Agronomy
UNIVERSITY OF WISCONSIN–MADISON

WCWS
Wisconsin
Crop Weed Science

Influence of management and atrazine use on late-season weed escapes in Wisconsin corn and soybean fields

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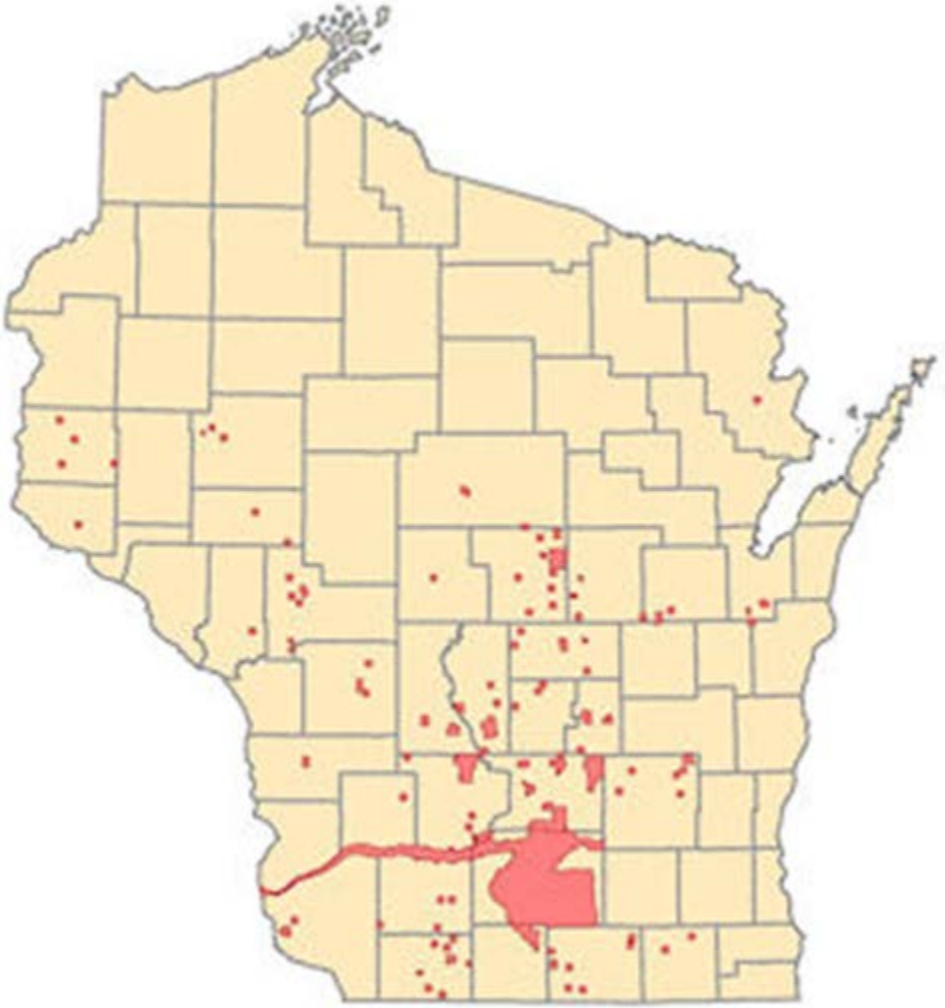
Funded by:
WISCONSIN CORN PROMOTION BOARD, INC.

Outline

- **Introduction**
  - Atrazine Prohibition Areas
- **Objective**
- **Materials and Methods**
  - On-line and in-field survey methods
  - Data summarization
- **Results**
  - Relative abundance, unadjusted frequency, density in occurrence fields
- **Conclusion**

INTRODUCTION:
Atrazine Prohibition Areas in Wisconsin

- **Atrazine Prohibition areas (PAs) are established where atrazine total chlorinated residues are found in concentrations greater than 3 parts per billion in drinking water wells**
- **First six PAs established in 1991**
- **Currently, over 100 PAs**



http://datcp.wi.gov/uploads/Environment/pdf/WeedMgtAtrazinePAs.pdf

What herbicides do growers use as alternatives to atrazine in corn?

Herbicide a.i.	Percentage of Respondents [1,2]
Glyphosate	**90**
s-Metolachlor	22
Mesotrione	21
Acetochlor	19
Dicamba	10
Clopyralid	10
Flumetsulam	10
2, 4-D	6
Tembotrione	4
Diflufenzopyr	4
Atrazine	4
Simazine	2

[1] Each grower was asked to respond with the top three herbicides in the past three years as alternatives to atrazine

[2] 102 growers responded

Courtesy: (WDATCP 2011)

Objective of late-season weed escape survey

Compare weed community composition in different types of management, including past atrazine use

Materials and methods

- **On-line survey distributed to Wisconsin producers in June 2012 and 2013**

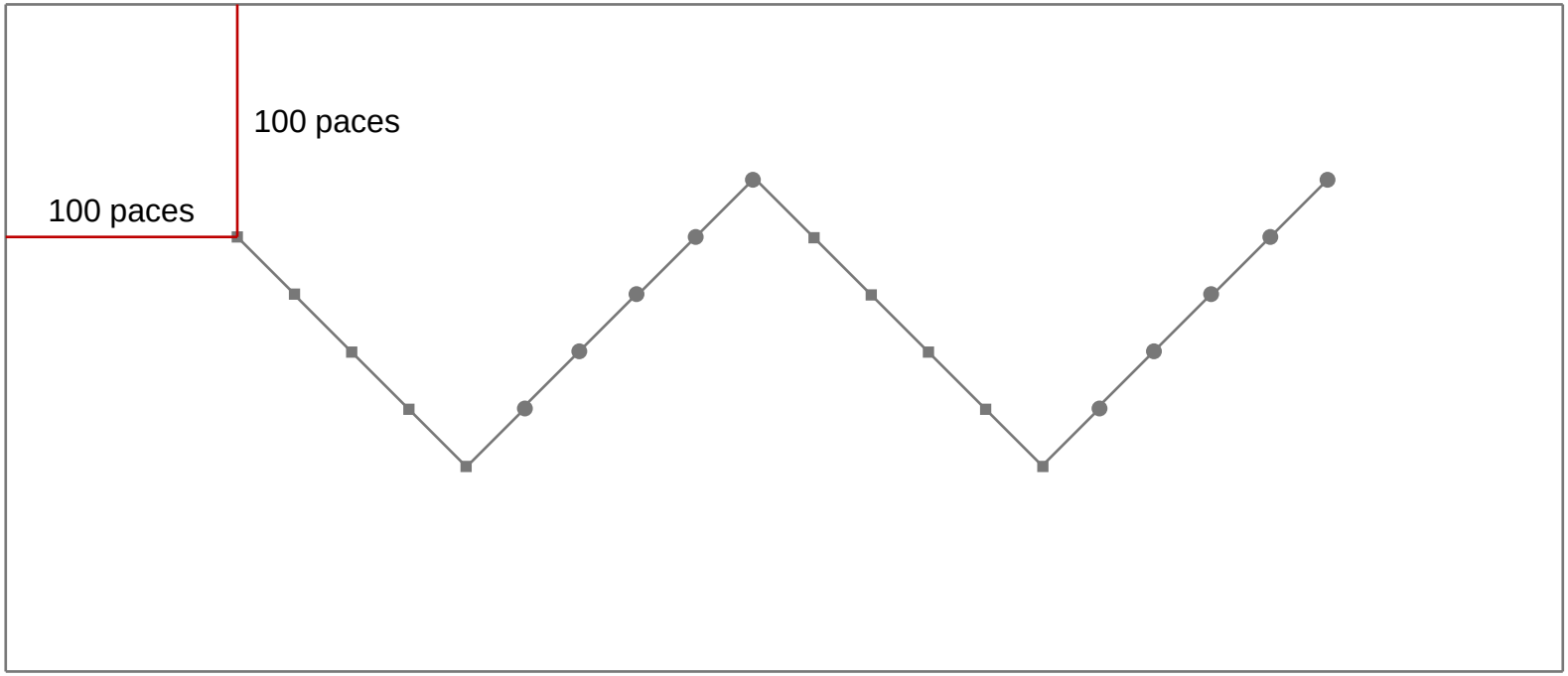
  Generated

  - Field history information
  - Grower's perspective of problematic weeds
  - Sample locations and permission for in-field survey

- **In-field survey in corn and soybean fields during late-July through mid-September followed the online survey in 2012 and 2013**

Data Collection

- **In-Field Survey Sampling Procedure**



  - 20 quadrats (m^2), spaced approximately 20 m apart
  - Counted number of each weed species in each quadrat

Methods adapted from Thomas A. G. 1985. Weed Sci. 33:34-43.

Data Summarization

- Mature weeds expected to produce seed were categorized as an "**expected escape**"

- **Weed count data were summarized for:**

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

$$\text{Uniformity All Fields} = \frac{\text{number of quadrats where species occurred}}{20 \times \text{number of fields sampled}} \times 100$$

$$\text{Density All Fields} = \text{Number of plants } m^{-2} \text{ averaged across all fields}$$

And….

Relative abundance

$$\text{Relative frequency for a species } (\mathbf{RF}) = \frac{\text{frequency of a species}}{\text{sum of frequency values for all species}} \times 100$$

$$\text{Relative uniformity for a species } (\mathbf{RU}) = \frac{\text{uniformity of a species}}{\text{sum of uniformity values for all species}} \times 100$$

$$\text{Relative density for a species } (\mathbf{RD}) = \frac{\text{density of a species}}{\text{sum of density values for all species}} \times 100$$

Relative abundance (RA) for a species:

RA = RF + RU + RD

Essentially, an index allows comparisons of the overall abundance between one species versus another.

Density (occurrence fields)

- **Density (all fields):** Used for relative abundance calculations

- **Density (occurrence fields):** Used for comparisons between fields with different types of management

  - Number of plants m^{-2} averaged across fields where the weed species was present

Materials and methods

- **Weed count data were summarized for:**
  - Frequency, uniformity, density, and relative abundance

- **Fields surveyed were grouped separately by**
  - Crop (corn or soybean)
  - Tillage (full, reduced, or no-till)
    - 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)
  - **Past atrazine use: Atrazine has been applied in the past**
    - **0 – 1 years (Recent)**
    - **2 – 9 years (Transition)**
    - **≥ 10 years (Discontinued)**

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  - Glyphosate resistance in Wisconsin
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Results

- **343 fields sampled total**

	----------Past Atrazine Use----------		
	Recent	~~Transition~~	Discontinued
Fields Surveyed	160	~~71~~	109

- **89 different expected weed species escapes documented**
  - 64 broadleaf species
  - 25 grass species or plants resembling grass species
- **Top 5 most problematic weeds & percentage of fields as indicated by on-line survey respondents**

1. Common lambsquarters (72%)
2. Foxtails (46%)
3. Velvetleaf (42%)
4. Giant ragweed (39%)
5. Amaranthus spp. (29%)

Relative Abundance

		------Relative Abundance------			--------Rank--------	
	Common Name	Statewide	Recent[1]	Disc.[2]	Recent[1]	Disc.[2]
1.	**Dandelion**	39	31	32	**2**	**1**
2.	**Common lambsquarters**	30	20	32	**5**	**2**
3.	**Giant foxtail**	21	35	23	**1**	**3**
4.	**Yellow nutsedge**	19	22	10	**3**	**10**
5.	**Yellow foxtail**	14	18	14	**6**	**7**
6.	**Fall panicum**	14	21	14	**4**	**6**
7.	**Large crabgrass**	12	3	16	**26**	**5**
8.	**Velvetleaf**	11	8	17	**12**	**4**
9.	**Green foxtail**	11	16	8	**7**	**13**
10.	**Quackgrass**	9	8	7	**11**	**14**

[1] Recent refers to the 160 fields where atrazine had been applied in the current or previous growing season

[2] Discontinued refers to the 109 fields where atrazine had not been applied for ≥ 10 years

Unadjusted Frequency

Common Name	Unadjusted Frequency		Chi-square test[3]
	Recent[1]	Disc.[2]	
	----------%----------		P value
All Broadleaves	60.6	73.4	**0.0302**
All Grasses	53.8	62.4	0.1599
Dandelion	22.5	31.2	0.1107
Common lambsquarters	18.8	33.0	**0.0075**
Velvetleaf	9.4	22.9	**0.0021**
Giant ragweed	7.5	8.3	0.8203
Amaranthus Spp.	7.5	14.7	**0.0584**

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[3] Chi-square may not be a valid test when expected probabilities are extremely low. In such cases, a P value from Fisher's exact test is also shown to quantify differences using exact probabilities.

Density (Occurrence Fields)

Common Name	Density		Transformation[3]	t-test
	Recent[1]	Disc.[2]		
	-------- Plants m^{-2} --------			P-value
All Broadleaves	0.19	0.40	ln(x)	**0.0001**
All Grasses	0.48	0.39	ln(x)	0.3934
Dandelion	0.11	0.12	$1/\sqrt{(x)}$	0.5439
Common lambsquarters	0.09	0.15	$1/\sqrt{(x)}$	**0.0438**
Velvetleaf	0.07	0.12	$1/\sqrt{(x)}$	**0.0571**
Giant ragweed	0.12	0.28	ln(x)	**0.0210**
Amaranthus Spp.	0.08	0.17	$1/\sqrt{(x)}$	**0.0724**

[1] Recent refers to the 160 fields where atrazine had been applied in the current or previous growing season

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[3] Type of transformation as suggested by the BoxCox method

Summary

- **Trend in relative abundance (RA)**
  - The RA of grasses is higher in fields where atrazine has been recently used compared to not being applied for 10 years.
  - The RA of broadleaves is higher in fields where atrazine use has been discontinued compared to recent use.

- **Frequency**
  - Total broadleaf escapes are more frequent in fields where atrazine use has been discontinued compared to recent use; primarily driven by more common lambsquarters, velvetleaf, and *Amaranthus* spp. escapes.

- **Density**
  - Total broadleaf escapes are more dense, especially common lambsquarters, velvetleaf, *Amaranthus* spp., and giant ragweed, in fields where atrazine use had been discontinued compared to recently used.

CONCLUSION

Weed communities are comprised of more frequent, dense, and in some cases abundant broadleaf weed species in fields where atrazine use has been discontinued compared to recently used.

THANK YOU

- **All the Growers, Crop Consultants and Farm Managers who participated in the survey**
- **Drs. Dave Stoltenberg, Paul Mitchell, and Joe Lauer**
- **Ryan Dewerff, Tommy Butts, Rebecca Bailey, Micheal Halle, Sara Maly, John Buol, Joe Zimbric, and Andrew Madden**
- **Funded by: Wisconsin Corn Promotion Board**

QUESTIONS?