Evaluating the effect of glyphosate dose and temperature on glyphosate-resistant *Echinochloa colona*

Drew Wolter, Sarah Morran, Bradley Hanson
Department of Plant Science, University of California, Davis

Introduction

- *Echinochloa colona* (junglerice) is a summer annual grass that has been ranked among the world's top ten worst.
- Currently, herbicide-resistant weeds are one of the most crucial and rapidly changing weed management issue facing California orchard and vineyard cropping systems.
- Previous research identified several different target site mutations causing ~4x level of resistance.
- Non-target-site mechanisms also provide resistance to glyphosate in other species suggesting that growth response to environmental stochasticity may vary among glyphosate resistance (GR) biotypes.
- Summer-annual weeds differ from winter species with respect to growth and phenology and are also subject to dissimilar climate conditions.

Objectives

- This research focused on the interaction of glyphosate dose and temperature on the response of seven known GR and GS junglerice populations from California's orchards and vineyards.
- Assess shikimic acid biosynthesis as a response to temperature and glyphosate dosage in the different junglerice populations.
- The overarching goal of this project is to help growers develop and implement a dynamic weed management plan to retain control of GR species.

References

Moretti, M. et al. In proceedings of the Western Society of Weed Sciences; WSWS: San Diego, 2013 pg. 24

Methods

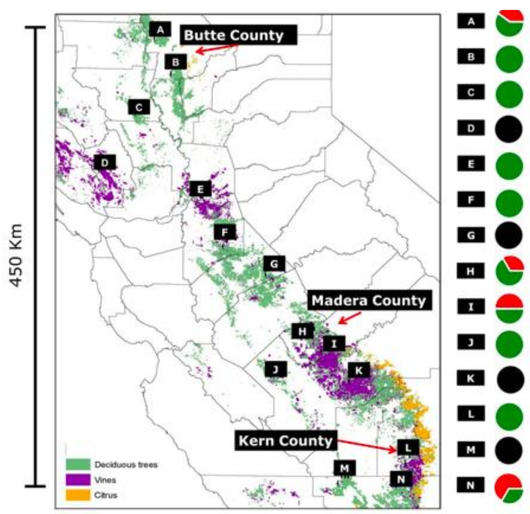

Figure 1. Pie charts indicate proportion of GR (**RED**) and GS (**GREEN**) with in population. No Data was collected for solid **BLACK** populations.
(Image courtesy of Moretti, M et al.)

- Sampling. Plants were derived from populations sampled from California's central valley, ranging from Butte to Kern country (Fig 1).
- Treatments. Plants were treated at the three to four leaf stage with a range of glyphosate doses (0, 0.5, 1x) and transferred to controlled environment chambers set at 20°C, 30°C, or 40°C with metal halide lighting. Each biotype *by* glyphosate dose *by* temperature treatment combination was replicated five times.
- Mortality and Growth Reduction. Aboveground plant biomass was harvested, dried and weighed and mortality recorded 21 days after treatment.
- Shikimic Acid Evaluation. Shikimic acid accumulation was measured in plant tissues at 6, 24, 48 and 72 hours after treatment to determine relative inhibition of the target enzyme by glyphosate.

Results (Shikimic Acid)

- Shikimic acid accumulation was used to assess the effect of glyphosate on its target site in the plant
- Results show lower accumulation of shikimic acid in GR than GS lines at different rates.

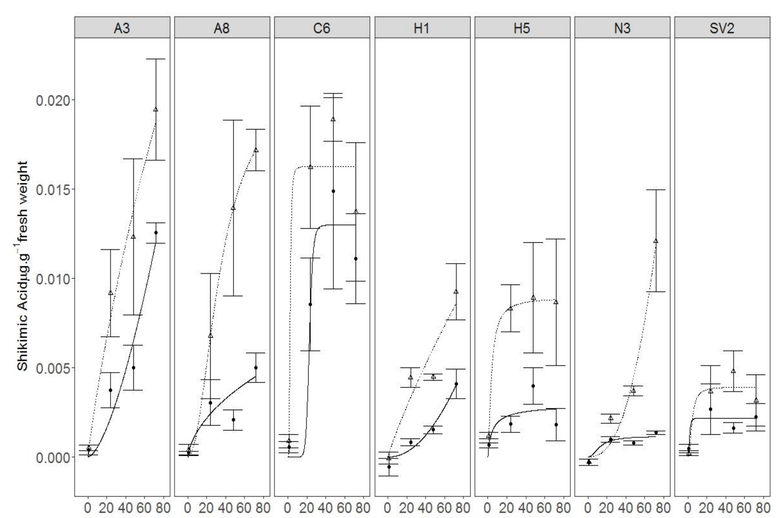

Fig 2. Shikimic acid accumulation in GR (H1,H5,N3,SV2), GS (A3,C6) and an intermediate (A8) grown in 30°C. Solid black line: 0.5X (435 g.a.e ha^{-1}) Dash line: 1.0x (870 g.a.e ha^{-1})

Results (Dose Response)

- None of the glyphosate-treated susceptible junglerice lines survived at any of the temperature regimes tested.
- Evaluation of the GR plants showed they were stunted by glyphosate treatment in the cooler environments whereas at higher temperatures and doses little or no stunting was observed.
- These results are consistent with the lower accumulation of shikimic acid in GR than GS lines seen in these plants.

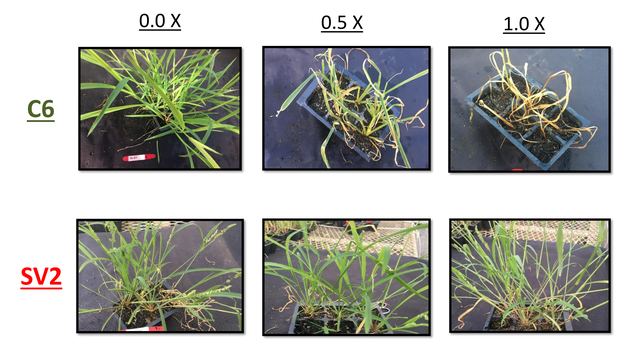

Fig 3. Dose response for C6 (glyphosate susceptible) and SV2 (glyphosate resistant) populations at 30°C.

Conclusions

- These results suggest temperature can influence glyphosate activity on GR junglerice, which may help explain the variability occasionally observed in the field.
- Ideal temperatures for applying post herbicides are between 20°C and 30°C. This work suggests the rate of control will be slower during cold weather.
- Higher rates can be used to overcome this reduced control if cold temperatures occur a few days before or if forecasted after application.

Acknowledgements

I would like to thank the WSSA for undergrad research funding, Dr. Hanson for allowing the opportunity to conduct the research and Sarah Morran for all the mentorship.