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University of Kentucky
College of Agriculture,
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Multi-SOA Pre-emergence Herbicides for Palmer Amaranth and Waterhemp Control

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Waterhemp control in soybean using a single site of action (left) and multi-site of action (right) preemergence herbicide four weeks after application.

Waterhemp and Palmer amaranth are among the most troublesome and hard to control weeds in soybean fields in Kentucky. Both species have spread across the state over the past ten to fifteen years. Resistance to ALS-inhibiting herbicides [Group 2] and glyphosate [Group 9] is widespread in both species, while PPO-resistance [Group 14] is continually spreading especially in waterhemp.

The presence of herbicide resistance in both species has limited effective postemergence options to either glufosinate [Group 10], 2,4-D [Group 4], or dicamba [Group 4] depending on the soybean herbicide resistance trait package planted. While all three of these herbicides are currently effective, farmers must preserve these options and avoid selection of herbicide resistant biotypes. Mitigation of further herbicide resistance selection can be achieved by using multiple herbicide site of action groups, specifically in the application of preemergence residual herbicides.

Research conducted at the University of Kentucky has shown that herbicide programs that contain a multiple site of action (Multi-SOA) soil residual, provide greater season-long control of waterhemp and Palmer amaranth than programs with a single site of action (SOA) soil residual or programs that completely lack a soil residual. The use of robust preplant or at planting residual herbicides with two to three effective sites of action, not only provide increased control of waterhemp and Palmer amaranth during the current season but reduce the likelihood of selection of herbicide resistant plants. Effective residual sites of action include Group 14 (sulfentrazone, flumioxazin, and fomesafen), Group 15 (S-metolachlor, pyroxasulfone, and acetochlor), and Group 5 (metribuzin).

Herbicide manufacturers have developed several herbicide premix formulations targeted at controlling waterhemp and Palmer amaranth that contain multiple effective sites of action, thus farmers have options to choose from. Table 1 provides a list of the available premixed residual herbicides that contain at least two effective sites of action. Several of the premix products also contain an ALS-inhibiting herbicide, which is provided in the footnote of the table. The ALS-inhibiting herbicides are not considered effective for control of waterhemp and Palmer amaranth due to herbicide resistance, although they will contribute to suppression and control of other weed species that are present in the field.

Each premixed product is presented with a high and low use rate for medium soils with 1.5 percent to 3 percent organic matter (consult herbicide labels for use rates on coarse and fine soils types), which is appropriate for most agricultural soils in Kentucky. A breakdown of the rate of each individual component is presented for each premix product rate. For example, 25 fl oz of Authority Elite or BroadAxe XC provides 4.4 fl oz Spartan (0.14 lb sulfentrazone) and 1.3 pt Dual II Magnum (1.23 lb S-metolachlor). This table allows one to compare and contrast premix products that contain similar components and the rates of each component available in each premix product.

Table 1. Premixed residual herbicides with multiple sites of action. Individual site of action components are listed for each premix product with the amount of a representative trade name product (in bold) and the active ingredient (italicized) in that product listed in lb ai/A.

Premix Product	Product Rate	Site of Action Groups													
		# 14						# 15						# 5	
		Spartan (fl oz/A)	*sulfentrazone (lb ai/A)*	**Valor EZ (fl oz/A)**	*flumioxazin (lb ai/A)*	**Flexstar (pt/A)**	*fomesafen (lb ai/A)*	**Dual II Magnum (pt/A)**	*S-metolachlor (lb ai/A)*	**Zidua SC (fl oz/A)**	*pyroxasulfone (lb ai/A)*	**Warrant (qt/A)**	*acetochlor (lb ai/A)*	**Tricor 4F (fl oz/A)**	*metribuzin (lb ai/A)*
Authority Elite / BroadAxe XC	25 fl oz/A	**4.4**	*0.14*					**1.3**	*1.23*						
	32 fl oz/A	**5.6**	*0.18*					**1.6**	*1.58*						
Authority Edge	5.5 fl oz/A	**3.8**	*0.12*							**2**	*0.07*				
	8.8 fl oz/A	**6**	*0.19*							**3.2**	*0.10*				
Authority Supreme	6 fl oz/A	**3.1**	*0.10*							**3**	*0.09*				
	9.8 fl oz/A	**5.1**	*0.16*							**4.9**	*0.16*				
Authority MTZ	14 oz/A	**5**	*0.16*											**7.6**	*0.24*
	18 oz/A	**6.5**	*0.2*											**9.7**	*0.3*
Antares Complete	2.5 pt/a	**4**	*0.13*					**1.5**	*1.47*					**10**	*0.31*
	3 pt/a	**4.8**	*0.15*					**1.8**	*1.76*					**12**	*0.38*
Tribal	2.8 pt/A	**3.9**	*0.12*					**1.2**	*1.16*					**6.9**	*0.22*
	3.2 pt/A	**4.5**	*0.14*					**1.4**	*1.32*					**8**	*0.25*
Fierce EZ	6 fl oz/A			**2**	*0.06*					**2.4**	*0.08*				
	9 fl oz/A			**3**	*0.09*					**3.7**	*0.12*				
Fierce XLT[1]	3.75 oz/A			**1.8**	*0.06*					**2.2**	*0.07*				
	4.5 oz/A			**2.2**	*0.07*					**2.7**	*0.08*				
Fierce MTZ / Kyber	1 pt/A			**2**	*0.06*					**2.5**	*0.08*			**6**	*0.19*
	1.25 pt/A			**2.5**	*0.08*					**3.1**	*0.10*			**7.5**	*0.23*
Trivence[2]	6 oz/A			**1.5**	*0.05*									**5.4**	*0.17*
	9 oz/A			**2.3**	*0.07*									**8**	*0.25*
Dimetric Charge	15 fl oz/A			**2.5**	*0.08*									**11.3**	*0.35*
	18 fl oz/A			**3**	*0.09*									**13.5**	*0.42*
Panther Pro[3]	12 fl oz/A			**2**	*0.06*									**9**	*0.28*
	15 fl oz/A			**2.5**	*0.08*									**11.3**	*0.35*
Prefix	2.25 pt/A					**1.1**	*0.27*	**1.3**	*1.22*						
	2.75 pt/A					**1.4**	*0.33*	**1.6**	*1.49*						
Warrant Ultra	48 fl oz/A					**1**	*0.24*					**1.4**	*1.1*		
	65 fl oz/A					**1.4**	*0.32*					**1.9**	*1.4*		
Intimidator	2.8 pt/A					**1**	*0.23*	**1.2**	*1.19*					**8.4**	*0.26*
	4.48 pt/A					**1.6**	*0.38*	**2.0**	*1.9*					**13.4**	*0.42*
Boundary	2.1 pt/A							**1.4**	*1.38*					**10.5**	*0.33*
	3 pt/A							**2.1**	*1.97*					**15**	*0.47*
Matador-S[4]	3 pt/A							**1.3**	*1.27*					**9**	*0.28*
		# 14						# 15						# 5	
		Site of Action Groups													

[1] Also includes 1 to 1.2 oz/A Classic (0.016 to 0.019 lb/A chlorimuron)
[2] Also includes 0.9 to 1.4 oz/A Classic (0.015 to0.022 lb/A chlorimuron)
[3] Also includes 3.4 to 4.2 fl oz/A Pursuit (0.053 to 0.066 lb ae/A imazethapyr)
[4] Also includes 4.1 fl oz/A Pursuit (0.064 lb ae/A imazethapyr)

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