# Herbicide Phytotoxicity in Tomato: Prevention and Rescue

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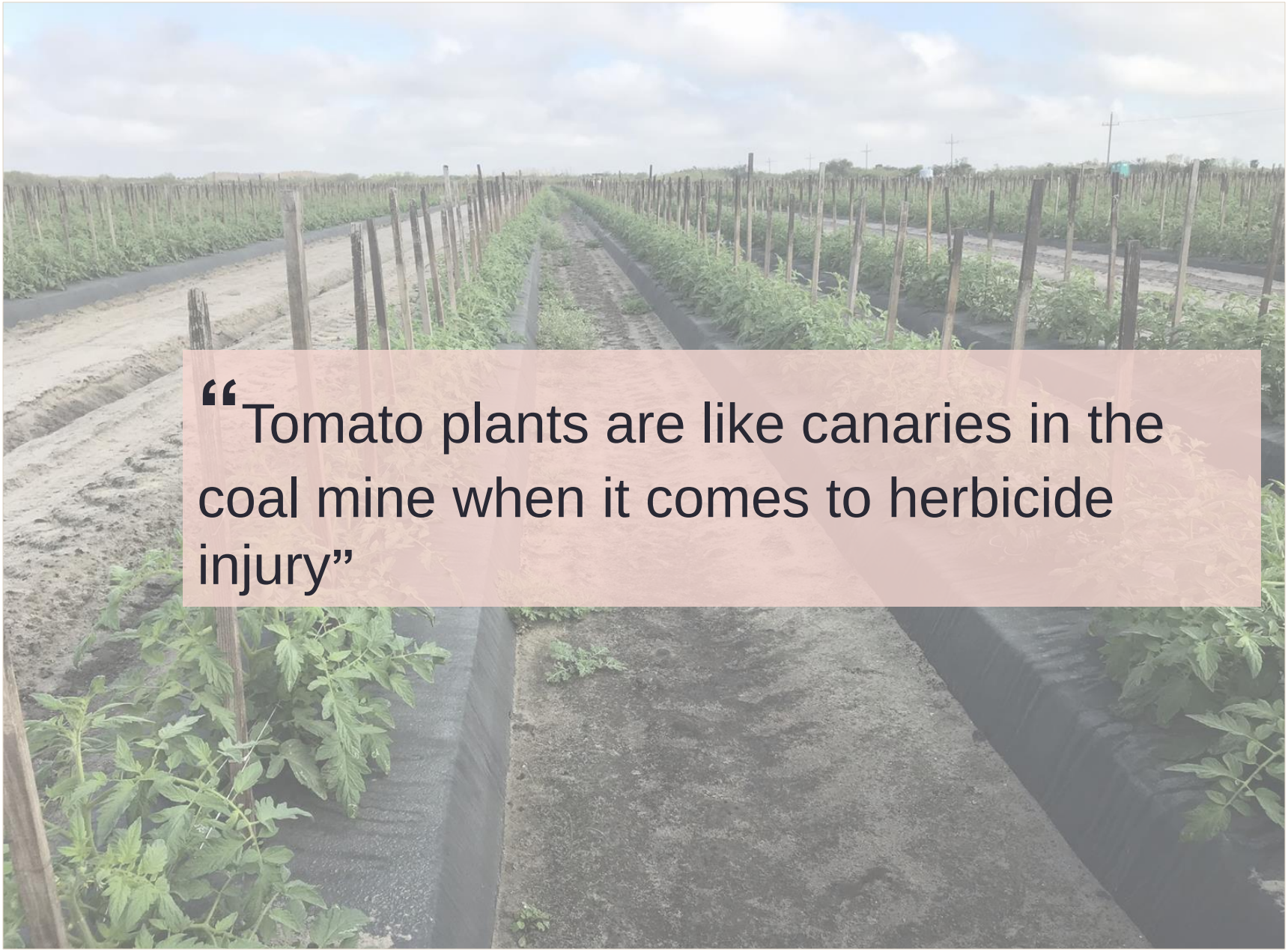
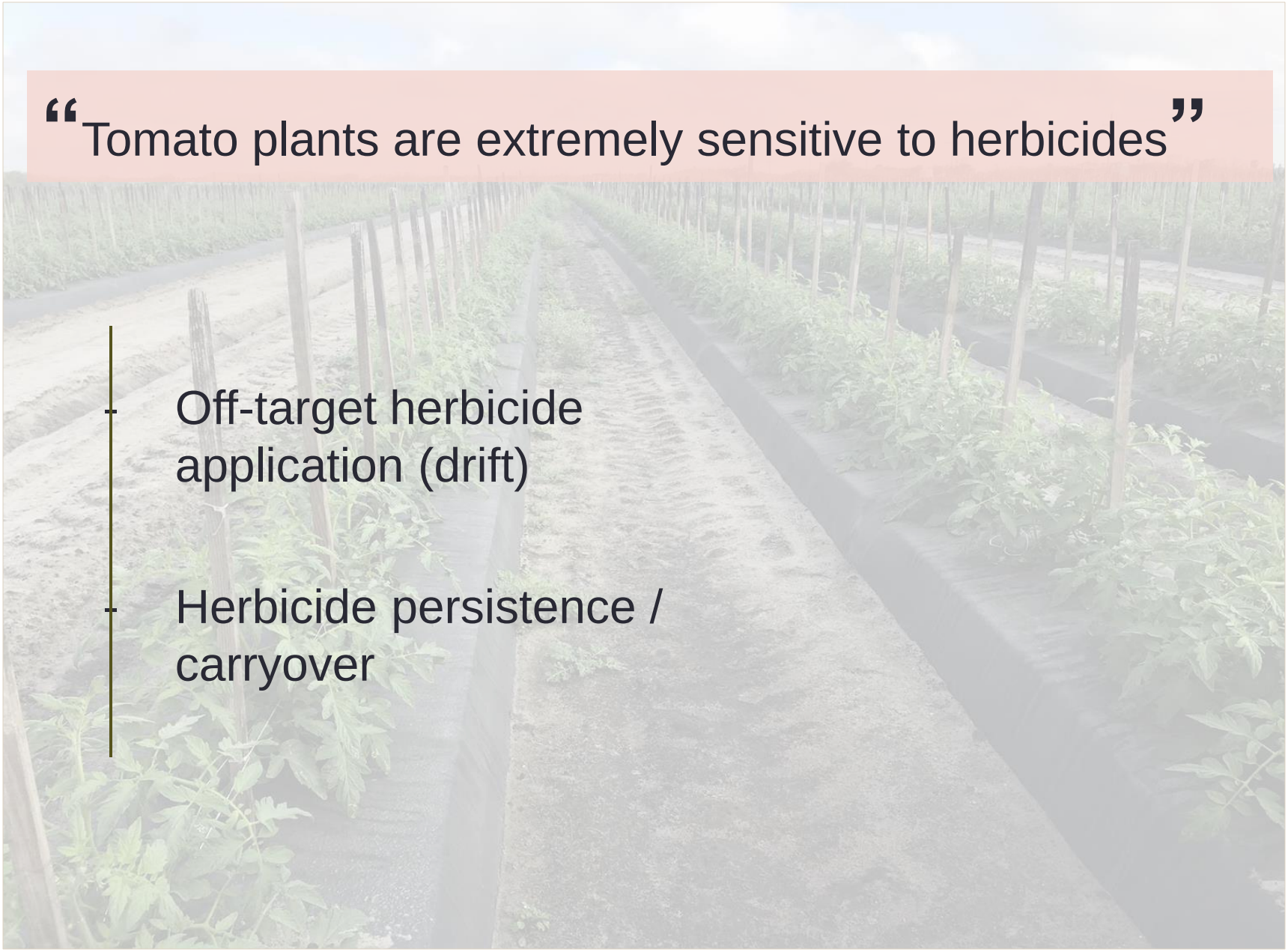
UF IFAS UNIVERSITY of FLORIDA

Horticultural Sciences



“Tomato plants are like canaries in the coal mine when it comes to herbicide injury”



"Tomato plants are extremely sensitive to herbicides"

- Off-target herbicide application (drift)
- Herbicide persistence / carryover

"Tomato plants are extremely sensitive to herbicides"

- **Off-target herbicide application**
- Herbicide persistence / carryover

# 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

# 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

# Herbicide injury in tomato plants

**Glyphosate injury on tomato**

# Herbicide injury in tomato plants

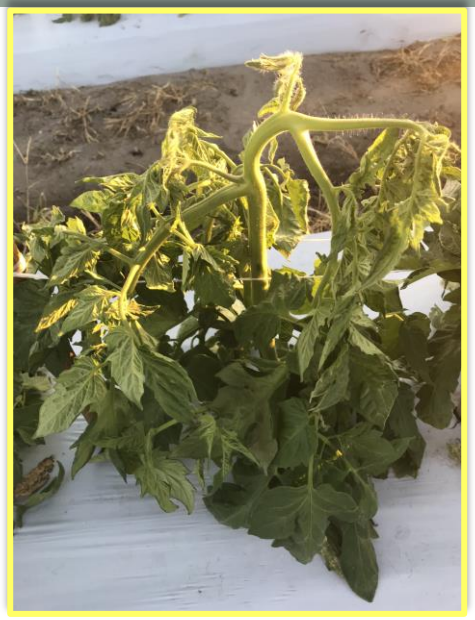
**Glyphosate injury on tomato**

- Necrosis of growing leaves and shoots

# Herbicide injury in tomato plants

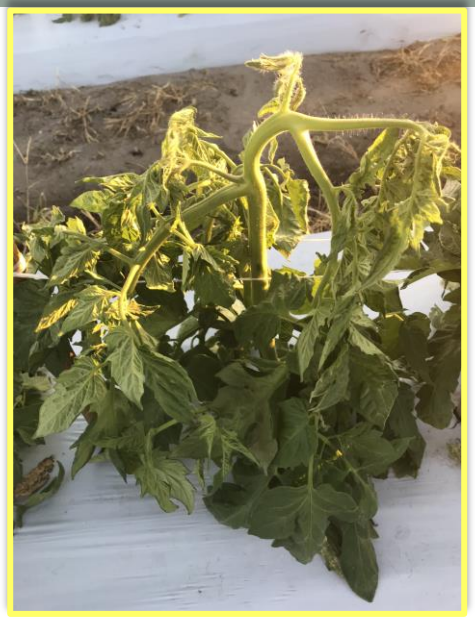
**2,4-D injury on tomato**

- Twisting of shoots
- Cupping of leaves



herbicide injury

Symptom severity



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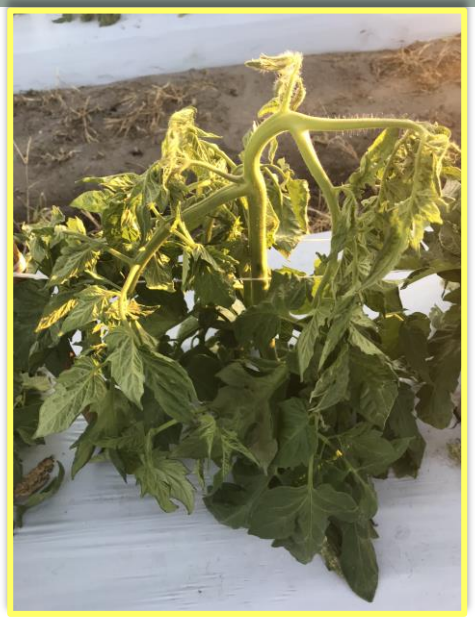
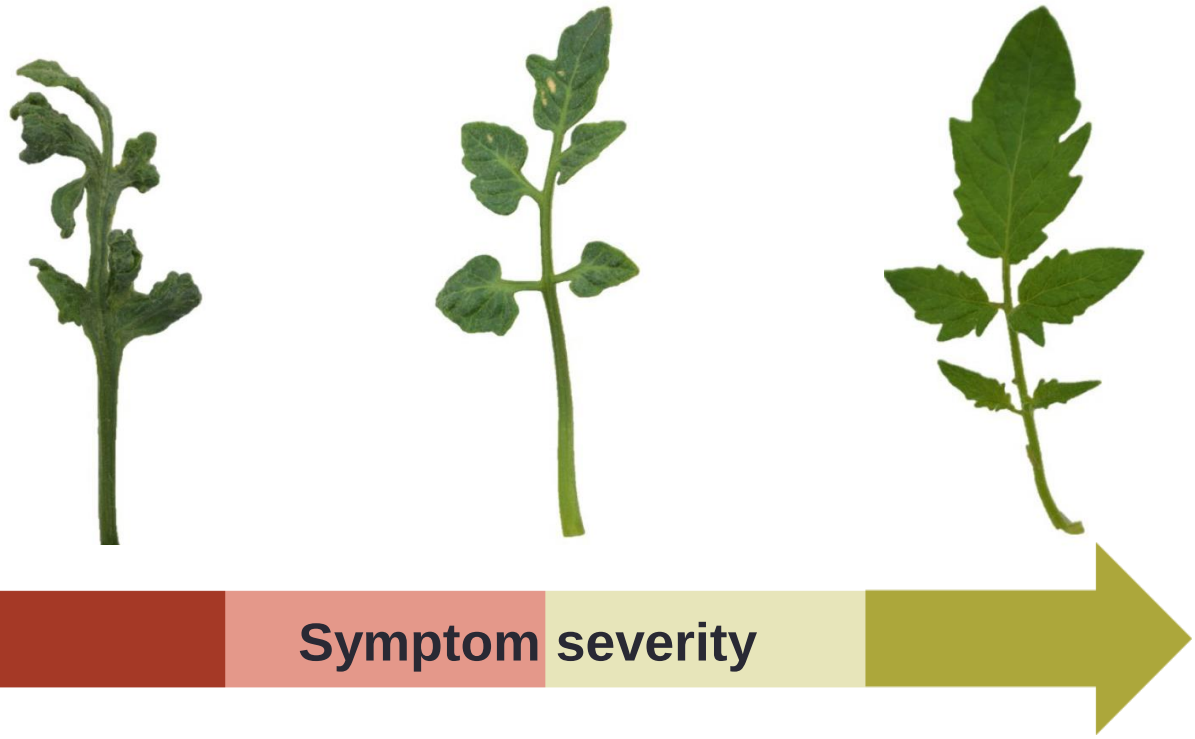
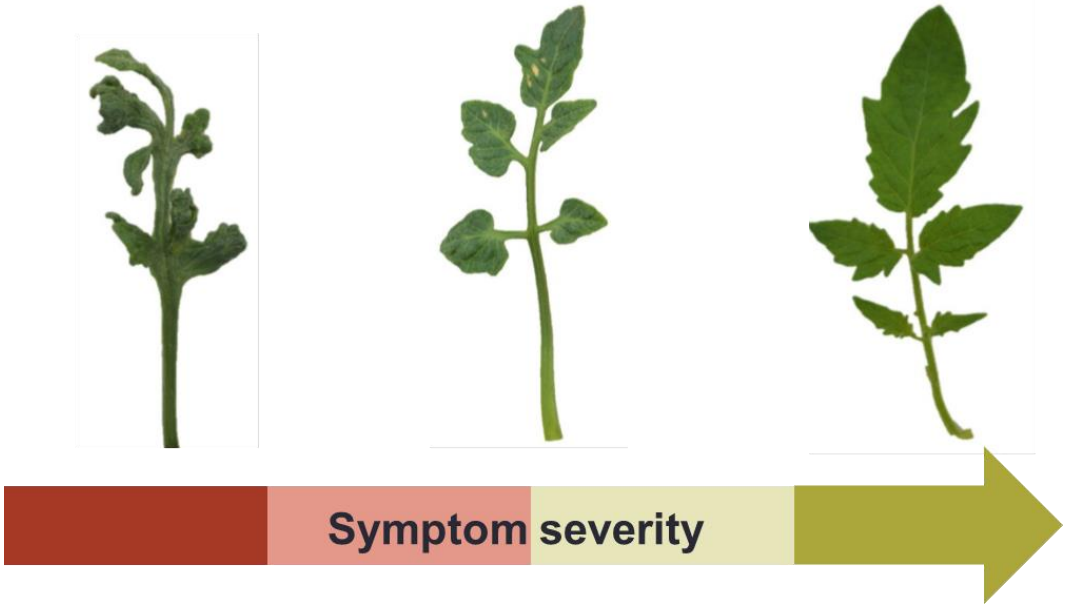


herbicide injury



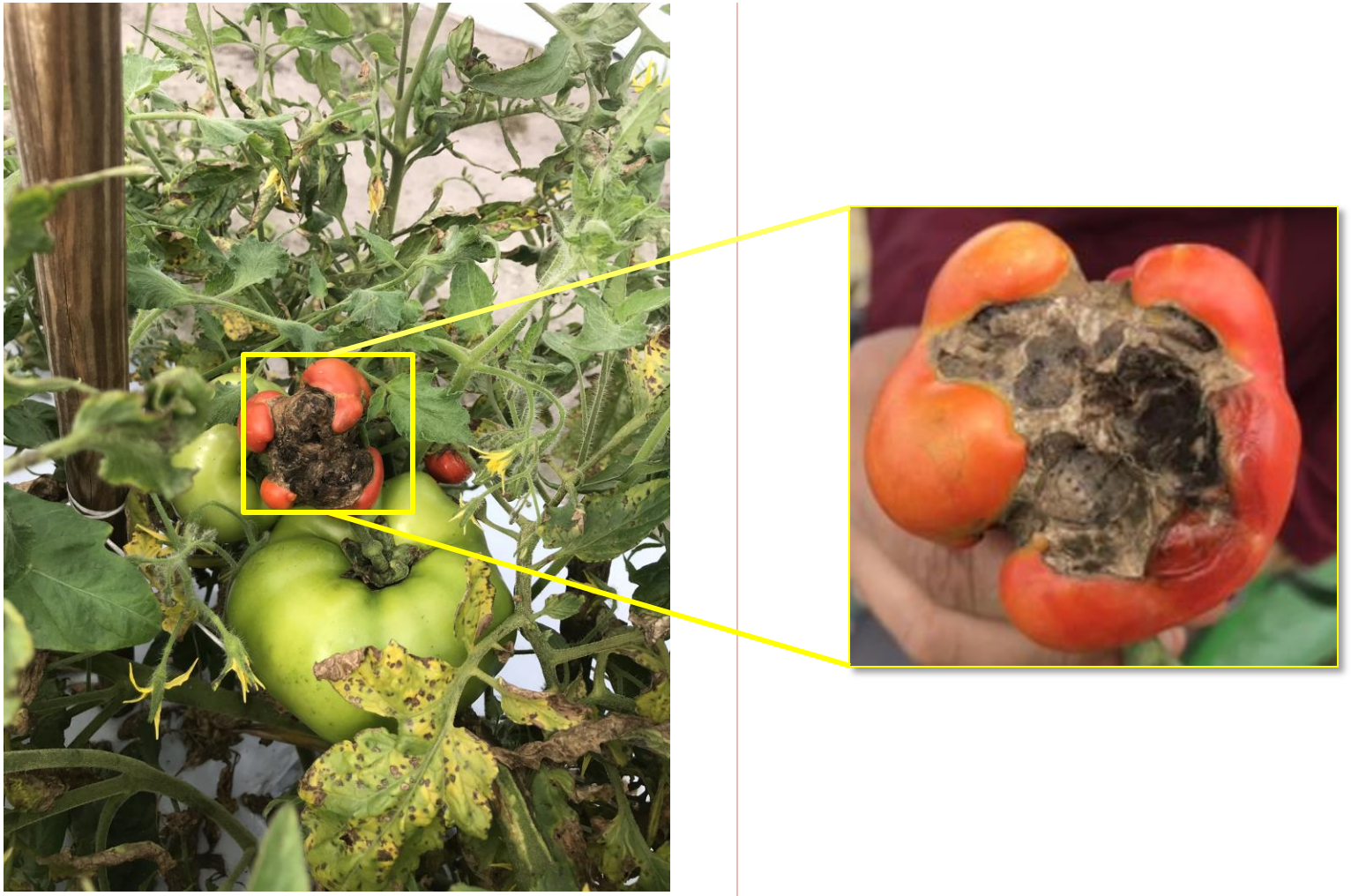

“After several weeks, the symptomatic plants may recover with healthy, normal growth”

# 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

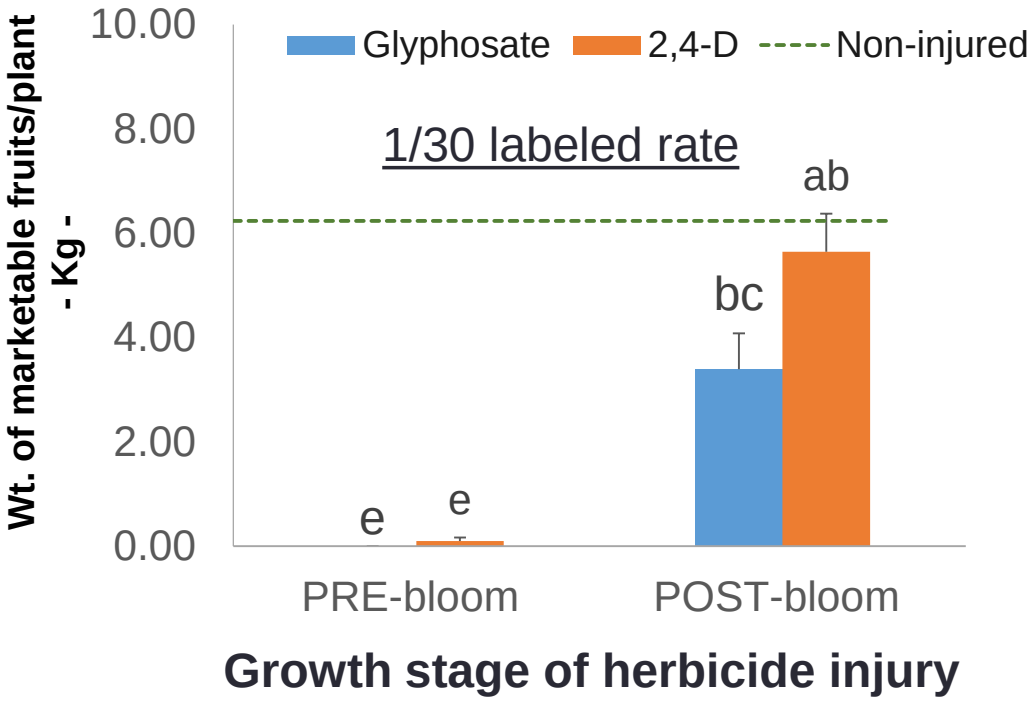
- Physiological disorder that occurs most often on large fruited, fresh-market tomatoes

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

# Study to look at possible **factors affecting the yield loss** in tomato due to sub-lethal herbicide exposure

- Trials were conducted during 2017-2018 at SWFREC Immokalee, FL
- Tomato plants were injured with sub-lethal doses of **2,4-D** and **glyphosate** herbicides.

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




- Replication (n) = 5
- Mean comparison: Tukey's hsd ($\alpha$ 0.05)

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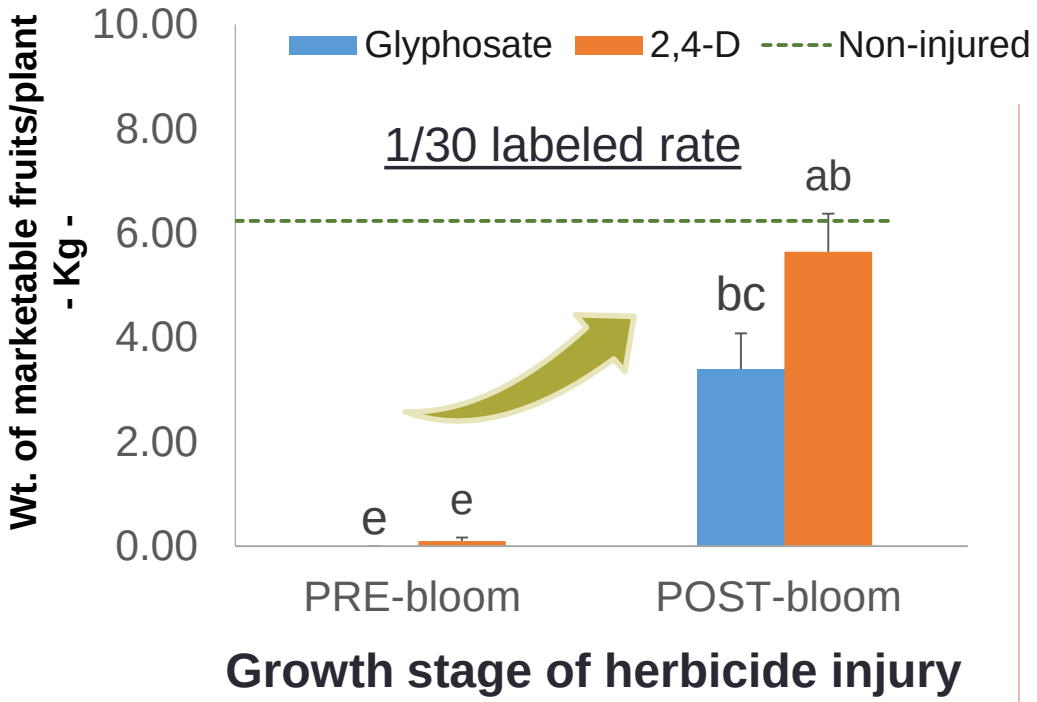


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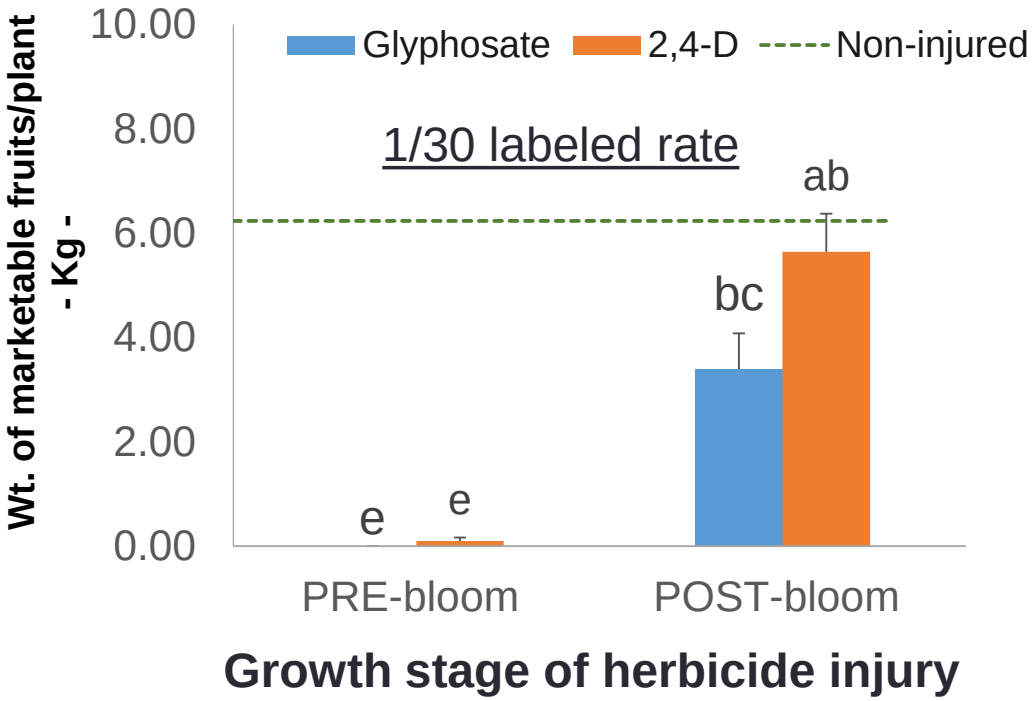
The plants were able to produce marketable fruits when injury was occurred in an advanced growth stage i.e., after bloom

Effects of **herbicide rates** on the marketable fruit yield in injured tomatoes

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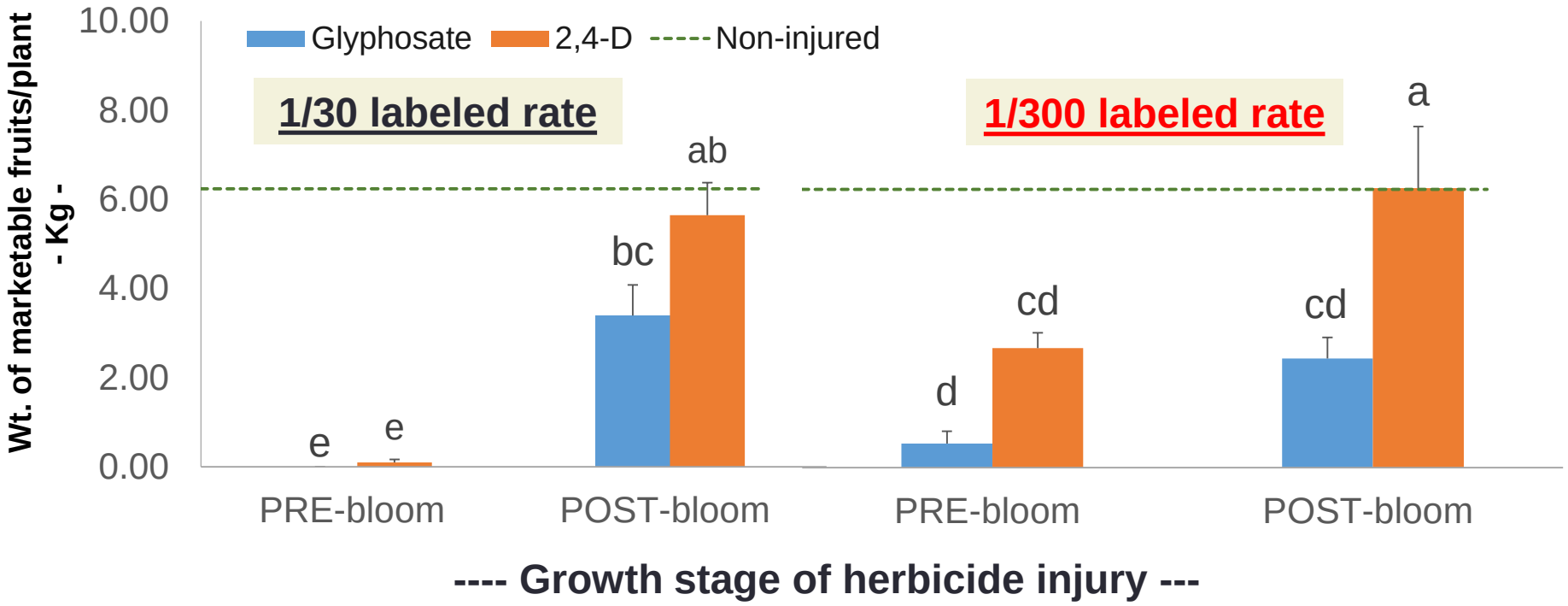


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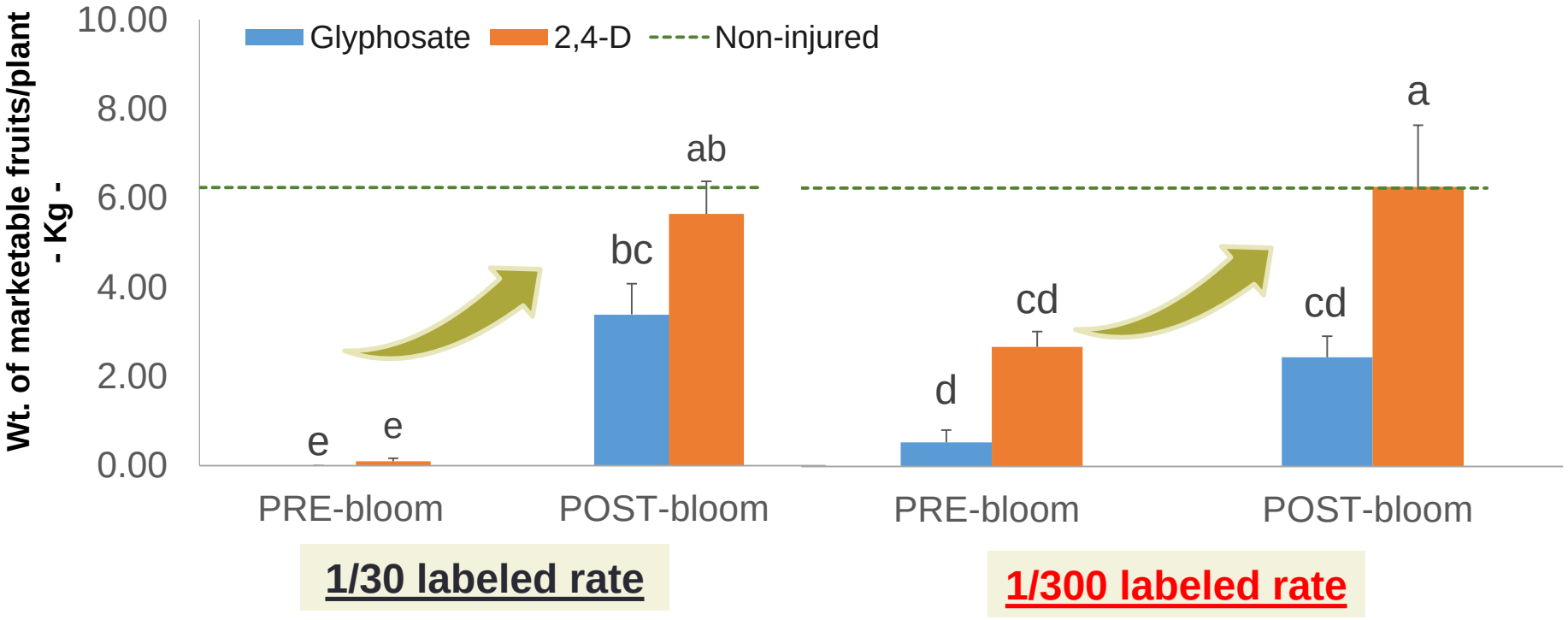
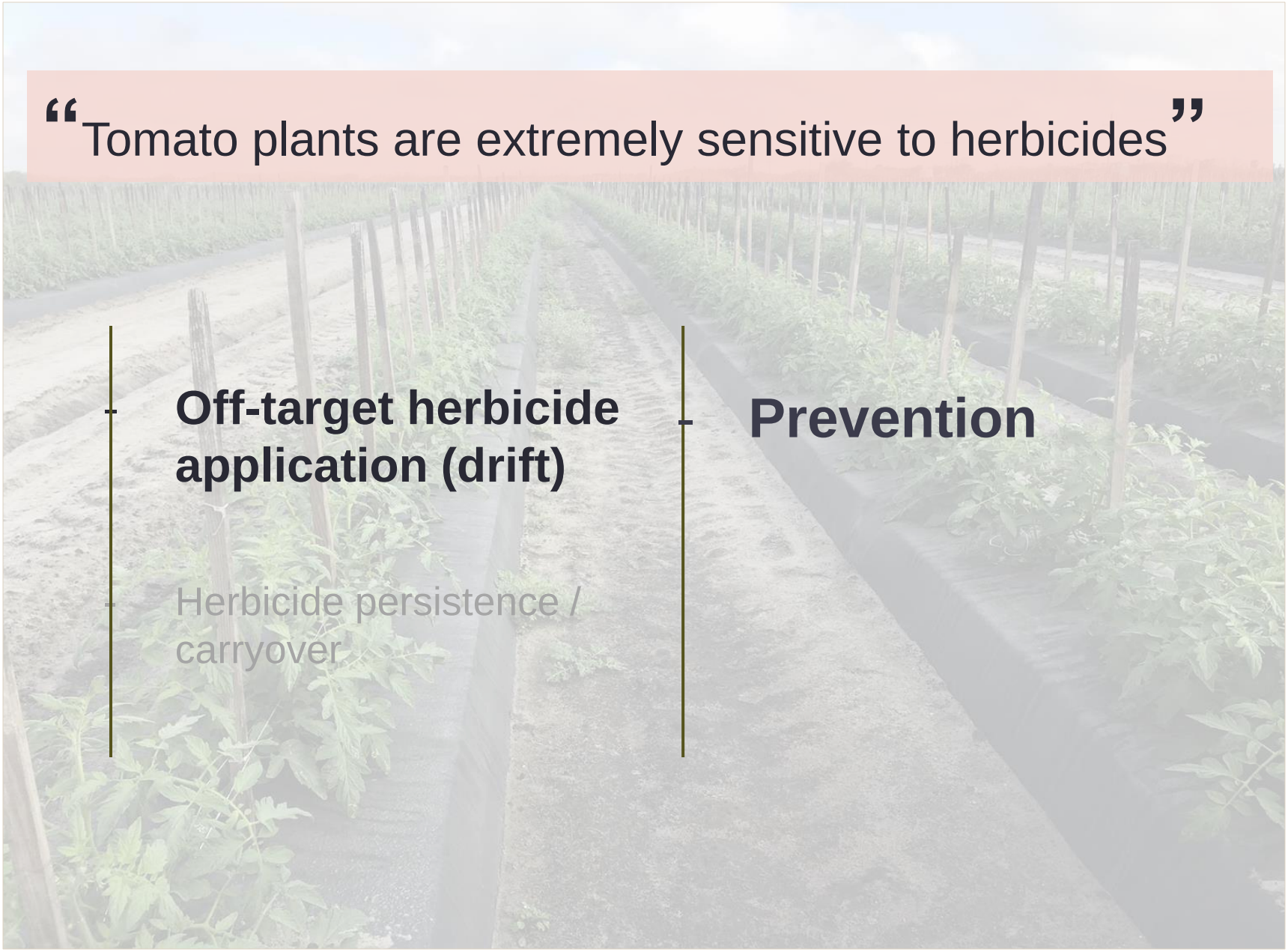



Injury from low herbicide rate has comparatively less effect on the marketable yield from injured tomatoes



"Tomato plants are extremely sensitive to herbicides"

- **Off-target herbicide application (drift)**
- Herbicide persistence / carryover

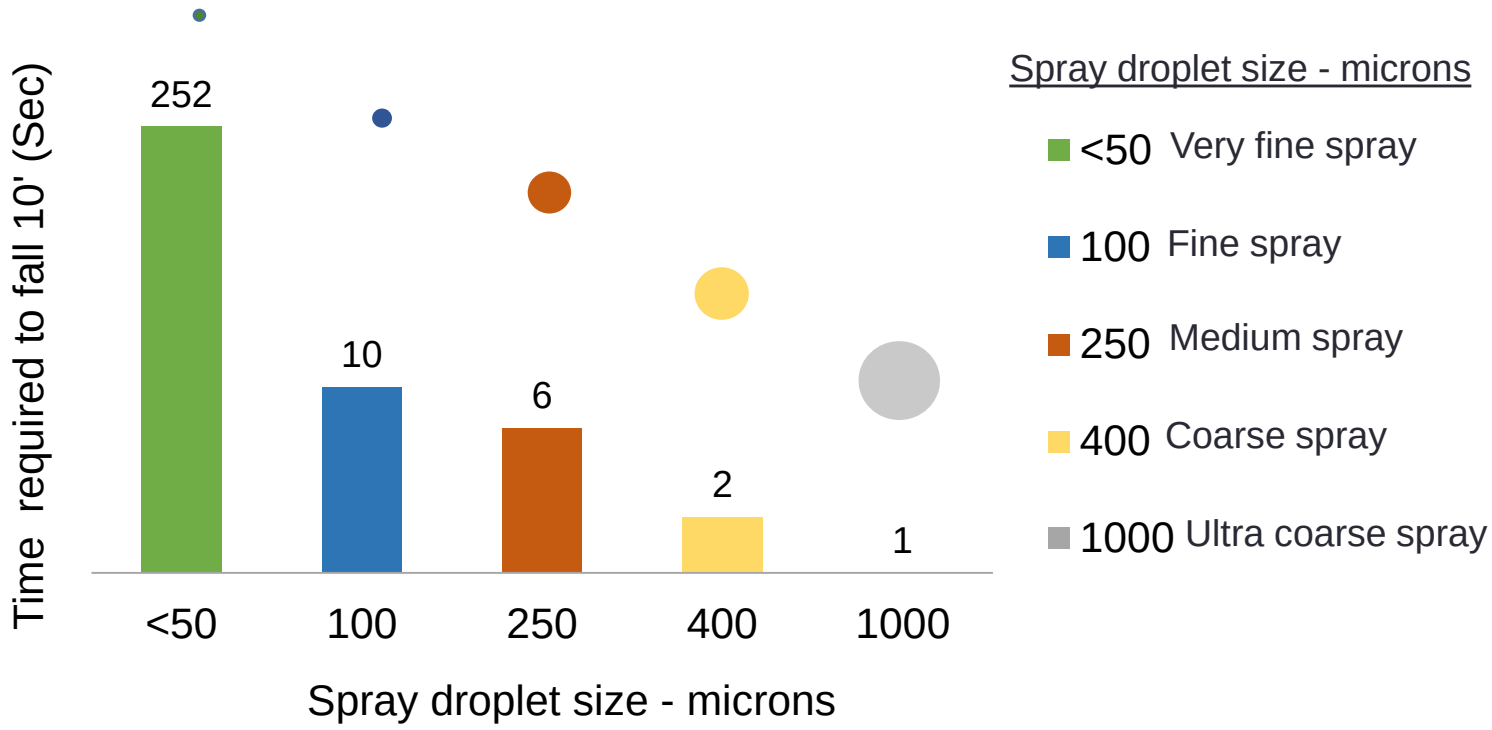
- **Prevention**

# Chances of drift will be **MORE**, at…

Herbicide drift increasing factors

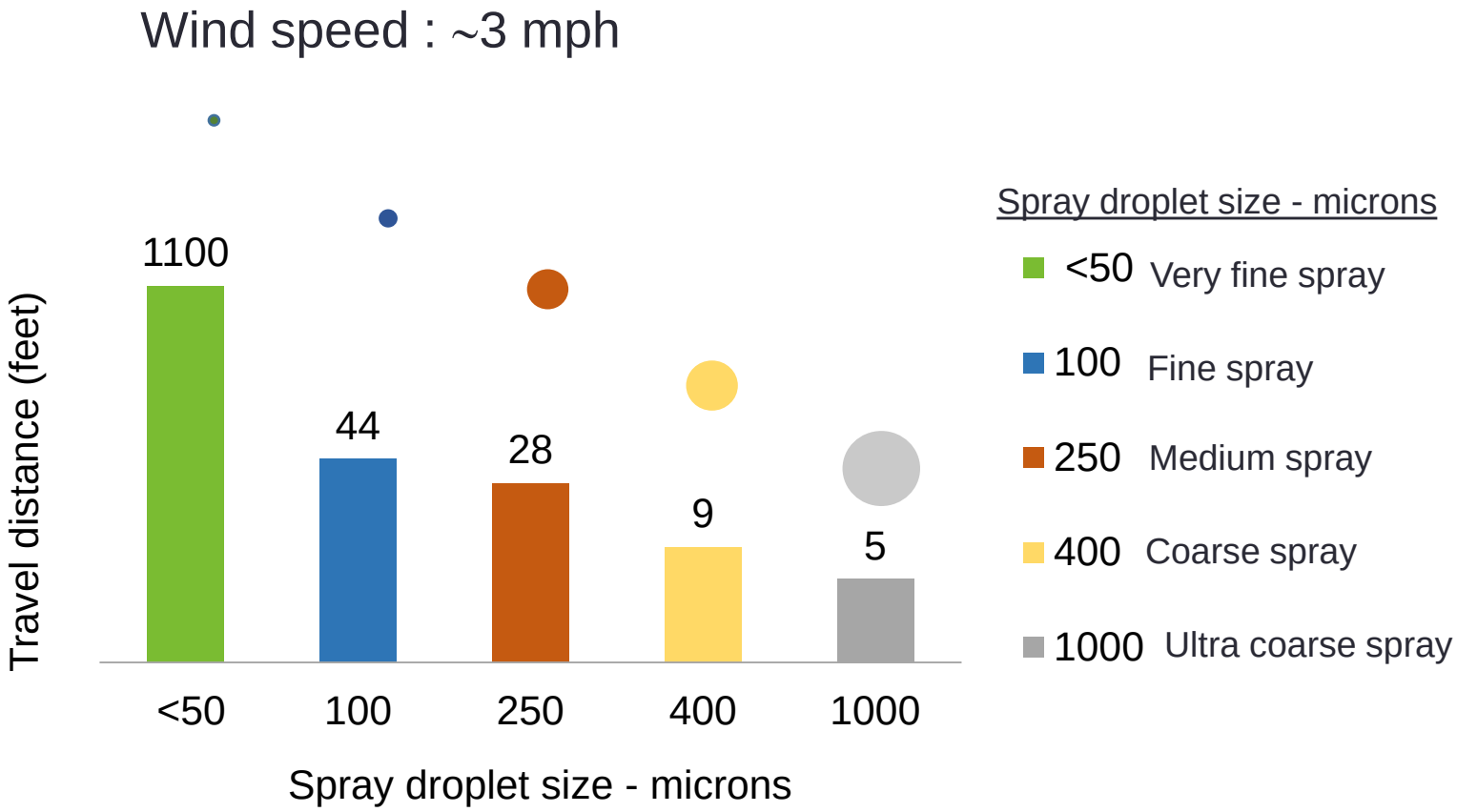
- **Smaller SPRAY DROPLETS**
- **Higher SPRAY PRESSURE**
- Smaller NOZZLE SIZE
- Higher WIND SPEED
- Lower HUMIDITY
- Using VOLATILE HERBICIDE PRODUCTS

# Herbicide spray droplet size v/s Time they spend in air




Modified from Dexter, 1993, NDSU extension

# Lateral travel distance spray droplets travel




***Smaller droplets can travel up to 3 miles!***

Modified from Dexter, 1993, NDSU extension

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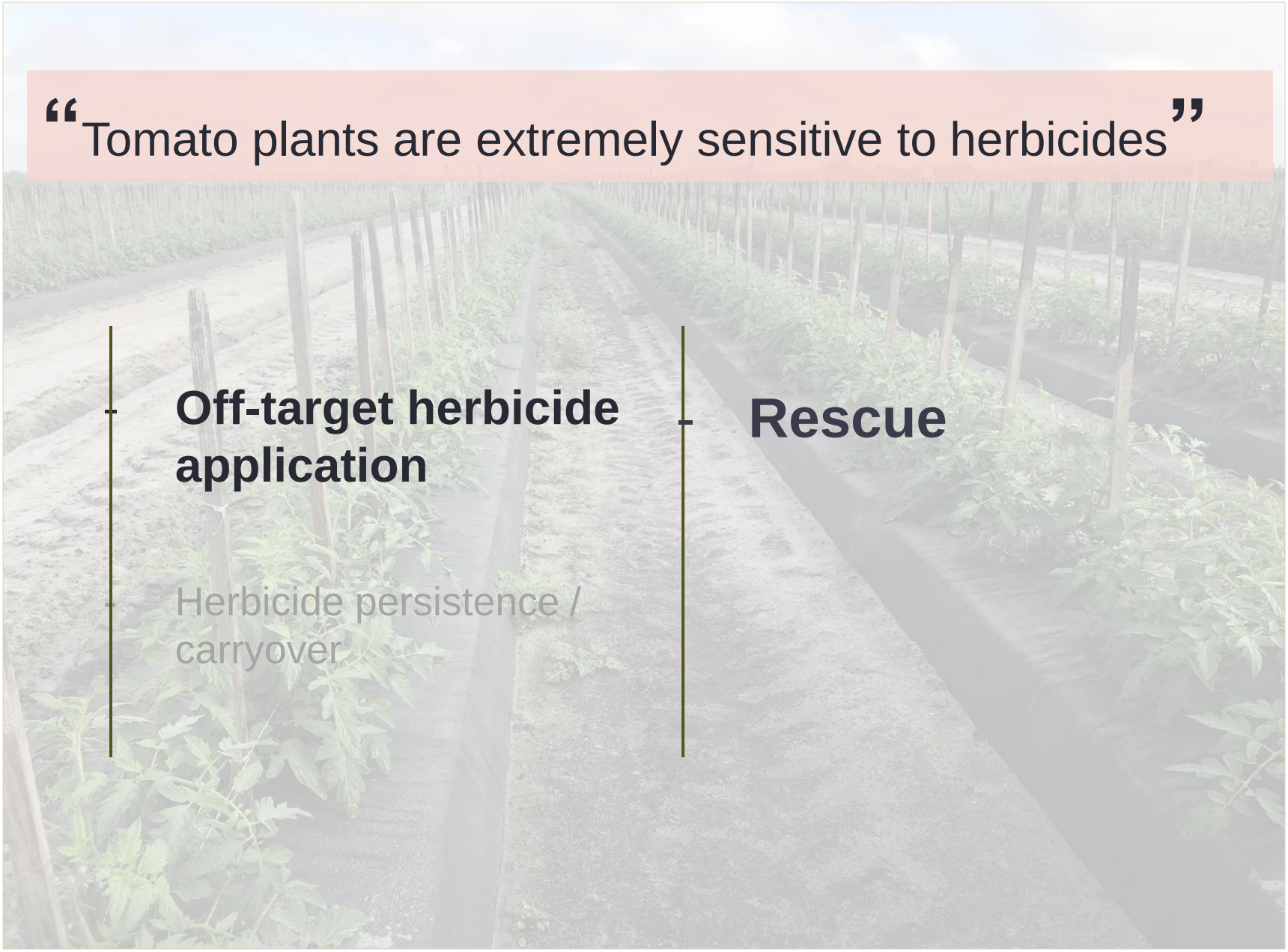
# Follow proper cleaning procedure to avoid tank contamination

- **Use cleaning agents**
  - Household ammonia (1 qt. / gal)
  - Trisodium phosphate (2 lbs. / gal)
- **Allow cleaning solution to sit in the tank overnight**
- **Flush lines, booms and nozzles**



"Tomato plants are extremely sensitive to herbicides"

- **Off-target herbicide application**
  - Herbicide persistence / carryover
- **Rescue**

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 **+**<br>Cobalt | X-cyte **+**<br>Keylate Cobalt | 12.50 ml<br>1.30 ml |
| 4 | Cytokinin **+**<br>NPK 5-10-27 **+**<br>Calcium / Boron | X-cyte **+**<br>Harvest More **+**<br>Sett | 12.55 ml<br>12.50 g<br>12.00 ml |

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




- **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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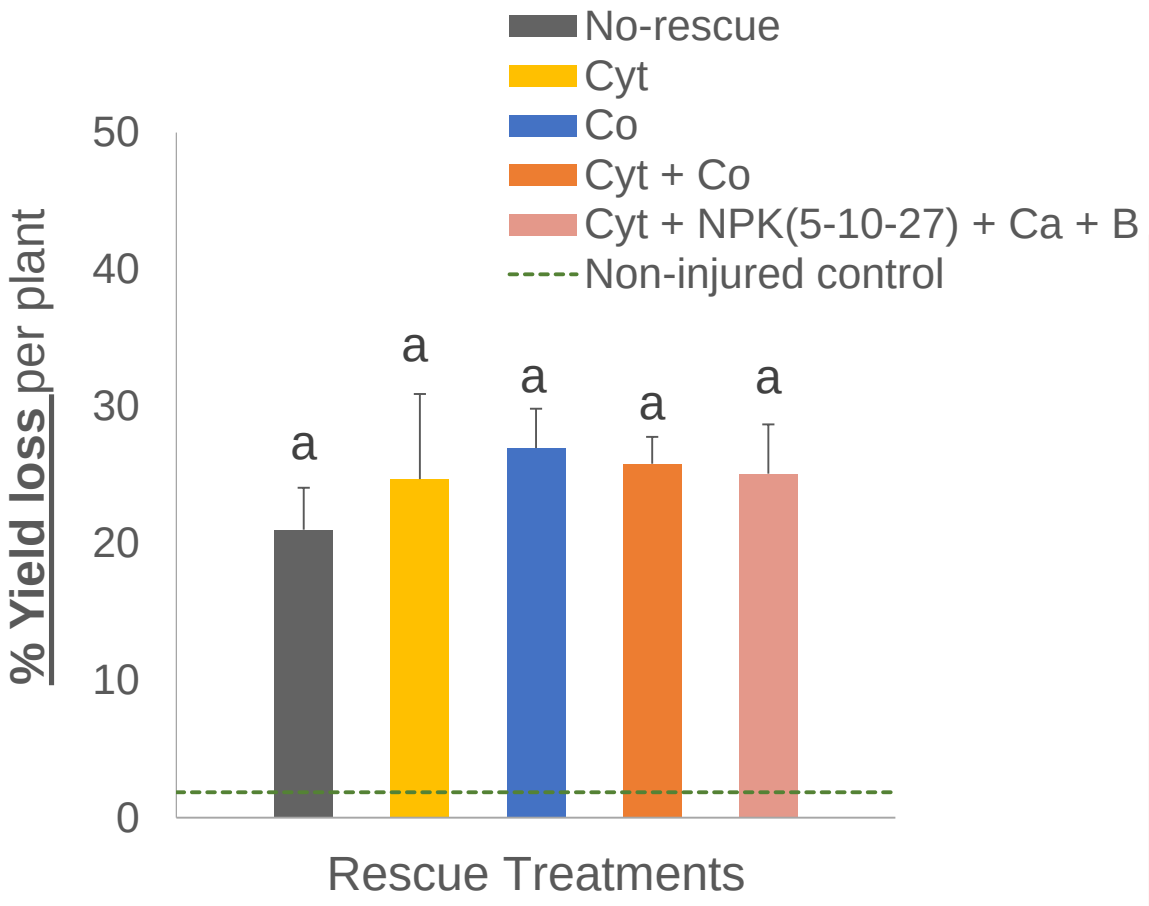
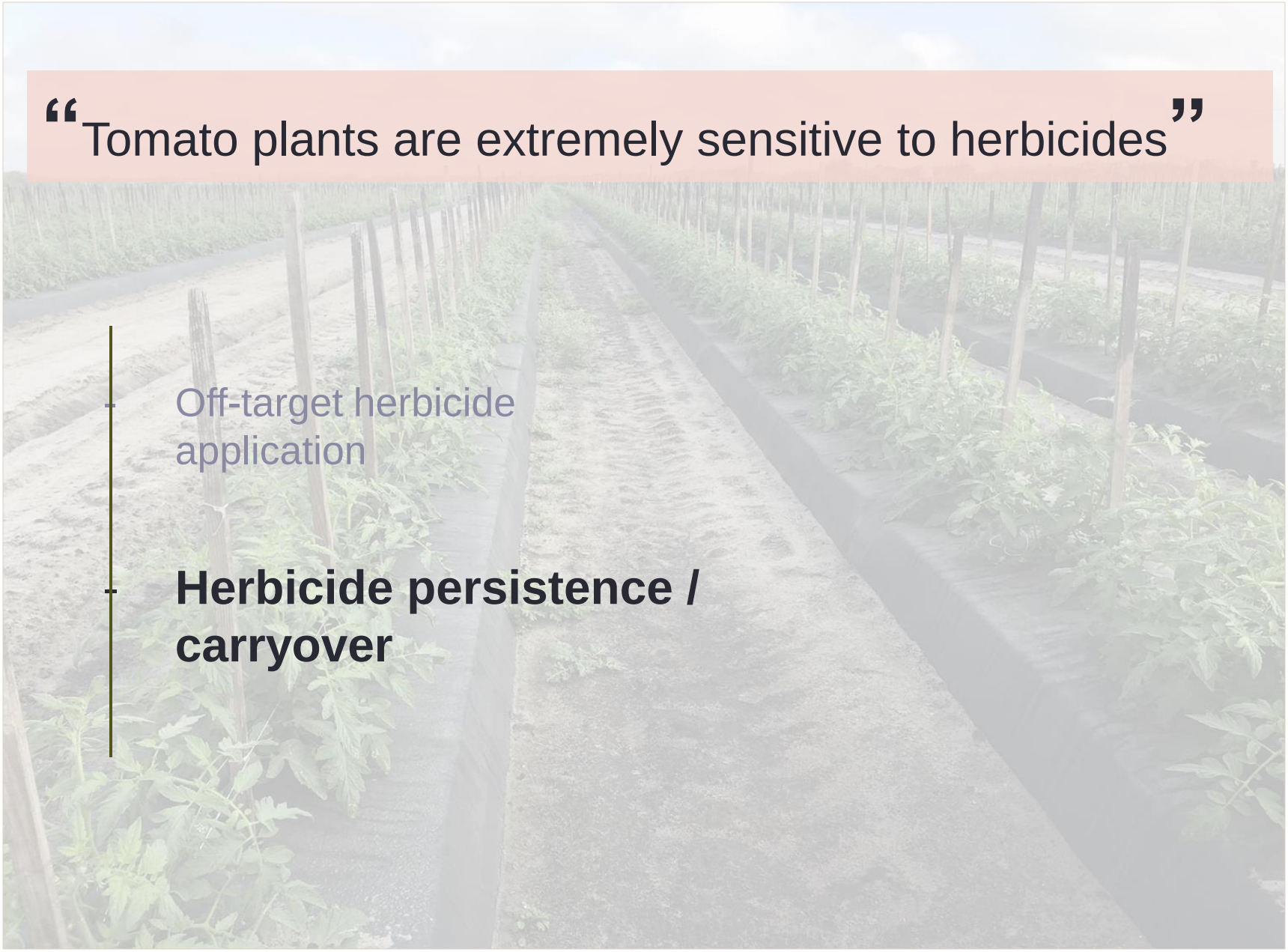



- Injury from **glyphosate**
- **1/100 labeled rate**
- **Pre-bloom stage**

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

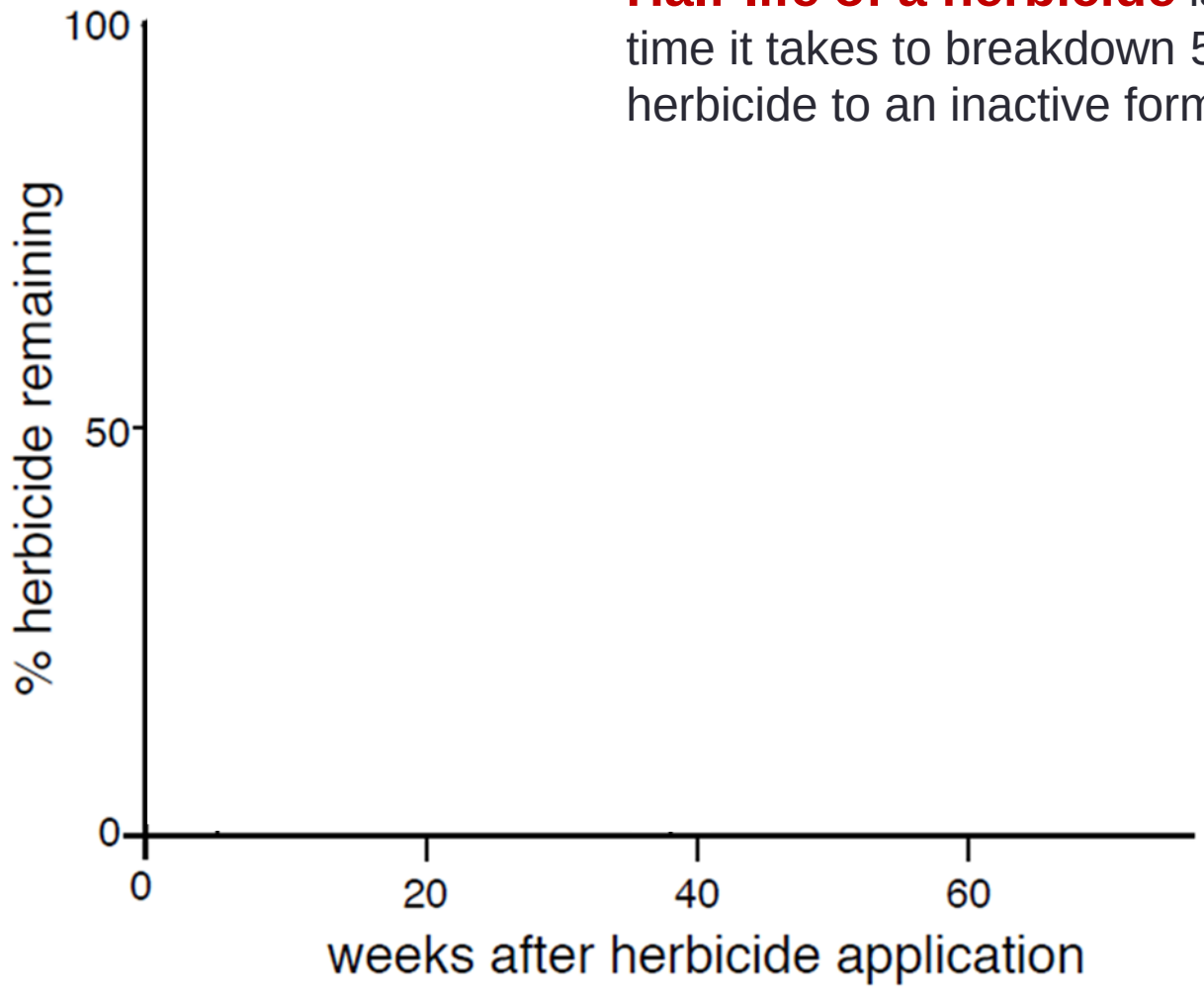


"Tomato plants are extremely sensitive to herbicides"

- Off-target herbicide application
- **Herbicide persistence / carryover**

# Half-life: indicator of herbicide persistence

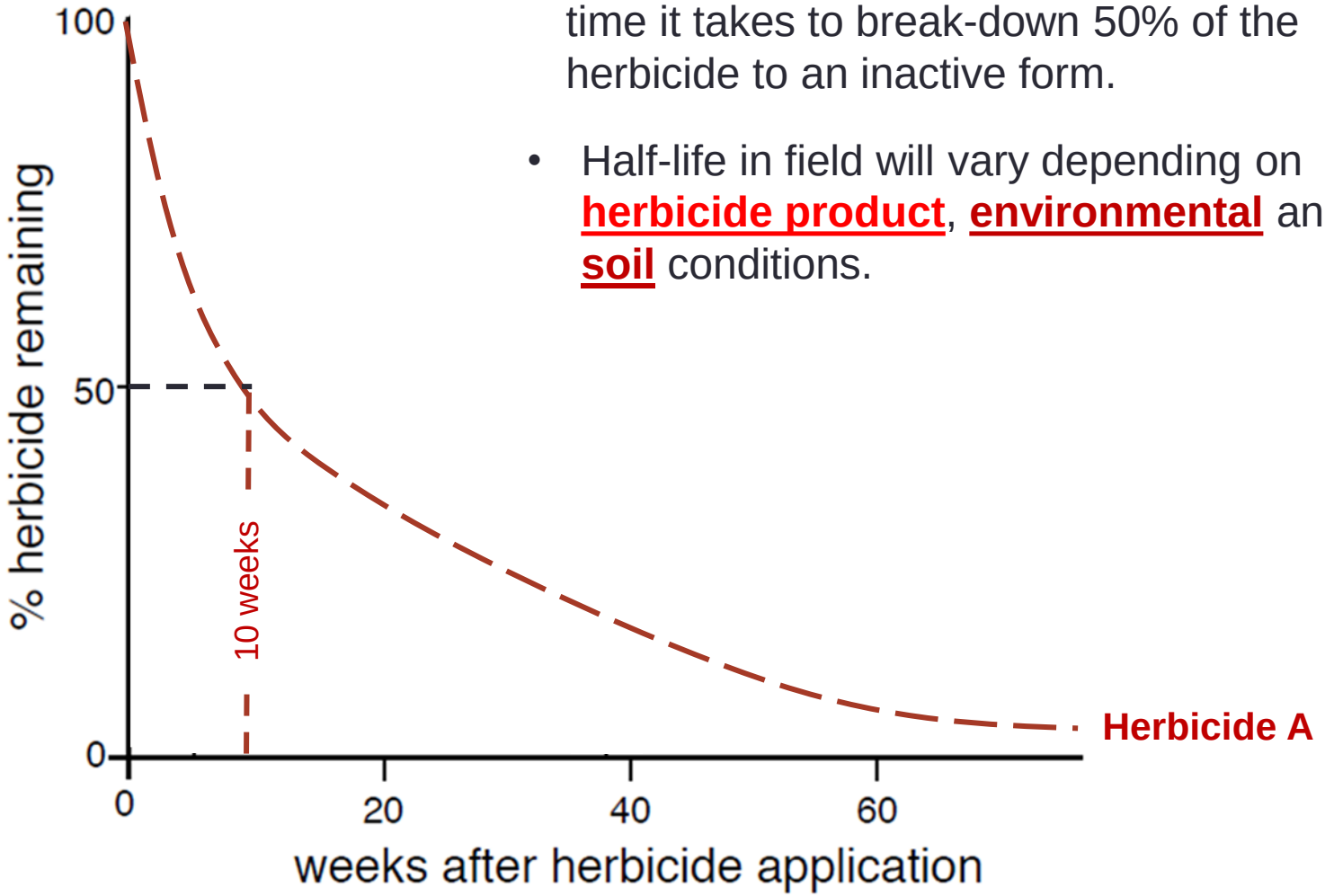
**Half-life of a herbicide** is the amount of time it takes to breakdown 50% of the herbicide to an inactive form.



# Half-life: indicator of herbicide persistence

**Half-life of a herbicide** is the amount of time it takes to break-down 50% of the herbicide to an inactive form.

- Half-life in field will vary depending on **herbicide product**, **environmental** and **soil** conditions.



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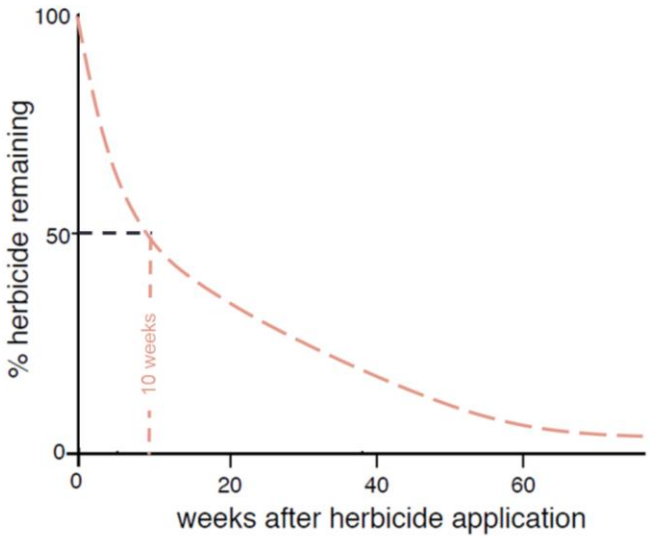
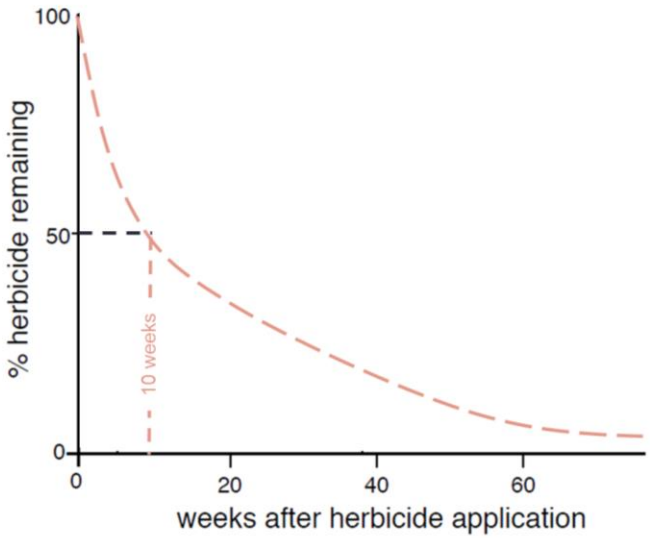



| Herbicide Product | Active ingredient | Half-life (Days) |
|---|---|---|
| Dual-Magnum | S-Metolachlor | 114 |
| Sandea | Halosulfuron | 25-30 |
| Reflex | Fomesafen | 120-240 |
| Eptam | EPTC | 7-14 |
| Sencor | Metribuzin | 60 |
| Round-up | Glyphosate | 47 |
| | | |

# Half-life: indicator of herbicide persistence

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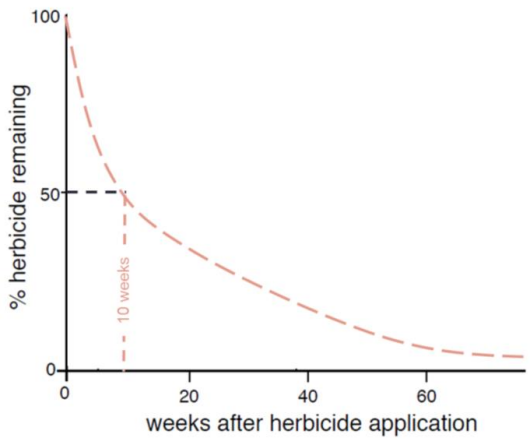
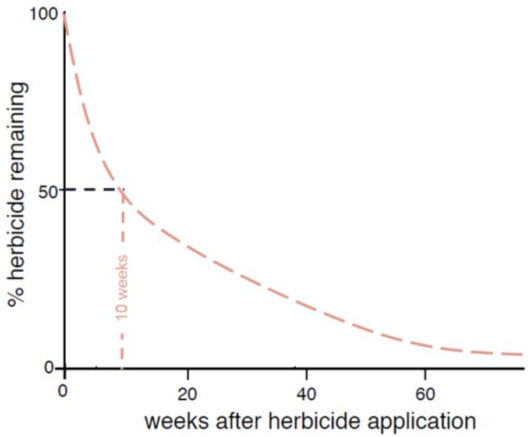



**Herbicide Carryover to Vegetables** is a great concern for growers

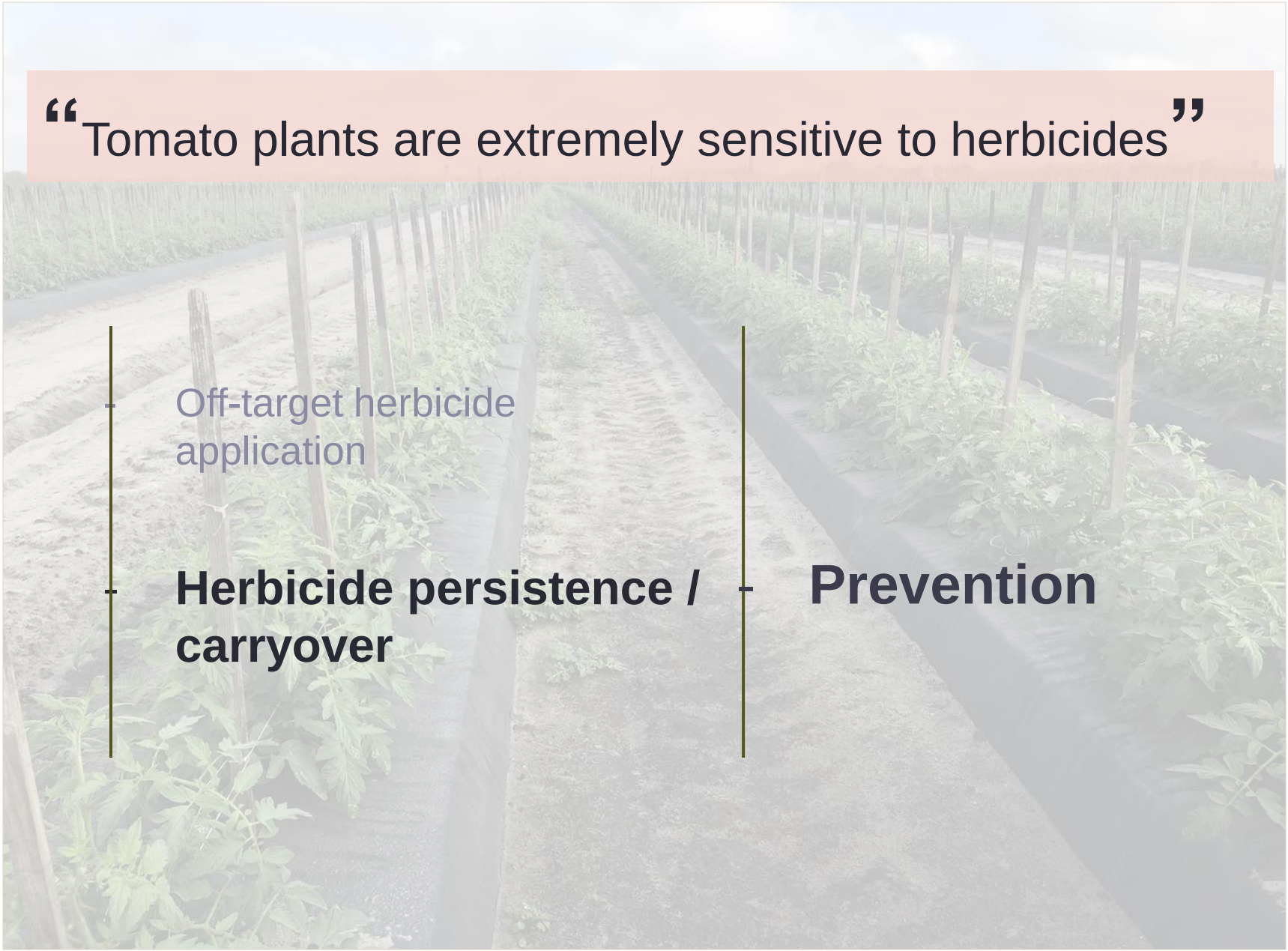
**S-metolachlor (Dual Magnum)**: Deformed growing points

Source: http://www.omafra.gov.on.ca




**Herbicide Carryover to Vegetables** is a great concern for growers


**Reflex**: Drying and twisting of leaves



"Tomato plants are extremely sensitive to herbicides"

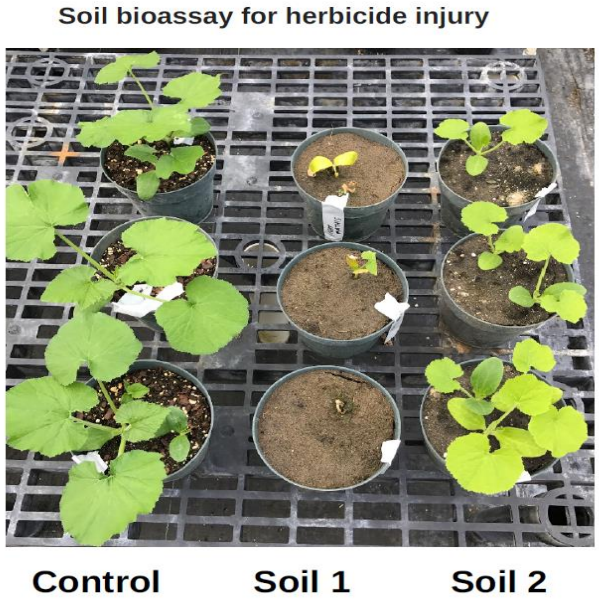
- Off-target herbicide application
- **Herbicide persistence / carryover**

- **Prevention**

# Herbicide Persistence Testing

## Bioassay

- Plant seeds in suspected soils
- Monitor the seedling growth for injury



## Herbicide Persistence Testing

- **Soil analysis for safe herbicide content**

Utilizing analytical methods – quantification of herbicide conc. in soil

Liquid chromatography

Mass spetrometry

- **Bioassay**
- **Soil analysis**

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GIVE

## Plant Diagnostic Clinic

Welcome to the UF/IFAS SWFREC Plant Diagnostic Clinic in Immokalee. We are a branch of the Florida Plant Diagnostic Network. We are open Monday through Friday 8:00 am – 5:00 pm (except state and UF holidays). We can be reached at 239-658-3432 (ext. 13432) or jinxkat@ufl.edu. We serve the state and region by offering disease, insect, and weed identification services for commercial, homeowner, and extension plant samples. We are currently accepting in-state samples. The clinic does not test soil samples.


We now offer weed identification services, including weed and invasive plant ID, herbicide phytotoxicity diagnosis, and herbicide residue management.

**All samples must include a completed sample submission form.** Please include as much detail as possible to help us with diagnosing plant problems. Forms may be submitted electronically (via fax or emailed to jinxkat@ufl.edu) or printed and included with the physical sample. Be sure to select the correct form for the service requested, either disease diagnosis or weed identification. Both forms include detailed sample submission instructions on the second page of the form.

Plant Diagnostic Clinic - Submission Form

Plant Diagnostic Clinic - Weed Identification Form

### Contact

**SWFREC Plant Diagnostic Clinic**

2685 State Road 29 North
Immokalee, Florida 34142
Phone: (239) 658-3431
Fax: (239) 658-3403
E-mail: jinxkat@ufl.edu

### Resources

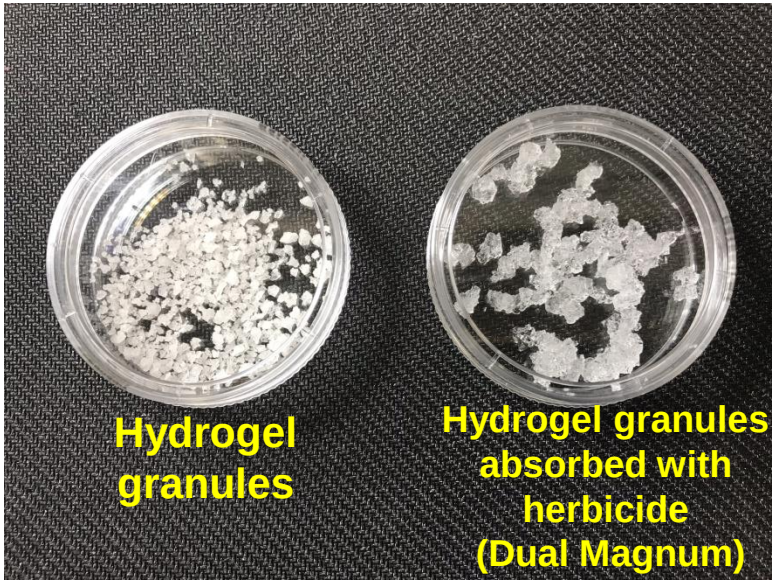
Dr. Pamela Roberts

Dr. Ramdas Kanissery

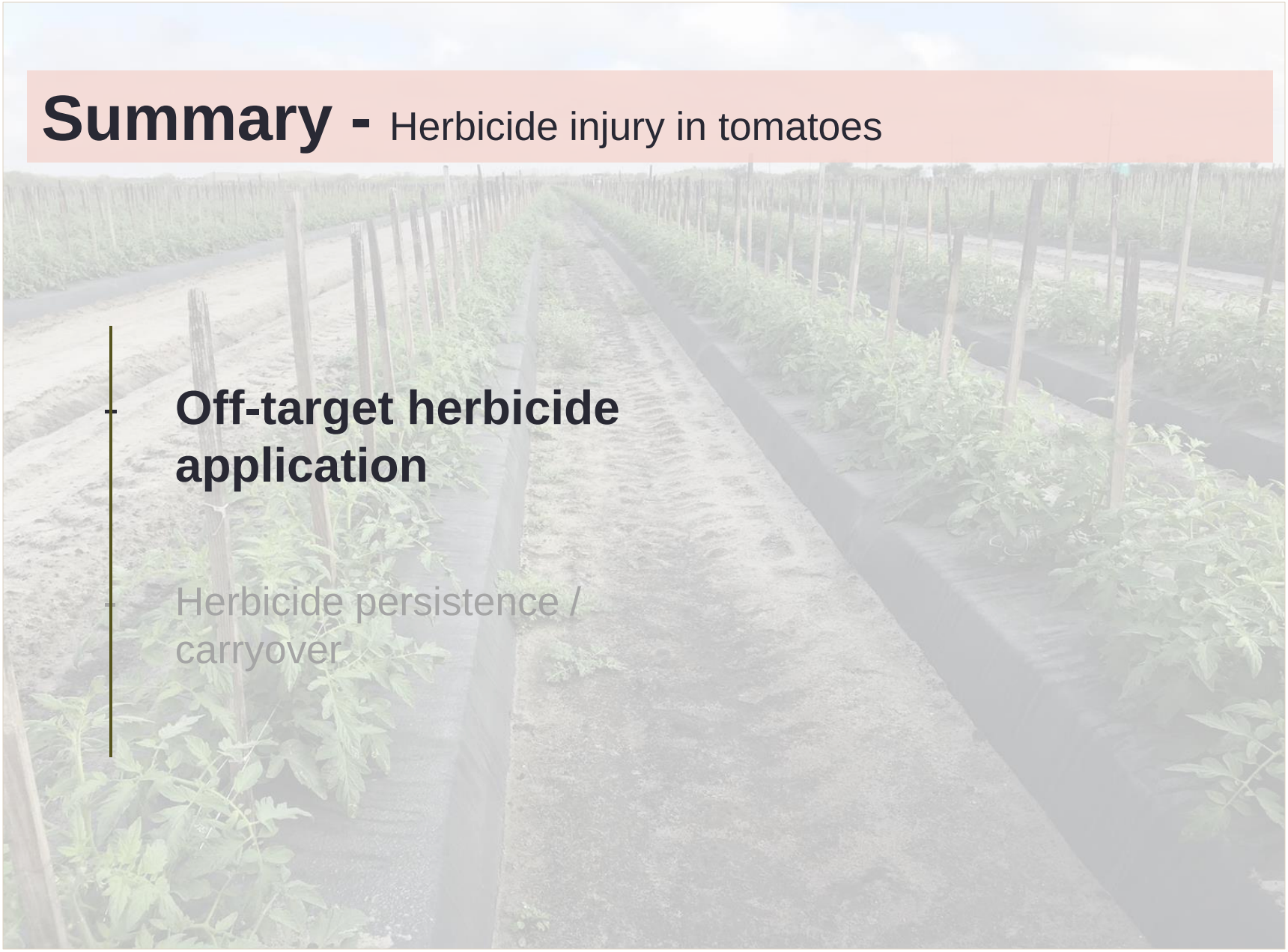
# Ongoing project at SWFREC

Reducing the crop-adverse effects of herbicides used under the plastic mulch

Utilizing hydrogels for slow-releasing herbicide under the plastic



# **Summary -** Herbicide injury in tomatoes



- **Off-target herbicide application**
- Herbicide persistence / carryover

# Summary

## Off-target herbicide application

- Can potentially cause fruit deformities in tomato
- Impacts may be less when occurred in an advanced growth stage e.g.., POST bloom
- Understand the factors causing drift
- Proper tank cleaning procedure to avoid tank contamination

# Summary

## Herbicide persistence / carryover

- Herbicide persistence - adversely affect the crop
- Half-life : indicator of persistence
- Avoid carry over impacts - read label, maintain application history
- When in doubt – **perform bioassay or Soil analysis**

# Thank you…

**SWFREC weed science team**

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

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

**Contact**

**Ramdas Kanissery**

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