Competitive Effects of Glyphosate-Resistant and Susceptible Horseweed with Young Grapevines and Established Vineyards

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Horseweed *(Conyza canadensis)* is an annual weed in the Asteraceae family that has recently became a major pest in San Joaquin Valley vineyards. A glyphosate-resistant (GR) biotype of horseweed was confirmed in California in 2005, from the banks along an irrigation canal in the central San Joaquin Valley. Studies have shown that the GR biotype flowers earlier and accumulates more biomass than the glyphosate-susceptible (GS) biotype of horseweed. This disparity in phenology and growth led us to hypothesize that the GR biotype may be more competitive than the GS biotype. To evaluate the competitive effects of both GR & GS biotypes of horseweed on grapevine, we conducted two experiments in 2006 and 2007. The goal of the first experiment was to compare the respective competitive abilities of GR and GS horseweed biotypes on one-year old grapevine in a greenhouse setting. Among the response variables measured were grapevine shoot length, dry vegetative biomass, chlorophyll levels, leaf number and leaf area. The goal of the second experiment was to examine the effects of increasing density of GS horseweed on grapevine growth, yield, and fruit quality in an established vineyard. Grape yield and time to harvest were measured. Soluble sugars, titratable acidity and the number of clean clusters per vine were also measured as indicators of fruit quality. Results from the greenhouse experiment showed that young grapevines were significantly affected by competition from either horseweed biotype. Both the GS & GR horseweed reduced grape aboveground dry mass significantly, as well as decreased leaf number, canopy leaf area, and chlorophyll levels in grapevines. However, contrary to our hypothesis, the two biotypes did not differ in their ability to suppress grapevine growth. Both biotypes compete equally with grapevine. Results from the density experiment showed that increasing horseweed densities did not affect grape yield, quality, or the time required to harvest the grapes. There was, however, a negative correlation between weed dry mass and pruning weights which suggests that high densities of annual weeds may reduce vegetative growth of established vines.

Biofuels and Invasive Species

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In response to growing energy demands and climate change awareness, alternative energy sources are being sought. Biomass-derived energy from dedicated biofuel crops is under active research by many nations with exotic rhizomatous perennial grasses as the leading candidates. To be economically viable, biofuel crops are being selected/breed/engineered that are highly efficient (e.g., water, nutrients), tolerate poor growing conditions (e.g., drought, saline and infertile soils), possess few resident pests, and produce highly competitive monospecific stands. These desired agronomic traits, however, typify much of our invasive flora, and pose a potential threat of some biofuel crops becoming invasive pests. To test the potential invasiveness of leading biofuel candidate crops, including switchgrass, giant reed, and miscanthus, we used the standard Weed Risk Assessment protocol to qualify their risk potential under various assumptions. In addition, we are conducting ecological studies of fitness responses to various environmental and disturbance scenarios, which will provide data in climate-matching models to predict the potential invasiveness of biofuel species in a variety of ecosystems. Breeding and genetic engineering for enhanced environmental tolerance (e.g., drought tolerance), increased harvestable biomass production (e.g., lower root-to-shoot ratio), and enhanced energy conversion through fermentation (e.g., lower lignin content) may have unexpected ecological consequences outside the agronomic framework. For example, using the WRA protocol, switchgrass was found to have a high invasive potential (‘reject’) in California, unless sterility was introduced (‘accept’). The potential societal benefits of a biologically-based energy supply are great, but the introduction and development of biofuel crops should be conducted to minimize the risk of these proposed feedstock species escaping cultivation and causing economic or environmental damage.