Wild Rice Field Trial Final Report
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Introduction:

The purpose of this trials was to evaluate the effect of several herbicides currently registered in California rice, on wild rice (*Zizania palustris*), to determine phytotoxicity levels under field settings. Herbicide efficacy on weeds were also rated, but the efficacy of these herbicides in California rice has already been determined in previous studies. Timings of application may need to be adjusted to better suit wild rice growing conditions. Preliminary timings were determined by the protocol laid out by the IR-4 program. Herbicides tested were Clincher CA® (cyhalofop-butyl), Loyant® (florpyrauxifen-benzyl), Granite SC® (penoxsulam), Grandstand CA® (triclopyr), and SuperWham® (propanil). An industry standard, Shark H2O® (carfentrazone) was also used as a comparative control.

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

Methods:

One trial was carried out in a grower field in Shasta County (41.068289, -121.384118) in 2022. The grower cooperator was Rick Maher. Information on field operations is included in Table 1 (where information was available). The seed was applied by fertilizer spreader onto dry ground. The field was flooded shortly after seeding.

Table 1. *Key grower practices in trial locations during the 2022 season.*

	Field (41.068289, -121.384118, Shasta County)
Seeding Date:	May 31, 2022
Variety:	Tuber
Seeding Rate:	90 lbs acre^{-1}

The trial was arranged in a randomized complete block design (RCBD) with four replications of each treatment (Table 2). Applications were made on June 27, July 11, and July 29. The application was made using a CO2-pressurized (30 PSI) hand-held sprayer equipped with a ten-foot boom and 8003 nozzles, calibrated to apply 20 gallons of liquid per acre. At application timing on June 27, conditions were: windspeed of 0.33 mph, temperature of 26.1 C, and relative humidity of 27.5%. At application timing on July 11, conditions 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%.

Evaluations were made on July 5 (8 Days After Application), July 11 (14 DAA), and July 18 (21 DAA), July 25 (28 DAA) and August 5 (39 DAA) for weed control and phytotoxicity (% Stunting, % Stand Loss, % Leaf Burn, % Leaf Cupping/Twisting, % Chlorosis, and % Lodged). Heading (%) was evaluated on August 5 (39 DAA). The field was harvested by hand on September 16, 2022, using a 1 m x 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.

Data was evaluated using R Statistical Software (v4.1.2; R Core Team 2021) and means were separated using a Tukey test at alpha = 0.05. Emmeans (Least Squared Means) were used when data points were missing.

Table 2. *Treatments and field rate of product applied (not active ingredient), timing, and date.*

	Treatment	**Rate (per Acre)**	**Timing**	**Date**
1	Untreated Control	NA	NA	NA
2	Untreated Control	NA	NA	NA
3	Clincher CA + COC	15 fl oz	1-2 leaf stage	June 27, 2022
4	Clincher CA + COC	30 fl oz	1-2 leaf stage	June 27, 2022
5	Loyant +MSO fb. Loyant +MSO	21 fl oz fb. 21 fl oz	2 leaf stage fb. 14 days after initial application	June 27, 2022 fb. July 11, 2022
6	Loyant +MSO fb. Loyant +MSO	42 fl oz fb. 42 fl oz	2 leaf stage fb. 14 days after initial application	June 27, 2022 fb. July 11, 2022
7	Granite SC + COC	2.8 fl oz	> 1 leaf stage	June 27, 2022
8	Granite SC + COC	5.6 fl oz	> 1 leaf stage	June 27, 2022
9	Grandstand CA + COC fb. Grandstand CA +COC	16 fl oz fb. 16 fl oz	3-4 leaf stage fb. 20 days after initial application	July 11, 2022 fb. July 29, 2022
10	Grandstand CA + COC fb. Grandstand CA +COC	32 fl oz fb. 32 fl oz	3-4 leaf stage fb. 20 days after initial application	July 11, 2022 fb. July 29, 2022
11	SuperWham + COC	96 fl oz	< 4 leaf stage	June 27, 2022
12	SuperWham + COC	192 fl oz	< 4 leaf stage	June 27, 2022
13	Shark H2O	7.5 oz	20-45 Days After Seeding	June 27, 2022

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

Results:

Phytotoxicity.

The plots were evaluated on a per-plot basis for percent phytotoxicity on the rice (% Stunting, % Stand Loss, % Leaf Burn, % Leaf Cupping/Twisting, % Chlorosis, and % Lodged). At 8 DAA (July 5) (Table 3), significant stand loss can already be seen in the Granite SC treatments (7 and 8). Both Loyant and Clincher also showed stunting at the higher rates. SuperWham showed low phytotoxicity overall. Note that Grandstand had not yet been applied. Shark H2O, the industry standard, also showed low phytotoxicity.

By 14 DAA (July 11), the Granite SC plots showed 100% stand loss (Table 4). The other herbicides showed little to no phytotoxicity. By 21 DAA (July 18), some phytotoxicity was seen in both the Loyant plots and the Grandstand plots. The Loyant treatment showed some leaf cupping and twisting, especially at the higher rates. The plants recovered well, and by the end of the season, no symptoms could be seen.

The Grandstand 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), the number of heads in each plot were significantly less in the Grandstand treatments. The Loyant treatment also showed reduced heading rates, in comparison to the Shark H2O treatment, although it was not significantly different. The Clincher treatment showed some reduction in heading at the higher rate, although it was not significantly different than the Shark H2O treatment, and at the lower rate, heading was not reduced. The SuperWham treatments looked the best terms of heading, even better than the Shark H2O treatment.

Table 3. *Phytotoxicity evaluations 8 days (July 5) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of significant differences (using a Tukey test).*

	Treatment	Rate (per Acre)	% Stunting	% Stand Loss	% Leaf Burn	% Leaf Cupping/Twisting	% Chlorosis	% Lodged
1	Untreated Control	NA	0 a	0.5 a	0.3 a	0 a	0 a	0 a
2	Untreated Control	NA	0 a	0 a	0 a	0 a	0 a	0 a
3	Clincher CA + COC	15 fl oz	0 a	2.5 a	0 a	1.3 a	1.3 a	0 a
4	Clincher CA + COC	30 fl oz	47.5 ab	13.8 ab	5.0 a	18.8 b	8.8 a	0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	2.5 a	10.0 ab	0 a	0 a	0 a	0 a
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	76.3 b	5.0 a	0 a	0 a	0 a	0 a
7	Granite SC + COC	2.8 fl oz	0 a	28.8 b	95.0 b	0 a	50.0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	30.0 b	100.0 b	0 a	50.0 a	0 a
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
11	SuperWham + COC	96 fl oz	1.3 a	5.0 a	0 a	0 a	0 a	0 a
12	SuperWham + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
13	Shark H2O	7.5 oz	0 a	3.8 a	0 a	0 a	0 a	0 a

Table 4. *Phytotoxicity evaluations 14 days (July 11) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of significant differences (using a Tukey test).*

	Treatment	Rate (per Acre)	% Stunting	% Stand Loss	% Leaf Burn	% Leaf Cupping/Twisting	% Chlorosis	% Lodged
1	Untreated Control	NA	0 a	0 a	0 a	0 a	1.3 a	0 a
2	Untreated Control	NA	0 a	2.5 a	0 a	0 a	1.3 a	0 a
3	Clincher CA + COC	15 fl oz	0 a	0 a	2.5 a	0 a	2.5 a	0 a
4	Clincher CA + COC	30 fl oz	0 a	7.5 a	0 a	10.0 b	0 a	0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	0 a	3.3 a	0 a	0 a	0 a	0 a
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	0 a	5.0 a	0 a	1.3 a	0 a	0 a
7	Granite SC + COC	2.8 fl oz	0 a	100.0 b	0 a	0 a	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	100.0 b	0 a	0 a	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	0 a	0 a	2.5 a	1.3 a	3.8 a	0 a
11	SuperWham + COC	96 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
12	SuperWham + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
13	Shark H2O	7.5 oz	0 a	1.3 a	0 a	0 a	0 a	0 a

Table 5. *Phytotoxicity evaluations 21 days (July 18) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test).*

	Treatment	Rate (per Acre)	% Stunting	% Stand Loss	% Leaf Burn	% Leaf Cupping/Twisting	% Chlorosis	% Lodged
1	Untreated Control	NA	0 a	2.5 a	0 a	0 a	12.5 a	0 a
2	Untreated Control	NA	0 a	7.5 a	0 a	0 a	0 a	0 a
3	Clincher CA + COC	15 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
4	Clincher CA + COC	30 fl oz	5.0 a	22.5 b	0 a	3.8 a	2.5 a	0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	5.0 a	0 a	0 a	0	0 a	2.5
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	0 a	0 a	0 a	12.5 a	17.5 a	50.0 ab
7	Granite SC + COC	2.8 fl oz	0 a	100.0 c	0 a	0 a	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	100.0 c	0 a	0 a	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	0 a	0 a	0 a	0 a	62.5 b	61.3 b
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	0 a	0 a	0 a	0 a	91.3 b	71.3 b
11	SuperWham + COC	96 fl oz	0 a	2.5 a	0 a	0 a	0 a	0 a
12	SuperWham + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
13	Shark H2O	7.5 oz	0 a	0 a	0 a	0 a	0 a	0 a

Table 6. *Phytotoxicity evaluations 28 days (July 25) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test).*

	Treatment	Rate (per Acre)	% Stunting	% Stand Loss	% Leaf Burn	% Leaf Cupping/Twisting	% Chlorosis	% Lodged
1	Untreated Control	NA	2.5 a	0 a	0 a	0 a	0 a	0 a
2	Untreated Control	NA	3.8 a	0 a	0 a	0 a	0 a	0 a
3	Clincher CA + COC	15 fl oz	3.8 a	0 a	0 a	0 a	0 a	0 a
4	Clincher CA + COC	30 fl oz	8.8 a	15.0 b	0 a	2.5 a	0 a	0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	3.8 a	0 a	0 a	0 a	0 a	0 a
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	2.5 a	5.0 ab	0 a	32.5 b	0.5 a	0 a
7	Granite SC + COC	2.8 fl oz	0 a	97.3 c	0 a	0 a	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	99.8 c	0 a	0 a	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	0 a	2.5 a	0 a	0 a	51.3 b	52.5 b
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	0 a	1.3 a	0 a	0 a	86.3 b	65.0 b
11	SuperWham + COC	96 fl oz	1.3 a	2.5 a	0 a	0 a	0 a	0 a
12	SuperWham + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
13	Shark H2O	7.5 oz	1.3 a	0 a	0 a	0 a	0 a	0 a

Table 7. *Phytotoxicity evaluations 39 days (August 5) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey 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	Clincher CA + COC	15 fl oz	7.5 a	0 a	0 a	0 a	0 a	0 a	92.5 cd
4	Clincher CA + COC	30 fl oz	17.5 a	23.8 b	0 a	0 a	0 a	0 a	70.0 bcd
5	Loyant +MSO fb Loyant +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	Loyant +MSO fb Loyant +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	Granite SC + COC	2.8 fl oz	0 a	100.0 c	0 a	0 a	0 a	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	100.0 c	0 a	0 a	0 a	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA +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	Grandstand CA + COC fb Grandstand CA +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	SuperWham + COC	96 fl oz	3.8 a	0 a	0 a	0 a	0 a	0 a	98.8 d
12	SuperWham + COC	192 fl oz	2.5 a	0 a	0 a	0 a	0 a	0 a	90.0 cd
13	Shark H2O	7.5 oz	2.5 a	0 a	0 a	0 a	0 a	0 a	95.0 cd

Weed Evaluations.

The plots were evaluated on a whole-plot basis for percent control (in comparison to the untreated control). Ratings reported in the tables are % control (in comparison to the untreated) (Table 8-12).

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, arrowhead were present in very small populations (less than 1%), so the data may not be reflective of control rates with larger populations.

Table 8. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 8 days (July 5) after the initial herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test). The untreated controls are reported as % cover of each species per plot, and Treatments 3-13 are reported as % control (compared to the untreated controls).*

	Treatment	Rate (per Acre)	Grass	Bulrush	Redstem	Ducksalad	Hyssop	Spikerush
1	Untreated Control	NA	0.51 a	0	0	23.8 ab	16.3 a	5.0 a
2	Untreated Control	NA	0.26 a	0	0	30.0 ab	16.3 a	10.8 a
3	Clincher CA + COC	15 fl oz	75.1 b	NA	NA	27.5 ab	25.0 a	25.0 a
4	Clincher CA + COC	30 fl oz	75.0 b	NA	NA	10.7 a	17.5 a	5.0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	100.0 b	NA	NA	57.1 ab	85.0 a	48.3 a
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	100.0 b	NA	NA	93.8 b	100.0 a	47.0 a
7	Granite SC + COC	2.8 fl oz	100.0 b	NA	NA	52.6 ab	75.0 a	37.5 a
8	Granite SC + COC	5.6 fl oz	100.0 b	NA	NA	60.6 ab	87.5 a	54.9 a
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	100.0 b	NA	NA	51.2 ab	75.0 a	25.0 a
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	100.0 b	NA	NA	37.3 ab	50.0 a	56.7 a
11	SuperWham + COC	96 fl oz	100.0 b	NA	NA	41.7 ab	49.5 a	45.8 a
12	SuperWham + COC	192 fl oz	100.0 b	NA	NA	31.2 ab	50.0 a	53.3 a
13	Shark H2O	7.5 oz	50.0 ab	NA	NA	42.9 ab	37.0 a	55.7 a

Table 9. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 14 days (July 11) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test). The untreated controls are reported as % cover of each species per plot, and Treatments 3-13 are reported as % control (compared to the untreated controls).*

	Treatment	Rate (per Acre)	Grass	Bulrush	Redstem	Ducksalad	Hyssop	Spikerush
1	Untreated Control	NA	0 a	0	0	18.8 a	8.0 a	11.8 a
2	Untreated Control	NA	0.5 a	0	0	21.3 a	10.0 a	13.8 a
3	Clincher CA + COC	15 fl oz	100.0 b	NA	NA	18.8 a	25.0 ab	33.3 ab
4	Clincher CA + COC	30 fl oz	100.0 b	NA	NA	0 a	0 a	0 a
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	100.0 b	NA	NA	43.2 ab	75.0 ab	33.3 ab
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	100.0 b	NA	NA	72.1 bc	100.0 b	41.7 ab
7	Granite SC + COC	2.8 fl oz	100.0 b	NA	NA	100.0 c	100.0 b	100.0 b
8	Granite SC + COC	5.6 fl oz	100.0 b	NA	NA	100.0 c	100.0 b	100.0 b
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	100.0 b	NA	NA	14.6 a	50.0 ab	8.3 a
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	100.0 b	NA	NA	31.3 a	29.2 ab	28.6 ab
11	SuperWham + COC	96 fl oz	100.0 b	NA	NA	25.1 a	43.8 ab	25.0 ab
12	SuperWham + COC	192 fl oz	100.0 b	NA	NA	2.8 a	35.4 ab	37.1 ab
13	Shark H2O	7.5 oz	100.0 b	NA	NA	13.5 a	12.5 a	16.7 a

Table 10. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 21 days (July 18) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test). The untreated controls are reported as % cover of each species per plot, and Treatments 3-13 are reported as % control (compared to the untreated controls).*

	Treatment	Rate (per Acre)	Grass	Bulrush	Redstem	Ducksalad	Hyssop	Spikerush	Plantain	Sprangletop
1	Untreated Control	NA	2.5 a	0	0	17.5 ab	3.8 a	13.3 a	2.5 ab	0 a
2	Untreated Control	NA	1.3 a	0	0	22.5 ab	3.8 a	15.5 a	5.0 ab	0.8 a
3	Clincher CA + COC	15 fl oz	100.0 b	NA	NA	27.3 abc	75.0 ab	40.0 a	50.0 ab	100.0 b
4	Clincher CA + COC	30 fl oz	100.0 b	NA	NA	10.0 a	33.3 ab	2.3 a	0 a	100.0 b
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	100.0 b	NA	NA	90.0 bc	75.0 ab	64.0 a	90.0 ab	100.0 b
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	100.0 b	NA	NA	100.0 c	100.0 b	33.5 a	100.0 b	100.0 b
7	Granite SC + COC	2.8 fl oz	100.0 b	NA	NA	75.0 abc	100.0 b	75.0 a	75.0 ab	75.0 b
8	Granite SC + COC	5.6 fl oz	100.0 b	NA	NA	70.5 abc	75.0 ab	71.8 a	100.0 b	100.0 b
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	100.0 b	NA	NA	100.0 c	100.0 b	63.9 a	50.0 ab	100.0 b
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	100.0 b	NA	NA	100.0 c	100.0 b	89.8 a	75.0 ab	100.0 b
11	SuperWham + COC	96 fl oz	100.0 b	NA	NA	43.9 abc	75.0 ab	31.8 a	75.0 ab	100.0 b
12	SuperWham + COC	192 fl oz	100.0 b	NA	NA	6.8 a	50.0 ab	29.8 a	75.0 ab	100.0 b
13	Shark H2O	7.5 oz	100.0 b	NA	NA	20.0 ab	75.0 ab	21.0 a	50.0 ab	100.0 b

Table 11. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 28 days (July 26) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test). The*

untreated controls are reported as % cover of each species per plot, and Treatments 3-13 are reported as % control (compared to the untreated controls).

	Treatment	Rate (per Acre)	Grass	Bulrush	Redstem	Ducksalad	Hyssop	Plantain	Sprangletop	Spikerush	Arrowhead
1	Untreated Control	NA	4.3 a	4.3 a	0.8 a	16.3 a	0	3.3 a	0 a	6.3 a	0
2	Untreated Control	NA	0.8 a	3.5 a	0 a	21.3 a	0	3.8 a	2.3 a	10.0 a	0
3	Clincher CA + COC	15 fl oz	100.0 b	25.0 ab	100.0 c	35.5 ab	NA	50.0 a	100.0 b	25.0 a	NA
4	Clincher CA + COC	30 fl oz	100.0 b	0 a	75.0 bc	2.8 a	NA	0 a	100.0 b	37.5 a	NA
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	100.0 b	81.5 ab	100.0 c	87.5 c	NA	93.8 a	100.0 b	42.5 a	NA
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	100.0 b	100.0 b	100.0 c	100.0 c	NA	100.0 a	100.0 b	20.0 a	NA
7	Granite SC + COC	2.8 fl oz	100.0 b	0 a	100.0 c	2.8 a	NA	50.0 a	30.2 a	25.0 a	NA
8	Granite SC + COC	5.6 fl oz	100.0 b	25.0 ab	25.0 ab	0 a	NA	75.0 a	30.0 a	25.0 a	NA
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	75.0 b	100.0 b	75.0 bc	77.3 bc	NA	65.0 a	100.0 b	90.0 a	NA
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	100.0 b	75.0 ab	100.0 c	95.8 c	NA	95.0 a	100.0 b	95.0 a	NA
11	SuperWham + COC	96 fl oz	68.3 b	25.0 ab	100.0 c	37.3 ab	NA	65.0 a	100.0 b	37.5 a	NA
12	SuperWham + COC	192 fl oz	100.0 b	25.0 ab	75.0 bc	0 a	NA	50.0 a	100.0 b	25.0 a	NA
13	Shark H2O	7.5 oz	68.3 b	25.0 ab	100.0 c	27.5 a	NA	50.0 a	100.0 b	22.5 a	NA

Table 12. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 39 days (August 5) after herbicide application. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test). The untreated controls are reported as % cover of each species per plot, and Treatments 3-13 are reported as % 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	Clincher CA + 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	Clincher CA + 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	Loyant +MSO fb Loyant +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	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	100.0 b	100.0 b	100.0 c	NA	NA	NA	100.0 b	100.0 b	67.9 bcd	NA
7	Granite SC + COC	2.8 fl oz	100.0 b	100.0 b	100.0 c	NA	NA	NA	100.0 b	100.0 b	100.0 d	NA
8	Granite SC + COC	5.6 fl oz	100.0 b	100.0 b	100.0 c	NA	NA	NA	100.0 b	100.0 b	100.0 d	NA
9	Grandstand CA + COC fb Grandstand CA +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 d	NA
10	Grandstand CA + COC fb Grandstand CA +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 d	NA
11	SuperWham + COC	96 fl oz	75.0 b	75.0 b	25.0 ab	NA	NA	NA	100.0 b	100.0 b	100.0 d	NA
12	SuperWham + COC	192 fl oz	100.0 b	75.0 b	16.7 a	NA	NA	NA	75.0 ab	100.0 b	100.0 d	NA
13	Shark H2O	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

Yield.

The highest yield was in the Shark H2O treatment, but the SuperWham treatments and the lower rate of Clincher as well as Loyant had yields that were slightly less, but not significantly different than the Shark H2O treatment. Both the Granite SC treatments were poor yielding (close to zero), and the Grandstand treatments were lower than the untreated controls.

Table 13. *Yields (lbs/A) adjusted to 14% moisture. Averages of the four treatment replications are reported, with different letters following each mean indicative of differences (using a Tukey test).*

	Treatment	Rate (per Acre)	Yield (lbs/A)
1	Untreated Control	NA	2370 bc
2	Untreated Control	NA	2353 bc
3	Clincher CA + COC	15 fl oz	2567 bc
4	Clincher CA + COC	30 fl oz	1805 abc
5	Loyant +MSO fb Loyant +MSO	21 fl oz fb 21 fl oz	2676 bc
6	Loyant +MSO fb Loyant +MSO	42 fl oz fb 42 fl oz	1637 abc
7	Granite SC + COC	2.8 fl oz	460 ab
8	Granite SC + COC	5.6 fl oz	NA
9	Grandstand CA + COC fb Grandstand CA +COC	16 fl oz fb 16 fl oz	1883 abc
10	Grandstand CA + COC fb Grandstand CA +COC	32 fl oz fb 32 fl oz	669 a
11	SuperWham + COC	96 fl oz	2305 bc
12	SuperWham + COC	192 fl oz	2611 bc
13	Shark H2O	7.5 oz	2982 c

Discussion and Future Recommendations:

Going forward, it will be important to determine timings and rates for each of the herbicides. Granite SC appears to be very phytotoxic to wild rice, and it may not be worth proceeding with continued testing. Grandstand also caused significant phytotoxicity, but rates could be adjusted down, as weed control was good for both the sedges and the broadleaves. Loyant caused phytotoxicity at the higher rate, but provided

good control of sedges and broadleaves as well. SuperWham and Clincher were the most promising due to low phytotoxicity and high yields. The weed control evaluations were lacking good grass control and sprangletop control data, so further testing is 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. The exception at this site was the spikerush population, which is not found widely in the Sacramento Valley rice system. Greenhouse testing on spikerush would help establish efficacy of SuperWham

Repeating this study at more sites in the next couple of years will yield more information on rates, as well as phytotoxicity and weed control on a wider spectrum of weed species. The current recommendation would be to continue testing Loyant, Clincher and SuperWham, and possible Grandstand as well, if rates can be re-evaluated.