Evaluation of micronutrients for their effectiveness in rescuing herbicide injured tomatoes

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Tomato production

Important to the economy of SW Florida
Tomato production

Important to the economy of SW Florida

“Tomato plants are extremely sensitive to off-target herbicide application”
Tomato plants are extremely sensitive to 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
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

“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?

"Herbicide prevents substrate linking to enzyme and kills the plant"
How herbicide generally works?

Plants have 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
“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"
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

- Amount of herbicide exposure
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Possible factors affecting the fruit deformation

- 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.
Experimental design

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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*
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
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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non-rescued control</td>
<td>n/a</td>
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<tr>
<td>2</td>
<td>Cytokinin</td>
<td>X-cyte</td>
<td>1.25 ml</td>
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<td>5</td>
<td>Cobalt</td>
<td>Keylate Cobalt</td>
<td>1.30 ml</td>
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<td>Cytokinin + Cobalt</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>
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Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

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

Rescue treatment application timing

Pre-bloom

- Herbicide injury
- Rescue treatments
- Harvest
Can we **rescue the herbicide injured tomato plants** from producing non-marketable fruits?

**Rescue treatment application timing**

- **Background – Methodology – Results – Summary**

  **Q 3**

  **Post-bloom**

  - **Herbicide injury**
  - **Rescue treatments**
  - **Harvest**

  **After ~50% bloom formed**
RESULTS

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?
RESULTS

Q 1
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

**Background – Methodology – Results – Summary**

**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

**Background – Methodology – Results - Summary**

**Q 1**

**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.
RESULTS

Does the herbicide rates have an effect on the fruit malformation in tomatoes
**Effects of herbicide rates on the marketable fruit yield in injured tomatoes**

**Background**
- Replication (n) = 5
- Mean comparison: Tukey’s hsd (α 0.05)

**Methodology**

**Results**

**Summary**

- Growth stage of herbicide injury

- PRE-bloom
- POST-bloom

- Glyphosate
- 2,4-D
- Non-injured

- 1/30 labeled rate

- Wt. of marketable fruits/plant - Kg -

- 0.00
- 2.00
- 4.00
- 6.00
- 8.00
- 10.00

- e
- ab
- bc
Effects of **herbicide rates** on the marketable fruit yield in injured tomatoes

### Results

- **1/30 labeled rate**
- **1/300 labeled rate**

--- Growth stage of herbicide injury ---

- Replication (n) = 5
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### Effects of **herbicide rates** on the marketable fruit yield in injured tomatoes

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<th>2,4-D</th>
<th>Non-injured</th>
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--- Growth stage of herbicide injury ---

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

**Background** – **Methodology** – **Results** – **Summary**

**Results**

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<th>Herbicide</th>
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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?
Effects of **rescue treatments on herbicide injured tomato plants** from producing non-marketable fruits

- **Background**
- **Methodology**
- **Results**
- **Summary**

**Q 3**

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

**Graph**

- **Glyphosate**
- **2,4-D**
- **Non-injured control**

**Legend**

- **a**
- **b**

**Axis**

- **Wt. of deformed fruits/plant**
  - Kg

- **Growth stage of injury**
  - PRE-bloom
  - POST-bloom

**Notes**

- 1/100 labeled rate
Effects of **rescue treatments on herbicide injured tomato plants** 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
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

- Rescue Treatments
  - 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 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.

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

Treatments were NOT effective in rescuing glyphosate injured tomato plants from yield loss.
Tomato fruit deformation was generally reduced when injury was occurred in an advanced growth stage i.e., POST bloom.
Summary

- 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.
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.
Dr. John Fisher, Stoller USA

Acknowledgements
Acknowledgements

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

*Not in picture: Cami McAvoy*
Thank you...

SWFREC weed science team

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

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