Wisconsin Crop Manager

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Vegetable Crop Update 7/5/14

The 12th issue of the Vegetable Crop Update is now available. This issue contains late blight updates, blitecast and P-Days for late blight and early blight management, cucurbit downy mildew updates, bacterial disease in vegetable crops, and the Hancock ARS Potato Field Day agenda. Click here to view this update.

Plant Disease Diagnostic Clinic (PDDC) Update

Brian Hudelson, Ann Joy, Joyce Wu, Tom Hinsenkamp, and Catherine Wendt, Plant Disease Diagnostics Clinic

The PDDC receives samples of many plant and soil samples from around the state. The following diseases/disorders have been identified at the PDDC from June 28, 2014 through July 4, 2014.

Plant/Sample Type, Disease/Disorder, Pathogen, County

FIELD CROPS,

Corn, Anthracnose, *Colletotrichum graminicola*, Lafayette

Corn, Eyespot, *Kabatiella zeae*, Lafayette

Soybean, Target Spot, *Corynespora cassiicola*, Marathon

FRUIT CROPS,

Apple, Winter Injury, None, Eau Claire, Jackson

Strawberry, Root Rot, *Pythium* sp., Brown

Strawberry, Winter Injury, None, Brown

VEGETABLES,

Pepper, Bacterial Spot, *Xanthomonas campestris* pv. *vesicatoria*, Dane

Tomato, Bacterial Spot, *Xanthomonas* sp., Dane

Tomato, Septoria Leaf Spot, None, Portage

SPECIALTY CROPS,

Hop, Root/Crown Rot, *Rhizoctonia* sp., *Fusarium* sp., Dane

For additional information on plant diseases and their control, visit the PDDC website at pddc.wisc.edu.

Data suggest glyphosate resistance of two Wisconsin water hemp populations

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Common waterhemp (*Amaranthus rudis*) is a dioecious, small seeded, broadleaf weed species native to North America, specifically common in the Midwest region of the United States. This weed species has become increasingly problematic for corn and soybean growers due to its prolific growth characteristics and highly competitive ability. Among its fellow pigweed (Amaranthaceae) family members, common waterhemp is second only to Palmer amaranth (*Amaranthus palmeri*) in growth rate and size reaching heights of nearly ten feet [4]. Furthermore, common waterhemp can produce over one million seeds per female plant under ideal growing conditions [8]. This intensifies the likelihood and speed that herbicide-resistant biotypes can increase in a population and transfer from one location to another through seed dispersal. If common waterhemp is left unmanaged in corn and soybean, growers can see yield reductions of 74 and 56%, respectively[2,7].

Control of common waterhemp has become increasingly difficult due to its ability of evolving resistance to numerous herbicide sites-of-action. To date, this weed species has been identified as resistant to six different sites-of-action, including an ALS-resistant biotype located in Wisconsin. Several common waterhemp populations have also evolved resistance to multiple herbicide sites-of-action, further complicating control methods[1,5]. Glyphosate-resistant common waterhemp biotypes have already been confirmed in fifteen other states including nearby Illinois, Indiana, Iowa, and Minnesota[3]. Our current research reported here suggests we will add Wisconsin to this list as data from our first greenhouse experiment indicates at least two Wisconsin common waterhemp populations are resistant to glyphosate out of 14 populations examined.

The two weed populations examined were collected from crop production fields in Eau Claire and Pierce counties. They were identified through the *Late-Season Weed Escape Survey in Wisconsin Corn and Soybean Fields* conducted in 2012 and 2013 by former graduate research assistant, Ross A. Recker. Plants that were collected in the field were likely to have survived a postemergence glyphosate application based on in-field observations of herbicide symptomology, plant locations, personal communication with growers, and other additional data documented during the survey. To confirm glyphosate resistance, seed was collected from 30 mature plants in the field, progeny were grown in the UW-Madison greenhouse, and 10 plants per glyphosate rate were sprayed with Roundup PowerMAX® plus ammonium sulfate at 17 lbs. per 100 gallons of spray solution when they reached three inches tall. Glyphosate rates used were 0, 0.22 (5.5), 0.43 (11), 0.87 (22), 1.74 (44), and 3.48 (88) kg ae ha^{-1} (fl. oz. ac^{-1}). Plant dry biomass data were collected 28 days after application (DAA). Comparisons between our putative resistant and susceptible biotypes were determined by the effective glyphosate dose needed to reduce plant dry biomass 50% (ED_{50}).

The ten Pierce County plants sprayed at the 0.87 kg ae ha^{-1} (22 fl. oz. ac^{-1}) rate all survived and grew to an average of three times their spray date height (Figure 1). At the 1.74 kg ae ha^{-1} (44 fl. oz. ac^{-1}) rate, nine of ten plants survived and grew to an average of two times their spray date height (Figure 2). The ED_{50} of glyphosate for the Pierce County and susceptible populations was 2.23 and 0.18 kg ae ha^{-1}, respectively (Figure 3). This indicates the Pierce County population has a 12.5-fold level of resistance.

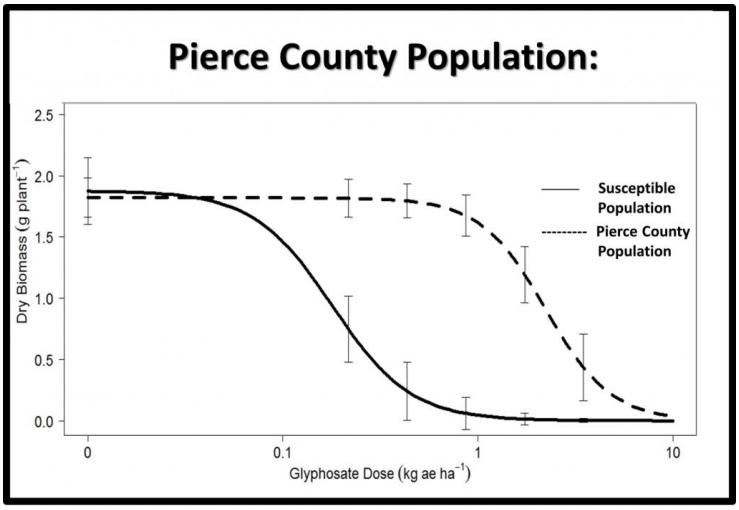

Figure 3. Glyphosate dose response models for two Wisconsin common waterhemp (*Amaranthus rudis*) populations. The Pierce County and susceptible populations were analyzed using the three parameter log logistic Dose Response Model in R.

Figure 4. Comparison of ten Eau Claire County common waterhemp plants (on right) versus susceptible plants (on left). Glyphosate applied at a 1x rate (22 fl. oz. ac^{-1}). Pictures taken at 22 days after application.

Figure 1. Comparison of ten Pierce County common waterhemp plants (on right) versus susceptible plants (on left). Glyphosate applied at a 1x rate (22 fl. oz. ac^{-1}). Pictures taken at 22 days after application.

Figure 2. Comparison of ten Pierce County common waterhemp plants (on right) versus susceptible plants (on left). Glyphosate applied at a 2x rate (44 fl. oz. ac^{-1}). Pictures taken at 22 days after application.

The ten Eau Claire County plants sprayed at the 0.87 kg ae ha-1 (22 fl. oz. ac-1) rate all survived and grew to an average of five times greater than their spray date height (Figure 4). All ten plants also survived the 1.74 kg ae ha-1 (44 fl. oz. ac-1) rate and quadrupled in size from their spray date height (Figure 5). The Eau Claire County population was not able to be analyzed using the log logistic Dose Response Model in R due to inadequate high rates of glyphosate to reduce dry biomass at 28 DAA. Therefore, linear glyphosate response models were established for the Eau Claire County and susceptible populations and analyzed using ANOVA tables which indicated significant differences at all glyphosate rates (Figure 6) (Table 1).

Figure 5. Comparison of ten Eau Claire County common waterhemp plants (on right) versus susceptible plants (on left). Glyphosate applied at a 2x rate (44 fl. oz. ac^{-1}). Pictures taken at 22 days after application.

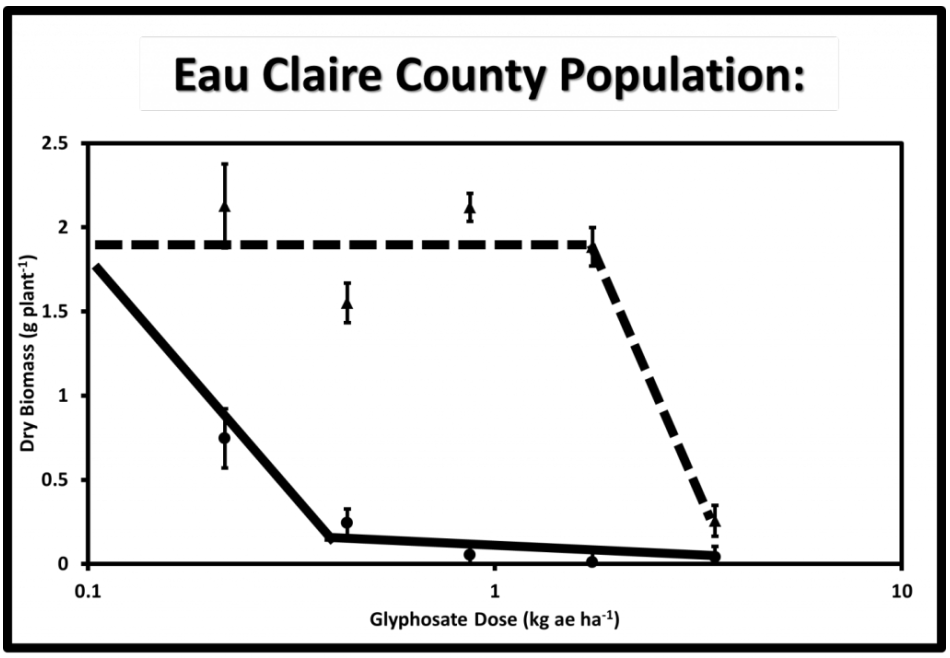

Figure 6. Glyphosate linear response models for two Wisconsin common waterhemp (*Amaranthus rudis*) populations.

Table 1. P-values comparing the dry biomass 28 DAA between the Eau Claire County and susceptible common waterhemp populations at each glyphosate rate.

Dose (kg ae ha^{-1})	p-value	Dose (kg ae ha^{-1})	p-value
0	NS	0.87	2.03e-15
0.22	2.86e-05	1.74	2.69e-12
0.43	1.72e-09	3.48	0.0297

There are several key components to an effective control strategy for glyphosate-resistant common waterhemp. The use of alternative herbicide sites-of-action, such as PPO inhibitors, and tank-mixing multiple herbicide sites-of-action will improve glyphosate-resistant weed control. An early planting date will allow crops to gain a head-start and out compete common waterhemp due to its late emergence timing6. Herbicide applications should be made at the correct timing when weeds are small and actively growing to ensure the greatest efficacy of the herbicide based on label recommendations. Furthermore, special care should be taken to clean tillage and harvest equipment thoroughly as they can quickly spread weed seed among fields. The focus of these best management practices is to diversify weed control measures, reduce weed seed additions to the soil seedbank, and utilize control measures in the most effective method possible.

This research experiment will be repeated to officially confirm glyphosate resistance in these common waterhemp populations. For updates on Wisconsin weeds please visit our Wisconsin Crop Weed Science website at http://wcws.cals.wisc.edu/. Further information on controlling common waterhemp or other glyphosate-resistant weeds can be found at: http://takeactiononweeds.com/. Finally, if you believe you may be facing glyphosate-resistant weeds in your fields, contact your local county extension agent and/or Dr. Vince Davis at vmdavis@wisc.edu or (608) 262-1392.

References:

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