



Competitive wheat—a key component of integrated weed management

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Introduction

Two studies were supported by the National Jointed Goatgrass Research Program. One determined plant traits that enhanced winter wheat competitiveness and the other measured the impact of winter wheat height on jointed goatgrass (JGG).

Figure 1: Height difference in 1994 between Eltan and Rohde (notice JGG overtopping Eltan)



Materials and Methods

The studies were conducted at the USDA Palouse Conservation Field Station near Pullman, WA (Figure 1). Competitive characteristics were determined using seven winter wheat cultivars and path analysis with latent variables in the 93/94 and 94/95 growing season. Impacts of height were determined using isolines of Nugaines for 0 to 2 reduced height genes (*Rht*₁ and *Rht*₂) in the 94/95 and 95/96 growing season.

Results and Discussion – Path analysis

A number of plant traits were measured to provide variables needed to create an analyzable model (Table 1). Of these variables, the rate of winter wheat height gain was most positively correlated to improved winter wheat yield when growing in competition with JGG. The rate of winter wheat height gain was also negatively correlated with JGG seed production in drier years (Figure 2). The rate of winter wheat height gain was not correlated to final height as illustrated (Figure 1 and 3) where Eltan, which has a final height of 88 cm, was less competitive than Rohde with a final height of 82 cm. Because Eltan gains its height at a rate similar to JGG there is no advantage in competition for light, whereas, Rohde maintains a 12 to 15 cm height advantage throughout the growing season. The most competitive cultivars reduced JGG seed production 27% in a dry and 46% in a wet year compared to less competitive cultivars. Cultivars with increased competitiveness did not have reduced yields compared to less competitive cultivars when grown without weeds. In a dry year with JGG, the more competitive cultivars yielded up to twice as much as the noncompetitive cultivars.

Table 1: Measured variables and their importance in competition

Winter wheat characteristic	When a significant factor
Rate of height gain	Primary in all comparisons
Rate of weight gain	Secondary in wheat yield in wet yr
Rate of water use	Secondary in dry year
Plant density	Secondary against JGG
Tiller number per m ²	Not significant
Tillers per plant	Not significant
Seeds per head	Secondary in wet yr on wheat yield
Heads per meter	Secondary in wheat yield
Test weight	Secondary in wheat yield in wet yr

Figure 2: Wheat traits and jointed goatgrass yields - 1994

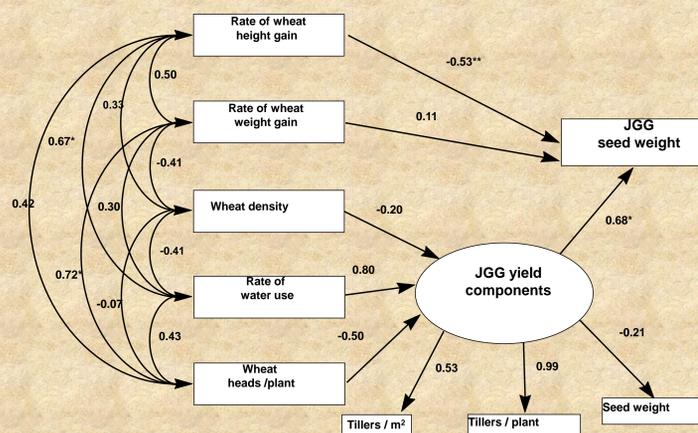
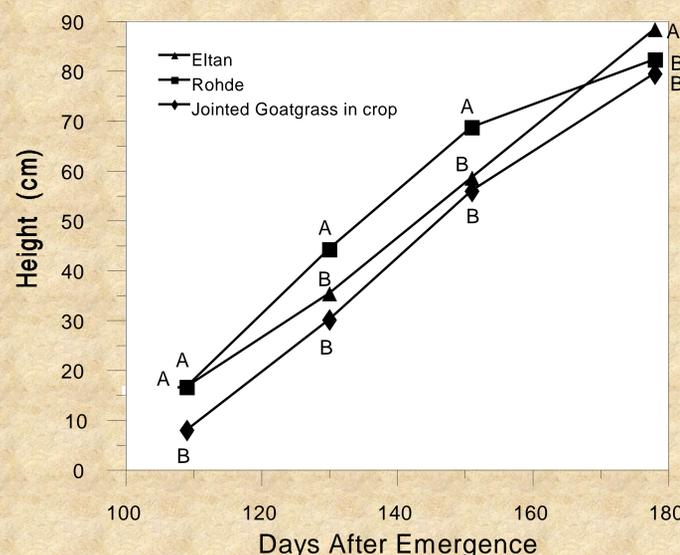


Figure 3: Importance of the rate of height gain



And what about downy brome?

Similar trials were conducted with downy brome (*Bromus tectorum*) from 1993 to 1996. There were no cultivar effects on either yield of downy brome or winter wheat. The early maturation of downy brome appears to be a method for the avoidance of competition.

Acknowledgements

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Results and discussion – Isolines

Grown in weed free conditions, Nugaines with no *Rht* genes (100 cm tall) had a trend of reduced yields compared to isolines with 1 (75 cm tall) or both (50 cm tall) *Rht* genes (Table 2). When grown in competition with JGG, the isolate with both *Rht* genes had lower seed yield. Jointed goatgrass produced the most seed when grown with the isolate that had both *Rht* genes. Selection for a tall winter wheat may come with a yield cost in a weed free condition.

Table 2. Isoline and Jointed goatgrass (JGG) seed yields

<i>Rht</i> gene	Wheat yield		JGG yield
	Weed free	With JGG	
-----g per 0.25 m ² -----			
1	190	131	32 B
2	191	136	27 B
1+2	189	119	50 A
None	164	134	25 B

Conclusions

- Although rate of winter wheat height gain is an important trait of a competitive winter wheat, other traits, not revealed in this research, are also important.
- In a field infested with JGG, the selection of a competitive winter wheat cultivar is a key first step in an integrated weed management system.
- Multiple techniques that further improve wheat yield while reducing JGG seed production, may result in an equilibrium where JGG populations are reduced to acceptable amounts.

Peer-reviewed Publications

1. Ogg, Jr. A..J. and S.S. Seefeldt. 1999. Characterizing traits that enhance the competitiveness of winter wheat (*Triticum aestivum*) against joint goatgrass (*Aegilops cylindrica*) Weed Science 47:74-80
2. Seefeldt, S.S., A.J. Ogg, Jr., and Y. Hou. Near-isogenic line for *Triticum aestivum* height and crop competitiveness Weed Science 47:316-320