Genotypic Response to Early and Late Planting in Winter Triticale

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Introduction

Production of triticale as a grain crop could provide several advantages to Midwestern USA cropping systems. Winter cereal grains can prevent soil erosion (Kessavalou and Walters, 1997; Strock et al., 2004) and capture nitrate-nitrogen left in the soil profile by previous crops (Kessavalou and Walters, 1999; Nance et al., 2007). They can also provide straw for bedding or possibly bio-energy production. Winter triticale will most likely follow soybean or corn silage in the cropping system creating a narrow planting window. Studies conducted in Iowa by Schwarte et al. (2006) found triticale grain yield reductions from planting in mid October rather than late September were in the range of 13 to 19% depending on the year and location. There is evidence from studies with winter wheat that some cultivars are more resilient to the loss of grain yield with late planting than others (Smid and Jenkinson, 1979; Fowler, 1986; Dahlke et al., 1993). If differences in cultivar response to late planting exist in winter triticale, they could be exploited to develop and/or select cultivars with resilience to late planting.

Objective

To determine the effect of planting date on grain yield of 12 winter triticale cultivars and determine the relationship among grain yield and autumn growing degree days.

Methods

A field experiment was conducted at Ames (42° 01'N, 93° 44' W; elevation 324 m asl), Crawfordsville (41°12' N, 91° 29' W; elevation 217 m asl), and Sutherland (42° 56' N, 95° 32'W; elevation 440 m asl), Iowa during the 2004-2005 and 2005-2006 growing seasons. Twelve winter triticale cultivars were sown after soybean [*Glycine max* (L.) Merr.] at an early and a late planting date at each location (Table 1). The cultivars were planted with a cone planter in four row plots, 3.66 m in length at a density of 336 seeds m^{-2}. Spacing between rows was 30.5 cm. Entire plots were harvested with a plot combine. The harvested grain was dried to equilibrium moisture content with forced air. Moisture was determined using a DICKEY john GAC 2100 grain analyzer (DICKY john Corporation, Auburn, IL). Grain yield was calculated using the weight of the cleaned grain. Final grain yields were adjusted to a 135 g kg^{-1} moisture basis. The experimental layout at each location in each year consisted of 12 cultivars planted in two blocks (one for early planting and another for late planting) with three plots per block for each cultivar.

Proc Reg of SAS was used to determine the relationship between the number of autumn GDD (base 0°C) accumulated after planting and relative grain yield for each planting date at each location in each year (Schwarte et al., 2006). Relative grain yield was calculated as the percentage yield level based on the mean of the highest yielding location and planting date combination within each growing season. Proc Mixed of SAS was used to test the main effects of planting date and cultivar on grain yield and to determine if there was a significant interaction for effects of planting date and cultivar on grain yield. Each location-year combination was treated as a replication in this analysis.

Table 1. Planting dates and accumulated growing degree days between planting and 31 December for early and late planting dates at Ames, Crawfordsville, and Sutherland, Iowa in 2004 and 2005.

	Early planting		Late planting	
Location	Date	GDD	Date	GDD
		°C (base 0°C)		°C (base 0°C)
		2004		
Ames	23 Sept.	637	11 Oct.	387
Crawfordsville	21 Sept.	746	11 Oct.	461
Sutherland	5 Oct.	427	19 Oct.	287
		2005		
Ames	4 Oct.	427	19 Oct.	245
Crawfordsville	27 Sept.	614	17 Oct.	333
Sutherland	3 Oct.	427	18 Oct.	240

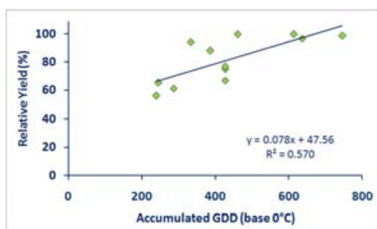

Figure 1. Effect of planting date on relative yield of 12 winter triticale genotypes grown at Ames, Crawfordsville, and Sutherland, Iowa during the 2004-2005 and 2005-2006 growing seasons.

Table 2. Grain yield of 12 winter triticale cultivars planted early and late at Ames, Crawfordsville, and Sutherland, Iowa during the 2004-2005 and 2005-2006 growing seasons.

Cultivar	Early	Late	Mean†
		Mg ha^{-1}	
NE426GT	5.38	4.97	5.18
Vero	4.95	4.53	4.74
Trical 815	4.98	4.35	4.67
Sorento	4.87	4.36	4.62
Kitaro	4.88	4.34	4.61
Lamberto	4.61	4.19	4.40
Décor	4.35	4.18	4.27
Danko Presto	4.48	3.92	4.20
Alzo	4.43	3.82	4.13
NE422T	4.28	3.78	4.03
Trical 336	4.22	3.61	3.92
Pika	3.36	3.20	3.28
Mean††	4.52	4.09	4.31

†Tukey's honest significant difference for comparing the mean grain yield of cultivars = 0.71 Mg ha^{-1}.

†† P>F for differences in planting dates when averaged across cultivars = 0.077. The interaction between planting date and cultivar was non-significant (P>F = 0.796).

Results

- There was a decline in grain yield as the number of accumulated growing degree days (GDD) fell below 670 (Figure 1). The response was linear and both the slope and intercept components of the equation were significantly different from zero ($P \leq 0.01$). Based on the trend line, relative grain yield was 67% when 250 GDD accumulated during the autumn growth period.
- When averaged for the six site years, late planting decreased mean grain yields 9.5% when compared to early planting (Table 2).
- The interaction for effects of planting date and cultivar on grain yield was not significant (*P* = 0.796).
- Differences in mean grain yield were observed among cultivars (Table 2).

Conclusions

The lack of an interaction between planting date and cultivar indicates little variability in grain yield response to late planting among the 12 cultivars and conditions of this experiment. The data did not support our hypothesis that some winter triticale genotypes would be more resilient against the effects of late planting than others. Selection of high yielding winter triticale cultivars can occur under both early and late planting with similar outcomes.

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