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Case Study: Characterizing the Response of young Glyphosate Susceptible and Glyphosate-Resistant *Amaranthus palmeri* (Palmer Amaranth) After Being Sprayed with a Ten Percent Acetic Acid Solution to Control Growth

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Abstract:

In this case study, we investigate the responses of Glyphosate-Susceptible and Glyphosate-Resistant *Amaranthus palmeri* to an organic 10% acetic acid herbicide solution instead of the standard 20 % acetic acid solution. We show that although both forms respond differently to glyphosate-based herbicides, both will respond the same way to organic-based herbicides that include acetic acid. Using a lesser concentration may be better for the environment since there will be less buildup over time. Using less is also less costly to the farmers' pocket.

Keywords: Adaxial surface, abaxial surface, glyphosate susceptible, glyphosate resistant, herbicide

Hypothesis: We hypothesized that although both forms respond differently to glyphosate-based herbicides, both will respond the same way to organic-based herbicides that include acetic acid. In this study, a 10% acetic acid solution was used versus the standard 20% acetic acid solution found in the organic agricultural vinegar herbicide. Previous studies suggest that at a very young age the 10% solution is strong enough to control growth. **This is important** because using a lesser concentration may be better for the environment since there will be less buildup over time. Using less is also less costly to the farmers' pocket.

- The history of glyphosate-based herbicides
  - Glyphosate pesticides were thought to do no harm. This led to overuse. The overuse of glyphosate herbicides has led to glyphosate resistance in some plants. *Amaranthus palmeri* is one of them.

- The health dangers of glyphosate-based herbicides
  - Glyphosate-based herbicides has been found to be harmful to ***teeth erosion*** , has been linked to potentially developing ***cancer*** , and irritation to **mucous cavities**.

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Methods

- **Pre-experiment prep**
  - Prepared 12 pots for Resistant and Susceptible, each
  - Placed seeds an inch below soil

- **Planting Conditions**
  - 12 hours of light, 12 hours of dark
  - Watered when necessary

- **Experimentation**
  - Treated when leaves were apparent at 0 and 2 hours with 10% acetic acid solution
  - Viewed leaves using JEOL Scanning Electron Microscope.

Results and Discussion

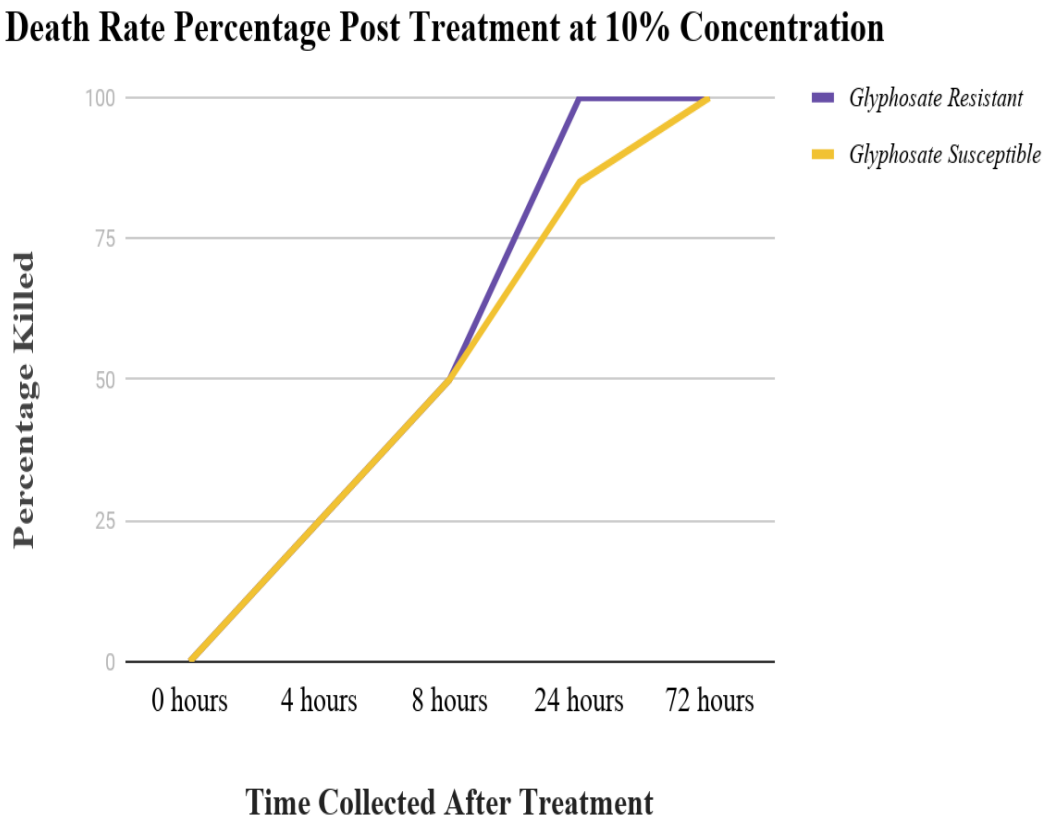

Figure 1. The graph shows the number of seedlings that die when treated with acetic acid a few days after germination. 100%of the Glyphosate Resistant (GR) *Amaranthus palmeri* seedlings die after treatment with the 10% acetic acid. 85% of Glyphosate Susceptible (GS) *Amaranthus palmeri* seedlings die after treatment with the 10% acetic acid.

t-test for significance: 0.4575021241

- No statistical difference between the death rate percentage of the glyphosate resistant and the glyphosate susceptible.

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Micrograph taken with the JEOL Scanning Electron Microscope.

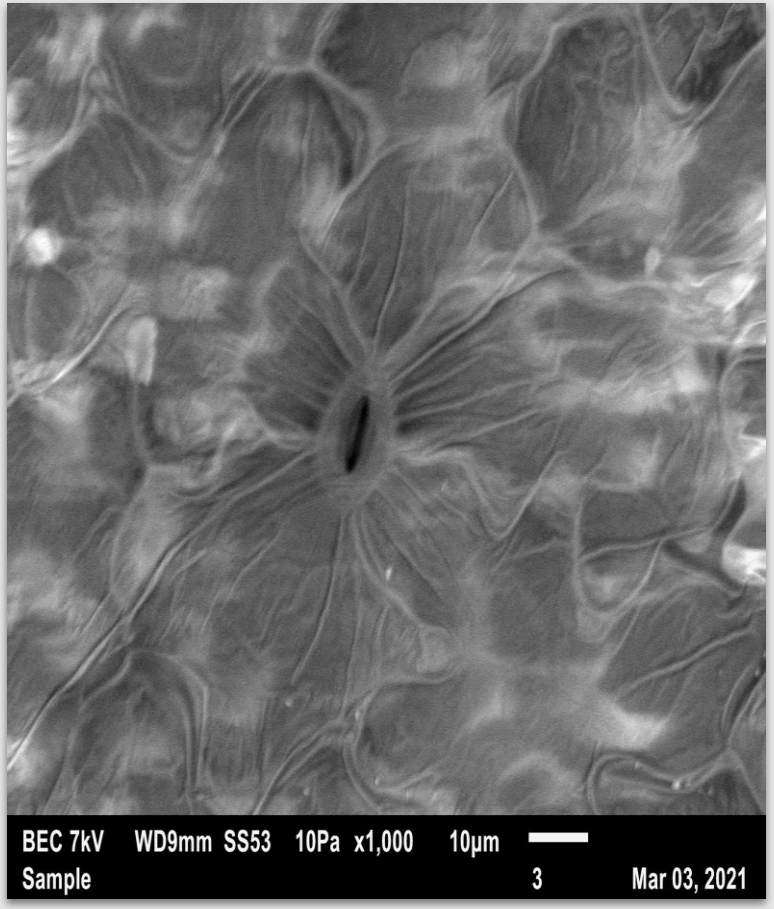
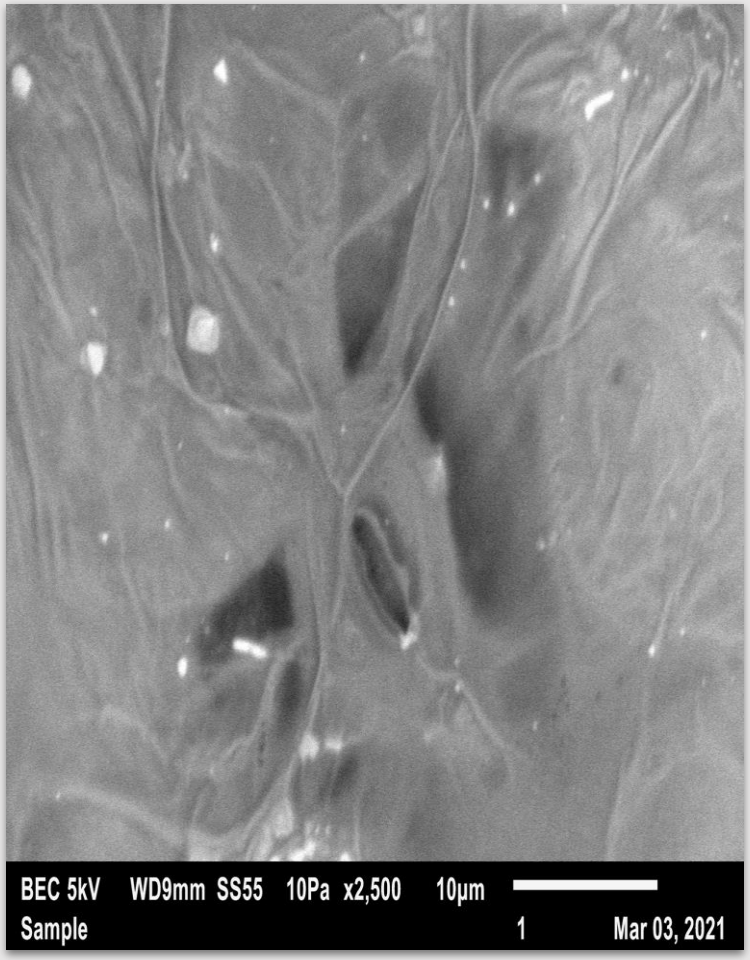


Figure 2. GS adaxial surface, 10% treatment @ 0 hours. Stomata are showing stress. The stomata start to close soon after treatment. These stomata are on the upper surface and are in direct contact with any herbicide that is sprayed.

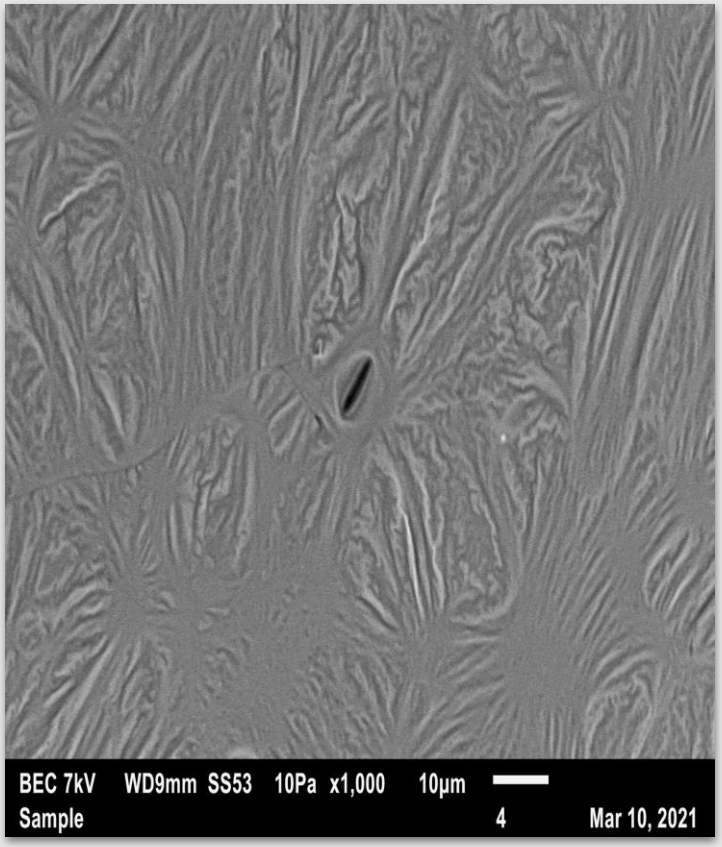
Micrograph taken with the JEOL Scanning Electron Microscope.

Figure 3. GR adaxial surface, 10% treatment @ 0 hours. Stomata are showing stress. The stomata start to close soon after treatment. These stomata are on the upper surface and are in direct contact with any herbicide that is sprayed.



Micrographs taken with the JEOL Scanning Electron Microscope.

Figure 4. GR adaxial surface, control. No stress. This micrographs was taken before the leaves were sprayed/treated. The stomata as they appear normal. There is no stress.



Micrograph taken with the JEOL Scanning Electron Microscope.

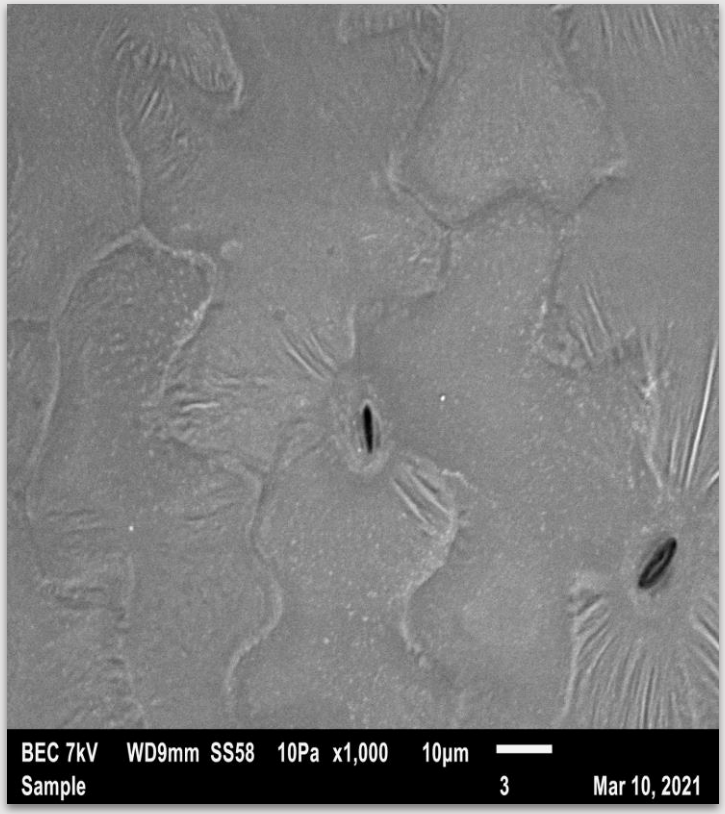
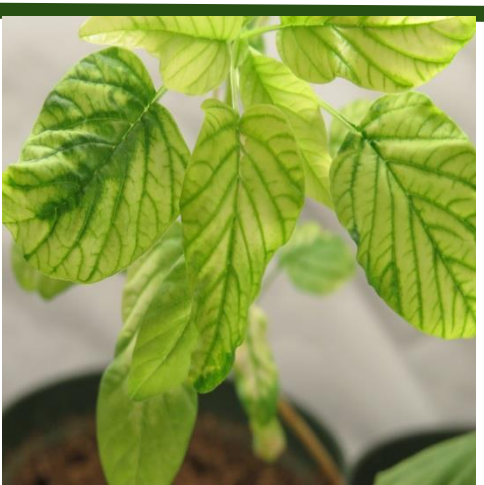


Figure 5. GS adaxial surface, control. No stress. This micrograph was taken before the leaves were sprayed/treated. The stomata as they appear normal. There is no stress.

Discussion



In the field, *Amaranthus palmeri* grow rapidly, up to 2-3 inches a day. The growing season typically occurs between March and September and temperatures may be between 5℃ and 35℃. Under similar conditions in our laboratory, the Susceptible and Resistant strains were able to grow up to 14 inches in height. In an effort to determine optimal growth conditions, various soil types were tested. The bar graph shows that germination and initial growth of the plant were best with the Carolina Seed Starter. By utilizing this information we have established the best growing conditions and we will continue to use this information moving forward in our trials.

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Acknowledgements

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