Minimizing the impact of weeds and invasive plants on Wisconsin's landscape

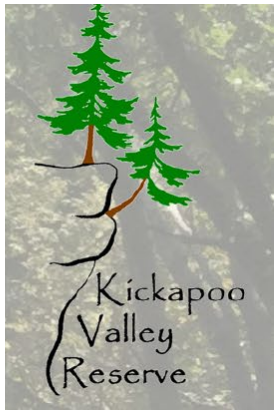
Extension
UNIVERSITY OF WISCONSIN–MADISON

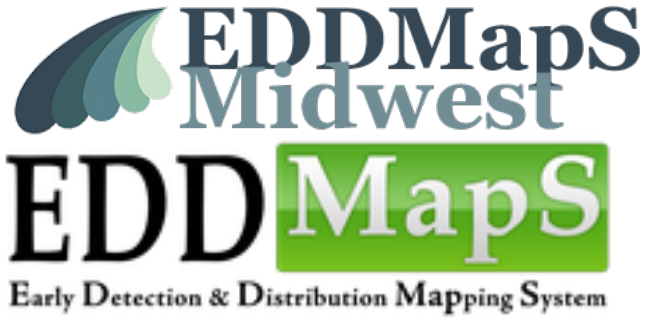
Mark Renz

Extension Weed Specialist

https://renzweedscience.cals.wisc.edu/

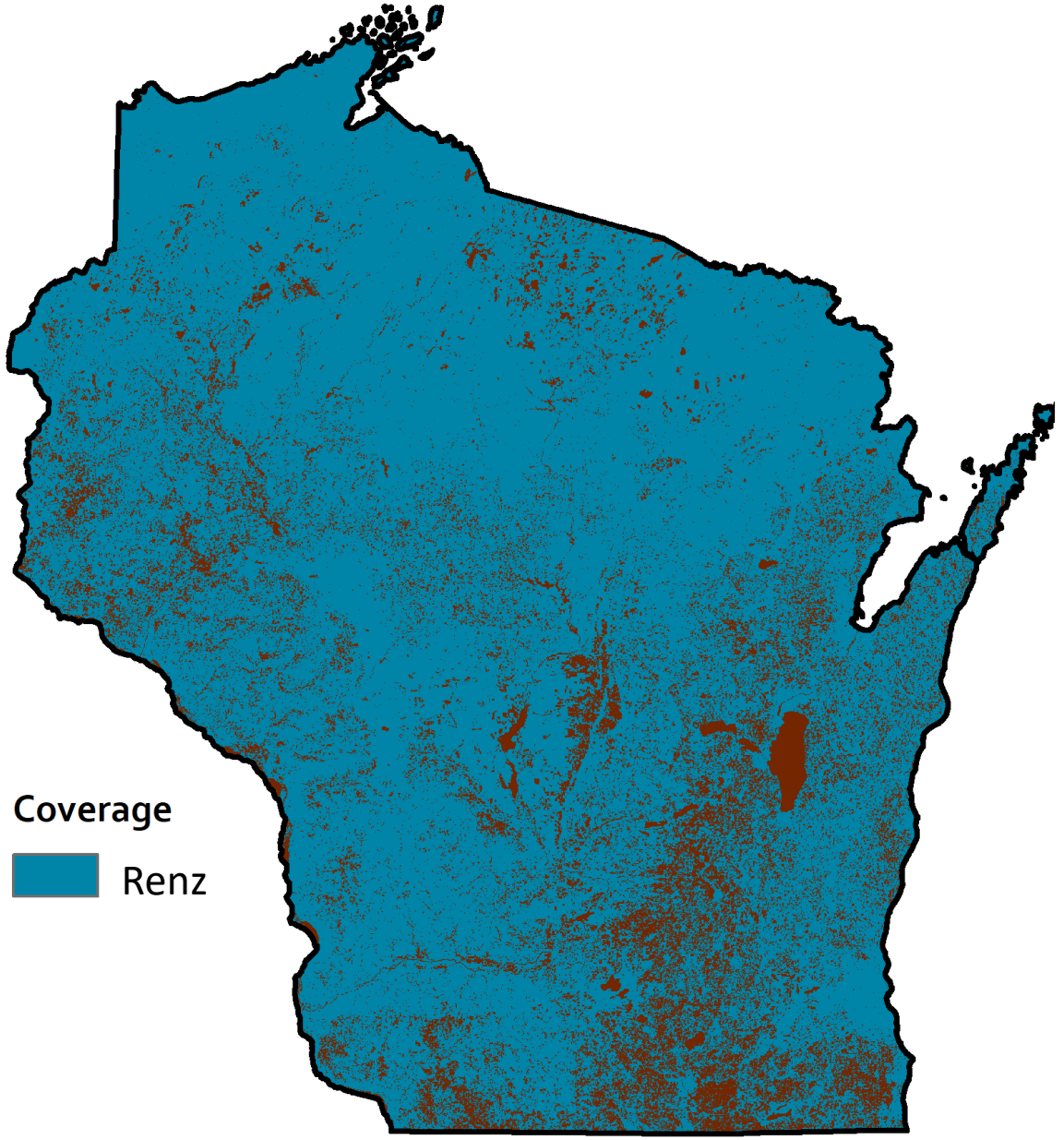
Colleagues, collaborators, staff & students





Benefit of strong weed science program

- Dr. Dave Stoltenberg
  - Herbicide resistance/cropping systems
- Dr. Rodrigo Werle
  - Annual row crops
- Dr. Jed Colquhoun
  - Vegetable and fruit crops
- Dr. Mark Renz
  - Forages, grasslands, forests, urban……..



What is a weed?

A plant that’s presence goes against the goal of the land

Impacts of weeds

Forages

- Reduces forage
  - establishment
  - quantity
  - quality
- Toxic plants

Natural / Non-crop

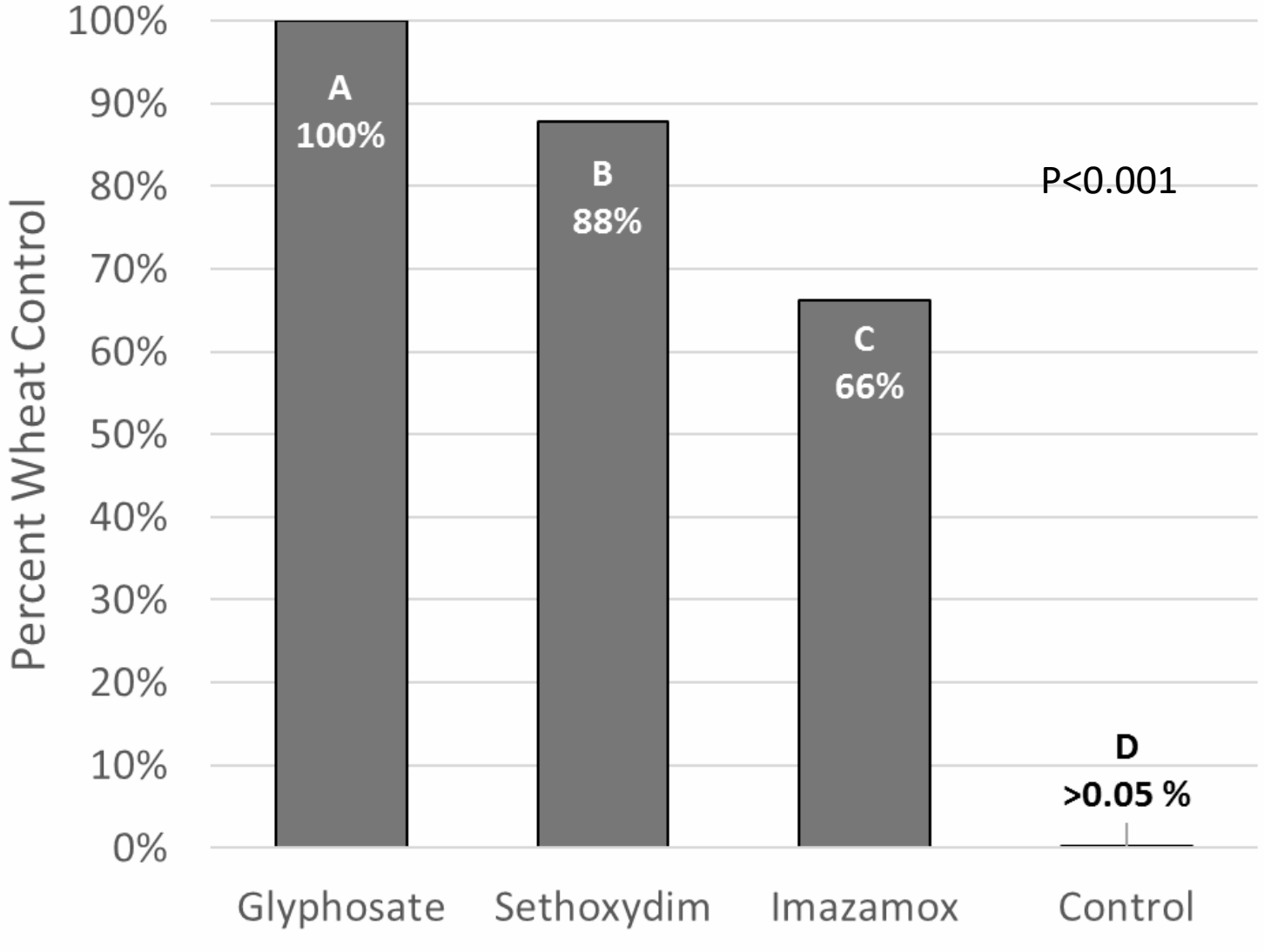
- Impacts to the
  - Environment
  - Human health
  - Economics of system

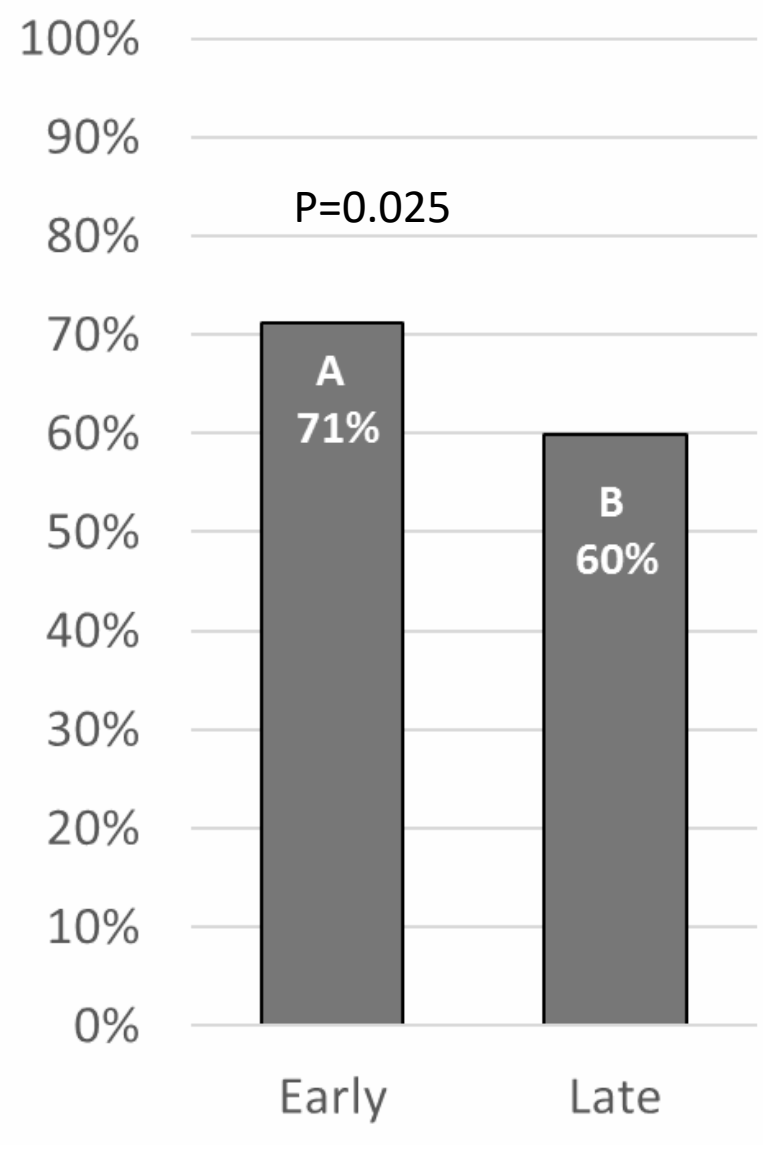
Management of Volunteer Winter Wheat in Summer Seeded Alfalfa

Chris Bloomingdale, Richard Proost, Mike Ballweg, & Mark Renz
University of Wisconsin-Madison

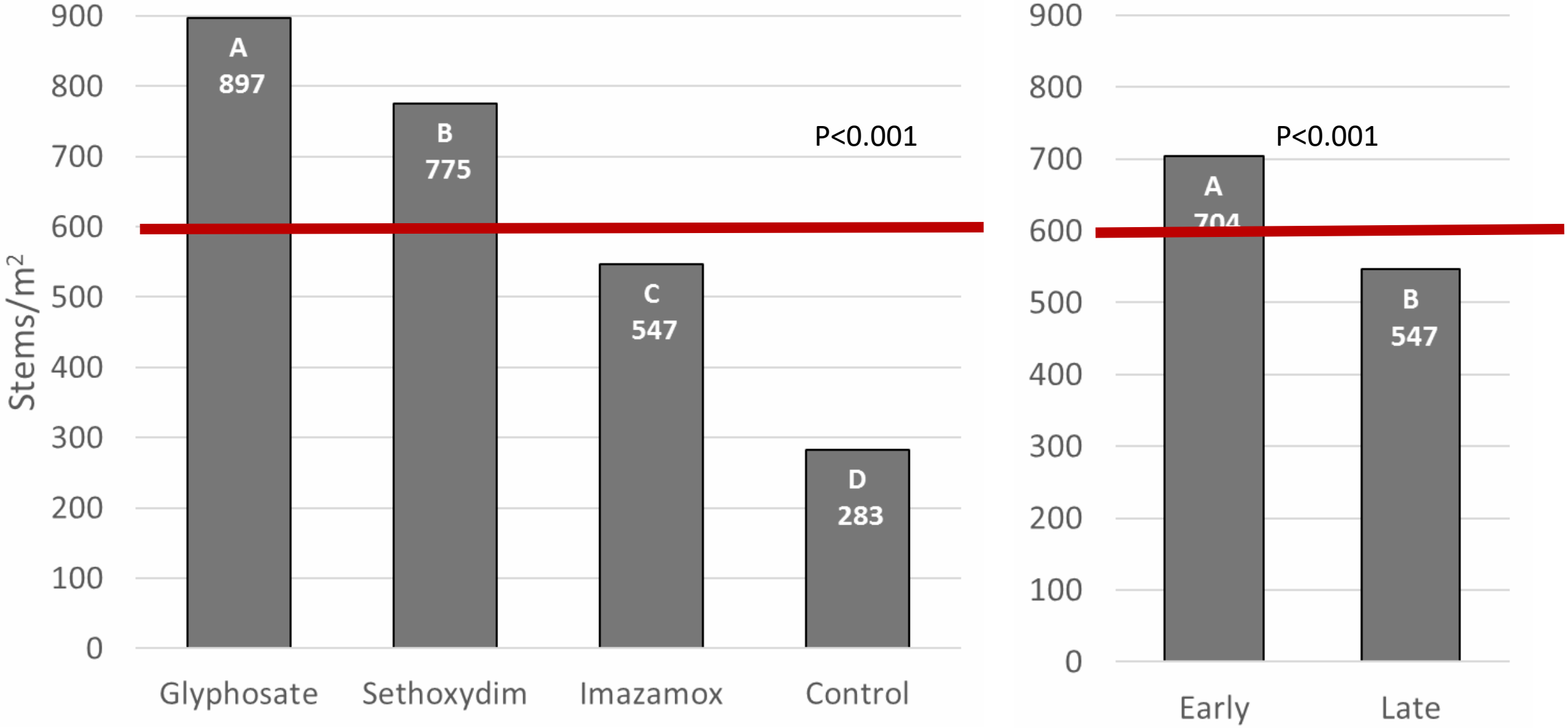
Impact on alfalfa the following spring

Volunteer Wheat Control Rating (28 DAT)

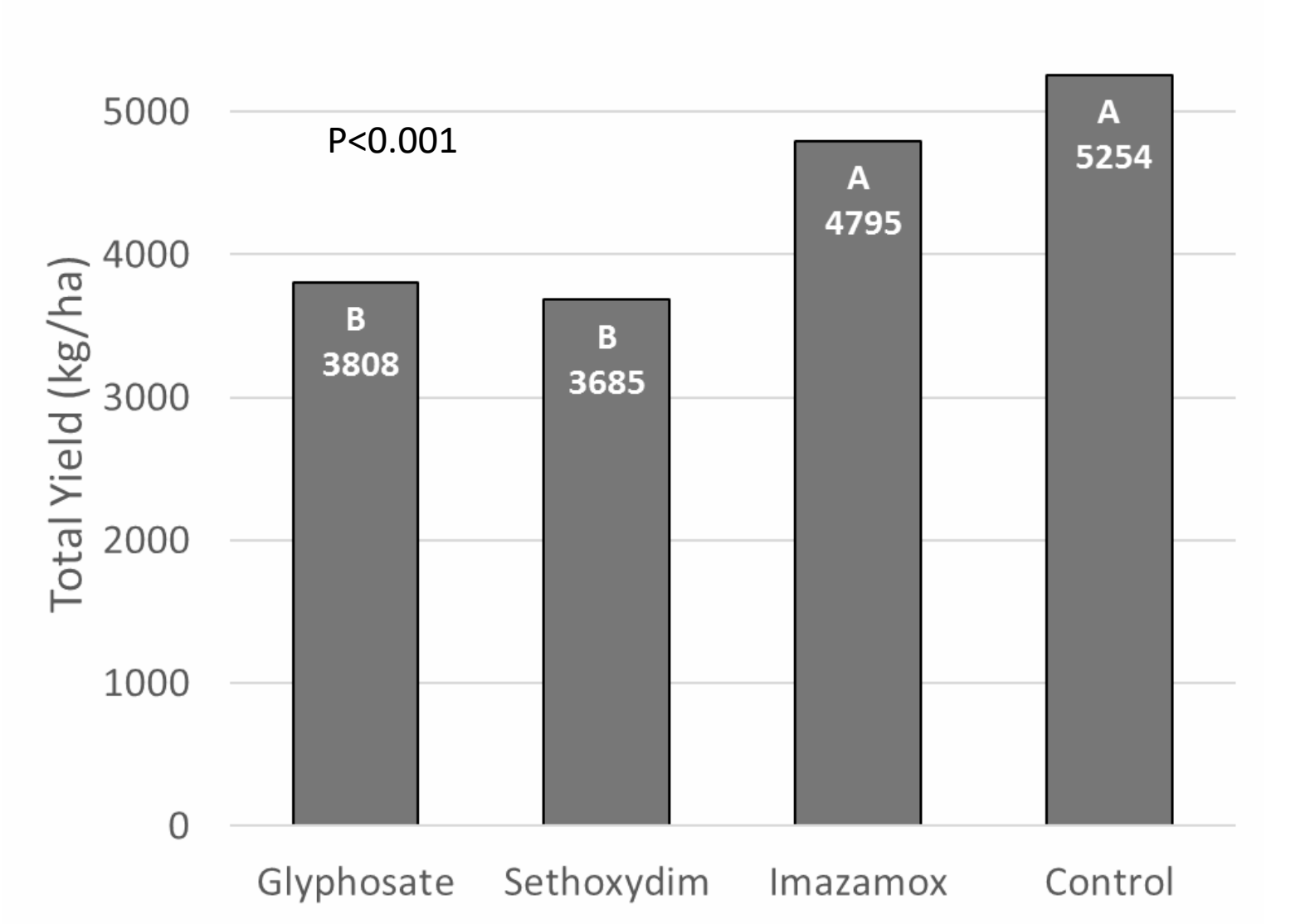




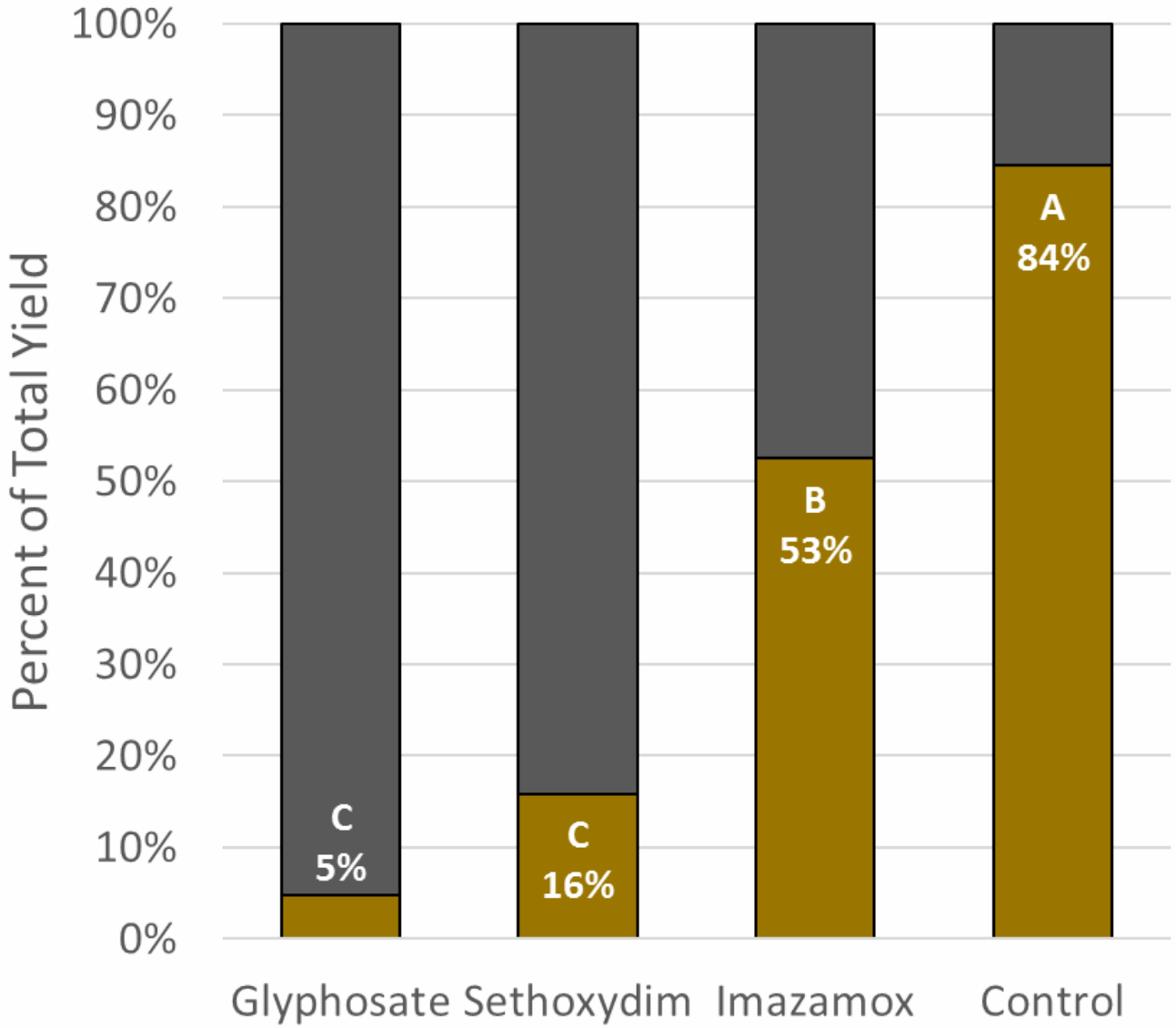
Spring Alfalfa Establishment



Results: First Cut Yield



Results: First Cut Wheat Yield



P<0.001

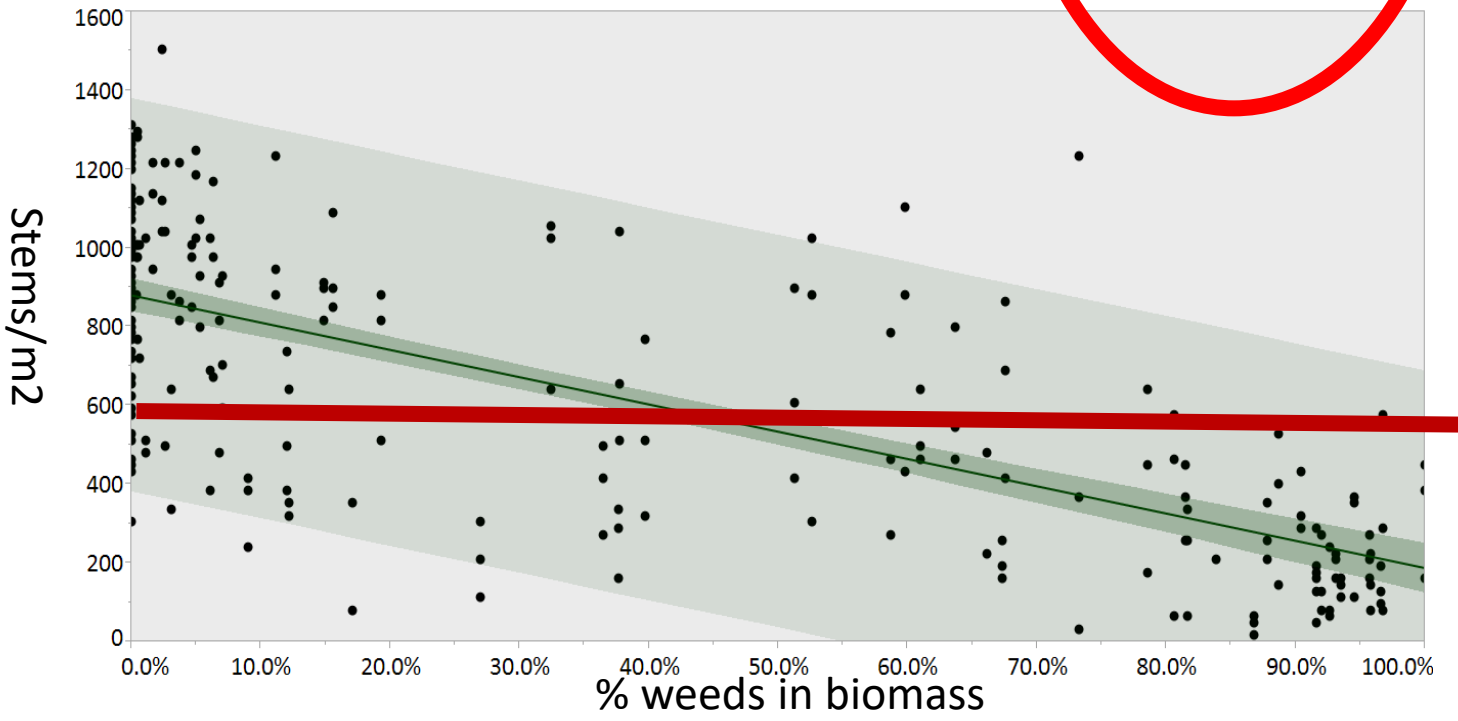
V. wheat has value as a forage……but

- milk production greatest when wheat biomass was high
- <40% wheat in biomass was needed to meet the minimum alfalfa stand stem (55 stems/ft2).

- Develop decision support tools
  - Keep volunteer wheat < 35% of the total forage the following spring.
    - 70% control 28 DAT

Forage quality averaged across three locations when volunteer wheat was managed by one of three herbicides (P value = <0.01)

Treatment	Crude protein	ADF	NDF	RFQ	Milk/ton forage	Milk/acre forage
Roundup (glyphosate)	21.6a	30.2b	37.5c	184a	3,190a	5,405b
Poast Plus (sethoxydim)	20.9a	30.3b	38.9c	178a	3,169a	5,200b
Raptor (imazamox)	16.7b	32.1a	47.0b	152b	3,030b	6,412a
Control (non-treated)	14.0c	32.7a	51.5a	138c	3,010b	6,967a



Extend information to stakeholders

https://ipcm.wisc.edu/blog/2018/09/managing-volunteer-wheat-in-late-summer-seeded-alfalfa/

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MANAGING VOLUNTEER WHEAT IN LATE SUMMER SEEDED ALFALFA

CURRENT NEWSLETTER

- Wisconsin Crop Manager 3-28-2019

MANAGING VOLUNTEER WHEAT IN LATE SUMMER SEEDED ALFALFA

College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

Mark Renz and **Chris Bloomingdale**,
University of Wisconsin-Madison,
Department of Agronomy

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University of Wisconsin-Madison

Mike Ballweg,
University of Wisconsin-Extension

UW Extension | NPM

Wheat is an important agronomic crop in the rotations of many Midwestern states and is often followed by a late summer seeding of alfalfa. In this situation, wheat seed not collected in the combine becomes a weed and impacts alfalfa establishment and productivity, especially in no and reduced till fields. Previous research in Wisconsin has shown that volunteer wheat can reduce alfalfa density by up to 50%, resulting in shorter alfalfa stand life and reducing forage quality the following spring. This past research documented a well-timed application of sethoxydim (Poast Plus) during establishment in the fall when wheat is less 6 inches tall can alleviate this impact and provide excellent control (see photo below).

This research (done between 2008-2010) led to further questions about managing volunteer wheat in alfalfa:

Does glyphosate (Roundup) in Roundup Ready Alfalfa or imazamox (Raptor) provide similar control as sethoxydim (Poast Plus) ?

Is performance maximized when applied to volunteer wheat that is less than or equal to 6 to 6-½ inch tall ?

What level of volunteer wheat control is needed to prevent impact on alfalfa establishment while maximizing forage productivity and quality for dairy-based systems?

METHODS

To address these questions, a study was initiated in 2015 at three locations across Wisconsin to compare the effectiveness of Roundup (glyphosate), Raptor (imazamox) and Poast Plus (sethoxydim) in controlling volunteer wheat in alfalfa. Research sites were located in central, eastern and southwestern parts of the state. Roundup Ready alfalfa was seeded into fields where winter wheat was harvested earlier that summer. Roundup WeatherMAX at 22 fl oz/acre, Poast Plus at 2.25 pt/acre and Raptor at 4 fl oz/acre were compared to an untreated control at all three locations. Adjuvants were used per label recommendations for each product. Early applications were made when wheat was 4-6 inches tall, and alfalfa was at the 2-3 trifoliate leaf stage; the later application was made 12-20 days later, when wheat was 6-12 inches tall. Results are averaged across all three locations.

Similar projects in pastures:

understanding benefits/costs of weeds

Public grasslands shrubs

Mob grazing Canada thistle

Status of organic dairy pasture forage composition, productivity, soil fertility and grazing management practices in Wisconsin

Wisconsin has the largest number of organic dairies in the United States with over 450 dairy farms that represents more than 25% of the nation's certified organic dairy farms (USDA NASS, 2014). Despite the large amount of organic dairy operations in Wisconsin, interest in expansion of existing and new operations exist due to the high amount of consumer demand for organic milk (Greene and McBride, 2015).

One of the major obstacles for dairies are the production and management of feed as costs for these two factors can be 50% of total costs of milk production (Hardie et al., 2014). While feed is obtained from several sources, pastures are a required component with certified organic dairies as at least 30% of animal feed must be from pastures during the growing season (at least 120 days). As this can be challenging, dairies typically utilize intensive grazing management methods that involve moving animals on and off of pastures to maximize forage production and quality required for dairy (called managed intensive rotational grazing, MIRG). While MIRG is an effective approach, a wide range of practices within this system can influence milk production. Forage composition (Brink et al., 2008; Sleugh et al., 2000), soil fertility (McCartney et al., 1998), and grazing management (e.g. rest period) (Dale et al., 2008), all can impact milk production. Given that limited land is available for expansion of existing operations (Jackson- Smith, 2002), increases in efficiencies on farm are needed to improve milk production, and pastures have been identified as a crop that can be improved on many farms.

Organic dairy pasture performance

Inter-seeding alfalfa into corn silage

Intensifying Wisconsin's forage production system

John Grabber, Mark Renz, William Osterholz, Heathcliffe Riday, Damon Smith, Matt Ruark, Natalia de Leon, and Joe Lauer

Dave Bjorneberg (USDA-ARS), Kim Cassida and Erin Burns (Michigan State Univ), and Jessica Williamson (Penn State Univ.)

Steps for successful establishment

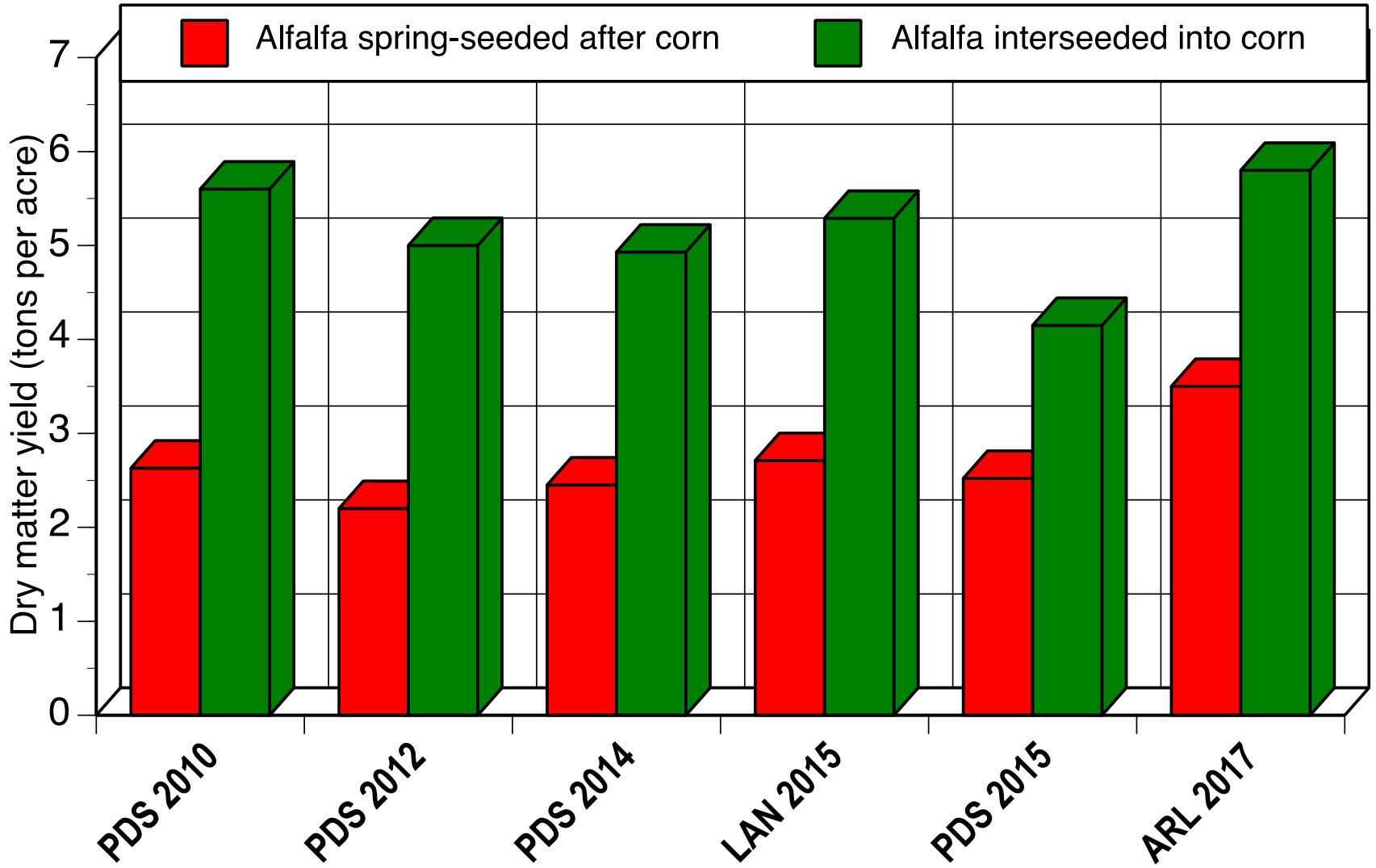
1. Interseed alfalfa soon after corn planting
   - At planting to VE

2. Apply “plant protection” products
   - growth regulator (prohexadione)
   - fungicide & insecticide (if present)

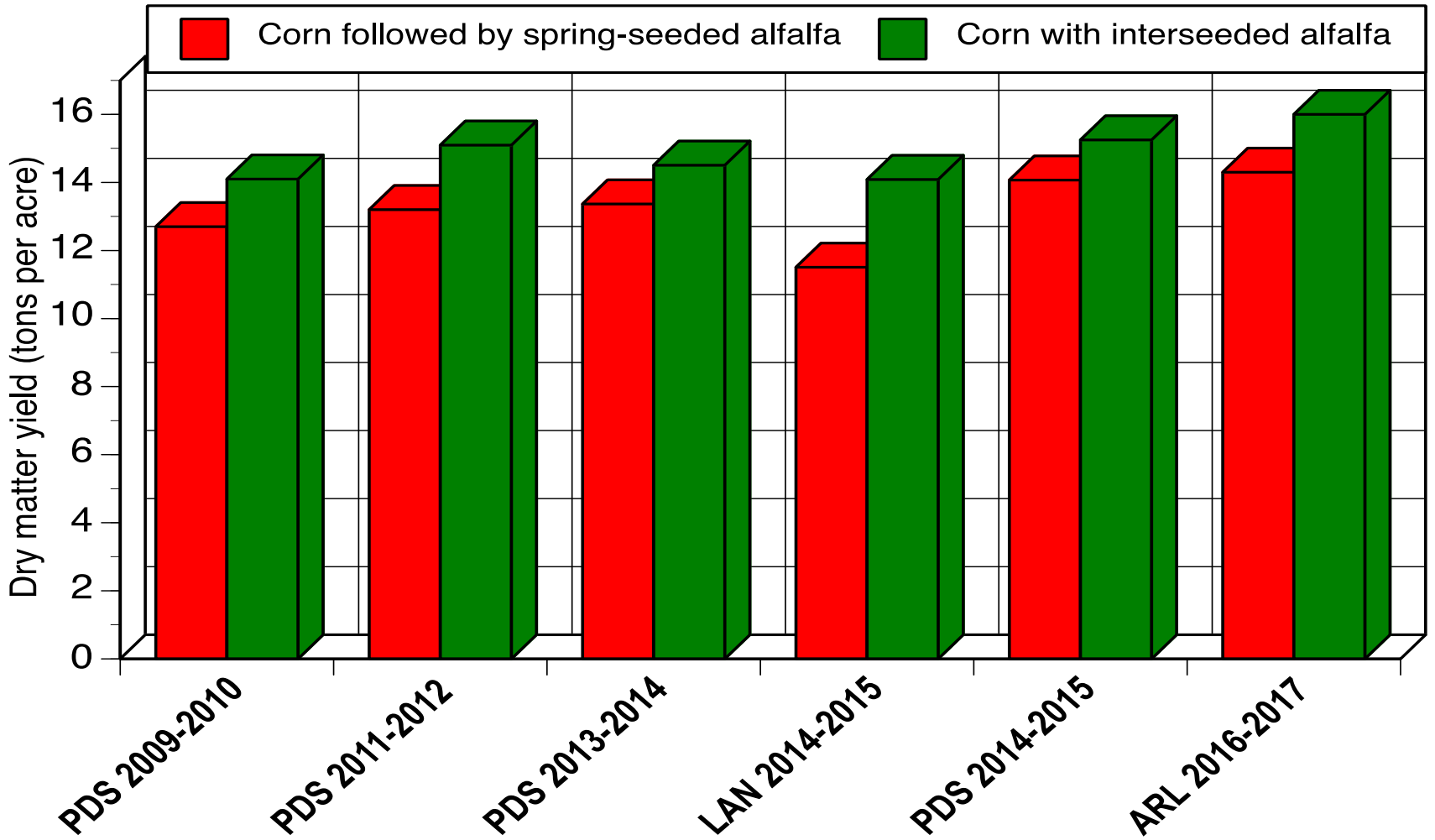
3. Interseed adapted alfalfa varieties

	July	August	October
Control			

Successful establishment by interseeding doubles first year alfalfa yields



Successful alfalfa interseeding increases total yields of corn plus first year alfalfa



12% increase
= 1.6 tons per acre

Weed management in corn/alfalfa interseeded system

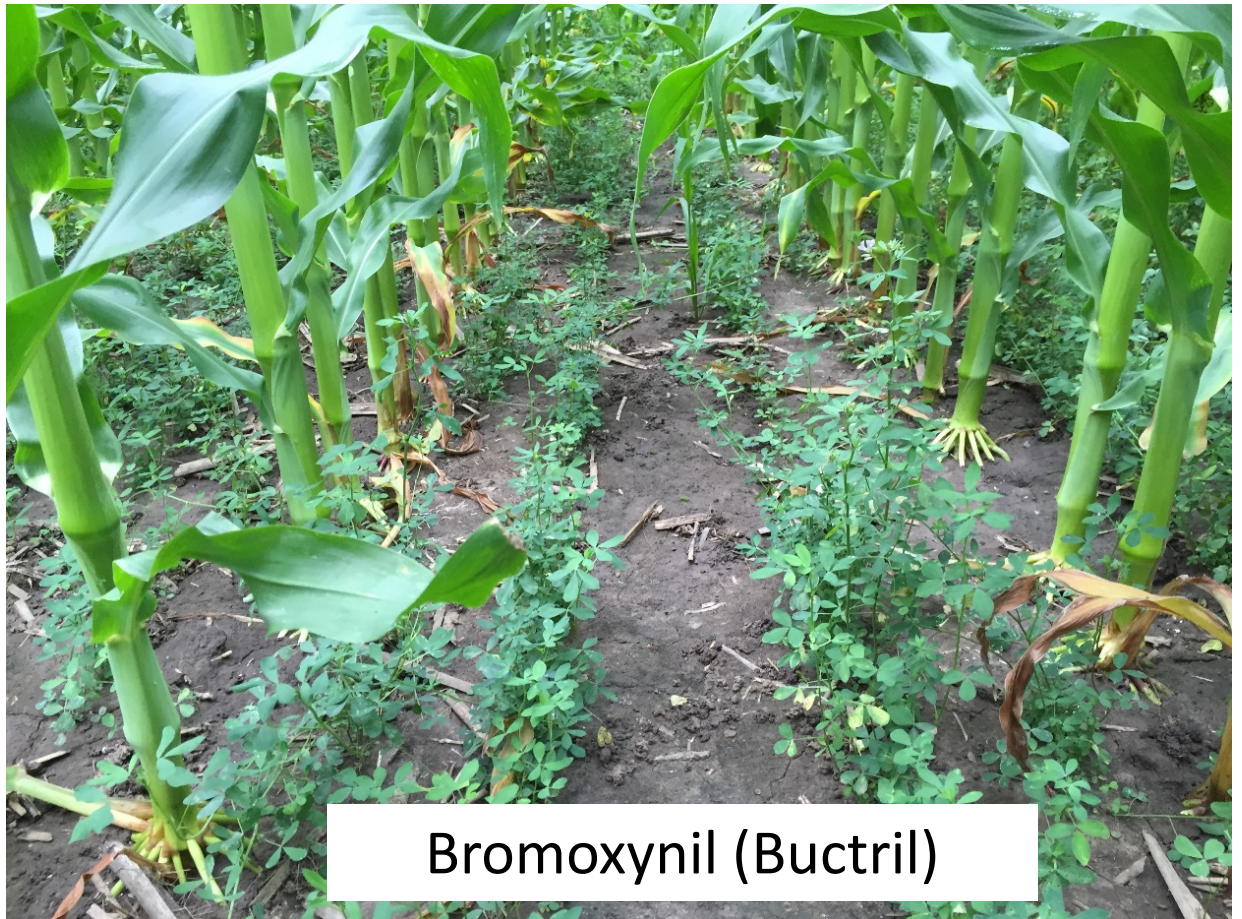
- Pursuit POST + Clearfield corn
  - PRO: effective season long control with one application
  - CON:
    - Few Clearfield hybrids available
    - ALS resistant weeds
- Glyphosate POST with Roundup Ready corn/alfalfa
  - PRO: effective season long control with one application
  - CON:
    - Glyphosate resistant weeds
    - Cost RR varieties planted compared to conventional varieties
    - **Current RR alfalfa varieties have poor survival in this system**

Screened glyphosate alternative herbicides

PRE HERBICIDES

Acetochlor (Warrant)

POST HERBICIDES



Bromoxynil (Buctril)

Effective non-glyphosate weed control options

Crop(s)	Herbicide treatment	Timing	Weed cover 2 WA POST	Weed cover 4 WA POST
Corn + alfalfa	Warrant 3 pt/A	PRE	6 C	6 B
Corn + alfalfa	Buctril 2EC 1 pt/A	POST	6 C	6 B
Corn + alfalfa	Warrant 3 pt/A + Buctril 2EC 1 pt/A	PRE+ POST	2 C	2 B
Corn + alfalfa	Non-treated control	-	23 B	16 B
Corn	Non-treated control	-	67 A	46 A
			P<0.05	P<0.05

Weed cover reduced to < 10%;

65% reduction in weed cover when alfalfa is included

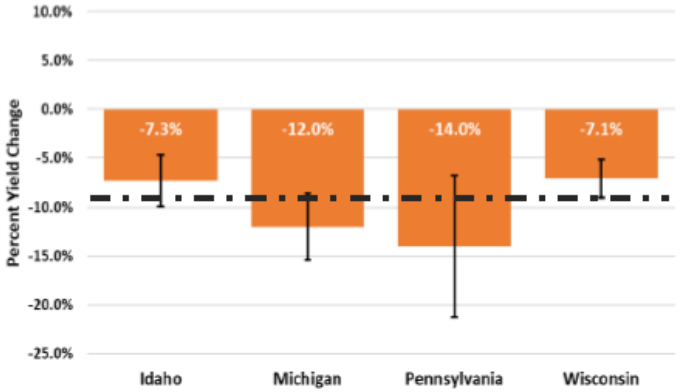
Optimize establishment success

- NIFA grant
  - USDA-ARS (WI, ID)
  - MICHIGAN STATE
  - PENN STATE
- Multiple locations over 2 yrs
  - Research Station (3/yr)
  - On farm (12/yr)

2018 Multi-State Results

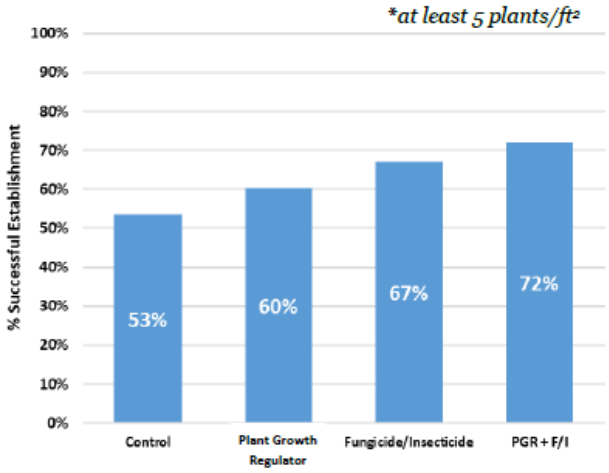
Factors influencing corn yield and alfalfa establishment

Does interseeding alfalfa in corn reduce corn silage yields?

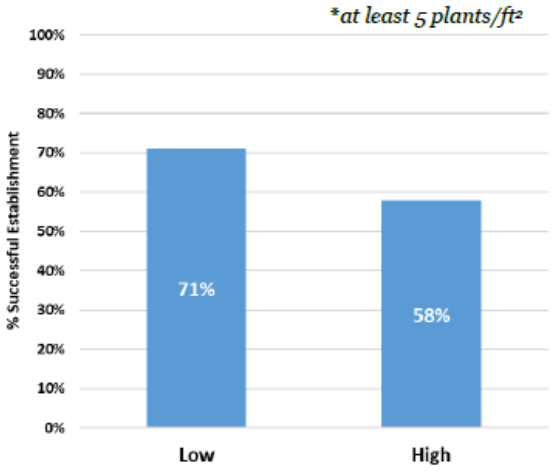


One year of results across 13 locations suggests 9% (dashed line) reduction in corn silage yield.

Does the addition of a plant growth regulator and/or fungicide and insecticide impact successful* fall alfalfa establishment?



Does corn planting density impact successful* fall alfalfa establishment?



One year of results across 14 locations suggests improved successful alfalfa establishment with additional inputs and lower corn planting densities.

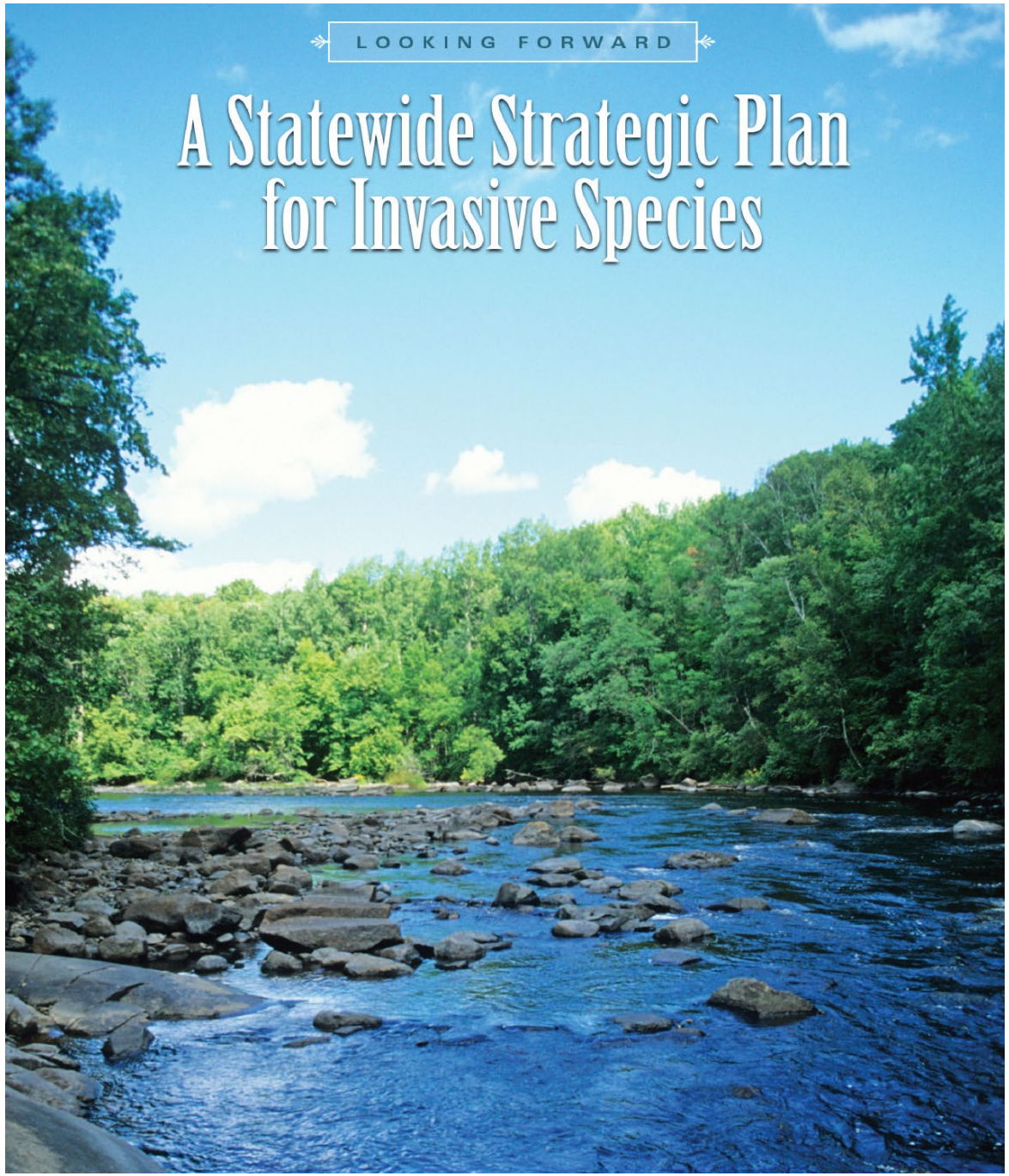
Challenges exist for adoption

Ongoing efforts to increase adoption

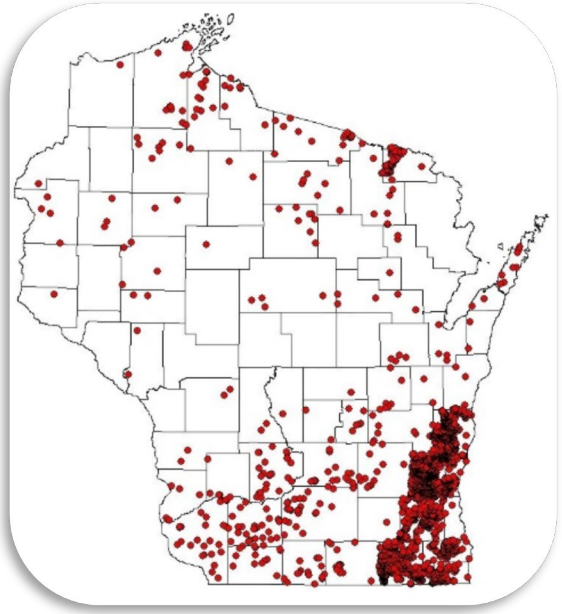
- Best rates/timing for prohexadione, fungicides, insecticides, and herbicides
- Optimal planting and harvest management
- Long-term survival and yield of interseeded alfalfa
- Corn hybrid selection and populations
- Fertilizer and manure management
- Economics of corn-interseeded alfalfa
- Breed alfalfa for interseeding
- Success rate in various environments
- Promote alfalfa interseeding to producers, industry, NRCS, crop insurance

Invasive plants

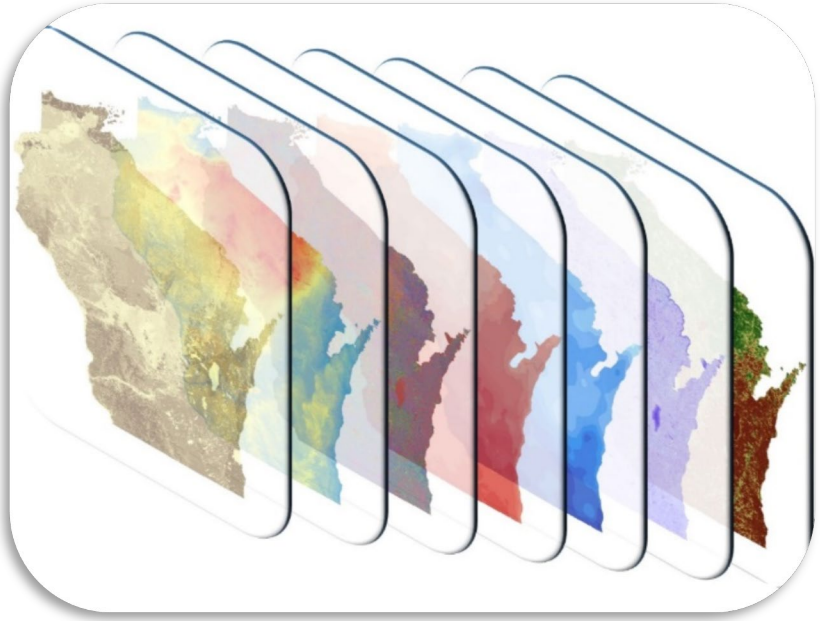
- Impact human health, environment, and economics of system
- Typically grow in minimally managed areas
  - Limited funding to monitor and manage
- Strategic plan emphasizes
  - Early detection and rapid response
  - Engaging with citizen scientists
  - Regulating species with high potential for spread/impact



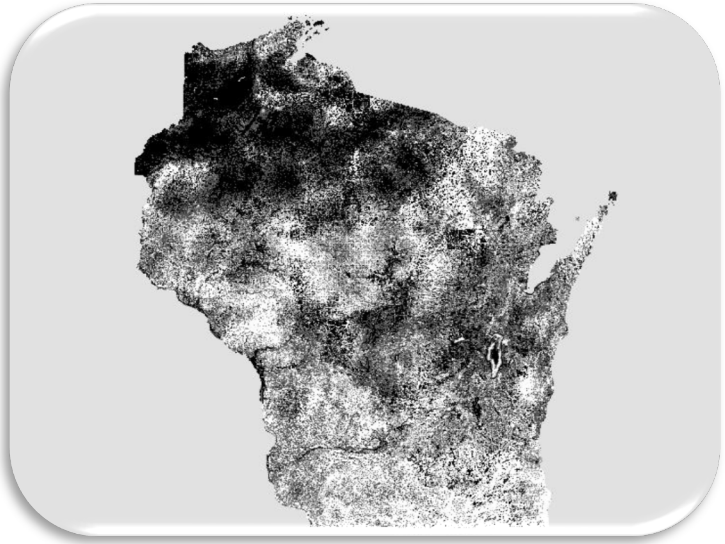
Creation and Validation of Invasive Plant Ensemble Habitat Suitability Models



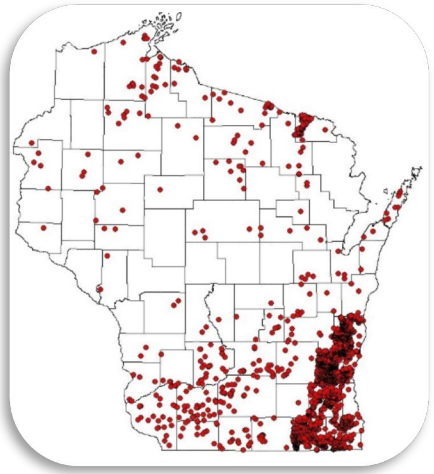
- Species occurrence records

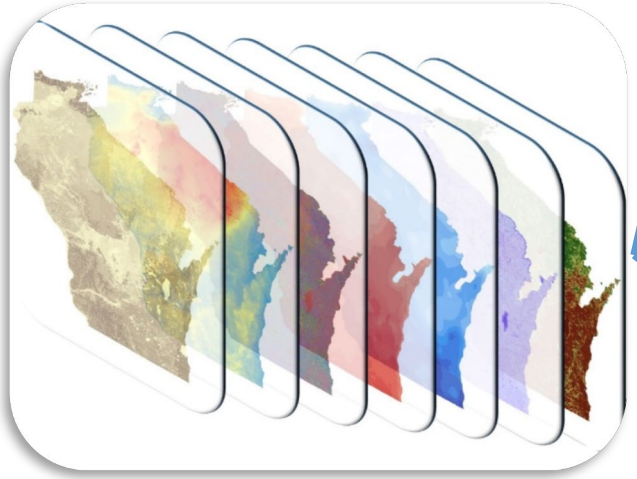


- Precipitation
- Temperature
- Soils attributes
- Distance to dispersal corridors
- Topographic attributes
- Vegetation indices



- Probability of suitable habitat





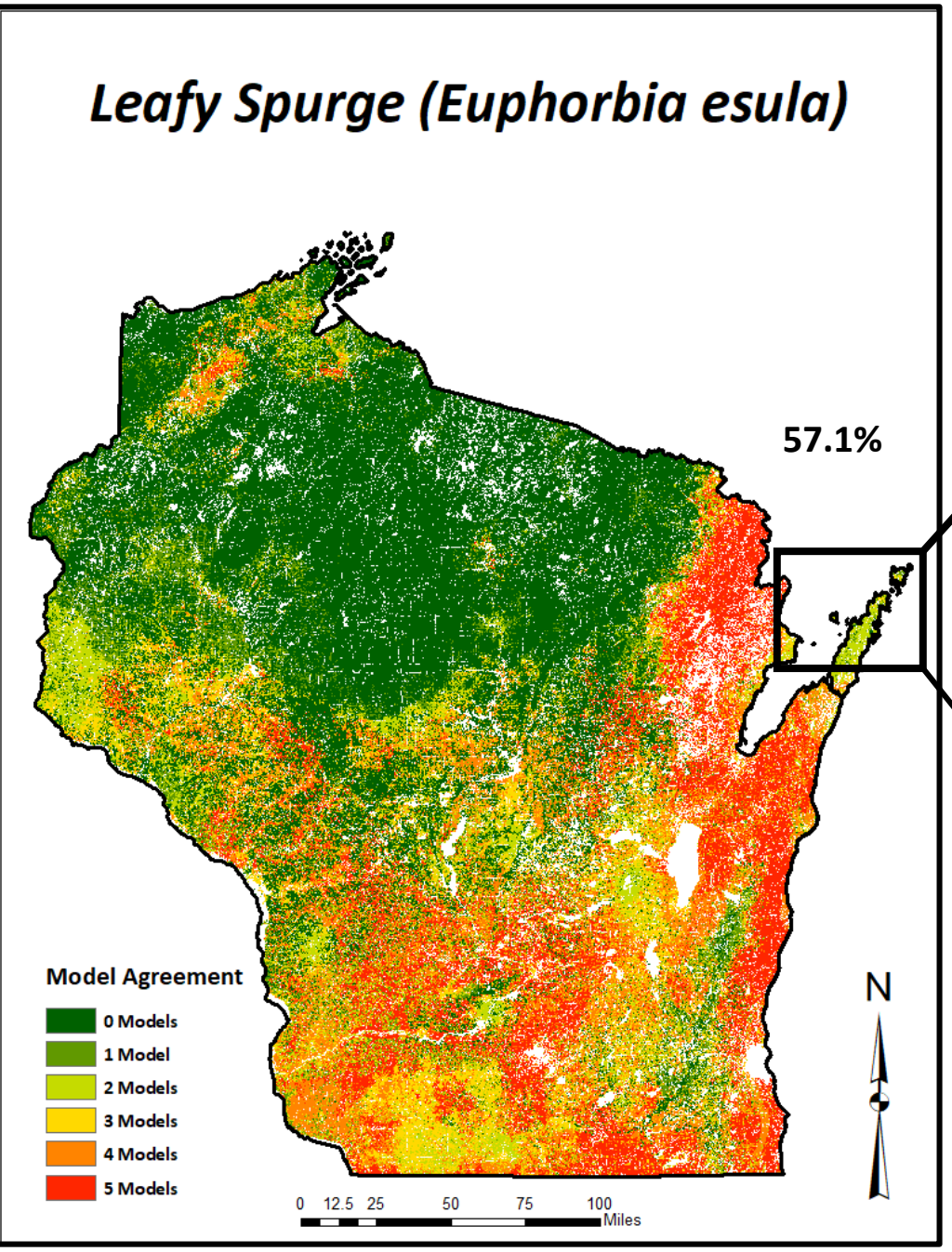
BRT

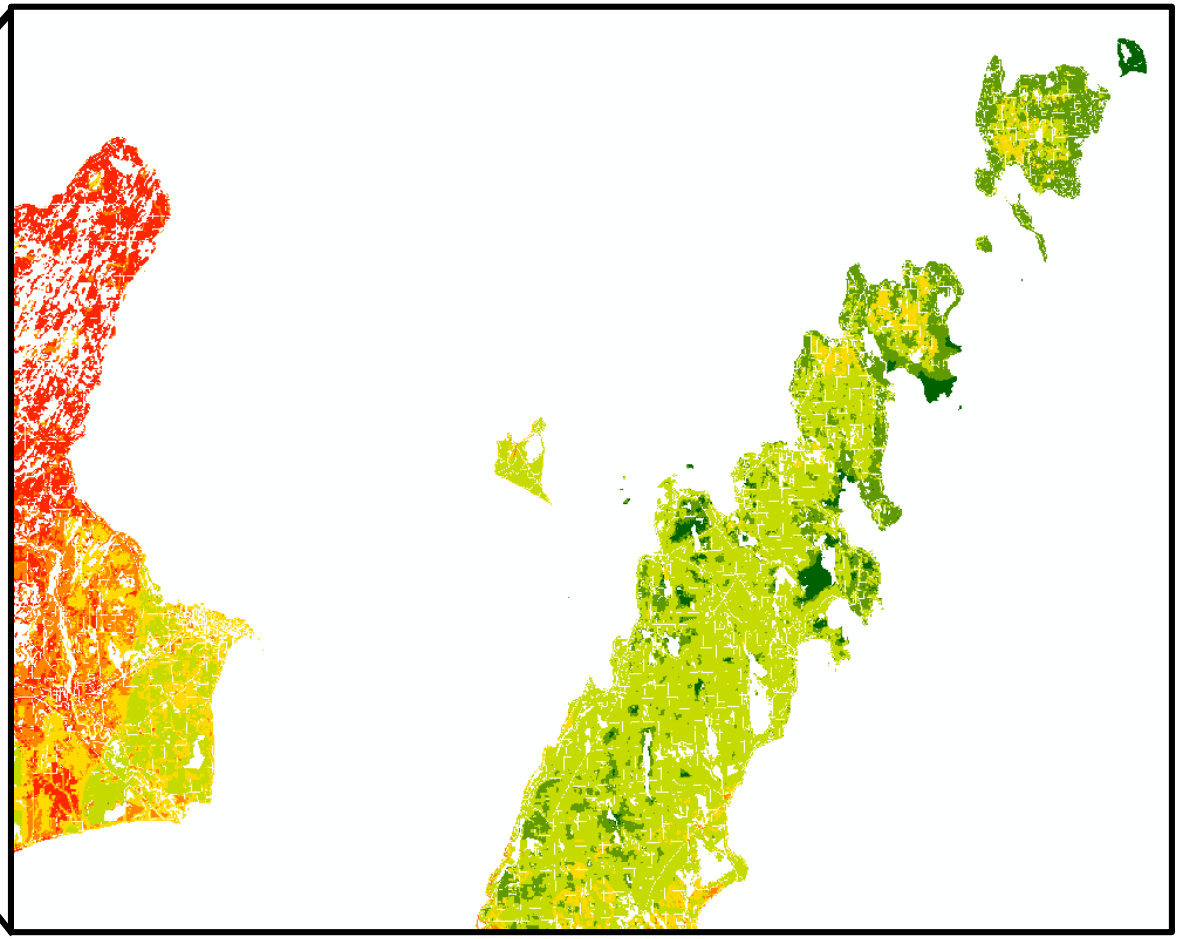
GLM

MARS

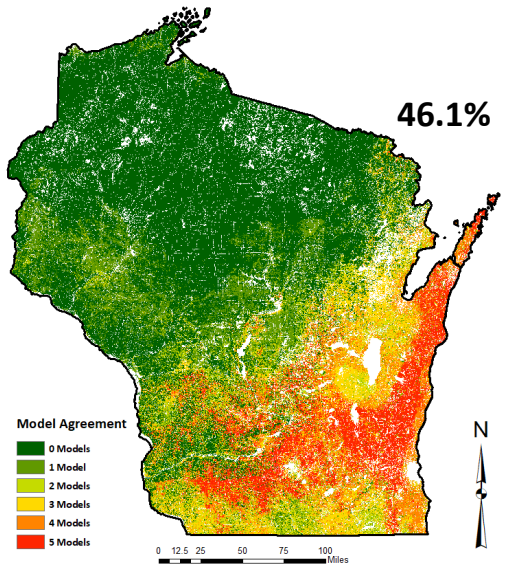
MAXENT

RF

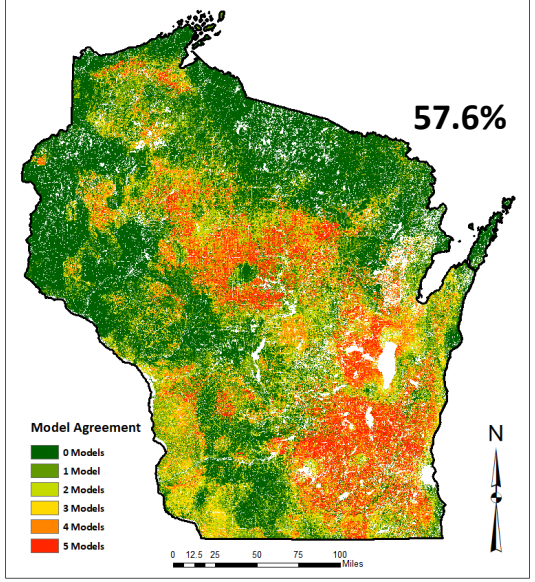

Leafy Spurge (Euphorbia esula)
57.1%
Model Agreement
0 Models
1 Model
2 Models
3 Models
4 Models
5 Models
N
0 12.5 25 50 75 100
Miles


Euphorbia esula

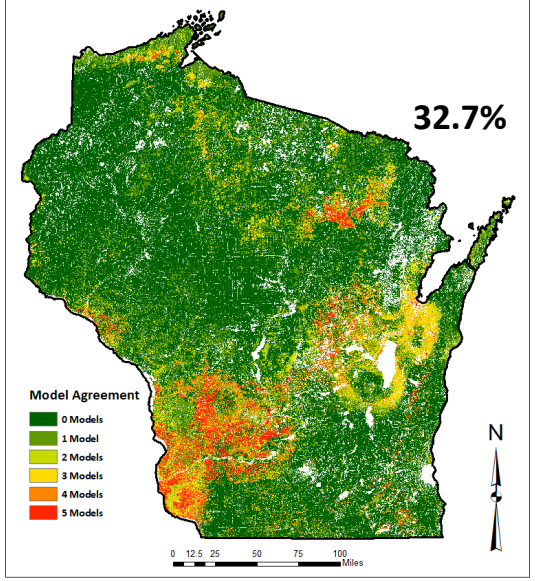
Autumn Olive (Elaeagnus umbellata)



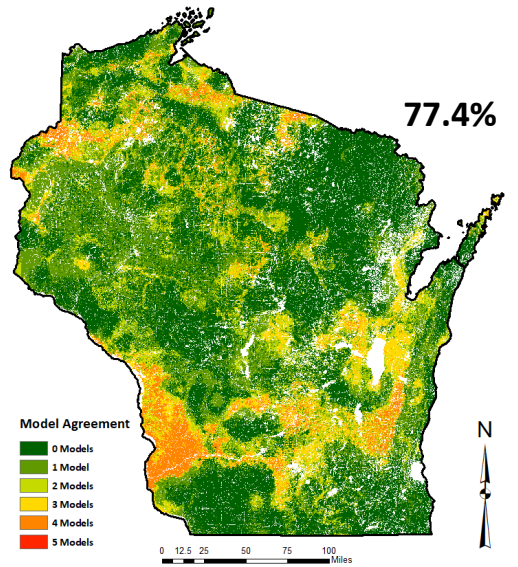
Canada Thistle (Cirsium arvense)



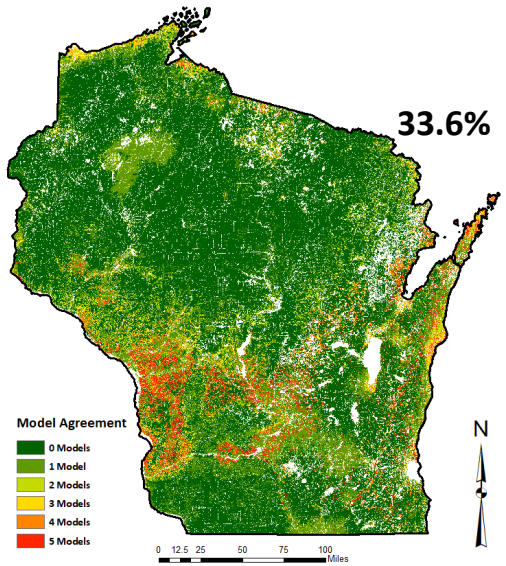
Garlic Mustard (Alliaria petiolata)



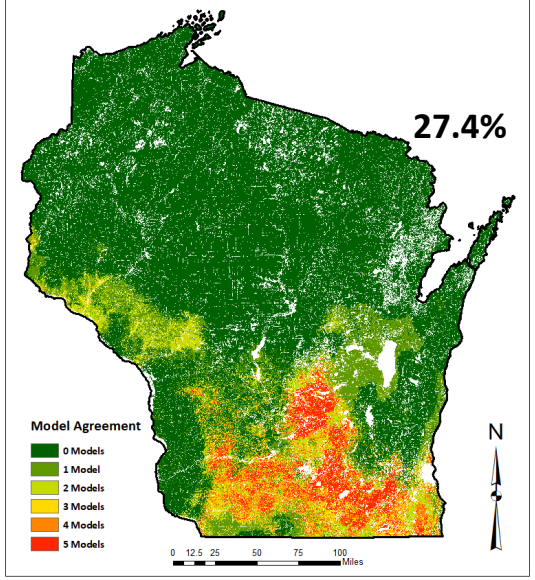
Exotic Bush Honeysuckles (Lonicera spp.)



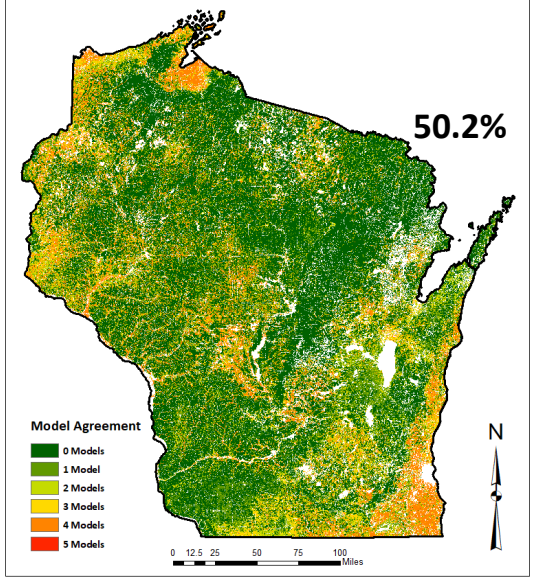
Japanese Barberry (Berberis thungbergii)



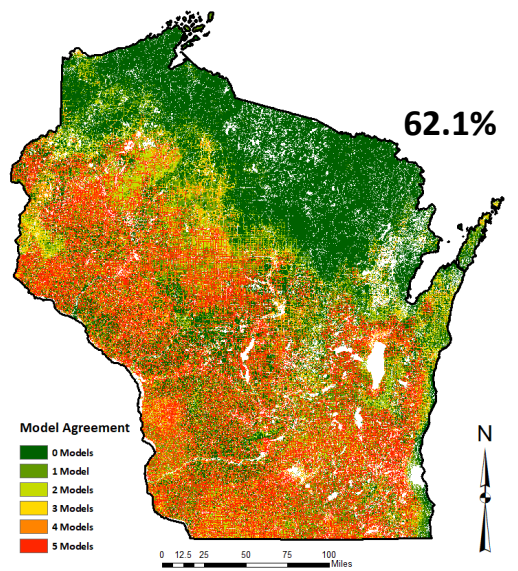
Japanese Hedge-Parsley (Torilis japonica)



Purple Loosestrife (Lythrum salicaria)



Wild Parsnip (Pastinaca sativa)



Priority Invasive Species Lists in Wisconsin

An Invasive

County Specific Priority Lists | Autumn Olive | Canada Thistle | Common Buckthorn | Crown Vetch | European Marsh Thistle | Exotic Hon

Invasive plants are a pervasive problem. The ability to detect an invasive species in the early stages of an invasion is critical to control and eradicate populations. The following map series depicts the results of efforts to model the suitable habitat of regulated invasive plants across the state of Wisconsin. This research was performed in the Renz Lab at the University of

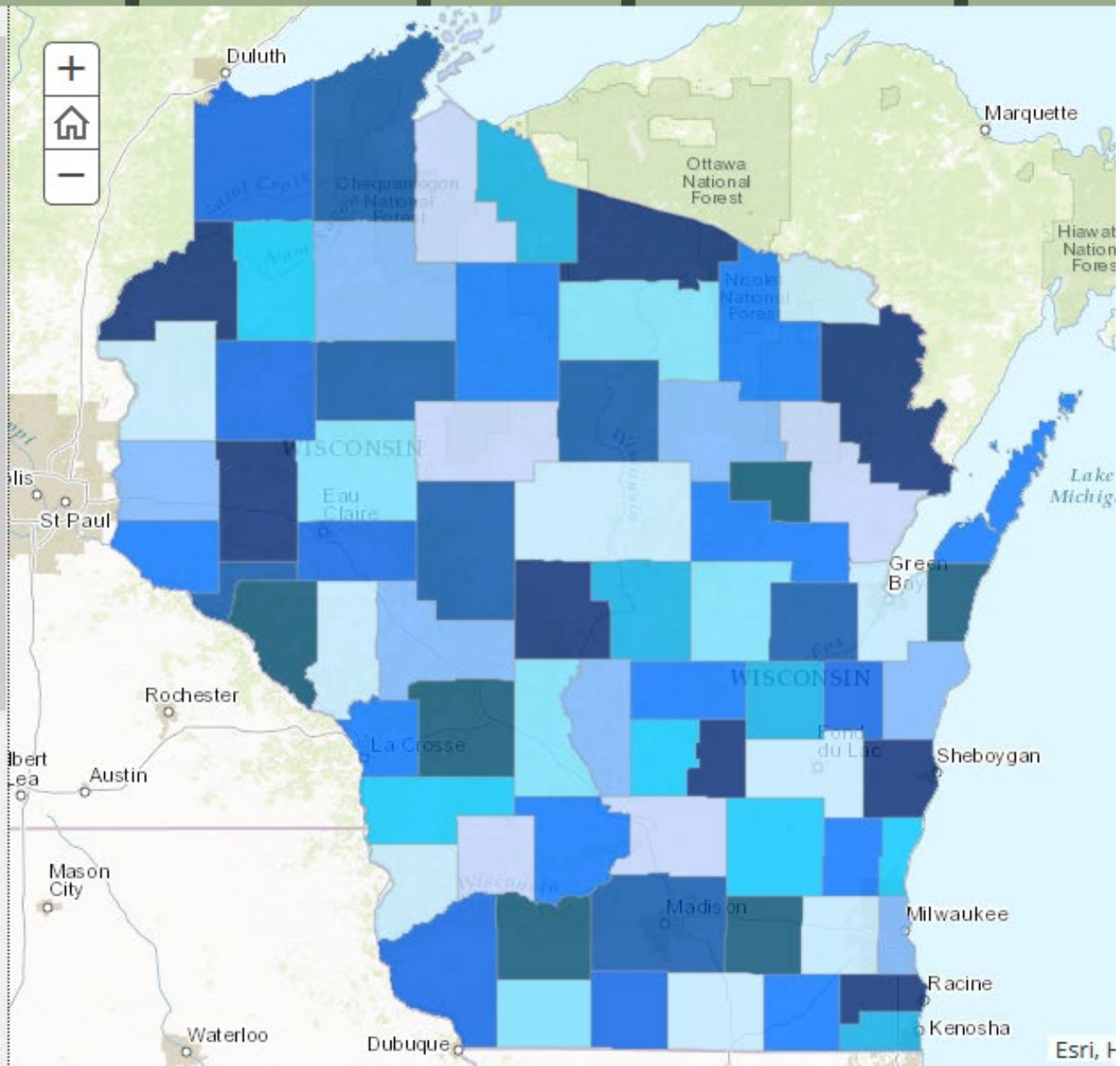
nsion.

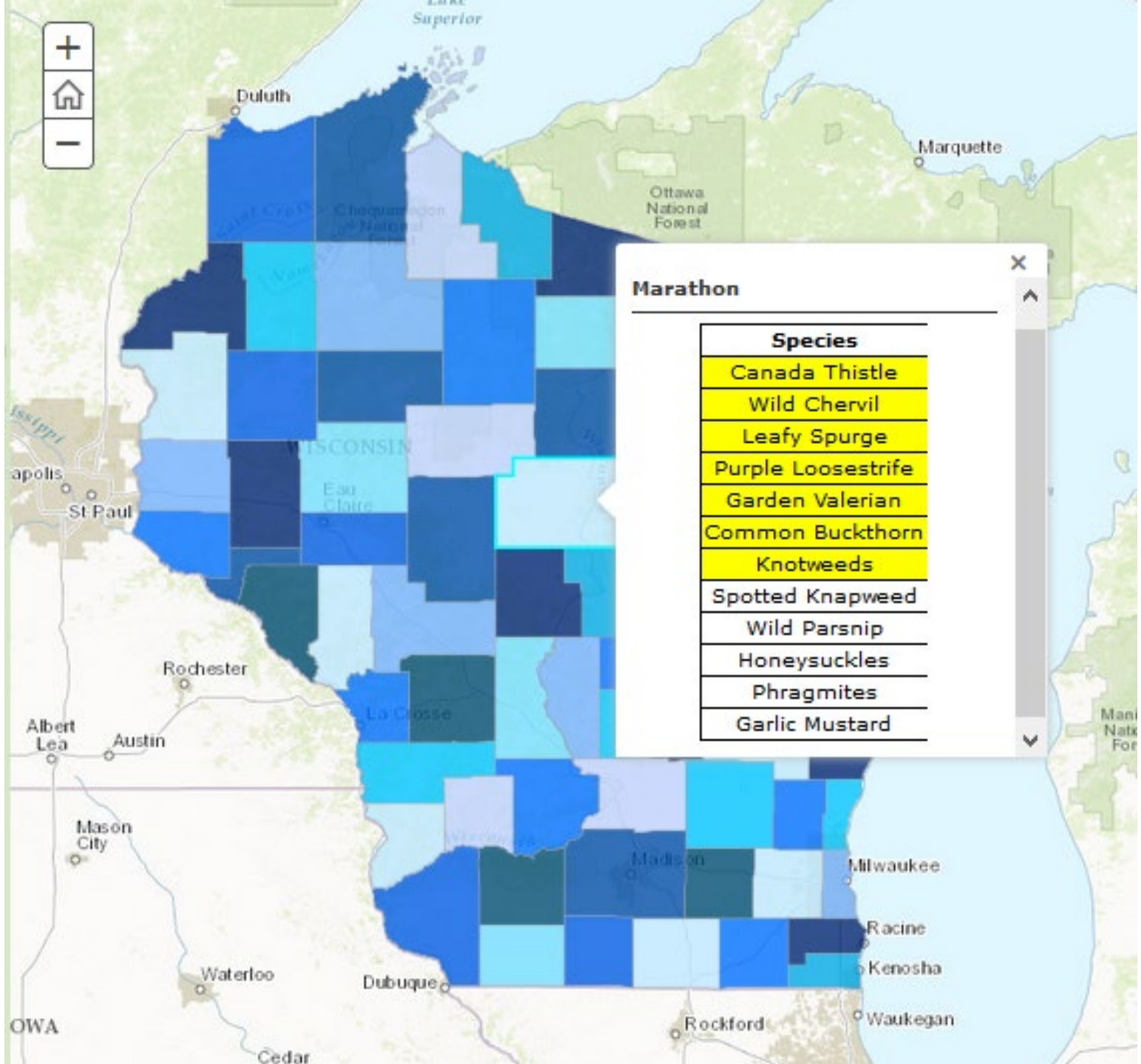
own

Access the story map at:
http://arcg.is/2ob5PdW

2. Display county-specific species lists for invasive species likely to be present (***10-15 species***)
3. Encourage reporting invasive species occurrences

If you are interested in getting involved with our project, we need help locating these (and other) species! Click on your county on the map to the right to find out which invasive plant species are of greatest priority. Species highlighted in ***yellow*** (high priority species) have been identified as those with large areas of suitable habitat in the county, but very few, if any, species occurrence records are currently available. If you are not sure if your location has been reported, click the tab that lists the species of interest to view a map of known locations and links to resources to aid in identification.



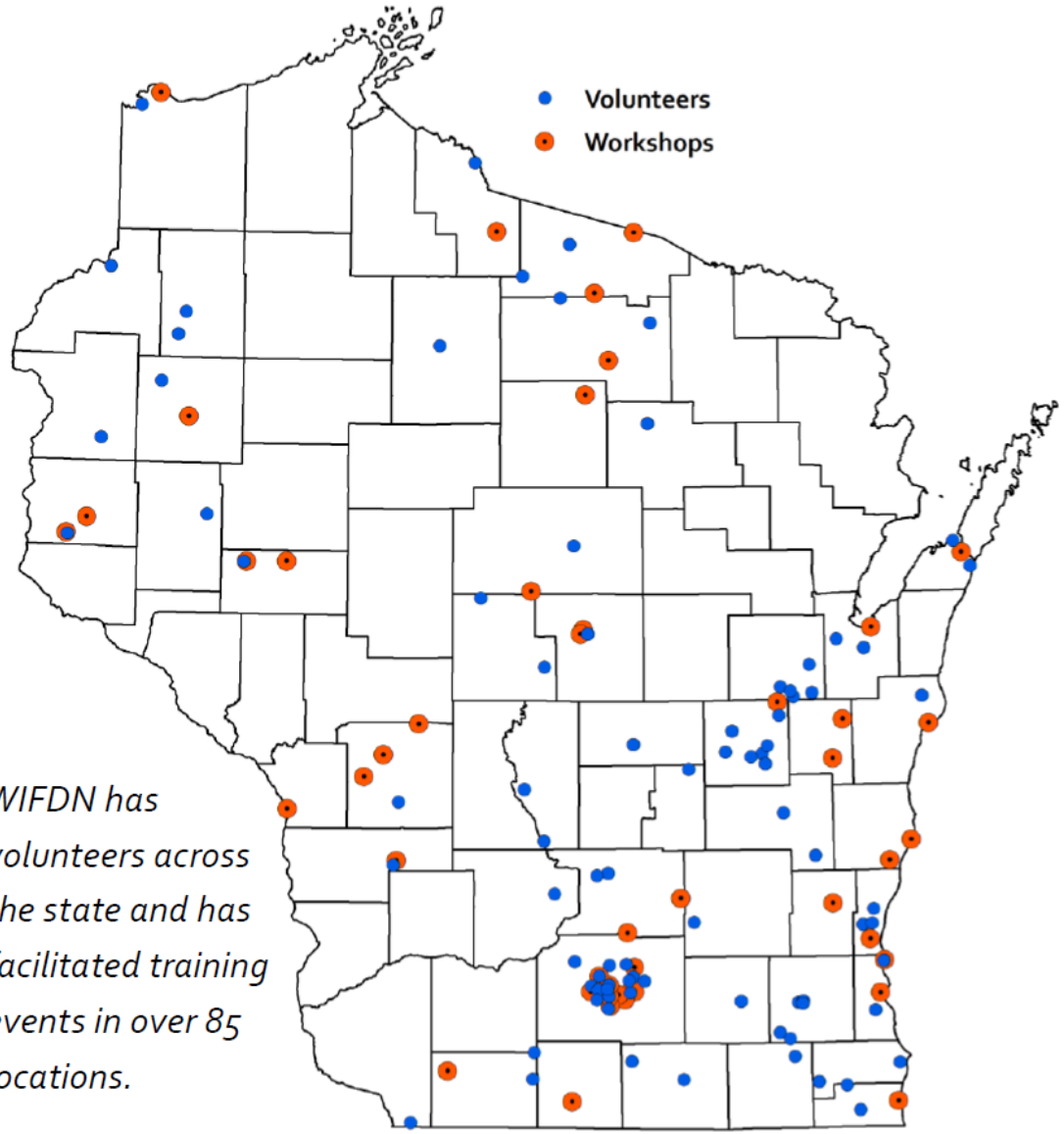


- Website viewed over 20,000 times per year
- New observations
  - 2016 to improve models
  - 2017 validate model

Field Validation Approach

- Engaged members of the Wisconsin First Detector Network (WIFDN) to assist
  - Established in 2013, launched 2014
  - trains citizen scientists to take action against invasive species by training individuals to identify and report observations

WIFDN Impacts 2014-2018



WIFDN has volunteers across the state and has facilitated training events in over 85 locations.

14,145

invasive species reports submitted via the GLEDN app, plus **>55,000** additional records added to EDDMapS by WIFDN partners

3,397

participants attended **> 100** workshops + webinars

27,563

views of WIFDN videos, totaling over **1,080** hours

2014-2018 WIFDN Volunteerism

12,905
reported volunteer hours

$24/hour
(Independent Sector's 2017 WI volunteer value)

$309,720

$316,462

12,602
miles traveled to volunteer activities

$0.535/mi
(2017 Federal mileage reimbursement rate)

$6,742

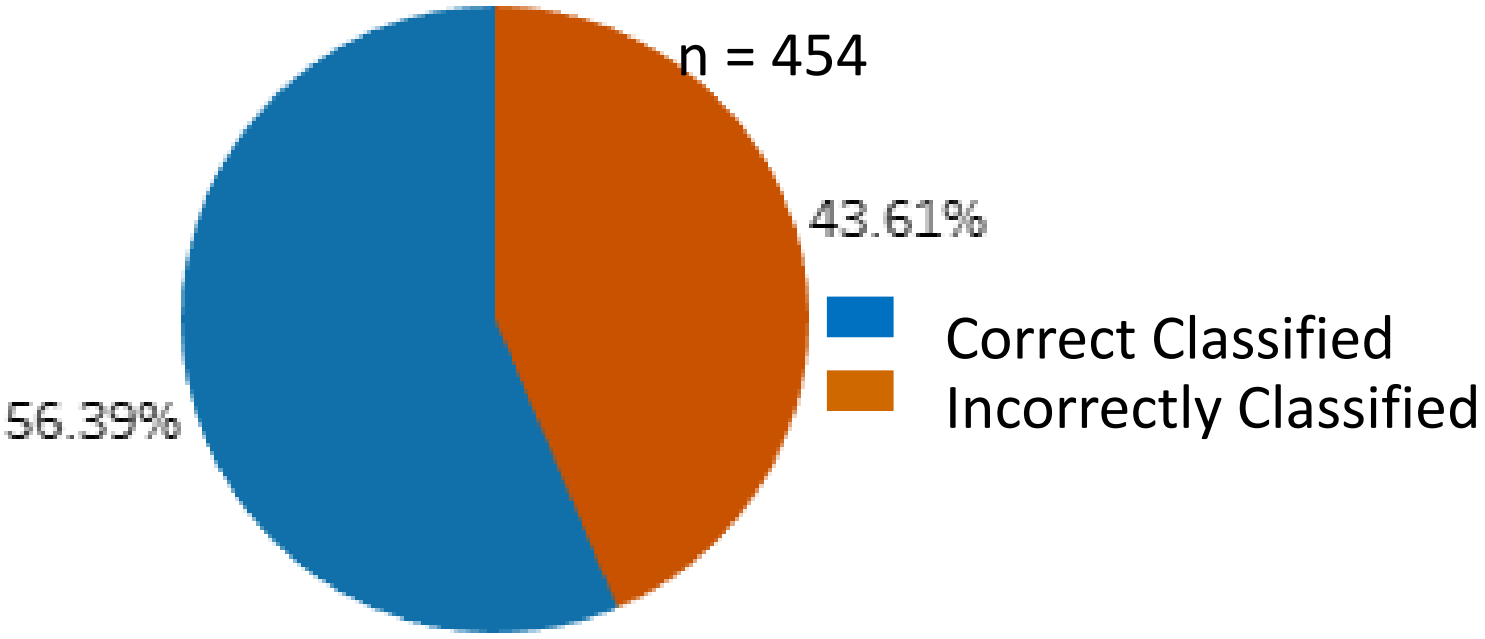
Field Validation:

% of presence observations correctly classified

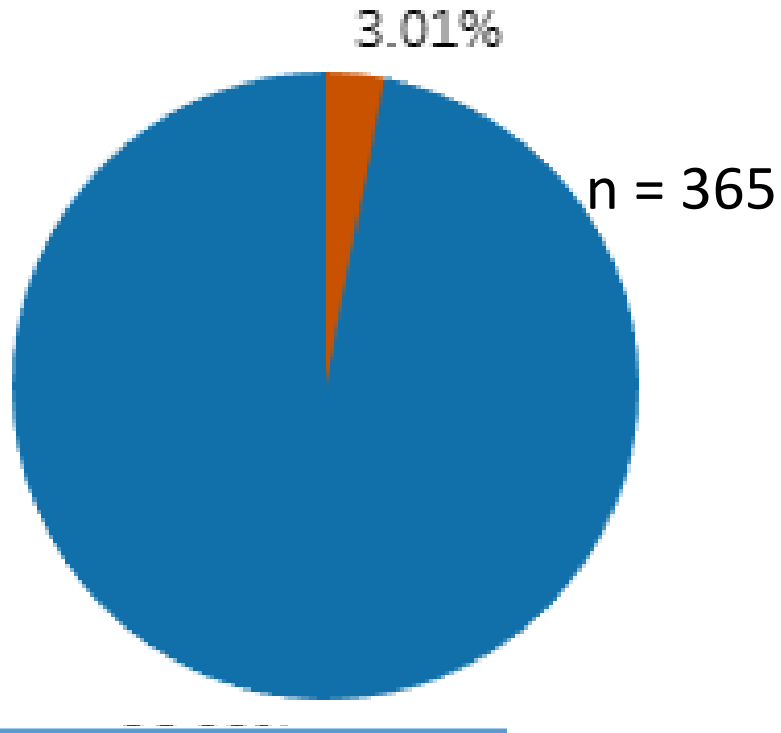
Common Name	Scientific Name	Total Reports	Correctly Classified
leafy spurge	*Euphorbia esula*	142	97.2%
wild parsnip	*Pastinaca sativa*	365	97.0%
Japanese hedge-parsley	*Torilis japonica*	228	96.9%
spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	98	95.9%
bush honeysuckles	*Lonicera* spp.	1291	92.3%
purple crown-vetch	*Securigera varia*	151	91.4%
Japanese barberry	*Berberis thunbergii*	674	86.4%
garlic mustard	*Alliaria petiolata*	601	83.7%
Canada thistle	*Cirsium arvense*	329	73.9%
purple loosestrife	*Lythrum salicaria*	48	72.9%
Japanese knotweed	*Reynoutria japonica*	50	68.0%
European buckthorn	*Rhamnus cathartica*	465	62.4%
autumn olive	*Elaeagnus umbellata*	454	56.4%
common tansy	*Tanacetum vulgare*	59	52.5%
teasels	*Dipsacus* spp.	50	42.0%

Two examples…….

Autumn Olive



Wild Parsnip



Species	AUC	TSS
Autumn olive	0.85-0.92	0.56-0.72
Wild parsnip	0.84-0.95	0.60-0.77

Results suggest field validation of models should be conducted

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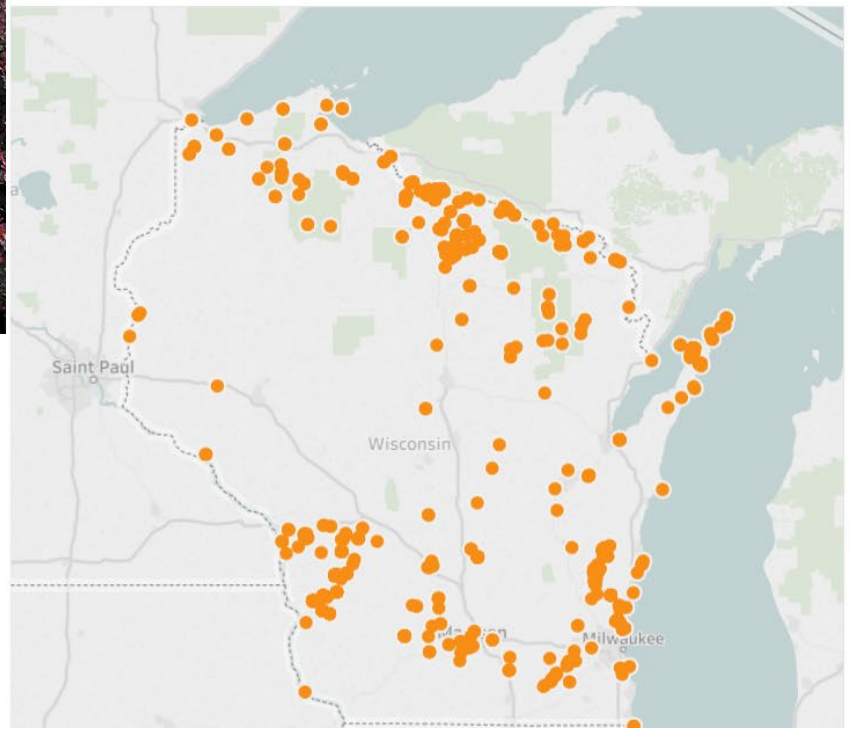
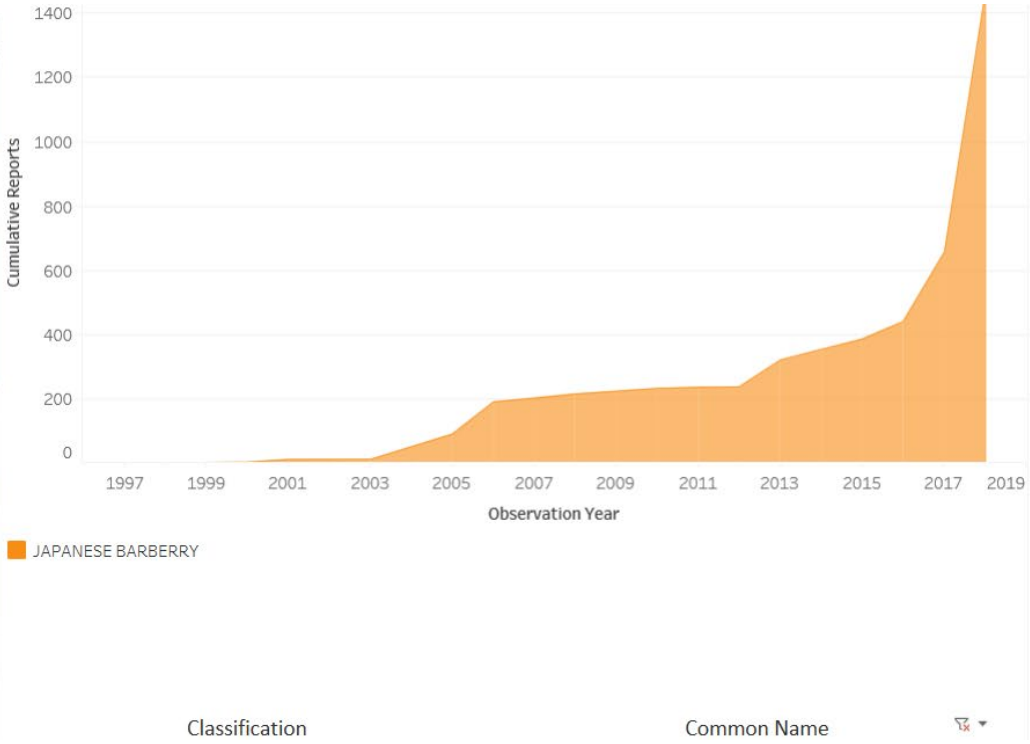
Rerun models with new data and repeat……

Exploring Current and Future Suitable Habitat for Japanese Barberry in Wisconsin

Japanese barberry distribution in Wisconsin

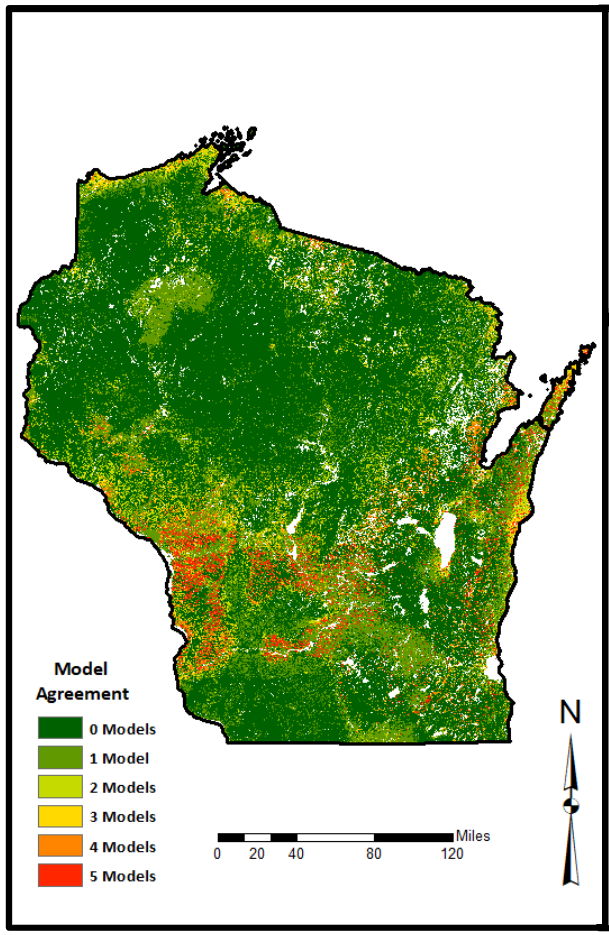




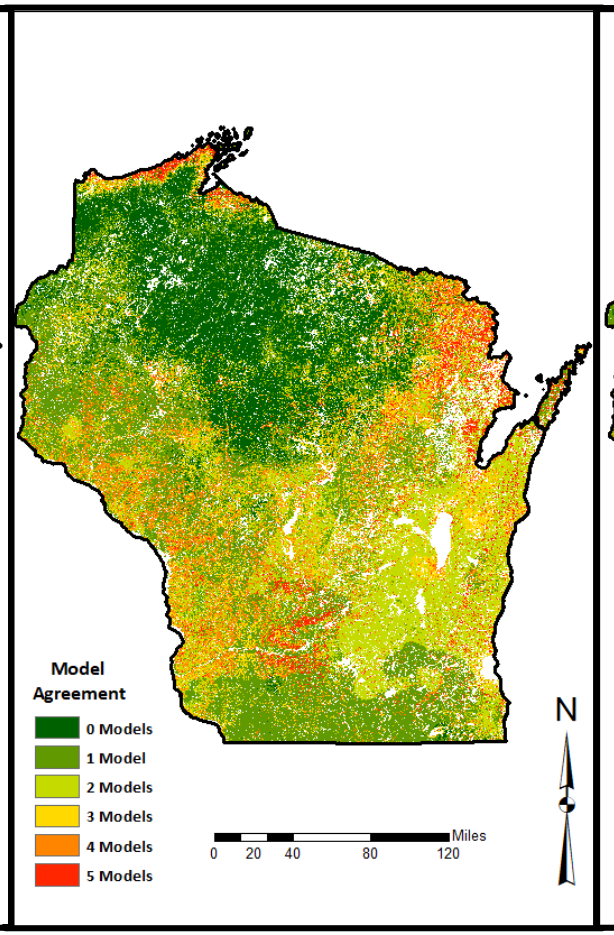
Niels Jorgensen

Current and Future Habitat Model Predictions

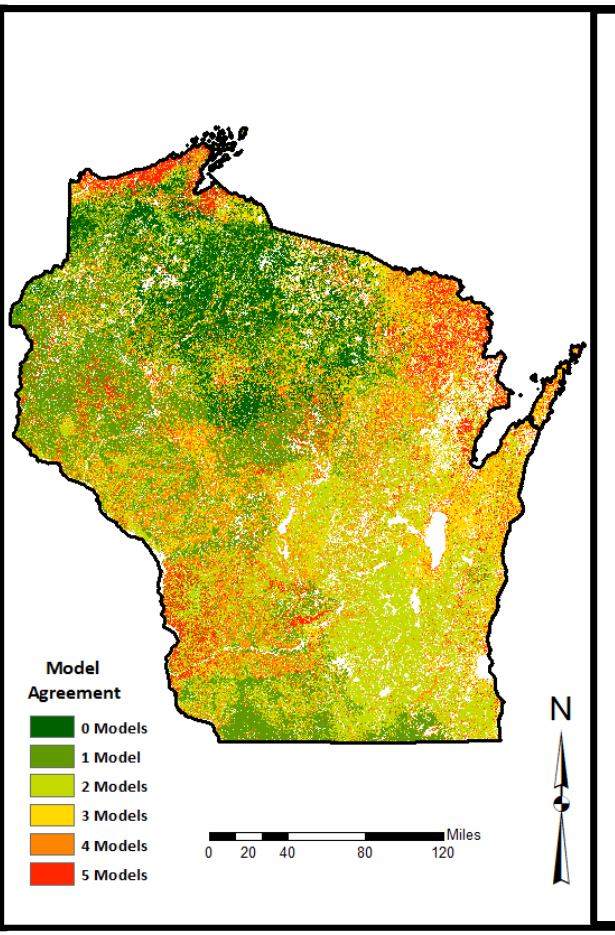
Current



2050s

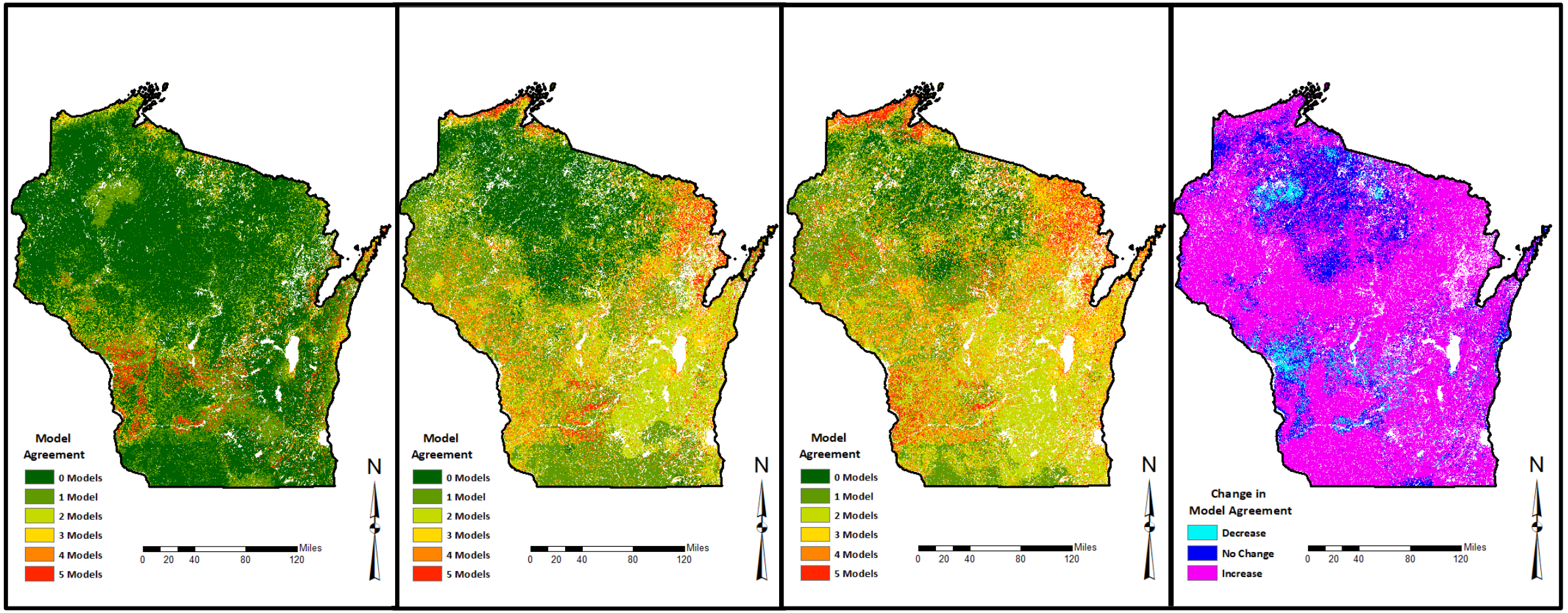


2080s



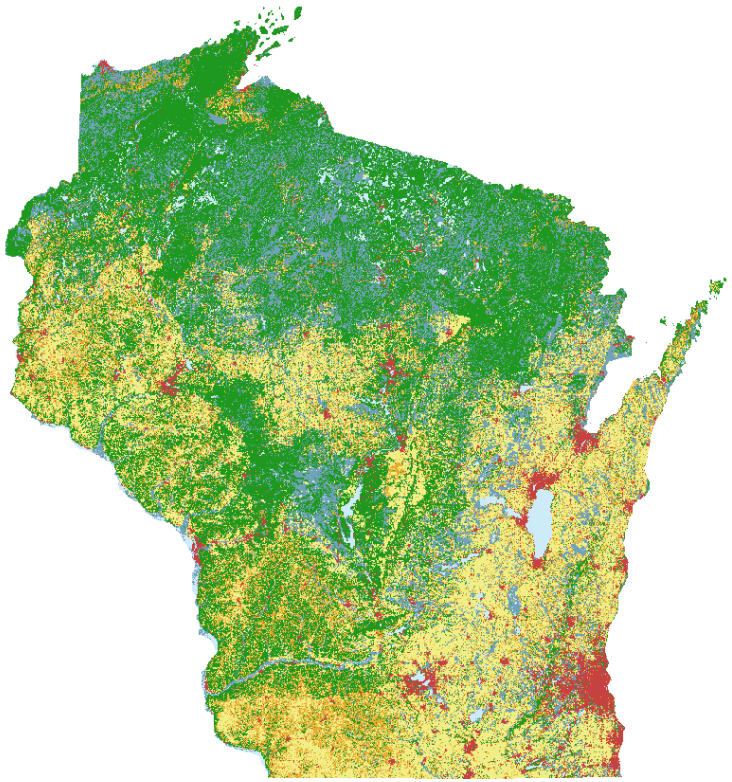
Current and Future Habitat Model Predictions

Current | 2050s | 2080s | Change



Habitats most likely to be invaded by Japanese barberry

Land Cover Type	Current Suitability	Percent Change from Current Suitability	
		2050s	2080s
Urban/Developed	37.70%	7.31%	22.82%
Agriculture	19.86%	-9.92%	21.51%
Grassland	16.12%	34.76%	85.96%
Forest	38.86%	56.93%	92.76%
Wetland	29.84%	22.01%	60.09%
Barren	22.43%	-18.13%	5.64%
Shrubland	14.26%	88.20%	80.42%



Greatest potential impacted area:

- >2.5 million hectares of *current* forests
- >500,000 hectares of *current* wetlands

Providing these and other resources to increase invasive plant management

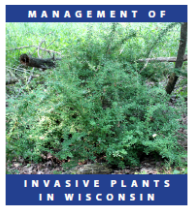
Invasive plants observed on property

The table below lists invasive plant species observed on the property. The species are listed in order of suggested management priority:

- **High**: few plants present (possible to eradicate before infestation grows) and/or species is a high priority spe (prohibited in state or high consequence species)
- **Medium**: Larger infestations that will take more effort to control on property; also includes species that hav high impact
- **Lower**: Largest infestations on property (will take significant effort to control on property) and/or species wi lower impact
- **Monitor**: species that were not observed on the property but which are known to be nearby and could infes property. Keep an eye out for new infestations of these species.

The area impacted refers to the general area infested by the species, including area not occupied by the species of interest.

Mgmt. priority	Species	Number of points	Number of polygons	Approx. area impacted (acres)	Abundance
High	Autumn olive (*Elaeagnus umbellata*)	1	0	-	Few individual plants
High	Biennial thistle (*Cirsium sp./ Carduus sp.*)	3	0	0.2	Scattered plants
High	Canada thistle (*Cirsium arvense*)	3	0	-	Scattered plants
Medium	Reed canary grass (*Phalaris arundinacea*)	4	0	1.5	Scattered dense patches
Medium	Purple crown vetch (*Securigera varia*)	5	1	0.5	Scattered dense patches
Lower	Bush honeysuckles (*Lonicera sp.*)	20	0	2.8	Scattered plants
Lower	Japanese barberry (*Berberis thunbergii*)	1	12	3.5	Scattered plants
Monitor	Multiflora rose (*Rosa multiflora*)	-	-	-	Absent, but present nearby
Monitor	European buckthorn (*Rhamnus cathartica*)	-	-	-	Absent, but present nearby



A3924-34

Brendon Panke and Mark Renz

Invasive plants can thrive and aggressively spread beyond their natural range, disrupting ecosystems. The *Management of Invasive Plants in Wisconsin* series explains how to identify invasive plants and provides common management options. Management methods recommend specific timings for treatment, as well as expected effectiveness.

Japanese barberry
(*Berberis thunbergii*)

Japanese barberry is a round, dense, spiny shrub, typically 2–3' tall, though it may grow up to 6' tall and 6' wide. The branches are reddish brown and deeply grooved with a single, sharp spine at each node. The wood beneath the bark is yellow. It spreads vegetatively through branches that root freely when they touch the ground.

Legal classification in Wisconsin: All wild plants are restricted. Select varieties/hybrids are also restricted. Consult Wisconsin's invasive species rule (NR 40) for details.

Leaves: Alternate, 0.5–1.5" long, entire, and shaped liked a spatula with a narrow base and wide end (spatulate). Color varies depending on the cultivar, but includes green, bluish-green, or dark reddish-purple. Leaves are arranged in clusters above a spine.

Flowers: Mid-spring. Yellow, umbrella-shaped, 0.25" across with 6 petals. Flowers are found along the stem individually or in clusters of 2–4.

Fruits and seeds: Bright-red, oblong berries, 0.3" long. Fruit are found on narrow stalks along the stem individually or in clusters of 2–4. Fruit mature in mid-summer and can persist on shrub into winter.

Roots: Shallow root system. When scratched, the inner layer of the root is yellow.

Similar species: European barberry (*Berberis vulgaris*) is another introduced species that is sometimes invasive. European barberry spines occur in sets of 3, while Japanese barberry spines occur singly.

Ecological threat:
- Invades open and closed canopy forests, woodlands, oak savannas, wetlands, pasture, and meadows. Grows more vigorously on well-drained soils.
- Seeds are readily dispersed by birds.
- Sites infested with Japanese barberry have significantly more deer ticks (*Ixodes scapularis*) than sites where Japanese barberry control efforts have taken place or where barberry is not present.

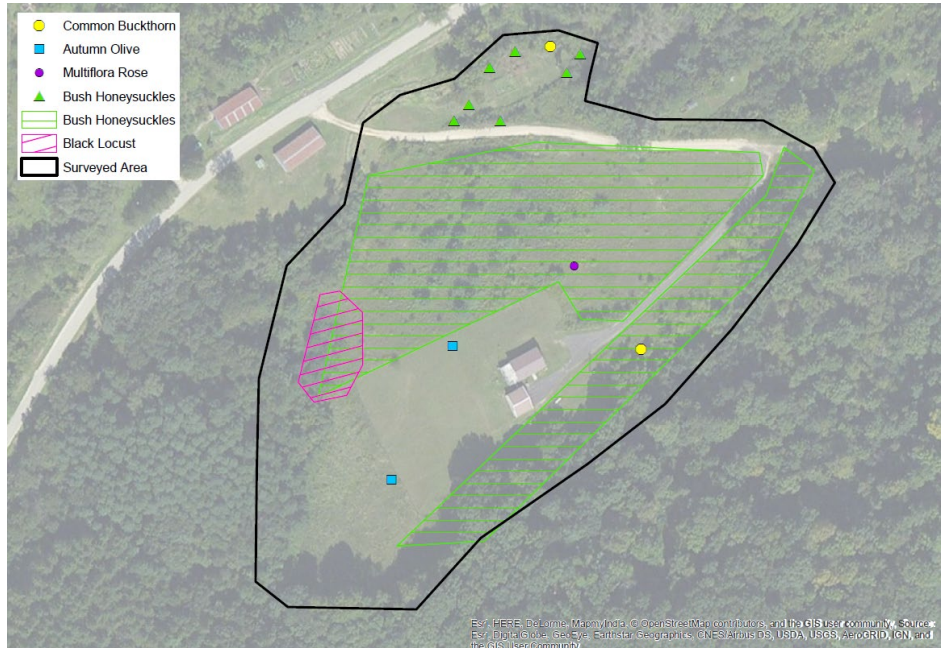
Non-chemical control

Removal

Effectiveness in season: 90–100%
Season after treatment: 70–90%

Pulling or digging up small- to medium-sized barberry any time of the year is an effective individual plant control strategy if soil conditions are amenable. Remove the root crown, as Japanese barberry resprouts from that area. Small bushes can be pulled by hand and larger bushes can be pulled using a leverage tool. Digging up soil surrounding larger bushes can facilitate plant removal. If fruiting, avoid movement unless material can be transported without spreading fruit to other locations.

Photo: Anne Pearce, WIFDN Coordinator



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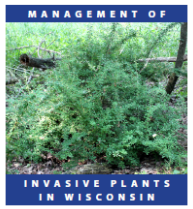

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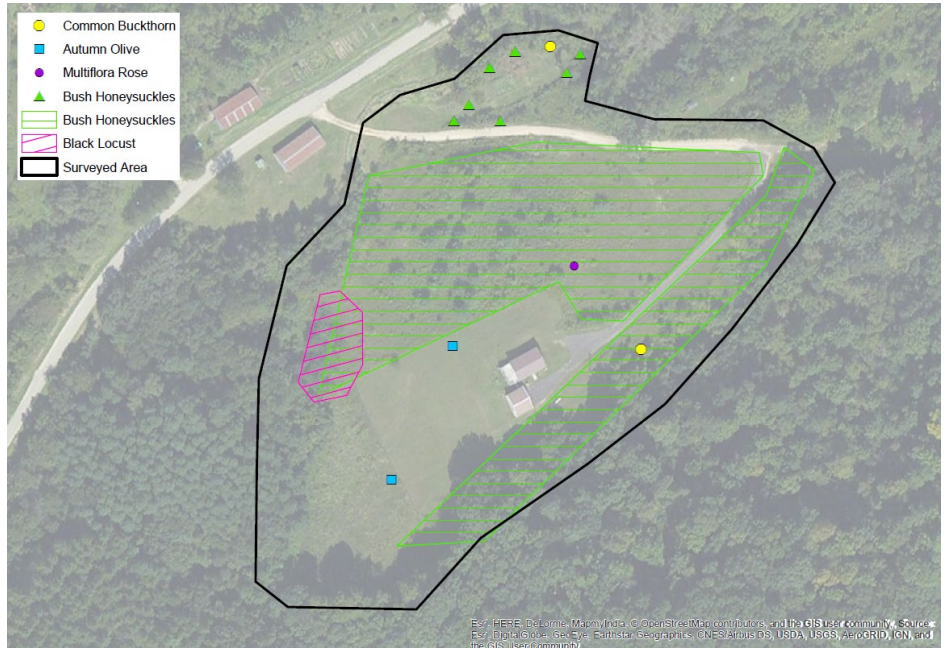
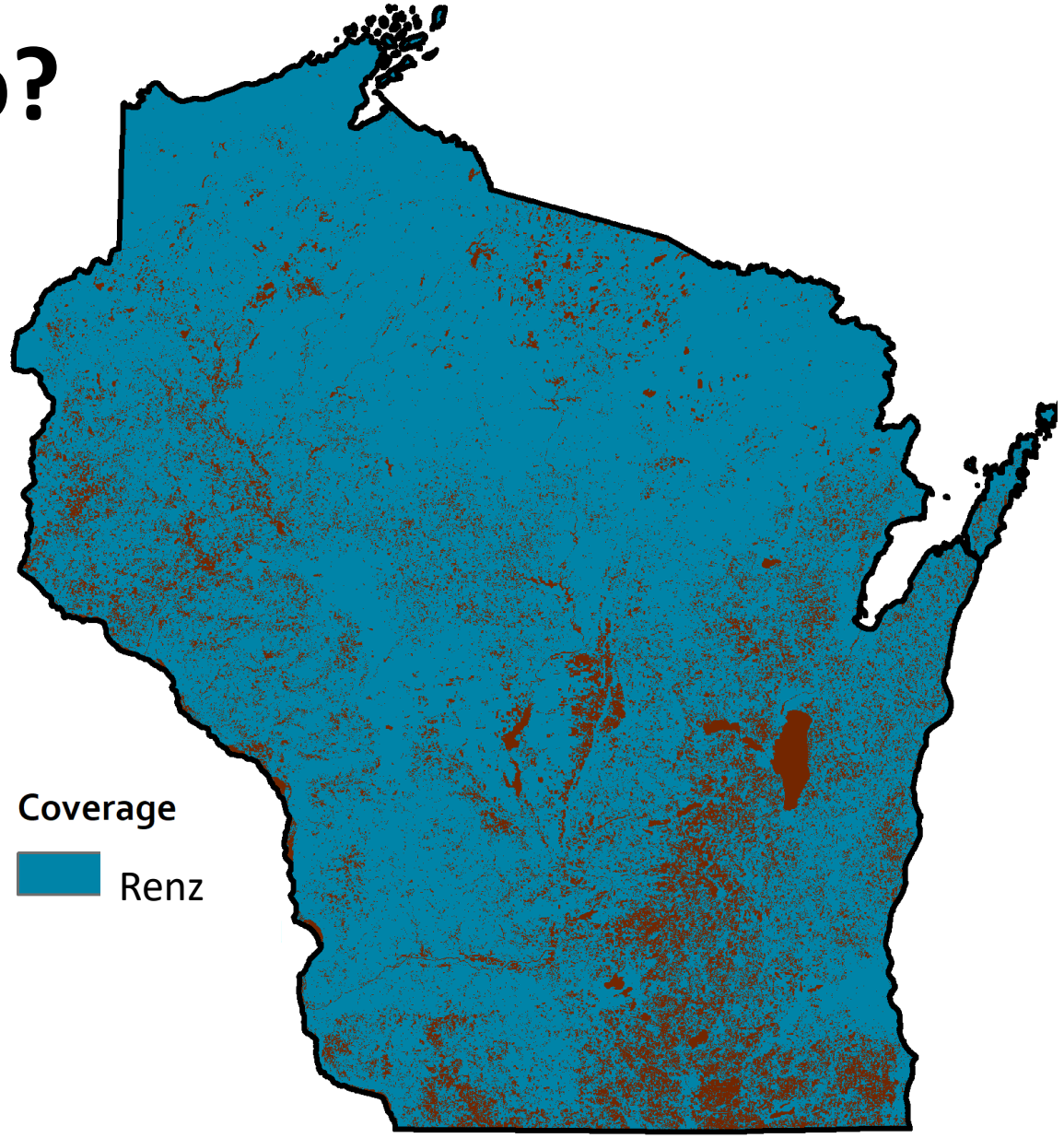


What does my program do?

- applied research aimed at minimizing the impacts of weeds in forages and natural areas

1. Develop and test methods
2. extend information to clientele
   - 590 presentations reach >35,000
   - 45 extension publications
   - 8 online media resources/databases
3. Document the impact of efforts
   - Information viewed 2.4 million times



29 million acres or 80% of Wisconsin

Future

- Continue with existing model/efforts and expand to region/nation

- Enhance collaboration
  - Waterhemp control in established alfalfa
  - Economics of Invasive shrub suppression in forests
  - Improving weed management during pollinator establishment