Jointed Goatgrass Research in Colorado Over Eleven Years

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Major Accomplishments Of a number of cultural practices evaluated for jointed goatgrass management, only delayed seeding and an increased wheat seeding rate provided a consistent reduction in jointed goatgrass biomass and seed production. Delayed planting caused reduced wheat yield as a penalty, and no combination of cultural practices eliminated joinged goatgrass over multiple years. Development of Clearfield wheat in Colorado was an outcome of this project; grower acceptance has been very high for both Above and Bond which now occupy about 8% of CO wheat acres. Beyond Herbicide has proved to be very effective for the control of jointed goatgrass. Although gene flow from Clearfield wheat to conventional wheat and jointed goatgrass was documented in this project, the rate was low and good stewardhip should help preserve the utility of this technology. This project enhanced collaboration among many CSU and ARS scientists in Colorado. Several outstanding graduate students received much of their scientific training on aspects of this project over 11 years, and newly funded basic research at CSU was made possible by early research projects in this program. We have seen a greatly increased awareness of jointed goatgrass problems among Colorado wheat producers and good adoption of management tactics that work in the field. This project provided a good blend of both field-based research and basic lab/greenhouse research on a specific weed. Most importantly, this project fostered colloboration among multiple scientists across multiple states where jointed goatgrass is a problem. We were fortunate to house Dr. Mack Thompson as a JGG extension coordinator for over 1 year; he helped on many WEB development ideas. We in Colorado acknowledge in particular the significant contributions of Dr. Alex Ogg and Darrell Hanavan to the long-term quality and success of the National Jointed Goatgrass Program which Colorado helped get funded.

Fertility of Wheat X Jointed Goatgrass Hybrids Collected in Commercial Wheat Fields

Wheat Hybrids Jointed Goatgrass

Hybrid Spikes in a Wheat Field

Discussion: **The existence of jointed goatgrass by wheat hybrids in wheat fields has been observed for many years, but until the National Jointed Goatgrass program was able to fund detailed research into this unusual weed and crop hybrid interaction, little was known about the genetics and dynamics of these hybrids at a large ecosystem scale. Even today, it appears that hybrid dynamics may be influenced by wheat cultivar, environmental conditions, and perhaps by crop rotation schemes.**

The presence of hybrids and their fertility were evaluated in 2002, 2003, and 2004 in eastern Colorado. Rigorous scouting of wheat fields containing jointed goatgrass patches led to the collection of more than 1,500 spikes over 3 years. The number of spikelets per spike was quite constant (Table 2). These spikes yielded a total of 17,029 spikelets that were evaluated for viable seed utilizing a greenhouse grow-out technique. Although the annual fertility rate ranged from 0.83 to 1.43%, the average fertility over 3 years was 1.1%. This level of fertility in Colorado hybrids is similar to fertility values reported in Oklahoma and Oregon from multi-year scouting studies (Table 1). Most seedlings came from spikelets 3,4,5, and 6 from the spike base (Figure 1). The BC_1 plants arising from these hybrid spikelets appeared normal and produced large numbers of reproductive tillers in the greenhouse. No seedlings emerged from 8197 spikelets from these plants. It is assumed this was due to pollen sterility. Preliminary indications are that some hybrids carried a resistant form of the ALS enzyme. Root chromosome counts showed the presence of 35 chromosomes in several plants.

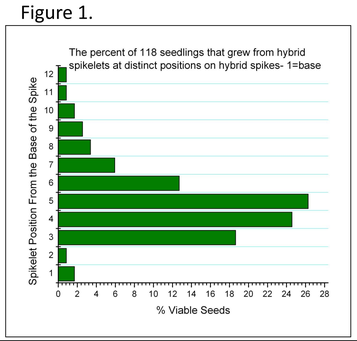
Table 1.

Year	Colorado		Oklahoma		Oregon	
	Spikelets tested	% viable seed	Spikelets tested	% viable seed	Spikelets tested	% viable seed
2004	9327	1.43	-	-	-	-
2003	5773	0.69	-	-	-	-
2002	1929	0.83	7626	1.1	-	-
2001	-	-	16659	1.0	-	-
2000	-	-	3338	0.4	25509	1.0
1999	-	-	-	-	25080	1.0
1998	-	-	-	-	10098	1.1

Table 2.

Year	Mean spikelets per spike
2002	9.4
2003	10.8
2004	10.8
BC_1 2003	10.6

Figure 1.

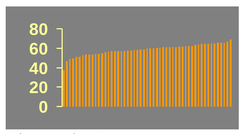


Does Pollen From Clearfield Winter Wheat Move the Imazamox Resistance Gene to Conventional Wheat and Jointed Goatgrass in Nearby Fields?

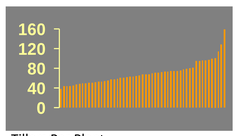
The potential introduction of wheat (*Triticum aestivum* L.) cultivars with transgenic traits has generated increased interest in pollen-mediated gene flow (PMGF). The objectives of this study were to estimate wheat PMGF between commercial fields across multiple years and locations, and to compare estimates from large fields to those from smaller experimental plots. The study was conducted in a total of 56 commercial field locations in eastern Colorado in 2003, 2004, and 2005. We measured PMGF by tracking the movement of an imidazolinone herbicide resistance gene from resistant to susceptible cultivars, sampled at distances of 0.23 to 61 m. At least one sample from all 56 fields and from all 18 evaluated cultivars had detectable PMGF. The highest observed PMGF was 5.3% at 0.23 m. The farthest distance at which PMGF was detected was 61 m and the highest PMGF at that distance was 0.25%. Higher levels and greater distances of PMGF were detected in commercial fields than in experimental plots. Based on estimates from a generalized linear mixed model with a random location effect, the distance required to ensure 95% confidence that 95% of locations have PMGF less than 0.9% is 41.1 m for cultivars heading earlier than the pollen source and 0.7 m for cultivars heading later than the pollen source. These confidence limits should represent the highest levels of PMGF expected to occur in winter wheat in the west-central Great Plains and will be useful for wheat biotechnology regulation.

Jointed Goatgrass Accession Common Nursery and Seed Production

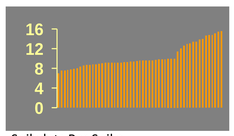
Common Nursery With Replicated Entries For Each Accession



Plant Height - CM



Tillers Per Plant

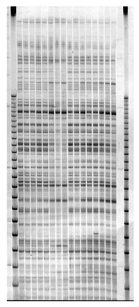


Spikelets Per Spike

Characteristic	P-value[a]	Mean		Biotype
Height (cm)	0.0009	Maximum Minimum	49 30	43 13
Number of Tillers	0.0015	Maximum Minimum	134 27	5 28
Cylinders per Spike	0.0005	Maximum Minimum	10 8	19 48
Mass of JGG tissue (grams m^{-2})	0.0986	Maximum Minimum	108 52	22 23
Mass of JGG joints (grams m^{-2})	0.1162	Maximum Minimum	31 13	43 47
Mass of 50 Joints (grams)	0.0001	Maximum Minimum	3 2	52 28
Maturity visual scale (1-5) 1- green 5- senescence	0.0060	Maximum Minimum	4 1	6 15

Range of Values For Various Parameters

A common garden nursery was used from 1994 to 1996 to evaluate the genetic diversity of US JGG accessions from CO, NE, KS, OK, ID, WA, OR, UT, WY, and MT. Field evaluations showed significant variation for various plant parameters evaluated, but AFLP showed a high degree of genetic relatedness among all the accessions. Newer molecular techniques allow us to detect more genetic differences than were possible by AFLP.



AFLP products electrophoresed on PAGE gels

Managing Imazamox-Resistant Wheat in Crop Rotations

Managing jointed goatgrass in crop rotations based on Clearfield wheat showed over seven years that jointed goatgrass population dynamics were highly influenced by environmental conditions; good wheat producing conditions produced higher goatgrass tiller numbers. The yields of dryland crops such as millet, corn, and sunflower were highly variable. The most useful tactic in this system appeared to be the use of Beyond herbicide which consistently provided over 95% control of jointed goatgrass.