UNIVERSITY OF NEBRASKA-LINCOLN

CropWatch

Nebraska crop production & pest management information

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Glyphosate-Resistant Common Waterhemp Confirmed in Nebraska

University of Nebraska-Lincoln greenhouse studies have confirmed glyphosate resistance in common waterhemp from six Nebraska counties: Antelope, Dodge, Lancaster, Pawnee, Seward, and Washington. Waterhemp, a summer annual broadleaf weed, was already one of the most problematic weeds in corn and soybean production, but glyphosate resistance adds a new wrinkle to its control. Glyphosate-resistant common waterhemp has been confirmed in 12 states over the last eight years.

Last year, we had several phone calls from growers about control failure of common waterhemp despite the repeated application of glyphosate (***Figure 1***). In fall 2012 common waterhemp seeds were collected from fields in selected counties (Antelope, Dodge, Lancaster, Pawnee, Seward, and Washington) and glyphosate dose response studies were conducted in a UNL greenhouse. Glyphosate (Touchdown HiTech) was applied at several rates (0.25x to 16x the recommended rate of 24 fl oz/acre) to confirm level of resistance in common waterhemp populations.

Dose response analysis was performed to estimate the ED50 (effective dose required to control 50% population) and ED90 (effective dose required to control 90% population) values for each common waterhemp population (***Figure 2***). Comparisons of dose response curves clearly showed glyphosate resistance at a minimum of six times the normal rate (shown as 6x) at the ED90 value (***Table 1)***. For example, 90% control of glyphosate-susceptible common waterhemp was achieved with a labeled rate of glyphosate (24 fl oz/acre); while the population from Antelope County needed a minimum of 147

Figure 1. Glyphosate-resistant common waterhemp in a Nebraska soybean field.

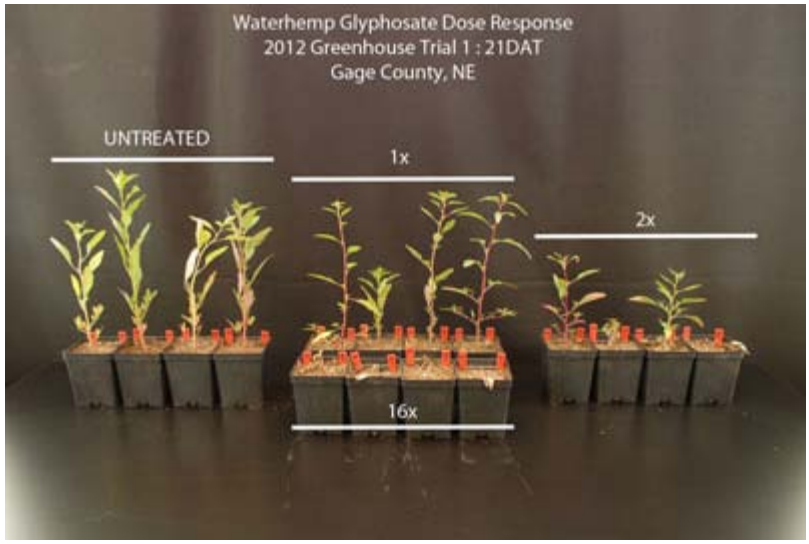

Figure 2. Greenhouse trial on effect of glyphosate

application to common waterhemp plants from Gage County.

fl oz/acre or about six times the recommended rate. In some cases, as much as 599 fl oz/acre (25x) of glyphosate was required to achieve 90% control (***Table 1***). Overall results suggested that the level of resistance was 6x to 25x in samples collected from Antelope, Dodge, Lancaster, Pawnee, Seward, and Washington County. Regardless of whether glyphosate-resistant common waterhemp is present in a given county in Nebraska, there is a good chance it will evolve resistance at some point based upon what has happened in other states.

Table 1: Values of ED50 and ED90 and the level of resistance for common waterhemp populations based on a visual control estimates at 21 days after treatment in a dose response study with glyphosate (Touchdown HiTech) in greenhouse[a].

County	ED50	Resistance level[b] at ED50	ED90	Resistance level[b] at ED90
	fl oz/acre			
Antelope	18	0x	147	6x
Dodge	29	1.2x	350	14x
Lancaster	42	1.75x	471	19x
Pawenee	30	1.25x	238	10x
Seward	41	1.75x	599	25x
Washington	32	1.33x	440	18x

[a]Abbreviations: ED50, effective dose required to control 50% population; ED90, effective dose required to control 90% population.

[b]Resistance level at the ED50 and ED90 was calculated by dividing the ED50 and ED90 value of resistant population by recommended rate of glyphosate (1x use rate= 24 fl oz/acre of Touchdown HiTech).

A Multi-Threat Survivor Warrants . . .

The confirmation of glyphosate-resistance in Nebraska waterhemp is further evidence of an ever-evolving weed spectrum, and further proof that using only glyphosate for weed control in corn and soybean is not a sustainable approach to weed management. In the face of herbicide selection pressure, common waterhemp has repeatedly proven to be an ecological survivor. In Nebraska, common waterhemp populations resistant to ALS (Pursuit), triazine (Atrazine), growth regulator (2,4-D), HPPD (Callisto), and now glyphosate (Roundup) have been confirmed. The common denominator in all instances where resistance evolved was near continuous use of the same or similar herbicide management approach with little or no diversity in herbicide mode of action used for many years.

Glyphosate-resistant weeds continue to be an increasing problem in Nebraska. Glyphosate-resistant marestail (horseweed), kochia, and giant ragweed previously were confirmed in Nebraska and have become very problematic in certain areas of the state. The confirmation of glyphosate-resistant common waterhemp will be an additional challenge to Nebraska growers. Resistance to any herbicide mode of action is troubling, but multiple-resistance (resistance in a weed population to more than one herbicide mode of action) is of particular concern. Common waterhemp populations with resistance to multiple herbicides have been confirmed in Iowa and Illinois. This resistance stacking is alarming and limits herbicide options for managing common waterhemp.

A Multi-Pronged Attack

The extended germination window of common waterhemp (May to August), increase in no-tillage crop production, and ability of waterhemp to evolve resistance to herbicide(s) have contributed to success of this weed species. Furthermore, it is a dioecious species, which means male and female flowers occur on separate plants and reproduction requires pollen movement. The resistant gene can be spread long distances via pollen and outcrossing.

A member of the pigweed family, common waterhemp is a competitive weed and the evolution of glyphosate resistance means it will require an effective integrated weed management program to achieve acceptable control. Continuing to rely only on glyphosate will only speed up the evolution of glyphosate-resistant weeds and diminish the effectiveness of glyphosate-based crops and weed control programs. Control of glyphosate-resistant waterhemp will require an integrated approach including:

- residual herbicides with different modes of action followed by labeled post-emergence herbicides other than glyphosate throughout the cropping system,
- crop rotation, and
- a combination of tillage systems.

When combined, these efforts will help slow the evolution of new glyphosate-resistant weed populations in Nebraska.

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