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INTEGRATED MANAGEMENT OF JOINTED GOATGRASS IN WINTER WHEAT

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Introduction

Jointed goatgrass (JGG) is a winter annual grass weed that infests an estimated 5 million acres of winter wheat in the western United States and over 710,000 acres in the Pacific Northwest (Ogg 1993). Jointed goatgrass reproduces only by seed, but seed can remain viable in the soil for up to 5 years. The presence of one JGG plant in a field, or one JGG spikelet in a seed-lot prohibits seed certification in Oregon and other states. Jointed goatgrass is very competitive with winter wheat, especially during dry, hot conditions, and as few as five JGG plants /ft^{2}can reduce grain yield by 25 percent. There are no herbicides available that will selectively control this weed in winter wheat.

Current management practices for JGG recommend not growing winter wheat or other winter cereal crops for at least 3 and preferably 5 years after JGG infestation (?). However, because spring wheat typically yields about two-thirds as much grain as winter wheat under eastern Oregon conditions, farmers are reluctant to grow spring crops as an alternative. In many instances they may be unable to sustain a favorable economic operation after more than 2 years of spring crops. In addition, reports of JGG infestations in spring-seeded cereals are becoming more common (Walenta et al. 1999). Burning stubble after winter wheat harvest kills about 90 percent of the seed in JGG spikelets lying on the soil surface, but has a detrimental impact on soil health. Practices that allow winter wheat to out-compete JGG in the field can provide help with the problem. For example, banding N fertilizer below the wheat seed row helps reduce wheat yield losses from JGG (Mesbah and Miller 1999). Winter wheat cultivars differ in their competitiveness with JGG (Seefeldt et al. 1999). By selecting a more competitive cultivar, producers can increase grain yield and reduce JGG seed production. The combination of stubble burning and improved seeding practices, in conjunction with spring cropping, has not been researched previously as a method to reclaim fields infested with JGG.

Methods

A multi-year study was conducted to determine the relative importance of wheat stubble burning, together with planting spring wheat in a wheat/fallow rotation, and “integrated seeding practices” on suppression of JGG. The study was initiated in a dryland winter wheat/fallow cropping region of Morrow County near Gooseberry, Oregon, during the autumn of 1996. The study was part of a larger, Pacific Northwest regional project in cooperation with USDA-Agricultural Research Service, in Pullman, Washington, and the University of Idaho.

The experimental design was a randomized complete block, split-split plot, with four replications located on a commercial field of winter wheat stubble. Main treatments consisted of either open burning of winter wheat stubble (conducted August 27, 1996) or unburned wheat stubble. Main plots were split into two sub-plots planted to either a fallow/winter wheat/fallow/winter wheat (F/WW/F/WW) crop rotation or a fallow/spring wheat/fallow/winter wheat (F/SW/F/WW) crop rotation. For the 1996-1997 fallow period, the F/SW/F/WW rotation underwent no-till fallow prior to seeding spring wheat, and the F/WW/F/WW rotation was conventionally tilled summer fallow. For the 1997-1998 cropping season, the F/WW/F/WW rotation was further split into two sub-sub treatments planted using either a standard commercial practice for winter wheat seeding or an "integrated" seeding practice to increase winter wheat crop competitiveness against JGG. The standard seeding practice consisted of Stephens wheat (1.6 oz/1,000 seeds) seeded on September 24, 1997 at 68 lb/acre (15 seeds/ft^2) using John Deere HZ drills with 16-in row spacing. Nitrogen fertilizer was applied as anhydrous ammonia in summer fallow prior to seeding winter wheat. The integrated seeding practice consisted of Stephens wheat screened for large seed size (2.1 oz/1,000 seeds) seeded on September 24, 1997 at 105 lb/acre (18 seeds/ft^2) using a John Deere 9400 hoe drill with 10- in row spacing. Nitrogen fertilizer was banded below the seed at planting and N-P starter was mixed with the seed at planting. Penawawa spring wheat was seeded in the F/SW/F/WW rotation on March 11, 1998 into no-till fallow using a Great Plains no-till disk drill with 16-20-0 starter fertilizer mixed in the seed box, and N fertilizer banded below the seed. Spring and winter wheat were harvested on August 3, 1998 and August 28, 1998, respectively. The entire plot area was then summer fallowed using conventional tillage practices for the 1998-1999 fallow period. For the 1999-2000 crop year, the standard seeding practice consisted of Stephens wheat seeded on October 10, 1999 at 75 lb/acre (18-seeds/ft^2) using a John Deere 9400 hoe drill on 10-in row spacing. Nitrogen fertilizer was applied as anhydrous ammonia in summer fallow on June 9, 1999 prior to seeding winter wheat. The integrated seeding practice consisted of Stephens wheat, screened for large seed size, seeded on October 10, 1999 at 105 lb/acre (21 seeds/ft^2) using the John Deere 9400 hoe drill. Nitrogen fertilizer was banded below the seed at planting and N-P starter was mixed with the seed at planting. All winter wheat plots were harvested on July 24, 2000.

Results

Although field burning reduced JGG plant numbers in the winter wheat grown after burning (Table 1), it resulted in loss of crop residue important for erosion control and soil health (data not shown). The reduction of JGG numbers was also evident 3 years after burning (Table 2). The integrated seeding practice with no burning also produced a reduction in JGG plant numbers similar to stubble burning, but without the loss of crop residue (Tables 1 and 2). The integrated seeding practice and no burning resulted in increased winter wheat plant height and grain yield, and reduced dockage compared to the standard seeding practice (Tables 1 and 2). It is interesting to note that even after 3 years, the use of integrated seeding of winter wheat resulted in winter wheat grain yields and dockage equal to those obtained from stubble burning and standard seeding practices (Tables 1 and 2), thereby negating much of the positive benefit derived from field burning.

Field burning in the fall reduced the number of JGG plants that emerged in early spring prior to seeding spring wheat (Table 3), but JGG numbers were greatly reduced from the spring cropping practice regardless of whether or not plots were previously burned (Table 2). Burning prior to establishment of the spring wheat crop produced negligible differences in spring wheat plant height or grain yield (Table 3). Spring wheat yielded 19-25 percent less than winter wheat when introduced to the wheat/fallow rotation for 1 year, but rotating to spring wheat reduced JGG plant count and harvested grain dockage in the subsequent winter wheat crop grown in the rotation (Table 2).

Results from this study indicate that the use of “integrated seeding” practices for planting winter wheat effectively suppressed JGG, particularly when combined with spring wheat added to the rotation. Burning of wheat stubble did JGG plant populations and increase winter wheat yield and reduce dockage. However, the practice of field burning produces a long-term, detrimental impact on soil quality, and increases the potential for soil erosion. Field burning is also coming under increased public scrutiny that has resulted in heightened restrictions. On the other hand, practices that enhance the competitive ability of the winter wheat crop, such as increased seeding rate, banding N fertilizer below the seed, and narrow row spacing, also reduced wheat yield losses from JGG. The inclusion of spring wheat in a conventional winter wheat/fallow crop rotation can further help reduce JGG populations. The combination of spring cropping and integrated seeding practices was more effective in reducing JGG losses in wheat than was stubble burning alone.

References

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Table 1. Jointed goatgrass (JGG) and winter wheat yield response to field burning and management practices. Gooseberry, Oregon, 1998.

Treatments			JGG stand count	Wheat plant height	Wheat grain yield	JGG dockage
			2/24/98	7/30/98		
			plants/m^2	cm	bu/acre	%
Burn	WW/F/**WW**/F/WW	Standard	36	86	52	1.7
		Integrated	16	98	63	0.4
No Burn	WW/F/**WW**/F/WW	Standard	140	84	47	3.1
		Integrated	100	97	63	0.5

Table 2. JGG and winter wheat response to crop rotation, field burning, and seeding practices, Gooseberry, Oregon, 2000.

Treatments			JGG plant count	Wheat plant height	Wheat grain yield	JGG dockage
	Rotation	Seeding	3/24/00	7/6/00	7/24/00	
			plants/m^2	cm.	bu/acre	%
Burn	WW/F/WW/F/**WW**	Standard	76	71	37	8.5
		Integrated	40	72	45	4.1
No Burn	WW/F/WW/F/**WW**	Standard	172	69	34	19.5
		Integrated	96	74	43	6.3
Burn	WW/F/SW/F/**WW**	Standard	24	66	39	4.0
		Integrated	20	71	42	1.3
No Burn	WW/F/SW/F/**WW**	Standard	72	69	40	8.3
		Integrated	92	73	46	4.3
	LSD (0.05)		42	4	6	6.9

Table 3. Jointed goatgrass (JGG) and spring wheat yield response to field burning, Gooseberry, Oregon, 1998.

Treatments		Preplant JGG plant count	Postplant JGG plant count	Wheat plant height	Wheat grain yield	JGG dockage
		2/24/98	4/27/98	7/30/98		
		plants/m^2	plants/m^2	cm	bu/acre	%
Burn	WW/F/**SW**/F/WW	64	0	78	47	0.1
No Burn	WW/F/**SW**/F/WW	272	2	74	41	0.5