Wild Rice Notes

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In This Issue

Whitney Brim-DeForest
UCCE Farm Advisor
Sutter, Yuba, Sacramento and Placer Counties
wbrimdeforest@ucanr.edu

New Advisor for Tehama, Shasta and Glenn Counties!

Ryan Hill is the new Agronomy and Weed Science Advisor headquartered in Tehama County, also serving Shasta and Glenn Counties. His training is in weed science and plant breeding from Oregon State University's Department of Horticulture, where he spent 6 years prior to starting with UCCE in Tehama County. His prior experience included work on pollinator habitat establishment, herbicide-induced trunk injury, chemical management of tree suckers, trials for new herbicide registrations, and chemigation of herbicides.

Since joining UCCE Tehama County in August 2023, Ryan has been conducting weed control trials in irrigated pasture, forage wheat, and orchards. He has presented at extension events and written newsletter articles on agronomy and orchard weed management. In addition to the activities he has undertaken, Ryan's main priority is to meet clientele and conduct a needs-assessment so feel free to give him a call and share your perspective.

University of California Farm Advisors are tasked with supporting their clientele through research projects, educational outreach, and farm consultation. As an agronomy advisor Ryan is tasked with support of all agronomic crops, including wild rice.

Reach out to him at rjahill@ucanr.edu or 530-527-3101 to share any comments or questions.

California Wild Rice Herbicide Field Trials 2022 and 2023

Whitney Brim-DeForest, UCCE Rice and Wild Rice Advisor
Taiyu Guan, UCCE Assistant Specialist
Consuelo Baez Vega, UCCE Junior Specialist

Introduction:

Wild rice (*Zizania palustris* L.) is a thriving and promising industry with a short history in California. By 1997, there were 11,780 acres of wild rice in California that produced 8,835 tons of green rice and 4,417.5 tons of finished product with a farm value of $12,810,750 (Regional IPM Centers 2000). The cultural management practices of wild rice are largely based on the production of rice. Although both species are annual cereals, wild rice grows taller and has different seeds and growth patterns than rice. Due to the low acreage, few research projects have been conducted in wild rice, and few products are registered in wild rice. The purpose of this study was to give wild rice growers more tools to control weeds, since at the time of the start of this study, only one herbicide was registered (carfentrazone). Furthermore, to prevent the selection of resistance, it is important to have more than one product, to allow for rotation of modes of action.

One field trial was conducted in 2022 and two field trials were conducted in 2023 to evaluate the effect of several herbicides currently registered in California rice (*Oryza sativa* L.) on wild rice to determine phytotoxicity levels under field settings. All currently-registered rice herbicides were preliminarily screened on wild rice in a greenhouse in 2020, to determine the potential for use in the field, and several were eliminated for use in field trials. Herbicide efficacy on weeds of wild rice was also rated, although their efficacy on California rice weeds has already been determined in previous studies. Preliminary timings were determined by the protocol laid out by the IR-4 Project which was adapted from rice-labeled timings. Herbicides tested were cyhalofop-butyl, florpyrauxifen-benzyl, penoxsulam, triclopyr, and propanil. An industry standard and currently registered product, carfentrazone, was included as a comparative control. Other than carfentrazone, none of these herbicides are currently registered for use on wild rice.

Methods:

One trial was carried out in a grower field in Shasta County (41.068289, -121.384118) in 2022. Information on field operations is included in Table 1. The seed was applied by fertilizer spreader onto dry ground. The field was flooded shortly after seeding. In 2023, two trials were carried out in grower fields in Shasta County (40.940495, -121.709427) and Yolo County (38.558126, -121.620503). The seed was applied by air or fertilizer spreader onto dry ground.

Weeds present at the 2022 site in Shasta County included watergrass species (*Echinochloa* spp.), smallflower umbrella sedge (*Cyperus difformis*), water hyssop (*Bacopa* spp.), redstem (*Ammannia* spp.), ricefield bulrush (*Schoenoplectus mucronatus*), ducksalad (*Heteranthera limosa*), spikerush (*Eleocharis palustris*), sprangletop (*Leptochloa* spp.), arrowhead (*Sagittaria montevidensis*), and plantain (*Alisma plantago aquatica*). Weeds present at the 2023 sites in Shasta County and Yolo County included water hyssop, ducksalad, arrowhead, pondweed (*Potamogeton nodosus*), and plantain.

Table 1. Key grower practices in trial locations during the 2022 season and 2023 seasons.

	Field (41.068289, -121.384118, Shasta County)	**Field** (40.940495, -121.709427, Shasta County)	**Field** (38.558126, -121.620503, Yolo County)
Seeding Date:	May 31, 2022	Early June, 2023	June 9, 2023
Variety:	Tuber	Tuber	Tuber
Seeding Rate:	90 lbs acre^{-1}	120 lbs acre^{-1}	135 lbs acre^{-1}

The trials were arranged in a randomized complete block design (RCBD) with four replications of each treatment (Table 2). In 2022, applications were made on June 27, July 11, and July 29. The applications were made using a CO_2-pressurized (30 psi) hand-held sprayer equipped with a ten-foot boom and 8003 nozzles, calibrated to apply 20 gallons of liquid per acre. Application timing conditions on June 27 were: windspeed of 0.33 mph, temperature of 26.1°C, and relative humidity of 27.5%. Application timing conditions on July 11 were: windspeed of 0 mph, temperature of 36°C, and relative humidity of 22.7%. On July 29, the wind speed was 0 mph, temperature was 33.2°C, and relative humidity was 30.2%.

Weed control and phytotoxicity (percent stunting, percent stand loss, percent leaf burn, percent leaf cupping/twisting, percent chlorosis, and percent lodged) evaluations were made on July 5 (8 days after application = DAA), July 11 (14 DAA), July 18 (21 DAA), July 25 (28 DAA) and August 5 (39 DAA). Heading (%) was evaluated on August 5 (39 DAA). The field was hand-harvested on September 16, 2022, using a 1 m by 3 m quadrat (panicles were harvested within that area). Seeds were threshed from the panicles using an Almaco Large Plot Thresher. Then seeds were weighed and moisture was measured using a John Deere Moisture Tester SW08120. Yields were adjusted to 14% moisture.

In the Shasta field in 2023, applications were made on July 21, August 4, and August 11. Application timing conditions on July 21 were: windspeed of 0.14–1.2 mph, temperature of 33.5°C, and relative humidity of 38.7%. Application timing conditions on August 4 were: windspeed of 0.14 mph, temperature of 25.7°C, and relative humidity of 22.7%. On August 11, the wind speed was 0 mph, temperature was 43°C, and relative humidity was 16.2%. In the Yolo field in 2023, applications were made on July 17, July 31, and July 29. Application timing conditions on July 17 were: windspeed of 0.13 mph, temperature of 29.6°C, and relative humidity of 47.7%. Application timing conditions on July 31 were: windspeed of 0.73 mph, temperature of 35.7°C, and relative humidity of 32.7%. On August 8, the wind speed was 5 to 7 mph, temperature was 27°C, and relative humidity was 46.7%.

In 2023, the Shasta field weed control and phytotoxicity (percent stunting, percent stand loss, percent leaf burn, percent dead, percent chlorosis, and percent lodged) evaluations were made on July 28 (7 DAA), August 4 (14 DAA), August 11 (21 DAA), and August 18 (28 DAA). The field was hand-harvested on September 14, 2023, using a 1 m by 3 m quadrat (panicles were harvested within that area). Seeds were threshed from the panicles using an Almaco Large Plot Thresher. Then seeds were weighed and moisture was measured using a John Deere Moisture Tester SW08120. Yields were adjusted to 14% moisture. Yolo field weed control and phytotoxicity (percent stunting, percent stand loss, percent leaf burn, percent dead, percent chlorosis, and percent lodged) evaluations were made on July 24 (7 DAA), July 31 (14 DAA), August 8 (22 DAA), and August 15 (29 DAA). The field was unable to be harvested.

Data was evaluated using R Statistical Software (v4.1.2; R Core Team 2021) and means were separated using a Tukey HSD test at alpha = 0.05. Emmeans (Least Squared Means) were used when data points were missing. Data from 2022 is presented separately, but in 2023, data from the two sites was combined, except for yield, as no yields were collected at the Yolo location.

Table 2. Treatments and field rate of product applied, timing, and date in Shasta County in 2022, and Shasta and Yolo Counties in 2023.

	Treatment	**Rate (per acre)**	**Timing**	**Shasta 2022 Dates**	**Shasta 2023 Dates**	**Yolo 2023 Dates**
1	Untreated Control	NA	NA	NA	NA	NA
2	Untreated Control	NA	NA	NA	NA	NA
3	cyhalofop-butyl + COC	15 fl oz	1 to 2 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
4	cyhalofop-butyl + COC	30 fl oz	1 to 2 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
5	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	21 fl oz fb. 21 fl oz	2 leaf stage fb. 14 days after initial application	June 27, 2022 fb. July 11, 2022	July 21, 2023 fb. August 4, 2023	July 17, 2023 fb. July 31, 2023
6	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	42 fl oz fb. 42 fl oz	2 leaf stage fb. 14 days	June 27, 2022 fb. July 11, 2022	July 21, 2023 fb.	July 17, 2023 fb. July 31, 2023

			after initial application		August 4, 2023	
7	penoxsulam + COC	2.8 fl oz	> 1 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
8	penoxsulam + COC	5.6 fl oz	> 1 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
9	triclopyr + COC fb. triclopyr + COC	16 fl oz fb. 16 fl oz	3 to 4 leaf stage fb. 20 days after initial application	July 11, 2022 fb. July 29, 2022	August 4, 2023 fb. August 11, 2023	July 31, 2023 fb. August 8, 2023
10	triclopyr + COC fb. triclopyr + COC	32 fl oz fb. 32 fl oz	3 to 4 leaf stage fb. 20 days after initial application	July 11, 2022 fb. July 29, 2022	August 4, 2023 fb. August 11, 2023	July 31, 2023 fb. August 8, 2023
11	propanil + COC	96 fl oz	< 4 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
12	propanil + COC	192 fl oz	< 4 leaf stage	June 27, 2022	July 21, 2023	July 17, 2023
13	carfentrazone	7.5 oz	20 to 45 days after seeding	June 27, 2022	July 21, 2023	July 17, 2023

fb. = followed by; MSO = methylated seed oil; COC = crop oil concentrate

Results:

Phytotoxicity 2022

The plots were evaluated on a per-plot basis for percent phytotoxicity on the rice (percent stunting, percent stand loss, percent leaf burn, percent leaf cupping/twisting, percent chlorosis, and percent lodged). At 8 DAA (July 5, 2022), significant stand loss can already be seen in the penoxsulam treatments (7 and 8). Both florpyrauxifen-benzyl and cyhalofop-butyl also showed stunting at the higher rates. Propanil showed low phytotoxicity overall. Note that triclopyr had not yet been applied. Carfentrazone, the industry standard, also showed low phytotoxicity.

By 14 DAA (July 11, 2022), the penoxsulam plots showed a 100% stand loss. The other herbicides showed little to no phytotoxicity. By 21 DAA (July 18), some phytotoxicity was seen in both the florpyrauxifen-benzyl plots and the triclopyr plots. The florpyrauxifen-benzyl treatment showed some leaf cupping and twisting, especially at higher rates. The plants recovered well, and by the end of the season, no symptoms could be seen. The triclopyr treatment showed chlorosis and lodging, and the wild rice plants never recovered, displaying symptoms through the end of the season.

By the end of the season (39 DAA) (Table 3), the number of heads in each plot was significantly less in the triclopyr treatments. The florpyrauxifen-benzyl treatment also showed reduced heading rates, in comparison to the carfentrazone treatment, although it was not significantly different. The cyhalofop-butyl treatment showed some reduction in heading at the higher rate, although it was not significantly different than the carfentrazone treatment, and at the lower rate, heading was not reduced. The propanil treatments looked the best in terms of heading, even better than the carfentrazone treatment.

Table 3. Phytotoxicity evaluations 39 days (August 5, 2022) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey HSD test).

	Treatment	Rate (per acre)	% Stunting	% Stand Loss	% Leaf Burn	% Leaf Cupping/Twisting	% Chlorosis	% Lodged	% Heading
1	Untreated Control	NA	12.5 a	10.0 ab	0 a	0 a	0 a	0 a	85.0 cd
2	Untreated Control	NA	8.8 a	6.3 ab	0 a	0 a	0 a	0 a	62.5 bcd
3	cyhalofop-butyl + COC	15 fl oz	7.5 a	0 a	0 a	0 a	0 a	0 a	92.5 cd
4	cyhalofop-butyl + COC	30 fl oz	17.5 a	23.8 b	0 a	0 a	0 a	0 a	70.0 bcd
5	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	21 fl oz fb 21 fl oz	7.5 a	0 a	0 a	0 a	0 a	0 a	77.5 bcd
6	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	42 fl oz fb 42 fl oz	6.3 a	6.3 a	0 a	0 a	0 a	0 a	52.5 bc
7	penoxsulam + COC	2.8 fl oz	0 a	100 c	0 a	0 a	0 a	0 a	0 a
8	penoxsulam + COC	5.6 fl oz	0 a	100 c	0 a	0 a	0 a	0 a	0 a
9	triclopyr + COC fb. triclopyr + COC	16 fl oz fb 16 fl oz	0 a	0 a	0 a	0 a	52.5 b	32.5 ab	38.8 ab
10	triclopyr + COC fb. triclopyr + COC	32 fl oz fb 32 fl oz	0 a	0 a	0 a	0 a	82.5 b	65.0 b	2.5 a
11	propanil + COC	96 fl oz	3.8 a	0 a	0 a	0 a	0 a	0 a	98.8 d
12	propanil + COC	192 fl oz	2.5 a	0 a	0 a	0 a	0 a	0 a	90.0 cd
13	carfentrazone	7.5 oz	2.5 a	0 a	0 a	0 a	0 a	0 a	95.0 cd

% = percent; fb. = followed by; MSO = methylated seed oil; COC = crop oil concentrate

Phytotoxicity 2023

The plots were evaluated on a per-plot basis for percent phytotoxicity on the rice (percent stunting, percent stand loss, percent leaf burn, percent dead, percent chlorosis, and percent lodged) across sites (Table 4).

At 7 DAA, penoxsulam treatments (7 and 8) showed some stand loss and leaf burn, while propanil treatments (11 and 12) displayed significant chlorosis. Phytotoxicity was minimal in all other herbicide treatments. Note that triclopyr had not yet been applied. By 14 DAA, significant death was observed in the penoxsulam treatments (7 and 8). The wild rice plants never recovered, displaying symptoms through the end of the season. Conversely, other herbicides showed minimal to no phytotoxicity. By 21 DAA for the Shasta field and 22 DAA for the Yolo field, triclopyr treatments (9 and 10) showed significant lodging, particularly at the higher rates, whereas all other treatments showed little to no lodging. By 28 DAA for Shasta and 29 DAA for Yolo (Table 4), propanil at the higher rate (12) showed more lodging than the last evaluation. However, wild rice under other treatments exhibited lower lodging compared to the last evaluation.

Table 4. 2023 phytotoxicity evaluations 28 days for the Shasta field and 29 days for the Yolo field after the initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters following each mean indicative of differences (using a Tukey HSD test).

	Treatment	**Rate (per acre)**	**% Stunting**	**% Stand Loss**	**% Leaf Burn**	**% Dead**	**% Chlorosis**	**% Lodged**
1	Untreated Control	NA	0 a	0 a	0 a	0 a	0 a	12.5 a
2	Untreated Control	NA	0 a	0 a	0 a	0 a	0 a	9.38 a
3	cyhalofop-butyl + COC	15 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
4	cyhalofop-butyl + COC	30 fl oz	0 a	0 a	0 a	0 a	0 a	2.5 a
5	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	21 fl oz fb. 21 fl oz	0 a	0 a	0 a	0 a	0 a	3.12 a
6	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	42 fl oz fb. 42 fl oz	0 a	0 a	0 a	0 a	0 a	2.5 a
7	penoxsulam + COC	2.8 fl oz	0 a	93.8 b	0 a	93.8 b	0 a	0 a
8	penoxsulam + COC	5.6 fl oz	0 a	87.5 b	0 a	87.5 b	0 a	0 a
9	triclopyr + COC fb. triclopyr + COC	16 fl oz fb. 16 fl oz	0 a	0 a	0 a	0 a	0 a	21.88 a
10	triclopyr + COC fb. triclopyr + COC	32 fl oz fb. 32 fl oz	0 a	0 a	0 a	0 a	0 a	58.12 b
11	propanil + COC	96 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
12	propanil + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	15.62 a
13	carfentrazone	7.5 oz	0 a	12.5 a	0 a	12.5 a	0 a	2.5 a

% = percent; fb. = followed by; MSO = methylated seed oil; COC = crop oil concentrate

Weed Evaluations 2022

The plots were evaluated on a whole-plot basis for percent control (in comparison to the untreated control). Ratings reported in the table are percent control (in comparison to the untreated; Table 5).

Grass control was inconsistent and may not reflect accurate control as the amount of grass in the field was very low (less than 1%) except for later in the season. The major weed species were ducksalad, hyssop, and spikerush, with low populations of other species (sprangletop, bulrush, plantain, grass, and redstem). Smallflower and arrowhead were present in very small populations (less than 1%), so the data may not be reflective of control rates with larger populations.

Penoxsulam treatments (7 and 8) and florpyrauxifen-benzyl treatments (5 and 6), especially at a higher rate demonstrated excellent control over nearly all weed species. However, florpyrauxifen-benzyl treatments (5 and 6) exhibited less effective control over spikerush compared to the penoxsulam treatments (7 and 8). Triclopyr treatments (9 and 10) also exhibited good weed control, notably targeting bulrush, plantain, and spikerush. Propanil treatments (11 and 12), especially at a higher rate provided effective control over grasses, plaintain, and spikerush. Cyhalofop-butyl (3 and 4) and carfentrazone (13) demonstrated effective control over arrowhead, with cyhalofop-butyl at the higher rate (4) also proving effective against pondweed.

Table 5: Evaluations of 2022 weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 39 days (August 5, 2022) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey HSD test). The untreated controls are reported as percent cover of each species per plot, and Treatments 3 to 13 are reported as percent control (compared to the untreated controls).

	Treatment	Rate (per acre)	Grass	Smallflower	Bulrush	Redstem	Ducksalad	Hyssop	Plantain	Sprangletop	Spikerush	Arrowhead
1	Untreated Control	NA	5.0 a	0 a	6.3 a	0	0	0	0.01	3.8 a	5.0 a	0
2	Untreated Control	NA	6.3 a	0 a	12.0 a	0	0	0	0.01	5.0 a	16.3 ab	0
3	cyhalofop-butyl + COC	15 fl oz	75.0 b	100.0 b	33.3 ab	NA	NA	NA	50.0 ab	100.0 b	60.7 abcd	NA
4	cyhalofop-butyl + COC	30 fl oz	100.0 b	75.0 b	0 a	NA	NA	NA	25.0 ab	100.0 b	33.6 abc	NA
5	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	21 fl oz fb 21 fl oz	100.0 b	100.0 b	75.0 bc	NA	NA	NA	75.0 ab	100.0 b	92.9 cd	NA
6	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	42 fl oz fb 42 fl oz	100.0 b	100.0 b	100 c	NA	NA	NA	100.0 b	100.0 b	67.9 bcd	NA
7	penoxsulam + COC	2.8 fl oz	100.0 b	100.0 b	100 c	NA	NA	NA	100.0 b	100.0 b	100.0 b	NA
8	penoxsulam + COC	5.6 fl oz	100.0 b	100.0 b	100 c	NA	NA	NA	100.0 b	100.0 b	100.0 b	NA
9	triclopyr + COC fb. triclopyr + COC	16 fl oz fb 16 fl oz	100.0 b	100.0 b	91.7 c	NA	NA	NA	100.0 b	100.0 b	100.0 b	NA

10	triclopyr + COC fb. triclopyr + COC	32 fl oz fb 32 fl oz	100.0 b	75.0 b	100.0 c	NA	NA	NA	100.0 b	100.0 b	100.0 b	NA
11	propanil + COC	96 fl oz	75.0 b	75.0 b	25.0 ab	NA	NA	NA	100.0 b	100.0 b	100.0 b	NA
12	propanil + COC	192 fl oz	100.0 b	75.0 b	16.7 a	NA	NA	NA	75.0 ab	100.0 b	100.0 b	NA
13	carfentrazone	7.5 oz	100.0 b	100.0 b	14.6 a	NA	NA	NA	75.0 ab	100.0 b	85.0 cd	NA

fb. = followed by; MSO = methylated seed oil; COC = crop oil concentrate

Weed Evaluations 2023

The plots were evaluated on a whole-plot basis for percent control (in comparison to the untreated control) across sites. Ratings reported in the table are percent control (in comparison to the untreated) (Figure 1). The major weed species in the Shasta field were ducksalad, pondweed, and arrowhead. The major weed species in the Yolo field were waterhyssop and plantain.

Penoxsulam treatments (7 and 8) and florpyrauxifen-benzyl treatments (5 and 6), especially at a higher rate demonstrated excellent control over nearly all weed species. However, florpyrauxifen-benzyl treatments (5 and 6) exhibited less effective control over pondweed compared to penoxsulam treatments (7 and 8). Triclopyr treatments (9 and 10) also exhibited good weed control, notably targeting pondweed, arrowhead, and waterhyssop, albeit with a slightly delayed weed control compared to penoxsulam and florpyrauxifen-benzyl. Propanil treatments (11 and 12), especially at a higher rate provided effective control over waterhyssop and plantain. Cyhalofop-butyl (3 and 4) and carfentrazone (13) demonstrated effective control over arrowhead, with cyhalofop-butyl at the higher rate (4) also proving effective against pondweed.

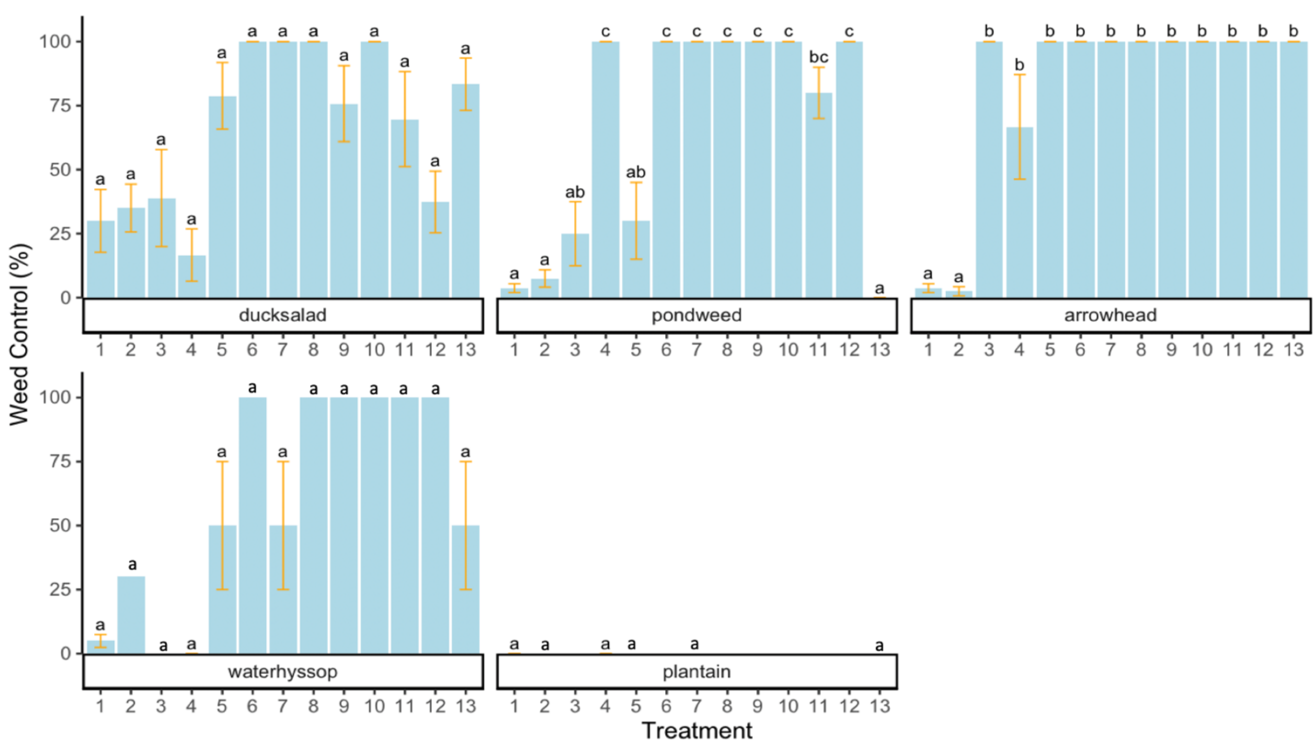

Figure 1. Evaluations of 2023 weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 28 days for Shasta field and 29 days for Yolo field after the initial herbicide application. Averages of the four treatment replications are reported, with different letters on the top of the standard error bar indicative of differences (using a Tukey HSD test). The untreated controls are reported as percent cover of each species per plot, and Treatments 3 to 13 are reported as percent control (compared to the untreated controls). 3 and 4 = cyhalofop-butyl; 5 and 6 = florpyrauxifen-benzyl; 7 and 8 = penoxsulam; 9 and 10 = triclopyr; 11 and 12 = propanil; 13 = carfentrazone

Yield 2022

The highest yield was in the carfentrazone treatment, but the propanil treatments and the lower rate of cyhalofop-butyl as well as florpyrauxifen-benzyl had yields that were slightly less, but not significantly different than the carfentrazone treatment. Both penoxsulam treatments were poor yielding (close to zero), and the triclopyr treatments were lower than the untreated controls (Table 6).

Table 6. 2022 yields (lbs/acre) adjusted to 14% moisture. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey HSD test).

	Treatment	Rate (per acre)	Yields (lbs/acre)
1	Untreated Control	NA	2370 bc
2	Untreated Control	NA	2353 bc
3	cyhalofop-butyl + COC	15 fl oz	2567 bc
4	cyhalofop-butyl + COC	30 fl oz	1805 abc
5	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	21 fl oz fb. 21 fl oz	2676 bc
6	florpyrauxifen-benzyl + MSO fb. florpyrauxifen-benzyl + MSO	42 fl oz fb. 42 fl oz	1637 abc
7	penoxsulam + COC	2.8 fl oz	460 ab
8	penoxsulam + COC	5.6 fl oz	NA
9	triclopyr + COC fb. triclopyr + COC	16 fl oz fb. 16 fl oz	1883 abc
10	triclopyr + COC fb. triclopyr + COC	32 fl oz fb. 32 fl oz	669 a
11	propanil + COC	96 fl oz	2305 bc
12	propanil + COC	192 fl oz	2611 bc
13	carfentrazone	7.5 oz	2982 c

fb. = followed by; MSO = methylated seed oil; COC = crop oil concentrate

Yield 2023

The highest yield was in the lower rate of florpyrauxifen-benzyl treatment (Figure 2). Yields from the carfentrazone treatment, propanil treatments, cyhalofop-butyl treatments, and the higher rate of florpyrauxifen-benzyl, as well as the lower rate of triclopyr, were slightly lower but not significantly different from those of the lower rate of florpyrauxifen-benzyl treatment. Both penoxsulam treatments resulted in poor yields, nearly approaching zero, while the higher rate triclopyr treatment yielded lower than the untreated controls.

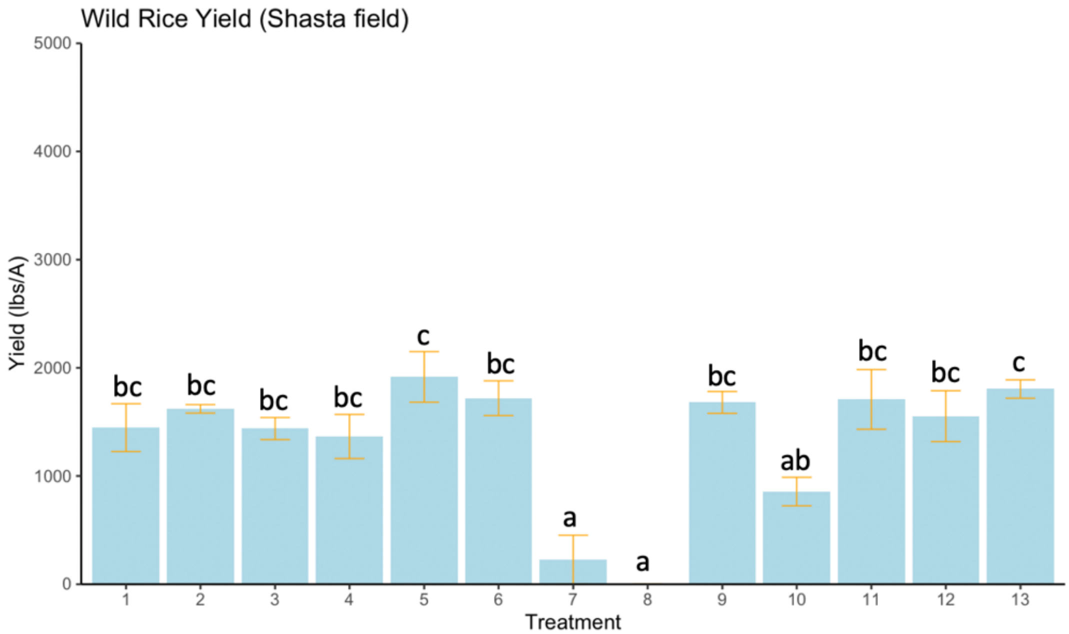

Figure 2. 2023 yields (lbs/acre) adjusted to 14% moisture. Averages of the four treatment replications are reported, with different letters on the top of the standard error bars indicative of differences (using a Tukey HSD test). 1 and 2 = untreated control; 3 and 4 = cyhalofop-butyl; 5 and 6 = florpyrauxifen-benzyl; 7 and 8 = penoxsulam; 9 and 10 = triclopyr; 11 and 12 = propanil; 13 = carfentrazone

Overall Discussion and Future Recommendations:

In both years, penoxsulam appears to be highly phytotoxic to wild rice, but does provide good control over a wide range of weed species. Despite causing notable lodging, triclopyr proves effective in managing pondweed, arrowhead, and waterhyssop. In 2022, it caused significant phytotoxicity, but rates could be adjusted down, as weed control was good for both the sedges and the broadleaves. Among the herbicides tested, florpyrauxifen-benzyl emerges as the most promising option due to its minimal phytotoxic effects, exceptional weed control, and high yields. Propanil and cyhalofop-butyl also show promise with low phytotoxicity, satisfactory weed control, and high yields.

In 2022 and 2023, the weed control evaluations lacked good grass control and sprangletop control data, so further testing may be necessary. However, since all of these herbicides are currently registered in rice in California, it is likely that weed control would be similar to the control provided in rice systems for these weeds. Since spikerush is not found widely in the Sacramento Valley rice system, further greenhouse testing on spikerush would help establish the efficacy of these herbicides.

References:

Regional IPM Centers. “Crop Profile for Wild Rice in California” Crop Profiles. January 2000. https://ipmdata.ipmcenters.org/documents/cropprofiles/CAwildrice.pdf