Methods for Confirming Resistance to Different Herbicide Modes of Action: Does One Size Fit All?

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INTRODUCTION

- The selectivity index (SI) is a measure of herbicide resistance (Burgos et al. 2013)
- SI= GR50 Resistant/GR50 Susceptible (R:S ratio)
- The SI is used across species and herbicide modes of action
  - Mechanisms of resistance and herbicide symptomology differ
- Environmental and experimental factors can influence the SI
  - Sterile vs. non-sterile soil using *Chenopodium album* (common lambsquarters) (Schafer et al. 2012)
  - Indoor vs. outdoor using *Kochia scoparia* (kochia) (Godar et al. 2015)

Objectives

- Determine the influence of pot size and response variable on the SI across species and herbicides
- Assess suitability of the SI for quantifying resistance using different herbicide modes of action

MATERIALS AND METHODS

Experiment 1:

- Common lambsquarters biotypes response to atrazine (n=4)
- Two different pot sizes (750 and 1200 cm^3)

Experiment 2 (Repeated):

- Common lambsquarters biotypes response to glyphosate (n=4)
- Five different pot sizes (750, 1200, 1500, 1700, and 3800 cm^3)

Experiment 3:

- Kochia biotypes response to dicamba (n=3)
- Four different pot sizes (750, 1200, 1700, and 3800 cm^3)

- Above ground biomass, injury, and survival were collected for all experiments
- Log-logistic model used to analyze the effect of glyphosate, dicamba, and atrazine on common lambsquarters and kochia (Seefeldt et al. 1995)

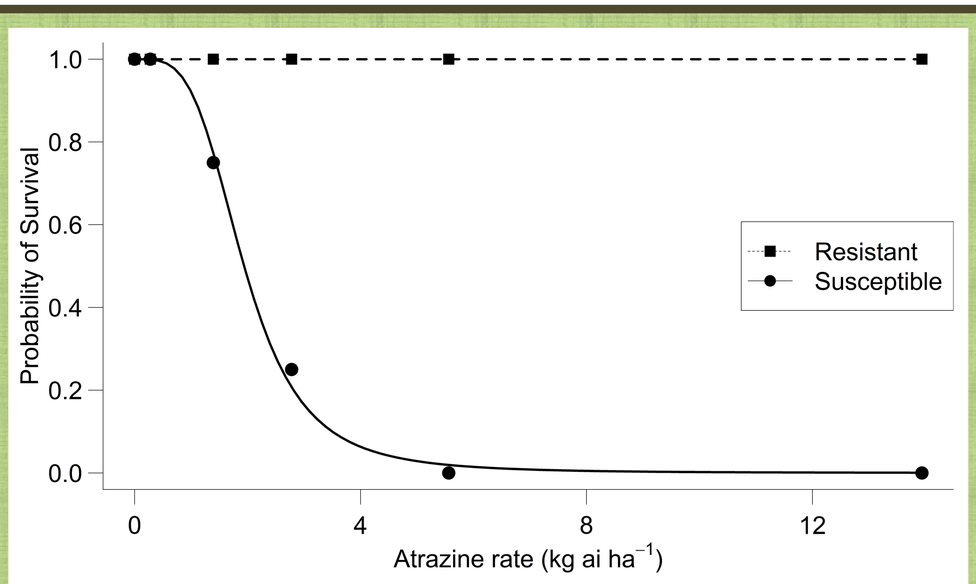

Figure 1. Probability of survival of common lambsquarters treated with atrazine

- The resistant biotype was immune to atrazine
  - No injury, mortality, or biomass reduction of the immune biotype
- Cannot calculate SI from data without a response
- For target site resistance mechanisms, the SI should not be used to quantify resistance

LITERATURE CITED

Burgos, et al. 2013. Weed Science. 61:4-20.
Schafer et al. 2012. Weed Science. 60:641-649.
Godar et al. 2015. Weed Science. 63:587-595.

Table 1. Variability in SI across pot sizes and response variables using dicamba and glyphosate

Pot size cm^3	Herbicide	Selectivity Index (SI)			Std Dev
		Above Ground Biomass	Injury	Survival	
750	dicamba	28	15	12	**8.5**
1200	dicamba	5	20	6	**8.4**
1500	dicamba	2	8	5	**3.0**
3800	dicamba	NA	3	5	**1.4**
Std Dev		**14.2**	**7.5**	**3.4**	
750	glyphosate	0.9	1.0	NA	**0.1**
1200	glyphosate	2.4	3.6	325	**151**
1500	glyphosate	27.3	2.1	2.9	**11.7**
1700	glyphosate	2.2	1.9	1.4	**0.3**
3800	glyphosate	1.9	2.1	2.1	**0.1**
Std Dev		**10.2**	**0.8**	**139**	

- SI was larger and more variable in smaller pots for dicamba (Table 1)
- Above ground biomass was the least consistent response variable across all herbicides and species
- Survival was the most consistent response variable using dicamba

Table 2. Difference in SI between replications of the same experiment using glyphosate and common lambsquarters at the three largest pot sizes

Pot size cm^3	Selectivity Index (SI)			Std Dev
	Above Ground Biomass	Injury	Survival	
1500	26	0.7	1.1	**11.9**
1700	0.4	0.9	1.9	**0.6**
3800	0.2	0.5	0.3	**0.1**
Std Dev	**12.1**	**0.2**	**0.7**	

- Injury was the most stable response variable between replications of the same experiment
  - Highest dose did not result in mortality using smallest pots (750 cm^3) in either experiment
- All response variables were stable at the largest pot size

DISCUSSION AND FUTURE DIRECTION

- Resistance mechanism impacts the usefulness of the SI
- If the SI is to provide useful information, variability due to experimental conditions needs to be addressed
- One size does not fit all for herbicide resistance studies
- Plans to further explore: environmental and methodological factors that influence the SI