ARE GEORGIA FARMERS LOSING THE ABILITY TO MANAGE PALMER AMARANTH WITH PPO-INHIBITING HERBICIDES APPLIED PRE AND POST?

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Abstract

In 2017, a population of Palmer amaranth was identified by the University of Georgia Extension Service as exhibiting a reduced sensitivity to PPO-inhibiting herbicides. These herbicides are heavily relied on in Georgia following the spread of glyphosate-resistant Palmer amaranth and are a critical component of numerous cropping systems in the state, including cotton, peanut, soybean, and vegetable crops. This situation was unique, as both the sample of the problematic population and the known sensitive population (included for comparisons) were collected from the same farm (200m apart), from areas exposed to different management practices and herbicide selection pressure. Initial field studies indicated that the problematic population was no longer being controlled by PPO-inhibiting herbicides; therefore, dose-response assessments were conducted from 2017-2020 to quantify the sensitivity of the population to PPO herbicides applied preemergence (PRE) and postemergence (POST), and calculate resistance levels within this problematic population.

In PRE dose-response experiments, flumioxazin (1X field use rate=210 g ai ha^{-1}) and fomesafen (1X field use rate=57 g ai ha^{-1}) were applied to greenhouse flats filled with field soil at rates ranging from a 1/27X to 3X field use rates for the problematic population, and a 1/279X to 1X for the known susceptible population. Prior to applying herbicides, 135 Palmer amaranth seed from either the problematic population or the susceptible population were planted in each flat. All herbicides were activated with overhead irrigation, after which subirrigation was utilized for the remainder of the study. Data collected included visual control, biweekly emergence counts, plant heights, and fresh-weight biomass.

For all response variables, flumioxazin applied PRE was less effective on the problematic population compared to the susceptible Palmer amaranth population. Visual control, plant mortality, and biomass reductions were 100% in the susceptible population at a 1/9X field use rate, compared to 90%, 97%, and 97% in the problematic population at a 3X field use rate. Calculations for i50 values for each aforementioned response variable indicated R:S ratios of 32, 22, and 18. Similar to flumioxazin, PRE fomesafen was less effective on the problematic population compared to the susceptible population. At a 3X field use rate in the problematic population, control, mortality, and biomass reductions were 91%, compared to complete control of the susceptible population at a 1X field use rate, and total mortality and biomass reduction at a 1/3X field use rate. Calculations of i50 values for control, mortality, and biomass reduction following PRE fomesafen applications indicated R:S ratios of 3, 5, and 3, respectively.

For POST dose-response studies, Palmer amaranth from both populations were grown to 8-10 cm tall and treated with fomesafen (1X=420 g ai ha^{-1}), lactofen (1X=219 g ai ha^{-1}), or acifluorfen (1X=420 g ai ha^{-1}). Additionally, rates ranging from 1/4X to 10X field use rates were included for the problematic population, and 1/16X to 2X field use rates were included for the susceptible population. Data collected was similar to PRE dose-response studies. POST applications of all three herbicides effectively controlled the susceptible population 85-99% and reduced biomass 93-96% at a 1X field use rate. In contrast, Palmer amaranth control was only 34-48%, with a maximum biomass reduction of 47% at the same rate in the problematic population.

Results suggest that PRE PPO applications to the problematic Georgia Palmer amaranth population appears to be unique, while POST applications show a similar response to PPO-resistant populations in other states. Future research will continue classifying resistance levels within this population.