



16-05

FINAL REPORT

1. TITLE: Effect of Controlling Jointed Goatgrass in Wheat Rotations in Nebraska in 2005.

2. PERSONNEL: Robert N. Klein, Gordon E. Hanson, and Gary W. Mahnken, University of Nebraska, 461 West University Drive, North Platte, NE 69101.

3. TIME LINE: Initiated 1996 to be completed 2003. Extended to 2005 to complete all rotations twice. We are complete.

4. ORIGINAL HYPOTHESIS: Jointed goatgrass (JGG) could be controlled using best weed and crop management practices used in winter wheat rotations.

5. SUMMARY OF PROGRESS: Initially in 1996, we overseeded with 200 JGG spiklets/m² across all plots in 15 acres of a non-uniform JGG infestation. The three rotations, winter wheat-fallow (W-F), winter wheat-ecofallow corn-fallow (W-C-F), and winter wheat-ecofallow corn-corn-fallow (W-C-C-F) have been in place 6 years. After 6 years of data collection, the effects of crop rotations, winter wheat cultivars, and time of tillage are affecting JGG densities. Preventing weed growth after wheat harvest with herbicides and beginning tillage for fallow and corn production in April provided conditions suitable for more JGG seed germination before wheat planting than no-till in the wheat or corn stubble. This trend has been consistent. Wheat yields were equal between tillage and no-till except 1998 and 2002. In 1998, JGG reduced yields 6 bu/A, but in 2002 no-till wheat yielded 4 bu/A more than wheat grown in a tilled seedbed. Tillage did not reduce corn yields following the ecofallow period in 1998 and 1999 because of timely rainfall, but yields were less than no-till in 1997, 2000, and 2001. In 2002, corn yields were zero because of drought.

In 2001, corn suffered from drought during the spring months. This reduced corn yields because of less crop residues needed to increase soil water storage and reduce evaporation. Corn was 5 inches taller when planted into >Pronghorn= winter wheat, a medium-tall cultivar, stubble than >Vista= a short wheat. Winter wheat yields were also reduced by drought. JGG plant density in the winter wheat at harvest was 10 to 14 times greater in the winter wheat-fallow (W-F) than W-C-C-F or W-C-F rotations. Hail May 31 reduced wheat yields to 15 bu/A. Over the years the trend has been that the medium-tall Pronghorn wheat is more competitive with JGG than the two shorter cultivars.

In 2002, we experienced the driest year on record (since 1907) on the dryland farm. No JGG germinated in the wheat since the wheat was seeded in September 2001. Spring JGG germination was low, but fall rains greatly increased JGG emergence. Although several hundred JGG seedlings were killed in the fallow portion of the W-F rotation before wheat seeding, sufficient seeds germinated following a 0.84 inch rain after wheat seeding September 23, 2002.

Few differences among winter wheat cultivars existed in 2002. Corn height was greater with corn planted into Pronghorn stubble than Vista wheat stubble. Corn height was shortest when corn followed corn.

In 2003, JGG counts were low at all times except for in the wheat crop under the W-F rotation. Drought was again a big factor, keeping crop yields low. We were, however, able to harvest all crops this year. The drought also kept all other weed counts low. The tillage treatment was the predominate factor determining JGG counts where JGG counts were achieved. Tillage resulted in lower JGG counts than no-tillage. When differences in crop yields existed, tillage resulted in higher wheat yields, but lower corn yields. Corn yield benefited from the higher amounts of crop residues in the no-tillage plots.

In the 2004 wheat crop, the W-C-F rotation had the most JGG, with W-F and W-C-C-F rotation having almost no JGG. This echoed the plant counts in the fallow in 2003. Seed rain was high enough in the W-C-F to be a possible problem in a future wheat crop except for the opportunities to control JGG in the next two years of this rotation. Herbicide plots had higher JGG counts than tillage plots as the drought conditions and lack of seed-soil contact allowed JGG seed to persist on the soil-surface without germinating. Wheat variety had no effect on JGG density in the wheat. The drought subsided in 2004 enough to allow a slightly below average corn crop to develop. In 2001-03 the drought destroyed at least part of the corn crop, and in the case of 2002 completely destroying it. JGG density was very low in both spring and fall, never exceeding more than one plant on average in a square meter. The only measurable effect was that of rotation, where the first year of corn in the W-C-C-F had the highest JGG density (0.22 JGG/m²).

In 2005, all rotations had been cycled through at least twice. The drought continues, but is subsiding in our area as cumulative rainfall since wheat planting in September 2004 stayed above the long term cumulative rainfall. JGG population has been reduced by W-C-F and W-C-C-F rotations, especially during the corn and fallow phases. In the 2005 growing season, the corn and fallow produced no mature JGG, with JGG populations being very low. In the W-F rotation, the block planted to wheat this year has increased in JGG populations, starting at 5 JGG/m² at harvest in 1997 and ending in 2005 at 241 JGG/m² (seed rain of 11,800 joints/m²).

6. OBJECTIVE: To determine the influence of best integrated weed management practices for controlling jointed goatgrass in winter wheat rotations. We are attempting to follow similar practices used by farmers using ecofallow.

7. EXPERIMENTAL DESIGN: Four replications of three rotations involving winter wheat-fallow, winter wheat-ecofallow corn-fallow, and winter wheat-ecofallow corn-corn-fallow were initiated in 1996. Pronghorn, Alliance, and Vista represent a medium-tall, medium, and short stature winter wheat cultivars adapted to western Nebraska were planted each year in the fallow

plots. Two tillage treatments were imposed on each cultivar during the fallow and corn phases. One, tillage was used to plant the JGG in the spring during the fallow period before seeding winter wheat or corn. The other tillage treatment was no-till. Half of the corn plots were tilled with a mulch treader in April and cultivated in June. The other half of the corn plots was no-till. Herbicides were used to control weeds as needed during the fallow period following winter wheat harvest. All plots were treated with herbicides before tillage was performed. This eliminated weed control as a factor. Each rotational phase is present each year.

8. PROGRESS/CONCLUSIONS: In 2005, the W-F rotation was the only block with a significant JGG population (Table 1). The W-C-F and W-C-C-F had less than a single plant in a meter square area. The JGG numbers in the W-C-F and W-C-C-F were also this low in the fall of 2004 prior to wheat planting. The number of viable cylinders in these blocks is very low, with no more than three plants in a meter square recorded since 2000; and almost none maturing. Continuing good weed control practices in these rotations will keep JGG very low. The W-F wheat block however has had an abundance of cylinders in the duration of this study. JGG control was excellent and no JGG matured during the fallow phase of the W-F rotation. The longevity of JGG cylinders results in an abundant supply of seed during the wheat phase. Without a corn crop in this rotation to interrupt the JGG life cycle, JGG density will remain high and will reproduce in the growing wheat. Tillage and wheat cultivar did not affect JGG densities in the growing wheat. In the W-F rotation, however, more JGG cylinders were produced in the no-tillage (herbicide treated) plots. Winter wheat yields were suppressed in by JGG in the W-F rotation. Wheat yields in W-F was only a third of the other two rotations. Within the W-F rotations the no-tillage plots, which had highest JGG densities only yielded a third of the tillage plots, but their was no cultivar difference in yield. 'Vista' was the top yielding cultivar in the W-C-F and W-C-C-F rotations, but no tillage effect on wheat yield was seen in these rotations. The winter wheat crop was difficult to harvest in the W-F rotation this year, as the crop had lodged and JGG density was high. Wheat grain yield dockage due to JGG was very high in the W-F rotation. Dockage was not affected by tillage treatment or wheat cultivar (data not shown). In the corn crop, W-C-F was the only rotation with JGG detected this year (Table 2). Tillage treatment and wheat cultivar had no effect on JGG density. Corn in the first year following wheat yielded better than the second year corn in the W-C-C-F rotation. Within the first year corn, the no-tillage treatment yielded better than the tillage treatment. In the fallow phase, virtually no JGG was reported (Table 3). The most significant finding of this study is the effect of inserting a row crop into the W-F rotation. In the rotation blocks containing corn, JGG populations were low the final year wheat occurred in those rotation blocks (Table 4). Likewise, JGG populations were zero the final year corn occurred in those rotation blocks.

9. PUBLICATIONS: One paper has been published. Wicks, G.A., G.E. Hanson, G.W. Mahnken, and S. D. Miller. 2001. Progress report on controlling jointed goatgrass in winter wheat in Nebraska with rotations. WWSS 54:67-71. A copy is available on the Web Site.

10. TECHNOLOGY TRANSFER ACTIVITIES: This program now has collected sufficient data for Technology Transfers. We now can follow JGG density changes throughout a rotation. Several wheat growers in southwest Nebraska have switched from winter wheat-fallow rotation to a three-year rotation to control JGG. Corn is the principle crop used following winter wheat in an ecofallow program. Growers using W-F had greater problems with JGG this fall. We revised our NebGUIDE on jointed goatgrass based on recent research. Field days were cancelled in 2003 due to drought and in 2004 due to health of the cooperator. A JGG poster developed for the North Central Weed Science Society was updated and presented to the public at the experiment station's Centennial Celebration.

11. BUDGET: Timeline table for dollars requested and received.

Amount	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Requested	\$7,500	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	---	---	---
Received	\$5,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	---	---	---

Project received a total of \$125,000.

Table 1. Jointed goat grass plants and cylinders in wheat and wheat yield in 2005 at North Platte, NE. ^{a, b}

	----- Jointed goatgrass plants -----						Jointed goatgrass cylinders			Wheat grain yield		
	May 23, 2005			June 21, 2005			June 21, 2005			W-C-F	W-C-C-F	W-F
	W-C-F	W-C-C-F	W-F	W-C-F	W-C-C-F	W-F	W-C-F	W-C-C-F	W-F			
Tillage treatment	----- no./m ² -----			----- no./m ² -----			----- no./m ² -----					
Tillage	0	0	375 b	0	0.17	209	0	0	9963 b	3352	3122	1589 a
Herbicide	0	0	531 a	0.08	0	273	1	0	14100 a	3298	3286	549 b
LSD (0.05)	NS	NS	98	NS	NS	NS	NS	NS	3217	NS	NS	372
Wheat Cultivar												
Alliance	0	0	409	0	0.25	183	0	0	11848	2930 c	2916 b	1157
Pronghorn	0	0	434	0	0	223	0	0	11054	3207 b	3005 b	1180
Vista	0	0	516	0.12	0	316	2	0	12744	3690 a	3690 a	870
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	157	265	NS

Rotation	----- Jointed goatgrass -----				Wheat grain yield	JGG dockage
	----- plants -----		----- cylinders -----			
	May 20	June 21	Aug 8	June 21	kg/ha	%
W-F	----- no./m ² -----					
	453 a	241 a	74 a	11822 a	1069 b	28 a
W-C-F	0 b	0 b	0 b	1 b	3275 a	0 b
W-C-C-F	0 b	0 b	0 b	0 b	3204 a	0 b
	38	38	12	1241	173	6

^a Rotations are winter wheat-corn-fallow (W-C-F), winter wheat-corn-corn-fallow (W-C-C-F), and winter wheat-fallow (W-F).

^b Numbers followed by the same letter within columns are not significantly different at the 0.05 level.

Table 2. Jointed goat grass plants in corn and corn yield in 2005 at North Platte, NE. ^{a, b}

	----- Jointed goatgrass plants -----						Corn grain yield		
	May 24, 2005			October 10, 2005					
	W- C -F	W- C -C-F	W-C- C2 -F	W- C -F	W- C -C-F	W-C- C2 -F	W- C -F	W- C -C-F	W-C- C2 -F
Tillage treatment	----- no./m ² -----			----- no./m ² -----			----- kg/ha -----		
Tillage	0.4	0	0	0	0	0	5615 b	6370 b	5232
Herbicide	13	0	0	0	0	0	6927 a	7025 a	4794
LSD (0.05)	NS	NS	NS	NS	NS	NS	286	513	NS
Wheat Cultivar									
Alliance	3	0	0	0	0	0	6200	4100	5387
Pronghorn	14	0	0	0	0	0	6419	4303	4591
Vista	3	0	0	0	0	0	6193	3751	5061
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Rotation	-- Jointed goatgrass --		---Corn--- grain yield
	May 24	Oct 10	
	-----no/m ² -----		kg/ha
W- C -F	7 a	0	6271 a
W- C -C-F	0 b	0	6697 a
W-C- C2 -F	0 b	0	5013 b
	6.2	NS	428

^a Rotations are winter wheat-corn-fallow (W-**C**-F), first year of corn in winter wheat-corn-corn-fallow (W-**C**-C-F), and second year of corn in winter wheat-corn-corn-fallow (W-C-**C2**-F).

^b Numbers followed by the same letter within columns are not significantly different at the 0.05 level.

Table 3. Jointed goat grass plants in fallow in 2005 at North Platte, NE. ^{a, b}

	----- Jointed goatgrass plants -----								
	May 25, 2005			July 7, 2005			August 7, 2005 (preplant)		
	W-F	W-C-F	W-C-C-F	W-F	W-C-F	W-C-C-F	W-F	W-C-F	W-C-C-F
Tillage treatment	----- no./m ² -----			----- no./m ² -----			----- kg/ha -----		
Tillage	0.07	0	0	0	0	0	0	0	0
Herbicide	0.05	0	0	0	0	0	0	0	0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Wheat Cultivar									
Alliance	0	0	0	0	0	0	0	0	0
Pronghorn	0.13	0	0	0	0	0	0	0	0
Vista	0.05	0	0	0	0	0	0	0	0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Rotation	----- Jointed goatgrass plants -----		
	May 25	July 7	Aug 5
	-----no/m ² -----		
W-F	0.06 a	0	0
W-C-F	0.01 b	0	0
W-C-C-F	0.05 b	0	0
	NS	NS	NS

^a Rotations are winter wheat-fallow (W-F), winter wheat-corn-fallow (W-C-F), and winter wheat-corn-corn-fallow (W-C-C-F).

^b Numbers followed by the same letter within columns are not significantly different at the 0.05 level.

Table 4. Jointed goat grass plants in final wheat and corn phase of rotations in North Platte, NE. ^{a, b}

	----- Jointed goatgrass plants ----- in summer, prior to wheat harvest								
	W-F 2004	W-F 2005	W-C-F 2003	W-C-F 2004	W-C-F 2005	W-C-C-F 2002	W-C-C-F 2003	W-C-C-F 2004	W-C-C-F 2005
Tillage treatment	----- no./m ² -----								
Tillage	0.04	209	0	2 b	0	0	0	0	0.17
Herbicide	1.0	273	0.08	22 a	0.08	0	0.12	0	0
LSD (0.05)	NS	NS	NS	6	NS	NS	NS	NS	NS
Wheat Cultivar	----- no./m ² -----								
Alliance	0.3	183	0.06	10	0	0	0.19	0	0.25
Pronghorn	0	223	0.06	13	0	0	0	0	0
Vista	1.2	316	0	13	0.12	0	0	0	0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

	----- Jointed goatgrass plants ----- in fall, prior to corn harvest						
	W-C-F 2003	W-C-F 2004	W-C-F 2005	W-C-C ² -F 2002	W-C-C ² -F 2003	W-C-C ² -F 2004	W-C-C ² -F 2005
Tillage treatment	----- no./m ² -----						
Tillage	0	0	0	0	0	0	0
Herbicide	0	0	0	0	0	0	0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS
Wheat Cultivar	----- no./m ² -----						
Alliance	0	0	0	0	0	0	0
Pronghorn	0	0	0	0	0	0	0
Vista	0	0	0	0	0	0	0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

^a Rotations are winter wheat-fallow (W-F), winter wheat-corn-fallow (W-C-F), first year of corn in winter wheat-corn-corn-fallow (W-C-C-F), and second year of corn in winter wheat-corn-corn-fallow (W-C-C²-F).

^b Numbers followed by the same letter within columns are not significantly different at the 0.05 level.