Vegetable weed management update

Jed Colquhoun,
UW-Madison

The future is bright… but different

- Checking the pulse: weed management status
- Housekeeping: registration updates
- Crystal ball: where do we go next?
- In the news: a quick dicamba update, but from a specialty crop perspective

There are few new herbicides on the way!

Weed Science

cambridge.org/wsc

Weed Management

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Investigations of 2,4-D and Multiple Herbicide Resistance in a Missouri Waterhemp (*Amaranthus tuberculatus*) Population

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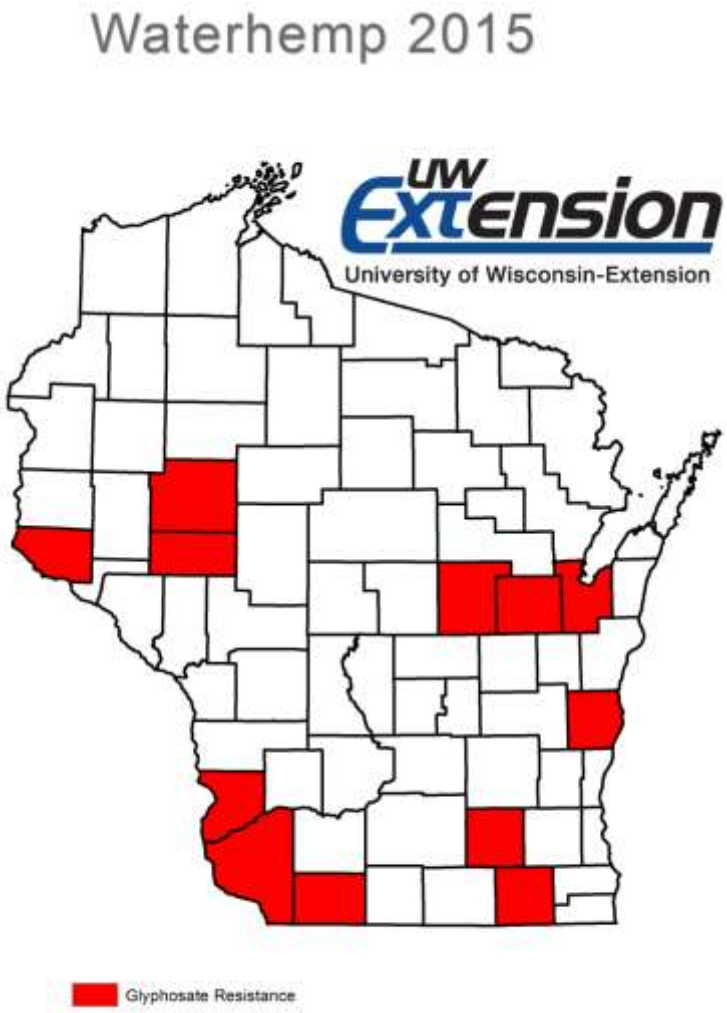
Abstract

Research was conducted from 2015 to 2017 to investigate the potential for 2,4-D and multiple herbicide resistance in a waterhemp [*Amaranthus tuberculatus* (Moq.) J. D. Sauer] population from Missouri (designated MO-Ren). In the field, visual control of the MO-Ren population with 0.56 to 4.48 kg 2,4-D ha^{-1} ranged from 26% to 77% in 2015 and from 15% to 55% in 2016. The MO-Ren population was highly resistant to chlorimuron, with visual control never exceeding 7% either year. Estimates of the 2,4-D dose required to provide 50% visual control (I_{50}) of the MO-Ren population were 1.44 kg ha^{-1} compared with only 0.47 kg 2,4-D ha^{-1} for the susceptible population. Based on comparisons to a susceptible population in dose–response experiments, the MO-Ren population was approximately 3-fold resistant to 2,4-D, and 7-, 7-, 22-, and 14-fold resistant to atrazine, fomesafen, glyphosate, and mesotrione, respectively. Dicamba and glufosinate were the only two herbicides that provided effective control of the MO-Ren population in these experiments. Examinations of multiple herbicide resistance at the individual plant level revealed that 16% of the plants of the MO-Ren population contained genes stacked for six-way herbicide resistance, and only 1% of plants were classified as resistant to a single herbicide (glyphosate). Results from these experiments confirm that the MO-Ren *A. tuberculatus* population is resistant to 2,4-D, atrazine, chlorimuron, fomesafen, glyphosate, and mesotrione, making this population the third 2,4-D–resistant *A. tuberculatus* population identified in the United States, and the first population resistant to six different herbicidal modes of action.

Wisconsin waterhemp as an example of rapid invasion and resistance

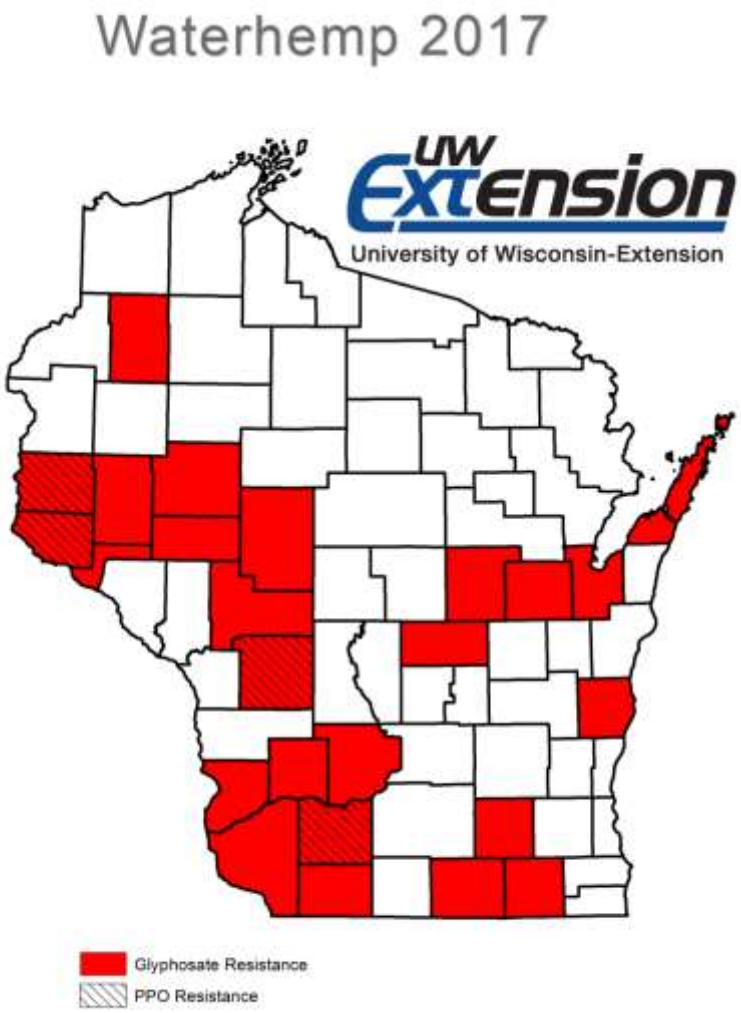
- **Glyphosate resistance confirmed in 12 counties as of 2015**



Slide courtesy D. Stoltenberg

Wisconsin waterhemp as an example of rapid invasion and resistance

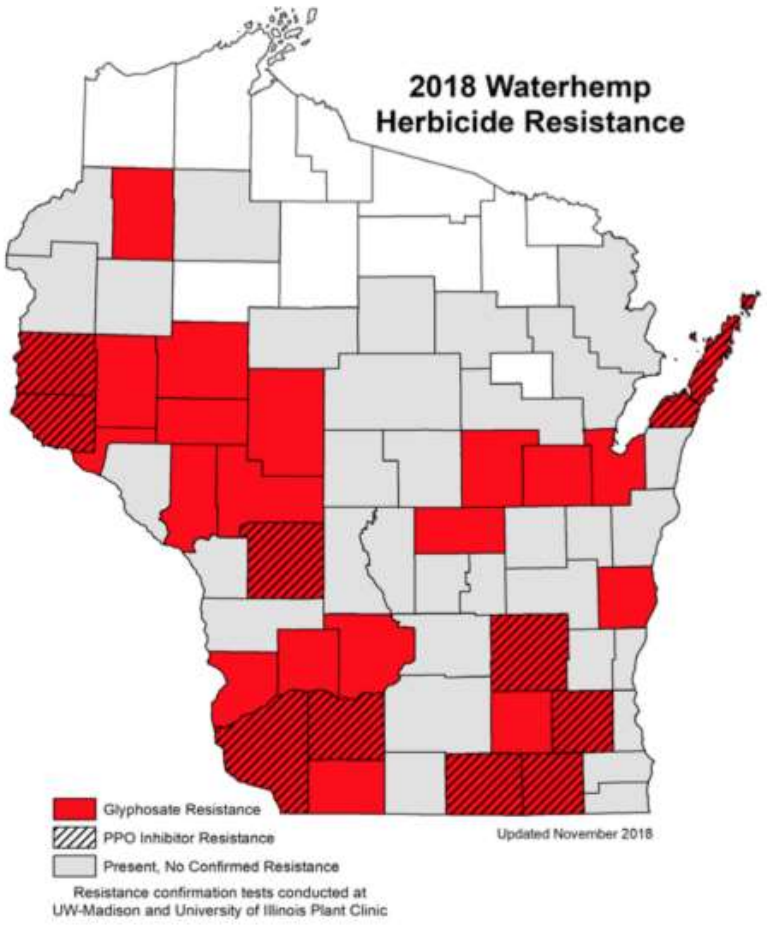
- **Glyphosate resistance has been confirmed in waterhemp from 25 counties as of 2017**
- **Multiple resistance to glyphosate and PPO inhibitors confirmed in 4 counties**



Resistance confirmed at UW-Madison or the University of Illinois Plant Clinic; slide courtesy D. Stoltenberg

Wisconsin waterhemp as an example of rapid invasion and resistance

- **Glyphosate resistance has been confirmed in waterhemp from 28 counties as of 2018**
- **Multiple resistance to glyphosate and PPO inhibitors confirmed in 10 counties**



Source: Zimbric, Stoltenberg, Renz and Werle, UW-Madison Agronomy

	Common Waterhemp	Redroot Pigweed	Smooth Pigweed	Powell Amaranth	Palmer Amaranth
Seedling shape					
Stem hairs					
Leaf shapes					
Separate male and female plants	Yes	No	No	No	Yes
Seedhead shape	smooth, long, slender	prickly, short, stout	slightly prickly, long, slender	prickly, very long, thick	very prickly, very long, thick

Source:
Pratt et al., Iowa State University, 1999

Registration update: What's happening with linuron?

- US registration:
  - Linuron is currently in EPA registration review
    - Ecological and human health risk assessment
    - All other potential label changes on hold until then
  - Registrant is working on studies to determine linuron fate in soil and groundwater risk
- Global registrations:
  - European Commission declined to renew registration based on endocrine disruption risk
- Weed resistance becoming widespread, particularly among *Amaranthus* spp.

Registration update: Diquat STILL in registration review

- Diquat undergoing normal EPA registration review required of all pesticides every 15 years
- Initial EPA review: use timing, number of applications and rate restrictions may be needed
- Open comment period: input from researchers and industry emphasized importance in potato desiccation
- Final EPA decision is overdue…

Registration update: Potential new potato herbicides

- Sonalan: working with registrant to expand regional registration to include WI – registrant is applying for a Special Local Needs (24c) label
- Zidua: tolerance has been approved and published, waiting on new commercial label

- Other potential herbicides showing good crop tolerance and broad-spectrum weed control in refined research:
  - Bicyclopyrone
  - Firstrate
  - Callisto
  - Basagran
  - Sandea
  - Caparol

These are not currently registered for use on WI potato

Zidua potential on potato

- Tolerance established, waiting on commercial label addition
- Hill-spray
- Sand, silt loam, and muck

Crystal ball: where do we go next?

An example from carrots

Herbicide programs without linuron: loamy sand

Prowl H2O, Caparol, Caparol*

Dual Magnum, Caparol, Caparol*

Can gibberellic acid increase competitiveness?

ProGibb® 4%

PLANT GROWTH REGULATOR

SOLUTION

For Agricultural Use

For Organic Production

ACTIVE INGREDIENT: Gibberellic Acid	4.0% w/w
OTHER INGREDIENTS	96.0% w/w
TOTAL	100.0% w/w

ProGibb 4% liquid contains approximately 1.0 gram active ingredient per fluid ounce of formulated product.

EPA Reg. No. 73049-15

EPA Est. No. 33762-IA-001 List No. 05016

Carrots, Fresh and Processing	To delay leaf senescence. Maintaining vigorous foliage has been shown to help reduce the incidence of infection by *Alternaria dauci*.	1-6	Make the first application 4-6 weeks after emergence using commercial ground or aerial equipment with spray concentrations of 20-30 ppm. In severe disease situations or cool weather a second spray 14 days later is sometimes required to achieve the desired amount of foliar recovery. Do not apply more than twice per crop.

NOTE:

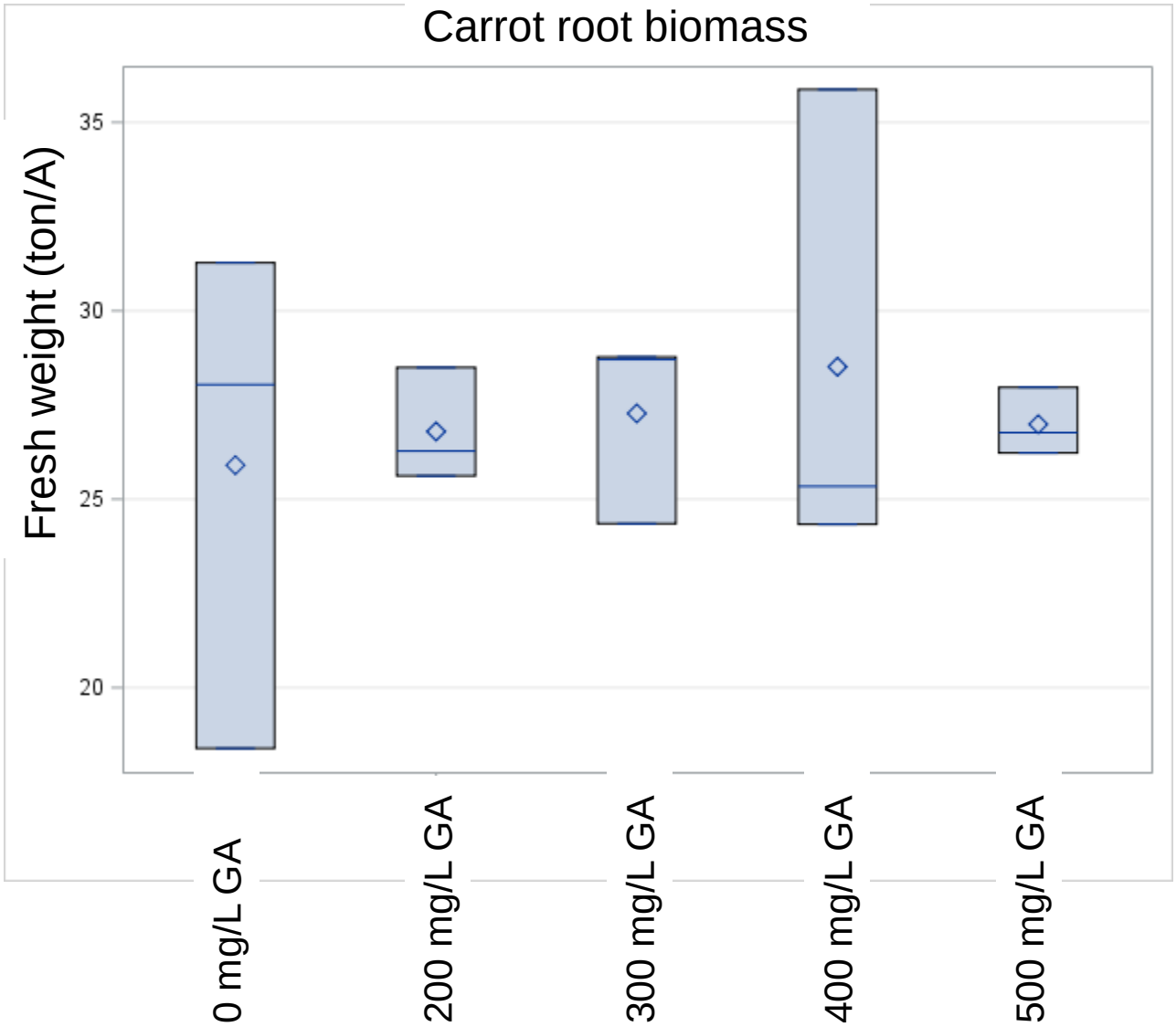
- Dilutions of greater concentration can increase the risk of excessive top growth, particularly with a second application.

Can gibberellic acid increase competitiveness?

O mg/L GA

400 mg/L GA

Can gibberellic acid increase competitiveness?



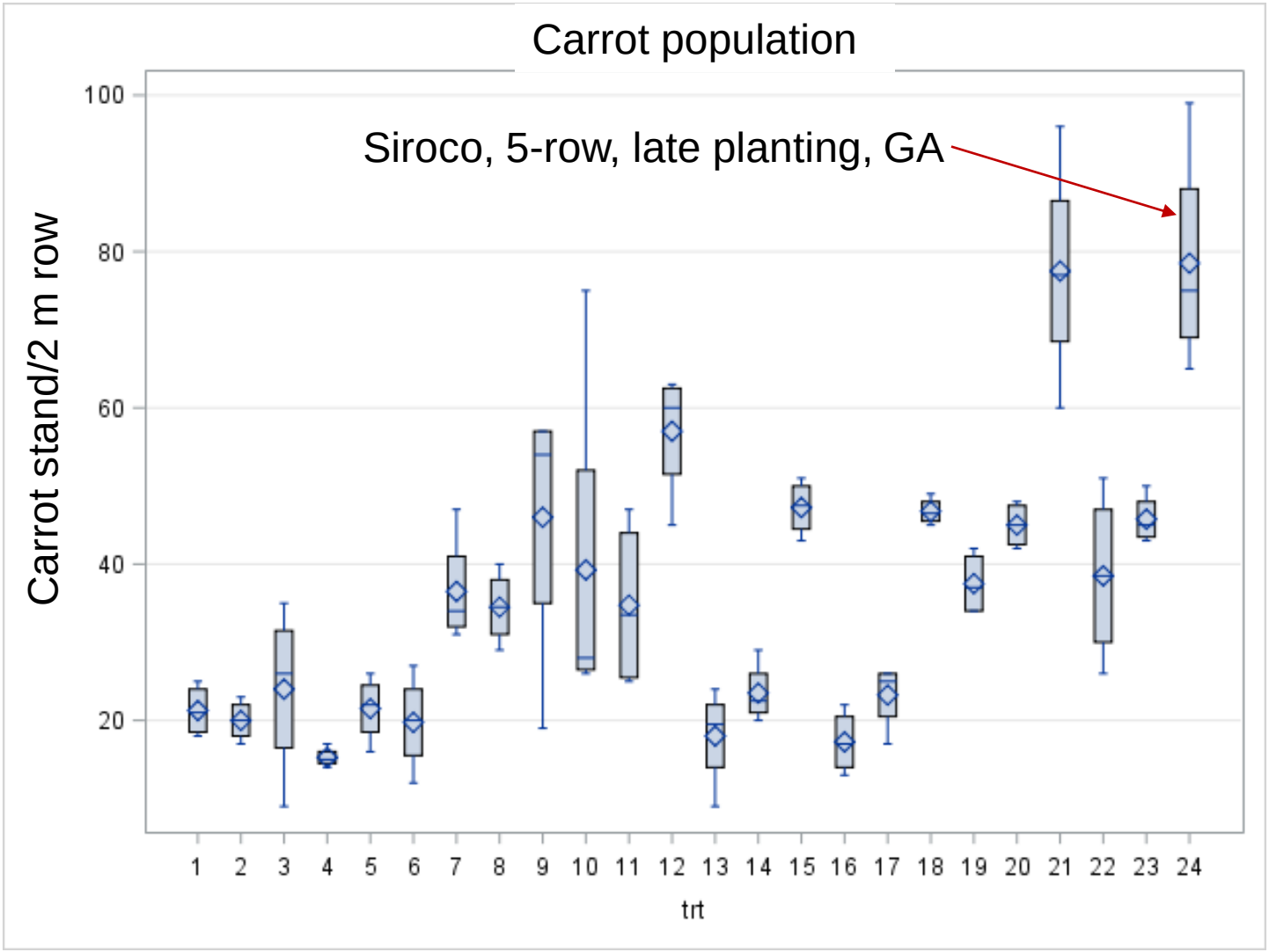
With no new herbicides in sight, it's time to really think out of the box…

- Putting together a systematic approach:
  - Competitive cultivars with foliar disease resistance
  - Rapid emergence with seed germinators
  - Later planting dates when flexible and yielding
  - Rapid top growth with GA
  - Competitive bed plantings

With no new herbicides in sight, it's time to really think out of the box…

- 2018 field research:
  - 3 carrot varieties with varying competitive ability
  - 2 planting dates (late-April and mid-May)
  - 2 row spacings/seeding densities
  - With and without plant hormone stimulants

Putting it all together, what worked best?



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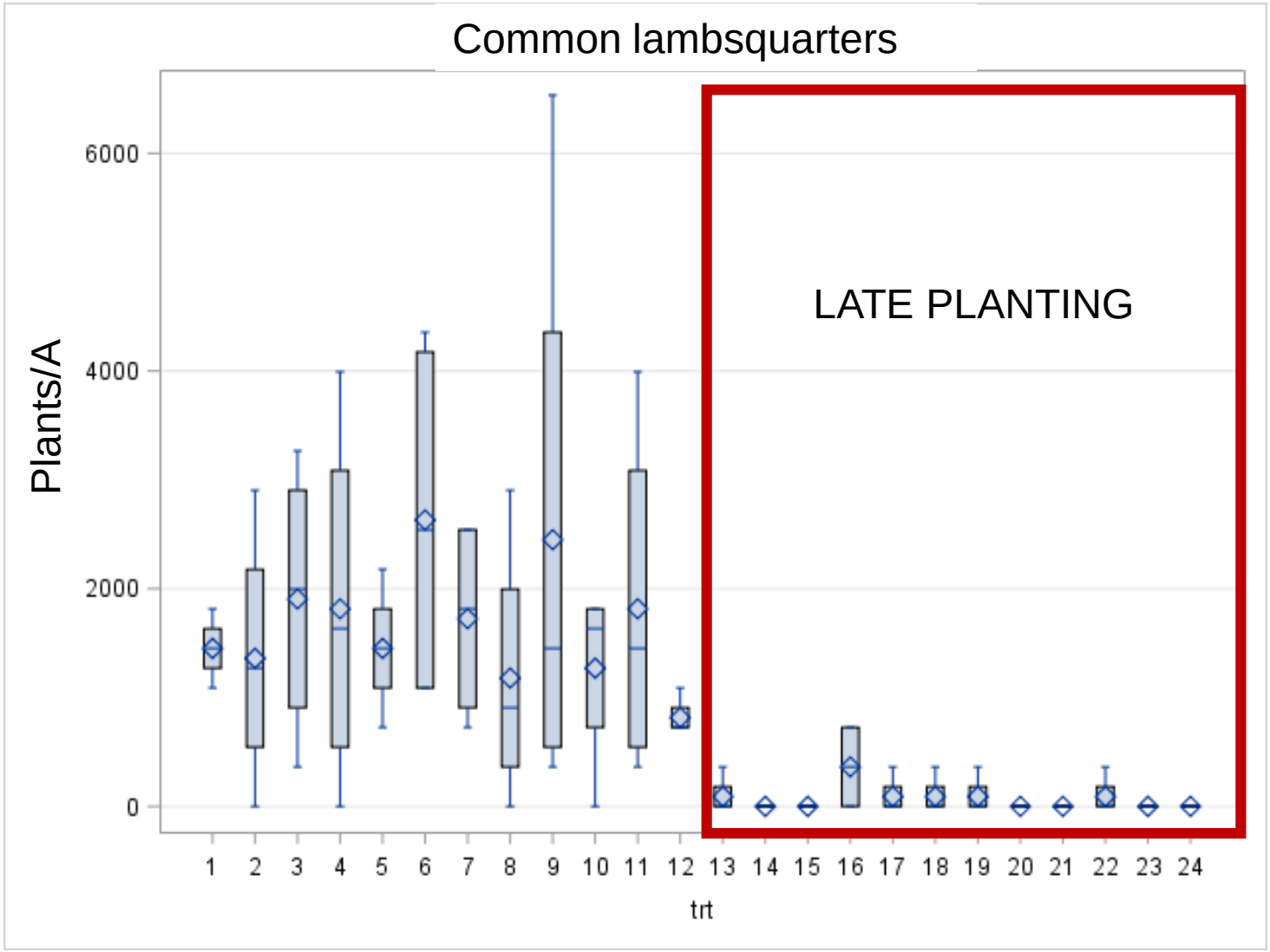

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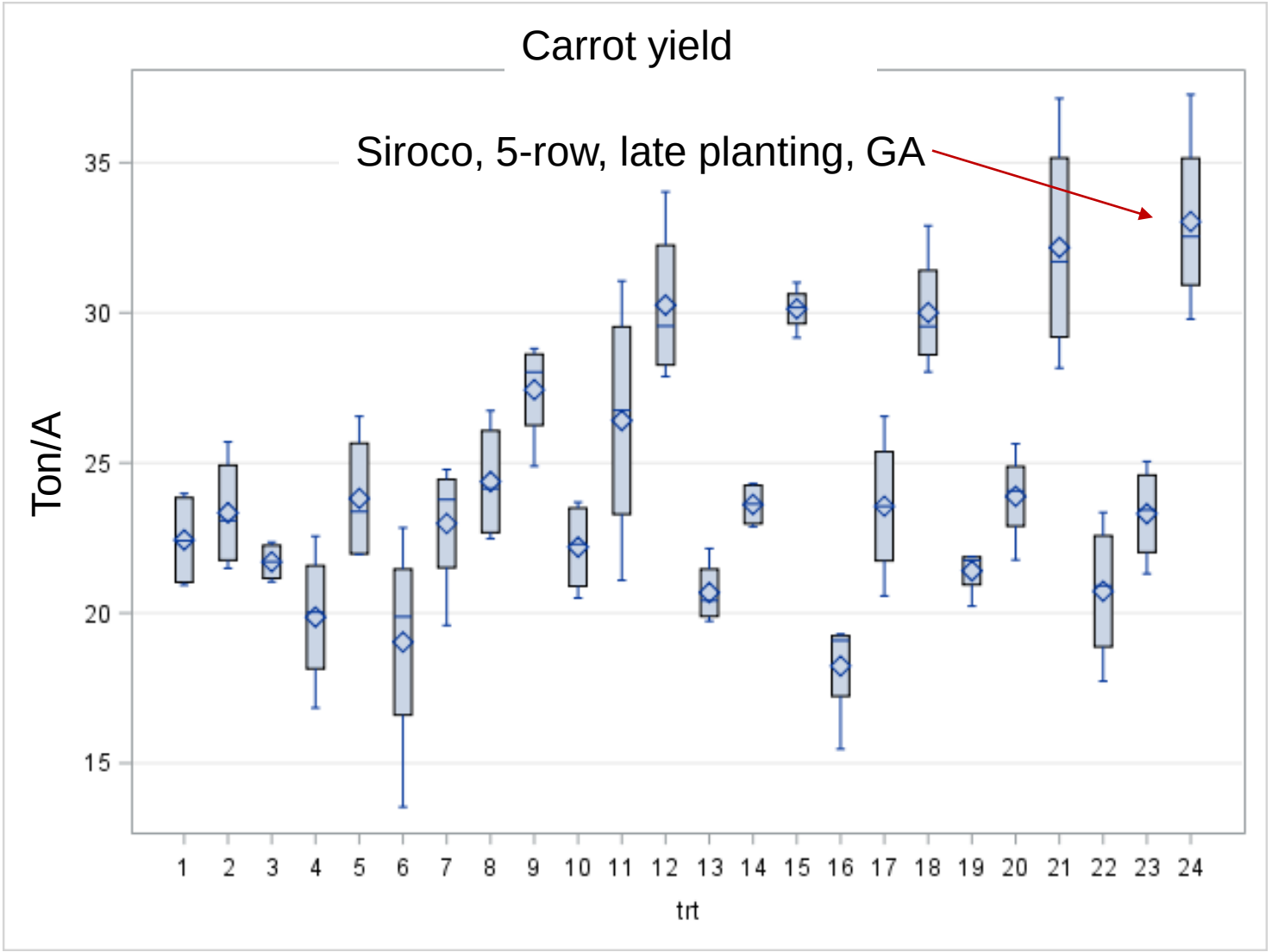


Carrot varieties

Canada

Cupar

Siroco

3-row vs. 5-row

3-row, no GA

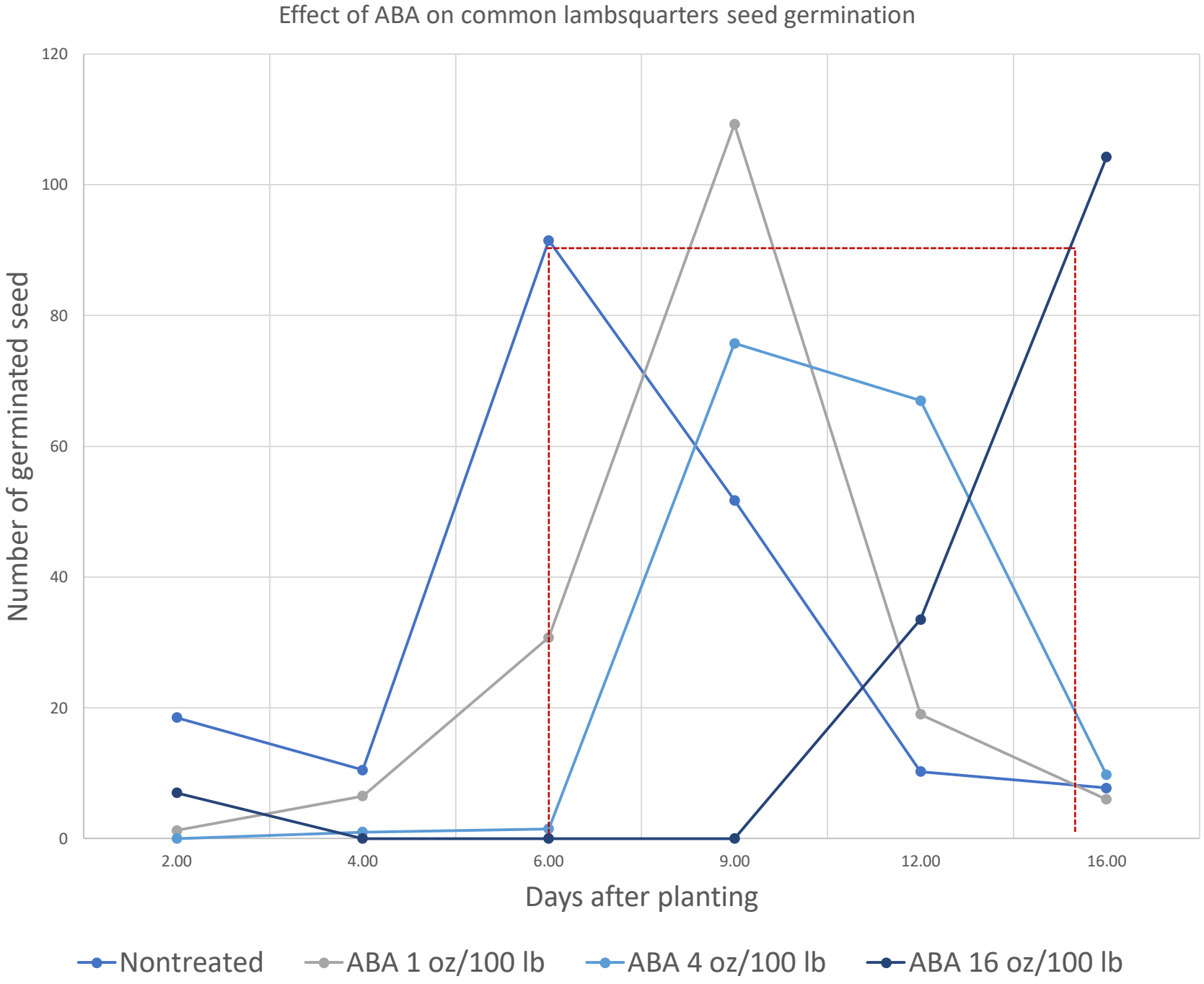
5-row, no GA

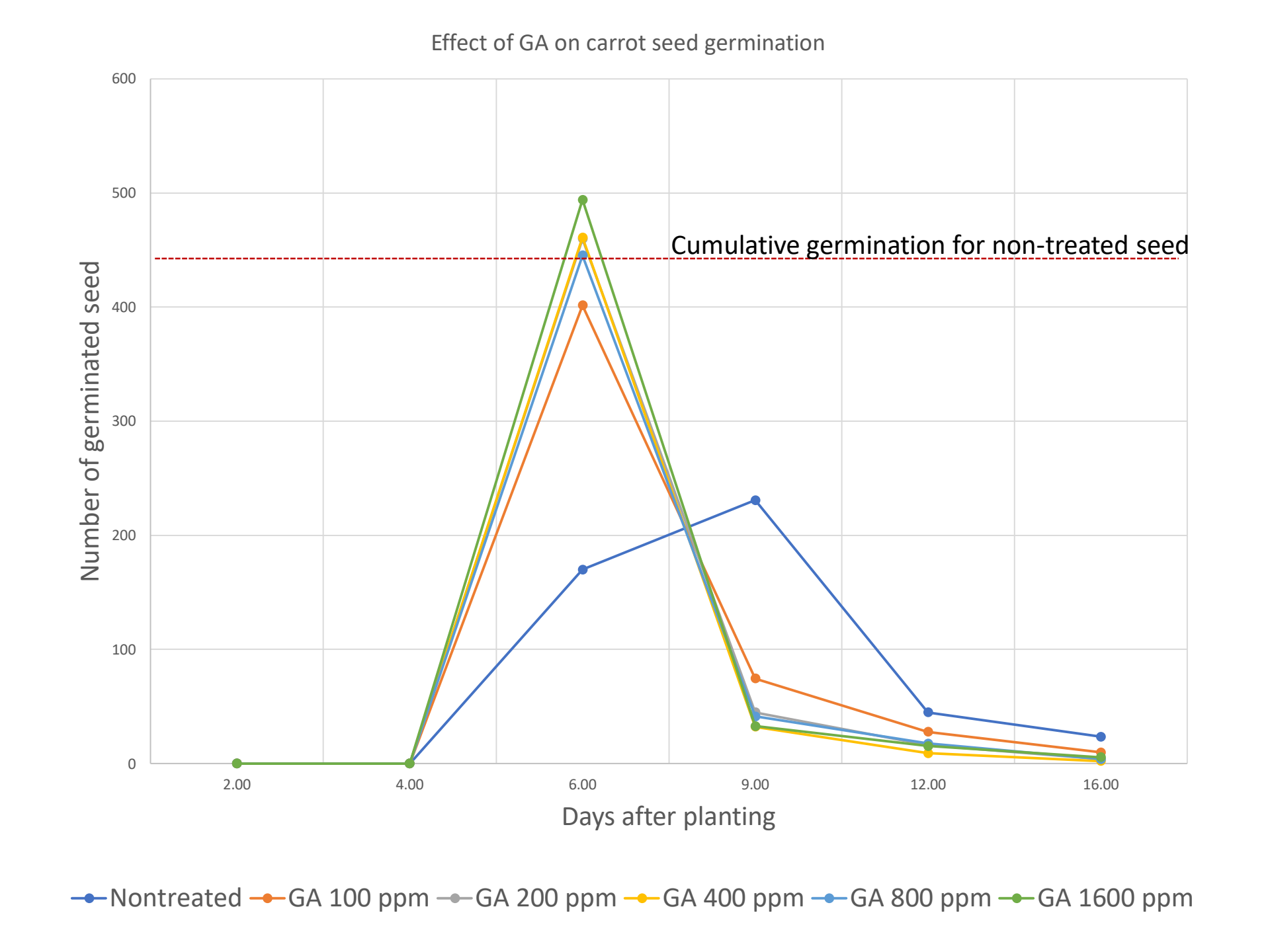
Current state vs. integrated system

Cupar, 3-row, no GA, early planting

Canada, 5-row, GA, late planting

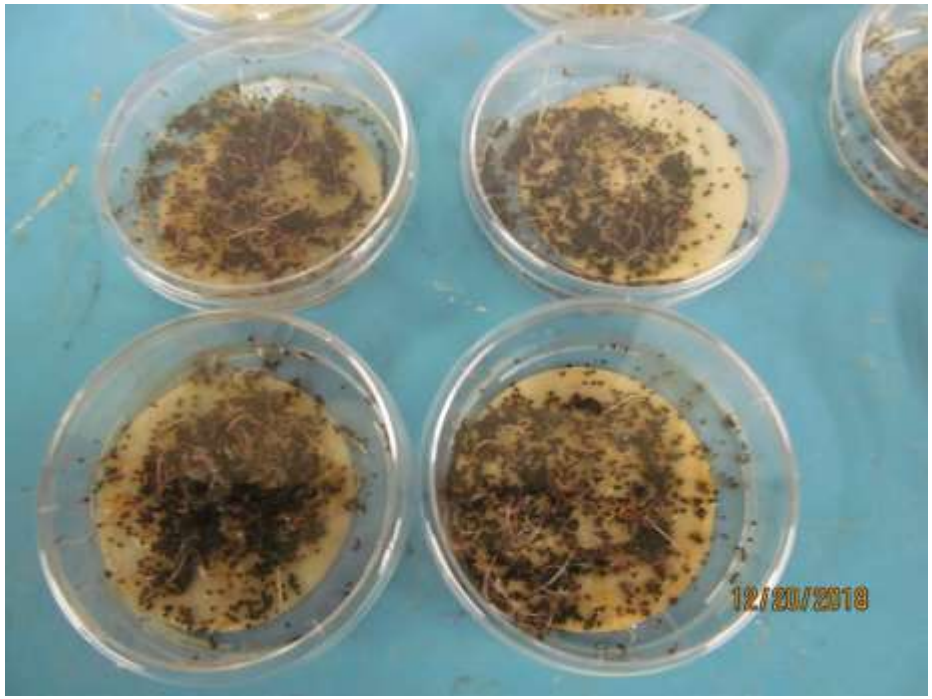
Can we influence weed and crop germination to create a competitive advantage?


Effect of ABA on common lambsquarters seed germination
Number of germinated seed
120
100
80
60
40
20
0
2.00
4.00
6.00
9.00
12.00
16.00
Days after planting
Nontreated
ABA 1 oz/100 lb
ABA 4 oz/100 lb
ABA 16 oz/100 lb

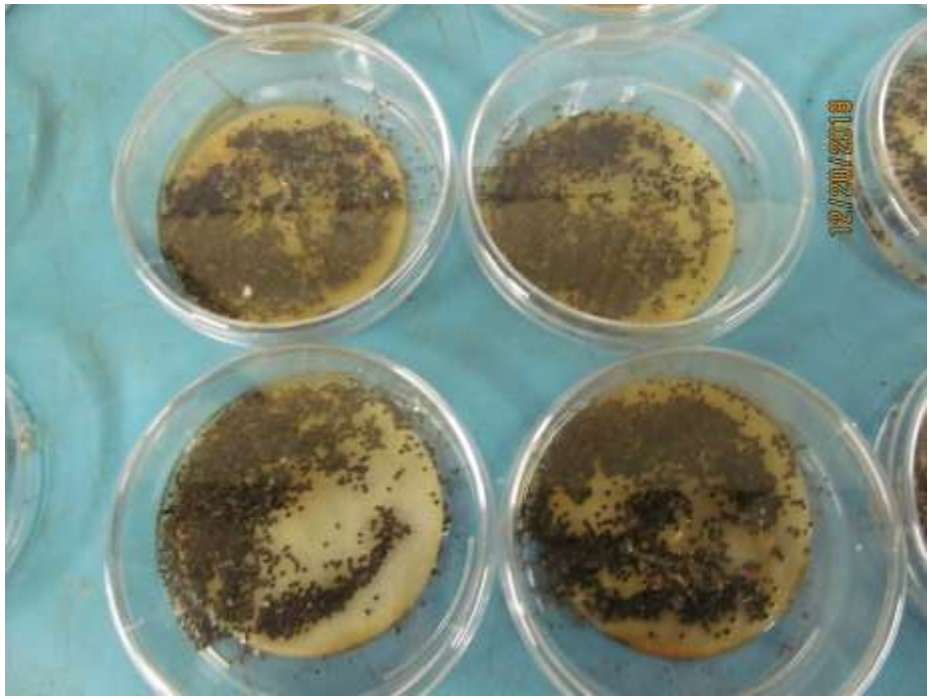

Effect of GA on carrot seed germination
600
500
400
300
200
100
0
Number of germinated seed
Cumulative germination for non-treated seed
2.00
4.00
6.00
9.00
12.00
16.00
Days after planting
Nontreated
GA 100 ppm
GA 200 ppm
GA 400 ppm
GA 800 ppm
GA 1600 ppm

ABA, common lambsquarters
9 days after planting

Non-treated

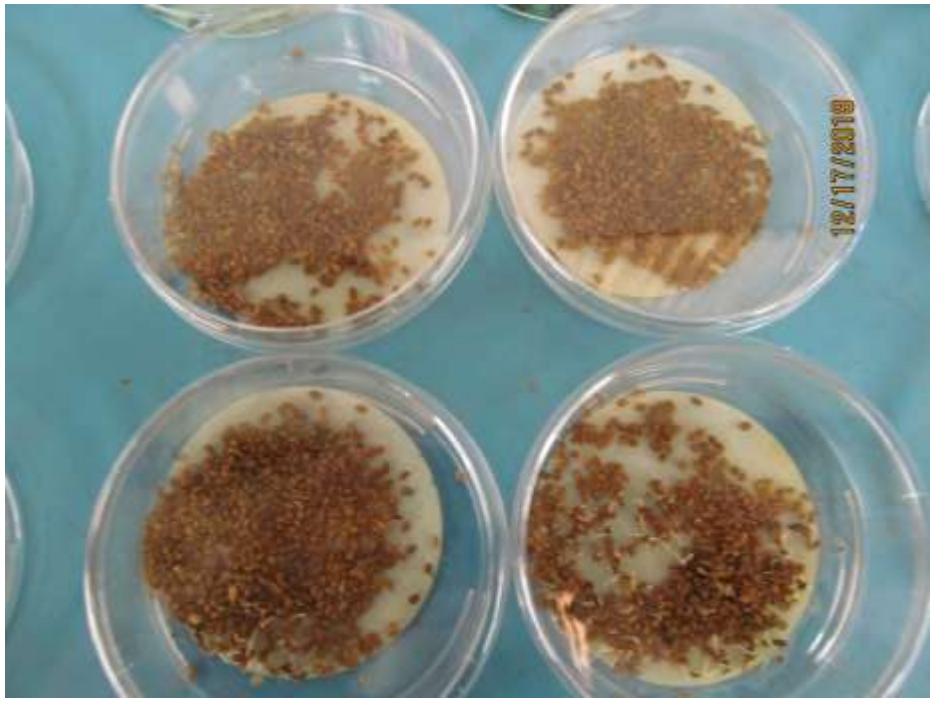


16 oz/100 lb seed

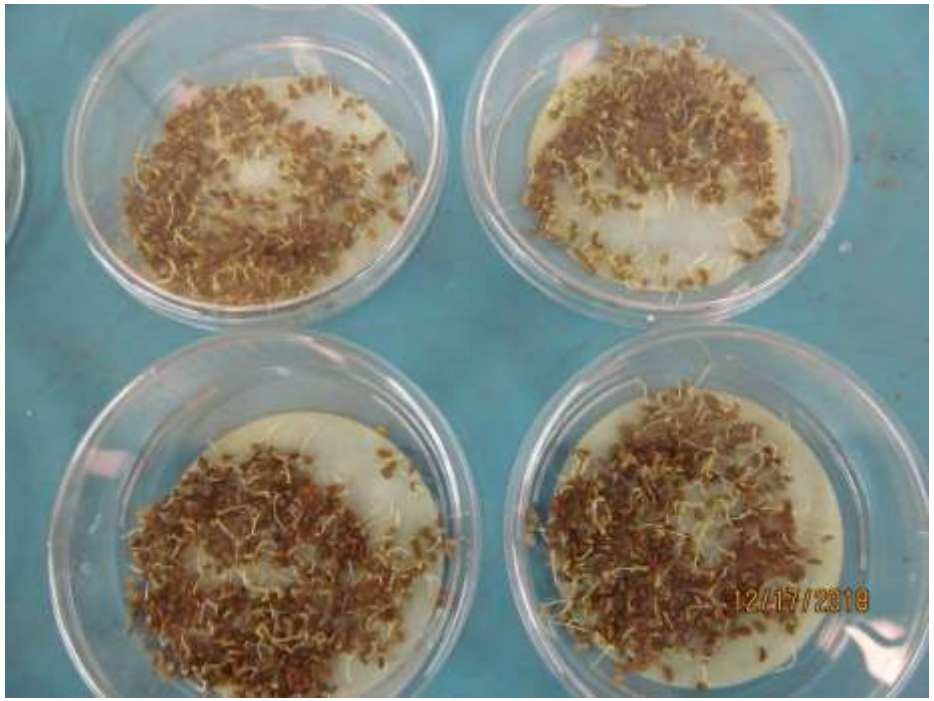


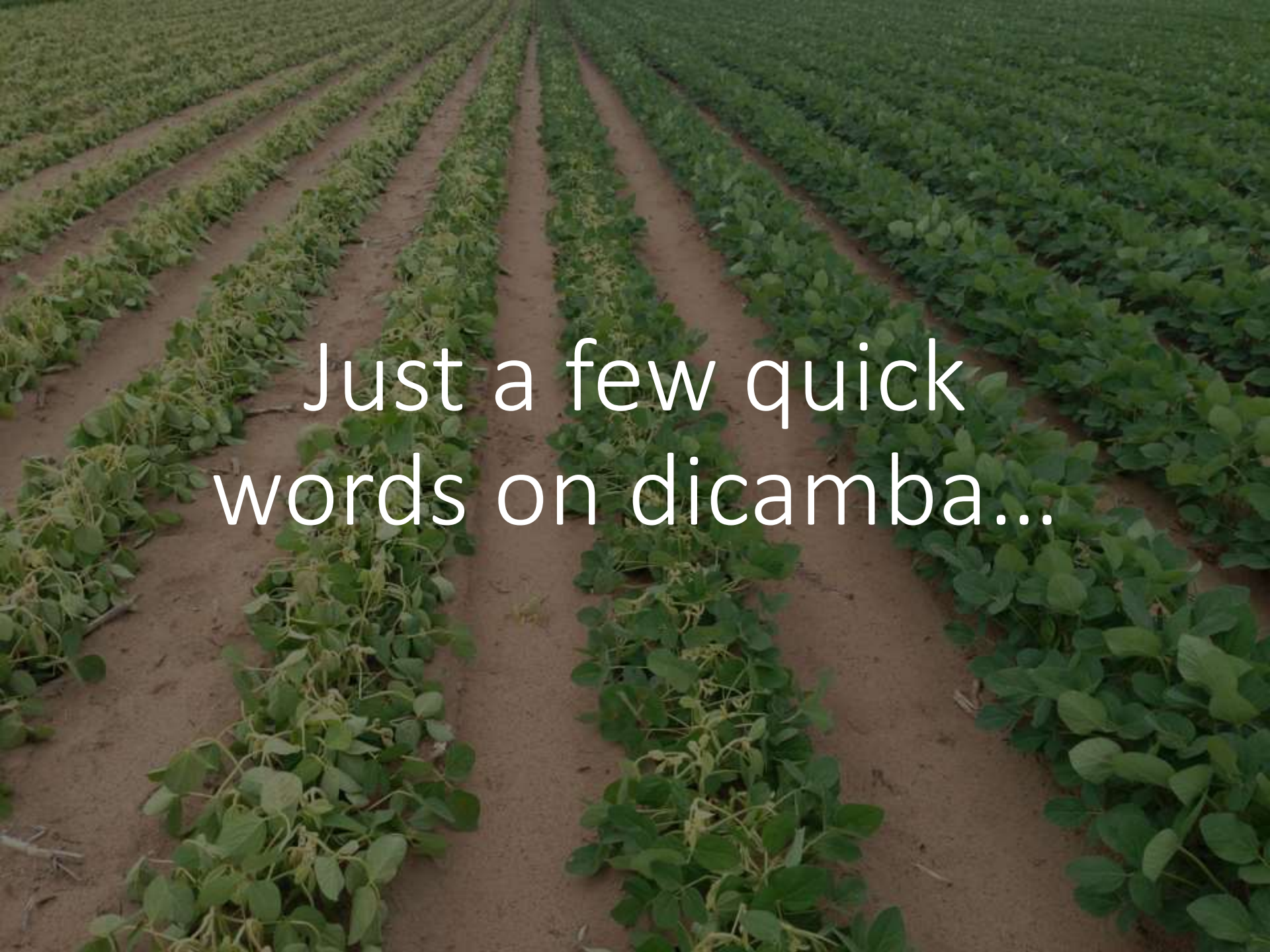
GA, carrot
9 days after planting

Non-treated



800 ppm




Just a few quick
words on dicamba…

In the new 2018 EPA dicamba OTT registrations, what uncertainties and risks were identified?

"The Agency does not know the extent of damage to sensitive crops, as investigators do not follow the damaged crop to yield. Damage could range from superficial visual symptomology to yield loss and/or plant death."

Source: US-EPA OPP, Over-the-top dicamba products for genetically modified cotton and soybeans: benefits and impacts. Issued 10/31/18

In the new 2018 EPA dicamba OTT registrations, what uncertainties and risks were identified?

4. Are dicamba residues on food safe?

Yes. EPA performed the analysis required by the Federal Food, Drug and Cosmetic Act (FFDCA) and determined that residues on food are "safe" – meaning that there is a reasonable certainty of no harm to all reasonably identifiable subpopulations, including infants and children, from dietary and all other non-occupational exposure to dicamba.

Source: https://www.epa.gov/ingredients-used-pesticide-products/registration-dicamba-use-dicamba-tolerant-crops#q2. Accessed 11-7-18

Are there tolerances for dicamba on specialty crops?

- Dicamba tolerances on fruit and vegetables:
  - Asparagus
  - Sweet corn

Source: https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&SID=5c209fc83ef1dcbcd979989abceb8c62&ty=HTML&h=L&mc=true&r=SECTION&n=se40.26.180_1227. Accessed 11-7-18