Waterhemp Wins Again

Waterhemp caused significant economic losses for many Iowa growers during the mid-1990's. With the introduction of new technologies, primarily Roundup Ready soybeans, most farmers have minimized the economic impact of waterhemp in corn and soybean production. However, the selection of herbicide resistant waterhemp biotypes (Table 1) threatens to return us to an era where uncontrolled waterhemp causes significant yield losses across the Cornbelt.

Table 1. Confirmed cases of resistance in waterhemp (*Amaranthus tuberculatus*)

Herbicide family	Herbicide Group	Commercial products
triazine	5	atrazine, simazine
ALS	2	Pursuit, Classic
PPO	14	Cobra, Reflex, Blazer
glyphosate	9	Roundup
HPPD	27	Callisto, Laudis, Impact

This article will discuss factors that resulted in the appearance of waterhemp resistant to the HPPD inhibitors in two fields in Iowa and Illinois in 2009. These are the first reports of resistance to this class of herbicide.

The two fields where HPPD resistance evolved are approximately 140 miles apart, but they have several similarities in management practices. The IL field was maintained in continuous corn since at least 2003, whereas the IA field was a corn-soybean rotation. However, both fields were used for seed corn production during the period of HPPD use. The specific herbicide programs of the fields are provided in Tables 2 and 3.

A cursory evaluation of the weed management programs for the two fields suggests the growers took a reasonable approach to managing waterhemp. Preemergence herbicides were used in all years, a benefit since these herbicides have activity on waterhemp. In most years, atrazine was tank-mixed with Callisto, a combination with synergistic activity on susceptible weeds. The herbicide programs resulted in waterhemp being exposed to three herbicide groups (5, 15, and 27) each year of corn production. In soybean, two herbicide groups (4 and 9) with activity on waterhemp were used. Exposing weeds to multiple herbicide groups is the key to resistance management, so what went wrong in these fields?

Table 2. Herbicide program in McLean county, IL.

Year	Crop	PRE	POST
2003	Corn	Dual + simazine	Callisto + atrazine
2004	Corn	Dual + simazine	Callisto + atrazine
2005	Corn	Dual + simazine	Callisto + atrazine
2006	Corn	Dual + simazine	Impact + atrazine
2007	Corn	Dual + simazine	Impact + atrazine
2008	Corn	Dual + simazine	Impact fb Callisto
2009	Corn	Dual + simazine	Impact fb Callisto

Table 3. Herbicide program in Henry county, IA.

Year	Crop	PRE	POST
2001	Corn	Dual	Callisto
2002	Soy	Prowl	glyphosate
2003	Corn	Dual	Accent+ atrazine fb Callisto + atrazine
2004	Soy	Prowl	glyphosate
2005	Corn	Dual	Accent + Callisto + atrazine
2006	Soy	Prowl	glyphosate
2007	Corn	Dual	Callisto + atrazine fb Impact + atrazine
2008	Soy	Prowl	glyphosate
2009	Corn	Dual	Callisto + atrazine

Several factors likely contributed to evolution of HPPD resistance in these two fields. The first is the production of seed corn. Corn inbreds are much less competitive with weeds than hybrid corn due to the smaller canopy of inbreds, thus seed corn production relies much more on herbicides than field corn production. A second factor is that the waterhemp in both fields was already resistant to atrazine, thus the inclusion of group 5 herbicides provided no benefit in terms of managing waterhemp. Thirdly, although the rates of the preemergence herbicides were not described in the publications, it is likely that below average rates of both preemergence herbicides (Dual II Magnum and Prowl) were used due to the lower tolerance of corn inbreds to herbicides than field corn. Finally,

at the first sign of waterhemp control failures the HPPD inhibitors remained the primary tool to manage waterhemp. Sequential applications of HPPD products were used in IL in 2008 and 2009, and in 2007 in Iowa, likely due to waterhemp surviving the initial treatment.

What should be learned from the evolution of HPPD resistance in these two fields? Over the last decade weed scientists have focused primarily on risks associated with our heavy reliance on glyphosate, but these two cases should remind us that all herbicides are at risk of resistance.

Resistance was confirmed after only five years of HPPD use in IA and seven years in IL, but the need for 'rescue' treatments in 2007 in IA and 2008 IL suggests the problem was present sooner. This shows how rapidly resistant biotypes can be selected from a weed population.

In today's production systems, herbicides and the crop canopy are the primary tools used to manage weeds. Cultural practices that enhance the crop's competitiveness should be adopted in order to help suppress weed populations. To protect the value of herbicides, weed management programs must be implemented that include multiple herbicide groups having significant activity on the important weeds found in the field. There is natural reluctance to this approach because 'who wants to pay to kill a weed twice?'. These two case studies show that managing herbicide resistance is not as simple as counting the number of herbicide groups used, but that the contribution of each herbicide in controlling individual weeds must be considered.

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References

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