Herbicide Phytotoxicity in Tomato: Prevention and Rescue

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Immokalee, FL
“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

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

Herbicide spraying in pasture land for summer weed control

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
herbicide injury

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

**Growth stage of herbicide injury**

- Replication (n) = 5
- Mean comparison: Tukey’s hsd (α 0.05)
Effects of **growth stage of injury** on marketable yield in herbicide injured tomatoes

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

**Growth stage of herbicide injury**

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

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--- Growth stage of herbicide injury ---

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

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

**Background – Methodology – Results – Summary**
“Tomato plants are extremely sensitive to herbicides”

- Off-target herbicide application (drift)
- Prevention

Herbicide persistence / carryover
Chances of drift will be **MORE**, at…

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

Herbicide drift increasing factors
Herbicide spray **droplet size** v/s **Time** they spend in air

Modified from Dexter, 1993, NDSU extension
**Lateral travel distance** spray droplets travel

Wind speed: ~3 mph

Smaller droplets can travel up to 3 miles!

Modified from Dexter, 1993, NDSU extension
Chances of drift will be **MORE**, at…

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- Higher SPRAY PRESSURE
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Herbicide drift increasing factors
Chances of drift will be **MORE**, at...

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

<table>
<thead>
<tr>
<th>Rescue treatments</th>
<th>Active ingredient(s) in rescue treatments</th>
<th>Product(s)</th>
<th>Product Conc. (L⁻¹)</th>
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<tbody>
<tr>
<td>1</td>
<td>Non-rescued control</td>
<td>n/a</td>
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</tr>
<tr>
<td>2</td>
<td>Cytokinin</td>
<td>X-cyte</td>
<td>1.25 ml</td>
</tr>
<tr>
<td>5</td>
<td>Cobalt</td>
<td>Keylate Cobalt</td>
<td>1.30 ml</td>
</tr>
<tr>
<td>6</td>
<td>Cytokinin + Cobalt</td>
<td>X-cyte + Keylate Cobalt</td>
<td>12.50 ml 1.30 ml</td>
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<tr>
<td>4</td>
<td>Cytokinin + NPK 5-10-27 + Calcium / Boron</td>
<td>X-cyte + Harvest More + Sett</td>
<td>12.55 ml 12.50 g 12.00 ml</td>
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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.
Effects of rescue treatments on herbicide injured tomato plants from producing non-marketable fruits

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

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

- No-rescue
- Cyt
- Co
- Cyt + Co
- Cyt + NPK(5-10-27) + Ca + B
- Non-injured control
Effects of rescue treatments on herbicide injured tomato plants from producing non-marketable fruits

- 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.
Half-life: indicator of herbicide persistence

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<th>Herbicide Product</th>
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<th>Half-life (Days)</th>
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<tr>
<td>Dual-Magnum</td>
<td>S-Metolachlor</td>
<td>114</td>
</tr>
<tr>
<td>Sandea</td>
<td>Halosulfuron</td>
<td>25-30</td>
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<tr>
<td>Reflex</td>
<td>Fomesafen</td>
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<td>Eptam</td>
<td>EPTC</td>
<td>7-14</td>
</tr>
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<td>Sencor</td>
<td>Metribuzin</td>
<td>60</td>
</tr>
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<td>Round-up</td>
<td>Glyphosate</td>
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## 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 spectrometry
• Bioassay
• Soil analysis
Ongoing project at SWFREC

Utilizing hydrogels for slow-releasing herbicide under the plastic

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

Contact

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Not in picture: Cami McAvoy