

Competitive effects of glyphosate-resistant and -susceptible Palmer amaranth plants with grapevines during vineyard establishment

ABSTRACT: A study was conducted in 2020 and 2021 to assess the difference in the competitive ability of glyphosate-resistant (GR) and -susceptible (GS) Palmer amaranth with young grapevines in a vineyard in Fresno, CA. Young Grenache 1A on Freedom Uber vines was transplanted on May 12 and March 19, 2020 and 2021, respectively in vine rows spaced 11 ft and 6 ft apart within a row. Treatments included grape alone, grape + one GR palmer, grape + one GS palmer, GR Palmer alone, and GS palmer alone. Each treatment was replicated five times and arranged in a randomized complete block design. The weed seedlings were transplanted 6 in close to the vines. The plants were allowed to grow till August 27 and July 19, in 2020 and 2021, respectively and then harvested. Mainstem length of the grapevine at harvest was recorded and the leaves and stems were separated, dried in a forced-air over at 60°C for 96 hours and the weights were recorded. Aboveground dry weight of the palmer amaranth plants was also recorded. Data were subjected to ANOVA and means were separated by Fisher's LSD test when significant at a 0.05 level of significance. There were no interactions between year and treatment for any of the variables, therefore the data for the two years was combined. In comparison to grape-alone, the mainstem length and total grape biomass was reduced by 30% and 43%, respectively by the GR plants but the GS palmer amaranth had no effect. The GS plants did not reduce the mainstem length or the biomass of the grapevines. Although the GR plants were more competitive, surprisingly it had similar biomass as the GS plants. Therefore, this study showed that the GR palmer amaranth plants were more competitive than the GS plants with young grapevines and showed no fitness penalty despite being glyphosate resistance. The mechanism for which may need to be studied.

INTRODUCTION: Palmer amaranth is ranked as one of the worst weeds in US agriculture. Some populations of this species have evolved resistance to several herbicides including glyphosate. GR populations of Palmer amaranth have also been documented in California. In recent years, Palmer amaranth populations are also being observed in vineyards (Fig. 1) where glyphosate is commonly used. However, it is not known if these are GR or GS types. Furthermore, it is not known if these two types are different in their competitive ability in vineyards, especially with newly established vines.

OBJECTIVE: To determine the competitive effect of GR and GS palmer amaranth with young grapevines and to compare the biomass of GR and GS plants.



Fig. 1. A young palmer amaranth plant (left) and populations (right) in a vineyard in Kerman, CA

METHODOLOGY: A study was conducted in a drip-irrigated vineyard at the Fresno State campus in 2020 and 2021. Young Grenache 1A on Freedom Uber vines was transplanted on May 12 and March 19, 2020 and 2021, respectively in vine rows spaced 11 ft and 6 ft apart within a row. Seeds of previously confirmed GR and GS Palmer amaranth plants were seeded, and when they reached the 2-3 leaf stage the seedlings were transplanted into the vineyard on May 19 and March 24, 2020 and 2021, respectively. Treatments included grape alone, grape + one GR palmer, grape + one GS palmer, GR palmer alone, and GS palmer alone. Each treatment was replicated five times and arranged in a randomized complete block design. The weed seedlings were transplanted 6 in close to the vines (Fig. 2). No additional fertilizers were added to the field. The plants were allowed to grow till August 27 and July 19, in 2020 and 2021, respectively and then harvested (Fig. 3). Mainstem length of the grapevine at harvest was recorded and the leaves and stems were separated, dried in a forced-air over at 60°C for 96 hours and the weights were recorded. Aboveground dry weight of the palmer amaranth plants was also recorded. The length of the mainstem of the grape plants was recorded and the leaves were separated from the stems. The stems weight and leaves were taken after drying them in a forced-air over at 60°C for 96 hours. Similarly, each palmer amaranth plant was also harvested, and the dry weight of the aboveground parts was recorded. Data on the mainstem length and dry weights were subjected to ANOVA and means were separated by Fisher's LSD test when significant at $\alpha = 0.05$.



Fig. 2. Palmer amaranth seedling transplanted next to a newly-planted grapevine



Fig. 3. Palmer amaranth and grapevines being harvested

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RESULTS:

Grapevine mainstem length: The GR Palmer amaranth plants reduced the mainstem length of the grapevine by approximately 30% but the GS plants had no effect (Fig. 5).

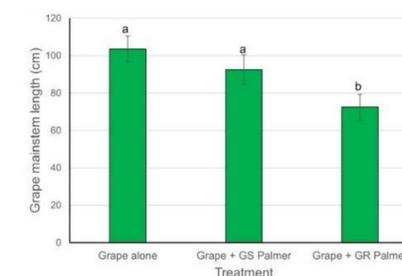


Fig. 5. Mainstem length of grapevines grown alone or with a GR or GS Palmer amaranth plant. Bars with the same letters are not significantly different at 0.05.

Grapevine stem and leaf biomass: The GR Palmer amaranth plants were very competitive (Fig. 6) and reduced the stem and leaf biomass of the grapevine by approximately 43% but the GS plants had no effect (Fig. 7).



Fig. 6. GR Palmer plant competing with a grapevine.

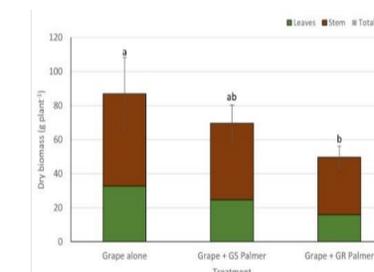


Fig. 7. Stem and leaf biomass of grapevines grown alone or with a GR or GS Palmer amaranth plant. Bars with the same letters are not significantly different at 0.05.

Palmer amaranth aboveground biomass: The GR and GS Palmer amaranth plants had similar aboveground dry biomass at harvest (Fig. 8). The grapevine did not affect the biomass of either GR or GS Palmer plants.

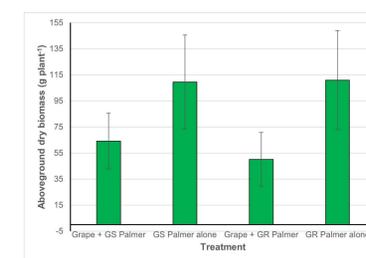


Fig. 8. Dry biomass of GR and GS Palmer amaranth in the various treatments.

CONCLUSION: This study showed that the GR palmer amaranth plants were more competitive than the GS plants with young grapevines and showed no fitness penalty despite being glyphosate resistance. The mechanism for which may need to be studied.