

Paraquat-resistant Italian Ryegrass Management Options in Orchard Crops in California. Caio Brunharo¹, Bradley D. Hanson². ¹PhD Student, UC Davis; ²UCCE Weed Science Specialist, UC Davis. *Corresponding author (cabrunharo@ucdavis.edu)

Italian ryegrass (*Lolium perenne* L. *spp. multiflorum* (Lam.) Husnot) is a worldwide weedy species and its infestation causes yield losses in a variety of cropping systems. Selection pressure imposed by repeated herbicide use has selected Italian ryegrass populations resistant to several herbicide mode of actions across the world. Recently, poor control of Italian ryegrass with paraquat was reported by orchard managers near Hamilton City, California. We hypothesize that, if paraquat selection pressure was applied on an already glyphosate-resistant population of Italian ryegrass, then the low paraquat efficacy may be due to the selection of a multiple-resistant biotype. In this context, greenhouse dose-response, field and laboratorial experiments were carried out to evaluate Italian ryegrass response to several PRE and POST herbicides and the mechanism that confers resistance to paraquat in this biotype. A susceptible Italian ryegrass biotype from an internal collection (S) and a suspected paraquat-resistant population (PRHC) from a prune orchard near Hamilton City, were used. Greenhouse dose-response treatments were applied using a spray chamber calibrated to deliver 20 GPA when plants were 4 inches tall in the Fall 2015. Clethodim, fluazifop, glufosinate, glyphosate, mesosulfuron, paraquat, pyroxsulam, rimsulfuron and sethoxydim were applied at seven fractional rates ranging from 0.125 to 8 times their field rate plus an untreated control, in order to model Italian ryegrass response and calculate resistance parameters. Aboveground biomass was collected at 28 DAT and used to develop log-logistic models and determine the resistance index ($RI = GR_{50R}/GR_{50S}$). A field experiment containing 15 POST treatments was carried in the prune orchard near Hamilton City. Treatments were applied in May 2015 when the ryegrass was 10 inches tall. Visual evaluations were carried out at 7, 14, 21 and 28 days after treatment, based on a 0-100 scale, where 0 represents no visible injury and 100 represents complete plant death. Preemergence herbicides commonly used in orchards in California were also tested for control of PRHC. Treatments were applied in Fall 2015, and visual assessments were carried out every 30 days up to 150 days after treatment (DAT). In the laboratory, the absorption and translocation of ¹⁴C-paraquat was quantified, and the possibility of paraquat metabolism in the resistant and susceptible biotypes was evaluated using HPLC-based analytical techniques. Greenhouse results indicated that PRHC had high RI when treated with paraquat and sethoxydim, and moderate RI when treated with clethodim, glyphosate and pyroxsulam. A low RI was obtained with mesosulfuron. The POST field experiment corroborates with data from the greenhouse studies, since control of PRHC with glyphosate and paraquat were the least efficient. On the other hand, most of the treatments containing glufosinate were effective for control of the resistant population. From the PRE field experiment, all treatments containing indaziflam controlled PRHC up to 150 DAT. Combinations of flumioxazin, flumioxazin + pendimethalin, flumioxazin + oryzalin, oryzalin, oxyfluorfen and pendimethalin exhibited control percentages above 90% up to 150 DAT. Although PRHC exhibited a slower ¹⁴C-paraquat absorption, the maximum absorption was similar compared to the S biotype. However, under light-manipulated laboratory conditions, PRHC exhibited reduced translocation of ¹⁴C-paraquat, where most of the herbicide was retained in the treated leaf. In summary, PRHC presents multiple resistance to ACCase-inhibitors, ALS-inhibitors, EPSPS inhibitors and PSI inhibitors; tankmixes containing

glufosinate control PRHC even at advanced plant developmental stages; several PRE herbicides may be used to control PRHC; and limited movement of ^{14}C -paraquat was observed in PRHC.