Evaluation of micronutrients for their effectiveness in rescuing herbicide injured tomatoes

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Horticultural Sciences

Tomato production

Important to the economy of SW Florida

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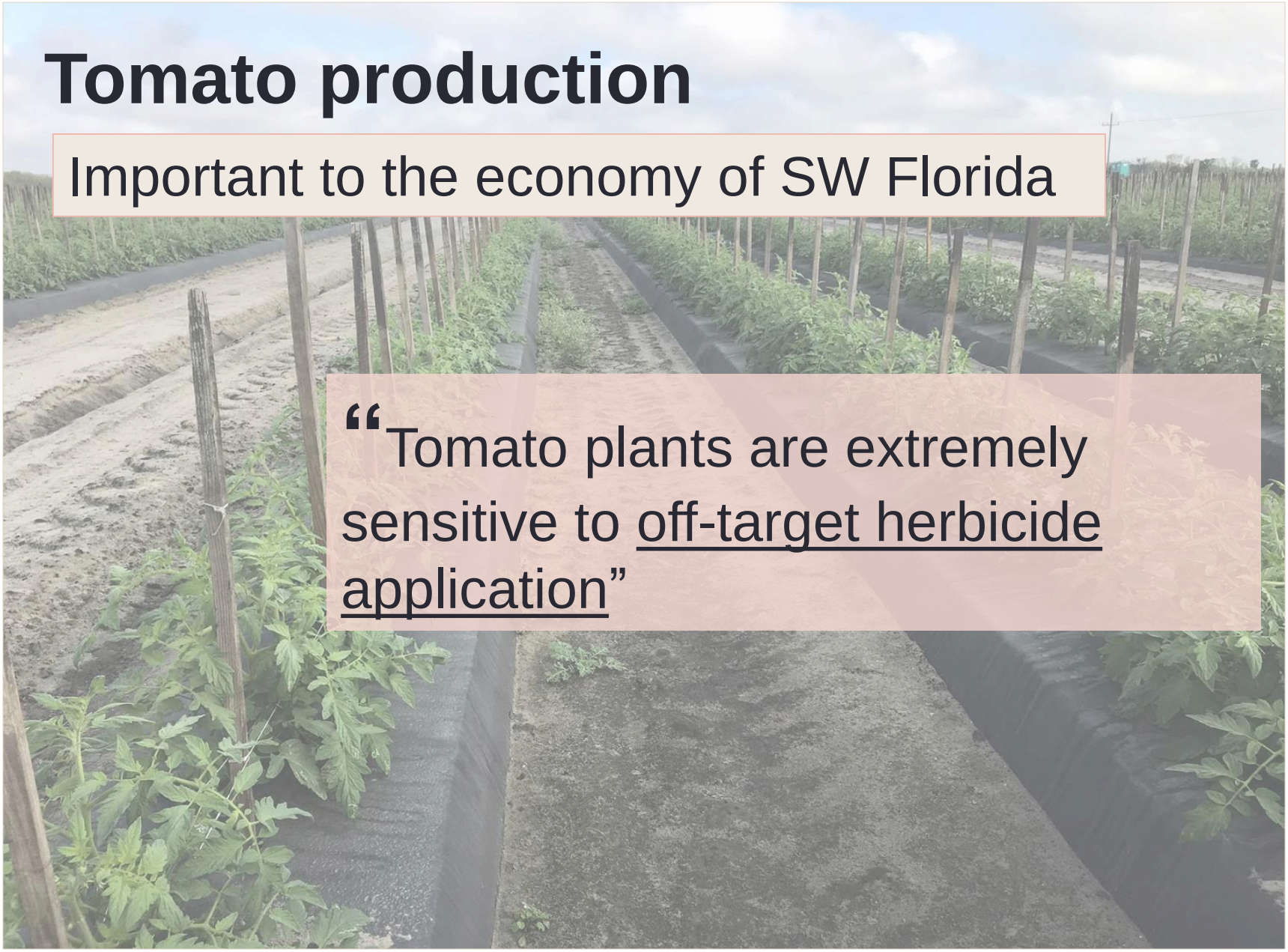


"Tomato plants are extremely sensitive to off-target herbicide application"

Tomato plants are extremely sensitive to Off-target herbicide application

Herbicide spraying in pasture land for summer weed control

- Susceptible to herbicide drift from neighboring citrus groves, pasture lands etc.
- Citrus groves – Glyphosate
- Pasture lands – 2,4-D

Image credits: Dr. Joe Paschal, Texas AgriLife Extension Service

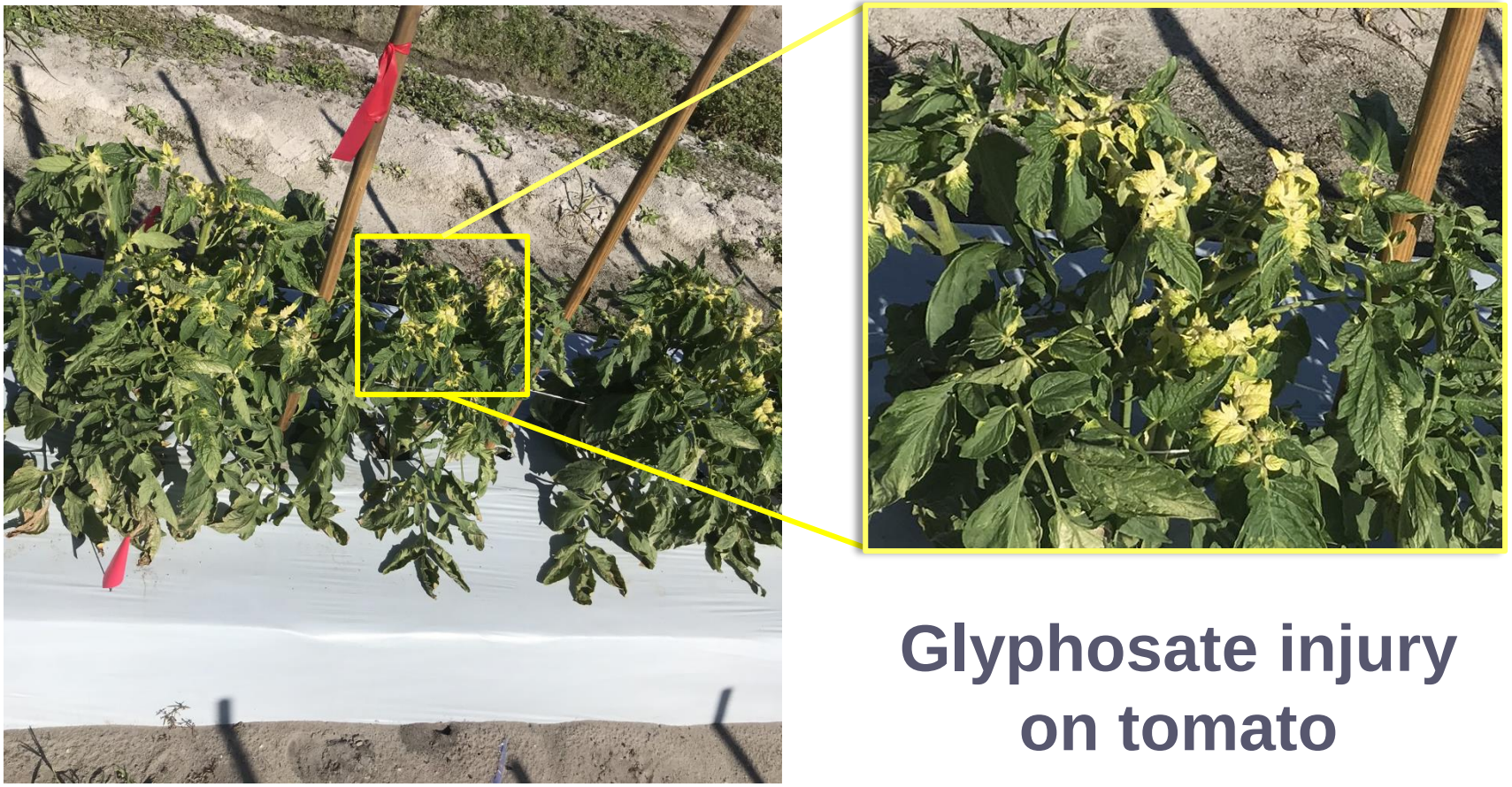
Tomato plants are extremely sensitive to Off-target herbicide application

- Glyphosate
- 2,4-D
  - When tomatoes encounter these products it will be affected
  - Even small amounts from drift will cause injury in tomatoes

Tomato plants are extremely sensitive to Off-target herbicide application

Glyphosate injury on tomato

Tomato plants are extremely sensitive to Off-target herbicide application



Glyphosate injury on tomato

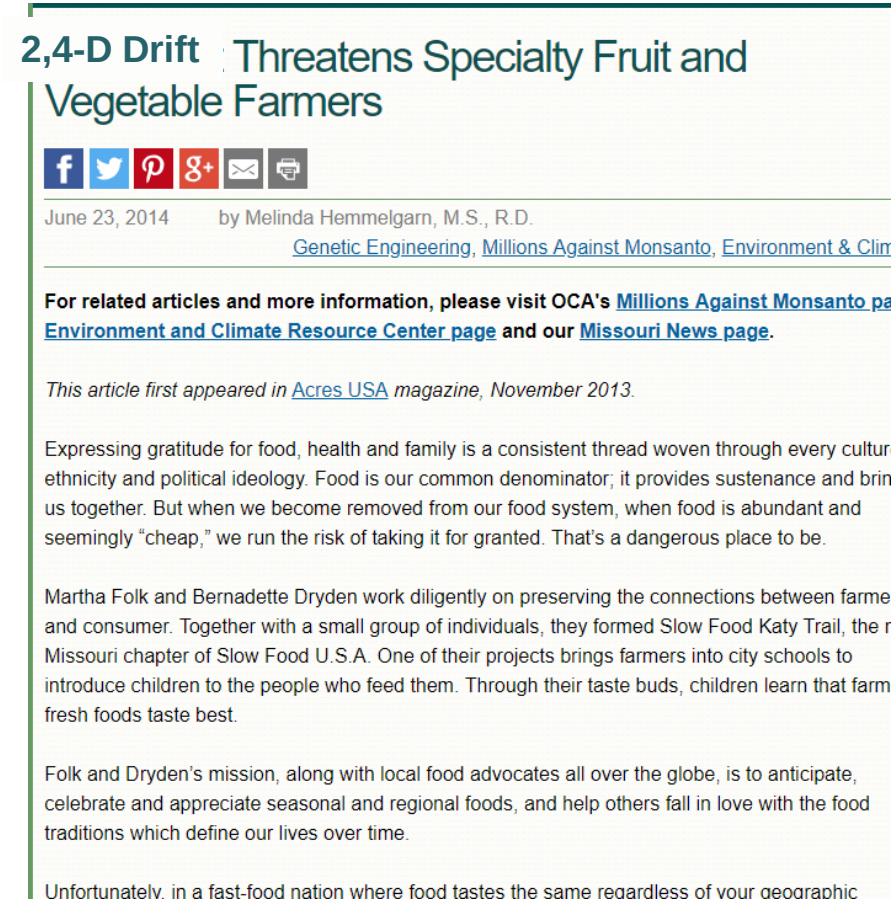
- Necrosis of growing leaves and shoots

Tomato plants are extremely sensitive to Off-target herbicide application

2,4-D injury on tomato

- Twisting of shoots
- Cupping of leaves

Tomato plants are extremely sensitive to Off-target herbicide application



2,4-D Drift Threatens Specialty Fruit and Vegetable Farmers

June 23, 2014 by Melinda Hemmelgarn, M.S., R.D.

Genetic Engineering, Millions Against Monsanto, Environment & Clim

For related articles and more information, please visit OCA's Millions Against Monsanto pa Environment and Climate Resource Center page and our Missouri News page.

This article first appeared in Acres USA magazine, November 2013.

Expressing gratitude for food, health and family is a consistent thread woven through every cultur ethnicity and political ideology. Food is our common denominator; it provides sustenance and brin us together. But when we become removed from our food system, when food is abundant and seemingly "cheap," we run the risk of taking it for granted. That's a dangerous place to be.

Martha Folk and Bernadette Dryden work diligently on preserving the connections between farme and consumer. Together with a small group of individuals, they formed Slow Food Katy Trail, the r Missouri chapter of Slow Food U.S.A. One of their projects brings farmers into city schools to introduce children to the people who feed them. Through their taste buds, children learn that farm fresh foods taste best.

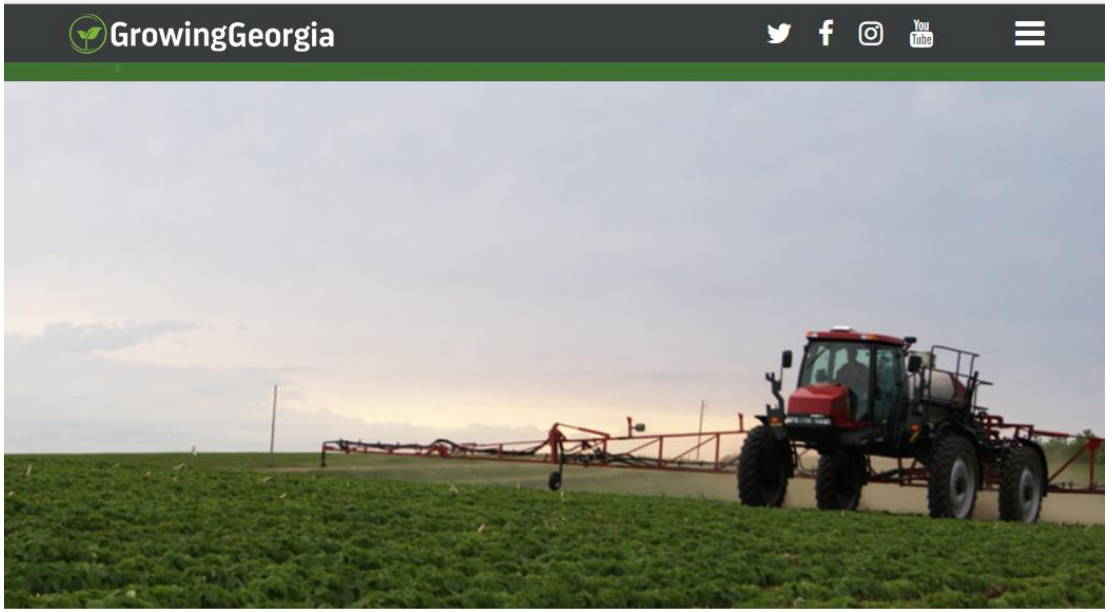
Folk and Dryden's mission, along with local food advocates all over the globe, is to anticipate, celebrate and appreciate seasonal and regional foods, and help others fall in love with the food traditions which define our lives over time.

Unfortunately, in a fast-food nation where food tastes the same regardless of your geographic

"Herbicide drift issues are always a challenge to tomato production"

Herbicide drift issues are always a challenge to tomato production

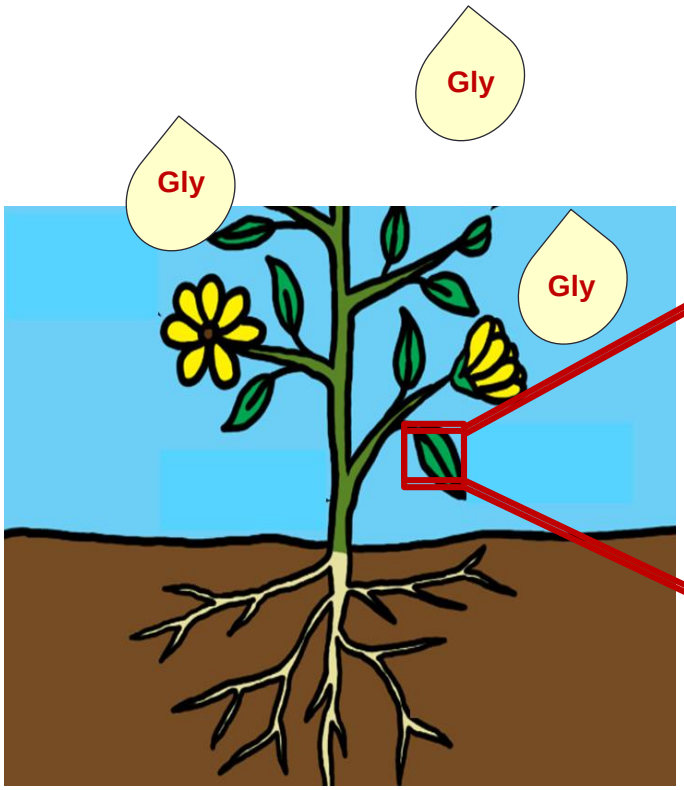
Other auxin type herbicides

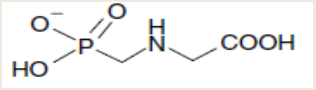


If damage does occur due to drift or application error the next question is:

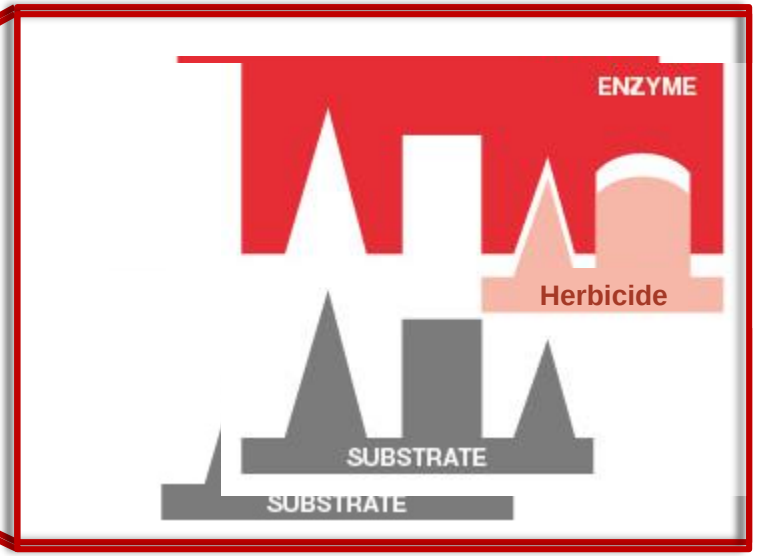
“Will the plants grow out of it and will I get any marketable yield?”

How herbicide generally works?



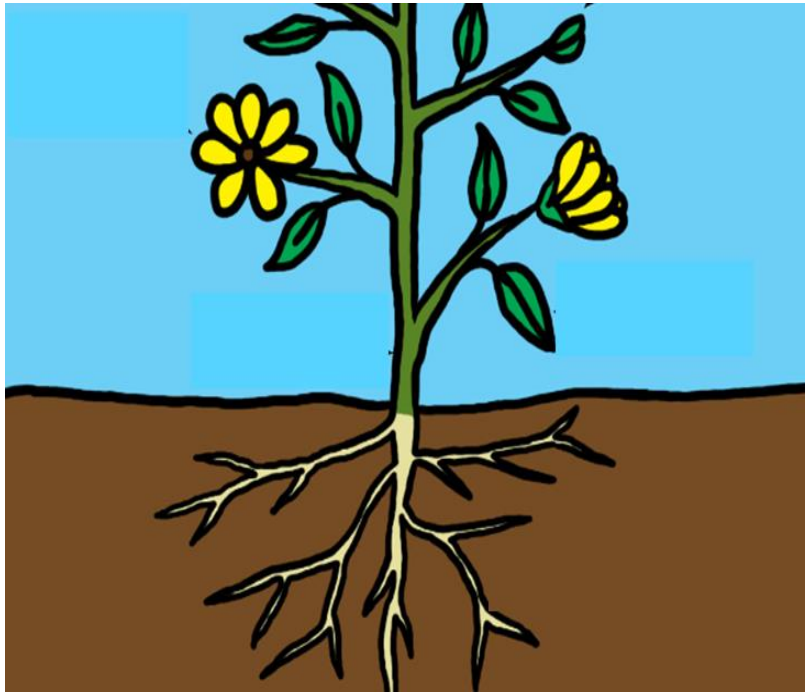


Glyphosate



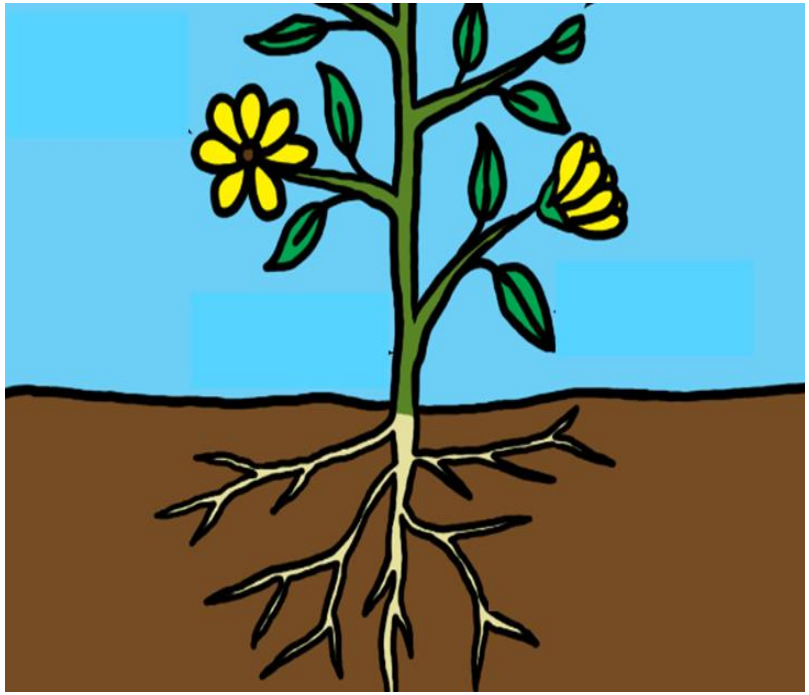
"Herbicide prevents substrate linking to enzyme and kills the plant"

How herbicide generally works?

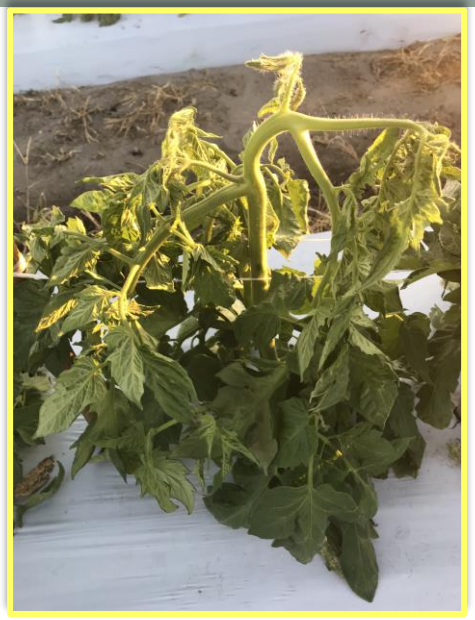


- Plants has the ability to metabolize herbicides from their system

Plants have the ability to metabolize the herbicides



- Sub lethal doses of herbicides – plant survives over time

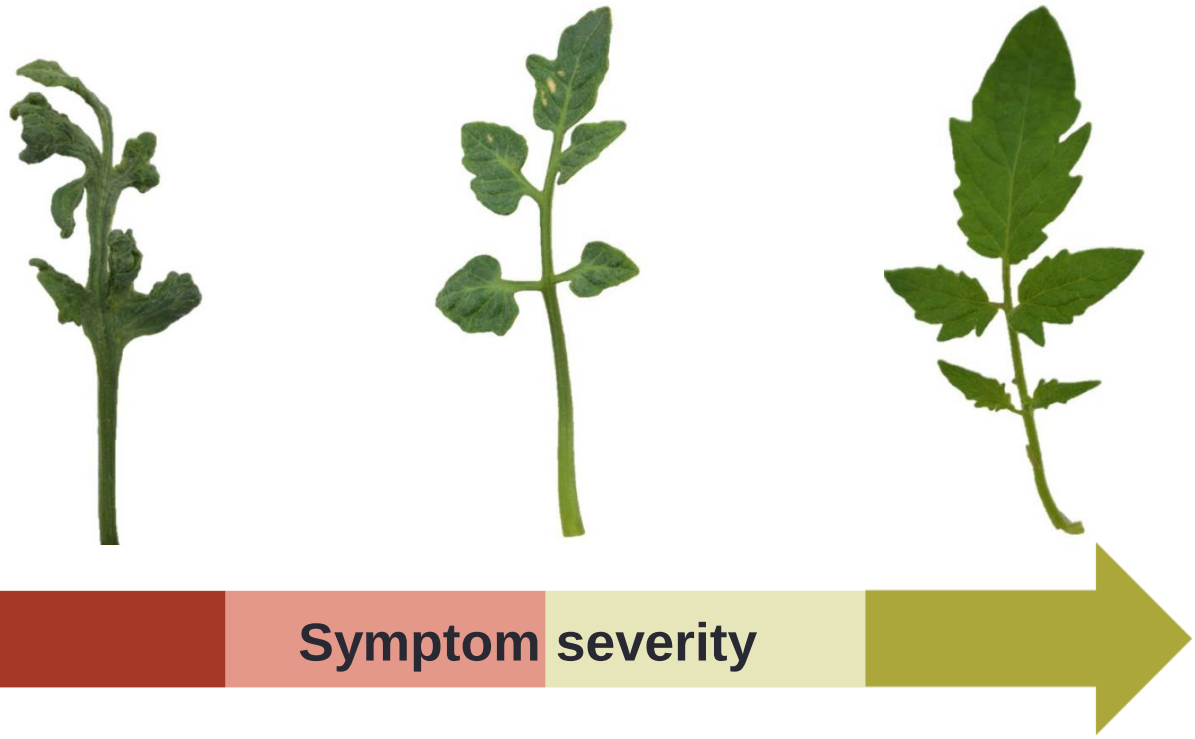


herbicide injury

Symptom severity

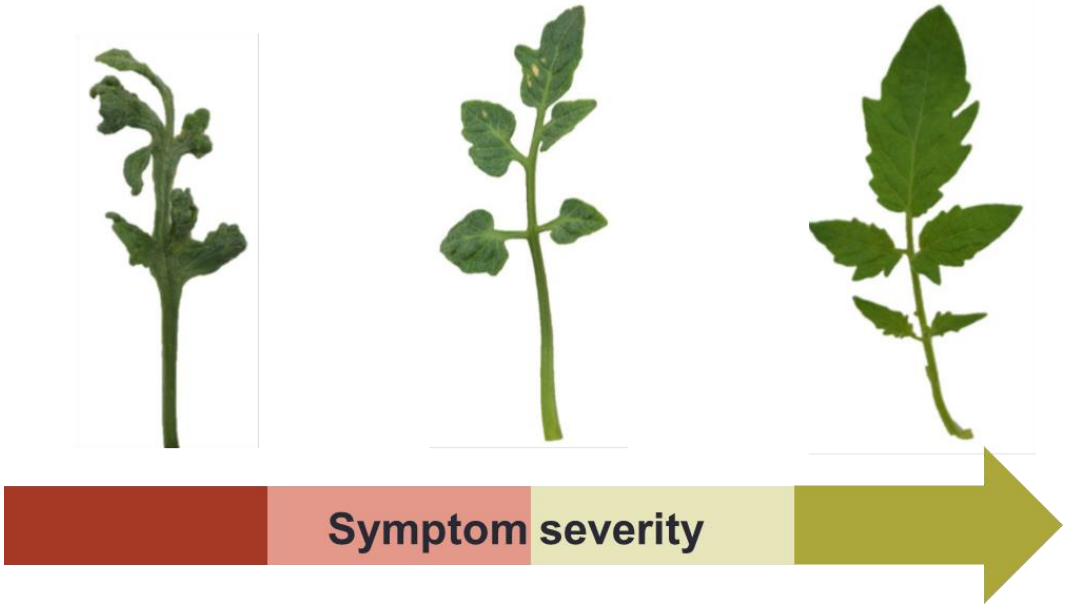
herbicide injury

herbicide injury



“After several weeks, the symptomatic plants may recover with healthy, normal growth”

Sub lethal doses of herbicides – plant survives over time



"But yield and fruit quality in tomato may be affected due to exposure to herbicides"

"Exposure to herbicide injury can cause deformed fruits in tomato"

Example for Fruit deformity in tomato

"Exposure to herbicide injury can cause deformed fruits in tomato"

Deformed tomato fruits

Scars and cavities in the fruits

Kidney-shaped Fruits

Distorted Fruits

"Exposure to herbicide injury can cause deformed fruits in tomato"

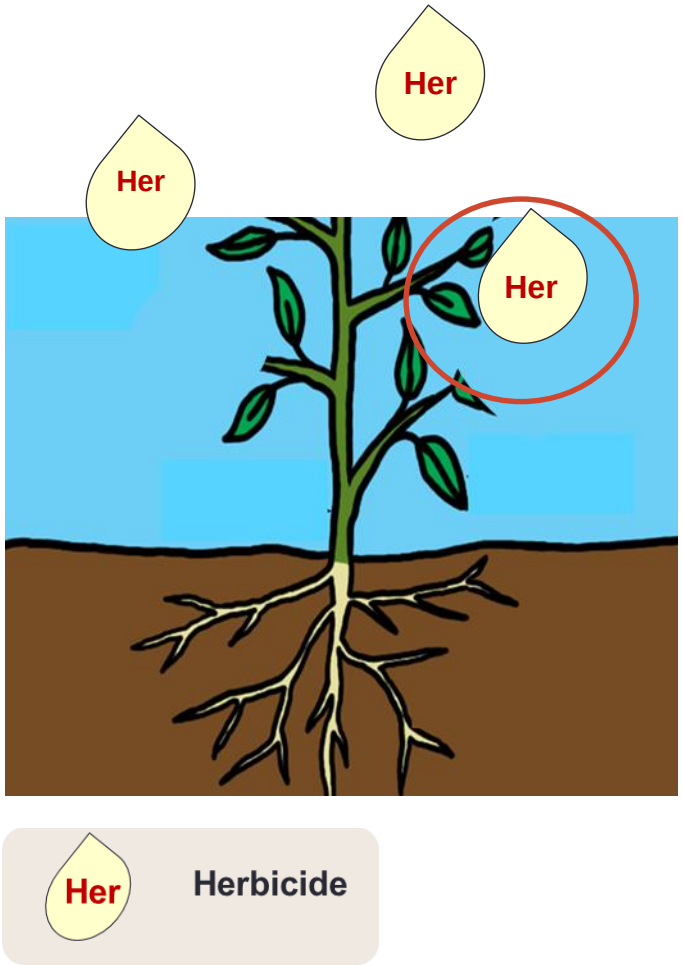
"Cat-facing" in tomato fruits

- Scarred, streaked and distorted fruits that are not marketable

- Physiological disorder that occurs most often on large fruited, fresh-market tomatoes

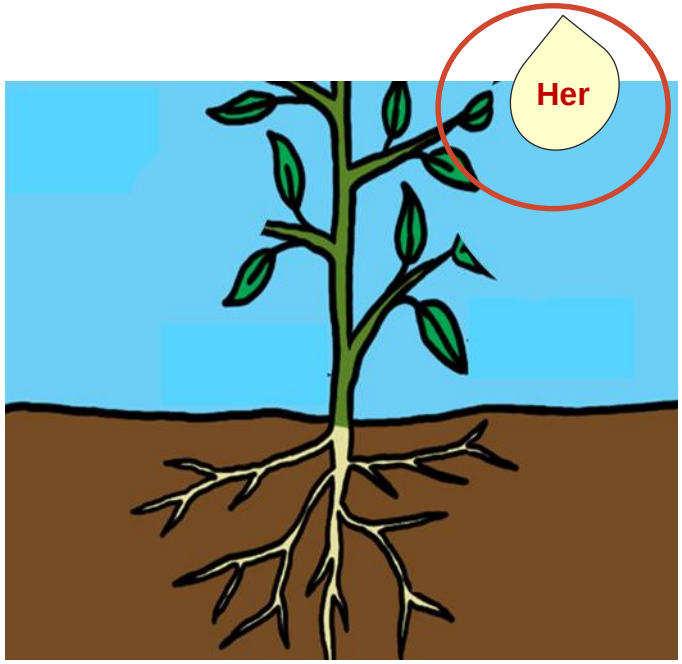
- Exposure to herbicide sprays are one of the reasons that is believed to be responsible for cat-face

Possible factors affecting the fruit deformation



- Amount of herbicide exposure
  - Low vs High herbicide rate

Possible factors affecting the fruit deformation



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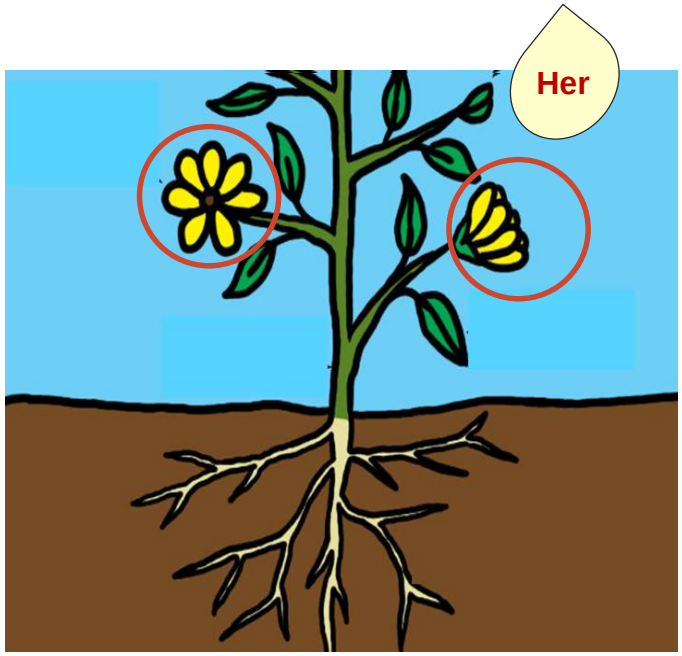

- Amount of herbicide exposure
  - Low vs High herbicide rate
- Growth stage of exposure
  - Before vs After bloom

Research Questions

Q 1 Does the **growth stage of injury** influence the fruit malformation in tomatoes

Q 2 Does the **herbicide rates** have an effect on the fruit malformation in tomatoes

Q 3 Can the **herbicide injured tomato plants be rescued** from producing non-marketable fruits?

Experimental design

- Trials were conducted at SWFREC Immokalee, FL
- Tomato plants were injured with 2,4-D and glyphosate herbicides.
  - Sprayer that can spray uniform amount of herbicide solution at a const. pressure was used to injure the plants.

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  - Sprayer that can spray uniform amount of herbicide solution at a const. pressure was used to injure the plants.
    - No. of plants per treatment plot = 5
    - Replication (n) = 5
    - Non injured control plants

Q 1

Does the **growth stage of injury** influence the fruit malformation in tomatoes

Tomato plants were injured at:

- Pre-bloom stage

  Early growth stage

- Post-bloom stage

  10-50% of the bloom was formed

Experimental design

Q 2

Does the **herbicide rates** have an effect on the fruit malformation in tomatoes

Herbicide rates used:

- 1/30 labeled rate
  tank contamination
- 1/300 labeled rate
  spray drift from adjacent farms

Q 3

Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

Herbicide injured plants were treated with foliar applied:

- Growth regulators,
- Nutrients
- Micronutrients

& their combinations

Q 3

Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

Rescue treatments	Active ingredient(s) in rescue treatments	Product(s)	Product Conc. (L^{-1})
1	Non-rescued control	n/a	n/a
2	Cytokinin	X-cyte	1.25 ml
5	Cobalt	Keylate Cobalt	1.30 ml
6	Cytokinin **+** Cobalt	X-cyte **+** Keylate Cobalt	12.50 ml 1.30 ml
4	Cytokinin **+** NPK 5-10-27 **+** Calcium / Boron	X-cyte **+** Harvest More **+** Sett	12.55 ml 12.50 g 12.00 ml

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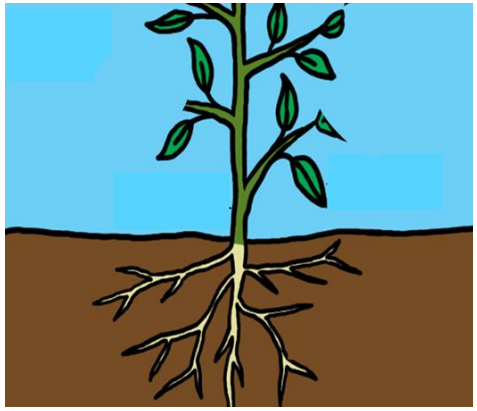
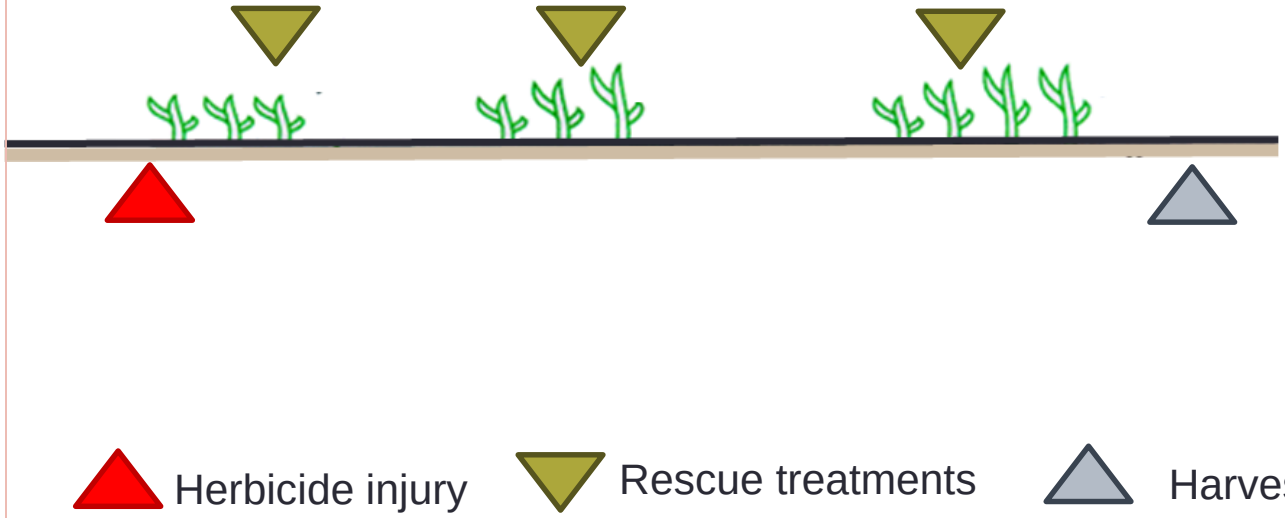
Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

Rescue treatment application timing

Rescue



Pre-bloom

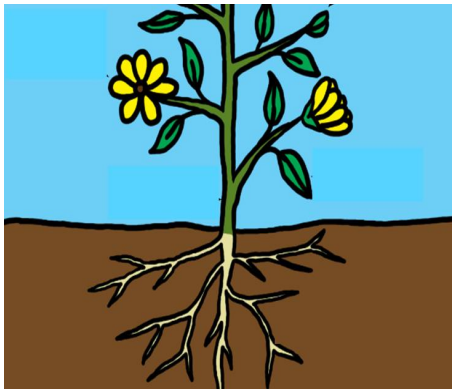


Q 3

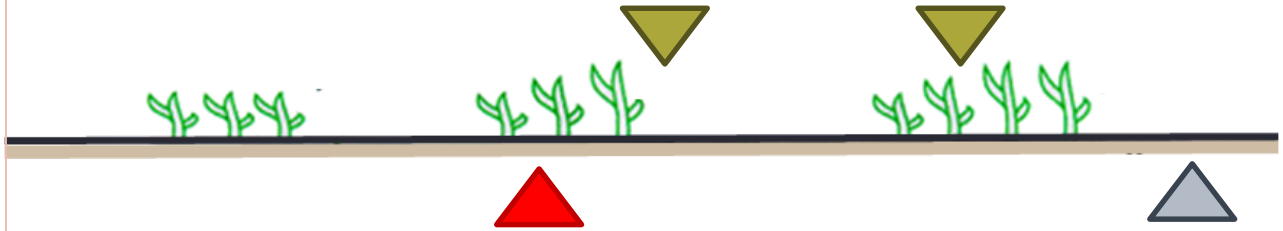
Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

Rescue treatment application timing

Rescue



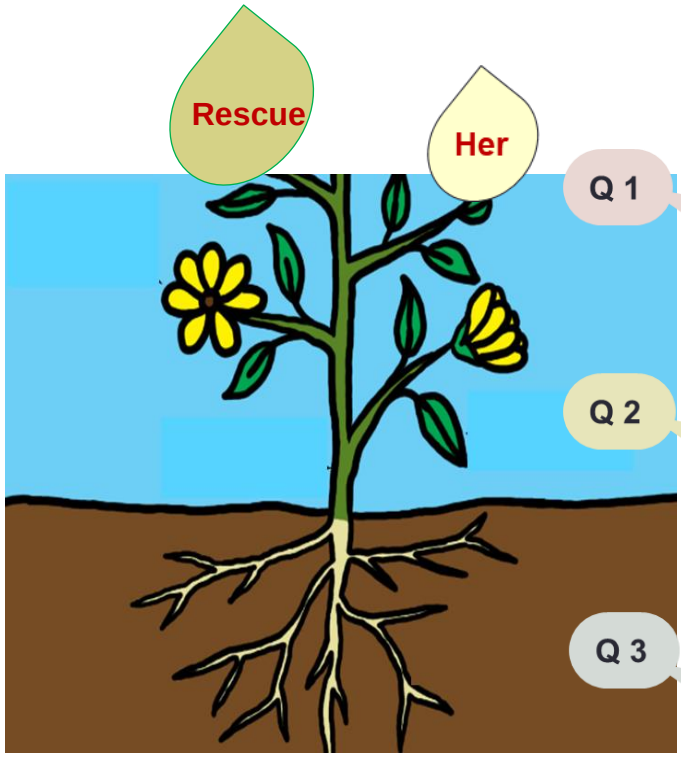
Post-bloom



After ~50% bloom formed

Herbicide injury Rescue treatments Harvest

RESULTS



Q 1 Does the **growth stage of injury** influence the fruit malformation in tomatoes

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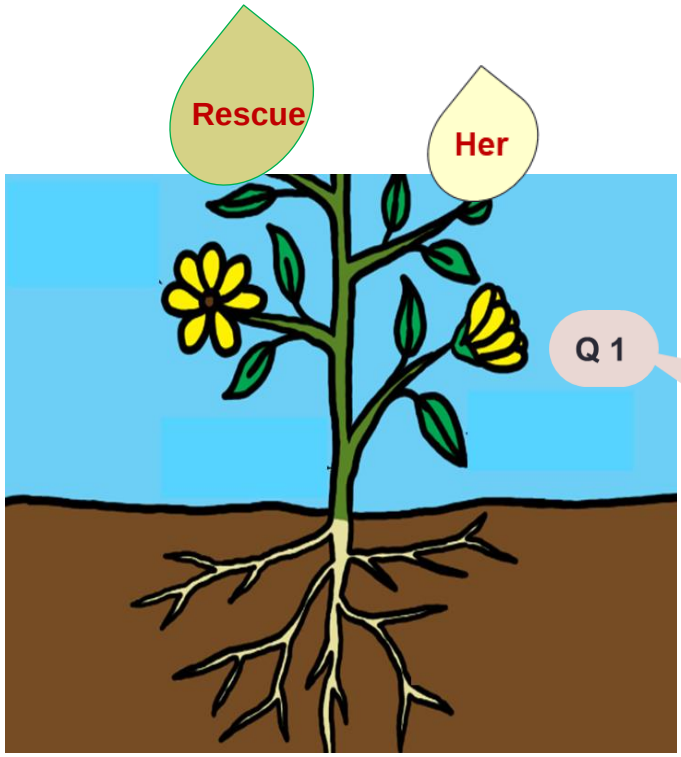
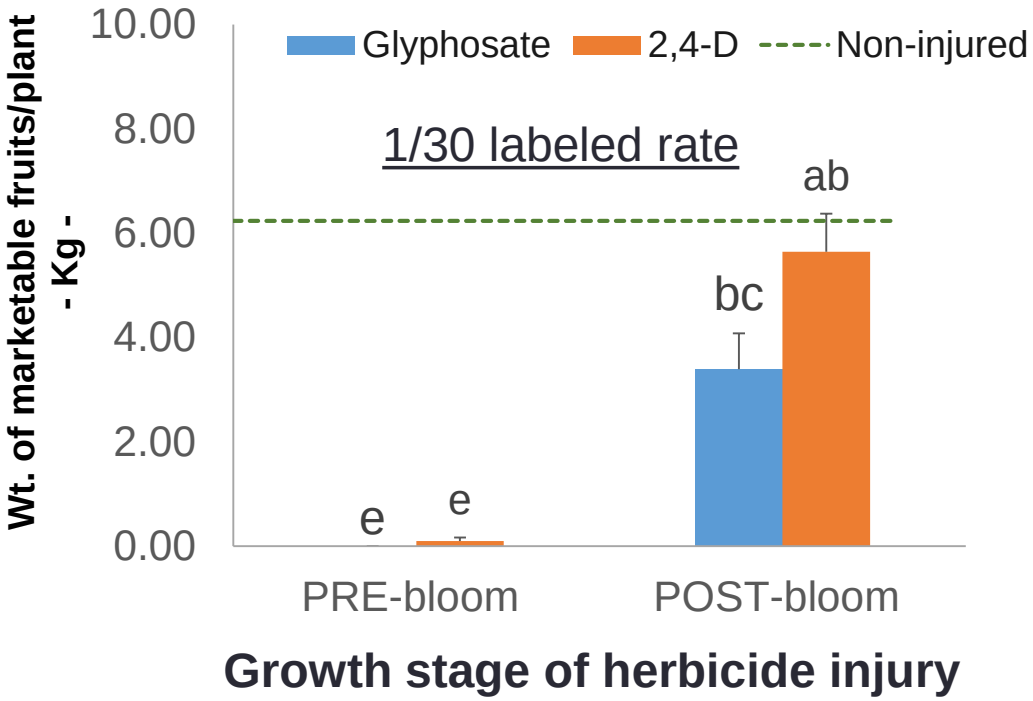


Does the **growth stage of injury** influence the fruit malformation in tomatoes

Q 1

Effects of **growth stage of injury** on marketable yield in herbicide injured tomatoes



- Replication (n) = 5
- Mean comparison: Tukey's hsd (α 0.05)

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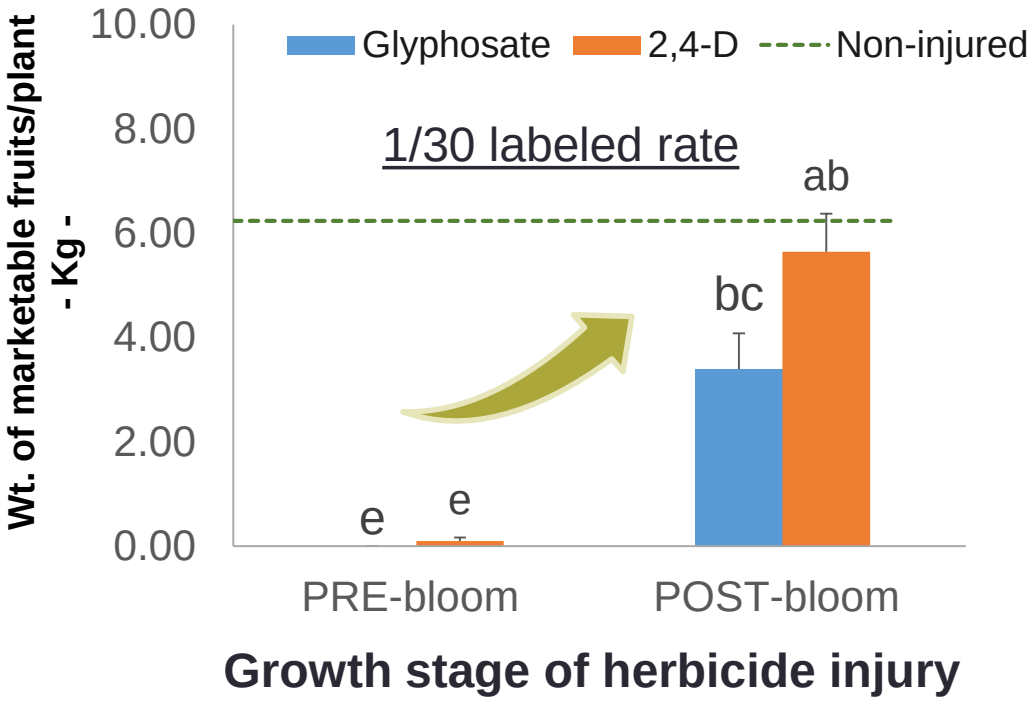

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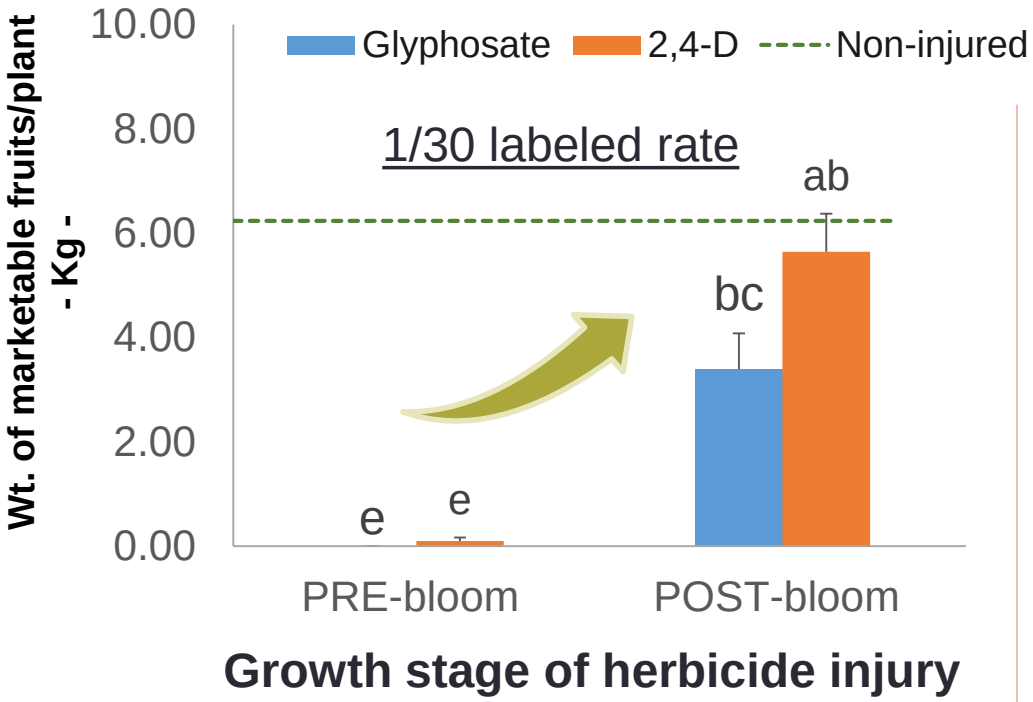

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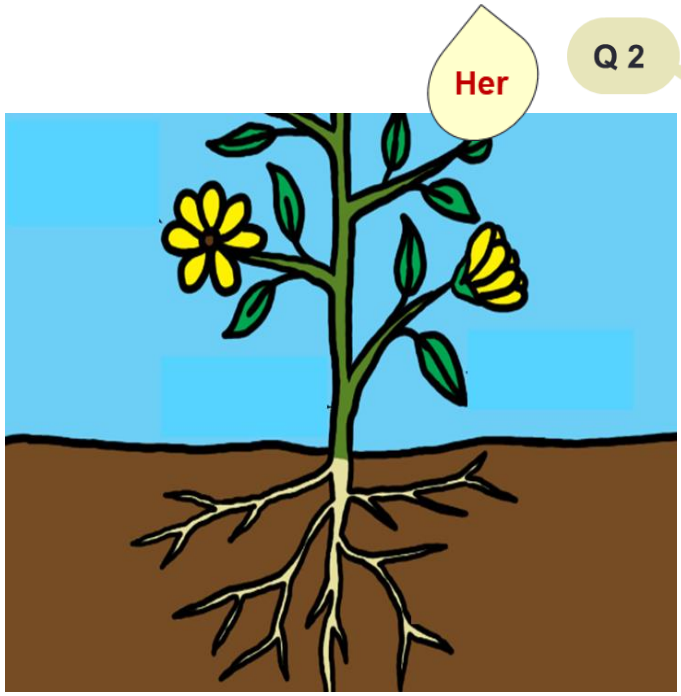
The plants were able to produce marketable fruits when injury was occurred in an advanced growth stage i.e., after bloom

RESULTS



Q 2

Does the **herbicide rates** have an effect on the fruit malformation in tomatoes

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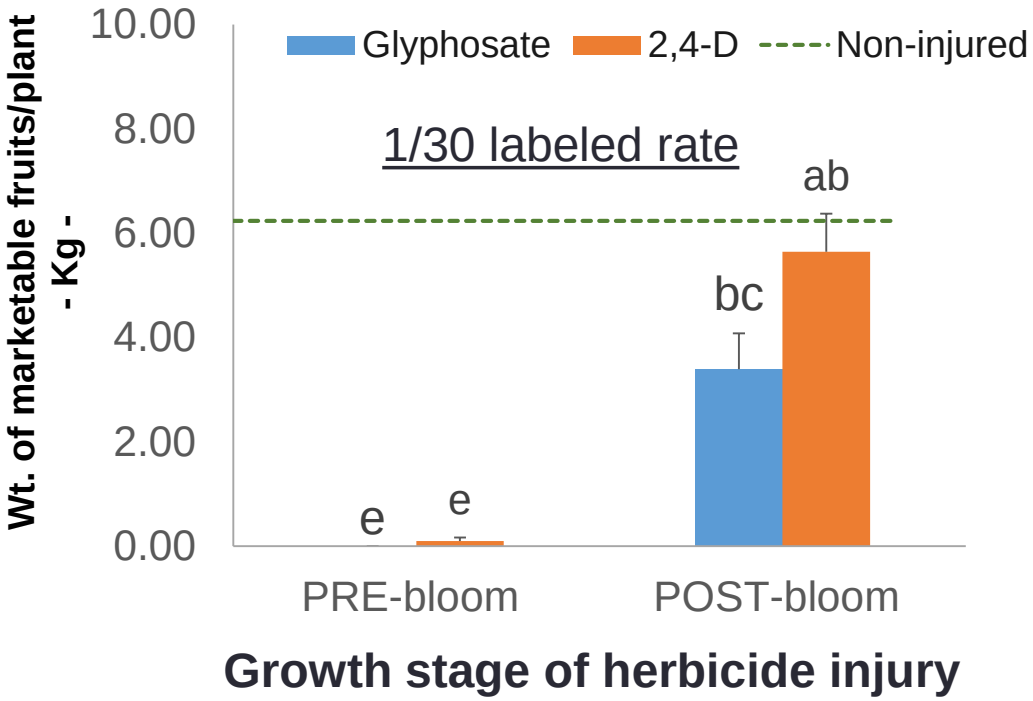

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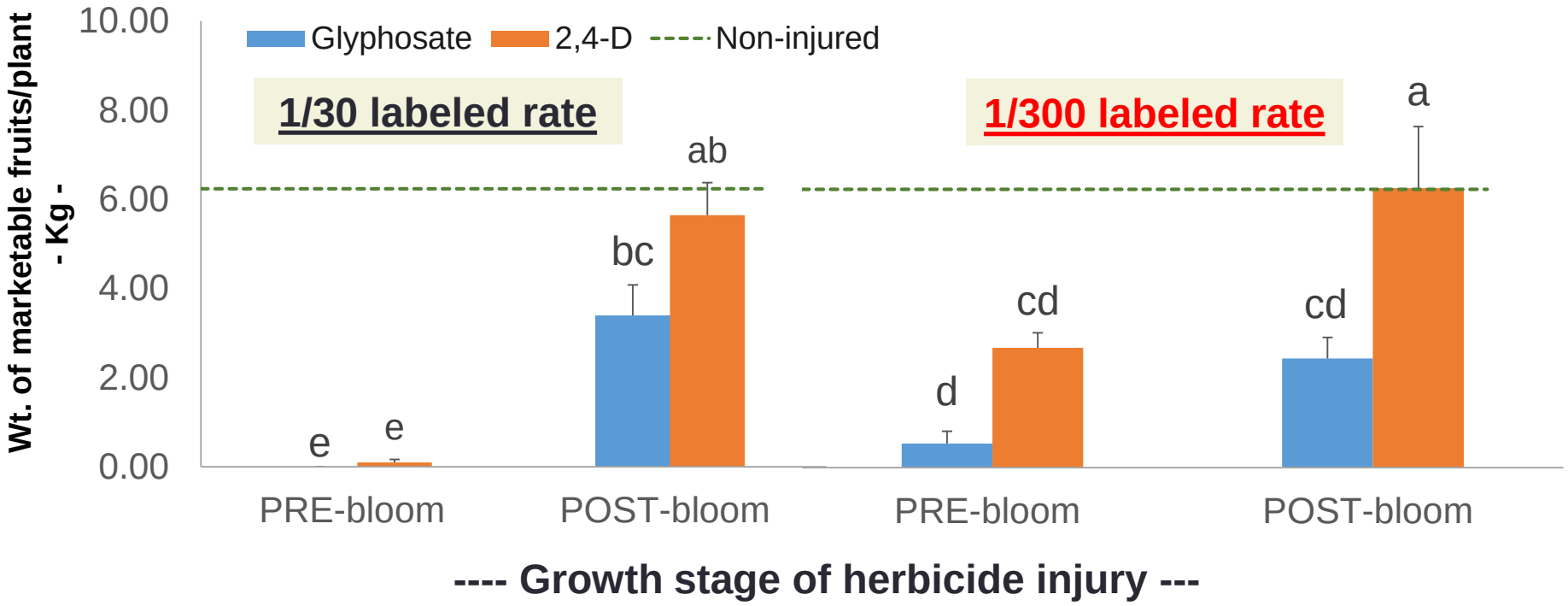

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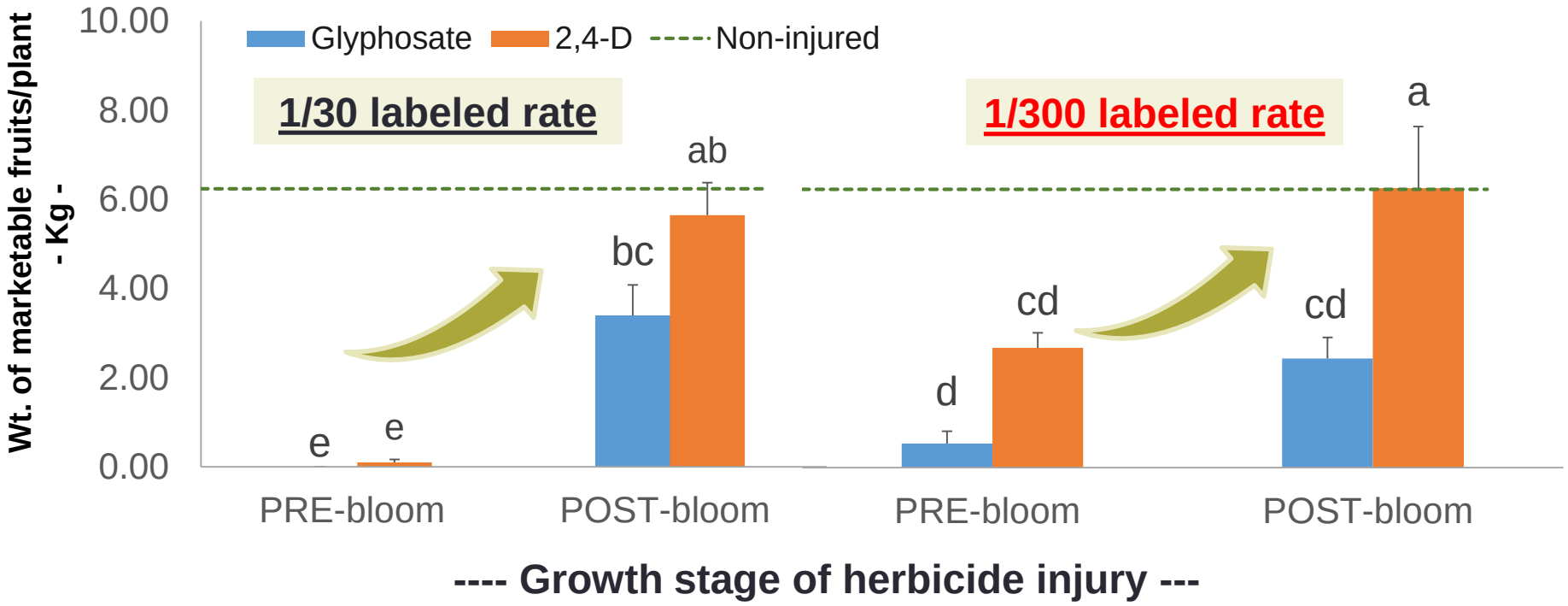

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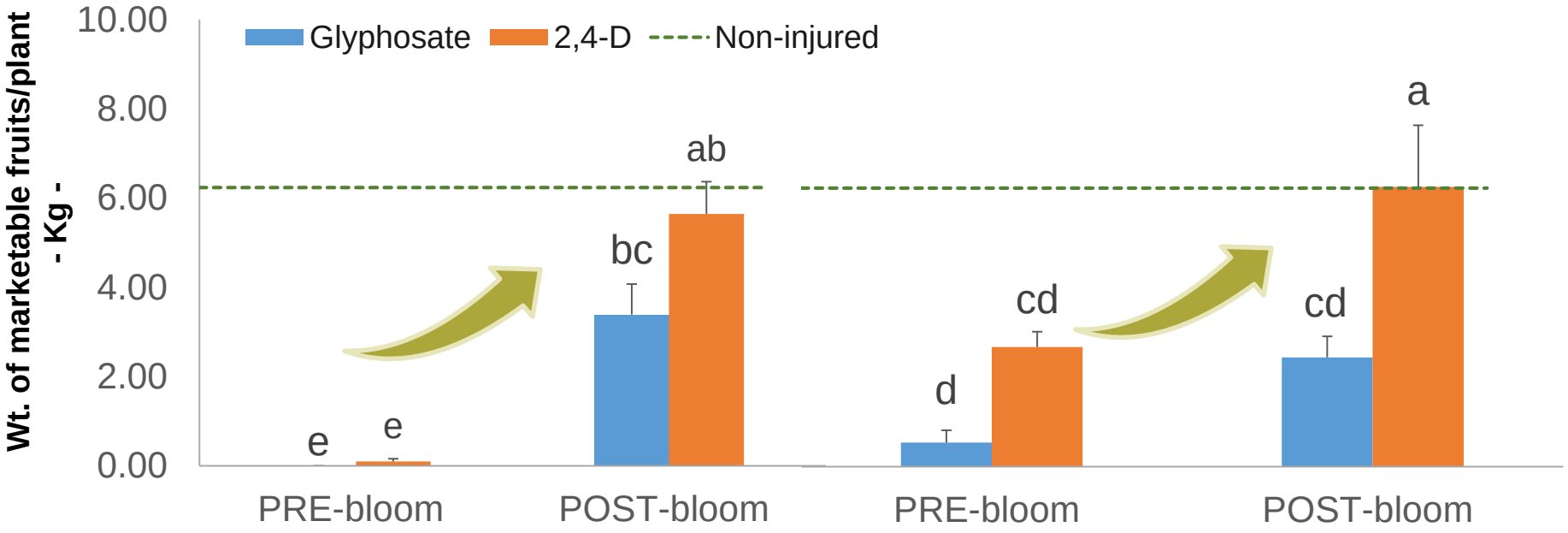
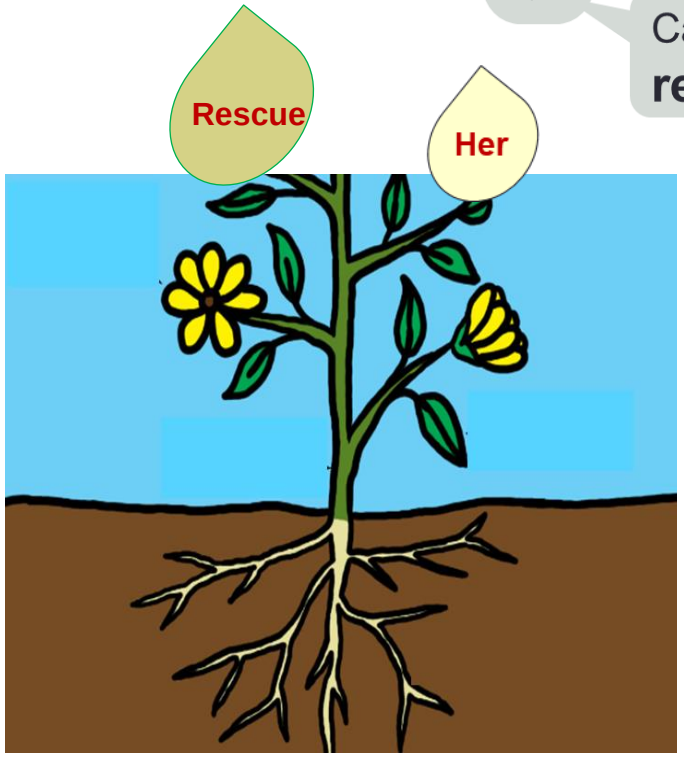


Injury from low herbicide rate has comparatively less effect on the marketable yield from injured tomatoes

RESULTS

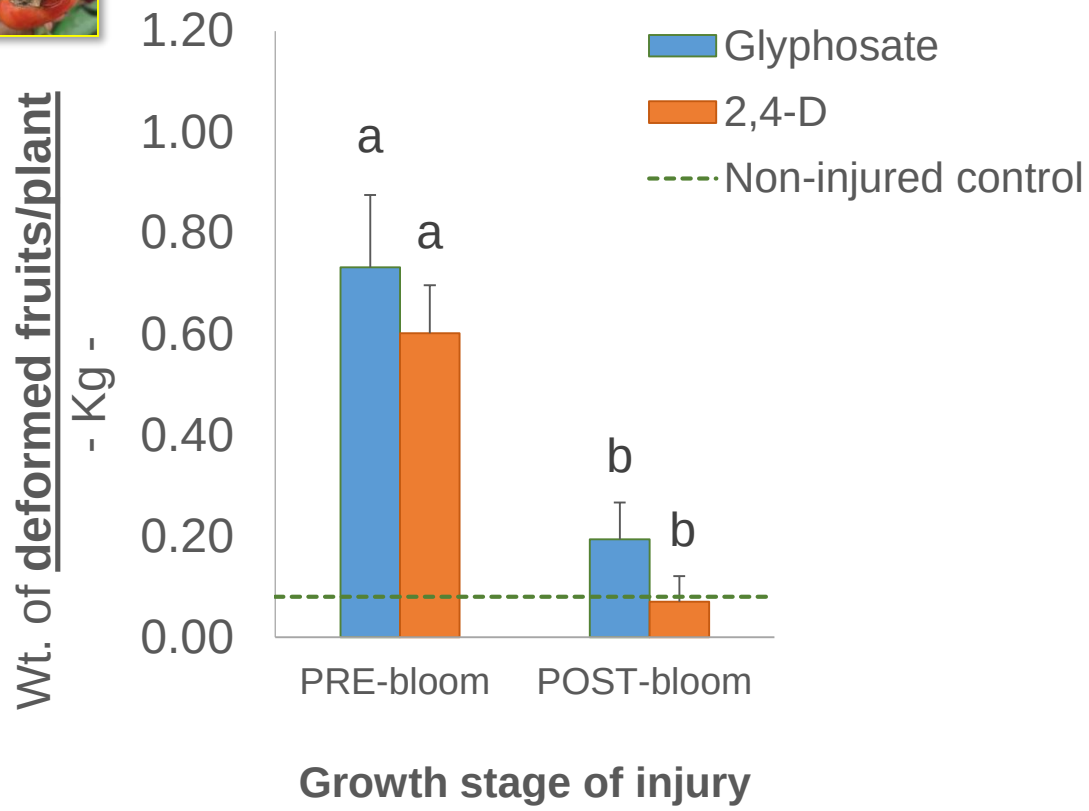
Q 3

Can the **herbicide injured tomato plants be rescued** from producing non-marketable fruits?



Q 3

Effects of **rescue treatments on herbicide injured tomato plants** from producing non-marketable fruits



- **1/100 labeled rate**

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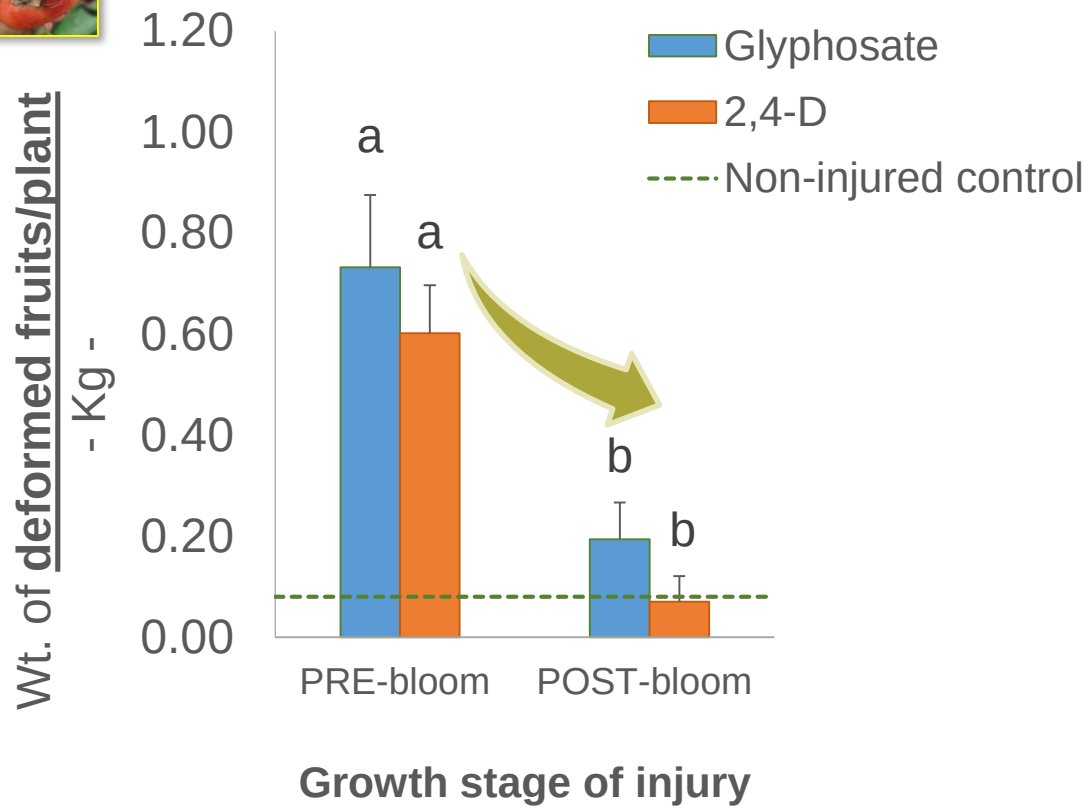

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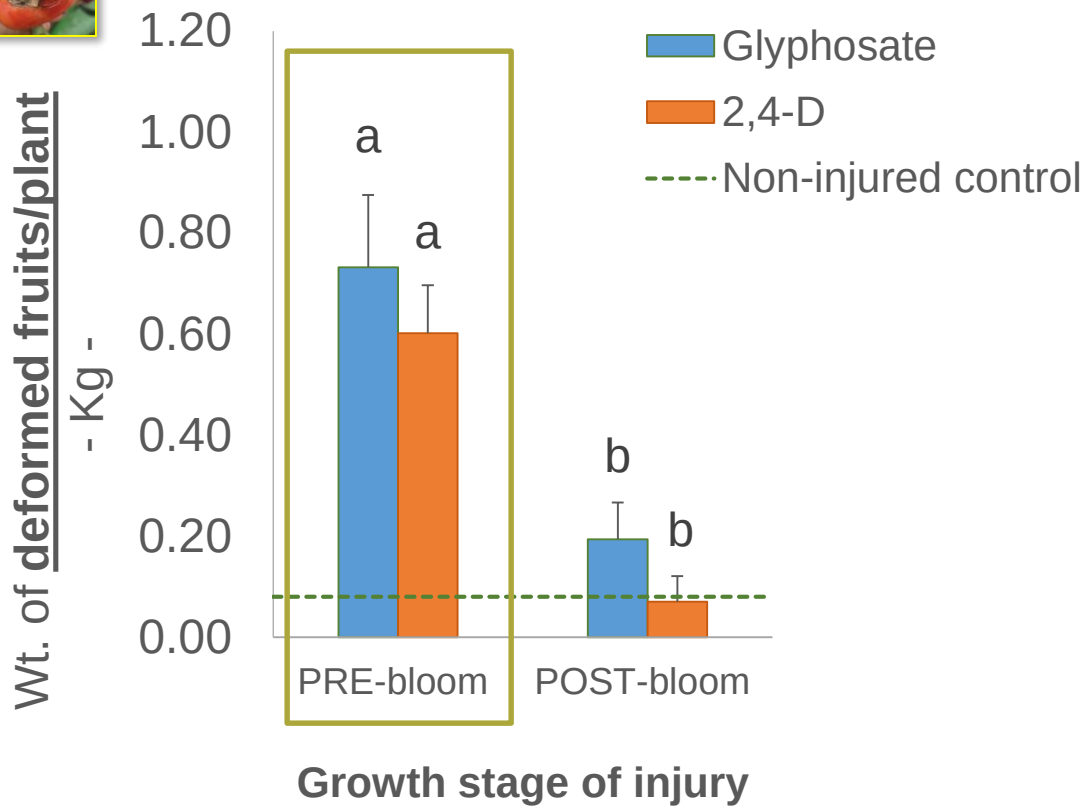

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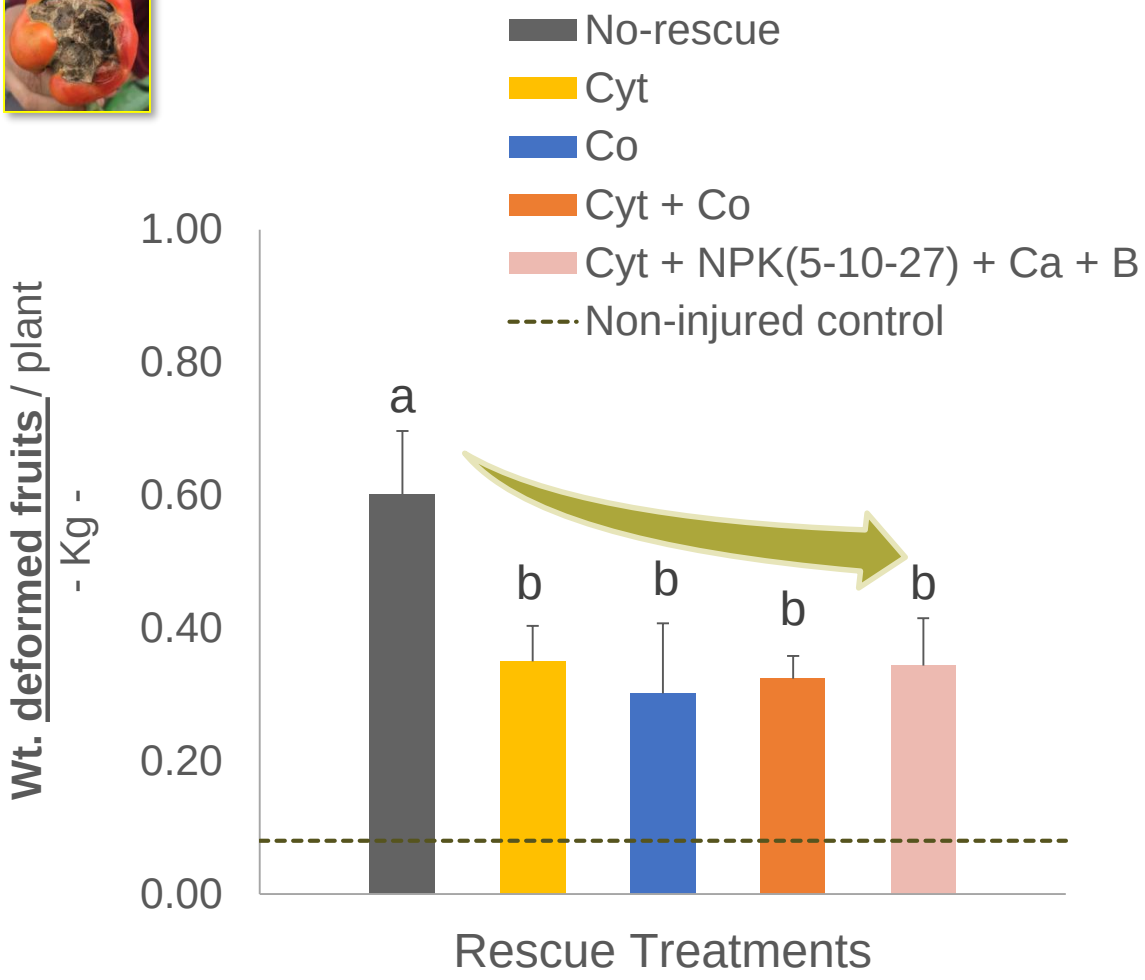

- **Injury from 2,4-D**
- **1/100 labeled rate**
- **Pre-bloom stage**

Foliar applications of growth regulator(s) and nutrient(s) were found effective in this preliminary screening

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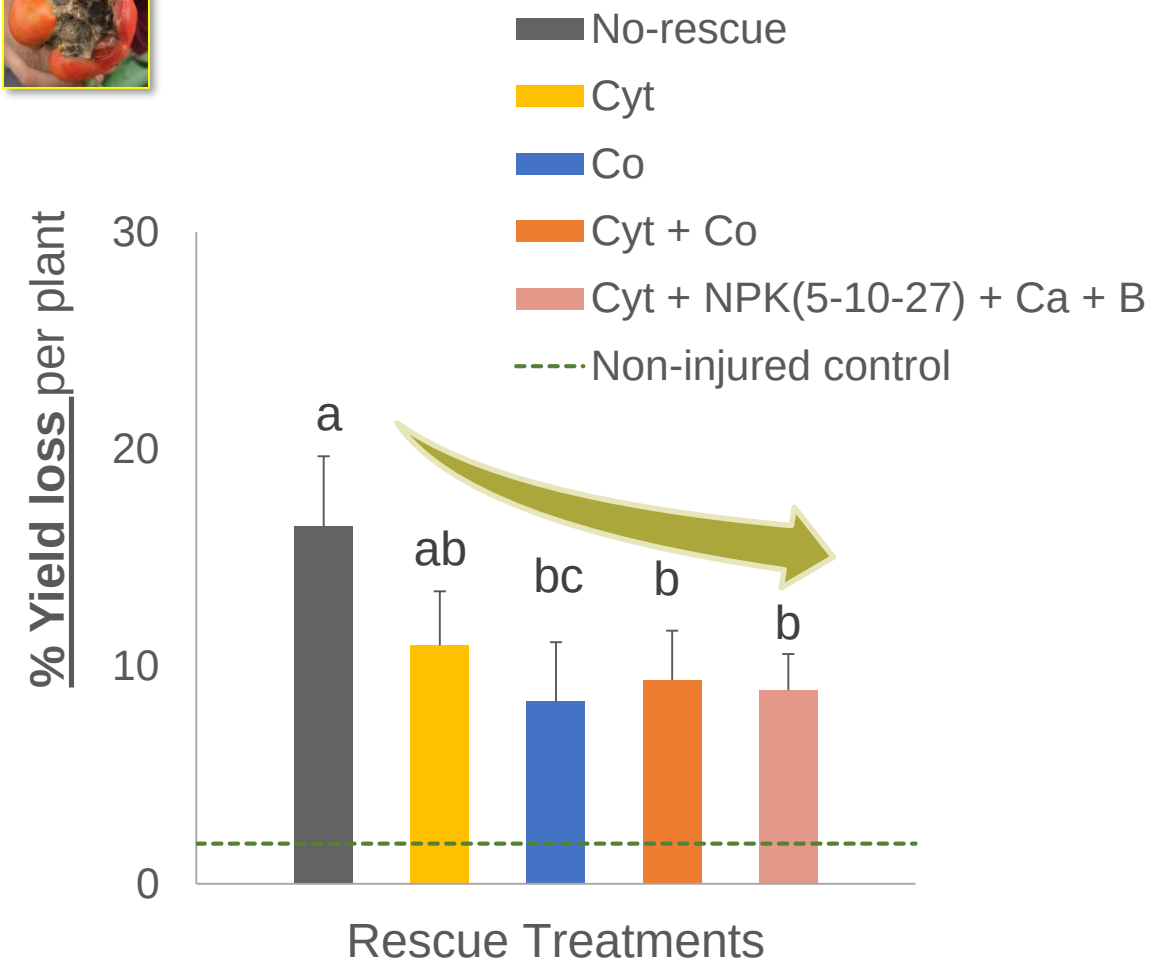

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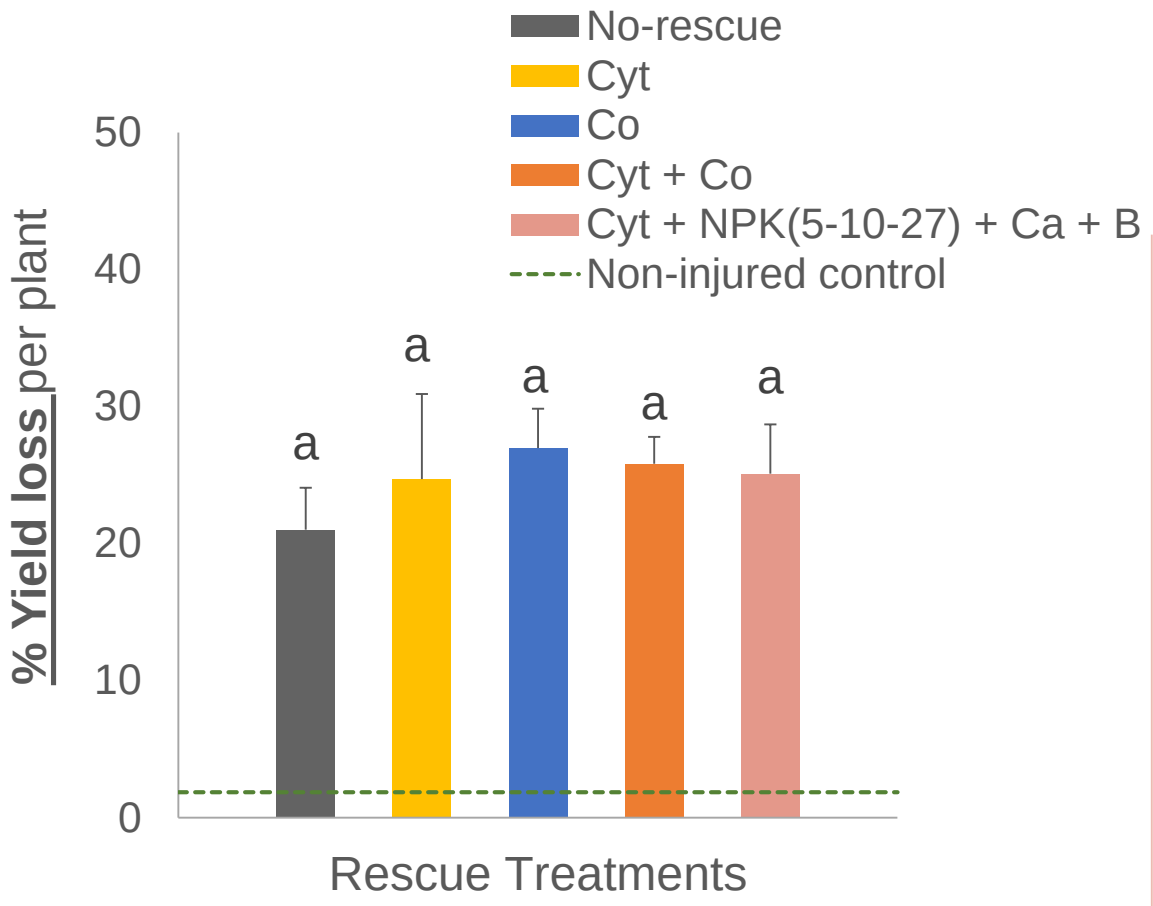
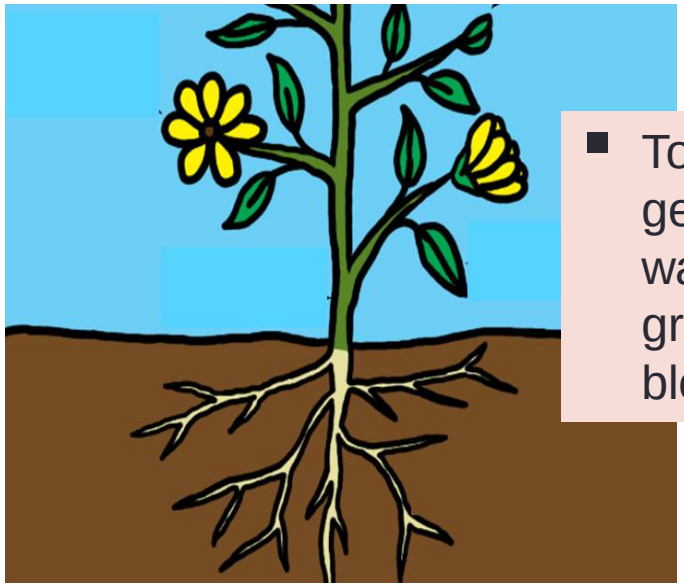


- Injury from **glyphosate**
- **1/100 labeled rate**
- **Pre-bloom stage**

Treatments were NOT effective in rescuing glyphosate injured tomato plants from yield loss.

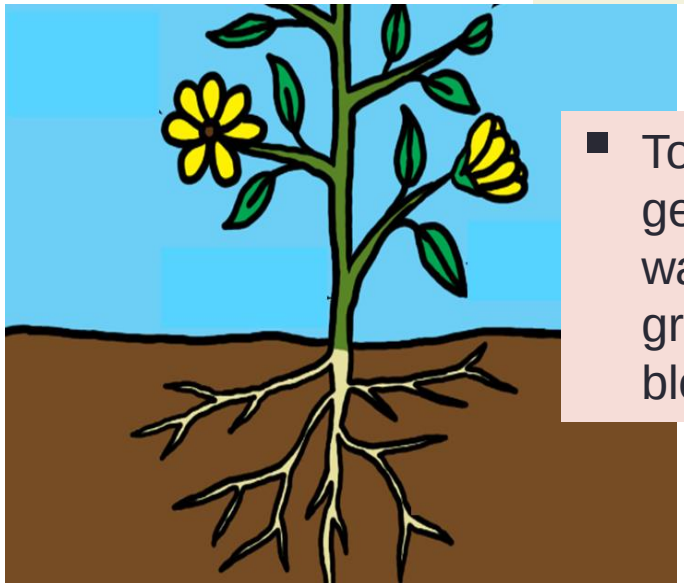
Summary



- Tomato fruit deformation was generally reduced when injury was occurred in an advanced growth stage i.e., POST bloom

Summary

- Injury from <u>low herbicide rate</u> has relatively less effect on the marketable yield from injured tomatoes.



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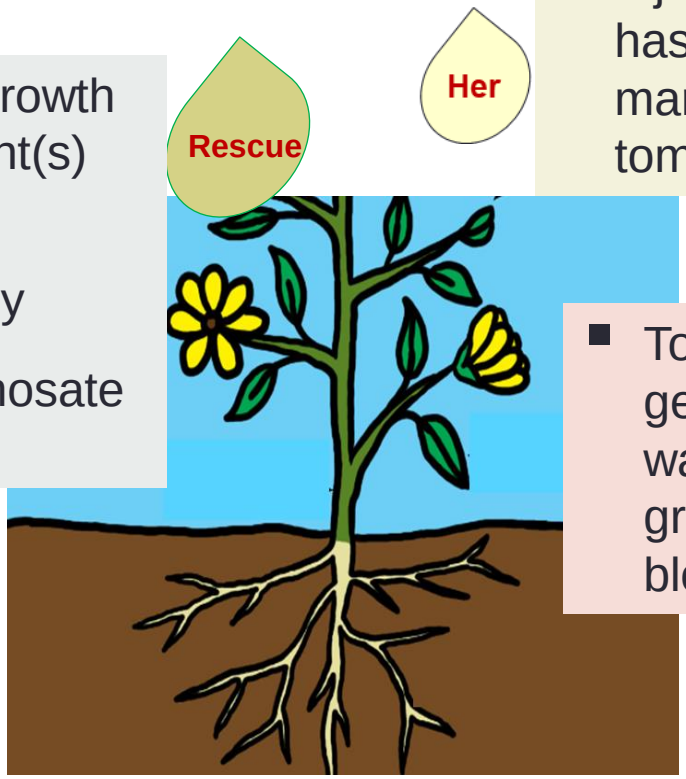
Summary

- Foliar applications of growth regulator(s) and nutrient(s) were
- effective for 2,4-D injury
- NOT effective for glyphosate injury



- Injury from low herbicide rate has relatively less effect on the marketable yield from injured tomatoes.
- Tomato fruit deformation was generally reduced when injury was occurred in an advanced growth stage i.e., POST bloom

Acknowledgements

Dr. John Fisher, Stoller USA

SWFREC weed science team

From left: ***Shea Teems, Biwek Gairhe, Robert Riefer, Ramdas Kanissery***

Not in picture: ***Cami McAvoy***

Acknowledgements

Thank you…

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