Weed Control in Sugarbeet
Grafton

Tom Peters

Extension Sugarbeet Agronomist and

Weed Control Specialist

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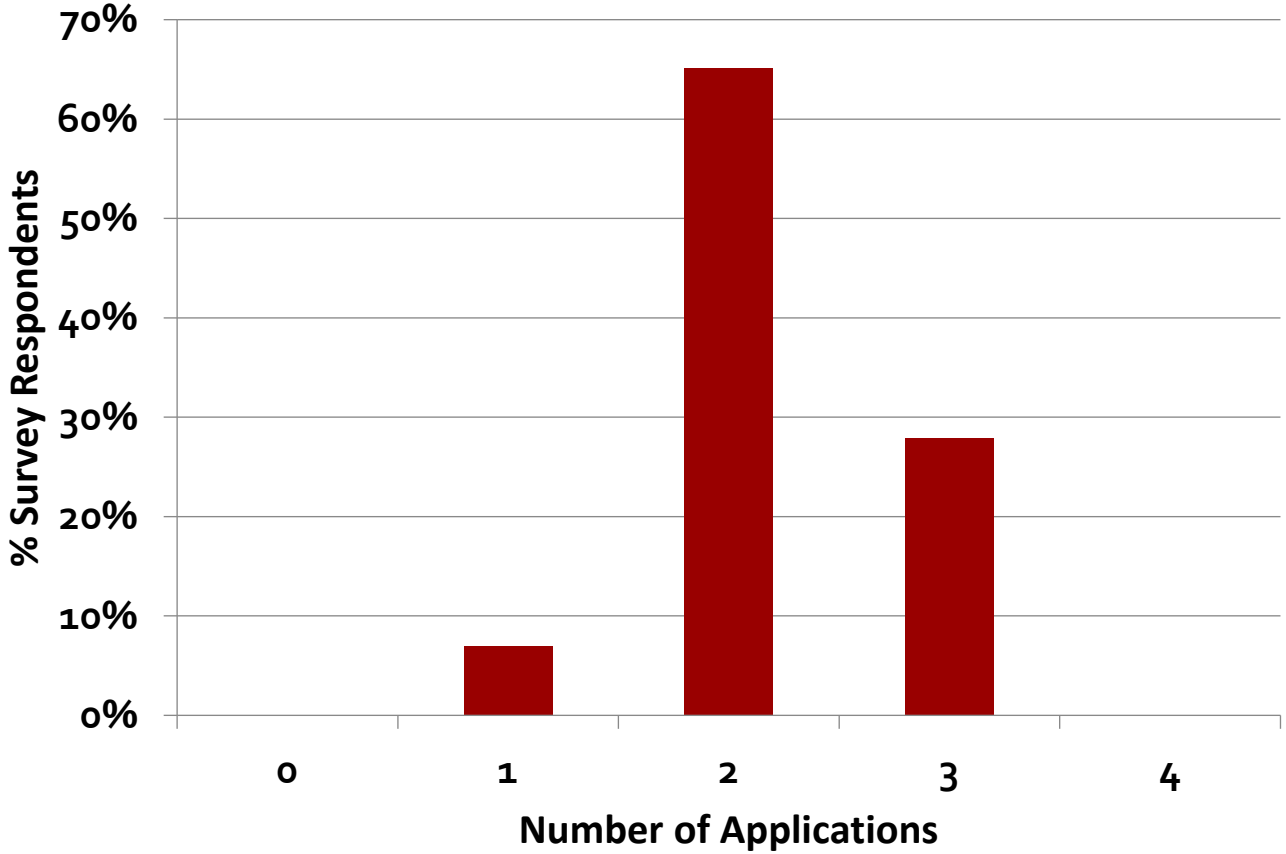
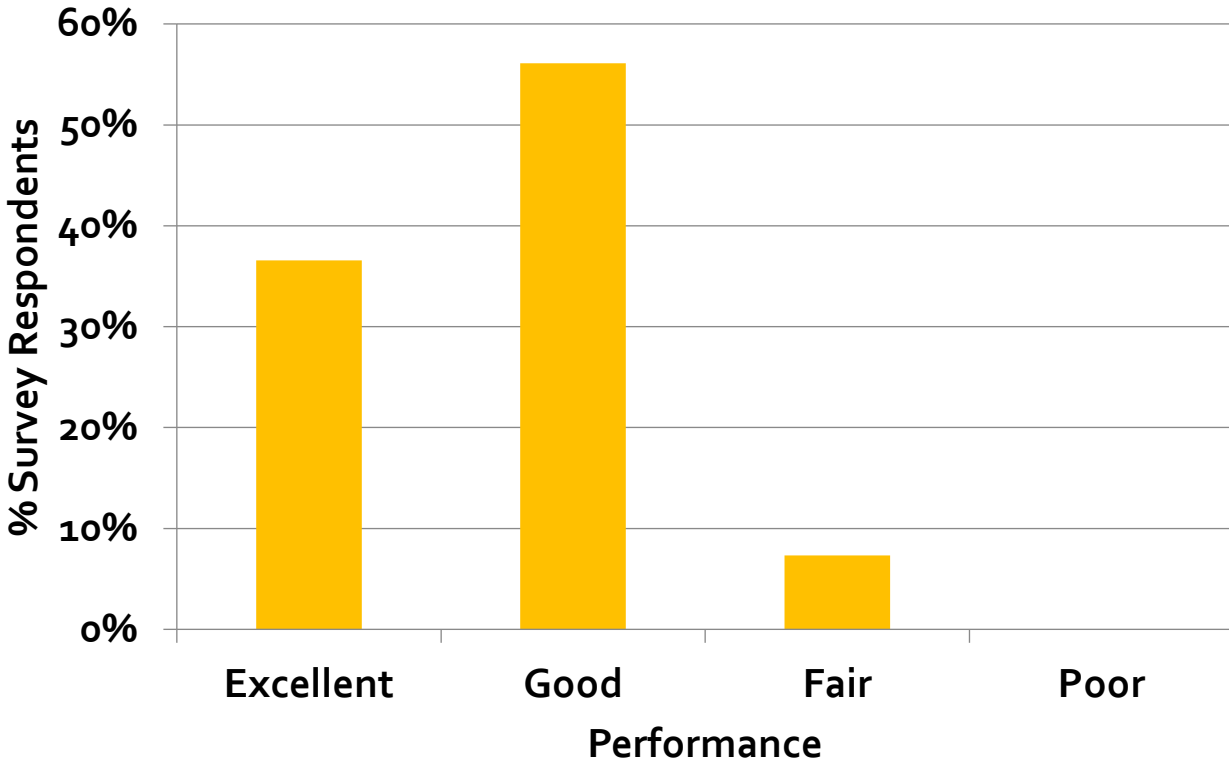
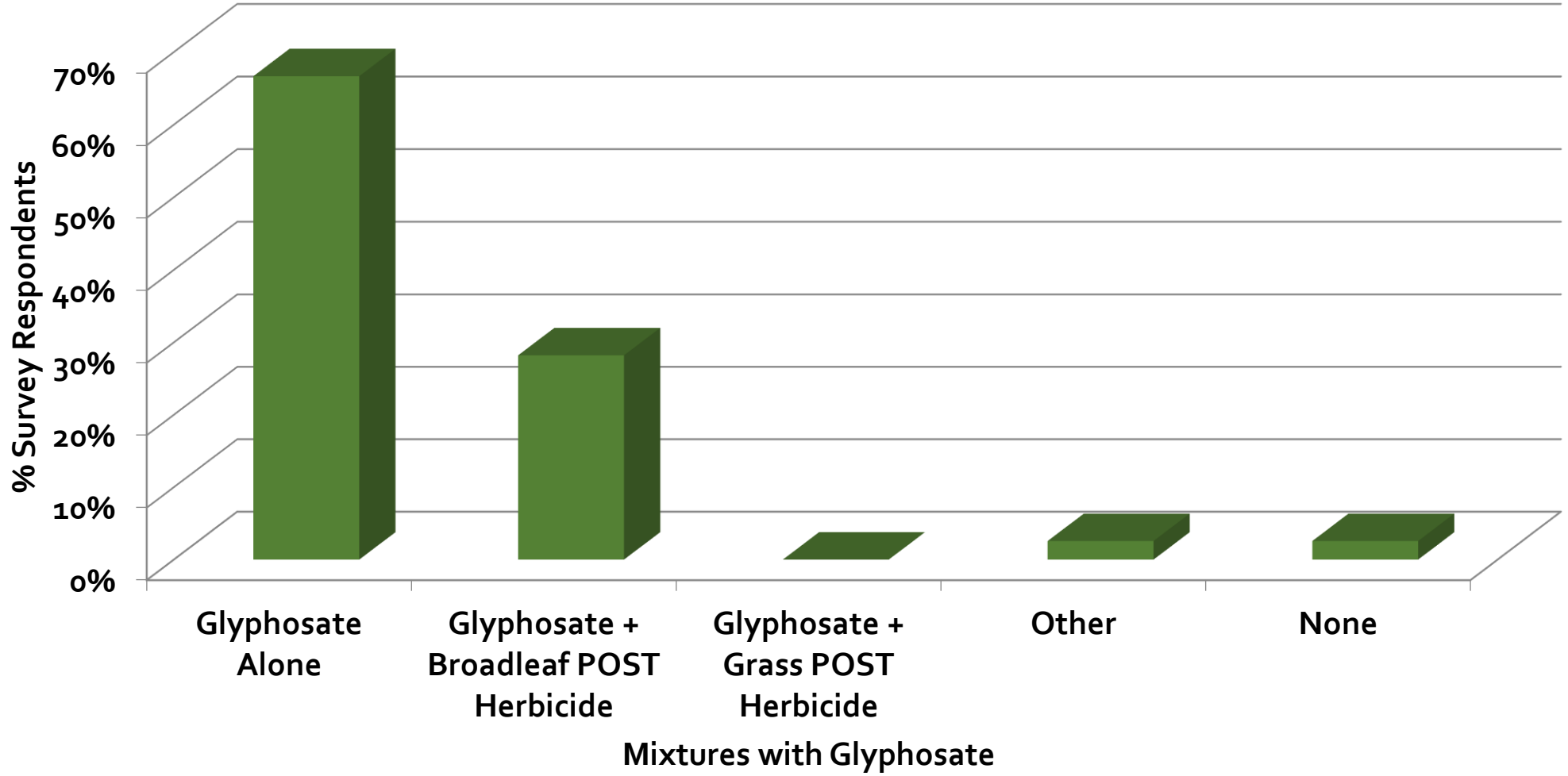
On average, how many glyphosate applications did you use post-emergence in 2018? How effective were glyphosate alone applications?[a]





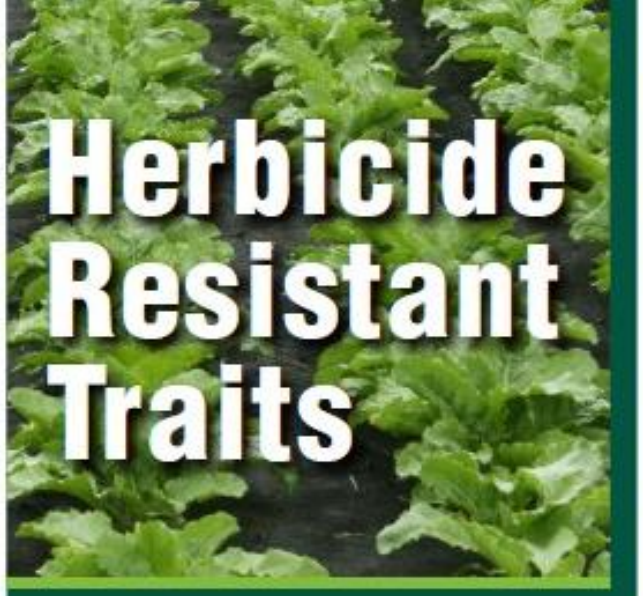
[a]Turning Point Survey of Growers; conducted at the 2019 Sugarbeet Growers Seminar, Grafton

What glyphosate application combination did you use in 2018?[a]



[a]Turning Point Survey of Growers; conducted at the 2019 Sugarbeet Growers Seminar, Grafton

Technical Bulletin to be distributed at Grower Seminars and other extension meetings in MN and ND



Herbicide Resistant Traits

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and herbicide-resistant traits.

It is important to read and follow label guidelines when app
herbicides to any crop. The label of some glyphosate prod
they can be applied to Roundup Ready® and glyphosate-t
Most glyphosate labels state the products are for use in R
Ready® crops or in crops that have the Roundup Ready® g
glyphosate labels have language stating the glyphosate pr
applied to glyphosate-tolerant crops.

This reference guide is designed to help clarify which herb
can be applied to various trait packages. You always shoul
tags and herbicide labels to ensure missapplications do n

**Table 1. Alfalfa herbicide-resistant traits and herbic
can be used in combination with resistant traits. A checkr
indicates that alfalfa herbicide trait packages have resista
various herbicide products.[a]**

Alfalfa Herbicide Trait	Glyphosate	Glufosinate
Conventional		
RR Alfalfa[b]	✔	

[a]Always consult herbicide labels for application requirements.
[b]Always consult herbicide label to determine if glyphosate formulation is
RR alfalfa.

**Table 2. Canola herbicide-resistant traits and herbi
can be used in combination with resistant traits. A checkr
indicates that canola herbicide trait packages have resist
various herbicide products.[a]**

Canola Herbicide Trait	Glyphosate	Glufosinate
Conventional		
Roundup Ready TruFlex	✔	
LibertyLink		✔
Clearfield Canola[b]		
SU Canola[c]		

[a]Always consult herbicide labels for application requirements.
[b]Apply Beyond (imazamox) to Clearfield canola varieties.
[c]Apply Draft (thifensulfuron and triberuron) to SU Canola varieties.

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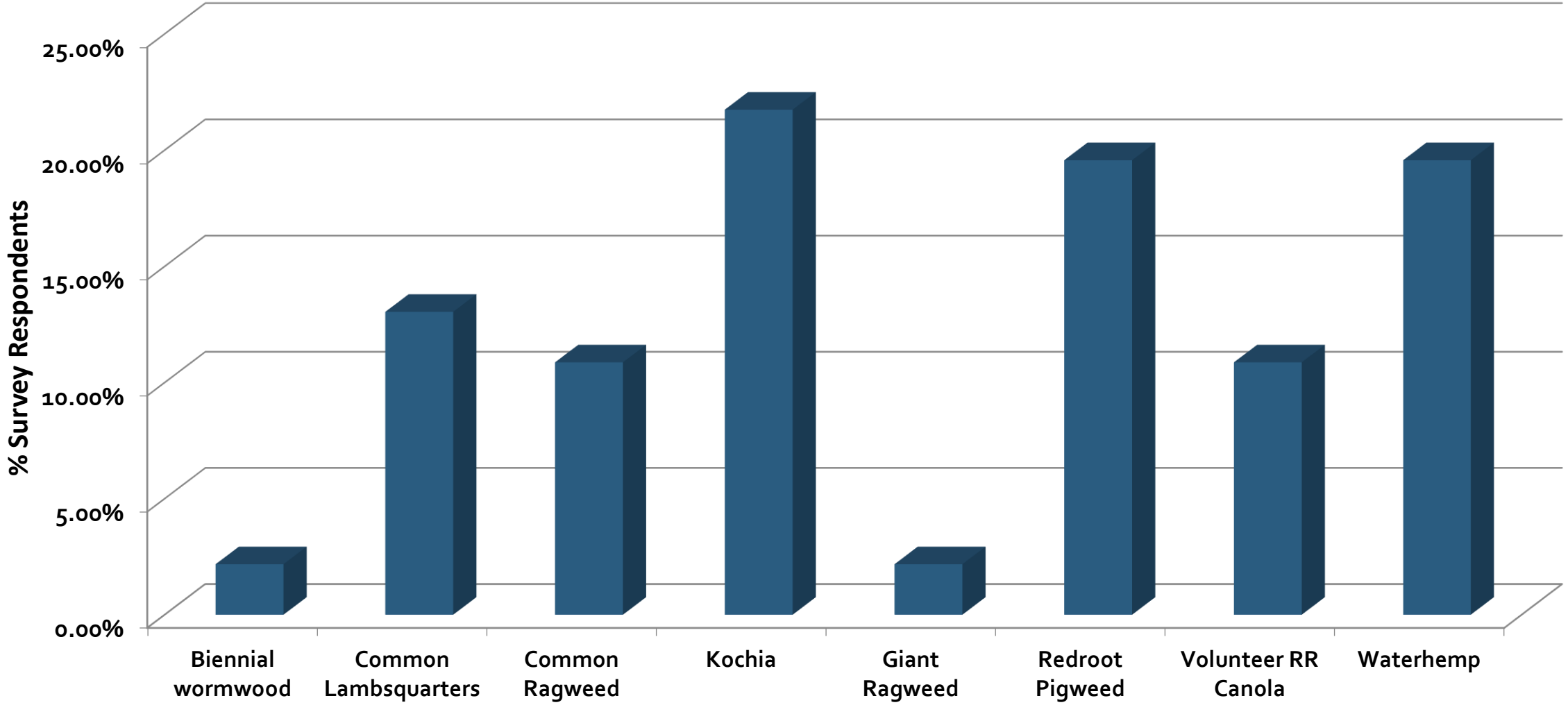
HT2 Sugarbeet

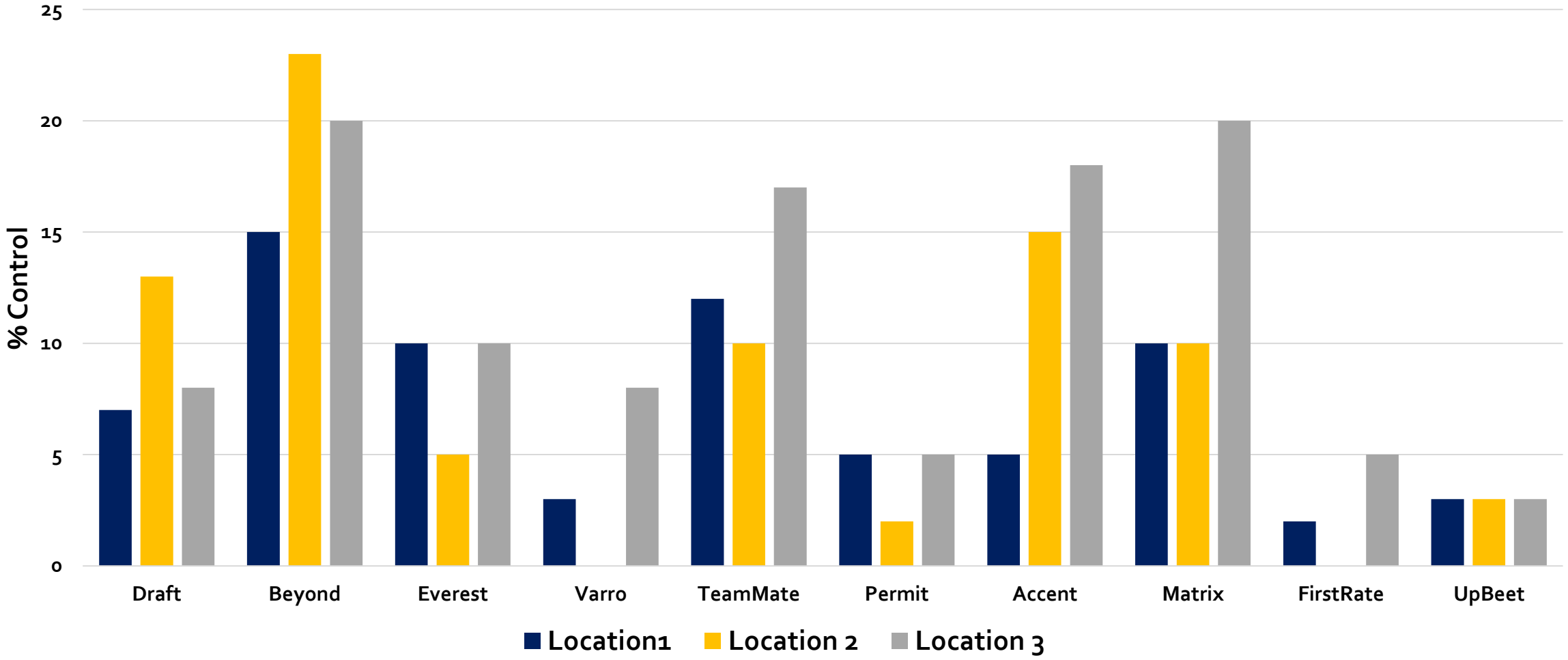
- A biotech trait featuring glyphosate, glufosinate and dicamba in the same vector.
- Commercialize in sugarbeet in the middle of the next decade
- We need to ensure the herbicide traits are useful when they are introduced.
- **Reinforce strategies to preserve future herbicide tolerant trait products in sugarbeet by creating educational / outreach modules emphasizing weed management across the crop sequence.**

What was your worst weed problem in 2018?

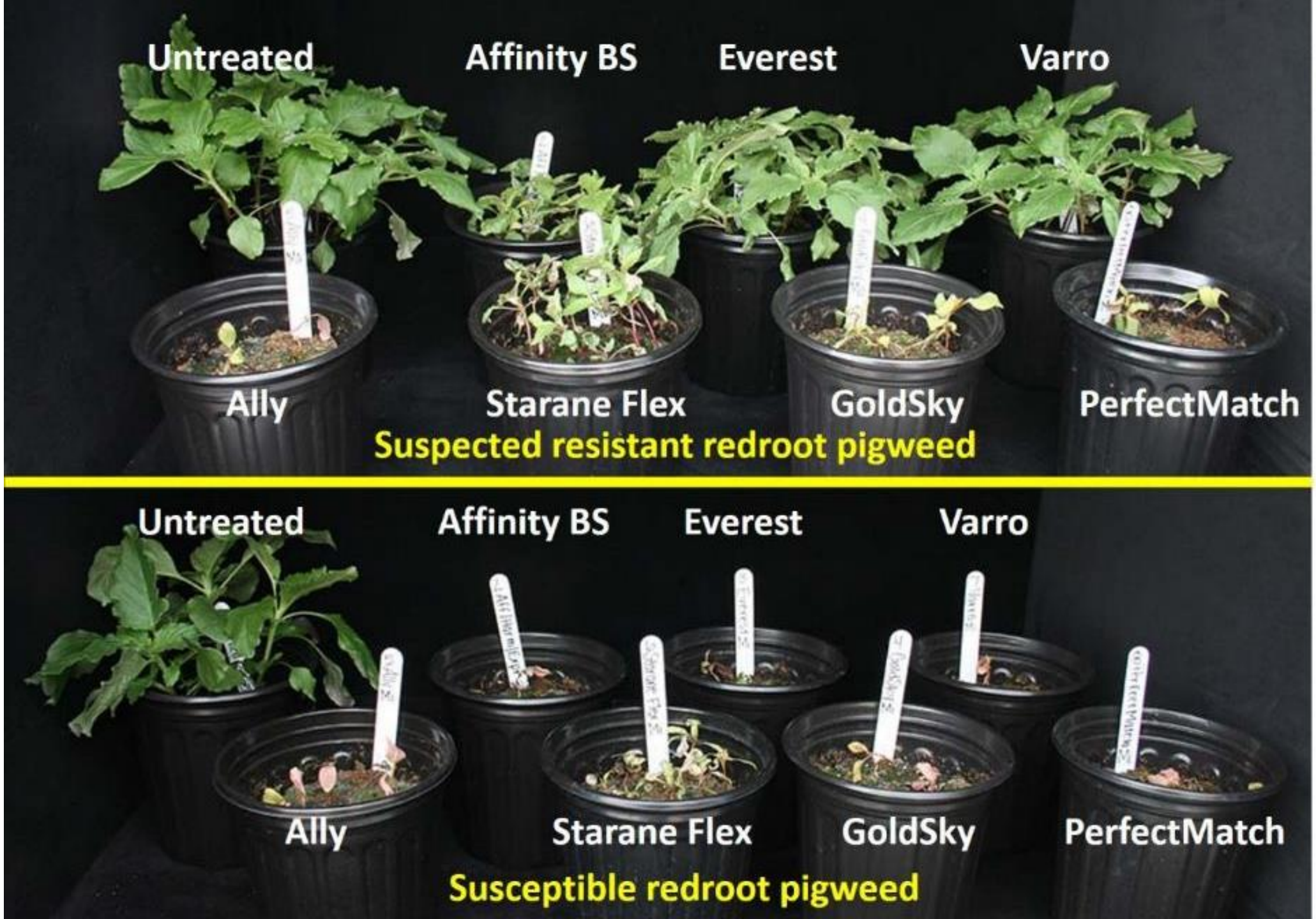


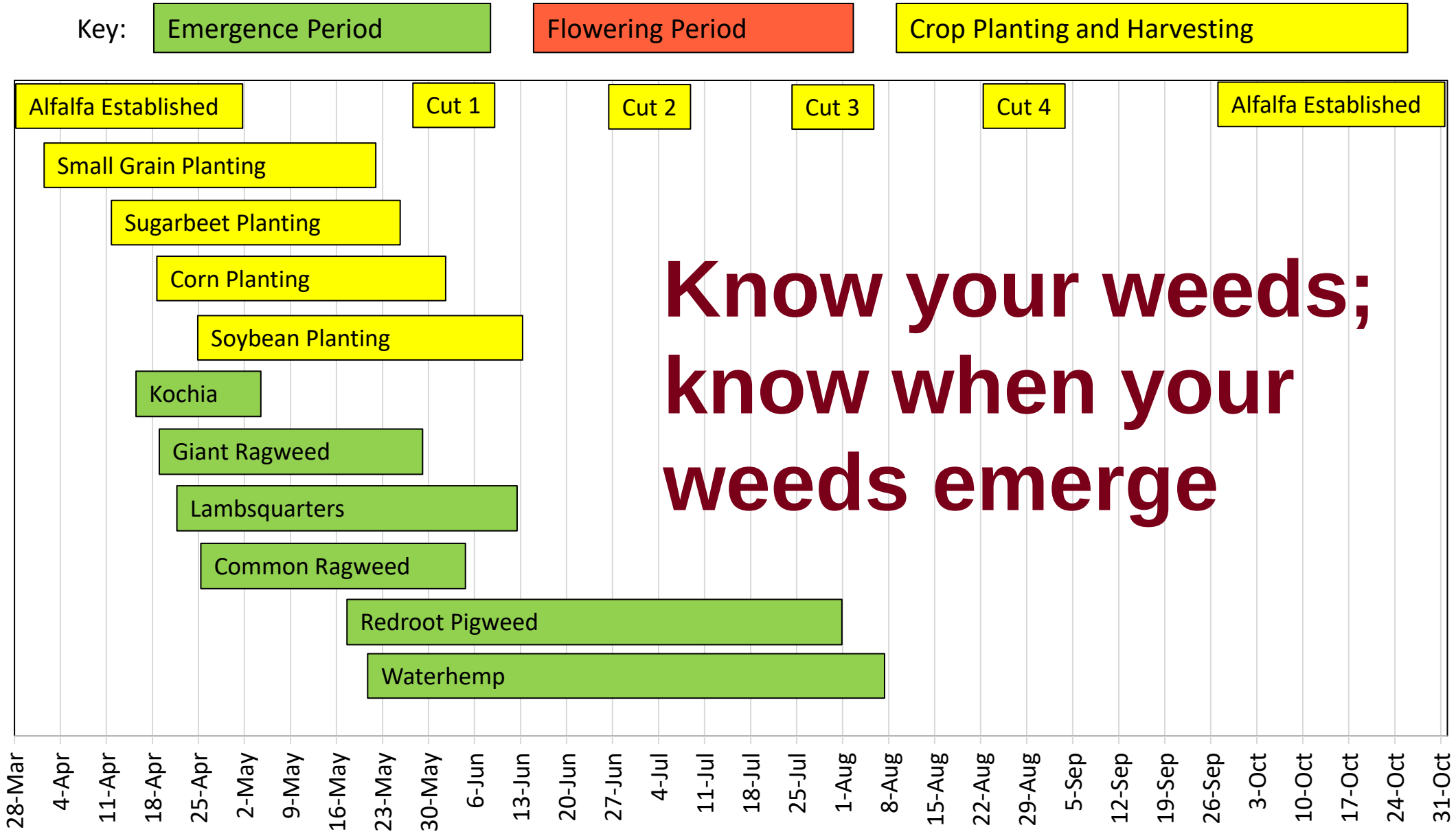
[a]Turning Point Survey of Growers; conducted at the 2019 Sugarbeet Growers Seminar, Grafton

ALS-resistant redroot pigweed control* in northeastern North Dakota



*samples submitted and tested by Dr. Kirk Howatt. Samples from NE North Dakota


Untreated
Affinity BS
Everest
Varro
Ally
Starane Flex
GoldSky
PerfectMatch
Suspected resistant redroot pigweed
Untreated
Affinity BS
Everest
Varro
Ally
Starane Flex
GoldSky
PerfectMatch
Susceptible redroot pigweed



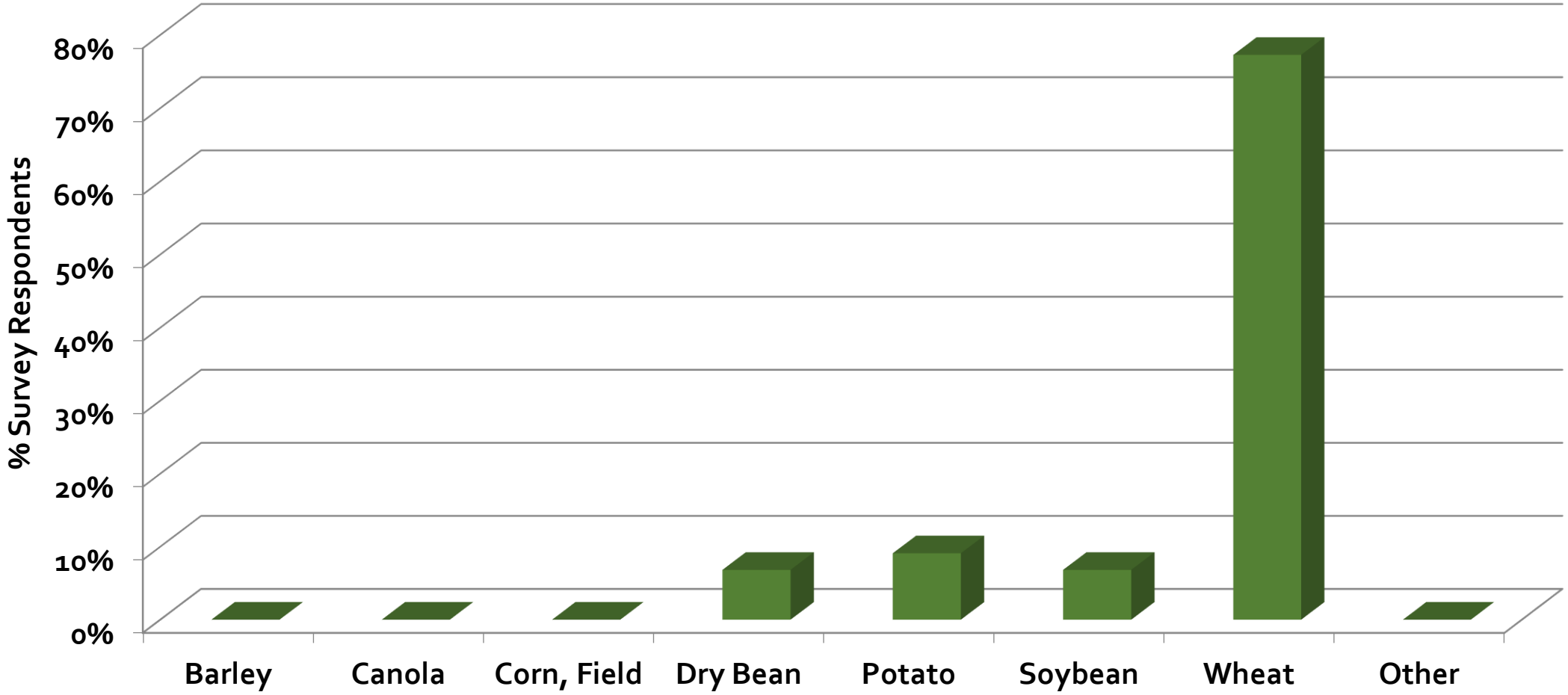
Adapted from Werle et al. 2014, Goplen et al. 2017, Weedometer 2008

Kochia

CBS-TumbleweedClip.mp4

- Life cycle, summer annual
  - One of the first weeds to emerge in spring
- Seed production, 15,000 seeds per plant
- Biology, very deep rooted, tolerates saline soils
- Biology, extremely competitive; a few plants will reduce yield
- Seed viability, 1 to 2 years
- Many document examples of herbicide resistance
  - ALS (SOA 2)
  - 2,4-D and dicamba (SOA 4)
  - Triazines (5)
  - Glyphosate (SOA 9)
  - Multiple resistance in ND, 2+4, 2+9, 2+4+9

What crop preceded most of your sugarbeet acres?[a]

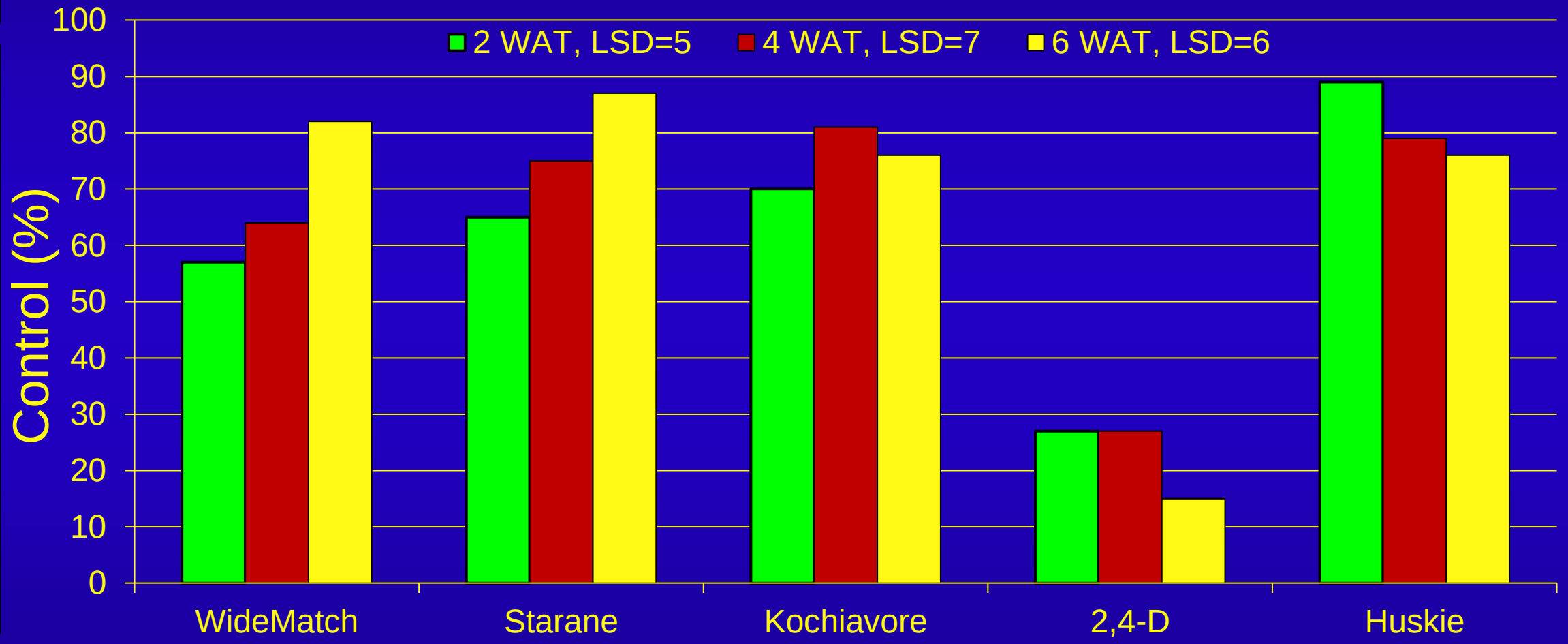


[a]Turning Point Survey of Growers; conducted at the 2019 Sugarbeet Growers Seminar, Grafton

Small grains are tremendous crop(s) to implement a kochia control protocol

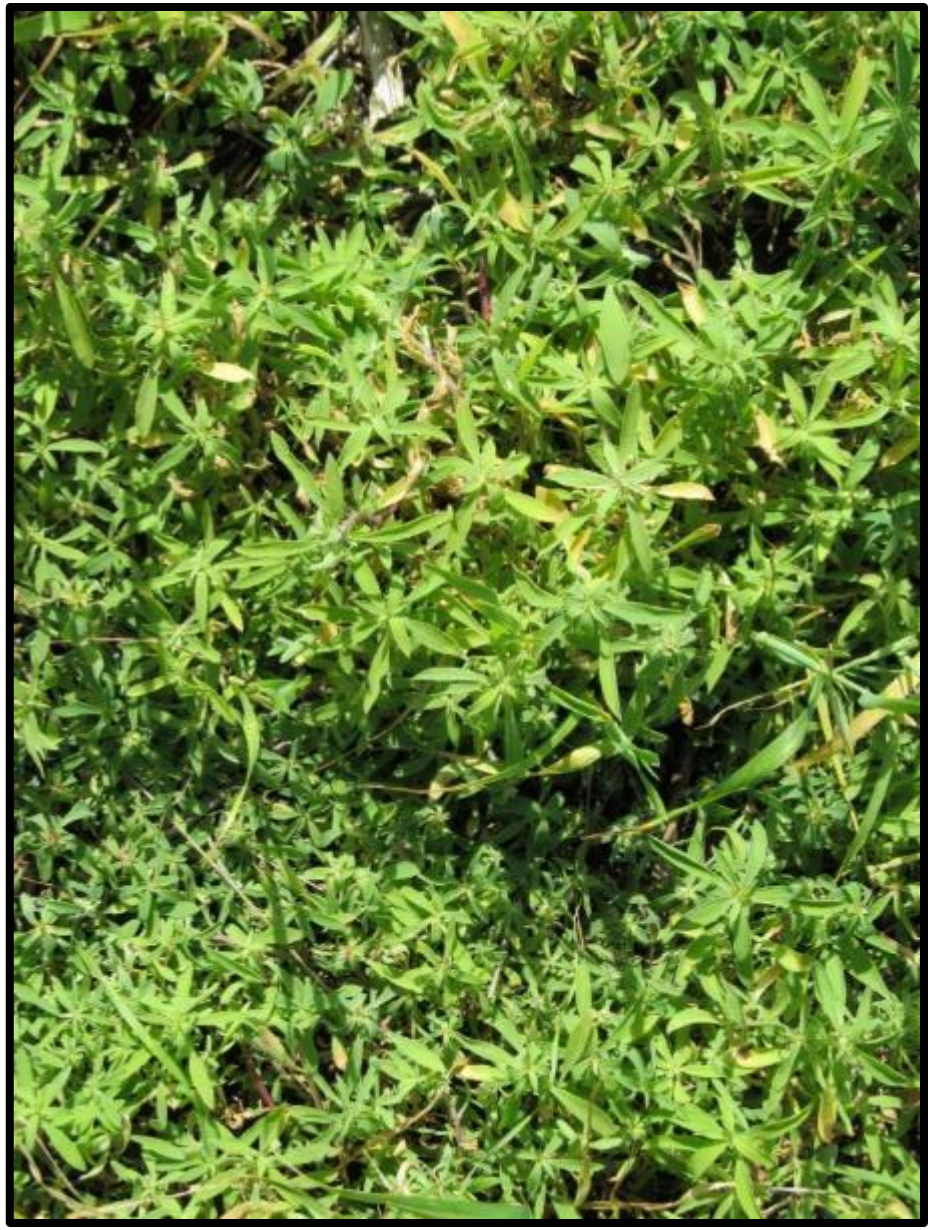
- Narrow rows provide canopy closure
- Herbicides and herbicide families are complimentary
  - Growth Regulators (SOA4)
    - Fluroxypyr, Starane, or Starane Ultra
    - Dicamba
    - Widematch (clopyralid+fluroxypyr)
  - PSII Inhibitors (SOA6)
    - Bromoxynil
  - PPO Inhibitors (SOA14)
    - Aim
  - HPPD Inhibitors (SOA27)
    - Husky, Husky Complete

Kochia Control



Slide from K Howatt, NDSU

Starane

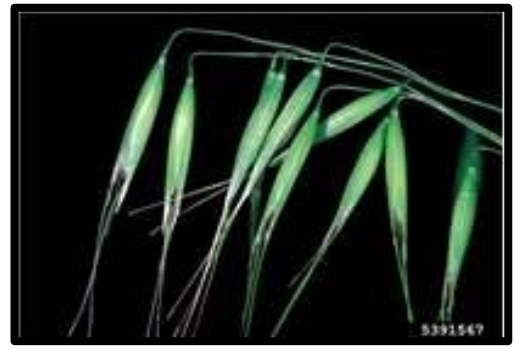


Products containing bromoxynil

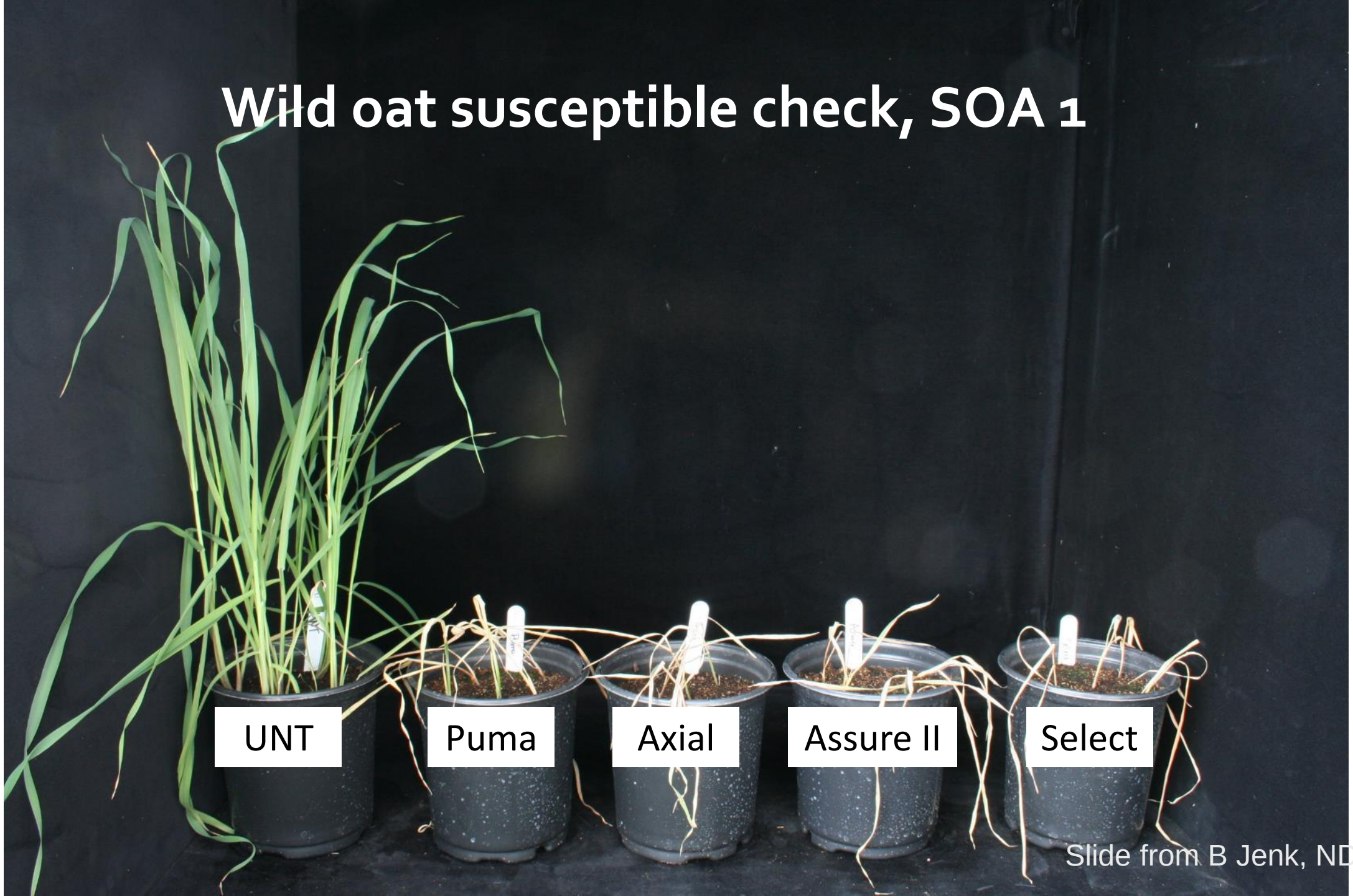
Slide from K Howatt, NDSU

Wild Oat

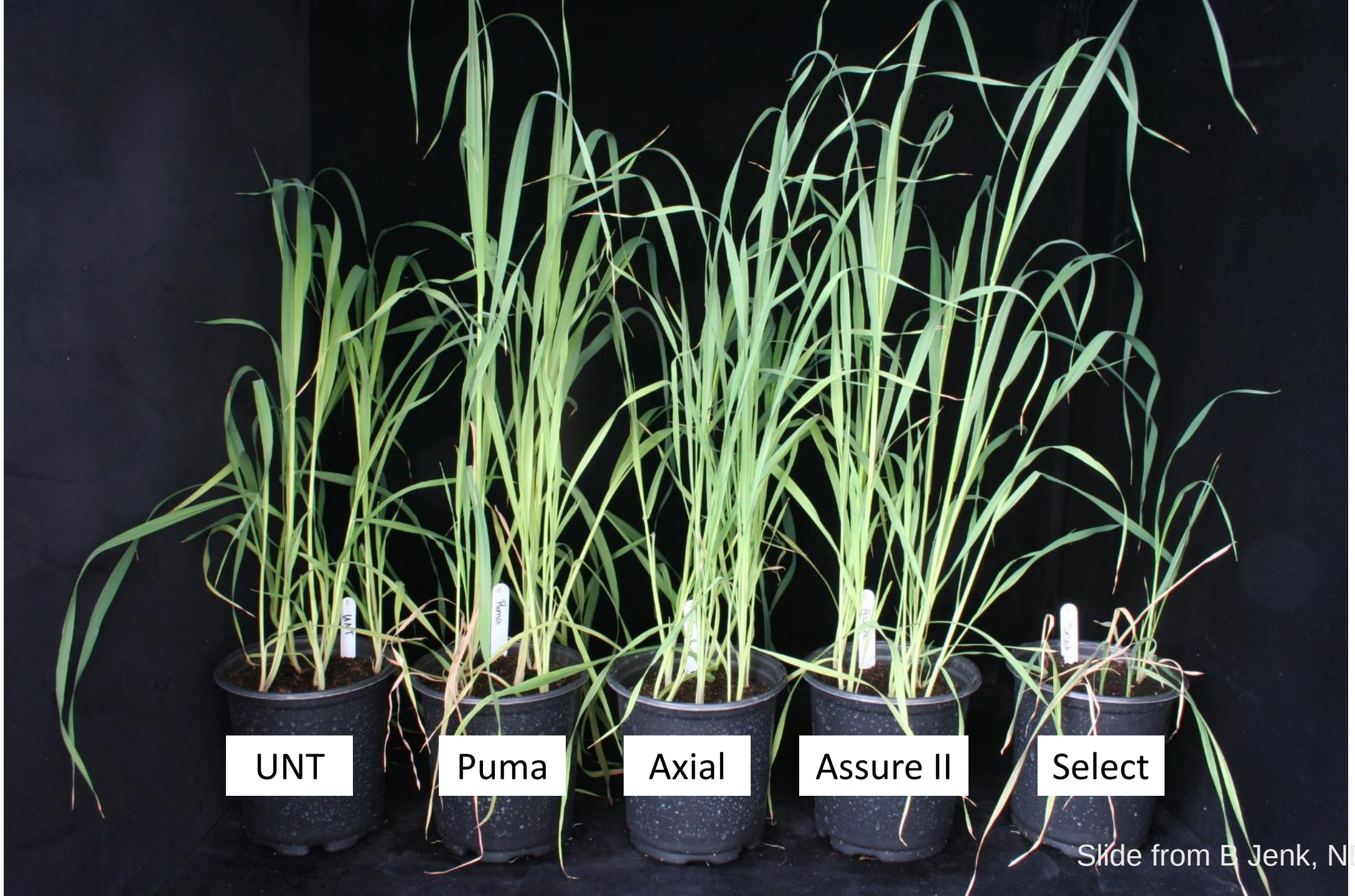
- Summer annual, germinate in response to moisture, oxygen, and 50F air temperature
- Hairs on the leaf margins and a membranous ligule, seedlings have an anti-clockwise twist
- Extremely competitive; 5 plants per sq. yard = 4 to 5% yield loss
- The panicle may contain up to 250 awned seeds
- Seed viability, 13 years; few beyond 3 years
- Document examples of herbicide resistance
  - ACC-ase Inhibitors (SOA 1)
  - ALS (SOA 2)



Wild oat susceptible check, SOA 1



Slide from B Jenk, NDSU



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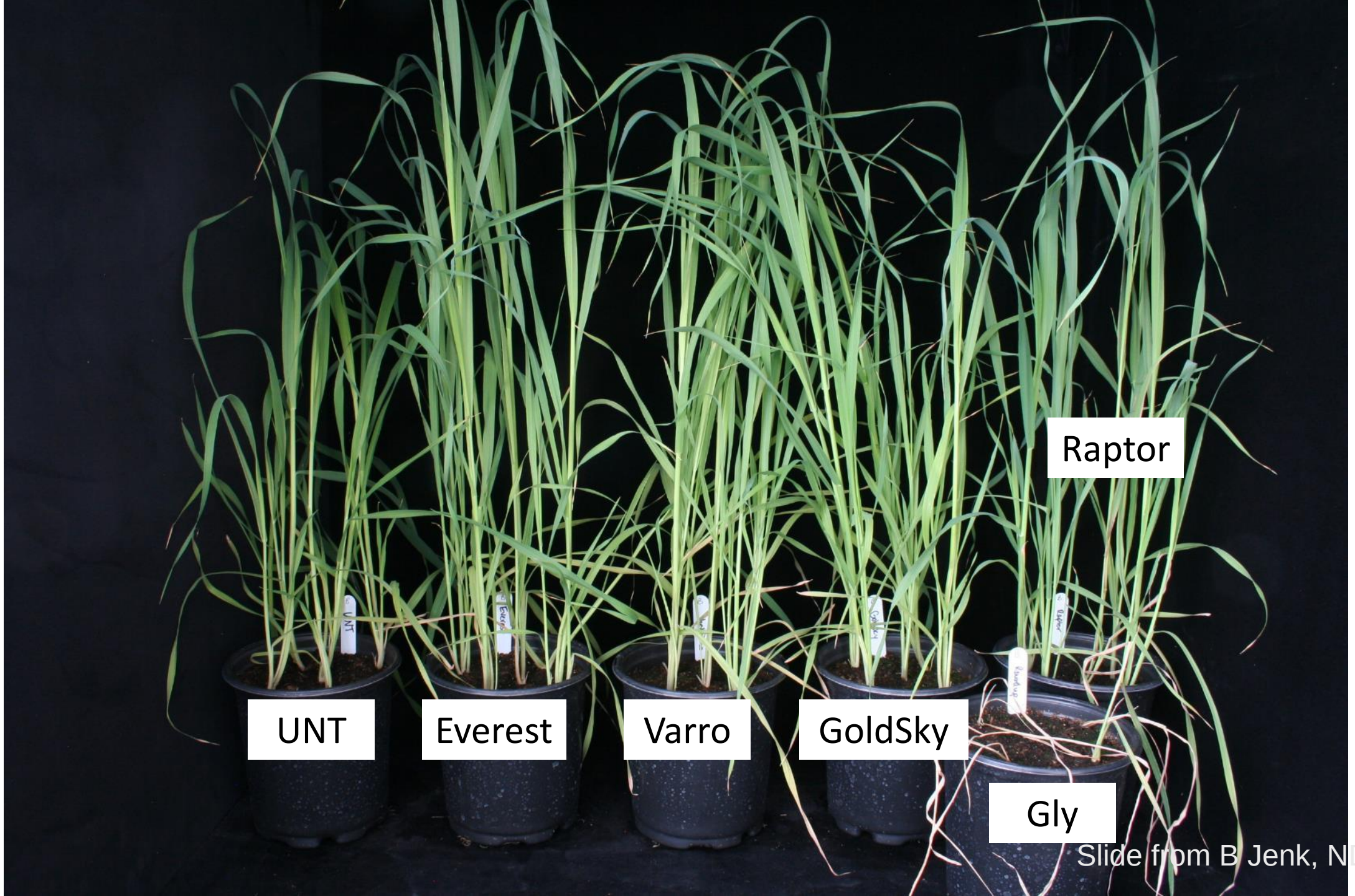


Slide from B Jenk, NDSU

67 Wild oat samples

Herbicide	SOA	% resistant
Puma	1	85
Axial XL	1	48
Everest	2	76
GoldSky	2	87
Varro	2	96
Raptor	2	45
Assure II	1	78
Select	1	7

19 Green foxtail samples

Herbicide	% resistant
Puma	79
Axial XL	58
Discover	79
Everest	21
GoldSky	21
Varro	21
Raptor	0
Assure II	63
Select	0
Assure II + Select	0
Roundup	0

Wild oat and green foxtail collected in 2018.

Slide from B Jenk, NDSU

Amaranthus spp.

- Summer annual
- Small-seeded broadleaves
- Jet black seed
- Commonly referred to as pigweed
- Catkin-like cymes of densely packed flowers
- Approximately 75 species
- Distributed throughout the United States and Canada

Waterhemp was the most important weed control challenge on 256,200 acres or 42% of acreage according to survey.

What was your worst weed control challenge in sugarbeet in 2018?

	Willmar	Wahpeton	Fargo	Grand Forks	Grafton
% Growers	91	90	82	14	20%
Rank	1	1	1	3	3

432 waterhemp per square meter, Herman, MN 2014

Why is waterhemp so difficult to manage?
Waterhemp is well-suited for modern agriculture

- Difficulty in weed identification
- Extended germination timing
- Rapid growth
- Well adapted for conserve tillage
- Has benefited from transition to POST herbicides
- Tremendous seed production
- Seed longevity in soil
- Genetic diversity and resistance


No hair on stem
Waterhemp


Hair on stem
Redroot pigweed

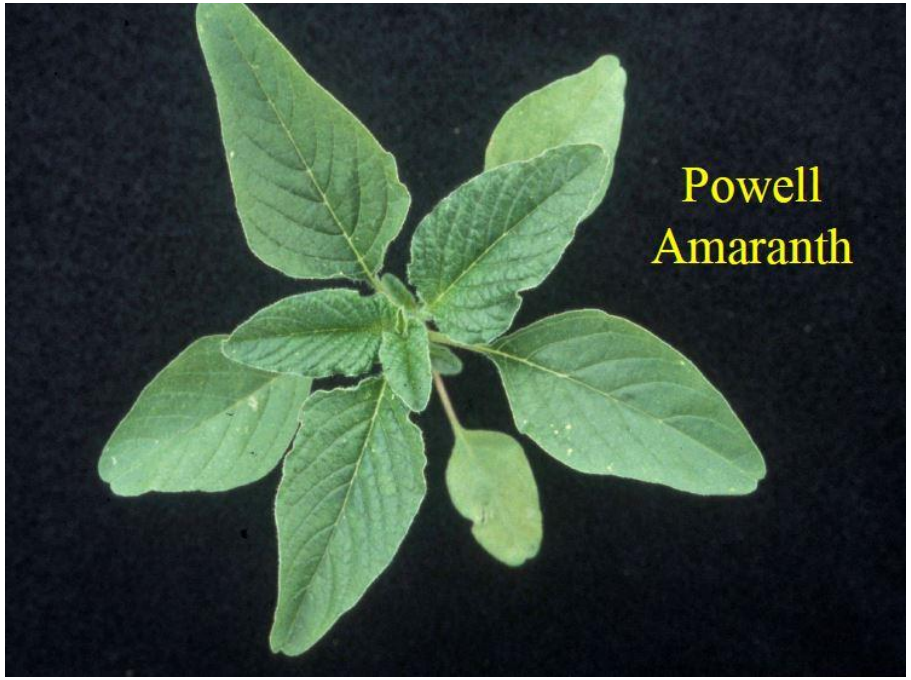
Waterhemp cotyledons are wider and shorter (row boats) than redroot pigweed (canoes)

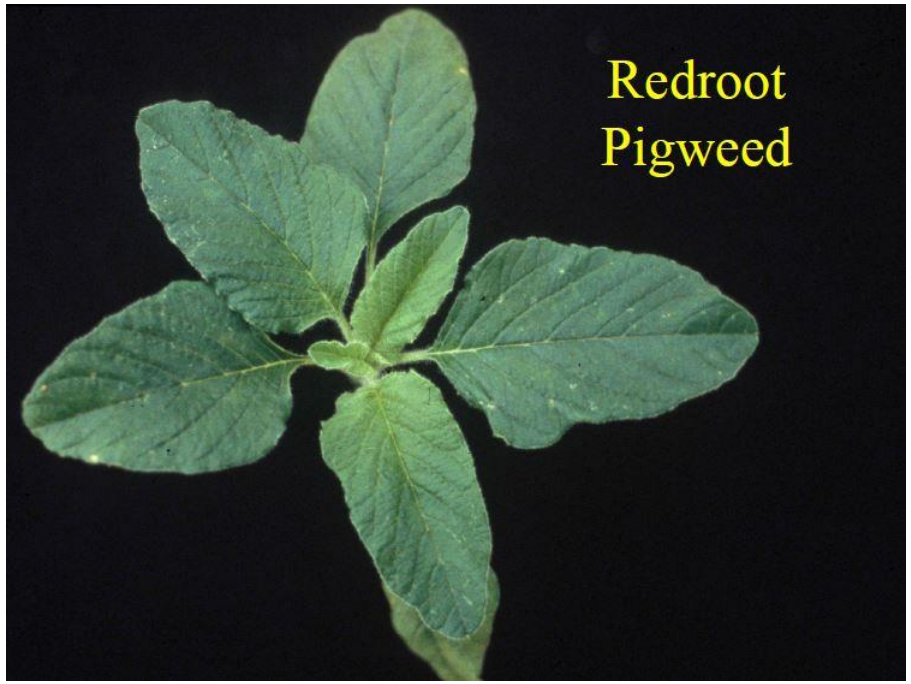
Waterhemp, credit, M. Horak, Kansas State Univ.

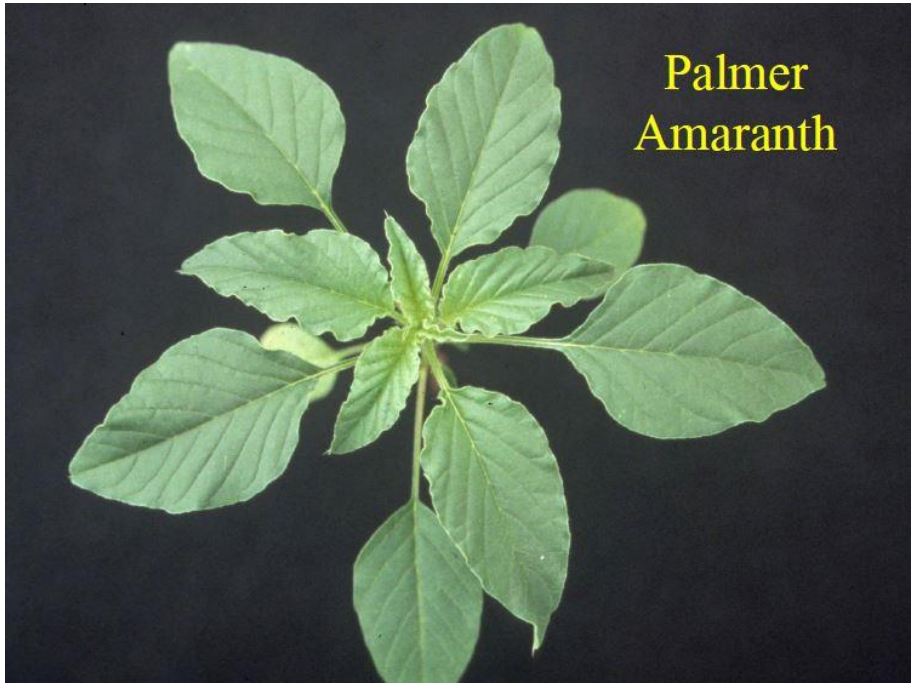
Waterhemp

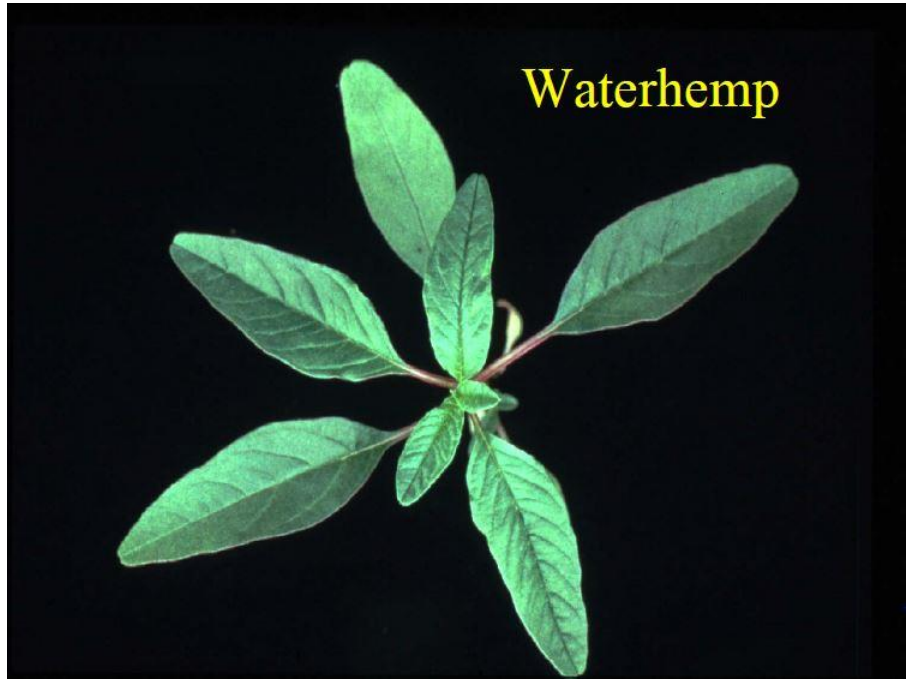
Redroot pigweed, credit, Bruce Ackley, The Ohio State Univ., Bugwood.org

Waterhemp


Powell
Amaranth

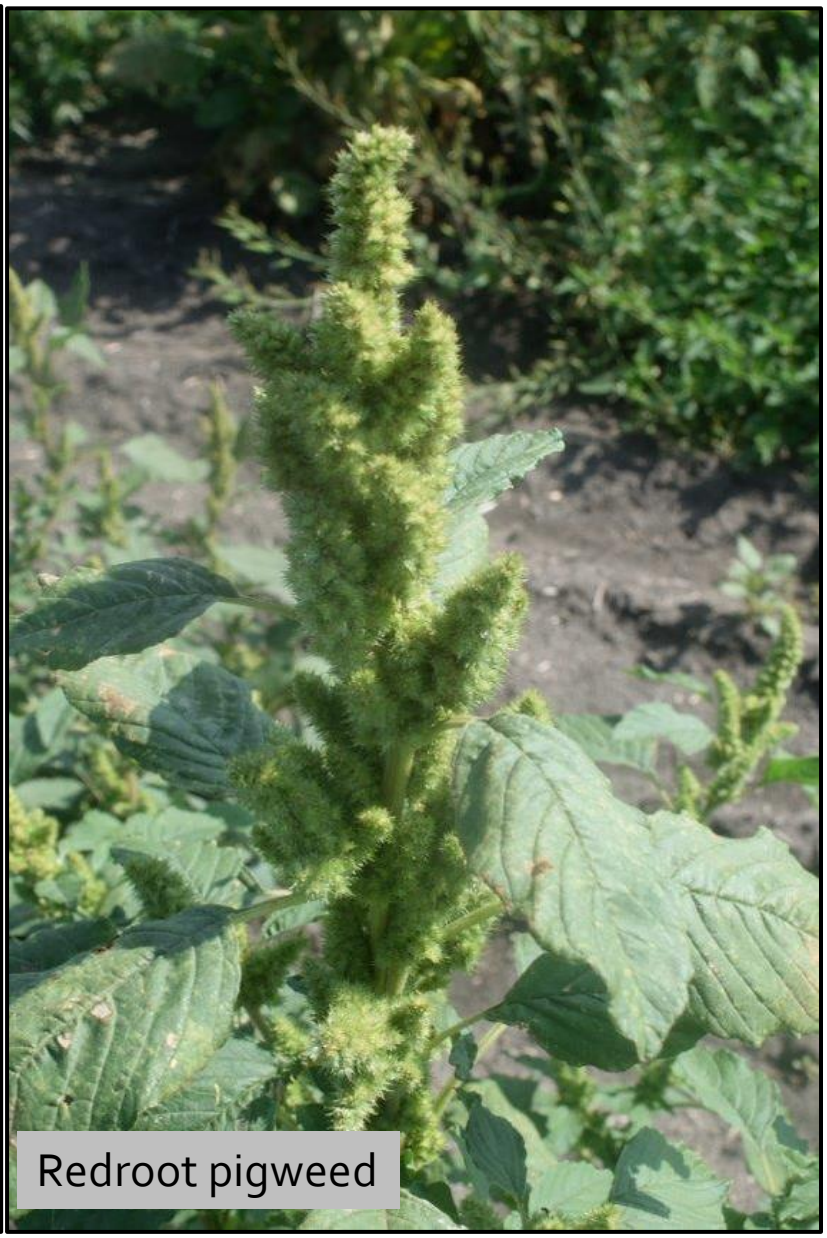

Redroot
Pigweed


Palmer
Amaranth

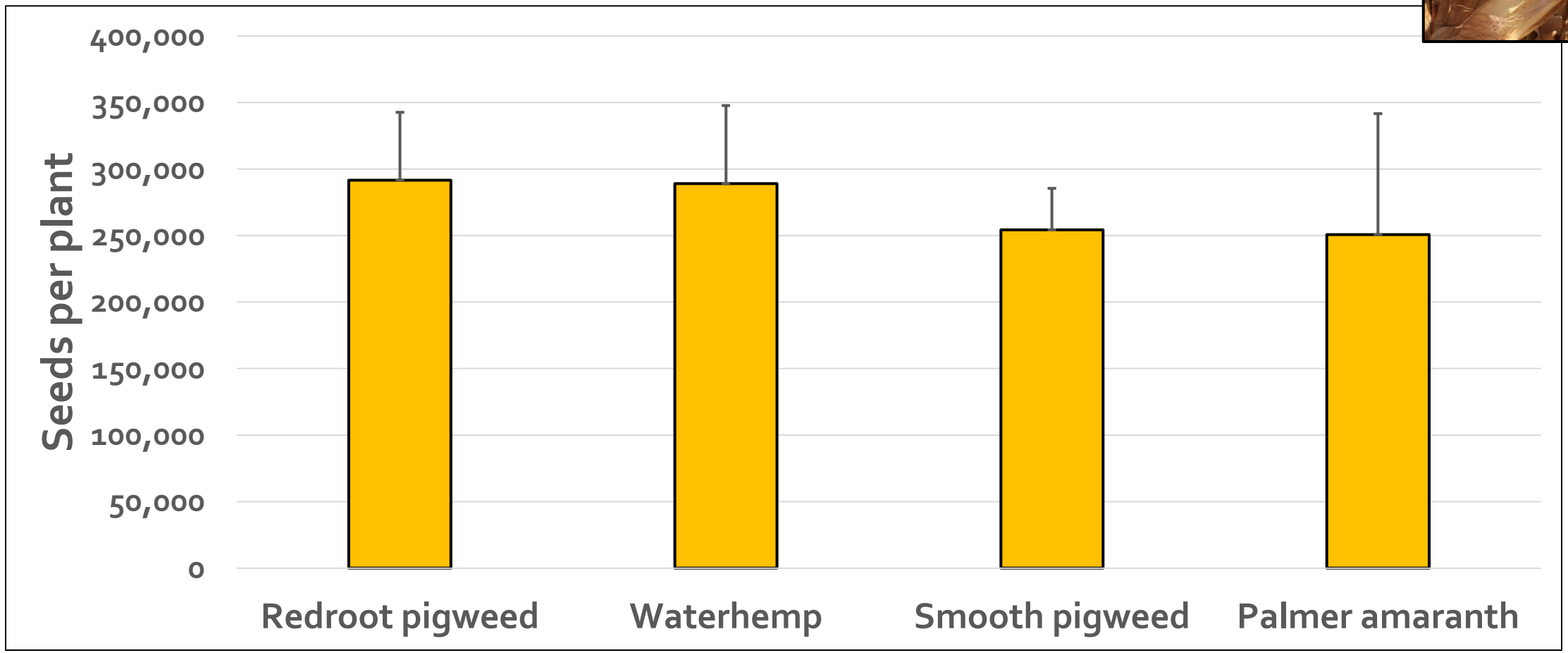

Waterhemp


Powell amaranth


Waterhemp

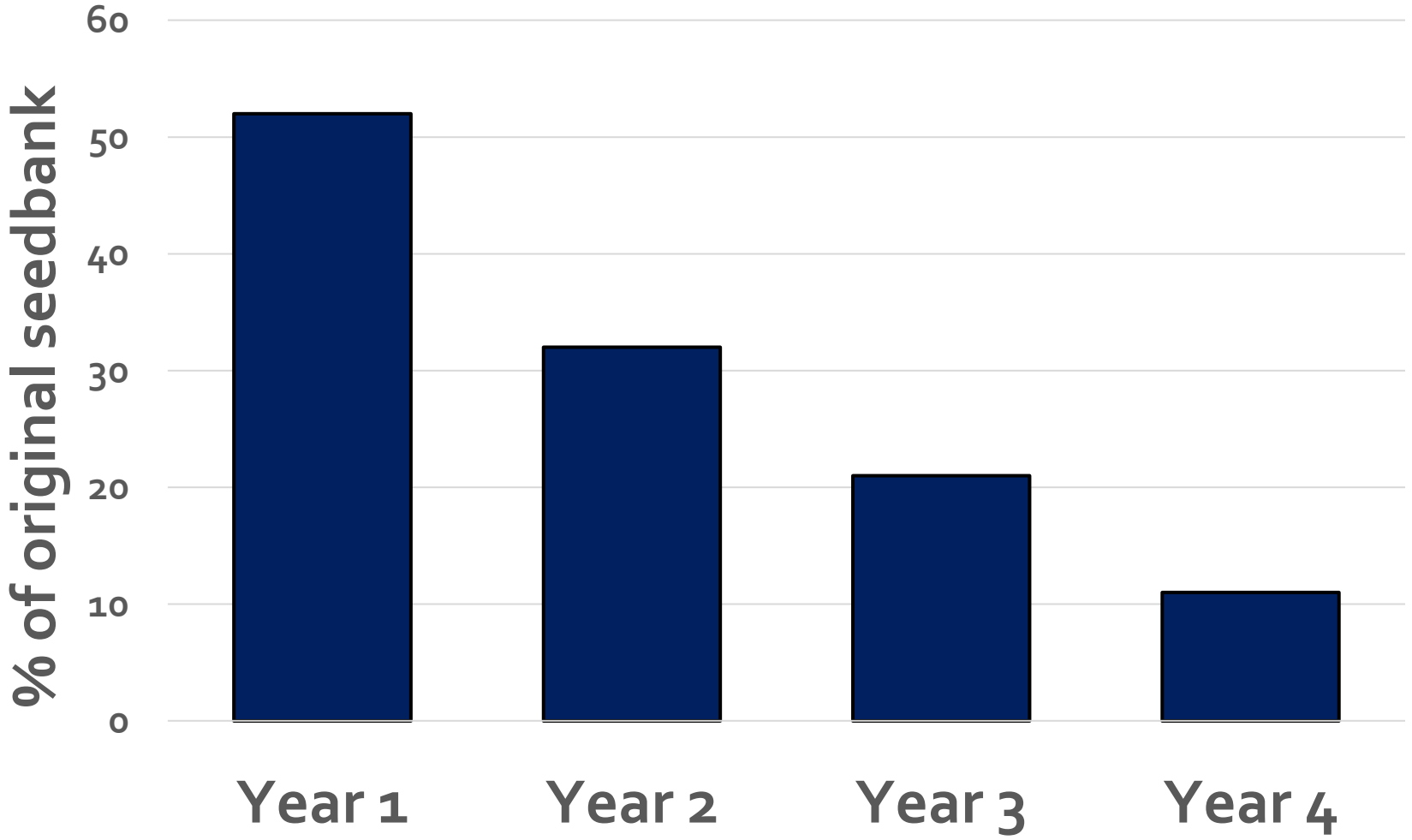

Redroot pigweed

Pigweed species make a lot of seed



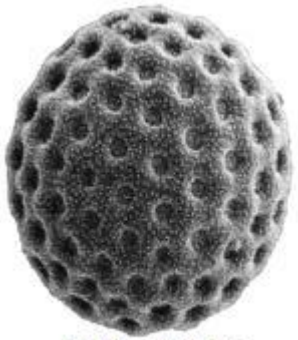
Sellers et al. 2003

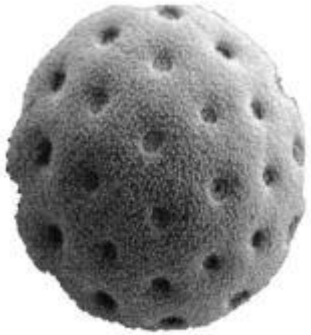
Percent of waterhemp seed viable four years following burial



Source: Buhler and Hartzler, 2001. Weed Science: 49:230-235

Pollen distribution has contributed to development of resistance to many groups of herbicides


Waterhemp

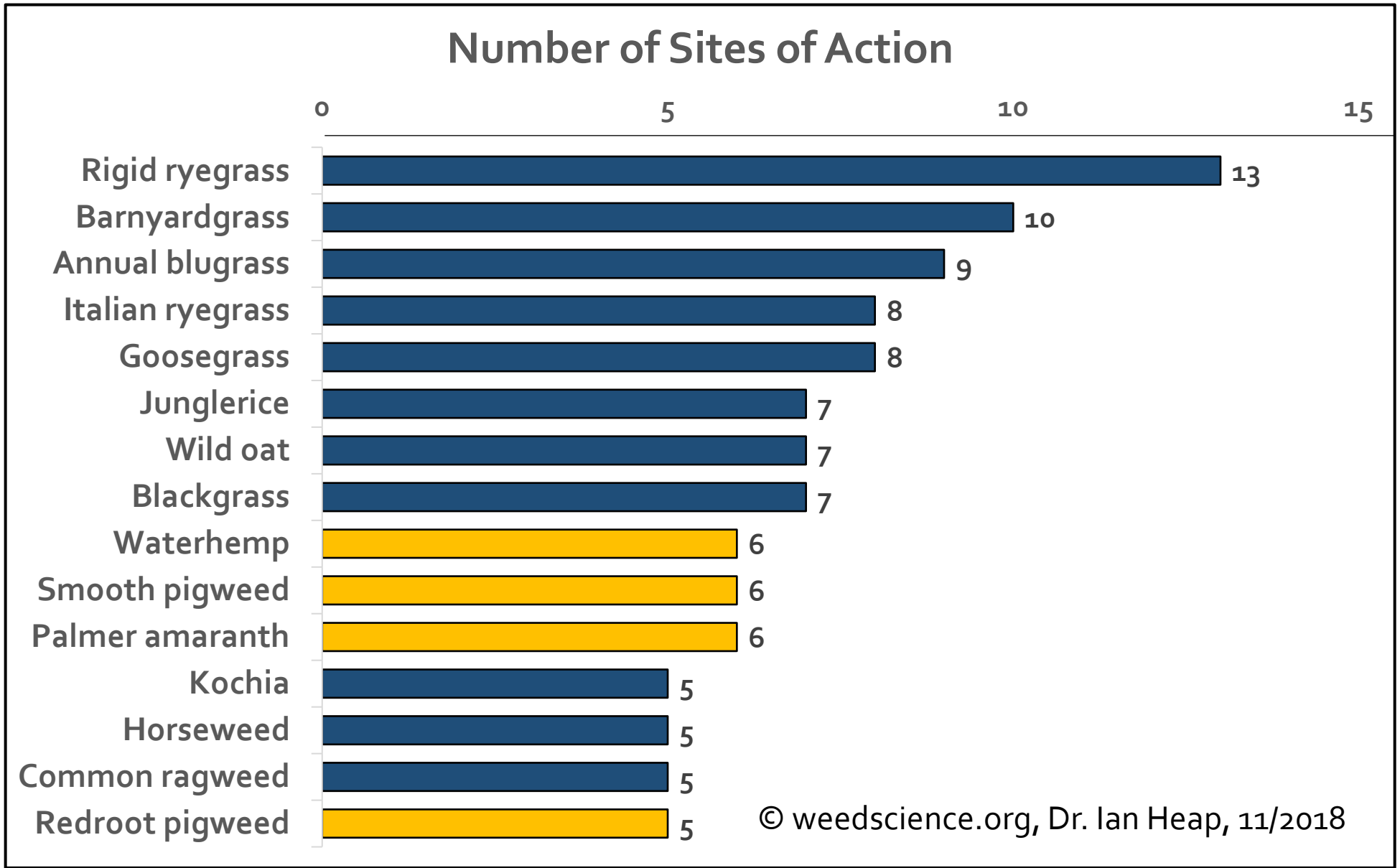

Palmer Amaranth

1. Dioecious. Male and female flowers on separate plants.
2. Waterhemp pollen can remain viable up to 120 hours after pollen shed.
3. Long distance pollen dispersal can occur with plants up to ½ mile apart.

Franssen et al. 2001. Weed Sci. 49:732-737; Liu et al. 2012. Weed Sci. 60:416-422; Sosnokie et al. 2012. Weed Sci. 60:366-373.

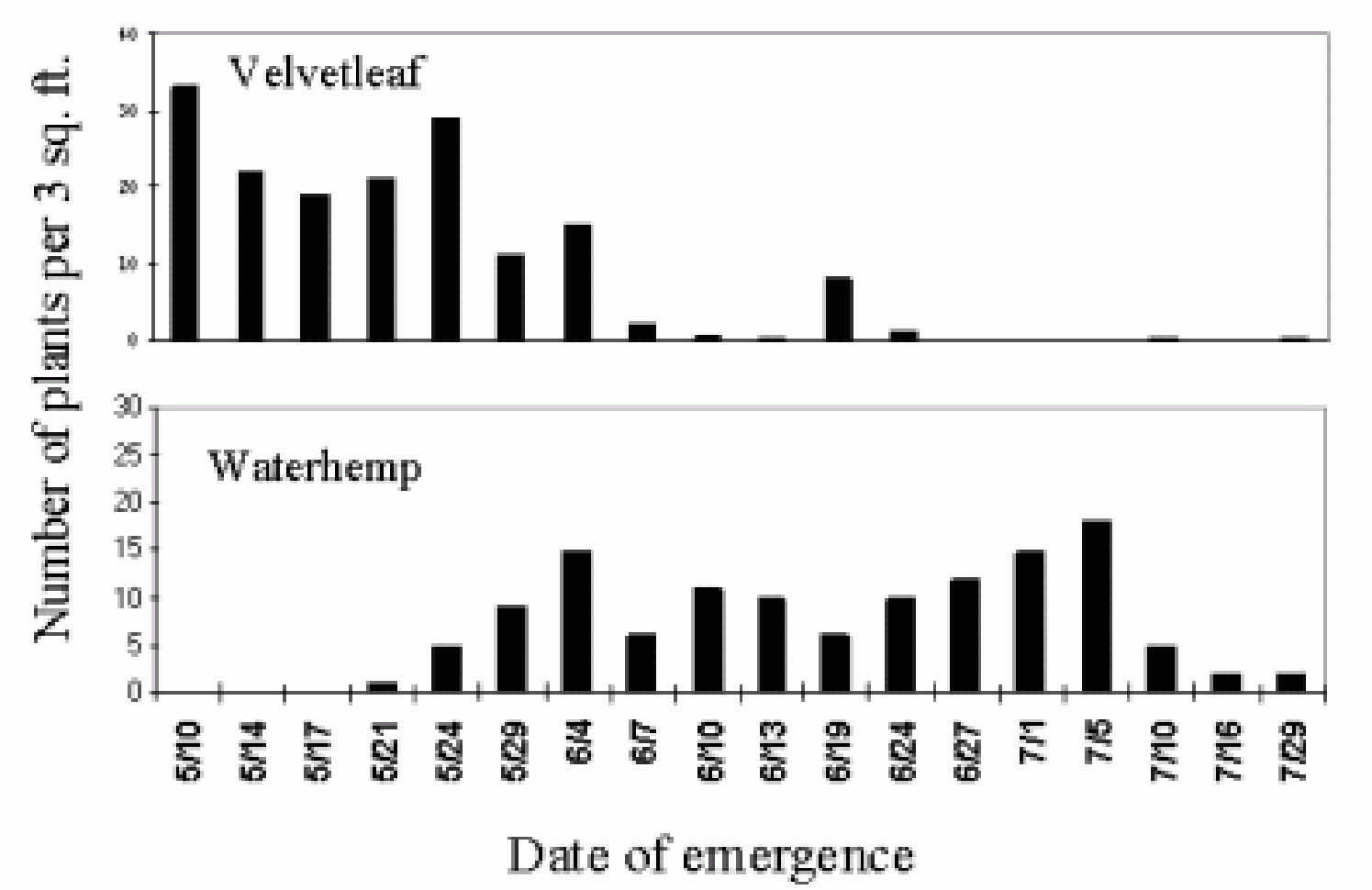
Image credit: Phil Westa,
Colorado State Univ.

Weed species resistance to multiple herbicide site of action



Waterhemp emerged, image, May 22

Delayed and prolonged emergence of waterhemp creates weed management challenges



Hartzler and Buhler, ISU and USDA-ARS, 1996

Percent visual waterhemp control from repeat applications of glyphosate[1]

	Herman 2014	Herman 2015	Moorhead 2015	Lake Lillian 2015
	----------% Preharvest control[2]----------			
Experiment 1	33	48	60	48
Experiment 2	35	56	34	-
Experiment 3	36	58	66	60
Experiment 4	-	48	39	-

[1]Roundup Power Max at 28/28/22 fl oz/A plus Prefer 90 NIS at 0.25% v/v and N-Pak AMS at 2.5% v/v

[2]Visual percent waterhemp control at preharvest evaluation

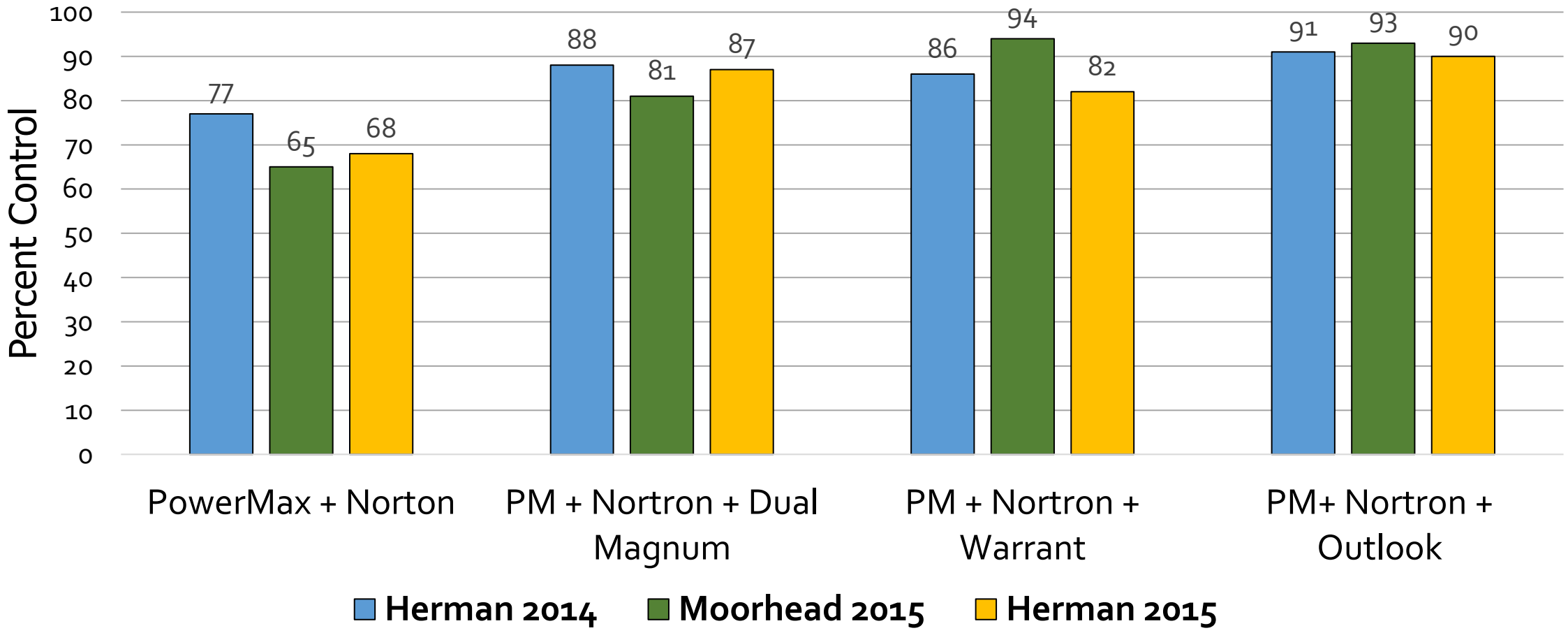
Etho might be our most versatile herbicide

Rate (pt/A)	Response
0.25	With PowerMax POST
0.38	With PowerMax POST
0.75	With PowerMax POST
1	With S-metolachlor
2	With S-metolachlor
3	With S-metolachlor
4	Kochia control PRE
5	Kochia control PRE
6	PRE for waterhemp control
7	PRE for waterhemp control

		Sgbt inj		W. hemp cntrl	
Treatment	Rate	12 DAT	20 DAT	Mid	Harvest
	fl oz /A	%	%	%	%
PM / PM / PM	28/28/22	1	0	63 de	48 e
PM+Etho / PM + Etho / PM Etho	28+4 / 28+4 / 22+4	2	1	76 c	67 cd
P-value		NS	NS	<.0001	<.0001

- Add AMS at 1% weight or 2.5% v/v liquid (8.5 lb/100 G water)
- HSMOC (tank-mixes)
- Ethofumesate 4SC = 45 day PHI

Waterhemp control from postemergence herbicides, across locations and years



How do you decide what product to use lay-by?
Risk management

- Replanting, select Dual Magnum
- Activation early, select Outlook
- Sugarbeet safety, Dual Magnum or Warrant
- Length of control, Warrant
- Spectrum, Warrant
- Relationship with industry?
- Don’t forget about the generic versions

WARRANT® HERBICIDE

Dual Magnum®

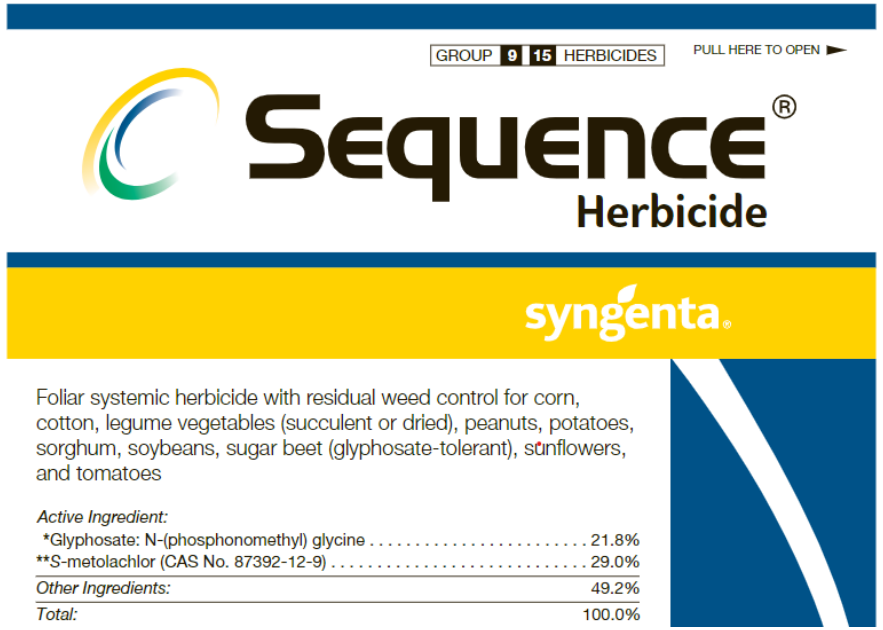
Outlook®
Herbicide

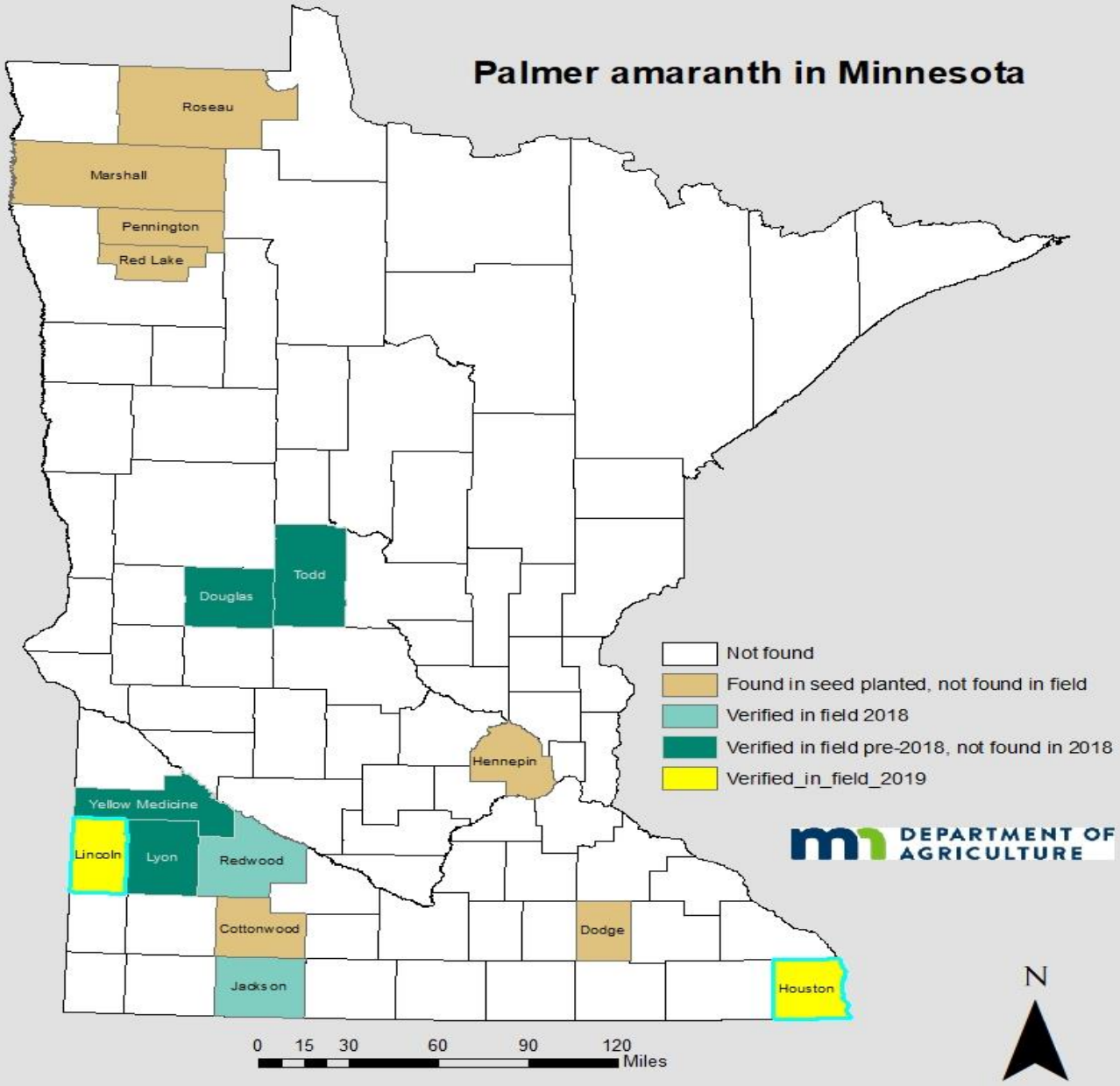
Sequence is glyphosate K salt and *S*-metolachlor

Sequence (pt/A	S-metolachlor (pt/A)	Glyphosate (fl oz /A)	PowerMax 28 fl oz/A	PowerMax 32 fl oz/A
2.5	0.98	20	8	12
2.75	1.08	22	6	10
3	1.18	24	4	8

Sugarbeet Growth Stage	Soil Texture	Single application (pt/A)	Season (pt/A)
Two to eight leaves	Coarse	2.5	6.8
Two to eight leaves	3	2.5	6.8

- Add AMS at 1% weight or 2.5% v/v liquid (8.5 lb/100 G water)
- HSMOC (tank-mixes)
- Minimum 10 GPA
- 14 to 21 days between applications
- 60 day PHI





In accordance with the Americans with Disabilities Act, this information is available in alternative forms of communication upon request by calling 651/201-6000. TTY users can call the Minnesota Relay Service at 711 or 1-800-627-3529. The MDA is an equal opportunity employer and provider.

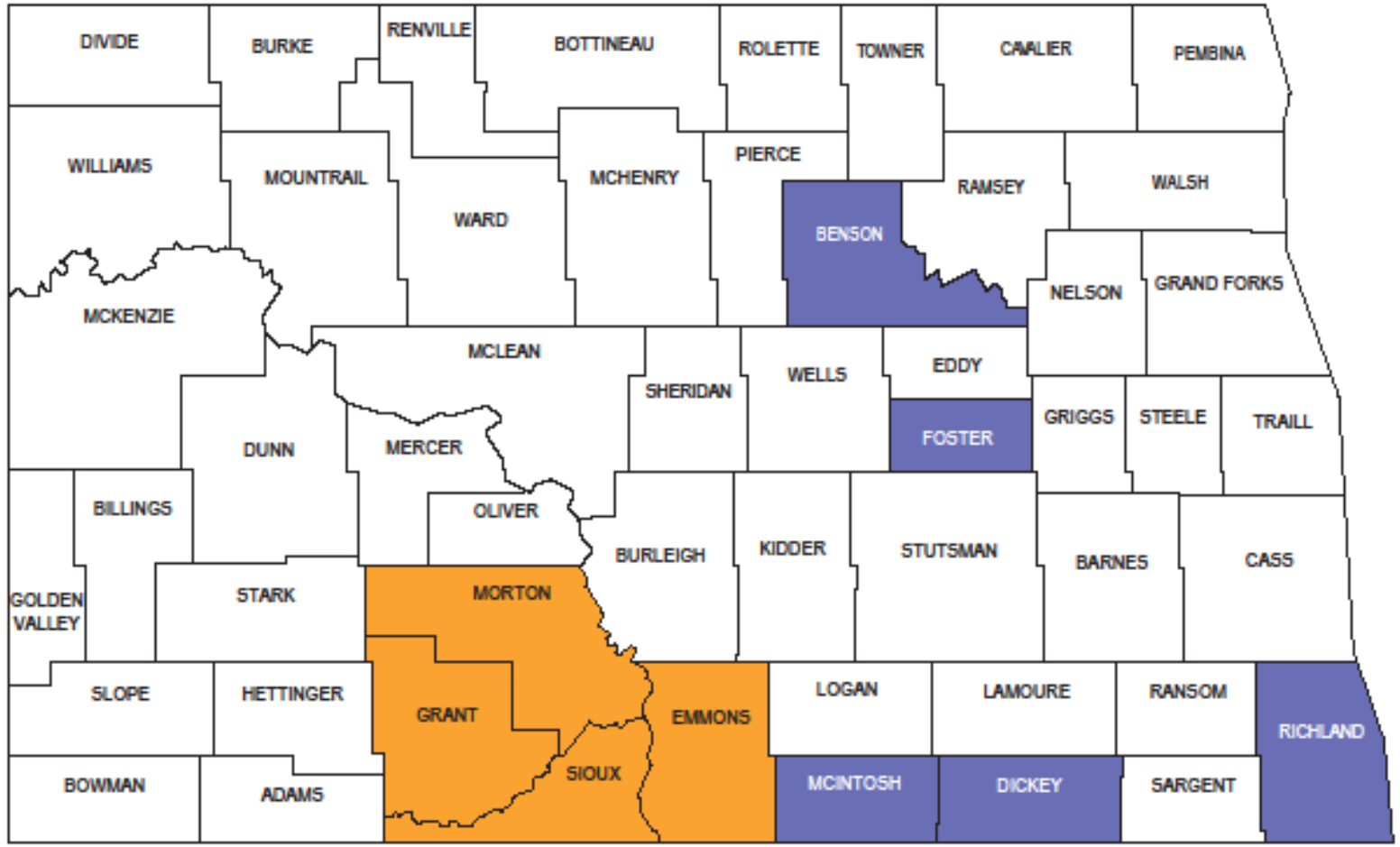
Status of Palmer amaranth in Minnesota

2019 New Counties

Lincoln County – Millet

Houston County – Two sites, no relation

North Dakota Department of Agriculture
Palmer Amaranth Distribution



Lab confirmed positive for Palmer amaranth
- 2018
- 2019

As of 10/15/19

Acknowledgements

- Sugarbeet Research and Education Board for funding these research

- Our cooperators: **James Bergman (Oslo), Glenn and Danny Brandt (Ada), Pinta Brothers (Minto),** American Crystal Sugar (Moorhead)

- North Dakota State University Experiment Station and Crookston Research and Outreach Center

Thank you for your Support

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