Palmer Amaranth (*Amaranthus palmeri*) Management Issues in California.

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Palmer amaranth (*Amaranthus palmeri*) has been ranked as the most troublesome weed in the U.S. by the Weed Science Society of America, based on a national survey. Widespread glyphosate-escapes of Palmer amaranth were reported in various annual and perennial cropping systems beginning in 2012 in the San Joaquin Valley (SJV) of California. In 2013/14, 25 field collected populations from the SJV were screened for resistance in greenhouse studies. The plants were tested for glyphosate resistance by making an application of a label rate of glyphosate (22 fl oz/ac of glyphosate) + 2% v/v solution of ammonium sulfate with a spray volume of 20 gallons/ac (GPA) on 5- to 8-leaf stage Palmer amaranth plants grown in pots. Plant mortality was rated 21 days after treatment (DAT) and compared to a confirmed glyphosate-resistant (GR) population from New Mexico. An untreated control treatment was also included. Glyphosate resistance was not observed in the SJV population in these initial studies.

Further experiments were conducted to compare the mortality of one of the SJV population to label rates of glyphosate, glufosinate, paraquat dichloride, saflufenacil, rimsulfuron, and a tank-mix of glyphosate + saflufenacil applied at the 4- to 6-, 8- to 10-, and 12- to 16-leaf stages (Rios et al, 2016). Complete control of Palmer amaranth was obtained with all treatments when applied at the 4- to 6-leaf stage but control was reduced with glyphosate and glufosinate at larger growth stages (Figure 1). The other treatments provided excellent control at all growth stages tested.

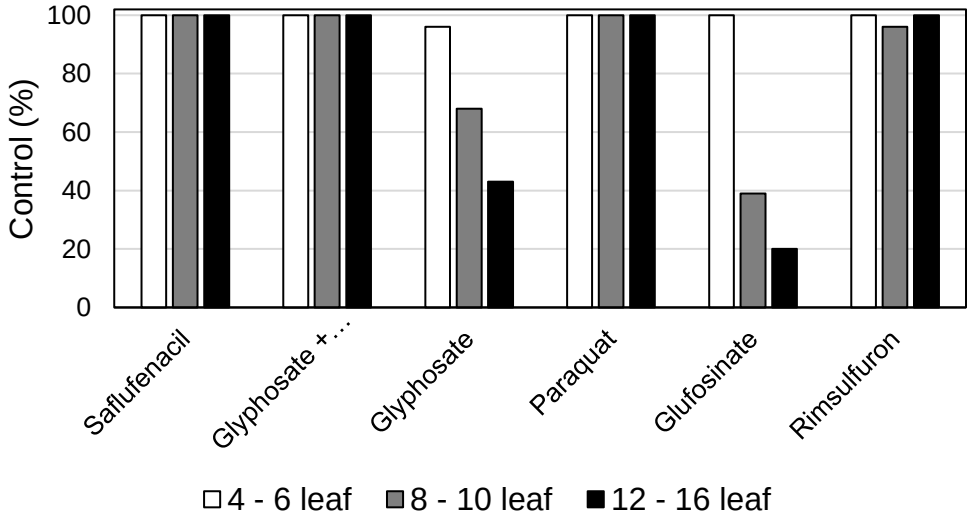

Figure 1. Mortality (% control) of Palmer amaranth plants treated with various herbicides at the 4- to 6-, 8- to 10-, and 12- to 16- leaf growth stages.

Tank-mix combinations (Table 1) of saflufenacil + glyphosate, saflufenacil + glufosinate, saflufenacil + dicamba, rimsulfuron + glyphosate, tembotrione + glyphosate, flumioxazin + pyroxasulfone + glyphosate, flumioxazin + pyroxasulfone + glyphosate, dicamba + paraquat dichloride, and glyphosate + glufosinate were also tested on 8- to 10-leaf stage Palmer amaranth plants and all the combinations provided excellent control (Rios et al. 2016).

Table 1. Mortality of Palmer amaranth plants 28 days after treatment at the 8- to 10-leaf stage with different herbicides.

Treatment[a]	Rate/acre	Plant mortality
		%
Saflufenacil + Glyphosate	1 oz + 22 fl oz	100
Saflufenacil + Glufosinate	1 oz + 29 fl oz	100
Saflufenacil + Dicamba	1 oz + 12 fl oz	100
Rimsulfuron + Glyphosate	4 oz + 22 fl oz	100
Tembotrione + Glyphosate	3 fl oz + 22 fl oz	100
(Flumioxazin + Pyroxasulfone) + Glyphosate	3 oz + 22 fl oz	100
(Flumioxazin + Pyroxasulfone) + Glufosinate	3 oz + 22 fl oz	100
(Flumioxazin + Pyroxasulfone) + Dicamba	3 oz + 12 fl oz	100
Dicamba + Paraquat	12 fl oz + 32 fl oz	100
Glufosinate + Glyphosate	20 fl oz + 22 fl oz	100

Glyphosate resistance screenings were continued on additional populations of Palmer amaranth collected from various locations in the SJV. In the process, in 2015, Palmer amaranth plants were collected from a Roundup Ready corn field in the Hilmar area of the SJV and grown to maturity in a greenhouse. Seeds produced from these plants were collected. In summer 2016, plants produced from these seeds were grown and tested for glyphosate resistance by comparing to a confirmed GR population from Tennessee and a glyphosate-susceptible (GS) population from Fresno, CA. Plants at the 4- to 6-leaf stage were sprayed with glyphosate at 0, 11, 22, 44, 88, and 176 fl oz/ac at a spray volume of 20 GPA with CO_2 backpack sprayer. Plants were periodically evaluated for mortality up to 28 DAT. At 28 DAT, the plants were clipped at the soil surface and the aboveground biomass was put in paper bags, dried in a forced-air oven at 140°F for 72 hours and dry weights were recorded. Treatments were replicated six times for each population and the experiment was repeated. About 60% of both the GR population from TN and the suspected GR population from CA survived up to the 176 fl oz/ac treatment; whereas none of the GS plants survived any of the treatments greater than 11 fl oz/ac (Figure 2). However, the biomass of the suspected-resistant plants from CA and GR plants from TN was reduced by 50% at 22 fl oz/ac compared to the control treatment. Based on mortality the suspected-resistant plants from CA showed about 8-fold resistance to glyphosate. This is the first confirmed case of GR Palmer amaranth in California.

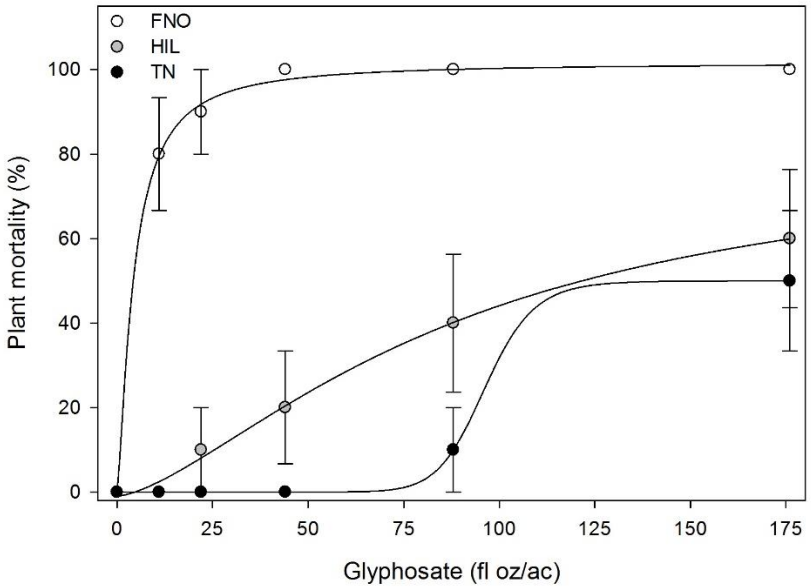

Figure 2. Mortality (% control) of Palmer amaranth plants from Fresno (FNO) and Hilmar (HIL), CA and a confirmed GR population from Tennessee (TN) treated with various rates of glyphosate at the 4- to 6-leaf growth stages.

Therefore, GR populations of Palmer amaranth exist currently in the SJV. If growers suspect that they still have GS populations of Palmer amaranth in their fields and desire to control them with glyphosate- or glufosinate-alone then applications should be made by the 6-leaf stage. If control with glyphosate at this growth stage is not satisfactory and glyphosate resistance is suspected, then other herbicides, or tank-mix combinations of herbicides, or other weed control methods should be used for immediate removal of these populations and prevention of seed set. Nevertheless, an integrated weed management strategy has to be adopted for successful control of Palmer amaranth to prevent it from being more problematic than it already is.

References:

Rios, S., S. D. Wright, G. Banuelos, and A. Shrestha. 2016. Tolerance of *Amaranthus palmeri* populations from California to postemergence herbicides at various growth stages. Crop Prot. 87:6-12.