# Assessment of the Sustainability of Glyphosate Resistant Cropping Systems – An Alternative Approach

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The Ohio State University

# Outline

# Background

- 2005 – 89% Indiana soybeans planted were Roundup Ready (USDA, 2005)
- 29 cases worldwide of Glyphosate Resistance (GR) (weedscience.org)
  - 8 different weed species

# Background

2002 - GR horseweed found in Indiana

- 28 counties as of 2005

Widespread GR corn adoption due to stack hybrids

# Background

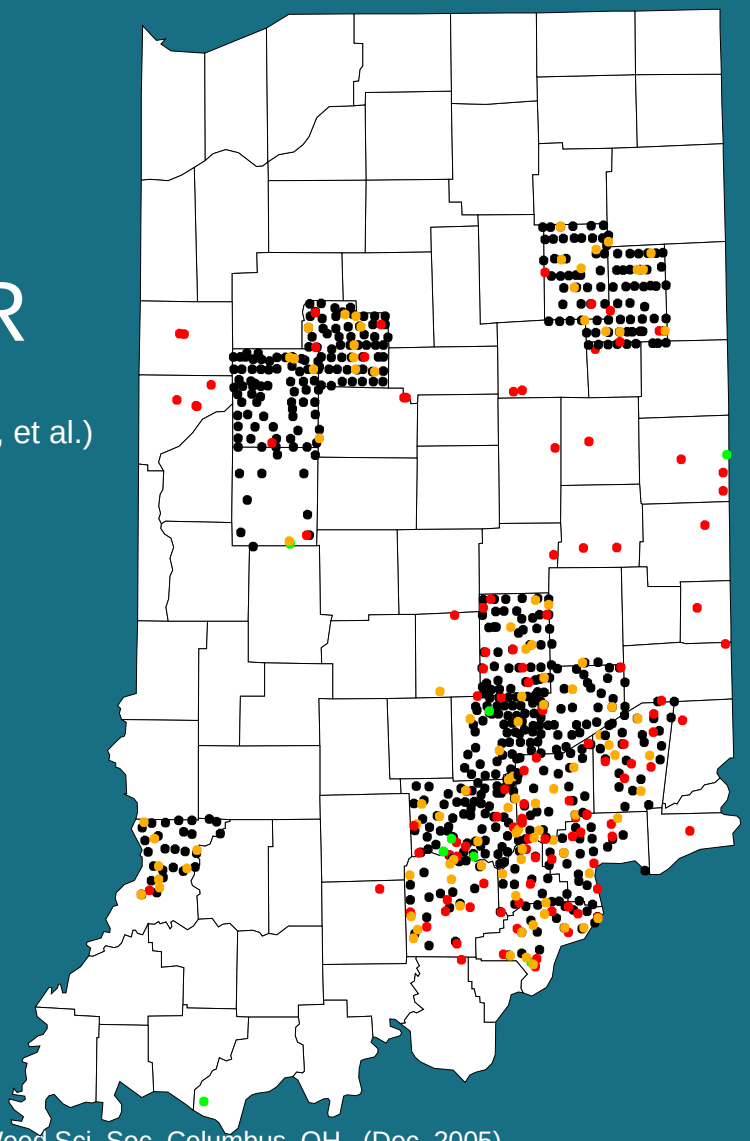
- Concurrent use of glyphosate for weed management in corn will undoubtedly increase likelihood of additional GR weed species.
- Sustainability of GR cropping systems could be at risk if management practices to minimize development and spread of resistance are not implemented.

# Objective

- Determine if the presence of GR horseweed can be used as an indicator species for other weeds with enhanced glyphosate tolerance.

# 2003 GR Horseweed Survey

- 782 sites surveyed for GR horseweed distribution (Davis, et al.)
- Notes taken and entered into database



Davis, Vince M., et al. 2004. North Central Weed Sci. Soc. Abstr. 175. North Central Weed Sci. Soc. Columbus, OH. (Dec. 2005)

# Survey Form

## Purdue Weed Science Marestail Field Survey

Field Number: BAR 31

County: Bartholomew / Brown / Monroe

Survey Date: 9/16/2003

Latitude: 39 14.825

Longitude: 85 46.304

Elevation: 698

Township:

Identifying Landmark: hwy 9 east side and 300N south side

Sample Code: 03-BAR 31-0056

### Site Information

Location Type: cropped field / woods / fallow ground / railroad right-of-way / river or creek bank / roadside / industrial site / municipal area / woods / rural house or shed / neighborhood / other - specify / pasture/hayfield / utility right-of-way

Soil Type:

Topography: gently rolling / hills with some slope / relatively flat / floodplain / valley / very hilly / other - specify

Current Crop: soybean / corn / tobacco / tomatoes / melons / pasture / hay / alfalfa / other vegetable crop / dcrop soybean / winter wheat w/o soybe / not applicable / milo

Field Tillage System: No-till / Mulch tillage / Reduced tillage / Full tillage / Ridge tillage / not applicable / unknown

Crop Growth Stage: R6

Residue Cover: <15% / 15 to 30% / >30% / not applicable / unknown

Crop Rotation: soybean / corn / tobacco / vegetable / alfalfa / small grains / not applicable / unknown / other - specify

Notes: PICTURES

### Marestail Information

Is marestail visible above the crop canopy? No / not applicable / Yes

If the location is not a cropped field, then is marestail present at the location? No / not applicable / Yes

Does the marestail appear to have been injured by herbicides? No / not applicable / Yes

Do you feel that the marestail population is resistant to glyphosate? maybe / No / not applicable / Yes

Marestail Distribution: not applicable / single plant / widely scattered/very low densities / widely scattered/moderate densities / scattered but uniform distribution / high density with uniform distribution / one small patch (<100ft) / multiple small patches / one large patch (>100ft) / multiple large patches

Field Coverage: 0 - 10 % / 10 - 30 % / 30 - 50 % / 50 - 70 % / 70 - 100 % / not applicable

Was a sample of the marestail collected? No / not applicable / To be taken in the future / Yes

Sampling Date: 9/16/2003 (If different than survey date)

# of sampled plants: 40

Sample Location: in the field / field border / non-cropped site / other - specify / not applicable

Marestail Description:

### Other Weed Information

In cropped fields, are other weeds present in the field? No / not applicable / Yes

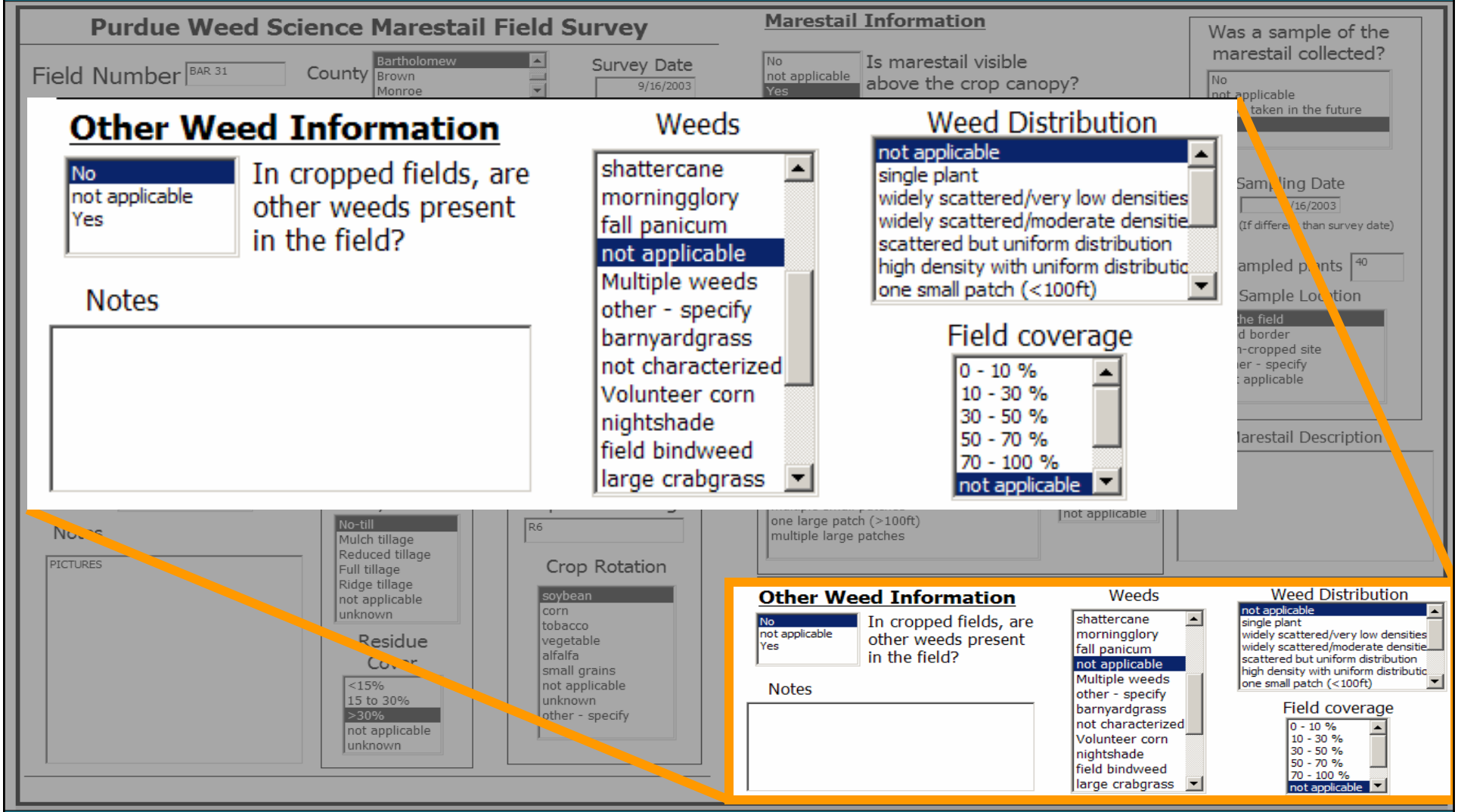
Notes:

Weeds: shattercane / morningglory / fall panicum / not applicable / Multiple weeds / other - specify / barnyardgrass / not characterized / Volunteer corn / nightshade / field bindweed / large crabgrass

Weed Distribution: not applicable / single plant / widely scattered/very low densities / widely scattered/moderate densitie / scattered but uniform distribution / high density with uniform distributic / one small patch (<100ft)

Field coverage: 0 - 10 % / 10 - 30 % / 30 - 50 % / 50 - 70 % / 70 - 100 % / not applicable

# Survey Form


Purdue Weed Science Marestail Field Survey
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BAR 31
County
Bartholomew
Brown
Monroe
Survey Date
9/16/2003
Marestail Information
No
not applicable
Yes
Is marestail visible above the crop canopy?
Was a sample of the marestail collected?
Other Weed Information
No
not applicable
Yes
In cropped fields, are other weeds present in the field?
Notes
Weeds
shattercane
morningglory
fall panicum
not applicable
Multiple weeds
other - specify
barnyardgrass
not characterized
Volunteer corn
nightshade
field bindweed
large crabgrass
Weed Distribution
not applicable
single plant
widely scattered/very low densities
widely scattered/moderate densitie
scattered but uniform distribution
high density with uniform distributic
one small patch (<100ft)
Field coverage
0 - 10 %
10 - 30 %
30 - 50 %
50 - 70 %
70 - 100 %
not applicable
PICTURES
No-till
Mulch tillage
Reduced tillage
Full tillage
Ridge tillage
not applicable
unknown
Residue
<15%
15 to 30%
>30%
not applicable
unknown
R6
Crop Rotation
soybean
corn
tobacco
vegetable
alfalfa
small grains
not applicable
unknown
other - specify
one large patch (>100ft)
multiple large patches
not applicable
Other Weed Information
No
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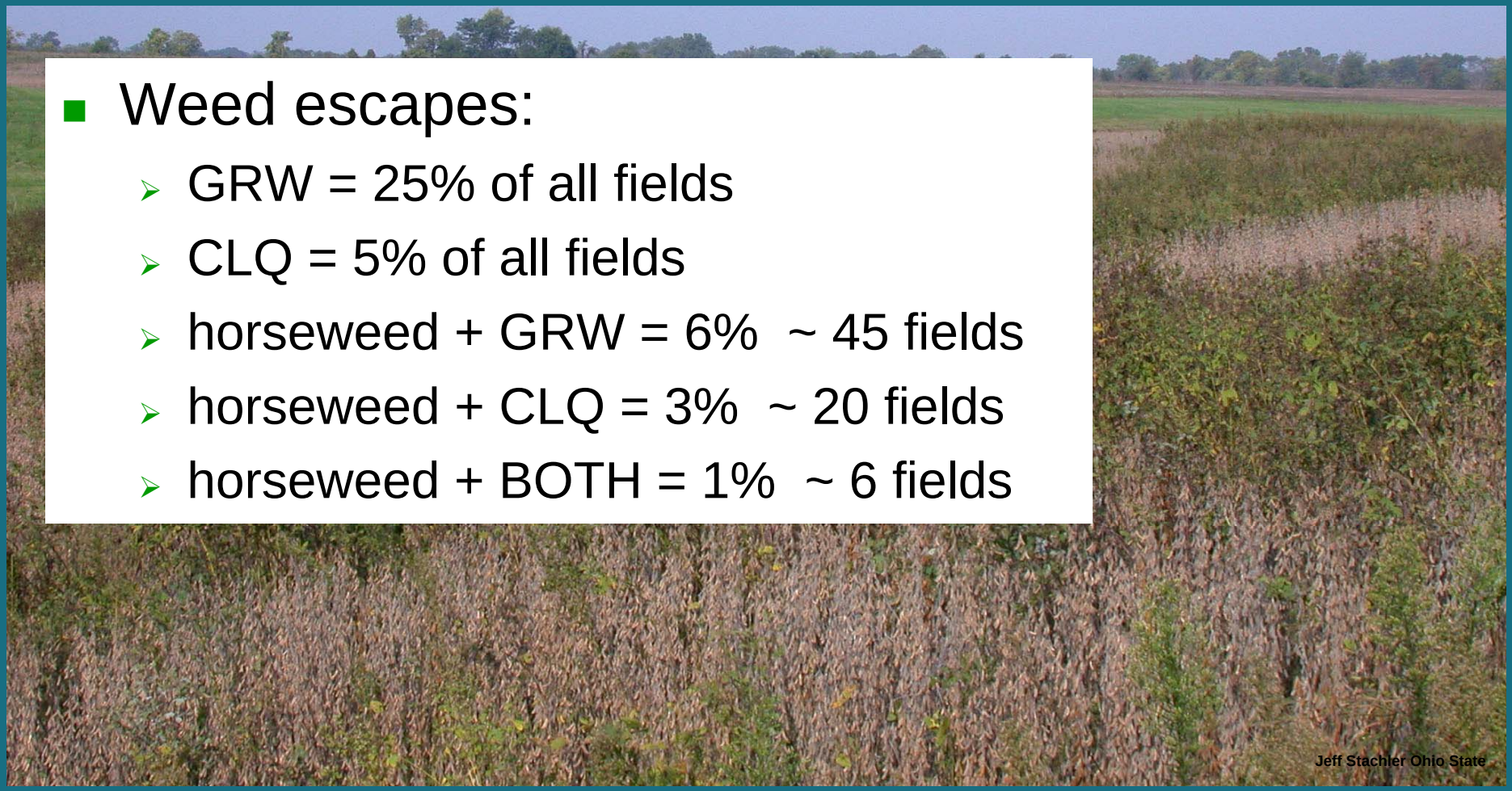
# 2003 Survey




- Weed escapes:
  - GRW = 25% of all fields
  - CLQ = 5% of all fields
  - horseweed + GRW = 6%  ~ 45 fields
  - horseweed + CLQ = 3%  ~ 20 fields
  - horseweed + BOTH = 1%  ~ 6 fields

# GRW and CLQ Herbicide Resistance

- GRW: 6 cases of biotypes resistant to ALS inhibitors (weedscience.org)
  - All within midwest
- CLQ: 41 cases of biotypes resistant to three mode of actions (weedscience.org)
  - 4th on top 10 list of most important herbicide resistant species
- Enhanced glyphosate tolerance in populations in Ohio (Stachler, Loux, Ohio State)

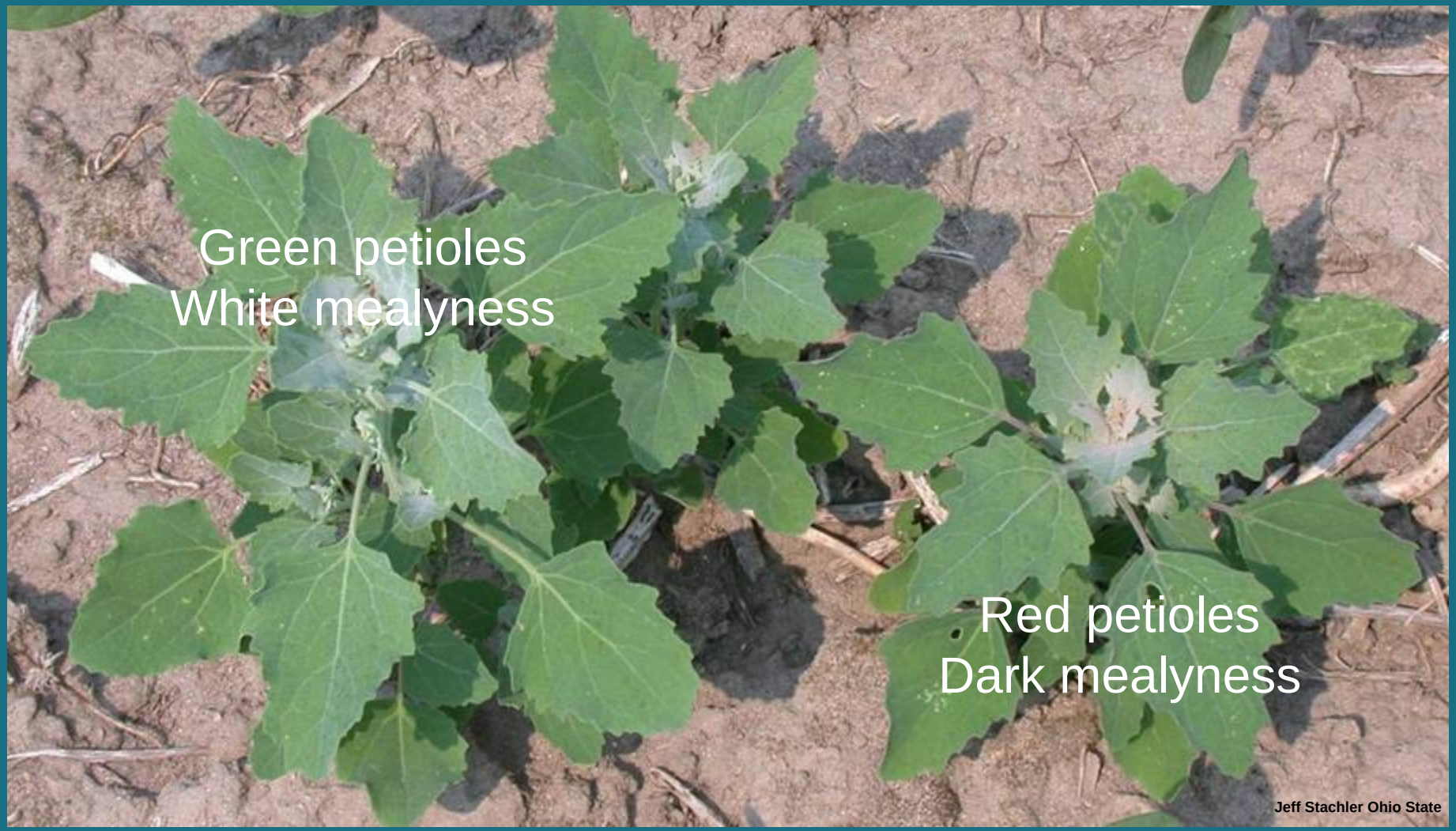
# Procedure

- From database, run queries to determine which fields had weed escapes
  - Specifically giant ragweed (GRW) and common lambsquarters (CLQ)
- Resample 2003 fields
- Collect 10-15 plants individually per field

# Procedure

- Detailed notes taken for each population
  - Field conditions
  - Unusual growth habits
  - Mealyness (Stachler Mealy Index)

# Stachler Mealy Index



# CLQ Methods - Current Research

- Process CLQ samples
- Planting
  - $H_2SO_4$ treatment (Andersen)
  - Use 10” x 10” trays
- Grown in greenhouse
  - 85/65 degrees F air temps
  - 14 hour day length

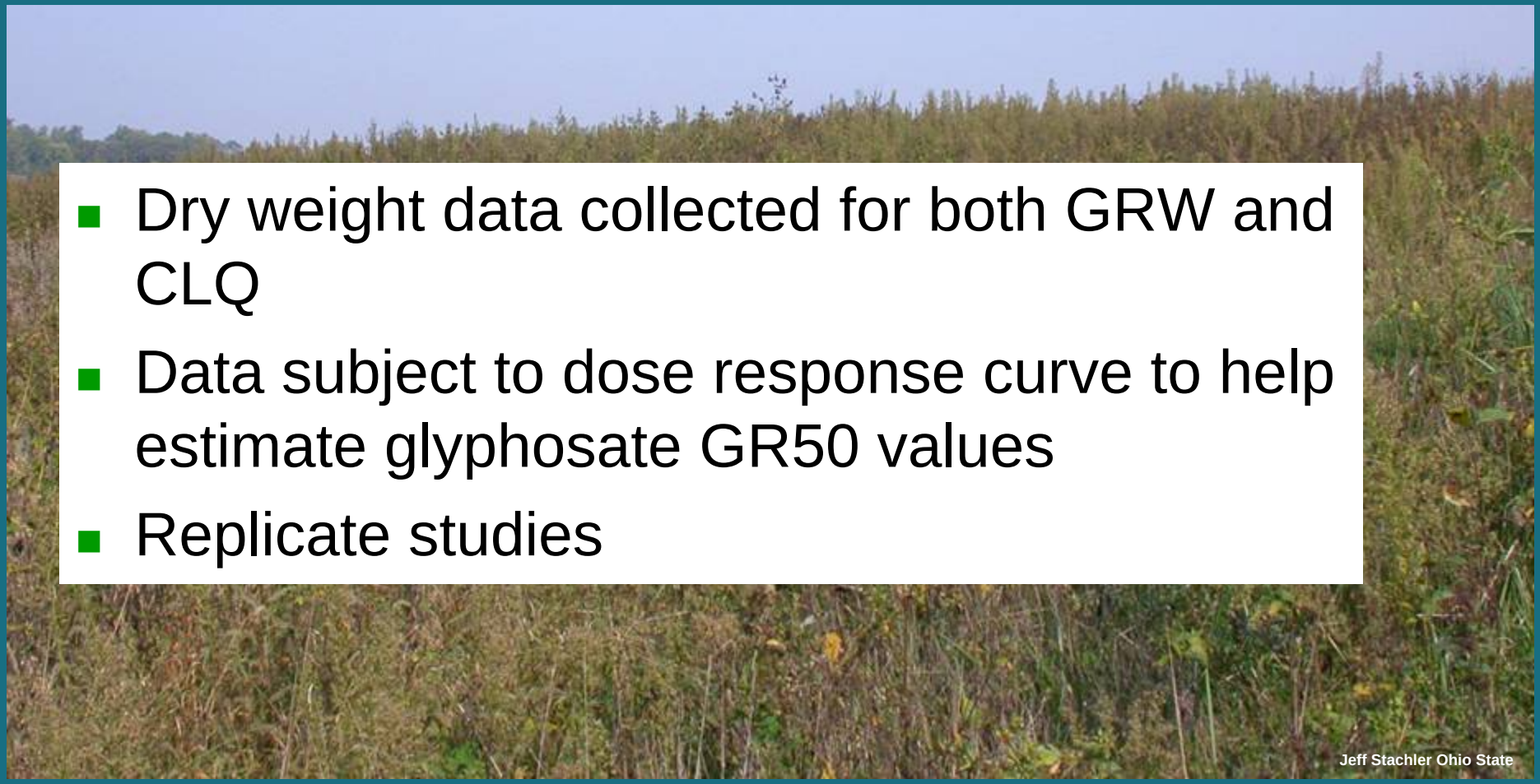
# CLQ Methods - Current/Future Research

- Thinning
- Plants allowed to grow to 7-8 nodes
- Spray with 2X rate of glyphosate (1.5 lb ae/A)
- Visual ratings 21 DAT
- Dose response

# GRW Methods - Future Research

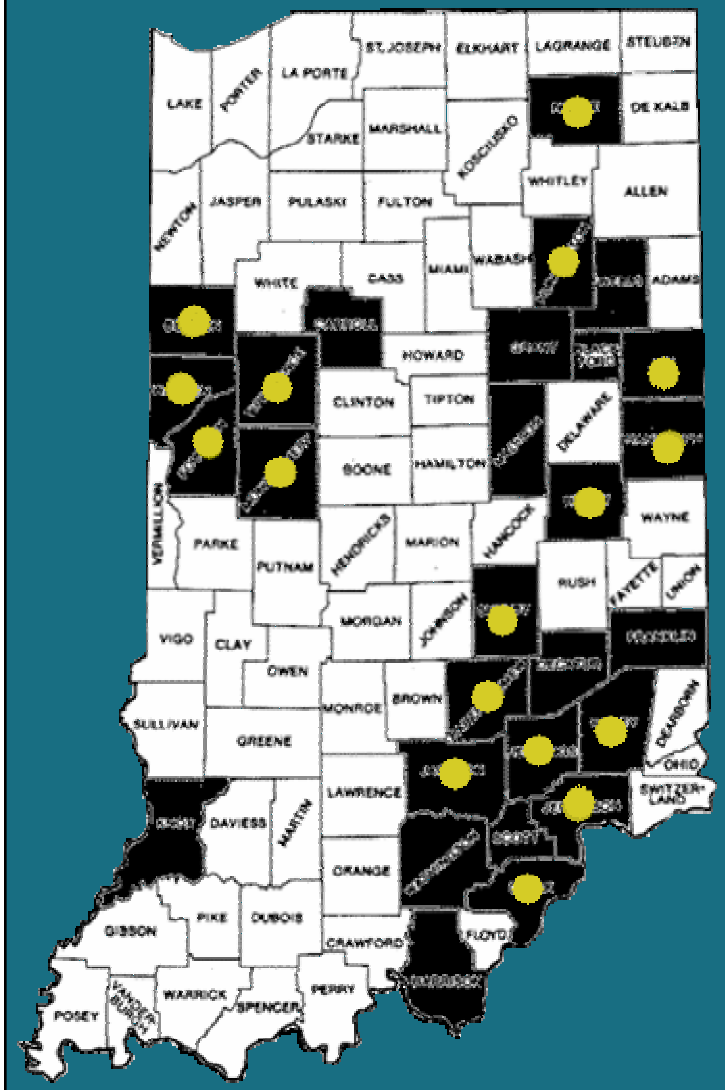
- Process GRW plant samples
- Break dormancy (Schutte, Ohio State)
- Plant in 10” x 10” trays
  - Transplant each plant into smaller tray
- Same greenhouse growing conditions as CLQ
- 3-4 nodes growth stage
- Sprayed with 2X rate of glyphosate (1.5 lb ae/A)
- Rate 21 DAT

# Methods




- Dry weight data collected for both GRW and CLQ
- Data subject to dose response curve to help estimate glyphosate GR50 values
- Replicate studies

# 2005 Survey




- Surveyed 73 sites in 28 counties
- Sampled 27 fields in 17 counties
- Sampled primarily in the SE

# Results

- Collected:  229 GRW and 173 CLQ samples
  - 20 GRW and 17 CLQ populations
- All fields sampled contained horseweed
  - Approximately 75 percent of sites visited still had horseweed present
  - Approximately 70 percent of sites visited documented as containing resistant horseweed populations in 2003 survey

# Results

From 2003 survey database, horseweed, GRW and/or CLQ were present at approximately **48 percent** of the soybean fields visited in 2005.

# Future Research

- Run queries from 2004 horseweed survey database
  - 335 sites surveyed
    - GRW = 51%
    - CLQ = 19%
    - Horseweed + GRW = 8%  ~ 26 fields
    - Horseweed + CLQ = 3%  ~ 11 fields
    - Horseweed + BOTH = 1%  ~ 4 fields
- Resample fields
  - Collect 10-15 plants individually per field
- Screen for enhanced glyphosate tolerance

# Future Research/Summary

# Any Questions??

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Purdue Weed Science Website
www.btny.purdue.edu/weedscience