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Multiple-resistant Palmer amaranth control with soil-applied herbicides in Michigan

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Field studies were conducted in 2011, 2012 and 2013 to determine effective soil-applied herbicides for control of glyphosate/ALS-resistant Palmer amaranth in Michigan. All three years, flumioxazin (90 g ha^{-1}) was amongst the best treatments for Palmer amaranth control. Control 28 DAT was 85, 64, and 99% in 2011, 2012, and 2013, respectively. A lower rate of flumioxazin (70 g ha^{-1}) was also applied in 2012 and 2013 and Palmer amaranth control was similar to the higher flumioxazin rate. Flumioxazin combinations, especially with pyroxasulfone also provided good Palmer amaranth control. Sulfentrazone provided similar Palmer amaranth control to flumioxazin in two of the three years. Differences between years, may be attributed to a lower rate of sulfentrazone (210 g ha^{-1}) applied in 2011 compared with 2012 and 2013 (280 g ha^{-1}) or possible differences in precipitation. To determine if these differences were due to precipitation, a subsequent greenhouse experiment was conducted evaluating the effect of simulated rainfall on control of glyphosate/ALS-resistant Palmer amaranth with flumioxazin and sulfentrazone. Twenty-five seeds of glyphosate/ALS-resistant Palmer amaranth were planted in pots containing a Capac loam soil. Immediately after planting, flumioxazin at 22, 45, and 90 g ha^{-1} and sulfentrazone at 70, 140, and 280 g ha^{-1} were applied to the soil surface, representing 0.25, 0.5 and 1X of the field use rates for the two herbicides. Two hours after herbicide application, pots were watered to simulate rainfall events of 0, 0.16, 0.32, 0.64, 1.3, 2.5, and 5 cm ha^{-1}. All pots were sub-irrigated to maintain a water level of 20% w/w. Palmer amaranth emergence was greatest in the absence of simulated rainfall for both herbicides with emergence counts ranging from 31 to 85% of the untreated control, depending on herbicide rate. A minimum of 0.32 cm of simulated rainfall was needed for the greatest reductions in Palmer amaranth emergence. However, at the lower sulfentrazone rates (0.25 and 0.5X) rainfall amounts of 5 cm resulted in greater Palmer amaranth emergence, suggesting that sulfentrazone may be leached below the Palmer amaranth emergence zone. This response was not observed at the highest sulfentrazone rate (280 g ha^{-1}) or with any rate of flumioxazin. This suggests that rainfall amounts and sulfentrazone rate may have a major effect on Palmer amaranth control and may help explain differences between flumioxazin and sulfentrazone in our field studies. For early-season control of glyphosate/ALS-resistant Palmer amaranth flumioxazin should be applied at a minimum of 70 g ha^{-1} and sulfentrazone should be applied at a minimum of 280 g ha^{-1} to mitigate the effects of rainfall. However, even with this early-season control, subsequent postemergence herbicide applications will still be necessary to provide season-long control of glyphosate/ALS-resistant Palmer amaranth in soybean.

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