ENVIORNMENTAL CONDITIONS ON POSTEMERGENCE HERBICIDES CONTROL OF GLYPHOSATE-RESISTANT JUNGLERICE (*Echinochloa colona*)

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ABSTRACT:

Junglerice (*Echinochloa colona*) is a problematic weed throughout the world. In recent years, it has become more problematic in California because of glyphosate-resistant (GR) populations. Alternative herbicides, such as glufosinate and sethoxydim, are being used for control of these populations. However, the efficacy of these herbicides is inconsistent in orchards because of shade from the trees and soil moisture levels. Therefore, the effect of shade and soil moisture level on efficacy of glufosinate and sethoxydim were evaluated. Three shade levels (0%, 50%, 70%) and two irrigation levels [50% and 100% of Field Capacity (FC)] were tested in 2016 and 2017. Potted GR junglerice plants were placed in tents made from shade cloths and irrigated according to the FC levels. Plants were sprayed with labeled rates of the herbicides after the first tiller and placed back in the treatment conditions. After 28 days, the plants were harvested and mortality, biomass, and seed production data were recorded. Temperature differences between the two years affected the treatments. In the cooler year (2016), plant mortality was greater in the 70% than in the 50% or 0% shade treatment while irrigation had no effect. Glufosinate provided best control (81%) of the plants in the 0% shade whereas, sethoxydim provided best control (94%) in the 70% shade treatment. In the warmer year (2017), both shade and irrigation level affected herbicide performance. Plant mortality with glufosinate was greatest (100%) in the 50% shade at both 50% and 100% FC. Control with sethoxydim was greatest (75%) at 50% FC but inconsistent in the other treatment combinations. Experiment was repeated 2020 for a third year, results were similar to the warmer year (2017), irrigation and treatment were factors. Glufosinate provided the best control (100%). The mortality in the 50% irrigation did affect the treatments. Mortality for sethoxydim (33%) was more slightly significant than control (20%). Therefore, environmental conditions could have a major effect on the efficacy of glufosinate and sethoxydim on jungelrice

INTRODUCTION:

Junglerice is a problematic weed in annual and perennial cropping systems in California. Moreover, in recent years, presence of glyphosate-resistant (GR) junglerice populations have compromised the effectiveness of glyphosate, a popular POST herbicide in orchards and vineyards (Fig. 1). Hence, there is a need to identify other effective postemergence herbicides. However, it has been observed that the efficacy of POST herbicides often vary according to the micro-environment of orchards and vineyards, especially shade and soil moisture conditions. Therefore, the influence of these micro-environments on efficacy of POST herbicides on junglerice needs to be evaluated.

Fig. 1. Glyphosate-resistant junglerice in an almond orchard in California (Photo: M. Moretti).

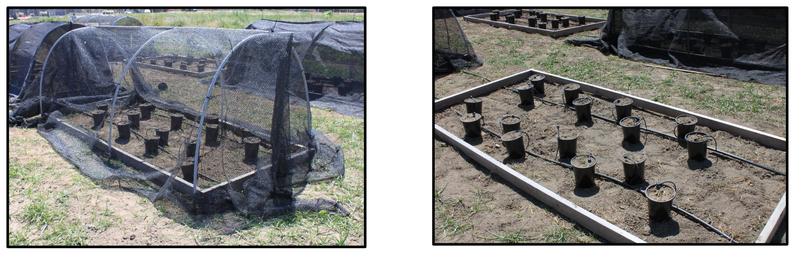

Fig. 2. Potted junglerice plants under different levels of shade (L) and soil moisture (R).

MATERIALS AND METHODS:

A study was conducted in Fresno, CA in summer 2016, 2017, and 2020. Seeds of previously-confirmed GR junglerice were obtained and sown in seedling trays. Once they developed 4-6 leaves they were planted into 3.8 l plastic pots containing field soil. Three levels of shade (70% shade, 50% shade, and 0% shade) were imposed using shade cloth of various transparency (Fig. 2) and two soil moisture regimes [(100% and 50% of field capacity (FC)] were imposed after determination of FC by a tensiometer. Each pot was individually irrigated with an automated drip irrigation system. The plants were treated with label rates of the selected herbicides between the second leaf and the first tiller stage. Herbicide applications were made with a CO_2 backpack sprayer calibrated to spray at 280 l ha^{-1} at 40 psi. Spray height was maintained at 45 cm. An untreated control was also included. Irrigation levels were maintained based on daily measurements with a TDR 100 soil moisture meter. The experimental design was a split-split-split plot with shade as the main effect, soil moisture as the sub-effect, and herbicide type as the sub-sub effect. Mortality of these plants were evaluated every 7 days after treatment (DAT) and plant biomass and number of seeds on each plant was recorded at 28 DAT (Fig. 3). The study was conducted twice. Data were analyzed using analysis of variance procedures in SAS at a significance level of 0.05. Interaction between the various factors were also tested. There were no interaction between the experimental runs and any of the factors; therefore, data for the two runs were combined.

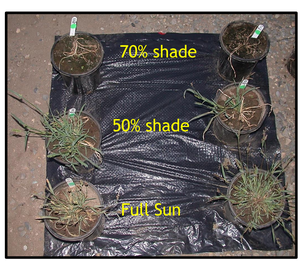

Fig. 3. Plants treated with glyphosate at 50% FC (L) and 100% FC (R) under different levels of shade.

Fig 5. Plants treated with different herbicides under full sun and 50% FC soil moisture

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Factors	2016	2017	2020
	P-value/Mortality%		
Shade	**0.035**	**0.034**	**0.251**
Full sun	35.9 b	53.1 a	53.1
50% shade	37.5 b	56.3 a	37.5
70% shade	57.8 a	34.4 b	34.4
Irrigation	**0.482**	**<0.0001**	**0.008**
100% FC	45.8	25.0 b	29.2 b
50% FC	41.7	70.8 a	54.2 a
Treatment	**<0.0001**	**<0.0001**	**<0.0001**
Control	2.1 c	47.9 b	12.5 c
Sethoxydim	60.4 a	39.6 b	33.3 b
Glufosinate	75.0 a	81.3 a	100.0 a
Glyphosate	37.5 b	22.9 c	20.8 bc
Shade x Irrigation	**0.967**	**0.397**	**0.175**
Irrigation x Treatment	**0.169**	**0.046**	**0.104**
100% FC			
Control	-	0.0 c	-
Sethoxydim	-	20.8.b	-
Glufosinate	-	70.8 a	-
Glyphosate	-	8.3 bc	-
50% FC			
Control	-	25.0 c	-
Sethoxydim	-	70.8 ab	-
Glufosinate	-	91.7 a	-
Glyphosate	-	45.8 b	-
Shade x Treatment	**0.015**	**0.212**	0.460
Full Sun			
Control	0.0 c	-	-
Sethoxydim	43.8 b	-	-
Glufosinate	81.3 a	-	-
Glyphosate	18.8 bc	-	-
50% shade			
Control	0.0 c	-	-
Sethoxydim	43.8 b	-	-
Glufosinate	75.0 a	-	-
Glyphosate	31.3 b	-	-
70% Shade			
Control	6.3 c	-	-
Sethoxydim	93.8 a	-	-
Glufosinate	68.8 ab	-	-
Glyphosate	62.5 b	-	-
Shade x Irrigation x Treatment	**0.682**	**0.212**	**0.366**

CONCLUSIONS:

There were significant interactions between year and shade (P = 0.0009), year and irrigation (P<0.0001), and year and treatment (P<0.0001). Therefore, data were analyzed separately for each year. Temperature may be one of the potential uncontrolled factors in the outcome of results. In the cooler year (2016), plant mortality was greater in the 70% than in the 50% or 0% shade treatment while irrigation had no effect. Glufosinate provided best control (81%) of the plants in the 0% shade whereas, sethoxydim provided best control (94%) in the 70% shade treatment. In the warmer year (2017), both shade and irrigation level affected herbicide performance. Plant mortality with glufosinate was greatest (100%) in the 50% shade at both 50% and 100% FC. Control with sethoxydim was greatest (75%) at 50% FC but inconsistent in the other treatment combinations. Experiment was repeated 2020 for a third year, results were similar to the warmer year (2017), irrigation and treatment were factors. Glufosinate provided the best control (100%). The mortality in the 50% irrigation did affect the treatments. Mortality for sethoxydim (33%) was more slightly significant than control (20%). Overall, Glufosinate seems to be alternative method to glyphosate control of glyphosate resistant junglerice control