Seed Shattering in Jointed Goatgrass (*Aegilops cylindrica*) Populations from Cropped and Non-Cropped Systems

Elena Sánchez-Olguín and Carol Mallory-Smith
Department of Crop and Soil Science

Introduction

Adaptations for seed dispersal are critical to the survival and spread of jointed goatgrass in wheat fields.

Seed shattering in jointed goatgrass can take place at the base of the spike, between spikelets or a combination of the two.

Jointed goatgrass populations from cropped and non-cropped systems are under different selection pressures.

We hypothesize that seed shattering patterns might differ across populations from cropped and non-cropped systems.

Objective: Determine the morphometic variation of seed shattering in jointed goatgrass populations, from non-cropping and cropping systems.

Materials and Methods

Six jointed goatgrass populations were included in the study. Two populations from winter wheat fields, one population from a spring wheat field and two populations from non-cropping areas (Table 1).

Table 1. Location and cropping history of jointed goatgrass populations

Population	History	System	Location	Elevation (m)
GS	Spring wheat	Cropped	Bickleton, WA	325
BW	Winter wheat	Cropped	Bickleton, WA	920
FW	Winter wheat	Cropped	Helix, OR	535
ID	Winter wheat	Cropped	ID	N/A
PF	Roadside ÷ feed lot, pasture	Non-Cropped	Umatilla, OR	111
AZ	Roadside, entrance to Tonto Natural Bridge State Park	Non-Cropped	Payson, AZ	1481

Forty-eight spikelets from each population were vernalized at 7°C for 8 weeks. After vernalization, 36 plantlets/population were transplanted to pots in the greenhouse. The treatment were replicated 3 times.

Three spikes per plant were analyzed (Figure 1). For each spike, 3 variables were evaluated: 1) Percentage of seed shattering (evaluated twice a week after anthesis), 2) Number of segments into which a spike disarticulated, and 3) Moisture content of spikelets. Seed shattering and moisture content were logit-transformed.

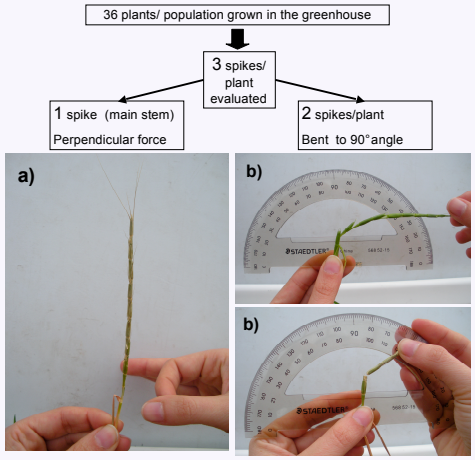

Figure 1. Evaluation of seed shattering: a) perpendicular force (performed on main stem), b) spike bent to 90°angle (two additional spikes).

Results and Discussion

Three different shattering patterns were observed among the jointed goatgrass populations (Figure 2).

Shattering varied significantly among populations (F=5.53 *P*<0.001).

Seed shattering was observed only between spikelets in 60% to 90% of plants within each jointed goatgrass populations (Figure 3).

Spikes of the BW populations were more likely to break at the base and remain intact compared to the other five populations (χ^2 = 240.9638, *P-value* <0.001) (Figure 3).

The percentage of plants with shattering at the base of the spike and in between spikelets was higher in the non-cropped populations and ID than in the BW, FW and GS (Figure 3).

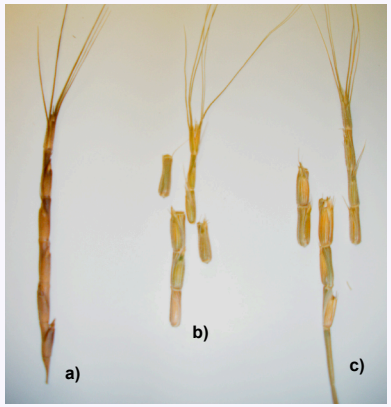

Figure 2. Shattering patterns a) shattering at the base (spikes remain intact), b) shattering at the base of spike and between spikelets, c) shattering only between spikelets (some spikelets remain attach to the culm at the end of the study).

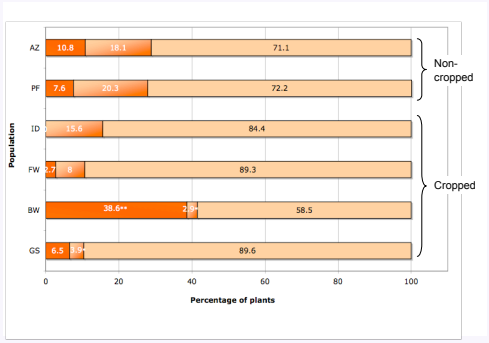

Figure 3. Percentage of plants having each shattering patterns by population.
spikes remain intact,
shattering takes place at the base of spike and between spikelets,
shattering takes place only between spikelets.

The number of segments spikes disarticulated was associated with shattering percentage (F=31.45, *P-value*<0.001).

Most jointed goatgrass spikes disarticulated in one or two segments.

Spikes from BW, more frequently disarticulated into fewer segments than the other 5 populations (χ^2 = 38.9337, *P-value* <0.001) (Figure 4).

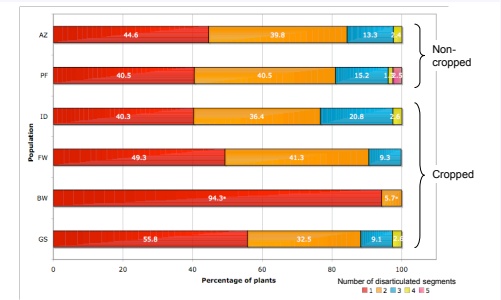

Figure 4 Percentage of plants according to the number of segments in which its spike disarticulated.

No correlation was found between moisture content and percentage of seed shattering (F=1.49, *P-value*=0.120). Once the moisture content in a spikelet dropped to 36.5%, it would separate from the spike when either force was applied (Figure 5).

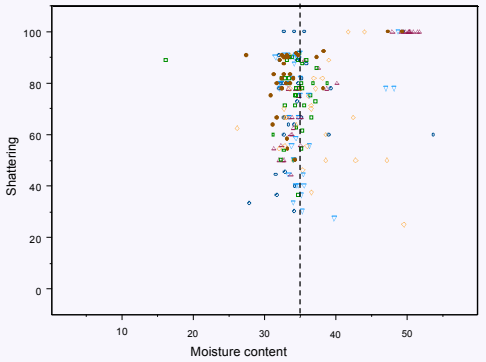

Figure 5. Relationship between the moisture content in the spikelets that shattered and percentage of shattering.

Conclusions

Diversity in seed shattering patterns between jointed goatgrass populations may be an advantage in promoting its invasiveness and spread.

The presence of basal seed shattering patterns could favor *in situ* seed dispersal if spikes mature before harvest, otherwise it would disperse with wheat seed. The BW population had a high frequency of plants with this pattern.

In most of jointed goatgrass populations, shattering only took place in between spikelets with some spikelets remaining attached to the culm. This mechanism could increase the dispersal of the seeds as some of the progeny would remain in the field and some would be harvested with the wheat.

The lower proportion of plants having both shattering mechanisms in the cropped populations might suggests that this shattering pattern is less advantageous in wheat production systems.