Occurrence of Glyphosate-Resistant Junglerice in Louisiana

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Introduction

Sugarcane (*Saccharum* spp. hybrids) is a major agricultural crop in Louisiana and was grown on 216,912 hectares in 2024. In sugarcane production, there is no option to use herbicide-resistant varieties, hence weed control is accomplished in both the fallow period and in-crop with tillage and herbicides combined with competition by shading from the crop. The fallow period is a critical time to control problematic weeds so that weed competition is minimized during the first production year in the plant cane crop. Typical weed control strategies in the fallow period include multiple tillage operations and multiple applications of glyphosate alone or in combination with other herbicides. Another strategy used by some producers is planting herbicide-resistant soybean [*Glycine max* (L.) Merr.] in fallowed sugarcane fields. Recently, populations of junglerice [*Echinochloa colona* (L.) Link] in fallow sugarcane fields were poorly controlled with glyphosate.

Hypothesis

Herbicide-resistant weeds pose a serious threat to agricultural production worldwide. Junglerice is among the top 15 weed species resistant to the greatest number of herbicide sites of action. We hypothesize that glyphosate-resistant (GR) junglerice has evolved in fallow sugarcane fields in Louisiana.

Materials and Methods

Dose-response assays were conducted in 2024 to compare the putative GR junglerice population (LA-2) to a known susceptible population (GS) (Figure 1A, B, C, Table 1). The experimental design was a randomized complete block with ten replications. Glyphosate doses included 0, 0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 10, and 12 times the field-use rate (840 g ae ha^{-1}). Plants were treated at the 2-tiller growth stage in a spray chamber calibrated to deliver 187 L ha^{-1}. Percent visual control (0-100%) ratings were conducted at 7, 14, and 21 days after treatment (DAT). Dry weights were recorded 21 DAT. Data were subjected to ANOVA in SAS and log-logistic regression in *R*.

Experiments to determine the potential mechanism of resistance in the LA-2 population were also conducted. RNA was extracted from the progeny of a junglerice plant that survived glyphosate treatment. A section of the 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) containing the Pro-106 site was cloned sixteen times and sequenced. Since no junglerice EPSPS sequences were present in GenBank, the sequences were aligned with glyphosate-susceptible Italian ryegrass [*Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot] EPSPS (Figure 2).

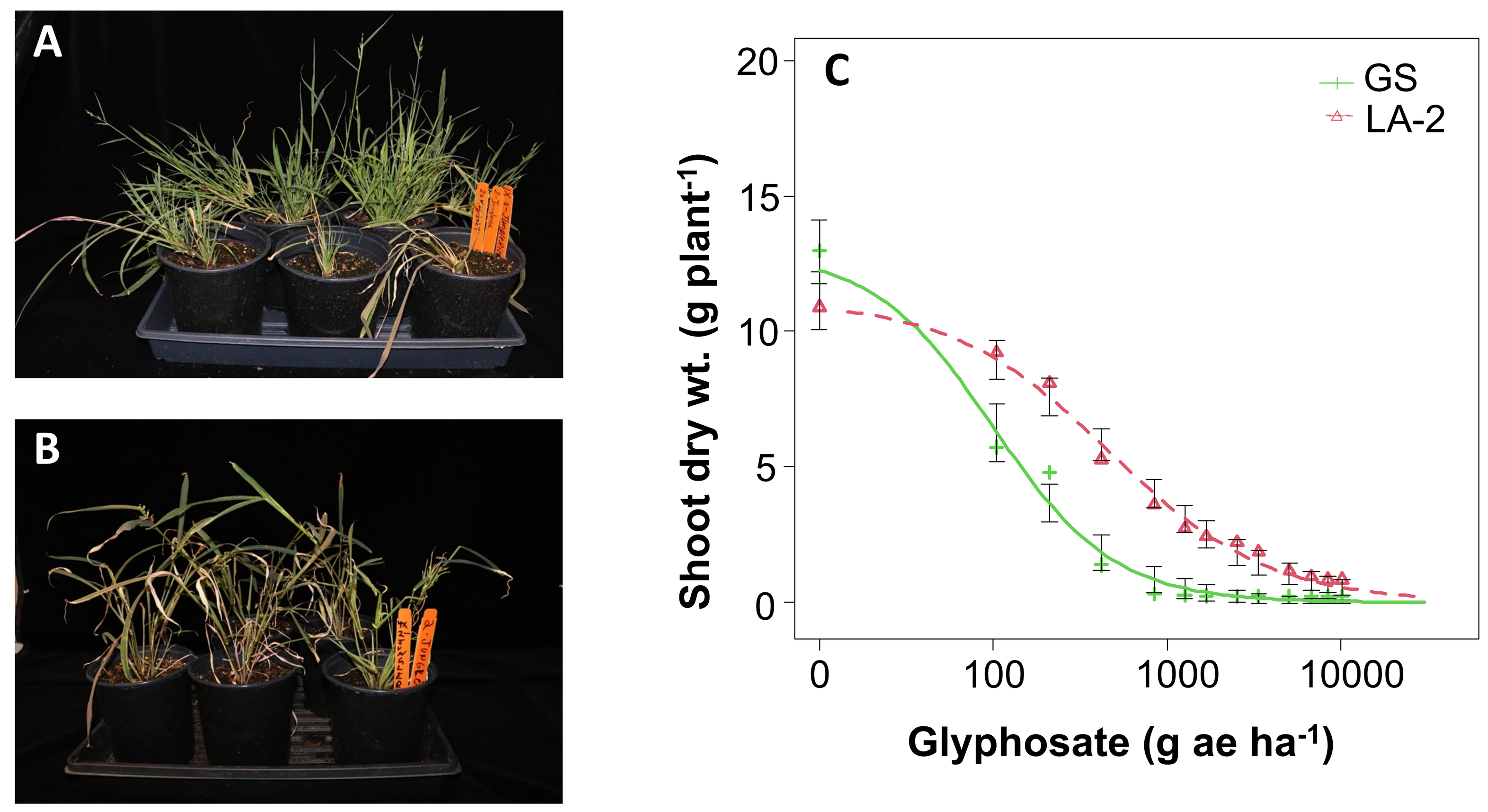

Figure 1A, B. Putative GR junglerice population (LA-2) surviving 1 and 4 times the field-use rate of glyphosate 21 DAT. **C.** Shoot dry weight of putative GR (LA-2) and susceptible (GS) junglerice with increasing glyphosate rates. Data averaged across two experiments.

Parameter Estimates (± SE)						
Population	**d**	**b**	**GR_{50}**	**95% CI**	**GR_{90}**	**R/S**
LA-2	11.1 (0.5)	0.9 (0.1)	462	312-612	4,632	4.6
GS	12.9 (0.6)	1.2 (0.2)	99	69-130	577	-

Table 1. Regression parameter estimates of putative GR (LA-2) vs. susceptible (GS) junglerice 21 DAT with increasing glyphosate rates. Data averaged across two experiments.

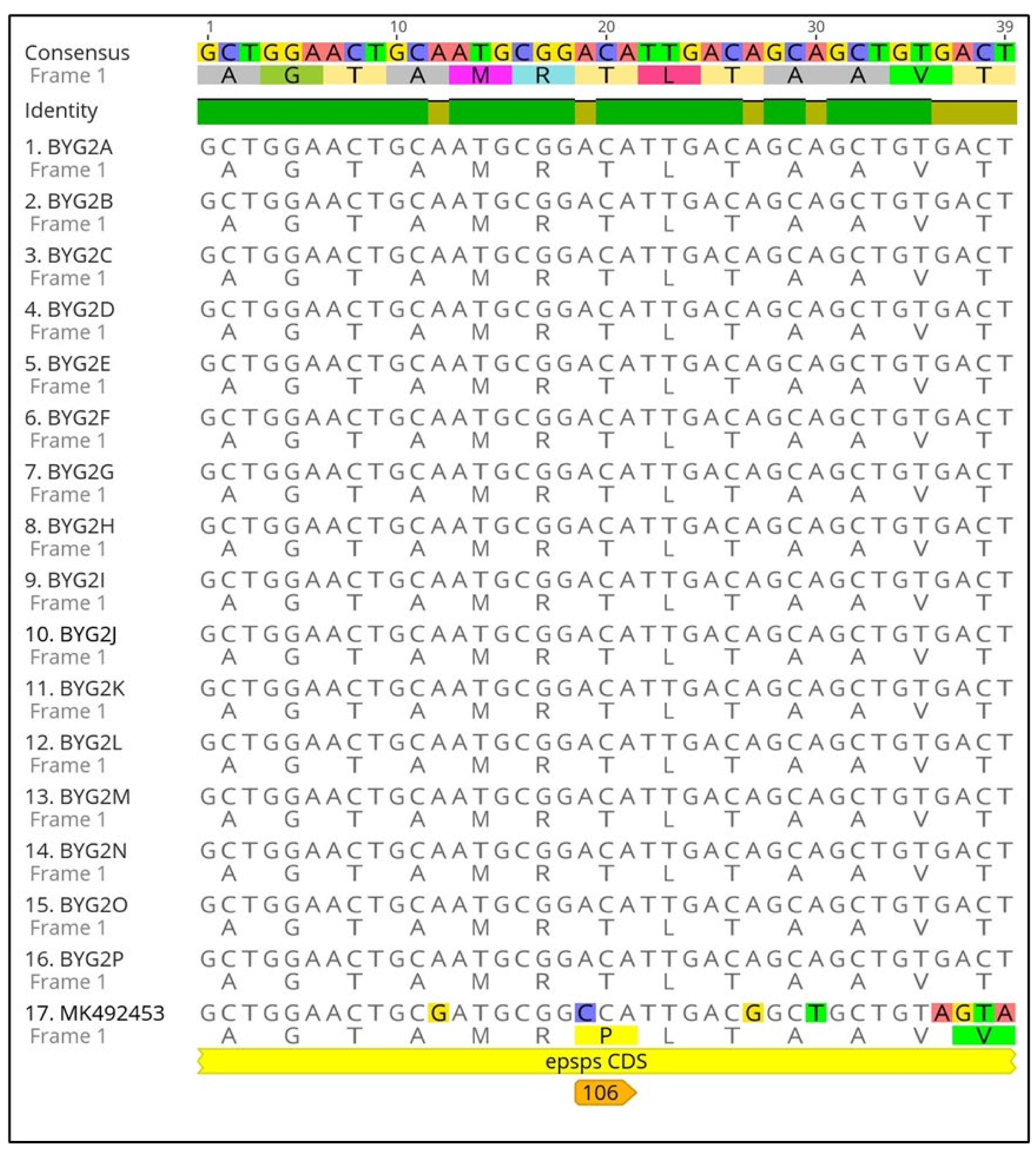

Figure 2. Alignment of 16 EPSPS clones for junglerice with the Italian ryegrass EPSPS sequence as a reference.

Results

Results from dose-response assays and EPSPS sequencing confirm that GR junglerice has evolved in fallow sugarcane fields in Louisiana.

The LA-2 junglerice population survived up to 6 times the field-use rate of glyphosate (840 g ae ha^{-1}). The GR_{50} of the LA-2 population was 4.6 times greater than the GS population (Figure 1B, Table 1). Sequence data showed a Pro-106-Thr EPSPS target-site mutation in the LA-2 population (Figure 2), which has been documented in GR junglerice. Quizalofop-P-ethyl, clethodim, glufosinate, and paraquat at field-use rates were effective in controlling the LA-2 population (data not shown).

Results provide insight into how junglerice evolved resistance to glyphosate in Louisiana and which herbicides still provide acceptable control.

Acknowledgements

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