Perennial Grass Weed Management in Cotton

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Highlights

Windmill grass herbicide efficacy

- Repeat applications of glyphosate (Roundup PowerMax 3) at high rates with AMS (2% v/v) alone or with s-metolachlor (Dual Magnum) was the most consistently effective herbicide option.
- Glyphosate efficacy on these grasses was reduced whenever dicamba was included in the mix.

Glyphosate-Resistant Johnsongrass

- A Runnels County Johnsongrass biotype propagated from seed was >10 times less sensitive to glyphosate than susceptible Johnsongrass.
- Suspected-resistant biotypes from Concho, Runnels and Jones Counties exhibited ~67–75% less injury compared to susceptible (Tom Green) 14 days after glyphosate application
- Despite initial visual injury of treated tissues, resistant populations showed substantial and rapid resprouting from rhizomes.
- ALS inhibitors imazapic, nicosulfuron, and sulfosulfuron provided the greatest control of glyphosate-resistant Johnsongrass under field conditions, although great potential exists for ALS resistance to also develop (which already occurs in Texas).
- Spring application (better growing conditions) was more effective than summer.

Windmill grass management

A herbicide efficacy trial was initiated in a grower's field in northern Runnels County. The dominant species at this site (and most problematic across the region) is windmillgrass (*Chloris* spp.). Treatments compared time of year (spring, summer, and fall) with different herbicide treatments. All treatments consisted of two consecutive applications (~2-3 weeks apart), and comprise high rates of glyphosate and clethodim, with and without dicamba, and with and without s-metolachlor in the second shot for residual control of new seedlings. Bunchgrass diameter, tiller count, and maturity were documented at the time of application, and photos and damage ratings were collected.

Figure 1 summarizes efficacy from a combined analysis of the spring and summer applications, reinforcing previous observations of tank-mix antagonism with dicamba and glyphosate (but not with dicamba and clethodim) in the spring timing.

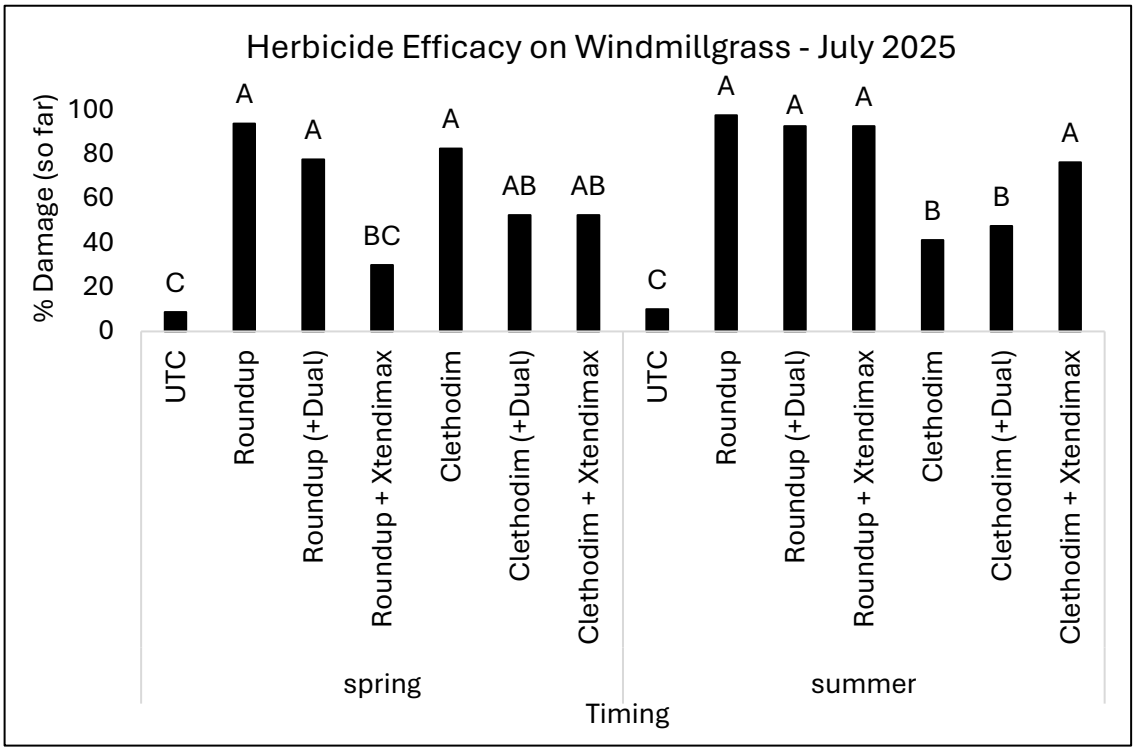

Figure 1. Percent damage of herbicides across spring and summer timings.

Glyphosate-resistant Johnsongrass management

Similar to the windmillgrass trial, time of application (spring, summer, or fall) was considered as a factor with several different herbicides in both glyphosate-resistant and glyphosate-susceptible populations of Johnsongrass in the field.

All three timings were successfully coordinated, although an over-spray incident occurred on our summer timing at the susceptible site, and the site was ultimately plowed up and lost, so our fall timing was moved to a new susceptible site which will be maintained through the winter for spring green-up ratings.

Clethodim appeared effective in the weeks following spring application, but ultimately ~50% regrowth occurred across treated plants. The most effective herbicides tested to-date are Group 2 (ALS inhibitor) herbicides including sulfosulfuron (Outrider), nicosulfuron (Zest), and imazapic (Plateau), particularly applied in the spring (Figure 2).

There are two major challenges with these herbicide options:

1) Most of these products are not easily compatible with cotton rotations in West Texas, so rimsulfuron was added in the fall applications as a more cotton-friendly option, and
2) ALS-resistant Johnsongrass already exists in Texas, so stewardship is essential and growers still may be able to rely on these products only for a limited time.

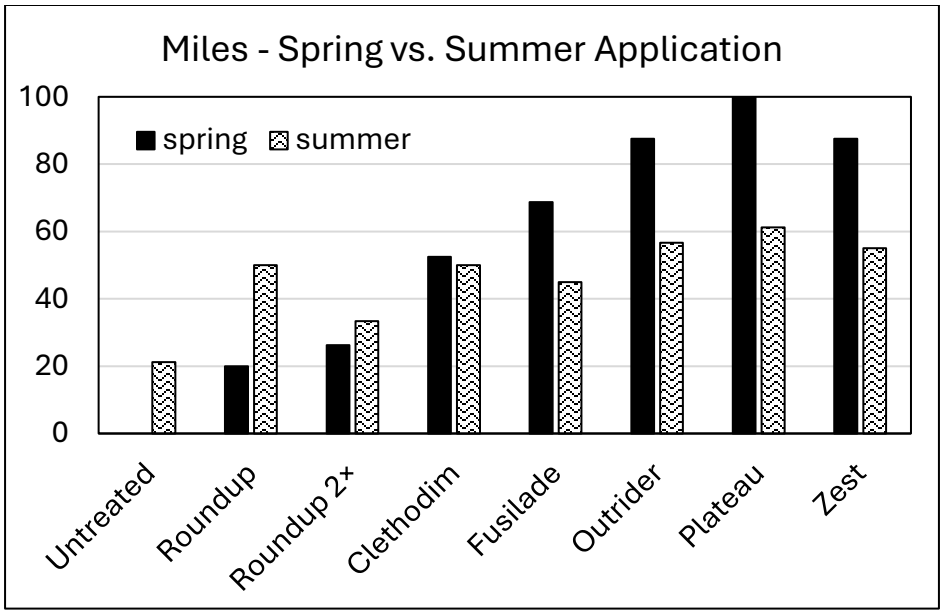

Figure 2. Efficacy of spring- and summer-applied herbicides in glyphosate-resistant Johnsongrass in Runnels County.

Geographic Distribution / Biotype Screening

In addition to field herbicide efficacy trials, greenhouse trials were coordinated with suspected glyphosate-resistant Johnsongrass. A dose-response trial was coordinated with seedling Johnsongrass from the Runnels County population compared to a known susceptible population. Eight doses were applied per biotype with 12 replications. Final ratings and biomass clippings have been coordinated from this trial. The 14 DAA results (Figure 3) indicate a clear reduction (>10 times) in glyphosate sensitivity in the resistant biotype.

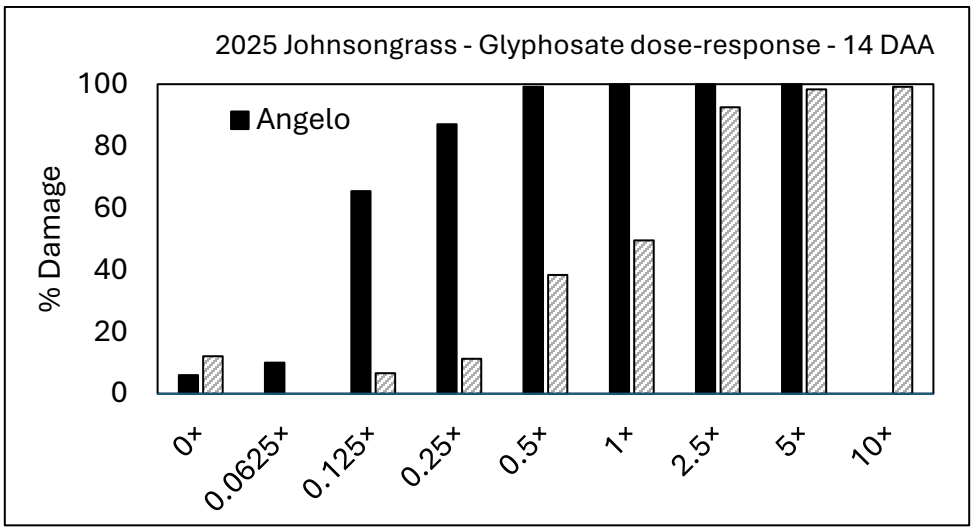

Figure 3. Percent damage of susceptible vs suspected resistant Johnsongrass seedlings at 14 DAA.

- Rhizomes of suspected glyphosate-resistant and susceptible populations were collected from Concho, Runnels, Jones, and Tom Green counties in Texas (Photo 1).
- Rhizomes were planted and grown in a temperature-controlled greenhouse.
- Plants were arranged in factorial arrangement with 3-4 replications and were irrigated at regular intervals to avoid water stress.
- Glyphosate doses were applied at 0.5×, 1.0×, 2.5×, 5×, 10× and 20× of the base rate of 1345 g a.e. ha^{-1} (32 oz/ac) and an untreated control treatment was maintained.
- Percent injury and regrowth were recorded 14 days after glyphosate application (14 DAA).

Photo 1: Geographic distribution of suspected resistant and susceptible johnsongrass biotypes (left), surveying West Texas cotton fields and collecting johnsongrass rhizomes with suspected resistance (middle) and abundant rhizome density (right).

Percent injury and regrowth (14 DAA)

- Resistant populations (Concho, Runnels and Jones) exhibited ~67–75% less overall injury compared to susceptible (Tom Green) at 14 DAA (Figure 6, Photo 2).

- Although treated tissues of resistant populations initially showed high visual injury, these populations exhibited rapid and substantial resprouting from rhizomes (Figure 4, Photo 2).

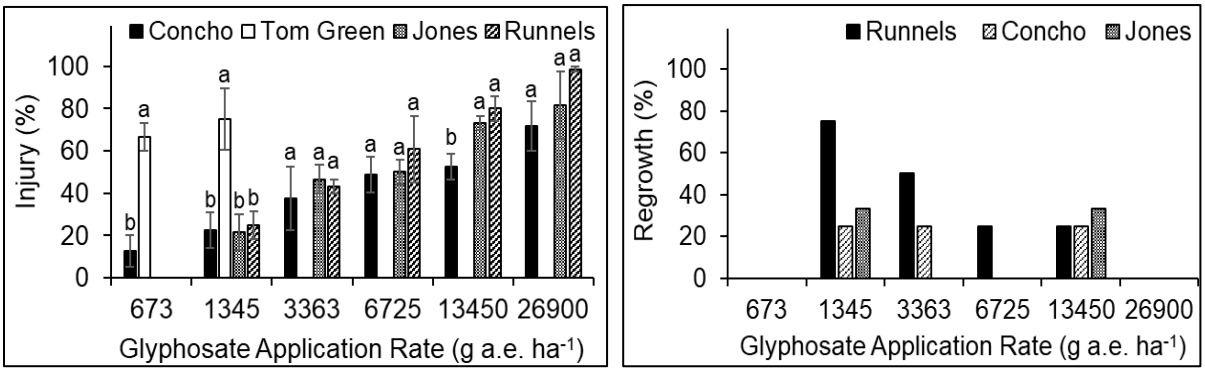

Figure 4. Percent injury (left) presented by means (± SE) and percent regrowth (right) 14 DAA among resistant and susceptible populations. Within glyphosate rates, letters indicate statistical differences in injury among populations (α = 0.05).

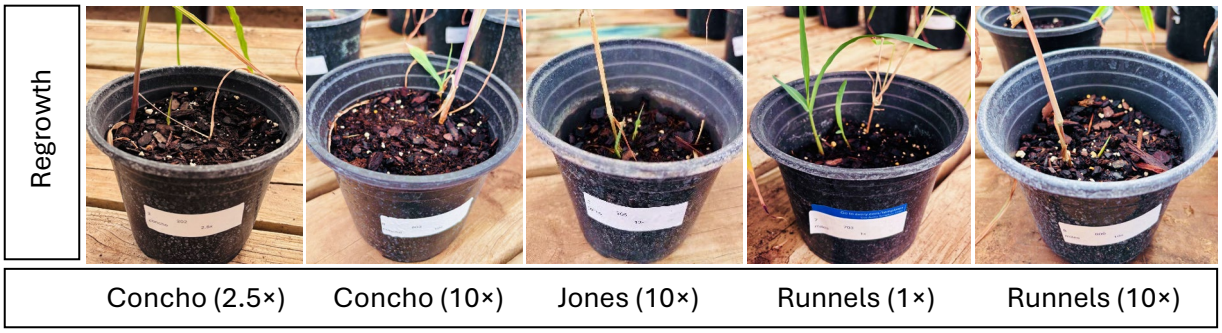

Photo 2. Visual comparison of regrowth at 14 DAA among tested populations at different glyphosate application rates.

Dose response analyses

Population-specific dose-responses showed reduced sensitivity in resistant johnsongrass populations compared to susceptible (Figure 5).

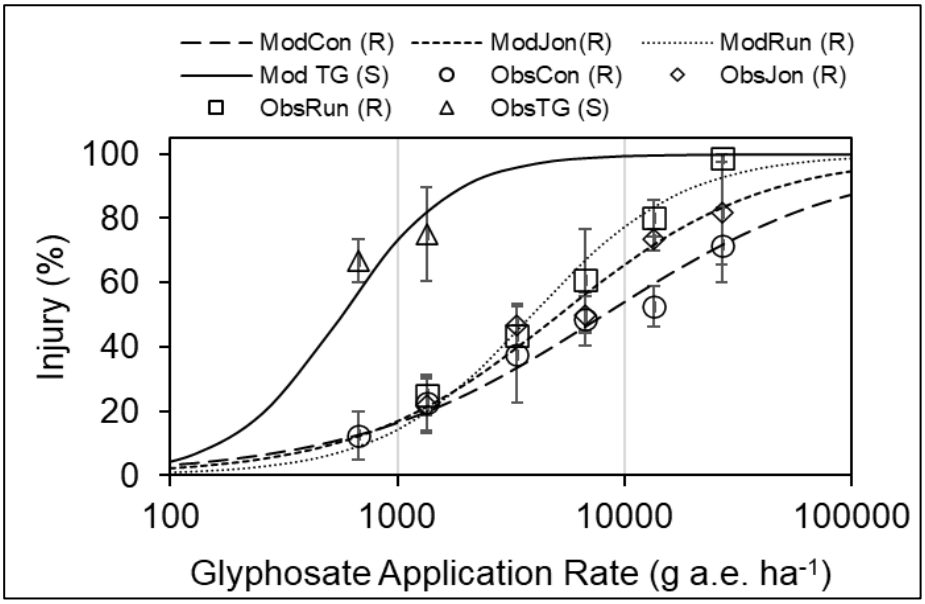

Figure 5. Observed (Obs) means (± SE) *vs* modeled (Mod) dose-response curves showing predicted control of resistant *vs* susceptible populations. Con: Concho, TG: Tom Green, Jon: Jones, Run: Runnels, R: Resistant, S: Susceptible.

Predicted relative resistance

- Projected ED50 and ED90 of resistant populations were substantially higher compared to susceptible population indicating drastically reduced sensitivity to glyphosate among all three suspected resistant biotypes (Figure 6).
- The Concho biotype indicated the highest relative resistance at ED50 (RR50 = 14) and ED90 (RR90 = 28).
- The Runnels population exhibited lower resistance ratios at ED50 (RR50 = 7) and ED90 (RR90 = 8) but had the highest regrowth potential.
- The Jones population exhibited intermediate resistance ratios with RR50 and RR90 values of 9 and 14, respectively and moderate regrowth potential.
- Based on relative resistance and regrowth potential, the Concho, Runnels and Jones biotypes were categorized as high, moderate and moderate-high resistant populations, respectively.

Table 1. Relative resistance (RR50, RR90) vs predicted resistance of tested populations.

Population	RR 50	RR 90	Regrowth	Predicted Resistance
Tom Green (S)	–	–	–	Susceptible
Concho (R)	14	28	Moderate	High
Runnels (R)	7	8	High	Moderate
Jones (R)	9	14	Moderate	Moderate-High

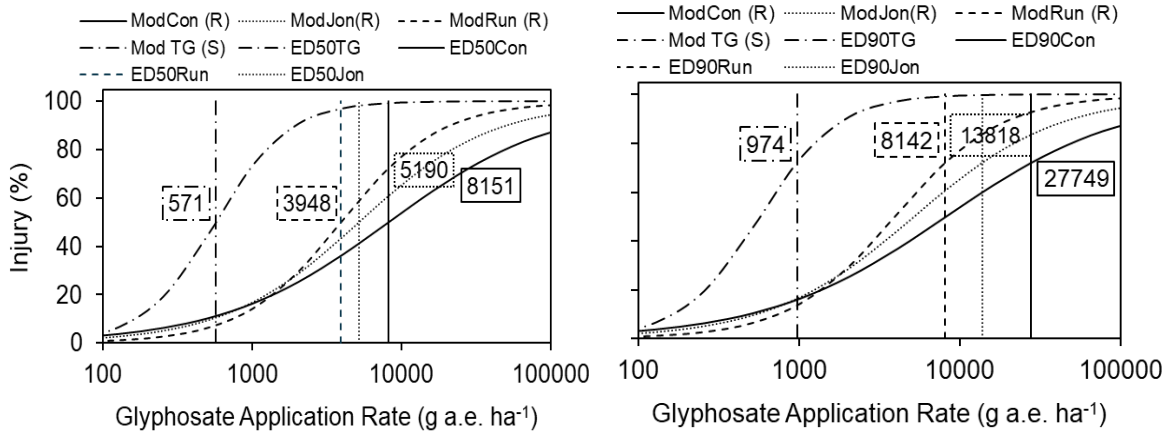

Figure 6. Modeled (mod) dose-response curves for resistant and susceptible populations and estimated doses required for 50% (left) and 90% injury (right). Con: Concho, TG: Tom Green, Jon: Jones, Run: Runnels, R: Resistant, S: Susceptible.