# Update on Herbicide Resistance in Wisconsin and Proactive Late-Season Weed Escape Survey Efforts

Ross A. Recker and Vince M. Davis

Graduate Research Assistant and Assistant Professor

Department of Agronomy

University of Wisconsin-Madison

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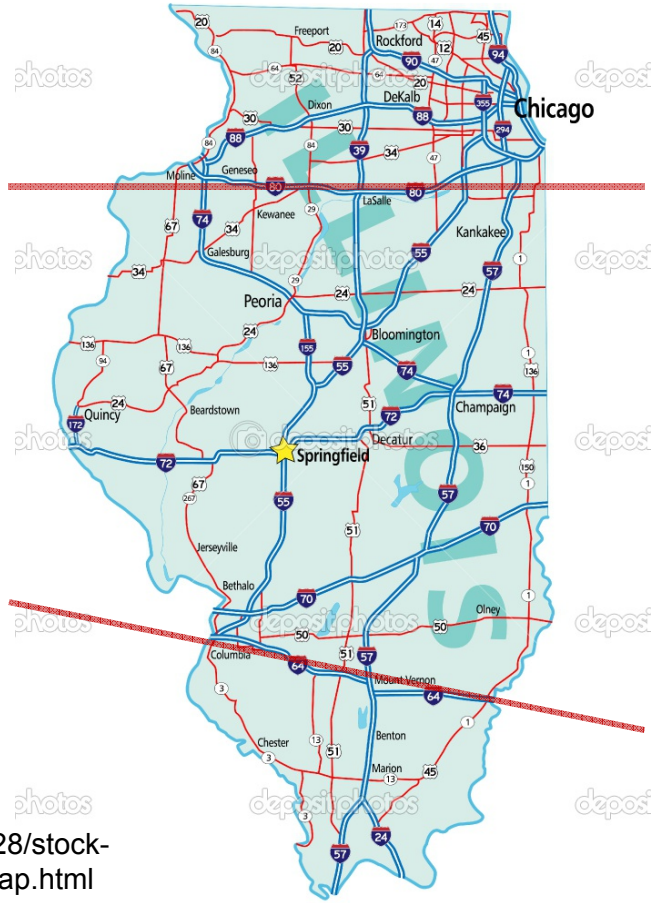
WISCONSIN CORN PROMOTION BOARD, INC.

# Southern Illinois

- **Myth: Southern Illinois is defined as South of I-80**
- **Southern Illinois is south of I-64**
- **Therefore, I am not a bears fan**




http://depositphotos.com/2616328/stock-illustration-Illinois-State-Road-Map.html

# OUTLINE

- **Introduction**
- **Update on herbicide resistance in Wisconsin**
- **Update on proactive late-season weed escape efforts**
  - Objective
  - Materials and Methods
  - Results
  - Future work

# INTRODUCTION: WHY WE CARE!

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# GIANT RAGWEED IN WISCONSIN

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Preemergence: S-metolachlor (Dual II Magnum)

Pictures taken 36 Days after Postemergence application of glyphosate (0.78 lb ae acre$^{-1}$)

# GIANT RAGWEED IN WISCONSIN

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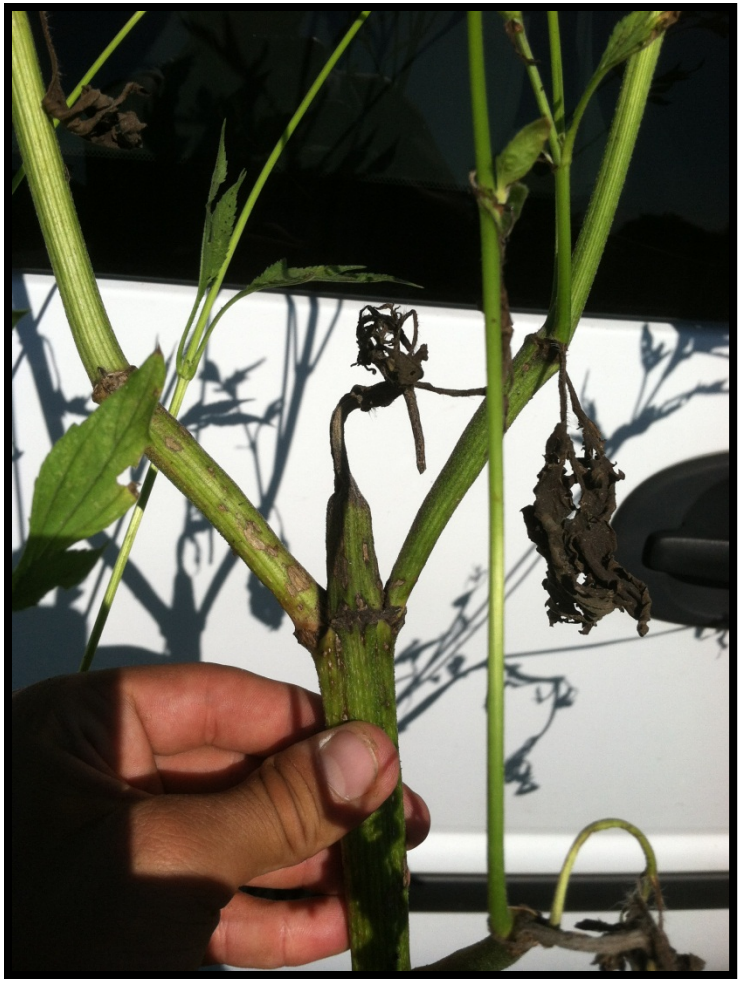
# GIANT RAGWEED IN WISCONSIN

- **Glyphosate activity in meristem**



# COMMON LAMBSQUARTERS

# COMMON LAMBSQUARTERS

## VELVETLEAF

## COMMON RAGWEED

# WATERHEMP

# HORSEWEED

# POWELL? AMARANTH

# SOYBEAN? FIELD


CORN? FIELD

# UPDATE ON HERBICIDE RESISTANCE IN WISCONSIN

- **In Wisconsin**
  - PSII Inhibitors – Lambsquarters, Smooth pigweed, kochia, velvetleaf
  - ACCase Inhibitors– Giant foxtail, Large crabgrass
  - ALS Inhibitors – Kochia, Common waterhemp, Giant foxtail, Green foxtail, Eastern Black Nightshade
  - Glyphosate – Giant ragweed
- **States bordering Wisconsin**
  - Glyphosate – Common Waterhemp, Horseweed, Palmer Amaranth, Common Ragweed, Giant Ragweed
  - Many other weeds resistant to other herbicide modes of action

DS1

# GLYPHOSATE-RESISTANT GIANT RAGWEED IN WISCONSIN

- Rock County population
- Photo taken 4 weeks after treatment
- 3.0 lb ae glyphosate per acre plus AMS
- **9-fold resistance**

- Dr. Stoltenberg's lab and Dr. Westra (Colorado State University) are working to determine physiological mechanism of resistance

Courtesy of Dr. Dave Stoltenberg

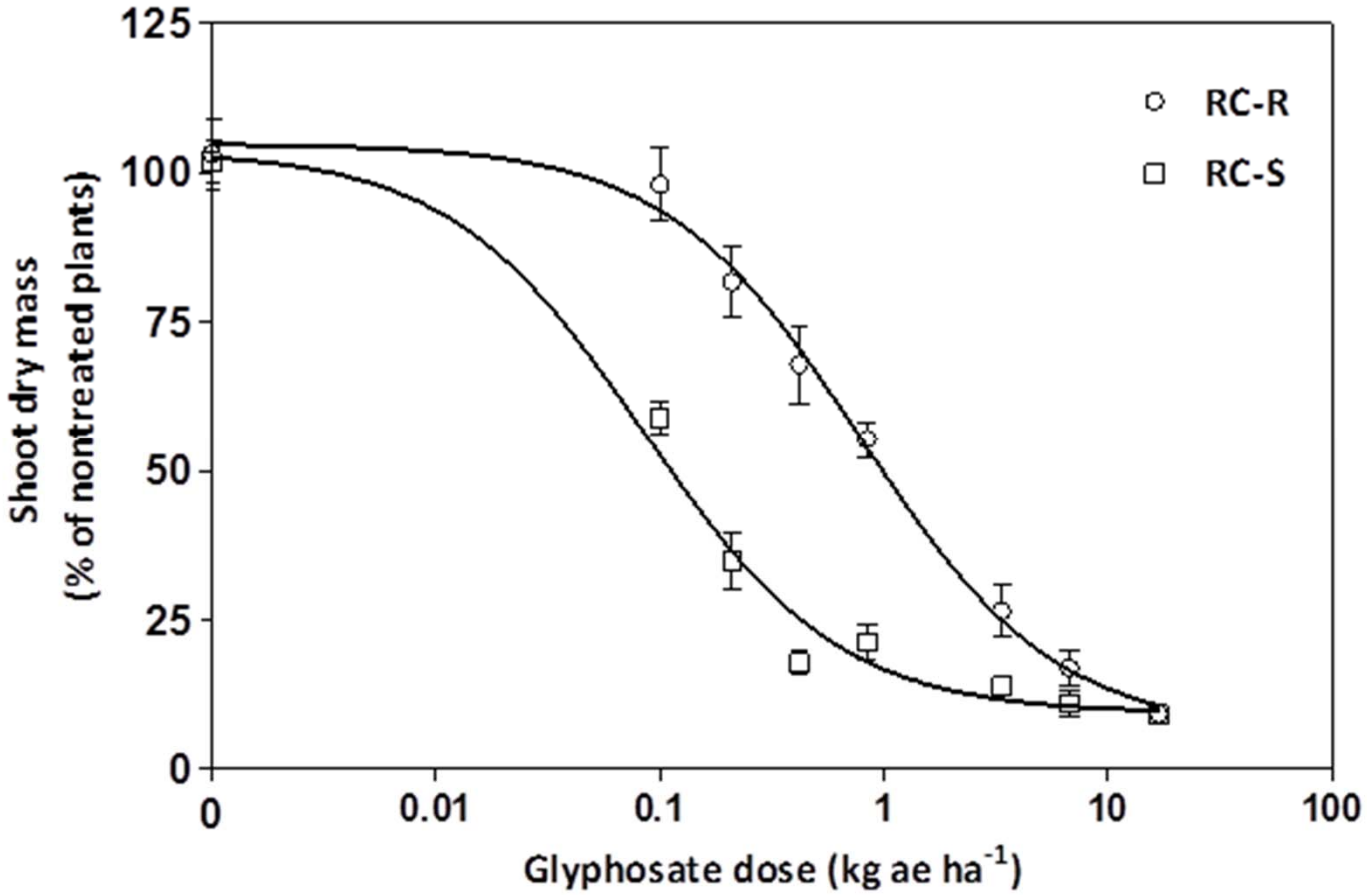
## Slide 20

**DS1** "County" was capitalized.

Deleted superscript for acre and inserted "per".
David Stoltenberg, 1/11/2013

DS2

# GLYPHOSATE-RESISTANT GIANT RAGWEED IN WISCONSIN




Shoot dry mass for Rock County resistant (RC-R) and Rock County sensitive (RC-S) giant ragweed in response to glyphosate 28 days after treatment.

Courtesy of Dr. Dave Stoltenberg

## Slide 21

**DS2** Caption was revised/simplfied.
David Stoltenberg, 1/11/2013

DS3

# ALS INHIBITOR-RESISTANT GIANT RAGWEED

Cloransulam-methyl (FirstRate®) was sprayed:

- PRE: 0.63 oz ai/a + POST: 0.25 oz ai/a + Late POST: 0.25 oz ai/a
- 3 applications !!!

Courtesy of Dr. Dave Stoltenberg

## Slide 22

**DS3** "ALS-Resistant" should be rephrased to "ALS inhibitor-Resistant" Giant Ragweed.

Also, may want to specify that herbicide rates were on acre basis, e.g. oz ai/a
David Stoltenberg, 1/11/2013

DS4

# ALS INHIBITOR-RESISTANT GIANT RAGWEED

- **Preliminary field and greenhouse results SUGGEST that a Columbia County WI population of giant ragweed has a high level of resistance to cloransulam-methyl (FirstRate)**
  - Full dose-response experiments still need to be conducted to confirm and quantify resistance
  - IF confirmed, further research will test if the mechanism of resistance is an altered target site

Courtesy of Dr. Dave Stoltenberg

## Slide 23

**DS4** As is previous slide title should be "ALS-Inhibitor..."

Capitalized Columbia "County".
David Stoltenberg, 1/11/2013

# LATE SEASON WEED ESCAPE SURVEY

- **Objective**
- **Materials and Methods**
- **Results and Discussion**
- **Future Work**

# OBJECTIVE OF LATE SEASON WEED ESCAPE SURVEY

- **Identify areas of Wisconsin for potential shifts to weeds that:**
  - are more difficult to control with glyphosate
  - where glyphosate resistant weeds may first appear
- **Direct attention to these areas**
- **Pro-active resistant management tactics can be implemented before wide-scale control failures occur**

# MATERIALS AND METHODS

- **On-line survey distributed to Wisconsin producers in June**
  - Generated sample locations
  - Gained crop history, herbicide use, tillage, and problematic weeds for sample locations
  - Lets take a quick look

# Field Survey for Late Season Weed Escapes

**Please enter information for just one field in your operation per survey.**
*You can fill out as many survys (entering as many fields from your operation) as you would like by filling out additional surveys.*

**What is the name of the field you are going to enter information for in this survey?**

**Approximate field size (acres):** **County:**

***What crop is currently growing in this field?***

***When was the last year atrazine was applied to this field?***

***What herbicides were applied to the field this year?***

Burndown and Preemergence:

Postemergence:

***What are the 5 most problematic weeds to control in this field?***

1.
2.
3.
4.
5.

*Compared to 10 years ago, how often do you now rely on atrazine in this field?* MORE, LESS, or ABOUT THE SAME

*Compared to 10 years ago, how often do you now rely on glyphosate in this field?* MORE, LESS, or ABOUT THE SAME

*Are you concerned about glyphosate-resistant weeds in this field?* VERY, A LITTLE, or NOT CONCERNED

*Which type of tillage system is typically used in this field?*

- Full ( < 15% residue at planting)
- Minimum (15% to 30% residue at planting)
- No-till ( > 30% residue at planting)

*How many total acres do you farm?*

*What percentage of your farm acres are usually planted to corn?*

*If you would allow UW Extension to survey this field for late-season weed escapes, please give the following information:*

Contact/Participant Name
Contact Phone Number
Contact Email

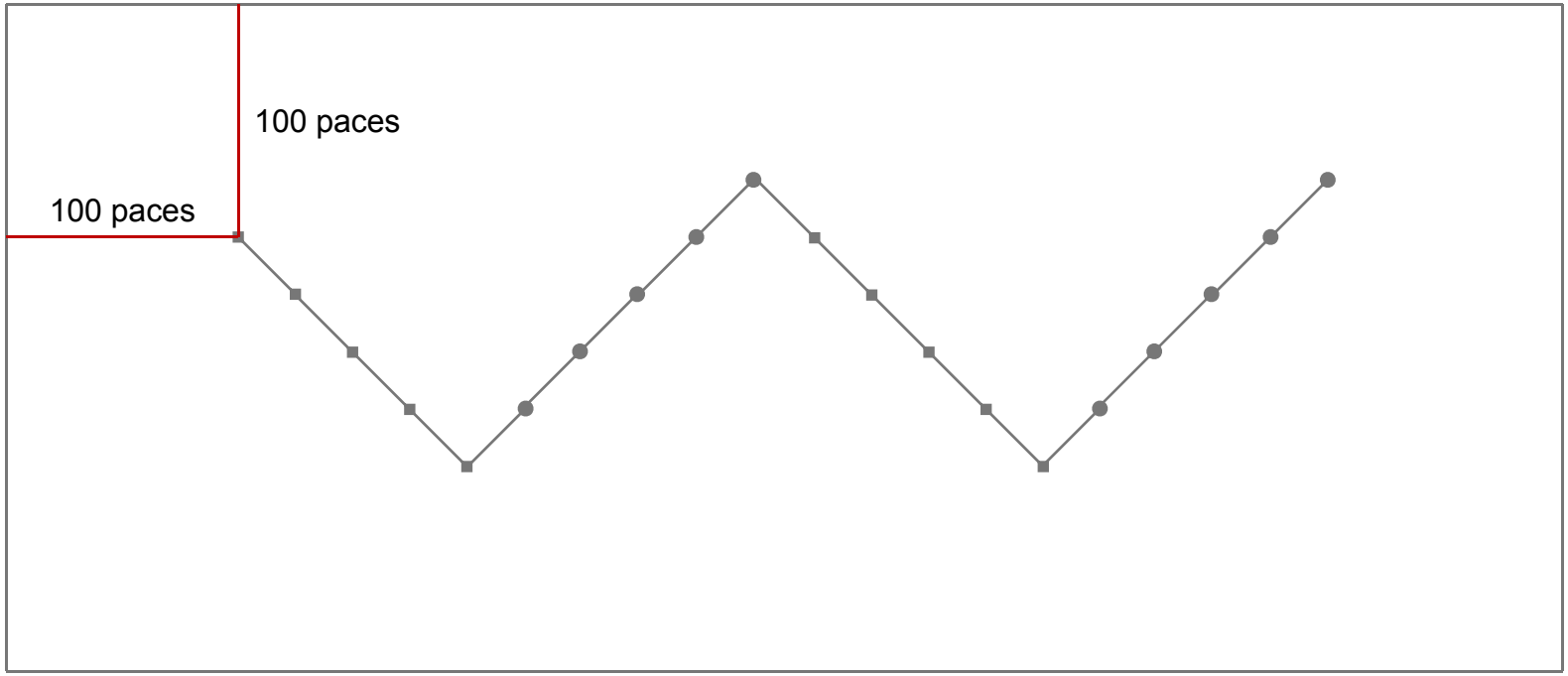
# MATERIALS AND METHODS

- **On-line survey distributed to Wisconsin producers in June**
  - Generated sample locations
  - Gained crop history, herbicide use, tillage, and problematic weeds for sample locations
  - Lets take a quick look

- **In-field survey in corn and soybean fields during late-July through early-September followed the online survey**

# MATERIALS AND METHODS

- **In-Field Survey Sampling Procedure**




  - 20 quadrants ($m^{-2}$), spaced approximately 20 m apart
  - Counted number of each weed species in each quadrant

# MATERIALS AND METHODS

- **Frequency data were calculated for each weed species**

$$\text{Frequency} = \frac{\text{number of fields where species occurred}}{\text{number of fields sampled}} \times 100$$

- **Data are grouped separately by**
  - Crop (corn or soybean)
  - Tillage (full, reduced, or no-till) defined by CTIC
    - Full: < 15% residue at planting
    - Reduced: 15% to 30% residue at planting
    - No-till: > 30% residue at planting
  - Region (based on National Agricultural Statistics Service reporting districts)

# MATERIALS AND METHODS

- **Regions**

| Region | NASS District |
|---|---|
| North Central (NC) | 20 |
| West (W) | 40 & 70 |
| Central (C) | 50 |
| South Central (SC) | 80 |
| East (E) | 60 & 90 |


http://www.nass.usda.gov/Charts_and_Maps/Crops_County/boundary_maps/wi.gif

# LATE SEASON WEED ESCAPE SURVEY

- **Materials and Methods**
- **Results and Discussion**
- **Future Work**

# 2012 ON-LINE SURVEY

- **Responses describing 167 fields**
- **Problematic weeds indicated by survey respondents shown below (expanded results in proceedings)**

| Common Name | Number of responses | Percentage of fields |
|---|---|---|
| Common lambsquarters | 127 | 76.0% |
| Foxtails | 90 | 53.9% |
| Velvetleaf | 72 | 43.1% |
| Giant ragweed | 57 | 34.1% |
| Pigweeds | 51 | 30.5% |
| Yellow nutsedge | 49 | 29.3% |
| Common ragweed | 45 | 26.9% |
| Dandelion | 23 | 13.8% |
| Crabgrass | 19 | 11.4% |
| Quackgrass | 18 | 10.8% |

# SUMMER 2012

- **Plentiful rainfall**
  - Great soil-applied herbicide activation
  - Rapid crop canopy closure to shade out weeds
  - Sufficient translocation of systemic herbicides

- **Example**
  - Small plot research location in Columbia county received less than **2 in** from planting (May 11) until corn canopy closure (July 13).

# 2012 IN-FIELD SURVEY

- **151 fields sampled (Number of fields surveyed by crop, tillage practice, and region shown below)**

| | --------Crop-------- | | ---------Tillage Practice--------- | | | ----------Region---------- | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Corn | Soybean | Full | Reduced | No-till | NC | W | C | E | SC |
| Fields Surveyed | 88 | 63 | 77 | 25 | 43 | 22 | 38 | 28 | 29 | 34 |

- **64 different weed species documented**
  - 43 broadleaf species
  - 21 grass species or plants resembling grass species
- **Top 5 most frequent weeds and percent frequency**

1) Common lambsquarters (58.3%)
2) Dandelion (57.6%)
3) Velvetleaf (32.5%)
4) Giant foxtail (24.5%)
5) Yellow foxtail (22.5%)

# WEED FREQUENCY BY CROP

| Common Name | Type[1] | Weed frequency by crop | | | Chi-square test[2] |
|---|---|---|---|---|---|
| | | Total | Corn | Soybean | |
| | | ---------- % ---------- | | | P-Value[3] |
| 1) Common lambsquarters | B | 58.3 | 61.4 | 54.0 | 0.3635 |
| 2) Dandelion | B | 57.6 | 61.4 | 52.4 | 0.2707 |
| 3) Velvetleaf | B | 32.5 | 34.1 | 30.2 | 0.6108 |
| **4) Giant foxtail** | G | 24.5 | **30.7** | 15.9 | **0.0370** ** |
| **5) Yellow foxtail** | G | 23.2 | **29.6** | 14.3 | **0.0284** ** |
| 6) Yellow nutsedge | G | 22.5 | 22.7 | 22.2 | 0.9416 |
| **7) Fall panicum** | G | 21.2 | **33.0** | 3.0 | **<0.0001** **** |
| 8) Common ragweed | B | 17.9 | 15.9 | 20.6 | 0.4549 |
| 9) Black nightshade | B | 17.9 | 18.2 | 17.5 | 0.9092 |
| **10) Volunteer corn** | G | 15.2 | 8.0 | **25.4** | **0.0033** *** |
| All weeds | | 95.4 | 96.6 | 93.7 | 0.4517 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species

[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'

[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# WEED FREQUENCY BY CROP (CONT.)

| Common Name | Type[1] | Weed frequency by crop | | | Chi-square test[2] |
|---|---|---|---|---|---|
| | | Total | Corn | Soybean | |
| | | ---------- % ---------- | | | P-Value[3] |
| **11) Large crabgrass** | B | 13.3 | **19.3** | 4.8 | **0.0093** *** |
| **12) Quackgrass** | G | 13.3 | **21.6** | 1.6 | **0.0003** **** |
| 13) Barnyardgrass | G | 11.9 | 14.8 | 7.9 | 0.2011 |
| **14) Wild proso millet** | G | 11.9 | **15.9** | 6.4 | **0.0738** * |
| 15) Lady's thumb smartweed | B | 11.3 | 8.0 | 15.9 | 0.1290 |
| 16) Green foxtail | G | 11.3 | 13.6 | 7.9 | 0.2745 |
| 17) Redroot pigweed | B | 9.9 | 11.4 | 7.9 | 0.4875 |
| **18) Giant ragweed** | B | 9.9 | 6.8 | **14.3** | **0.1303** |
| 19) Shepherd's-purse | B | 9.3 | 12.5 | 4.8 | 0.1060 |
| 20) Common waterhemp | B | 8.6 | 5.7 | 5.3 | 0.1296 |
| All weeds | | 95.4 | 96.6 | 93.7 | 0.4517 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species

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# WEED FREQUENCY BY CROP

- Expanded results can be found in proceedings

| Common Name | Type[1] | Weed frequency by crop | | | Chi-square test[2] |
|---|---|---|---|---|---|
| | | Total | Corn | Soybean | P-Value[3] |
| | | ---------- % ---------- | | | |
| 1) Common lambsquarters | B | 58.3 | 61.4 | 54.0 | 0.3635 |
| 2) Dandelion | B | 57.6 | 61.4 | 52.4 | 0.2707 |
| 3) Velvetleaf | B | 32.5 | 34.1 | 30.2 | 0.6108 |
| **4) Giant foxtail** | G | 24.5 | **30.7** | 15.9 | **0.0370** ** |
| **5) Yellow foxtail** | G | 23.2 | **29.6** | 14.3 | **0.0284** ** |
| 6) Yellow nutsedge | G | 22.5 | 22.7 | 22.2 | 0.9416 |
| **7) Fall panicum** | G | 21.2 | **33.0** | 3.0 | **<0.0001** **** |
| 8) Common ragweed | B | 17.9 | 15.9 | 20.6 | 0.4549 |
| 9) Black nightshade | B | 17.9 | 18.2 | 17.5 | 0.9092 |
| **10) Volunteer corn** | G | 15.2 | 8.0 | **25.4** | **0.0033** *** |
| **11) Large crabgrass** | B | 13.3 | **19.3** | 4.8 | **0.0093** *** |
| **12) Quackgrass** | G | 13.3 | **21.6** | 1.6 | **0.0003** **** |
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| **14) Wild proso millet** | G | 11.9 | **15.9** | 6.4 | **0.0738** * |
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| **18) Giant ragweed** | B | 9.9 | 6.8 | **14.3** | **0.1303** |
| 19) Shepherd's-purse | B | 9.3 | 12.5 | 4.8 | 0.1060 |
| 20) Common waterhemp | B | 8.6 | 5.7 | 5.3 | 0.1296 |
| All weeds | | 95.4 | 96.6 | 93.7 | 0.4517 |

- Grasses are significant
  - More frequent in corn
  - Except volunteer corn
- Giant ragweed
  - Not significant at α = 0.1

However,

- 11th most frequent weed species in soybean fields
- 25th most frequent weed species in corn fields

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species
[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'
[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# GRASS PRESSURE IN CORN

# WEED FREQUENCY BY TILLAGE

| Common Name | Type[1] | Weed frequency by tillage | | | Chi-square test[2] | |
|---|---|---|---|---|---|---|
| | | Full | Reduced | No-till | P-Value[3] | |
| | | ---------- % ---------- | | | | |
| 1) Common lambsquarters | B | 53.3 | 76.0 | 53.5 | 0.1140 | |
| 2) Dandelion | B | 59.7 | 52.0 | 51.2 | 0.6047 | |
| 3) Velvetleaf | B | 35.1 | 28.0 | 25.6 | 0.5248 | |
| 4) Giant foxtail | G | 22.1 | 24.0 | 30.2 | 0.6083 | |
| 5) Yellow foxtail | G | 16.9 | 36.0 | 27.9 | 0.1044 | |
| 6) Yellow nutsedge | G | 28.6 | 8.0 | 23.3 | 0.1080 | |
| 7) Fall panicum | G | 26.0 | 12.0 | 20.9 | 0.3347 | |
| 8) Common ragweed | B | 16.9 | 24.0 | 16.3 | 0.6829 | |
| 9) **Black nightshade** | B | 13.0 | **32.0** | 16.3 | **0.0898** | * |
| 10) Volunteer corn | G | 14.3 | 8.0 | 23.3 | 0.2163 | |
| 11) **Large crabgrass** | B | 11.7 | **28.0** | 9.3 | **0.0721** | * |
| 12) Quackgrass | G | 16.9 | 12.0 | 9.3 | 0.4928 | |
| All weeds | | 96.1 | 100.0 | 90.7 | 0.2756 | |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species

[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'

[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# WEED FREQUENCY BY TILLAGE (CONT.)

| Common Name | Type[1] | Weed frequency by tillage | | | Chi-square test[2] |
|---|---|---|---|---|---|
| | | Full | Reduced | No-till | P-Value[3] |
| | | ---------- % ---------- | | | |
| 13) Barnyardgrass | G | 16.9 | 12.0 | 4.7 | 0.1494 |
| **14) Wild proso millet** | G | 7.8 | **24.0** | 14.0 | **0.0957** * |
| | | | | | Fisher's exact test[2] |
| 15) Lady's thumb smartweed | B | 11.7 | 16.0 | 4.7 | 0.2783 |
| 16) Green foxtail | G | 6.5 | 16.0 | 14.0 | 0.2071 |
| 17) Redroot pigweed | B | 13.0 | 0.0 | 9.3 | 0.1743 |
| **18) Giant ragweed** | B | 9.1 | 0.0 | **16.3** | **0.0754** * |
| **19) Shepherd's-purse** | B | **16.9** | 4.0 | 0.0 | **0.0035** *** |
| 20) Common waterhemp | B | 6.5 | 8.0 | 14.0 | 0.3842 |
| **21) Woolly cupgrass** | G | 3.9 | **24.0** | 9.3 | **0.0126** ** |
| **22) Smooth crabgrass** | G | 5.2 | **24.0** | 2.3 | **0.0055** *** |
| **23) Yellow woodsorrel** | B | 6.5 | **16.0** | 2.3 | **0.1000** * |
| All weeds | | 96.1 | 100.0 | 90.7 | 0.2756 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species

[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'

[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# WEED FREQUENCY BY TILLAGE

- Expanded results can be found in proceedings

| Common Name | Type[1] | Weed frequency by tillage: Full | Reduced | No-till | Chi-square test[2] |
|---|---|---|---|---|---|
| | | ---------- % ---------- | | | P-Value[3] |
| 1) Common lambsquarters | B | 53.3 | 76.0 | 53.5 | 0.1140 |
| 2) Dandelion | B | 59.7 | 52.0 | 51.2 | 0.6047 |
| 3) Velvetleaf | B | 35.1 | 28.0 | 25.6 | 0.5248 |
| 4) Giant foxtail | G | 22.1 | 24.0 | 30.2 | 0.6083 |
| 5) Yellow foxtail | G | 16.9 | 36.0 | 27.9 | 0.1044 |
| 6) Yellow nutsedge | G | 28.6 | 8.0 | 23.3 | 0.1080 |
| 7) Fall panicum | G | 26.0 | 12.0 | 20.9 | 0.3347 |
| 8) Common ragweed | B | 16.9 | 24.0 | 16.3 | 0.6829 |
| **9) Black nightshade** | B | 13.0 | **32.0** | 16.3 | **0.0898** * |
| 10) Volunteer corn | G | 14.3 | 8.0 | 23.3 | 0.2163 |
| **11) Large crabgrass** | B | 11.7 | **28.0** | 9.3 | **0.0721** * |
| 12) Quackgrass | G | 16.9 | 12.0 | 9.3 | 0.4928 |
| 13) Barnyardgrass | G | 16.9 | 12.0 | 4.7 | 0.1494 |
| **14) Wild proso millet** | G | 7.8 | **24.0** | 14.0 | **0.0957** * |
| | | | | | Fisher's exact test[2] |
| 15) Lady's thumb smartweed | B | 11.7 | 16.0 | 4.7 | 0.2783 |
| 16) Green foxtail | G | 6.5 | 16.0 | 14.0 | 0.2071 |
| 17) Redroot pigweed | B | 13.0 | 0.0 | 9.3 | 0.1743 |
| **18) Giant ragweed** | B | 9.1 | 0.0 | **16.3** | **0.0754** * |
| **19) Shepherd's-purse** | B | **16.9** | 4.0 | 0.0 | **0.0035** *** |
| 20) Common waterhemp | B | 6.5 | 8.0 | 14.0 | 0.3842 |
| **21) Woolly cupgrass** | G | 3.9 | **24.0** | 9.3 | **0.0126** ** |
| **22) Smooth crabgrass** | G | 5.2 | **24.0** | 2.3 | **0.0055** *** |
| **23) Yellow woodsorrel** | B | 6.5 | **16.0** | 2.3 | **0.1000** * |
| All weeds | | 95.4 | 96.6 | 93.7 | 0.4517 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species
[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'
[3] A significant p-value indicates a correlation between weed species frequency and crop type.

- Trend of highest frequency in reduced tillage practices
- Giant ragweed
  - Correlation between weed species frequency and tillage practice at α = 0.1
  - Highest frequency in no-till

# WEED FREQUENCY BY REGION

| Common Name | Type[1] | Weed frequency by region | | | | | Chi-square test[2] |
|---|---|---|---|---|---|---|---|
| | | NC | W | C | E | SC | P-value[3] |
| | | ---------- % ---------- | | | | | |
| 1) Common lambsquarters | B | 63.6 | 55.3 | 60.7 | 55.2 | 58.8 | 0.9642 |
| 2) Dandelion | B | 77.3 | 55.3 | 53.6 | 58.6 | 50.0 | 0.3338 |
| **3) Velvetleaf** | B | 31.8 | 26.3 | 7.1 | **55.2** | 41.2 | **0.0021** *** |
| 4) Giant foxtail | G | 13.6 | 29.0 | 10.7 | 37.9 | 26.5 | 0.1080 |
| 5) Yellow foxtail | G | 18.2 | 21.1 | 28.6 | 20.7 | 26.5 | 0.8830 |
| 6) Yellow nutsedge | G | 27.3 | 26.3 | 17.9 | 13.8 | 26.5 | 0.6415 |
| 7) Fall panicum | G | 22.7 | 23.7 | 14.3 | 14.3 | 26.5 | 0.7706 |
| **8) Common ragweed** | B | 13.6 | 2.6 | **32.1** | **27.6** | 17.7 | **0.0171** ** |
| **9) Black nightshade** | B | 4.6 | 15.8 | 32.1 | 27.6 | 8.8 | **0.0340** ** |
| All weeds | | 95.5 | 92.1 | 100.0 | 93.1 | 97.1 | 0.6232 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species
[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'
[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# WEED FREQUENCY BY REGION (CONT.)

| Common Name | Type[1] | Weed frequency by region | | | | | Fisher's exact test[2] | |
|---|---|---|---|---|---|---|---|---|
| | | NC | W | C | E | SC | P-value[3] | |
| | | ---------- % ---------- | | | | | | |
| **10) Volunteer corn** | G | 4.6 | 18.4 | 7.1 | 31.0 | 11.8 | **0.0669** | * |
| **11) Large crabgrass** | B | 9.1 | 15.8 | 28.6 | 3.5 | 8.8 | **0.0718** | * |
| **12) Quackgrass** | G | 31.8 | 13.2 | 10.7 | 3.5 | 11.8 | **0.0776** | * |
| **13) Barnyardgrass** | G | 22.7 | 2.6 | 14.3 | 6.9 | 17.7 | **0.0853** | * |
| 14) Wild proso millet | G | 4.6 | 5.3 | 17.9 | 10.3 | 20.6 | 0.2020 | |
| 15) Lady's thumb smartweed | B | 13.6 | 5.3 | 14.3 | 20.7 | 5.9 | 0.2541 | |
| **16) Green foxtail** | G | 0.0 | 2.6 | 3.6 | 24.1 | 23.5 | **0.0011** | *** |
| **17) Redroot pigweed** | B | **31.8** | 10.5 | 3.6 | 3.6 | 8.8 | **0.0041** | *** |
| **18) Giant ragweed** | B | 0.0 | **26.3** | 0.0 | 0.0 | **14.7** | **0.0001** | **** |
| **19) Shepherd's-purse** | B | 22.7 | 2.6 | 3.6 | 10.3 | 11.8 | **0.0944** | * |
| 20) Common waterhemp | B | 4.6 | 10.5 | 0.0 | 10.3 | 14.7 | 0.2545 | |
| All weeds | | 95.5 | 92.1 | 100.0 | 93.1 | 97.1 | 0.6232 | |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species

[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'

[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# WEED FREQUENCY BY REGION

- Expanded results can be found in proceedings

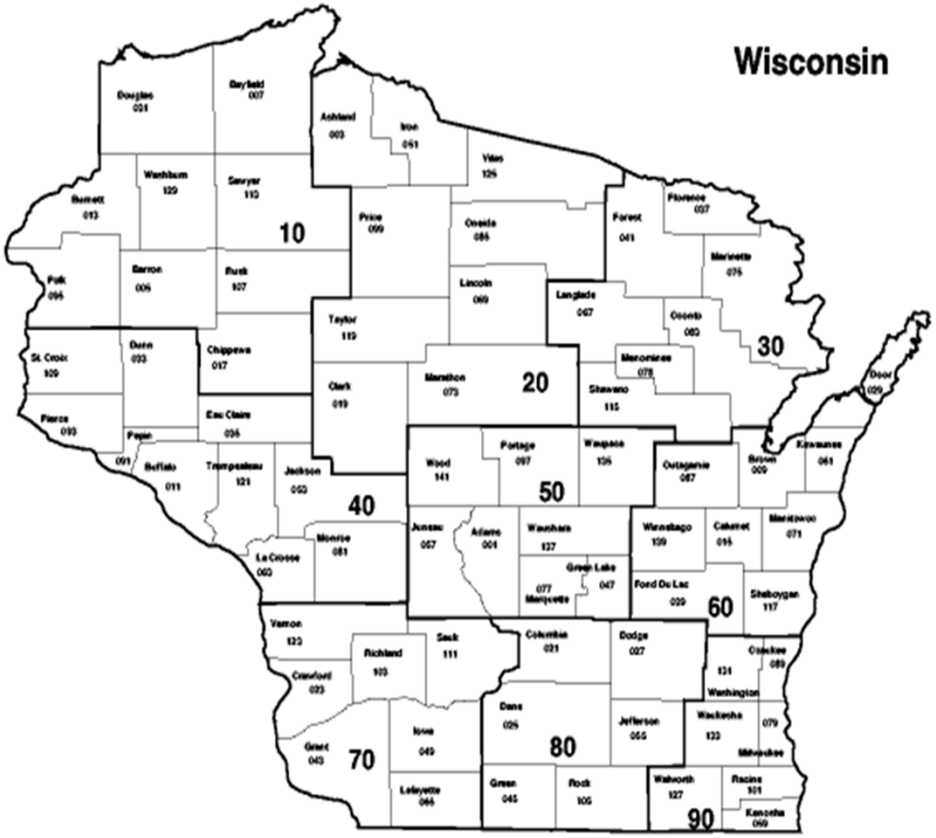
| | | Weed frequency by region | | | | | |
|---|---|---|---|---|---|---|---|
| Common Name | Type[1] | NC | W | C | E | SC | Chi-square test[2] |
| | | ---------- % ---------- | | | | | P-value[3] |
| Common lambsquarters | B | 63.6 | 55.3 | 60.7 | 55.2 | 58.8 | 0.9642 |
| Dandelion | B | 77.3 | 55.3 | 53.6 | 58.6 | 50.0 | 0.3338 |
| Velvetleaf | B | 31.8 | 26.3 | 7.1 | 55.2 | 41.2 | **0.0021** *** |
| Giant foxtail | G | 13.6 | 29.0 | 10.7 | 37.9 | 26.5 | 0.1080 |
| Yellow foxtail | G | 18.2 | 21.1 | 28.6 | 20.7 | 26.5 | 0.8830 |
| Yellow nutsedge | G | 27.3 | 26.3 | 17.9 | 13.8 | 26.5 | 0.6415 |
| Fall panicum | G | 22.7 | 23.7 | 14.3 | 14.3 | 26.5 | 0.7706 |
| Common ragweed | B | 13.6 | 2.6 | 32.1 | 27.6 | 17.7 | **0.0171** ** |
| Black nightshade | B | 4.6 | 15.8 | 32.1 | 27.6 | 8.8 | **0.0340** ** |
| | | | | | | | Fisher's exact test[2] |
| Volunteer corn | G | 4.6 | 18.4 | 7.1 | 31.0 | 11.8 | **0.0669** * |
| Large crabgrass | B | 9.1 | 15.8 | 28.6 | 3.5 | 8.8 | **0.0718** * |
| Quackgrass | G | 31.8 | 13.2 | 10.7 | 3.5 | 11.8 | **0.0776** * |
| Barnyardgrass | G | 22.7 | 2.6 | 14.3 | 6.9 | 17.7 | **0.0853** * |
| Wild proso millet | G | 4.6 | 5.3 | 17.9 | 10.3 | 20.6 | 0.2020 |
| Lady's thumb smartweed | B | 13.6 | 5.3 | 14.3 | 20.7 | 5.9 | 0.2541 |
| Green foxtail | G | 0.0 | 2.6 | 3.6 | 24.1 | 23.5 | **0.0011** *** |
| Redroot pigweed | B | 31.8 | 10.5 | 3.6 | 3.6 | 8.8 | **0.0041** *** |
| Giant ragweed | B | 0.0 | 26.3 | 0.0 | 0.0 | 14.7 | **0.0001** **** |
| Shepherd's-purse | B | 22.7 | 2.6 | 3.6 | 10.3 | 11.8 | **0.0944** * |
| Common waterhemp | B | 4.6 | 10.5 | 0.0 | 10.3 | 14.7 | 0.2545 |

[1] Type of weed: B=broadleaf species, G= grass species or plants resembling grass species
[2] P-Value Significance: 0 to 0.001 = '****'; 0.001 to 0.01 = '***'; 0.01 to 0.05 = '**'; 0.05 to 0.1 = '*'
[3] A significant p-value indicates a correlation between weed species frequency and crop type.

- What to do with all these numbers?
  - Focus on species with high significance
  - Highly competitive
  - High risk for herbicide resistance

# WEED FREQUENCY BY REGION

| Region | NASS District |
|---|---|
| North Central (NC) | 20 |
| West (W) | 40 & 70 |
| Central (C) | 50 |
| South Central (SC) | 80 |
| East (E) | 60 & 90 |




http://udel.edu/~mcdonald/statransform.html

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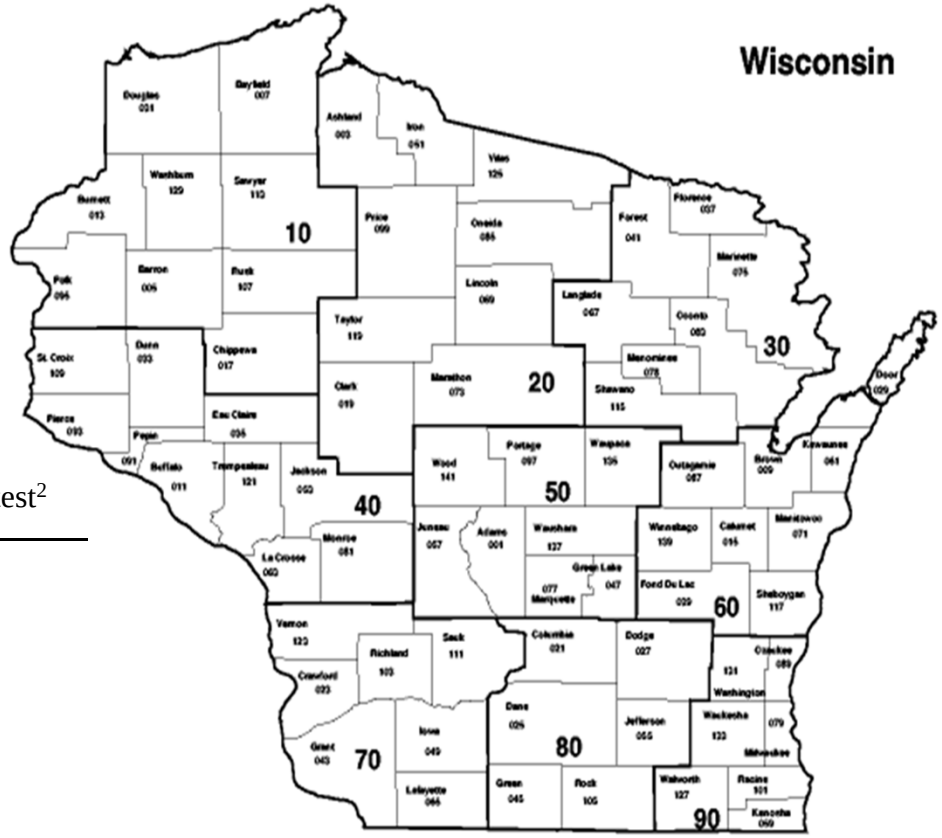
| Common Name | Region | | | | | Chi-square test[2] |
|---|---|---|---|---|---|---|
| | NC | W | C | E | SC | |
| | ---------- % ---------- | | | | | P-value[3] |
| Common lambsquarters | 63 | 55 | 60 | 55 | 58 | 0.9642 |
| Dandelion | 77 | 55 | 53 | 58 | 50 | 0.3338 |

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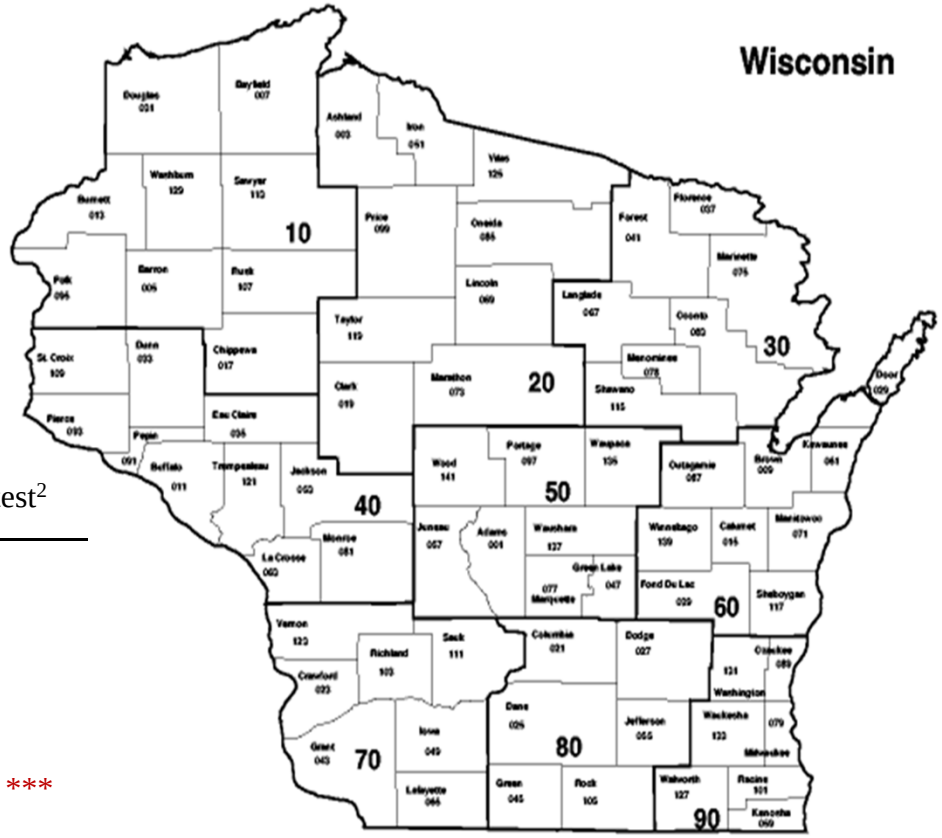
| Dandelion | 77 | 55 | 53 | 58 | 50 | 0.3338 |
| Velvetleaf | 31 | 26 | 7 | 55 | 41 | **0.0021** *** |
| Common ragweed | 13 | 2 | 32 | 27 | 17 | **0.0171** ** |




http://udel.edu/~mcdonald/stattransform.html

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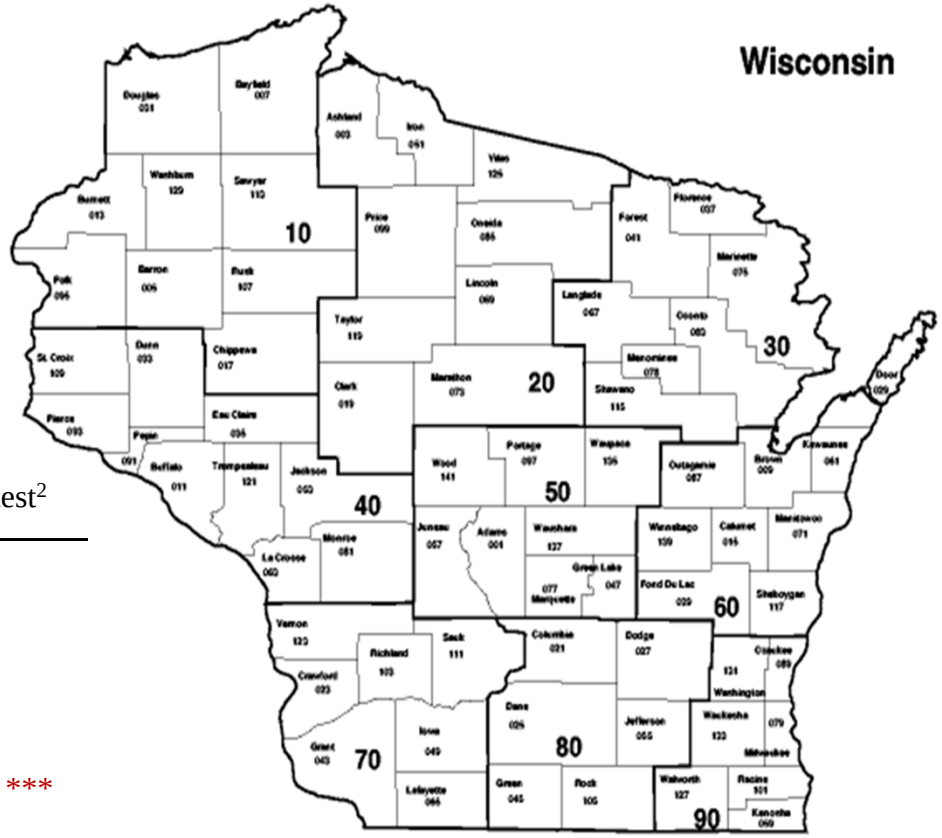
| Common Name | Region NC | W | C | E | SC | Chi-square test[2] |
|---|---|---|---|---|---|---|
| | ---------- % ---------- | | | | | P-value[3] |
| Common lambsquarters | 63 | 55 | 60 | 55 | 58 | 0.9642 |
| Dandelion | 77 | 55 | 53 | 58 | 50 | 0.3338 |
| Velvetleaf | 31 | 26 | 7 | 55 | 41 | **0.0021** *** |
| Common ragweed | 13 | 2 | 32 | 27 | 17 | **0.0171** ** |
| | | | | | | Fisher's exact test[2] |
| Redroot pigweed | **31** | 10 | 3 | 3 | 8 | **0.0041** *** |
| Giant ragweed | 0 | **26** | 0 | 0 | 14 | **0.0001** **** |

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[3] A significant p-value indicates a correlation between weed species frequency and crop type.

# FUTURE WORK

- **Will conduct on-line and in-field survey again in 2013**
  - If willing to participate please contact Ross Recker or Dr. Vince Davis (emails also are in the Proceedings)
    - rrecker@wisc.edu or vmdavis@wisc.edu
  - Scouting reports for individual growers who participate
- **Screen populations of weeds for herbicide resistance**
- **Categorize data by other variables (herbicide use history)**
- **Calculate species richness, density, and uniformity**
- **Develop herbicide resistance risk index**
  - Based solely off of a species herbicide resistance history
  - In order to identify areas of the state where the risk of glyphosate resistance is highest

# THANK YOU

- **All the Growers and Farm Managers who participated in the survey**
- **Drs. Dave Stoltenberg, Paul Mitchell, and Joe Lauer**
- **Tim Trower, Ryan Dewerff, Rebecca Redline, Micheal Halle, Sara Maly**
- **Funded by: Wisconsin Corn Promotion Board**

# QUESTIONS?

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