

Introduction

The presence of Palmer amaranth (*Amaranthus palmeri*) [Figure 1] and waterhemp (*Amaranthus tuberculatus* [syn *rudis*]) [Figure 2] was limited except for a few localized areas of west Kentucky prior to the year 2000. Between 2005 and 2010 isolated problems with control of these *Amaranthus* species with glyphosate in grain crops began to develop and were reported in counties in west Kentucky adjacent to major rivers including the Mississippi, Ohio, Cumberland, and Green Rivers. Several county extension agents reported that infestations of these pigweeds often occurred in fields within the floodplains. It was thought that excessive flooding caused a rapid spread of both *Amaranthus* species on bottomlands, but weed seed was also spread on some upland areas with equipment, especially combines and other equipment used at harvest.



Figure 1. Palmer Amaranth, Bourbon County, KY 2014



Figure 2. Waterhemp, Adair County, KY 2014

Materials and Methods

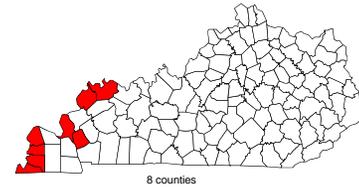
- Began surveying county extension agents during 2010 for the presence of Palmer amaranth and waterhemp.
- Confirmed reports of Palmer and waterhemp were documented each year from 2011 through 2015.
- In 2012 leaf samples were collected from Palmer amaranth and waterhemp plants in 17 counties to analyze for resistance to glyphosate and ALS-type herbicides.
- Follow up surveys in fall 2015 were used to assess the spread of Palmer amaranth and waterhemp across Kentucky and the acres impacted.
- Leaf samples collected in 2015 from a field with a mixed population of both species to determine potential resistance to glyphosate and PPO-inhibitor herbicides.

Results and Discussion

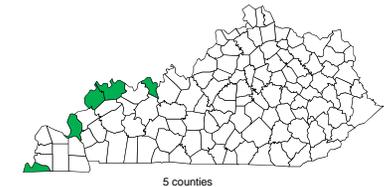
- In 2010 Palmer Amaranth was reported in eight west Kentucky counties and waterhemp in five counties.
- Based on surveys during 2011 Palmer amaranth and waterhemp were reported in 17 and 11 counties in west KY, respectively, and populations were not effectively controlled by glyphosate (data not shown).
- Leaf samples of Palmer amaranth and waterhemp collected in 2012 indicated that most of the plants which had spread across the state were introduced from seed sources that were already genetically resistant to glyphosate; there was evidence indicating ALS-resistance was present in some populations of both species.
- By 2013 Palmer amaranth had spread eastward across the state and was present in 24 counties, including 2 observations near central Kentucky; Waterhemp was still mostly observed in 10 counties that bordered the lower Ohio River, but was also present in four counties up river-between Louisville and Cincinnati.
- A survey of county extension agents in 2015 confirmed glyphosate-resistant Palmer amaranth is present in 56 counties that extend from west Kentucky eastward to counties within the central parts of Kentucky including three counties northeast of Lexington.
- Glyphosate-resistant waterhemp is not as widespread compared with Palmer amaranth but now occupies 34 counties that include counties that border the lower and upper Ohio River valley and a few isolated counties throughout the state.
- DNA analysis of leaf tissue indicate PPO-resistant Palmer amaranth and waterhemp are also present in Kentucky [Figure 3].
- A primary source of introduction of both species is from equipment used in the production and harvest of crops. Another known source of Palmer amaranth seed is through cotton seed hulls fed to cattle and the subsequent manure spread onto cropland. Other sources include contamination in cover crop seed, as well as, potentially birds and other animals.

Surveys

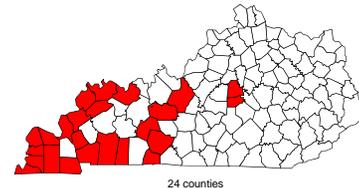
Palmer Amaranth Distribution in Kentucky - 2010



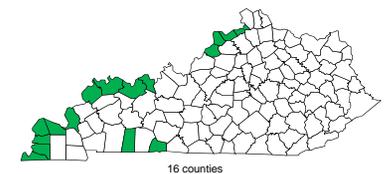
Waterhemp Distribution in Kentucky - 2010



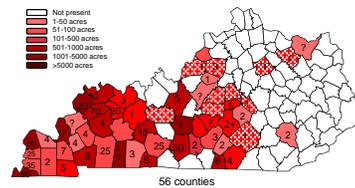
Palmer Amaranth Distribution in Kentucky - 2013



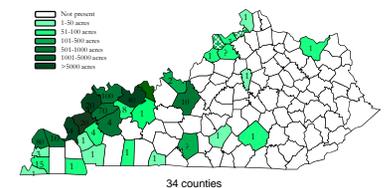
Waterhemp Distribution in Kentucky - 2013



Palmer Amaranth Distribution in Kentucky
2015 ANR Agent Survey



Waterhemp Distribution in Kentucky
2015 ANR Agent Survey



PPO Resistance Analysis



Figure 3. A mixed population of Palmer and Waterhemp, Ballard County, KY 2015

DNA TEST RESULTS - 2015

- Palmer Amaranth**
 - 3 of 10 plants tested positive for PPO Resistance
 - Waterhemp**
 - 10 of 10 plants tested positive for PPO Resistance
- [Pat Tranel lab, University of Illinois]

Summary

- In Kentucky, Palmer amaranth is currently present in 56 counties and waterhemp in 34 counties as non-native species, most populations consist of glyphosate-resistant biotypes.
- Palmer amaranth estimated to be present in approximately 60,000 acres; Waterhemp present in approximately 36,000 acres.
- Sources of introductions have included: 1) overflow or rivers and flood plains, 2) importing of harvest equipment and transportation of crops, 3) cotton seed hulls fed to livestock; 3) cover crop seed; and 4) potentially birds and other animals.
- Recently discovered biotypes with PPO and glyphosate resistance in both species are new threats to grain crop production within Kentucky.

Acknowledgements

- Financial support provided by United Soybean Board and Kentucky Soybean Promotion Board.
- The authors express their appreciation to Dr. Pat Tranel (University of Illinois) for assistance with genetic plant analysis; Marcy Rucker, Nick Fleitz and the cooperation of county ANR agents, crop consultants, and other agriculturalists who assisted with surveys or provided information relative to the observance of these *Amaranthus* species in Kentucky.