43.0**
	Equinox	49.2	46.5	46.6	46.5	47.0	**47.2**
Mean		**46.2**	**43.9**	**45.1**	**45.1**	**45.1**	**45.1**
200	Claire	43.7	44.3	43.9	44.8	43.9	**44.1**
	Consort	41.6	41.3	41.9	42.7	41.7	**41.9**
	Equinox	47.1	48.1	46.6	46.1	46.3	**46.8**
Mean		**44.1**	**44.6**	**44.1**	**44.5**	**44.0**	**44.3**
S.R. Mean	Claire	44.3	44.5	44.8	44.8	44.7	**44.6**
	Consort	43.0	40.9	42.6	43.4	42.2	**42.4**
	Equinox	48.1	47.3	46.6	46.3	46.7	**47.0**
Mean		**45.1**	**44.2**	**44.6**	**44.8**	**44.5**	**44.7**
			p-value	SED			
	Rate		0.02	0.31			
	Variety		<0.001	0.38			
	Fungicide		0.449	0.49			
	Rate*variety		0.687	0.54			
	Rate*fungicide		0.077	0.69			
	Variety*fungicide		0.115	0.85			
	Rate*variety*fungicide		0.970	1.20	58 d.f.		

3.3.9.4.4.2 Kent

Thousand grain weight averaged 44.1 g across all treatment combinations (Table 3.3.143). Increasing seed rate from 100 to 200 seeds m^{-2} only slightly decreased TGW, but these decreases were statistically significant ($p<0.001$). Equinox had the largest TGW, significantly greater than Consort, which in turn had significantly greater TGW than Claire ($p<0.001$). There were no significant fungicide or treatment interaction effects.

Table 3.3.143 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Kent 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	41.6	41.4	42.2	41.9	41.9	**41.8**
	Consort	43.8	44.1	44.3	42.0	44.7	**43.8**
	Equinox	47.9	50.0	50.1	49.8	47.5	**49.1**
100 Mean		**44.4**	**45.1**	**45.5**	**44.6**	**44.7**	**44.9**
200	Claire	40.4	40.8	41.2	40.9	40.3	**40.7**
	Consort	42.9	42.5	43.0	43.2	41.6	**42.6**
	Equinox	48.1	46.2	46.4	46.1	47.5	**46.9**
200 Mean		**43.8**	**43.2**	**43.5**	**43.4**	**43.1**	**43.4**
S.R. Mean	Claire	41.0	41.1	41.7	41.4	41.1	**41.3**
	Consort	43.3	43.3	43.6	42.6	43.1	**43.2**
	Equinox	48.0	48.1	48.2	48.0	47.5	**48.0**
Mean		**44.1**	**44.2**	**44.5**	**44.0**	**43.9**	**44.1**

	p-value	SED	
Rate	<0.001	0.348	
Variety	<0.001	0.427	
Fungicide	0.828	0.551	
Rate*variety	0.355	0.603	
Rate*fungicide	0.681	0.779	
Variety*fungicide	0.995	0.954	
Rate*variety*fungicide	0.140	1.349	58 d.f.

3.3.9.4.4.3 Bedfordshire

Across all treatments, TGW averaged 43.9 g (Table 3.3.144). Increasing seed rate from 100 to 200 seeds m^{-2} had no significant effect on TGW. Averaged across seed rate and fungicide treatments, Equinox had a significantly higher TGW than that of Consort, which in turn had a higher TGW than Claire ($p<0.001$). These rankings were maintained at both seed rates, though at 100 seeds m^{-2} TGW of Consort was not significantly different to that of Claire; Equinox was still significantly greater ($p=0.003$). There were no significant effects of fungicide treatment, nor were there any other significant treatment interactions.

Table 3.3.144 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Bedfordshire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	42.6	42.8	42.9	43.0	43.1	**42.8**
	Consort	41.6	43.9	42.9	42.5	42.6	**42.7**
	Equinox	46.2	46.8	45.6	46.3	47.0	**46.4**
100 Mean		**43.5**	**44.5**	**43.8**	**43.9**	**44.2**	**44.0**
200	Claire	41.3	41.4	41.4	41.3	41.1	**41.3**
	Consort	43.1	43.8	43.4	43.0	42.6	**43.2**
	Equinox	47.3	47.1	47.8	46.5	46.1	**47.0**
200 Mean		**43.9**	**44.1**	**44.2**	**43.6**	**43.3**	**43.8**
S.R. Mean	Claire	41.9	42.1	42.1	42.1	42.1	**42.1**
	Consort	42.4	43.9	43.1	42.7	42.6	**42.9**
	Equinox	46.8	47.0	46.7	46.4	46.6	**46.7**
Overall mean		**43.7**	**44.3**	**44.0**	**43.8**	**43.8**	**43.9**

	p-value	SED	
Rate	0.364	0.27	
Variety	<0.001	0.33	
Fungicide	0.438	0.42	
Rate*variety	0.003	0.46	
Rate*fungicide	0.585	0.60	
Variety*fungicide	0.947	0.73	
Rate*variety*fungicide	0.981	1.04	58 d.f.

3.3.9.4.4.4 Gloucestershire

Thousand grain weight averaged 41.7 g across all treatment combinations (Table 3.3.145). Increasing seed rate from 100 to 200 seeds m^{-2} did not significantly affect TGW. Equinox had the largest TGW, significantly greater than Consort, which in turn had significantly greater TGW than Claire ($p<0.001$). There were no significant fungicide or treatment interaction effects.

Table 3.3.145 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Gloucestershire 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	40.3	37.6	39.6	38.8	39.5	**39.1**
	Consort	41.6	42.7	41.7	41.4	42.6	**42.0**
	Equinox	44.9	42.8	46.4	45.9	43.2	**44.6**
100 Mean		**42.2**	**41.0**	**42.6**	**42.0**	**41.7**	**41.9**
200	Claire	39.3	39.6	38.9	40.3	37.8	**39.2**
	Consort	39.6	41.3	42.2	42.1	41.7	**41.4**
	Equinox	43.3	43.4	44.6	43.8	42.5	**43.5**
200 Mean		**40.7**	**41.4**	**41.9**	**42.1**	**40.7**	**41.4**
S.R. Mean	Claire	39.8	38.6	39.2	39.6	38.6	**39.2**
	Consort	40.6	42.0	42.0	41.8	42.2	**41.7**
	Equinox	44.1	43.1	45.5	44.9	42.9	**44.1**
Mean		**41.5**	**41.2**	**42.2**	**42.1**	**41.2**	**41.7**

	p-value	SED	
Rate	0.112	0.303	
Variety	<0.001	0.371	
Fungicide	0.109	0.479	
Rate*variety	0.153	0.525	
Rate*fungicide	0.257	0.678	
Variety*fungicide	0.054	0.830	
Rate*variety*fungicide	0.289	1.174	58 d.f.

3.3.9.4.4.5 Northumberland

Thousand grain weight averaged 45.9 g across all treatment combinations (Table 3.3.146). Increasing seed rate from 100 to 200 seeds m^{-2} had no significant effect. Equinox had significantly greater TGW than Claire or Consort ($p<0.001$). There were no significant fungicide or treatment interaction effects.

Table 3.3.146 Thousand grain weight immediately preharvest at two different sowing rates in three varieties under five different fungicide regimes, Northumberland 2002/03. Fungicide treatments are 1 – standard T1, T2, T3; 2 –additional autumn fungicide; 3 –additional spring fungicide; 4 –additional autumn and spring fungicides; 5 – standard T2, T3, early T1.

		Fungicide					
Seeds m^{-2}	**Variety**	**1**	**2**	**3**	**4**	**5**	**Mean**
100	Claire	44.0	44.7	43.1	45.5	42.5	**44.0**
	Consort	43.8	45.1	44.6	44.7	44.1	**44.4**
	Equinox	50.2	49.7	48.5	49.3	50.6	**49.7**
100 Mean		**46.0**	**46.5**	**45.4**	**46.5**	**45.7**	**46.0**
200	Claire	43.4	44.1	42.3	43.0	44.8	**43.5**
	Consort	42.9	44.6	45.4	43.7	44.7	**44.2**
	Equinox	49.0	50.8	49.5	50.3	48.3	**49.6**
200 Mean		**45.1**	**46.5**	**45.7**	**45.7**	**45.9**	**45.8**
S.R. Mean	Claire	43.7	44.4	42.7	44.3	43.7	**43.8**
	Consort	43.3	44.8	45.0	44.2	44.4	**44.3**
	Equinox	49.6	50.2	49.0	49.8	49.4	**49.6**
Overall mean		**45.6**	**46.5**	**45.6**	**46.1**	**45.8**	**45.9**

	p-value	SED	
Rate	0.46	0.330	
Variety	<0.001	0.404	
Fungicide	0.343	0.522	
Rate*variety	0.907	0.572	
Rate*fungicide	0.635	0.738	
Variety*fungicide	0.628	0.904	
Rate*variety*fungicide	0.128	1.278	58 d.f.

3.3.9.4.4.6 2002/03 Summary

Thousand grain weights were reasonably consistent across sites, though TGW at the Gloucestershire site was comparatively low. Effects of the seed rate treatment were small and generally not significant, though there was a tendency for reduced TGWs at the higher seed rate. Equinox generally had the highest TGW, significantly more so than the other two varieties; Claire generally had the lowest TGWs. Fungicide treatments had no effect at any of the sites sampled, and there were no significant treatment interactions that were consistent across sites.

3.3.9.4.5 Thousand grain weight - summary

Increasing seed rate generally led to decreased TGW, though decreases were generally small, and not always significant, particularly when comparing 100 and 200 seeds m^{-2} seed rates. Of the three varieties sampled, Equinox tended to have the largest TGW and Claire the smallest, though differences between Consort and Claire were much smaller than differences between Equinox and Consort. There was only one instance of additional spring or additional autumn and spring fungicides significantly increasing TGW compared to the standard fungicide regime. At all other 12 site/season combinations where TGW was measured, fungicide treatment had no significant effect. Treatment interaction effects were not consistent across sites or seasons.

3.4 DISCUSSION

3.4.1 Seed rate effects

In general, across the five sites and four seasons, reducing seed rates led to reduced plant population, increased percentage establishment, reduced *S. tritici* and eyespot infection, reduced shoot numbers, reduced GAI, no effect on radiation use efficiency (RUE), only slightly reduced photosynthetically active radiation (PAR) interception, significantly increased PAR interception per shoot, reduced lodging where this was observed, increased yield in lodging years, but reduced biomass production and yield in non-lodging years, small increases in harvest index (HI), increased grain number per ear, and slightly increased thousand grain weight (TGW).

3.4.1.1 Seed rate and site latitude

One of the hypotheses tested was whether sowing rates would affect northern sites more than southern sites, due to reduced thermal time between sowing and vernalisation. In the 2000/01 and 2002/03 seasons the East Yorkshire site did show a slightly increased response to increasing seed rate compared to the Kent site in terms of grain yield (0.3 and 0.2 t ha^{-1} response at East Yorkshire over that of the Kent site response for 2000/01 and 2002/03 respectively). In 2001/02 absolute responses were the same at each site (0.2 t ha^{-1}), though in proportionate terms they were larger in Kent. In the 1999/2000 season, yields decreased in response to increased seed rates, most probably as a result of increased lodging at the higher seed rates in this year. These yield decreases were much larger at the East Yorkshire site probably because of the high lodging encountered over the entire site. At the Northumberland site, there was a 1.75 t ha^{-1} increase at the higher seed rate. However, establishment had suffered through a frit fly infestation, thus this response cannot be due to seed rate *per se*. In terms of GAI, responses to increasing seed rate were larger at the Kent site in 2000/01 and larger at the East Yorkshire site in 2001/02 and 2002/03. For fertile shoot numbers and accumulated biomass, immediately pre-harvest seed rate responses were higher at the East Yorkshire site in all years. On balance therefore, there is some evidence to suggest that higher seed rates are more beneficial at northern sites in terms of tiller survival, biomass accumulation and perhaps green area production, but in terms of impacts on grain yield, seed rate choice appears to be little affected by latitude within England in early sown crops.

3.4.1.2 Sowing rate and establishment

Sowing at lower seed rates can be a risky strategy in years where there are poor conditions for establishment, and these are particularly likely with early sown crops with dry seed beds. However, there were only three site/season combinations where establishment was poor, Gloucestershire in 1999/2000 and 2001/02, and

Northumberland in 2001/02. The 1999/2000 season's seed rate effects on yield were confounded by lodging, but in the 2001/02 season increasing seed rate from 100 to 200 seeds m^{-2} increased yield at the Gloucestershire and Northumberland sites by 0.8 and 1.7 t ha^{-1} respectively. Corresponding figures for the East Yorkshire and Kent sites in 2001/02, where there was good establishment, were 0.2 t ha^{-1} at each site. Therefore, under conditions where poor establishment is likely, compensatory tillering at low seed rates may not be enough to offset the disadvantages of reduced plant density, and higher seed rates would be more appropriate. This confirms work done by Papastylianou (1995) in barley. Due to a lack of weather data it is not possible to determine whether the Gloucestershire site showed poor establishment because of inadequate rainfall after drilling. The reason for the poor establishment at Northumberland in 2001/02 however was a frit fly infestation. Awareness, monitoring and if necessary treatment of insect pests will therefore be a pre-requisite if considering use of low seed rates in early sown crops.

3.4.1.3 Sowing rate and disease

Increasing sowing rate generally led to increased disease, in this study diseases affected were *Septoria tritici* and eyespot (*Pseudocercosporella herpotrichoides*), mildew levels were so small in all years that treatment effects could not be precisely determined. These results are supported by previous work on seed rate effects on *S. tritici* (Tompkins, Fowler and Wright, 1993), eyespot (Goulds and Fitt, 1991; Colbach *et al*., 1997; Colbach and Saur, 1998) and powdery mildew (Tompkins, Wright and Fowler, 1992). Generally, differences in disease levels between sowing rates were larger earlier on in the season and reduced as the season progressed. Early in the season, denser plant populations at high seed rates mean there is more chance of host-inoculum encounter (i.e. primary infection). Later in the season however, the lower tillers per plant at higher seed rates means opportunities for secondary infection (i.e. spread of infection from and already infected host to a healthy host) are reduced, whereas they are increased at the low seed rates (Colbach and Saur, 1998) because of increased tillers per plant. Thus, over the course of a season, seed rate effects on primary and secondary infection could effectively cancel each other out. On the balance of results from this project, different disease control strategies for different seed rates would seem to be inappropriate. However, investigations into targeting of primary or secondary infection disease cycles depending on seed rate could provide interesting and potentially useful results.

Eyespot epidemics may result in increased lodging (Scott and Hollins, 1974; DeBoer *et al*., 1993, Berry *et al*., 2004), though there is only one experimental year, 1999/2000, where lodging was observed. Unfortunately, eyespot levels in this year were not assessed, and therefore it is not possible to comment on any seed rate/eyespot/lodging interactions.

3.4.1.4 Seed rate and photosynthetically active radiation interception

Green area index (GAI) was always greater at the higher seed rate. Generally however, photosynthetically active radiation (PAR) interception m^{-2} was not substantially increased by increasing seed rate. This was because in most experiments maximum GAI was above five, above which even relatively large changes in GAI do not greatly effect PAR interception (Sylvester-Bradley *et al*., 1997a, b). Intercepted PAR m^{-2} was substantially increased at Kent in 2000/01 and East Yorkshire in 2002/03 but at both these sites GAI at both seed rates never reached five, and therefore small differences in GAI would have larger impacts on PAR interception.

Similar to Whaley *et al*. (2000), absolute differences in GAI between seed rates increased as the season progressed, but proportional differences decreased, most likely due to decreasing differences in shoots m^{-2} as increased tiller death affected the high seed rate. This was reflected by increasing disparity in PAR intercepted per shoot in absolute terms between seed rates, in favour of the lower seed rate. Whaley *et al*. (2000) attributed increases in PAR interception per plant at lower seed rates to increased tiller production per plant, increased tiller survival and increased green area per shoot; main shoot leaf number, phyllocron or tiller production rate were not affected by seed rate. This study's results generally agree with these findings, though tiller production rate was not measured, and data for main shoot leaf number and phyllocron are not presented.

Photosynthetically active radiation use efficiency (PARUE) was not significantly or consistently increased by reducing seed rate. This contrasts with the findings of Whaley *et al*. (2000), but agrees with the results of Gooding, Pinyosinwat and Ellis (2002). However, the study of Whaley *et al*. (2002), used a broader range of seed rates (640 – 20 seeds m^{-2}), and only the lowest seed rate showed a significantly increased RUE compared to higher seed rates.

Therefore plots at the lower seed rate were able to use compensatory mechanisms on a per shoot basis that allowed them to capture close to the PAR intercepted by plots at the higher seed rate on a per area basis. However, where GAI did not reach five in a season, these compensatory mechanisms were inadequate.

3.4.1.5 Seed rate and yield

Despite near-equivalence in PAR interception at both seed rates, there were consistent and significant increases in yield at the higher seed rate, of around 0.4 t ha^{-1}, largely through an increase in the numbers of ears m^{-2} which increased grains m^{-2}, rather than an increase in grain size. When looking at just Claire at the Kent and East Yorkshire sites from 2001-03, for which PAR interception data are available, yield increases were greatest at East Yorkshire in 2000/01 (1 t ha^{-1}), and lowest at both sites in 2001/02 (0 t ha^{-1}). These do not correspond with the respective seed rate effects on PAR interception; at East Yorkshire 2000/01 there were no significant effects of seed rate, whereas in 2001/02 there were significant, albeit small, increases at the higher seed rate.

Abbate *et al*. (1997) found that reduced PAR interception during grain fill reduced grains m^{-2} rather than grain weight, which they took to imply that yield was limited by number of grain sites (i.e. sink limited). This study found that grains m^{-2} was increased at the higher seed rates, but that these increases were only poorly related to increases in PAR interception between anthesis and harvest (Figure 3.4.1). Frequency of PAR interception measurements was not as frequent as those in Abbate *et al*. (1997), who measured PAR between the interval during which ears were between 5 and 100% of the dry weight they accumulated 7 days after anthesis. It is possible therefore that more precise PAR measurements taken in this study could have produced a better correlation between PAR and grains m^{-2}.

One group of variates that were not measured in this study were those relating to below ground resource capture. Whaley *et al*. (2000) found only small effects of decreasing seed rate on nitrogen (N) uptake. VandenBoogaard et al. (1996) found that higher seed rates took up more water early in the season, but as they depleted soil reserves faster, later in the season lower seed rates were able to take up more water, until at harvest differences in water uptake were negligible. However, the experiments of VandenBoogaard *et al*. (1996) were carried out in a Mediterranean climate, and therefore severe water limitations later in the season would be more likely than those in a UK climate. Tompkins, Fowler and Wright (1991) found that although disparity in water uptake were much higher earlier in the season when comparing 140 and 35 kg seeds ha^{-1} (equivalent to 311 and 78 seeds m^{-2} at a TGW of 45 g), there was a 4% increase across the whole season. It is possible therefore, on the balance of the limited information available, that the higher seed rate was able to take up more water on a per unit area basis.

With increased water uptake the canopy could be maintained for longer at the higher seed rate. Accurate measurements of the period of leaf senescence were not made in this study, so it is not possible to say whether green area was maintained longer at the higher seed rates thus leading to greater radiation interception than is actually reported here. However, Stapper and Fischer (1990a) found no effect of different seed rates on development or maintenance of a canopy, and Peltonen-Sainio and Jarvinen (1994) observed that individual oat plants had a longer canopy duration when sown at a lower seed rate, but had a smaller growth rate on a per unit area basis. If greater canopy duration was not responsible for the increase in yield, increased water uptake could have allowed the plants at the higher seed rate to maintain greater transpiration rates and therefore CO_2 assimilation on a per unit area basis. Since no measurements of water uptake were made however, this possibility is an open question, Karrou (1998) found that in one year water use efficiency decreased as seed rate was increased, though water use had only been estimated from rainfall rather than directly measured, and experiments were carried out in a more water limited environment that the UK would experience.

In most years therefore, increasing seed rate led to moderate increases in yield, though most likely not as a result of increased PAR interception. Halving seed rate did not reduce yields by half; compensatory mechanisms of maintaining greater tillers per plant allowed PAR interception per plant to be increased. This allowed the maintenance of larger numbers of grains ear^{-1}, as well as slightly increased TGW and HI, and allowed yield losses to be limited to only 0.4 t ha^{-1} averaging across sites and years.

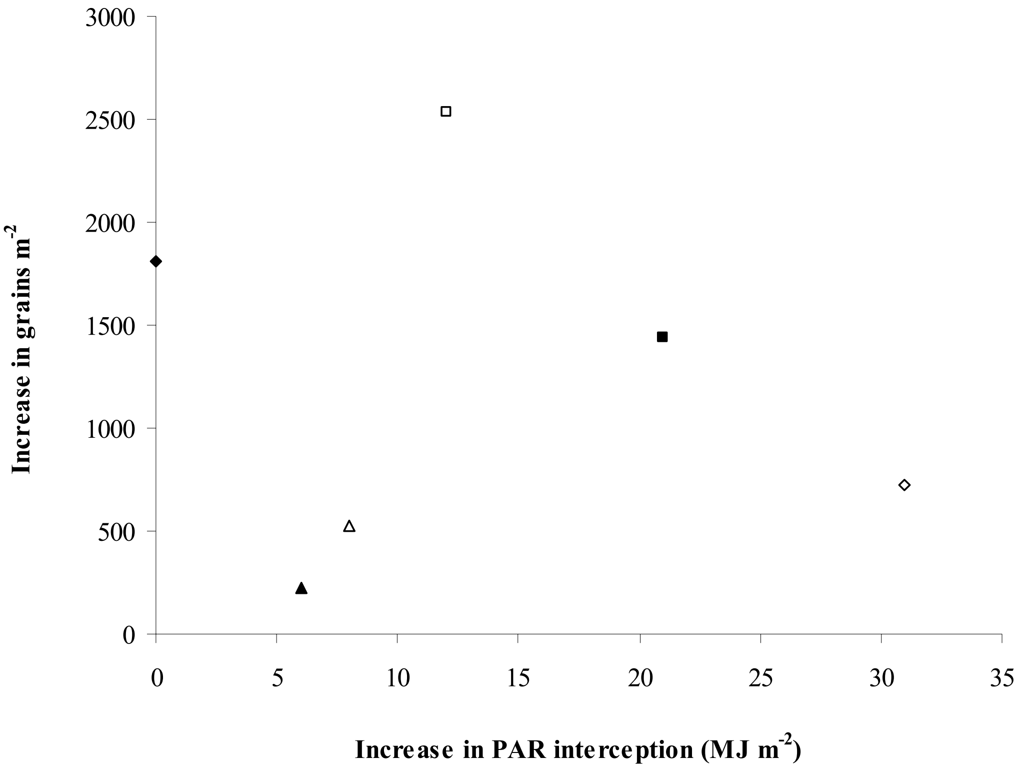

Figure 3.4.1 Correlation between increase in PAR interception between anthesis and harvest and increase in grains m^{-2} with increases in seed rate from 100 to 200 seeds m^{-2} in Claire. Symbols represent the East Yorkshire site (closed symbols) and the Kent site (open symbols) in 2000/01 (♦), 2001/02 (▲) and 2002/03 (■).

3.4.1.6 Economics of increasing seed rate

Assuming a TGW of 44 g, seed costs of £230 t^{-1} and feed grain prices of £70, £100 or £60 t^{-1}, a cost benefit analysis was performed on the yield differences between seed rates of 100 and 200 or 250 seeds m^{-2} (Table 3.4.1). In the 1999/2000 season increasing seed rate led to increasing costs, due to greater lodging at these rates. In following years however, increasing seed rate generally led to benefits, of the order £34 ha^{-1} at a feed wheat price of £70 t^{-1} where lodging was absent. However, there was some variation between sites. In 2001/02 in particular, the Gloucestershire and Northumberland sites contributed most to the positive cost benefits of the high seed rates, whereas at the other sites cost benefits were minimal. In 2000/01 and 2002/03 cost benefits of high seed rates were more even across sites, but no one site could be singled out as having a pre-disposition to higher profits at higher seed rates over a run of years. Of note is the fact that in lodging years all sites suffered uniformly high costs from increasing seed rates, and that these costs were nearly double the benefits averaged over non-lodging years. In this study, there was a lodging year one year in four, a frequency reported by Berry *et al*. (1998) over a 20 year period after the introduction of varieties with good standing power. However, this figure was from a period where crops were normally sown in early-mid October, and it is likely that with early sown crops the frequency of lodging could increase (Berry *et al*., 1998).

The positive effects of increasing seed rate are improved as grain prices are increased from £70 to £100 t^{-1} (the price of feed wheat at the time of this report), and reduce the negative effects in lodging years. The grower therefore will have to be aware of fluctuations in grain prices and adjust seed rate accordingly. If prices are low, lower seed rates will provide substantially more income in a lodging year, and in a non-lodging year profit increases at higher seed rates will not be as large. At high prices, the increasing returns may justify sowing at higher seed rates provided that the risk of substantial financial loss in a lodging year is borne in mind. A survey on frequency of lodging years in early sown wheat crops would provide an indication of how big this risk was.

Table 3.4.1 Yield benefits (£ ha^{-1}) in increasing seed rates from 100 to 200 seeds m^{-2} (250 seeds m^{-2} in 1999/2000 except the East Yorkshire site) after costs of extra seed have been deducted. Calculations assume seed costs of £230 t^{-1}, thousand seed weights of 44 g and feed wheat prices of £70 (a), £100 (b) and £60 (c) t^{-1}.

a

	Year				
Site	1999/2000	2000/01	2001/02	2002/03	**Mean**
East Yorkshire	-60	65	3	31	**10**
Kent	-72	28	7	16	**-6**
Bedfordshire	-69	73	5	17	**7**
Gloucestershire	-63	16	47	25	**6**
Northumberland	*	*	112	19	**65**
Mean	**-66**	**45**	**35**	**22**	**9**

b

	Year				
Site	1999/2000	2000/01	2001/02	2002/03	**Mean**
East Yorkshire	-82	97	9	48	**18**
Kent	-97	44	14	27	**-3**
Bedfordshire	-92	109	12	29	**14**
Gloucestershire	-83	27	71	41	**14**
Northumberland	*	*	164	31	**98**
Mean	**-89**	**69**	**54**	**35**	**17**

c

	Year				
Site	1999/2000	2000/01	2001/02	2002/03	**Mean**
East Yorkshire	-53	54	1	25	**7**
Kent	-64	22	4	12	**-6**
Bedfordshire	-61	61	3	13	**4**
Gloucestershire	-56	12	39	20	**4**
Northumberland	*	*	95	15	**55**
Mean	**-59**	**37**	**28**	**17**	**6**

* No experiments present at these sites.

3.4.2 Varietal effects

The three varieties used in the experiments in the harvest years 2001-03 (Claire, Consort, Equinox) were chosen on the basis of suitability for early sowing. The characteristics required were varieties with good standing power and those that were popular with growers. Disease resistance was also important, though the three varieties differed in resistance and susceptibility to various diseases. Equinox was perhaps the variety worst suited to early sowing and low sowing rates, as its tillering capacity is less than that of Claire or Consort.

There were some consistent varietal differences over the sites and years. Claire tended to yield higher, and Equinox tended to have the largest TGWs. Consort and Equinox had higher levels of *S. tritici* infection than Claire, whereas when mildew was present, Claire had more severe infections. These results reflect the ratings given in the HGCA recommended lists.

There were no consistent interactions between seed rate and varietal choice; all varieties in the years 2001-03 performed equally well at either seed rate. In the 1999/2000 season, where a wider range of varieties were used, there were statistically significant interactions but these were related to lodging resistance rather than any intrinsic developmental or tillering properties *per se*. This supports the work of Spink *et al*. (2000).

Low disease levels in two years out of three where detailed disease assessments were available meant that consistent variety/fungicide interactions were not observed. However, in 2001/02, where there were higher levels of *S. tritici* and significant fungicide effects, *S. tritici* severity in Claire generally responded least to the different fungicide treatments, and at the Kent site this interaction was statistically significant. This effect was not carried through to yield however, where all varieties responded similarly. Because of the low levels of mildew and other leaf pathogens (such as rusts, data not shown) it is not possible to say what interactions may be expected, though as there is less disparity in mildew resistances for the three varieties, interaction effects should be less likely.

In summary, the three varieties selected for detailed analysis did not show any significant differences in their responses to seed rate treatments. There were limited differences in responses to fungicide treatment which corresponded to resistance rankings to individual pathogens, but these were only seen in years of high disease pressure.

3.4.3 Fungicide effects

3.4.3.1 Disease control

As mildew levels were very low or entirely absent in most years, and there were no significant fungicide effects on eyespot levels, this discussion will restrict itself to fungicide treatment effects on *S. tritici*.

In all years there were moderate to high levels of *S. tritici* early in the season on the lower leaves, but in 2000/01 and 2002/03 there were only very low levels of disease later in the season. In 2002/03 disease levels appeared to drop between May and June in East Yorkshire and between April and May in Kent, before increasing slightly at the July sampling; at the Northumberland site there were only small amounts of *S. tritici* by July. Epidemics of *S. tritici* require adequate rainfall (Royle, Shaw and Cook, 1986; Thomas, Cook and King, 1989) in order to spread from one leaf layer to the next (Shaw and Royle, 1993), though disease can also spread through contact between newly emerged and established leaves (Lovell *et al*., 1997). May rainfall at the East Yorkshire and Kent sites in 2000/01 was comparatively low at 26 and 18 mm respectively, compared to values of 51 and 88 mm in 2001/02 and 79 and 50 mm in 2002/03. In 2002/03, rainfall between 12th February and 24th April was only 35 mm at East Yorkshire and only 37 mm at Kent, compared to figures of 83 and 72 mm in 2001/02. In 2001/02, between the May and June samplings only 60 mm of rain fell in East Yorkshire, compared to 113 mm at the Kent site. Therefore, where there were interruptions in rainfall, epidemic progress was slowed.

Thomas *et al*. (1989) found that applying fungicides every two weeks from around 1st October significantly controlled disease levels in the winter, but that by harvest yields were not significantly different from plots where fungicide application had not commenced until the onset of stem extension. In this study, additional autumn fungicides significantly lowered *S. tritici* levels early in the season in some cases, but only in one experiment was this effect retained until quite late in the season (East Yorkshire 2000/01). Some chemical control methods, such as control of take-all with silthiofam, can have lasting effects throughout the season, even if they are only active at the very start of the crop's life (Bailey *et al*., 2004). However, take-all epidemics take the form of a primary infection cycle followed by a single secondary infection cycle, and any treatment that can reduce the level of primary infection will have a strong impact on the level of secondary infection. In an epidemic of *S. tritici*, multiple secondary infection cycles will occur in a season, representing transfer of inoculum from one leaf layer to the next. Theoretically, a halving in inoculum early in the season by application of fungicides should result in a halving of infectious particles reaching the next leaf layer at each one of these infection cycles. However, inoculum for infecting the next leaf layer is produced by lesions spreading over the leaf surface. The percentage area infected will increase at a rate partly determined by how many infectious particles are on the leaf, and will reach an asymptote as uninfected host material becomes less available. In a fungicide treated plant, because infectious particles have been reduced, this asymptote will be reached later than the untreated plant, due to reduced rate of increase and a delay in the onset of increase. However, if the untreated epidemic reaches the asymptote too soon and is not able to transfer to the next leaf layer (because it is not there, or environmental conditions are not suitable), infection levels in treated plants will begin to catch up with those in untreated plants. Rate of disease increase has even been shown to increase in fungicide treated plants, both in theory (Berger, 1988) and in practice (Paveley *et al*., 2000). Thus effects of the early fungicide have the potential to be reduced at each infection cycle if there is a delay in production of a new leaf layer, such as in early sown crops, where phyllocrons are longer (Kirby *et al*., 1998b), or where environmental conditions prevent transmission (such as low rainfall). In most sites and seasons there were significant periods of low rainfall, with the exception of East Yorkshire in 2000/01 (at least until later in the season); this was the only case where additional fungicides applied in the autumn had long lasting effects.

Additional spring fungicides had no effects in 2002/03, except for some small effects at the East Yorkshire site. Effects were transient at both sites where disease was measured in 2000/01, and in 2001/02 effects varied with site. The lack of effects in 2002/03 and 2000/01 were probably due to the very low levels of disease observed later in the season, which itself was probably caused by the lack of adequate rainfall to allow transmission of disease from established to newly emerging leaf layers. However, this does not explain why there were spring fungicide effects early in the season in 2000/01 and not in 2002/03, when there were moderate-high *S. tritici* levels in both years. One possible explanation for this is that at both sites in 2000/01 there were moderate and frequent levels of rainfall around the time of spring fungicide application, meaning that adequate transmission of *S. tritici* could occur in untreated plants, whereas disease levels on treated plants would not be able to catch up as mentioned above. In 2002/03, there was hardly any rainfall immediately after spring fungicide application, and therefore disease levels on treated plants could catch up with those on untreated plants, meaning effects on the next leaf layer would be less affected by the additional fungicide. At the Kent site in 2001/02 there were large reductions in *S. tritici* infection with additional spring fungicide from soon after it was applied through to harvest. The smaller, but still statistically significant reductions at the East Yorkshire site were due to lower levels of disease at the June sampling time, related to low rainfall from May to mid-June. The lack of effects at the Northumberland site can be ascribed to low background levels of disease.

Applying additional autumn and spring fungicides together rarely gave any additional benefits over an additional spring fungicide applied alone. This was probably because any beneficial effects of additional autumn fungicides had worn off by the time additional spring fungicides were applied. In the one case where autumn fungicides provided significant control until later in the season (East Yorkshire 2000/01), disease levels on plots with additional autumn and spring fungicides were not examined.

Applications of T1 fungicide at the fourth leaf rather than third leaf stage had no significant effect on disease control, apart from in 2002/03, when at the Kent and Northumberland sites it appeared to increase percentage leaf area infected with *S. tritici*. This is consistent with works that have examined fungicide timing effects on end of season disease levels (Thomas *et al*., 1989; Cook, Hims and Vaughan, 1999; Paveley *et al*, 2000), namely that fungicide applications should aim to protect the upper three leaves, or at worst the flag leaf (Hardwick *et al*., 1994) and that any applications before that are unlikely to have additional effect.

Effects of the different fungicide treatments were not affected by seed rate, presumably because although differences in disease levels were sometimes statistically significant between seed rates, they were small in absolute terms, especially towards the end of the season for reasons noted above.

3.4.3.2 Crop growth and yield

Effects of the different fungicide treatments on crop growth variates generally followed fungicide treatment effects on *S. tritici*. However, despite significant and sometimes substantial reductions in *S. tritici* infection early in the season where additional autumn fungicides were applied, there were no corresponding increases in crop growth early on. This supports work by Leitch and Jenkins (1995) who found that despite differences in *Septoria* epidemics early in the season, dry matter production was not affected until after anthesis. As tiller production and survival occur pre-anthesis, the lack of fungicide effects on these variates was not unexpected, and is consistent with the results of Cornish, Baker and Murray (1990).

Effects of *S. tritici* on yield have previously been correlated with amounts of infection on leaves responsible for most of yield formation (Thomas *et al*., 1989; Leitch and Jenkins, 1995) or area of those leaves that remains uninfected (Jenkins and Morgan, 1969; Cornish *et al*., 1990). In 2000/01 and 2002/03, where there were no effects of fungicide treatment on disease levels until later in the season, there were no effects on GAI or PAR interception. In 2001/02, use of additional spring fungicides increased PAR interception by around 10 MJ m^{-2} at both sites where it was measured. However, at the East Yorkshire site, GAI was apparently reduced by additional fungicides, and yet still managed to increase PAR interception. This was due to higher extinction coefficient (k) values for treatments with additional fungicides later in the season (data not shown), though there was some senescent leaf tissue present that may have reduced the accuracy of estimates of k, and therefore the apparent increase in PAR interruption at the East Yorkshire site may be an artefact.

Additional fungicide applications had no effect on yield in 2000/01, as might be expected from the lack of effects on *S. tritici* or GAI. In 2001/02 there were significant increases in yield where additional autumn and spring or additional spring fungicides were applied of 1.6 t ha^{-1} at the Kent site, and 0.3 t ha^{-1} at the East Yorkshire site. In 2002/03 the same treatments increased yield by around 0.3 t ha^{-1} at both the Kent and East Yorkshire sites. At only the Kent site in 2001/02 were these significant yield increases preceded by significant increases in GAI. However, one of the effects of additional fungicides that was not assessed in this study was that of canopy duration, which has been found by previous researchers to be reduced with increased disease (Leitch and Jenkins, 1995). This could explain some of the positive yield effects seen with additional autumn and spring/spring fungicides in the absence of apparent effects on GAI or PAR interception, such as in 2002/03.

Additional autumn fungicides on their own had no effect on yield, presumably because its disease control effects had worn off too early in the season. The early T1 fungicide treatment rarely had an effect on yield, again due to the lack of effects on *S. tritici* levels.

In summary, additional fungicides above the standard three spray programme were only of benefit in seasons and at sites where there was high disease pressure. Additional autumn fungicides on their own had no significant effect on yield, and when applied with additional spring fungicides, rarely increased yields significantly above that of yields with additional spring fungicides alone. Additional spring fungicides did provide a yield benefit in situations where disease control was small but significant, as in 2002/03, possibly as a result of extending green area duration, though this cannot be confirmed here.

3.4.3.3 Economics of fungicide treatments

Calculations were made of the economic benefits (or costs) of applying additional or differently timed fungicides in terms of extra yield gained over that of the standard T1, T2, T3 regime. Costs of the fungicides were assumed as £19 l^{-1} for Twist, £3 l^{-1} for Bravo, and £20 l^{-1} for Opus, and price of feed wheat was fixed at £100 t^{-1}. Results are shown in Table 3.4.2. In general, benefits of the non-standard fungicide regimes were quite small, and in the case of the additional autumn fungicide and early T1 treatments, mostly negative. Treatments that included additional spring fungicides gave seemingly reasonable benefits of around £20 ha^{-1} over the three years measured. However, this was largely due to the very substantial benefits seen at the Kent site in 2001/02, where additional fungicides allowed maintenance of larger canopies through disease control. If the figures for this site are excluded, the benefits of additional spring fungicides overall are only around £10 ha^{-1}. It is unlikely that with these levels of benefits farmers will want to consider changing their fungicide regimes; along with the extra costs of the fungicides, there are the extra labour and machinery costs, which have not been taken into account in these calculations. Also there are management issues; time spent spraying additional fungicides could be spent more profitably elsewhere on the farm.

Although the application of additional spring fungicides seems to be economically unfavourable in most years, it has been demonstrated in one case that in situations where substantial disease control and maintenance of larger leaf area is achieved, large economic benefits are possible. Improved forecasting of when these situations are likely to occur would therefore make this a viable strategy for improving yields of early sown winter wheat.

Table 3.4.2 Costs/benefits (£ ha^{-1}) compared to standard T1, T2, T3 fungicide programme for application of additional autumn or spring, or early T1 fungicides assuming feed grain price of £100 t^{-1}. Costs of fungicides are Twist at £19 l^{-1}, Bravo at £3 l^{-1} and Opus at £20 l^{-1}. Figures for each site are averaged across seed rate and varietal treatments.

		Fungicide treatment			
Year	Site	Additional autumn	Additional spring	Additional autumn and spring	Early T1
2000/01	East Yorkshire	-5.33	-12.70	-4.89	-15.88
	Kent	1.31	22.39	9.83	36.38
	Bedfordshire	22.28	-32.61	-13.42	-11.51
	Gloucestershire	-1.98	7.58	10.17	14.88
	Mean	**4.07**	**-3.83**	**0.42**	**5.97**
2001/02	East Yorkshire	0.48	26.97	57.47	45.32
	Kent	-18.61	151.73	145.66	-14.55
	Bedfordshire	18.36	6.32	16.65	-3.07
	Gloucestershire	-7.56	30.75	19.02	-10.85
	Northumberland	9.36	-53.80	21.43	-48.77
	Mean	**-1.83**	**53.94**	**59.70**	**4.21**
2002/03	East Yorkshire	-3.68	-3.48	11.49	-5.61
	Kent	-7.47	18.11	23.33	-17.55
	Bedfordshire	12.02	11.25	2.08	0.83
	Gloucestershire	-8.67	12.16	19.71	-11.70
	Northumberland	-1.77	8.91	4.63	0.05
	Mean	**-1.91**	**9.39**	**12.25**	**-6.80**
Overall mean		**0.11**	**19.83**	**24.12**	**1.13**

3.4.4 Management of early sown winter wheat crops - conclusions

The aims of this project were to establish seed rate, varietal and fungicide management options for early sown winter wheat crops. The following points have emerged:

1) Crops sown at 200 seeds m^{-2} will generally yield better than those sown at 100 seeds m^{-2} in non-lodging years. However, in lodging years, financial penalties for sowing at high rates are very large, whereas benefits in non-lodging years were comparatively low. If feed wheat prices remain at around £100, sowing at higher rates may be a risk worth taking, but a survey of frequency of lodging years in the era of early sowing would better quantify this risk.
2) Sowing at a higher rate benefited crops at northerly English latitudes (East Yorkshire and Northumberland) in terms of vegetative growth compared to crops grown in the south (Kent). However, these benefits did not translate to grain yield.
3) Crops sown at higher seed rates tended to have more disease than those at lower rates early in the season, but later these differences were negligible. Lack of any interaction effects with different fungicide regimes suggest that different disease control strategies are not applicable to different sowing rates.
4) In years of poor establishment, higher seed rates will be required to achieve yield potential.
5) Performance of the three main varieties tested, Claire, Consort and Equinox, did not vary at different seed rates, and therefore no special attention need be paid in this regard. Under conditions where *S. tritici* was the dominant foliar pathogen, Claire consistently yielded highest of the three cultivars and responded less well to different fungicide treatments. Matching of cultivar to expected disease problems would reduce fungicide costs and increase yields.
6) Additional autumn fungicides had only transitory effects on disease levels, and rarely led to economic yield increases.
7) Additional spring fungicides only had lasting effects under conditions of high disease pressure. Where conditions were unfavourable for disease spread, its superior disease control was only temporary.
8) Despite only transitory effects on disease control, additional spring fungicides generally led to economic increases in yield. However, except where there was high disease pressure, these were only small.

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APPENDIX

SITE MANAGEMENT DETAILS

1999/2000

East Yorkshire

Fertiliser

06/09/99	315	kgs	0-24-24
06/09/00	112	kgs	46% N urea
06/04/00	215	kgs	46% N urea
04/05/00	176	kgs	46% N urea

Herbicides

26/10/99	1.1	litres	Grenadier
26/10/99	1.4	litres	Tolkan Turbo

Insecticides Growth stage

26/10/99	13	0.25	litres	Toppel
27/01/00	23	1.5	litres	Dursban

Growth Regulators

30/03/00	31	2.4	litres	Standup
09/05/00	37	1	litres	Terpal

Fungicides

24/04/00	32	0.25	litres	Landmark
24/04/00	32	0.25	litres	Opus
24/04/00	32	0.25	litres	Tern
20/05/00	39	0.7	litres	Landmark
20/05/00	39	0.25	litres	Agrys
13/06/00	59	0.25	litres	Amistar

Kent

	Product:	Rate:	Date:
Fertiliser:	N 34.5%	40 kg/haN	09/03/00
	N 34.5%	160 kg/haN	10/04/00
Fungicides:	Landmark	0.5 l/ha	11/04/00
	Tern	0.25 l/ha	11/04/00
	Amistar	0.75 l/ha	15/05/00
	Opus	0.25 l/ha	15/05/00
	Opus	0.25 l/ha	15/06/00
	Mistral	0.25 l/ha	15/06/00
Growth Regulators:	Brevis	2.25 l/ha	16/03/00
	5C Cycocel	1.25 l/ha	11/04/00
	Moddus	0.2 l/ha	11/04/00
	Terpal	1.0 l/ha	08/05/00
Herbicides:	CMPP	2.0 l/ha	26/10/00
	Javelin	1.0 l/ha	26/10/00
	IPU	2.0 l/ha	26/10/00
	Hawk + Wetter	2.5 l/ha	09/11/99
	Lexus 50 DF	20 g/ha	07/03/00
	Topik + Wetter	85 ml/ha	07/03/00
	Starane	0.75 l/ha	09/05/00
Insecticides:	Hallmark	100 ml/ha	06/10/99

Bedfordshire

Fertiliser	EXTRAN 34.5%	40 kg N/ha	06/03/00
	NITRAPRILL 34.5%	120 kg N/ha	03/05/00
Fungicides	LANDMARK	0.50 l/ha	01/05/00
	LANDMARK	0.75 l/ha	02/06/00
	OPUS	0.25 l/ha	20/06/00
Growth Regulators	5C CYCOCEL	2.50 l/ha	17/03/00
	TERPAL	1.00 l/ha	22/05/00
Herbicides	ISOTOP	3.00 l/ha	28/10/99
	ZODIAC	1.00 l/ha	28/10/99
	TOPIK	0.12 l/ha	20/03/00
	ALLY	0.03 kg/ha	04/05/00
Insecticides	DECIS	0.20 l/ha	13/10/99
	APHOX	0.14 kg/ha	20/06/00
	DECIS	0.25 l/ha	20/06/00
Molluscicides	METAREX GREEN	5.50 kg/ha	06/09/99
Molluscicides	DRAZA	5.50 kg/ha	14/10/99
Wetters	ACTIPRON	1.00 l/ha	20/03/00
	AGRAL	0.08 l/ha	22/05/00

Gloucestershire

Fertilisers	34.5%N	40 kg/ha N	08/03/00
	34.5%N	160 kg/ha N	10/04/00
Herbicides	Avadex	22.5 kg/ha	14/09/99
	Tolkan Turbo	5 l/ha	13/10/99
	Astix K	2 l/ha	15/10/99
	Starane	0.5 l/ha	09/05/00
	Topic	0.125 l/ha	09/05/00
Fungicides	Opus	0.25 l/ha	10/04/00
	Amistar	0.5 l/ha	10/04/00
	Opus	0.25 l/ha	22/05/00
	Amistar	0.75 l/ha	22/05/00
	Opus	0.25 l/ha	15/06/00
Growth regulators	3C cycocel	2.3 l/ha	15/03/00
	Terpal	1 l/ha	08/05/00
Pesticides	Cypermethrin	0.25 l/ha	13/10/99
	Cypermethrin	0.25 l/ha	12/11/99
Molluscicides	Draza	5 kg/ha	26/10/99

2000/01

East Yorkshire

	Product:	Rate:	Date:
Fertiliser:	0-24-24	325 kg/ha	06/10/00
	46% N Urea	59 kg/ha N	14/03/01
Growth Regulators:	70% Chlormequat	1.25 l/ha	02/04/01
	70% Chlormequat	1.25 l/ha	12/04/01
	Moddus	0.2 l/ha	12/04/01
	Terpal	1.25 l/ha	16/05/01
Herbicides:	Javelin Gold	2.5 l/ha	15/10/00
Insecticides:	Toppel	0.25 l/ha	15/10/00
	Dursban	1.5 l/ha	27/01/01
	Aphox	140 g/ha	02/07/01
Adjuvants:	Enhance	20 ml/ha	16/05/01

Kent

Fertilisers		175 kg N	19/04/01
Herbicides	Hawk	1.7 l/ha	19/10/00
	IPU	1.0 l/ha	15/01/01
	Javelin	1.0 l/ha	15/01/01
	Lexus 50 DF	20 g/ha	19/10/00
Pesticides	Hallmark zeon	50 ml/ha	19/10/00
	Hallmark zeon	50 ml/ha	15/01/01
Growth regulators	Terpal	1.0 l/ha	10/05/01
Molluscicides	Draza	5.5 kg/ha	20/09/00
	Draza	5.5 kg/ha	19/10/00
Adjuvants	Toil	1.0 l/ha	19/10/00

Bedfordshire

	Product	Rate	Date
Fertiliser	Nitraprill 34.5%	100 kg N/ha	12/04/2001
	Nitraprill 34.5%	42 kg N/ha	22/05/2001
Growth Regulators	5C Cycocel	1.25 l/ha	12/04/2001
	Moddus	0.20 l/ha	12/04/2001
Herbicides	Hawk	2.50 l/ha	18/10/2000
	Lexus 50DF	20 g/ha	18/10/2000
	Topik	0.12 l/ha	20/03/2001
	Harmony M	75 g/ha	20/03/2001
	Starane 2	1.00 l/ha	17/04/2001
Insecticides	Hallmark Zeon	0.05 l/ha	18/10/2000
	Aphox	200 g/ha	04/07/2001
Molluscicides	Draza	5.50 kg/ha	22/09/2000
	Draza	5.50 kg/ha	19/10/2000
Wetters	Axiom	1.00 l/ha	18/10/2000
	Axiom	1.00 l/ha	20/03/2001

Gloucestershire

	Product	Rate	Date	GS
Nitrogen	Nitram	40kg/ha N	07/03/01	25
	Nitram	160kg/ha N	18/04/01	31-32
Insecticide	Hallmark	50ml/ha	10/11/00	23
	Dursban	1.0l/ha	12/06/01	59-65
Herbicides	Terbutryne	5.0l/ha	13/09/00	Pre-em.
	Tolkan (IPU)	3.0l/ha	10/11/00	23
	Stomp	3.0l/ha	10/11/00	23
	Ally	20g/ha	14/05/01	33-34
	Starane 2	0.5l/ha	14/05/01	33-34
	Topic	0.125l/ha	14/05/01	33-34
PGR	3C Cycocel	2.3l/ha	29/03/01	30
	Terpal	1.0l/ha	23/05/01	39

2001/02

East Yorkshire

Herbicides	Panther	1 l/ha	15/10/01
	IPU	1.5 l/ha	15/10/01
	Duplosan	0.5 l/ha	15/10/01
Fertiliser	0-20-30	325 kg/ha	02/11/01
	46% urea	50 kg/ha N	02/03/02
	46% urea	92 kg/ha N	09/04/02
	34.4%N	80kg/ha N	01/05/02
Growth regulators	3c cycocel	1.25 l/ha	23/03/02
	Moddus	0.15 l/ha	23/03/02
	5C cycocel	2 l/ha	03/04/02
	Moddus	0.1 l/ha	03/04/02
	Terpal	1.25 l/ha	10/05/02
Insecticides	Cypermethrin	0.25 l/ha	12/10/01
	Dursban	1.5 l/ha	08/02/02
Wetters	Enhance	0.02 l/ha	15/05/02

Kent

	Product:	Rate:	Date:
Fertiliser:	Double Top	40 kg/haN 17.5 kg/haS	26/03/02
	N34.5	160 kg/haN	9/04/02
Growth Regulators:	3C Cycocel	1.25 l/ha	26/03/02
	5C Cycocel	2.5 l/ha	16/04/02
Herbicides:	Javelin	1.0 l/ha	12/10/01
	Platform S	0.5 kg/ha	12/10/01
	IPU	2.0 l/ha	12/10/01
	Ingot	2.5 l/ha	01/11/01
	Grasp	1.0 l/ha	01/11/01
	Output	1.0 l/ha	01/11/01
	Grasp	1.4 l/ha	16/05/02
	Output	1.0 l/ha	16/05/02
Insecticides:	Hallmark Zeon	50 ml/ha	12/10/01

Bedfordshire

	Product	Rate	Date
Fertiliser	Nitraprill 34.5%	50 kg N/ha	23/03/2002
	Nitraprill 34.5%	100 kg N/ha	11/04/2002
Growth Regulators	3C Chlormequat	2.30 l/ha	23/03/2002
	5C Cycocel	1.25 l/ha	02/04/2002
	Moddus	0.20 l/ha	02/04/2002
Herbicides	Crystal	3.00 l/ha	12/09/2001
	IPU	4.00 l/ha	17/10/2001
	Stomp 400SC	3.00 l/ha	17/10/2001
	Compitox Plus	1.00 l/ha	17/10/2001
	Lexus 50DF	20 g/ha	23/11/2001
	Hawk	2.50 l/ha	23/11/2001
	Topik	0.13 l/ha	04/03/2002
	Ally	30 g/ha	16/04/2002
	Starane 2	0.90 l/ha	16/04/2002
Insecticides	Decis	0.20 l/ha	17/10/2001
	Hallmark Zeon	0.04 l/ha	23/11/2001
Molluscicides	Draza	5.50 kg/ha	23/10/2001
Wetters	Drill	1.00 l/ha	23/11/2001
	Drill	1.00 l/ha	04/03/2002

Gloucestershire

Fertilisers:	Double Top	50 kg/ha N + 22 kg/ha S	05/03/02
	Nitram	150 kg/ha N	18/04/03
Growth Regulators:	5C Cycocel	1.75 l/ha	12/03/02
	5C Cycocel	0.75 l/ha	15/04/03
Herbicides:	Terbutyrne	5.0 l/ha	12/09/01
	Lexus	20 g/ha	02/11/01
	Stomp	3.0 l/ha	02/11/01
	Topik	0.125 l/ha	16/04/02
	Codacide Oil	2.5 l/ha	16/04/02
	Starane 2	0.5 l/ha	16/04/02
Insecticides:	Hallmark Zeon	0.05 l/ha	12/10/01
	Toppel 10	0.25 l/ha	01/11/01

Northumberland

Fertilisers	Nitrogen	40 kg/ha N	18/03/02
	Nitrogen	40 kg/ha N	18/04/02
Herbicides	IPU	2 l/ha	14/10/01
	Javelin	1 l/ha	14/10/01
	Duplosan	0.35 l/ha	14/10/01
	IPU	2 l/ha	25/03/02
Pesticides	Dusban	1.5 l/ha	15/10/01
Growth regulators	Hive	1.25l/ha	26/03/02
	Modus	0.2l/ha	26/03/02
	Terpal	1.0 l/ha	16/05/02
Molluscicides	Draza	5 kg/ha	30/09/01
	Draza	5 kg/ha	30/10/01

2002/03

East Yorkshire

	Product:	Rate:	Date:
Fertiliser:	0-20-30	370kg/ha	02/10/02
	46% Urea	58.9kg/haN	18/03/03
	46% Urea	63.5kg/haN	15/04/03
	34.5% Litfert	88.7kg/haN	13/05/03
Growth Regulators:	Chlormequat 720	1.25l/ha	26/03/03
	Moddus	0.10l/ha	26/03/03
	Chlormequat 720	1.25l/ha	04/04/03
	Moddus	0.10l/ha	04/04/03
	Chlormequat 720	1.00l/ha	17/04/03
	Moddus	0.100l/ha	17/04/03
	Terpal	0.75l/ha	16/05/03
Herbicides:	Panther	1.0l/ha	31/10/02
	Isoproturon	1.5l/ha	31/10/02
	Duplosan	0.5l/ha	31/10/02
	Ally	20.0l/ha	31/03/03
Insecticides:	Hallmark Zeon	0.05l/ha	05/10/02
	Cypermethrin	0.25l/ha	31/10/02
	Dursban	1.5l/ha	15/02/03
Adjuvants:	Enhance	0.02l/ha	16/05/03

Kent

	Product:	Rate:	Date:
Fertiliser:	Double Top	40 kg/haN	13/03/03
		17.5 kg/haS	
	N34.5	175 kg/haN	09/04/03
Growth Regulators:	5C Cycocel	1.25 l/ha	26/03/03
	5C Cycocel	1.25 l/ha	11/04/03
Herbicides:	Javelin	1.0 l/ha	18/10/02
	IPU	2.0 l/ha	18/10/02
	CMPP	1.5 l/ha	18/10/02
	IPU	2.0 l/ha	05/12/02
	Stomp	3.0 l/ha	05/12/02
	Grasp	1.0 lha	05/12/02
	Output	0.75 l/ha	05/12/02
	Starane 2	0.75 l/ha	14/05/03
	Topik	125 m/ha	14/05/03
	Phase II	1.0 l/ha	14/05/03
Insecticides:	Hallmark Zeon	50 ml/ha	29/11/02

Bedfordshire

	Product	Rate	Date
Fertiliser	NITRAPRILL 34.5%	50 kg N/ha	10/03/03
	NITRAPRILL 34.5%	100 kg N/ha	11/04/03
Growth Regulators	3C CHLORMEQUAT	2.25 l/ha	26/03/03
	5C CYCOCEL	2.00 l/ha	16/04/03
Herbicides	AVADEX EXCEL	15.00 kg/ha	13/09/02
	COMPITOX PLUS	2.00 l/ha	02/10/02
	IPU	4.50 l/ha	24/10/02
	STOMP 400SC	3.00 l/ha	24/10/02
	ALLY	30 g/ha	06/05/03
	STARANE 2	0.80 l/ha	06/05/03
Insecticides	HALLMARK ZEON	0.05 l/ha	02/10/02
	DURSBAN WG	0.60 kg/ha	03/06/03
Molluscicides	DRAZA	5.50 kg/ha	10/10/02
	DRAZA	5.50 kg/ha	23/10/02
Wetters	NONE		

Gloucestershire

	Product:	Rate:	Date:
Herbicides:	Ice	3.0 l/ha	11/09/02
	Alpha Isoproturon	3.0 l/ha	28/10/02
	Stomp	3.0 l/ha	28/10/02
	Grasp	1.0 l/ha	08/05/00
PGR's:	New 5C Cycocel	1.75 l/ha	19/03/03
	New 5C Cycocel	0.75 l/ha	11/04/03
Insecticides:	Hallmark Zeon	0.05 l/ha	03/10/02
	Toppel	0.25 l/ha	28/10/02
	Hallmark Zeon	0.05 l/ha	30/05/03
Adjuvants:	Ouput	0.75 l/ha	08/05/03
Fertilisers	Double Top	50 kg/ha N & 22 kg/ha S	05/03/03
	Nitraprill	150 kg/ha N	01/04/03

Northumberland

Herbicides:

12/12/02 - 5 ltrs Cardelia, 240 g C
26/3/03 - 3 ltrs IPU, 2 ltrs Picona

Insecticides:

24/9/02 - Hallmark 75ml ha-1.
2/9/02 - Slug pellets.
18/9/02 - Slug pellets.

Fertiliser:

8/4/03 - 90 kg N ha-1.
23/4/03 - 90 kg N ha-1.