Herbicide Resistance in Waterhemp

Problem – waterhemp is becoming resistant to everything

- Waterhemp is dioecious species, with separate male and female plants. Cross pollination results in tremendous variability within populations, which is evident from differences in plant color and other characteristics.
- This genetic variability results in a relatively high frequency of mechanisms that can impart resistance to herbicides, enabling waterhemp to develop resistance more rapidly than most weeds
- Waterhemp can produce over 1,000,000 seeds per plant
- The abundant seed from a few resistant plants can rapidly shift the response of a population to an herbicide, increasing the risk of failure the next time that herbicide is used.

Seedheads illustrating inherent genetic variability within a waterhemp population

Illinois multiple-resistant population surviving 2,4-D

Which herbicides is waterhemp resistant to - Ohio

- Site 2 (ALS) - all populations
- Site 9 (glyphosate) - most populations, some in eastern OH still sensitive
- Site 14 (PPO) – 30 to 50% of populations in areas with longest waterhemp history, lower elsewhere
- Multiple resistance - populations resistant to site 14 are resistant to sites 2 and 9 also
- Only two POST options for multiple-resistant populations – dicamba (Xtend) or glufosinate (LL)

Which herbicides is waterhemp resistant to – Midwest

- In areas with long history of waterhemp, populations have developed multiple resistance to herbicide from up to six sites of action
- In 2018, a Missouri population was determined to have six-way resistance:
  - Site 2 (ALS), Site 4 (auxin inhibitor – 2,4-D), Site 5 (PSII – atrazine), Site 9 (glyphosate), Site 14 (PPO), Site 27 (HPPD)
- Populations with 5- or 6-way resistance have several resistance mechanisms occurring concurrently:
  - Target site mutation – three separate mutations that impart resistance to sites 2, 9, and 14
  - Enhanced herbicide metabolism – mutations that impart resistance to sites 4, 5 and 27

Ohio waterhemp populations will continue to develop multiple resistance with these same characteristics without appropriate management to slow this phenomenon.

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Steps to reduce selection for resistance and preserve herbicide utility

1. **Know whether population is already resistant to glyphosate and site 14 herbicides**
   - have population tested for presence of resistance
   - University of Illinois, $50 per field

2. **Use a combination of PRE and POST herbicide applications**
   - use PRE herbicides rated 8 or 9 in the "Weed Control Guide for Ohio, Indiana, and Illinois"
   - combinations or premix of several PRE herbicides can extend the duration of residual control

3. **Apply early POST when weeds are small and add residual herbicide**
   - reduces or prevents the need for a second POST application
   - Residual products containing one of the following:
     - acetochlor – Warrant, Warrant Ultra
     - metolachlor – Dual II Magnum, Prefix, others
     - pyroxasulfone – Zidua, Anthem Maxx

4. **Diversity traits and herbicides**
   - Use different herbicide sites of action between corn and soybeans
   - Avoid repeated use of the same POST herbicide(s) throughout the rotation

5. **POST applications - use two sites of action that are still effective on waterhemp**

   Possible examples:
   - glufosinate + fomesafen (LL soybeans)
   - mesotrione + atrazine (corn)
   - glufosinate + atrazine (LL corn)

6. **Integrate cover crops to reduce the population and selection for resistance**
   - up to 50% reduction in waterhemp population
   - use cereal rye, wheat, or barley as a base
   - terminate cover close to time of planting, or after, to extend effect into the season

7. **Scout after the final POST herbicide and into late season – remove waterhemp plants**
   - **it is essential to prevent seed from plants that may have survived herbicide treatment**
   - **herbicide-resistant plants cannot be allowed to go to seed**
   - **it is not possible to prevent resistance by management of herbicides alone**

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HERBICIDE-RESISTANCE MANAGEMENT

No pigweed left behind
Go Rogue! Stop the seed

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