Herbicide Injury of Pecan Trees

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Area Pecan Agent, Southeast District

UGA Extension
Georgia Agriculture

• Ranks #1: Blueberries, broiler chickens, peanuts, pecans, spring-season onions
• Ranks #2: Cotton, rye, various vegetables

TOP 10 COMMODITIES
1. Broilers
2. Cotton
3. Eggs
4. Peanuts
5. Timber
6. Beef
7. Greenhouse
8. Pecans
9. Dairy
10. Horses
Georgia Pecan Production

• Approx. 140,000 acres of mature orchards in production
• Approx. 30K – 35K acres of new orchards planted in last 5 to 7 years
• Avg orchard planting increasing in size and planting density
• Pecans share area with all row crops, hay/pasture fields, forest land and produce
Herbicide Drift

• Particle Drift
• Volatilization
• Root Uptake

• *Long-term injury risk is rated on 0 – 10 scale, where 0 = no risk of damage and 10 = potential tree death or long-term loss*
Auxin Herbicide Technology

2,4-D
1. Elist Duo (Glyphosate + 2,4-D)
2. 2,4-D Choline

Dicamba
1. Round Up Extend (Glyphosate + Dicamba)
2. Extendimax (Dicamba)
3. Engina (Dicamba)?
Visual Sensitivity Scale for Dicamba in GA

<table>
<thead>
<tr>
<th>Lower</th>
<th>Moderate</th>
<th>Severe</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broccoli</td>
<td>Cantaloupe</td>
<td>Cotton</td>
<td>Grapes*</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Cucumber</td>
<td>Pepper</td>
<td>Lima Bean</td>
</tr>
<tr>
<td>Kale</td>
<td>Peach</td>
<td>Tomato</td>
<td>Southern Pea</td>
</tr>
<tr>
<td>Mustard</td>
<td>Peanut</td>
<td>Watermelon</td>
<td>Snap Bean</td>
</tr>
<tr>
<td>Pecan</td>
<td>Squash</td>
<td></td>
<td>Soybean</td>
</tr>
<tr>
<td>Turnip</td>
<td></td>
<td></td>
<td>Sweet potato*</td>
</tr>
</tbody>
</table>

Herbicide Rate of Visually Detectable Injury

For relative comparison, tomato, squash, and watermelon response to Roundup would be in the “lower” category.

*Data from literature; all other data generated in 64 UGA field experiments.
Visual Sensitivity Scale For 2,4-D in GA

<table>
<thead>
<tr>
<th>Herbicide Rate of Visually Detectable Injury</th>
<th>Lower</th>
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</tr>
</thead>
<tbody>
<tr>
<td>&gt;1/75X</td>
<td>Broccoli Cabbage Kale Mustard Onions Turnip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/75-1/300X</td>
<td>Cantaloupe Canola Cucumber Peaches Peanut Pecan Squash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/300-1/800X</td>
<td>Pepper Tomato Watermelon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1/800X</td>
<td>Cotton Grapes* Sweet potato* Tobacco*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Data from literature; all other data generated in 64 UGA field experiments.
Symptoms of Herbicide Drift
Glyphosate

• Symptoms: Thin, strap-like leaves. (May resemble Zn deficiency)

• Injury: when chemical contacts foliage or bark of young trees

• Short-term: Deformed leaves, defoliation; subsequent growth returns

• Long-term: Repeat applications, kill limbs, tree death

• Long-term risk: 4
Glyphosate Injury Compared to Zn Deficiency
Paraquat / Glufosinate / Flumioxazin

- Symptoms: Yellow spots – necrosis
- Injury: Usually within 24-48 hrs.
- Old Tree: If large areas of leaf turn yellow, then brown and fall off. Same happens with flowers and nuts. Usually, tree refoliates with no long-term issues
- Young Tree: Paraquat contacting bark of < 3 year-old-tree can girdle and kill tree

Long-term risk: 2

Paraquat injury to pecan. Damaged spots turn yellow, then brown.
2,4-D / Dicamba

- Symptoms: Folding/Cupping → twisting/curling → chlorosis → dieback
- UGA Research 2013 – 2017
Auxin Injury

Older auxin injury of pecan

80% rate 2,4-D, Ponder Farm, Tifton

Arrested nut development from auxin herbicide
Simulated Single Drift Events of 2,4-D and Dicamba on Pecan Trees

Table 1
Severity of herbicide injury from 2,4-D and dicamba on pecan in July and Oct. 2013 following treatment in June 2013.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Application rate (% by vol)</th>
<th>July 2013 Herbicide injury severity (0–10 scale)*</th>
<th>Oct. 2013 Herbicide injury severity (0–10 scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicamba</td>
<td>1.0</td>
<td>5.8 ab*</td>
<td>10.0 a</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>4.0 b</td>
<td>4.3 b</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>0.3 c</td>
<td>5.3 b</td>
</tr>
<tr>
<td>2,4-D</td>
<td>1.0</td>
<td>6.7 a</td>
<td>9.3 a</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>3.7 b</td>
<td>5.3 b</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>1.3 c</td>
<td>0.0 c</td>
</tr>
<tr>
<td>Control</td>
<td>–</td>
<td>0.0 c</td>
<td>0.0 c</td>
</tr>
</tbody>
</table>

*Visual estimates of herbicide injury severity were obtained using a rating scale from 0 to 10 with 0 = no damage, 1–3 = minor foliar damage symptoms (10% to 30% of foliage with visible symptoms), 4–6 = severe foliar damage symptoms (>30% to 60% of foliage with visible symptoms and/or weak/stunted/branches /limbs), and 7–10 = (>60% to 100% foliage with visible symptoms and/or dead limbs/branches).

*Means in the same column with the same letter are not significantly different within year according to Duncan’s multiple range test (P ≤ 0.10).
Table 2.
Severity rating of herbicide injury from 2,4-D and dicamba on pecan in July 2014 following treatment in June 2013.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Application rate (% by vol)</th>
<th>Herbicide injury severity (0–10 scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicamba</td>
<td>1.0</td>
<td>8.0 a&lt;sup&gt;y&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>5.0 b</td>
</tr>
<tr>
<td></td>
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<td>3.3 bc</td>
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<td>Control</td>
<td>–</td>
<td>0.0 c</td>
</tr>
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Table 4. Mean pecan yields and percent kernel observed from 2,4-D and dicamba application during the year of application and in subsequent years.

<table>
<thead>
<tr>
<th>Yr of application</th>
<th>Herbicide</th>
<th>Application rate (% by vol)</th>
<th>2016 Yield (kg/tree)</th>
<th>2017 Yield (kg/tree)</th>
<th>2016 Kernel (%)</th>
<th>2017 Kernel (%)</th>
</tr>
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<tbody>
<tr>
<td>2013</td>
<td>Dicamba</td>
<td>1.0</td>
<td>25 a</td>
<td>24 a</td>
<td>57.4 a</td>
<td>57.1 cd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1</td>
<td>24 a</td>
<td>28 a</td>
<td>57.5 a</td>
<td>58.2 abc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>20 a</td>
<td>31 a</td>
<td>57.6 a</td>
<td>59.3 ab</td>
</tr>
<tr>
<td></td>
<td>2,4-D</td>
<td>1.0</td>
<td>21 a</td>
<td>25 a</td>
<td>56.9 a</td>
<td>57.8 c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1</td>
<td>24 a</td>
<td>24 a</td>
<td>60.3 a</td>
<td>57.3 c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>21 a</td>
<td>24 a</td>
<td>56.5 a</td>
<td>57.9 bc</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>-</td>
<td>14 a</td>
<td>24 a</td>
<td>54.9 a</td>
<td>59.5 a</td>
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<tr>
<td>2016</td>
<td>Dicamba</td>
<td>1.0</td>
<td>17 a</td>
<td>31 a</td>
<td>56.1 cd</td>
<td>52.3 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1</td>
<td>17 a</td>
<td>30 a</td>
<td>57.0 ab</td>
<td>53.1 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>23 a</td>
<td>29 a</td>
<td>56.4 bcd</td>
<td>51.9 a</td>
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<tr>
<td></td>
<td>2,4-D</td>
<td>1.0</td>
<td>20 a</td>
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<td>51.6 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>26 a</td>
<td>37 a</td>
<td>57.7 a</td>
<td>52.9 a</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>-</td>
<td>24 a</td>
<td>24 a</td>
<td>55.8 d</td>
<td>47.0 a</td>
</tr>
<tr>
<td>2017</td>
<td>Dicamba</td>
<td>1.0</td>
<td>-</td>
<td>23 a</td>
<td>-</td>
<td>49.4 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1</td>
<td>-</td>
<td>23 a</td>
<td>-</td>
<td>50.9 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>-</td>
<td>21 a</td>
<td>-</td>
<td>50.2 a</td>
</tr>
<tr>
<td></td>
<td>2,4-D</td>
<td>1.0</td>
<td>-</td>
<td>21 a</td>
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<td>50.1 a</td>
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<td>-</td>
<td>-</td>
<td>23 a</td>
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<td>50.6 a</td>
</tr>
</tbody>
</table>

1 kg = 2.2046 lb.

2 Means in the same column with the same letter are not significantly different within year according to Duncan’s multiple range test (P ≤ 0.10).
Auxin Herbicide Summary

- No difference in response to 2,4-D and Dicamba at similar rates.
- Damage at auxin rates ≥ 1% have potential to cause significant injury (deformed foliage, dead foliage, dead limbs / branches and arrested nut development).
- Yield was not negatively affected by any treatments, suggesting that pecan trees can compensate for the observed injury to still produce in a similar manner to untreated trees.
- 2017: percent kernel with the 1% rate of dicamba and all rates of 2,4-D was LOWER than that of the control from 2013 (59.5%, 57.1%) This is economically significant to growers.
- 2016: the 0.1% dicamba and 1.0% and 0.01% 2,4-D treatments had higher percent kernel than that of the control.
- High rates of dicamba resulted in abnormally small-sized nuts and reduced development on limbs receiving contact with the herbicide.
- Long-term risk: 8
Defoliants

• Ethphon

• Ethylene Effects: fruit ripening, chlorophyll loss, abortion of plant parts, stem shortening, leaf abscission (shedding)

• Symptoms: Leaf drop, leaf abscission occurs within a few days, ripeing of fruit – shuck split

• No Long-term Injury: Before September and after November.

• Long-term Injury: September, October

• Long-term risk: 5
Herbicide Update by Tree Roots

• Pre-emergent herbicides applied to pecans inside the herbicide strip

• Pre-emergent herbicides applied to adjacent row crops

• Herbicides used in forestry or pasture
Pre-emergent pecan herbicides

- Diruon
- Symptoms: Necrosis (yellowing, browning, scorching) between veins of leaves
- Injury: Trees normally recover; at heavy rates, may see limb dieback
- Example: On sandy soil, following heavy rainfall event a few days after application
- Long-term risk: 2
Pre-emergent herbicides in other crops

- Imazapic
- Symptoms: No visible external signs initially; however, fruits result in hollow “pops”
- Injury: Longterm injury depends on soil type and amount applied
- Example: Long residual may cause damage to appear again following year
- Can kill young trees
- Long-term risk: 5

Injury from Cadre results in ‘pops’
Herbicides used in Forestry

- Common herbicides: Triclopyr, imazapyr, hexazinone, picloram, sulfometuron, metsulfuron
- Symptoms: Trees do not leaf out in spring; leaves and buds bunched on branches
- Injury: Greater long-term risk
- Long-term risk: 9

*Injury from Chopper and triclopyr in Tatnall County, GA, 2019.*
Herbicides used in forestry
Herbicides used in forestry
<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Symptoms</th>
<th>Long-term injury risk</th>
</tr>
</thead>
</table>
| Glyphosate                | Thin, strap-like leaves  
Dieback at high rates  
Repeated exposure can result in limb/tree death | 4                     |
| Paraquat                  | Exposed areas turn yellow initially, then brown  
Dieback at high rates  
Repeated exposure can result in limb/tree death | 2                     |
| Glufosinate               | Same as paraquat above                                                   | 2                     |
| Flumioxazene              | Same as paraquat above                                                   | 2                     |
| Auxins (Dicamba, 2,4-D)   | Folding/cupping of leaflets  
Twisting, curling of leaflets  
Chlorosis  
Dieback  
Limbs/trees with complete coverage at full rates may die | 8                     |
| Cotton Defoliants (Ethylene) | Leaf drop  
Depending on date of occurrence, quality or return crop may be affected  
Defoliation after November 1 rarely causes significant damage | 5                     |
| Diuron                    | Necrosis between leaf veins  
Some limb dieback in severe cases                                          | 2                     |
| Imazapic                  | Root uptake results in unfulfilled kernels  
Planting young trees into fields to which imazapic has been applied  
can result in repeated dieback or death of trees until herbicide has leached out (Usually requires one year; longer on heavy clay soils) | 5                     |
| Forestry/Pasture Herbicides | Symptoms vary  
Can include dieback and delayed tree death depending on chemistry used and degree/nature of exposure | 9                     |

*a Long-term injury risk is rated on a 0-10 scale, where 0 = no risk of damage and 10 = potential tree death or long-term production loss.

*b Forestry or pasture herbicides may include triclopyr, imazapry, hexazinone, picloram, sulfometuron methyl, and metsulfuron methyl among others.
Conclusion

• Symptoms of injury

• Level of injury dependent on:
  1. Herbicide
  2. Rate
  3. Wind speed / direction
  4. Timing
  5. Coverage

• Document symptoms of injury ASAP. Tissue sampling through state department.
Acknowledgements

- **Wells, L.M.** 2019 Herbicide Injury of Pecan Trees
- **Wells, L.M., Prostko, E.P., Carter, W.O.,** 2019 Simulated Single Drift Events of 2,4-D and Dicamba on Pecan Trees
Questions?