Wild Rice Field Trial Final Report
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Introduction:

The purpose of these two trials were 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 on California rice weeds 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 sites in Shasta County and Yolo County included water hyssop (*Bacopa* spp.), ducksalad (*Heteranthera limosa*), arrowhead (*Sagittaria montevidensis*), pondweed (*Potamogeton nodosus*), and plantain (*Alisma plantago-aquatica*).

Methods:

In 2023, two trials were carried out in grower fields in Shasta County (41.068289, -121.384118) and in Yolo County (38.558126, -121.620503) in 2023. Information on field operations is included in Table 1 (where information was available). The seed was applied by air or fertilizer spreader onto dry ground.

Table 1. *Key grower practices in trial locations during the 2023 season.*

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

Trials were arranged in a randomized complete block design (RCBD) with four replications of each treatment (Table 2 and Table 3). All applications were 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. In the Shasta field, applications were made on July 21, August 4, and August 11. At application timing on July 21, conditions were: windspeed of 0.14 – 1.2 mph, temperature of 33.5 C, and relative humidity of 38.7%. At application timing on August 4, conditions 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, applications were made on July 17, July 31, and July 29. At application timing on July 17, conditions were: windspeed of 0.13 mph, temperature of 29.6 C, and relative humidity of 47.7%. At application timing on July 31, conditions were: windspeed of 0.73 mph, temperature of 35.7 C, and relative humidity of 32.7%. On August 8, the wind speed was 5-7 mph, temperature was 27 C, and relative humidity was 46.7%.

In the Shasta field, evaluations were made on July 28 (7 Days After Application), August 4 (14 DAA), August 11 (21 DAA), and August 18 (28 DAA) for weed control and phytotoxicity (% Stunting, % Stand Loss, % Leaf Burn, % Dead, % Chlorosis, and % Lodged). The field was harvested by hand on September 14, 2023, 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. In the Yolo field, evaluations were made on July 24 (7 Days After Application), July 31 (14 DAA), August 8 (22 DAA), and August 15 (29 DAA) for weed control and phytotoxicity (% Stunting, % Stand Loss, % Leaf Burn, % Dead, % Chlorosis, and % Lodged). The field was not able to be harvested due to all plot stakes being pulled out by a field worker by accident before harvest.

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 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 (not active ingredient), timing, and date in the Shasta field.*

	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	July 21, 2023
4	Clincher CA + COC	30 fl oz	1-2 leaf stage	July 21, 2023
5	Loyant +MSO fb. Loyant +MSO	21 fl oz fb. 21 fl oz	2 leaf stage fb. 14 days after initial application	July 21, 2023 fb. August 4, 2023
6	Loyant +MSO fb. Loyant +MSO	42 fl oz fb. 42 fl oz	2 leaf stage fb. 14 days after initial application	July 21, 2023 fb. August 4, 2023
7	Granite SC + COC	2.8 fl oz	> 1 leaf stage	July 21, 2023
8	Granite SC + COC	5.6 fl oz	> 1 leaf stage	July 21, 2023
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	August 4, 2023 fb. August 11, 2023
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	August 4, 2023 fb. August 11, 2023
11	SuperWham + COC	96 fl oz	< 4 leaf stage	July 21, 2023
12	SuperWham + COC	192 fl oz	< 4 leaf stage	July 21, 2023
13	Shark H2O	7.5 oz	20-45 Days After Seeding	July 21, 2023

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

Table 3. *Treatments and field rate of product applied (not active ingredient), timing, and date in the Yolo field.*

	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	July 17, 2023
4	Clincher CA + COC	30 fl oz	1-2 leaf stage	July 17, 2023
5	Loyant +MSO fb. Loyant +MSO	21 fl oz fb. 21 fl oz	2 leaf stage fb. 14 days after initial application	July 17, 2023 fb. July 31, 2023
6	Loyant +MSO fb. Loyant +MSO	42 fl oz fb. 42 fl oz	2 leaf stage fb. 14 days after initial application	July 17, 2023 fb. July 31, 2023
7	Granite SC + COC	2.8 fl oz	> 1 leaf stage	July 17, 2023
8	Granite SC + COC	5.6 fl oz	> 1 leaf stage	July 17, 2023
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 31, 2023 fb. August 8, 2023
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 31, 2023 fb. August 8, 2023
11	SuperWham + COC	96 fl oz	< 4 leaf stage	July 17, 2023
12	SuperWham + COC	192 fl oz	< 4 leaf stage	July 17, 2023
13	Shark H2O	7.5 oz	20-45 Days After Seeding	July 17, 2023

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, % Dead, % Chlorosis, and % Lodged) across sites.

At 7 DAA (Table 4), Granite SC treatments (7 and 8) showed some stand loss and leaf burn, while SuperWham treatments (11 and 12) displayed significant chlorosis. Phytotoxicity was minimal in all other herbicide treatments. Note that Grandstand had not yet been applied. By 14 DAA (Table 5), significant death can already be seen in the Granite SC treatments (7 and 8), and 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/ 22 DAA for the Yolo field (Table 6), Grandstand 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/29 DAA for Yolo (Table 7), SuperWham 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. *Phytotoxicity evaluations 7 days after initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters following each mean indicative of significant differences (using a Tukey HSD means separation 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	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	0.625 ab	0 a	0 a	0 a	0 a	0 a
4	Clincher CA + COC	30 fl oz	2.5 ab	3.12 ab	1.25 ab	0 a	1.88 a	0 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	3.75 ab	3.12 ab	0 a	0 a	0 a	0 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	6.25 b	1.25 a	0 a	0 a	0 a	0 a
7	Granite SC + COC	2.8 fl oz	4.375 ab	15 c	22.75 bc	0 a	0 a	0 a
8	Granite SC + COC	5.6 fl oz	5.625 ab	11.88 bc	31.88 c	0 a	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 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 fl 32 fl oz	0 a	0 a	0 a	0 a	0 a	0 a
11	SuperWham + COC	96 fl oz	1.875 ab	1.25 a	0 a	0 a	28.12 b	0 a
12	SuperWham + COC	192 fl oz	0 a	1.88 ab	0 a	0 a	52.5 c	0 a
13	Shark	7.5 oz	1.25 ab	1.25 a	2.25 ab	0 a	0 a	0 a

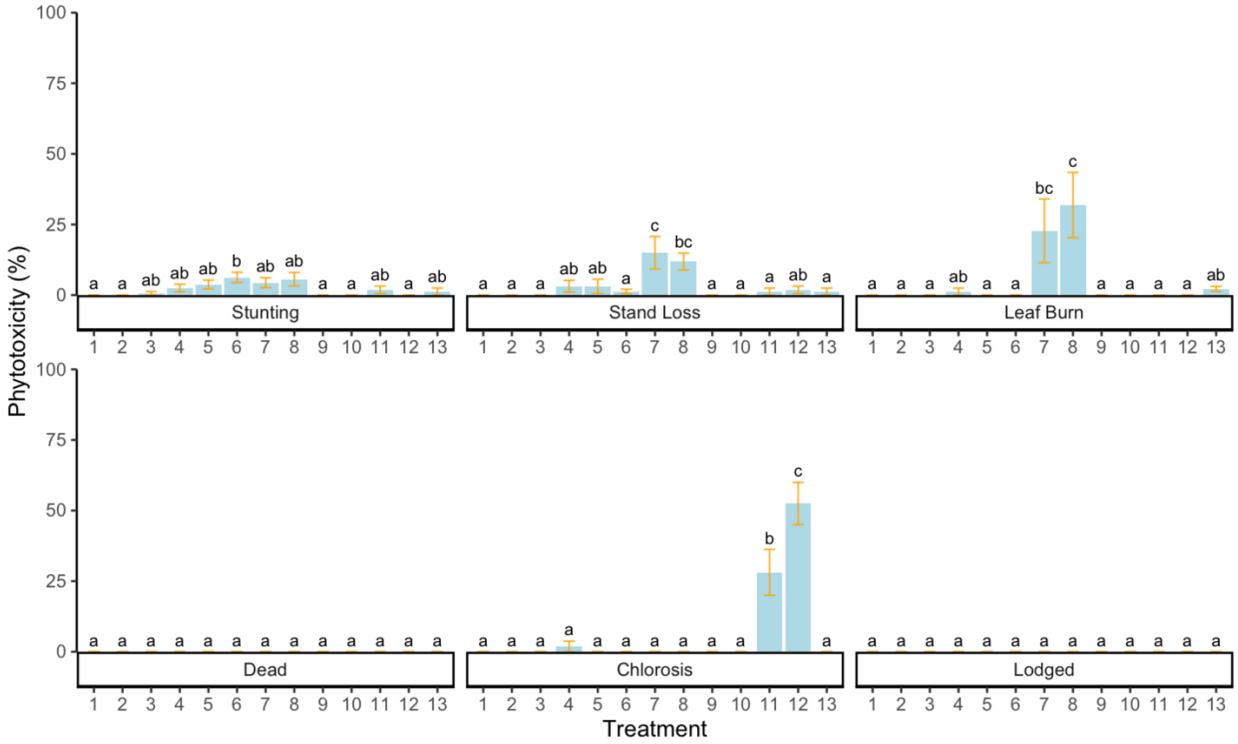

Figure 1. *Phytotoxicity evaluations 7 days after initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters on the top of the standard error bars indicative of significant differences (using a Tukey HSD means separation test).*

Table 5. *Phytotoxicity evaluations 14 days after initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters following each mean indicative of significant differences (using a Tukey HSD means separation 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	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	0 a	0 a	0 a	0 a	0 a
4	Clincher CA + COC	30 fl oz	4.375 bc	1.875 a	0.625 a	0 a	1.25 ab	0 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	1.25 ab	1.25 a	0 a	0 a	0 a	0 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	3.125 abc	0 a	0 a	0 a	0 a	0 a
7	Granite SC + COC	2.8 fl oz	0 a	93.125 b	0 a	93.1 b	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	100 b	0 a	100 c	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	0.625 ab	0 a	0 a	0 a	0 a	0 a
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	0 a	0.625 a	0 a	0 a	0 a	0 a
11	SuperWham + COC	96 fl oz	2.75 abc	1.875 a	0.625 a	0 a	1.88 ab	0 a
12	SuperWham + COC	192 fl oz	6.25 c	0 a	6.25 b	0 a	3.25 b	0 a
13	Shark	7.5 oz	0.625 ab	0 a	0 a	0 a	0 a	0 a

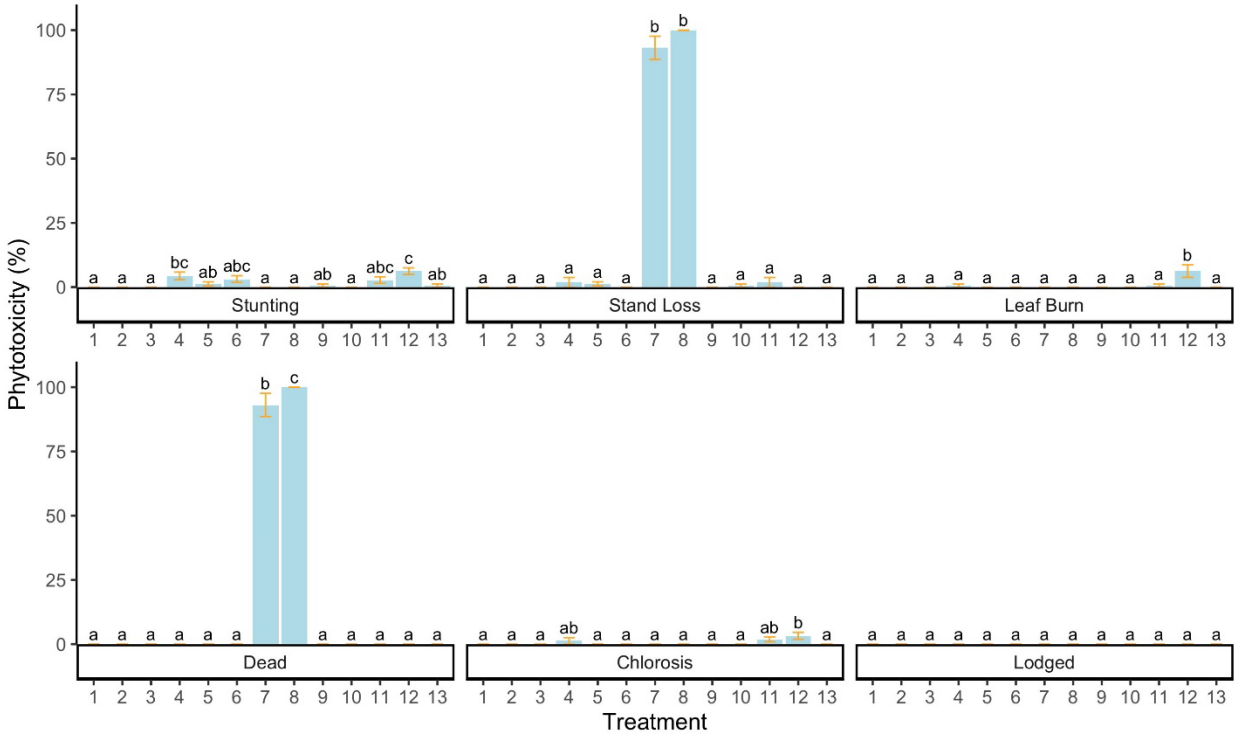

Figure 2. *Phytotoxicity evaluations 14 days after initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters on the top of the standard error bars indicative of significant differences (using a Tukey HSD test).*

Table 6. *Phytotoxicity evaluations 21 days for the Shasta field/22 days for the Yolo field after 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	15 a
2	Untreated Control	NA	0 a	0 a	0 a	0 a	0 a	18.75 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	0 a	0 a	0 a	0 a	0 a	0 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	0 a	0 a	0 a	0 a	0 a	6.25 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	0 a	0 a	0 a	0 a	0 a	2.5 a
7	Granite SC + COC	2.8 fl oz	0 a	91.9 a	0 a	91.88 b	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	87.5 a	0 a	87.5 b	0 a	12.5 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	0 a	0 a	0 a	0 a	0 a	28.12 a
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	0 a	0 a	0 a	0 a	0 a	81.25 b
11	SuperWham + COC	96 fl oz	0 a	0 a	0 a	0 a	0 a	1.25 a
12	SuperWham + COC	192 fl oz	0 a	0 a	0 a	0 a	0 a	5 a
13	Shark	7.5 oz	0 a	0 a	0 a	0 a	0 a	6.25 a

Figure 3. *Phytotoxicity evaluations 21 days for Shasta field/22 days for Yolo field after the initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters on the top of the standard error bars indicative of significant differences (using a Tukey HSD test).*

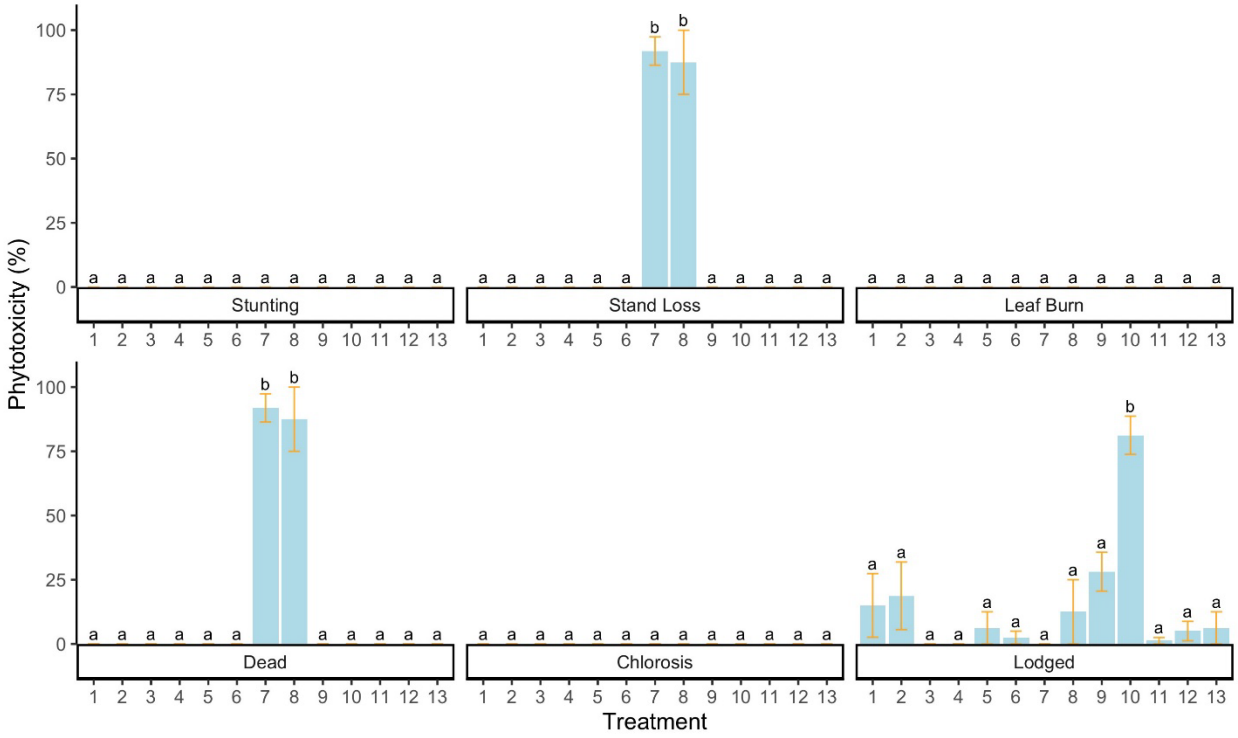

Table 7. *Phytotoxicity evaluations 28 days for the Shasta field/29 days for the Yolo field after the initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters following each mean indicative of differences (using a Tukey HSD test).*

	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	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	0 a	0 a	0 a	0 a	0 a	2.5 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	0 a	0 a	0 a	0 a	0 a	3.12 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	0 a	0 a	0 a	0 a	0 a	2.5 a
7	Granite SC + COC	2.8 fl oz	0 a	93.8 b	0 a	93.8 b	0 a	0 a
8	Granite SC + COC	5.6 fl oz	0 a	87.5 b	0 a	87.5 b	0 a	0 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	0 a	0 a	0 a	0 a	0 a	21.88 a
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	0 a	0 a	0 a	0 a	0 a	58.12 b
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	15.62 a
13	Shark	7.5 oz	0 a	12.5 a	0 a	12.5 a	0 a	2.5 a

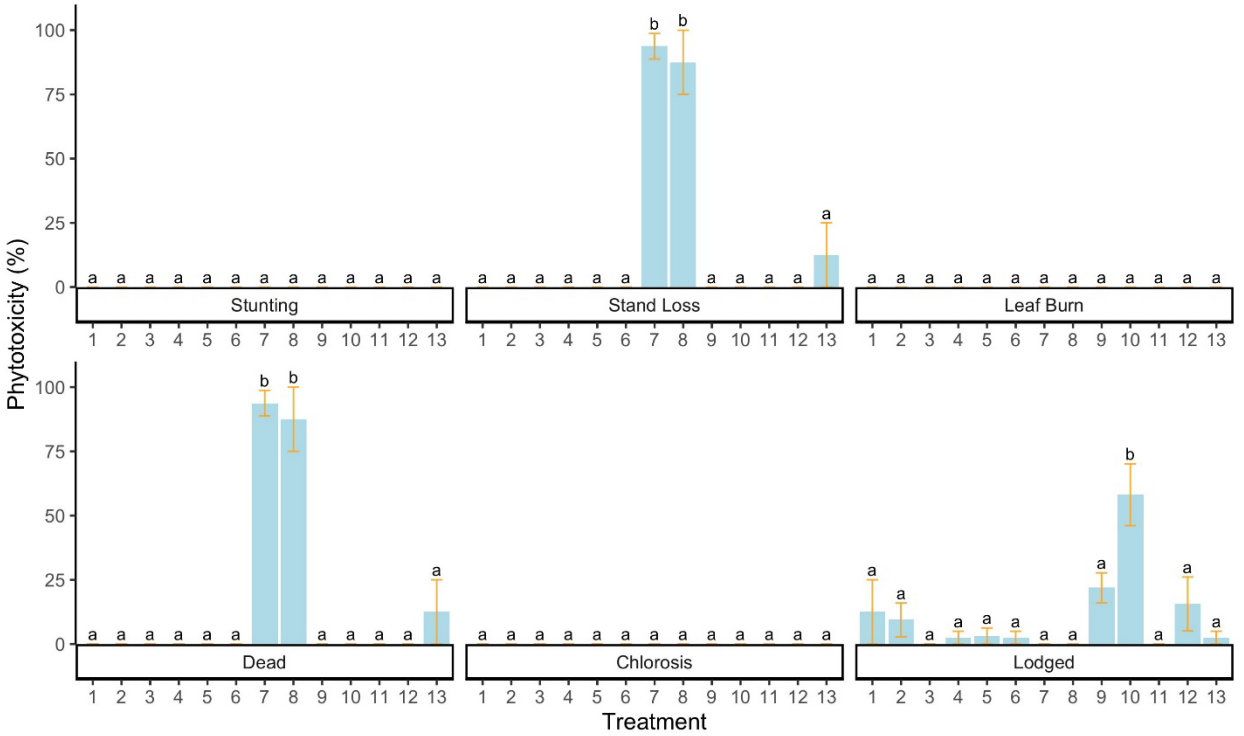

Figure 4. *Phytotoxicity evaluations 28 days for the Shasta field/29 days for the Yolo field after the initial herbicide application. Averages of the four treatment replications across the two sites are reported, with different letters on the top of the standard error bars indicative of significant differences (using a Tukey HSD test).*

Weed Evaluations.

The plots were evaluated on a whole-plot basis for percent control (in comparison to the untreated control) across sites. Ratings reported in the tables are % control (in comparison to the untreated) (Table 8-11). 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.

Granite SC treatments (7 and 8) and Loyant treatments (5 and 6), especially at higher rate demonstrated excellent control over nearly all weed species. However, Loyant treatments (5 and 6) exhibited less effective control over pondweed compared to Granite SC treatments (7 and 8). Grandstand treatments (9 and 10) also exhibited commendable weed control, notably targeting pondweed, arrowhead, and waterhyssop, albeit with a slightly delayed weed control compared to Granite SC and Loyant. SuperWham treatments (11 and 12), especially at higher rate provided effective control over waterhyssop and plantain. Clincher (3 and 4) and Shark (13) demonstrated effective control over arrowhead, with Clincher at the higher rate (4) also proving effective against pondweed.

Table 8. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 7 days 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)	Ducksalad	Pondweed	Arrowhead	Waterhyssop	Plantain
1	Untreated Control	NA	31.2 abc	23 a	0.25 a	38.8 a	NA
2	Untreated Control	NA	50 abc	22.5 a	1.25 a	35.4 a	NA
3	Clincher CA + COC	15 fl oz	30.7 abc	8.33 a	100 b	45 a	NA
4	Clincher CA + COC	30 fl oz	0 a	27.92 a	60 ab	39.2 a	NA
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	86.4 c	31.54 a	100 b	77.5 a	NA
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	100 c	55.99 a	100 b	60 a	NA
7	Granite SC + COC	2.8 fl oz	76.7 bc	35.21 a	100 b	25 a	NA
8	Granite SC + COC	5.6 fl oz	76 bc	40.42 a	100 b	25 a	NA
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	31.8 abc	18.75 a	0 a	68.3 a	NA
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	10 ab	6.25 a	50 ab	49.2 a	NA
11	SuperWham + COC	96 fl oz	56.4 abc	25 a	100 b	75 a	NA
12	SuperWham + COC	192 fl oz	53 abc	25 a	100 b	50 a	NA
13	Shark	7.5 oz	79.7 bc	39.58 a	100 b	51.2 a	NA

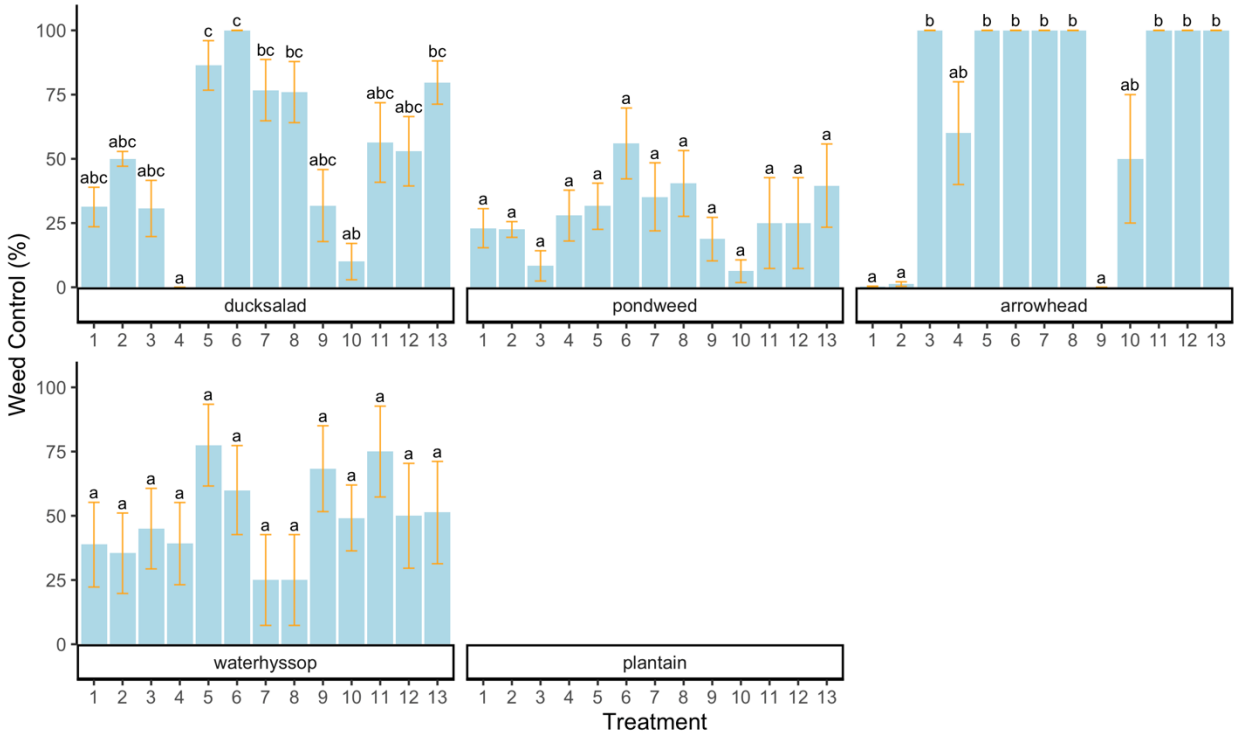

Figure 5. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 7 days after the initial herbicide application. Averages of the four treatment replications are reported, with different letters on the top of standard error bar indicative of differences (using a*

Tukey HSD 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).

Table 9. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 14 days 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 HSD 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)	Ducksalad	Pondweed	Arrowhead	Waterhyssop	Plantain
1	Untreated Control	NA	38.8 abc	12.5 a	2.5 a	30 a	20.7 a
2	Untreated Control	NA	46.2 abc	0 a	11.2 a	0 a	68.2 a
3	Clincher CA + COC	15 fl oz	36.4 abc	0 a	75 ab	100 a	28 a
4	Clincher CA + COC	30 fl oz	14.9 a	100 a	40 ab	33.3 a	26 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	90 bc	25 a	100 b	50 a	66.7 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	100 c	50 a	100 b	100 a	66.7 a
7	Granite SC + COC	2.8 fl oz	82.1 abc	100 a	100 b	50 a	50 a
8	Granite SC + COC	5.6 fl oz	100 c	100 a	100 b	100 a	33.3 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	13 a	50 a	70 ab	100 a	73.3 a
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	30.5 ab	50 a	60 ab	100 a	73.9 a
11	SuperWham + COC	96 fl oz	54 abc	50 a	75 ab	100 a	100 a
12	SuperWham + COC	192 fl oz	52.8 abc	50 a	100 b	100 a	77.6 a
13	Shark	7.5 oz	61.3 abc	50 a	75 ab	50 a	73.3 a

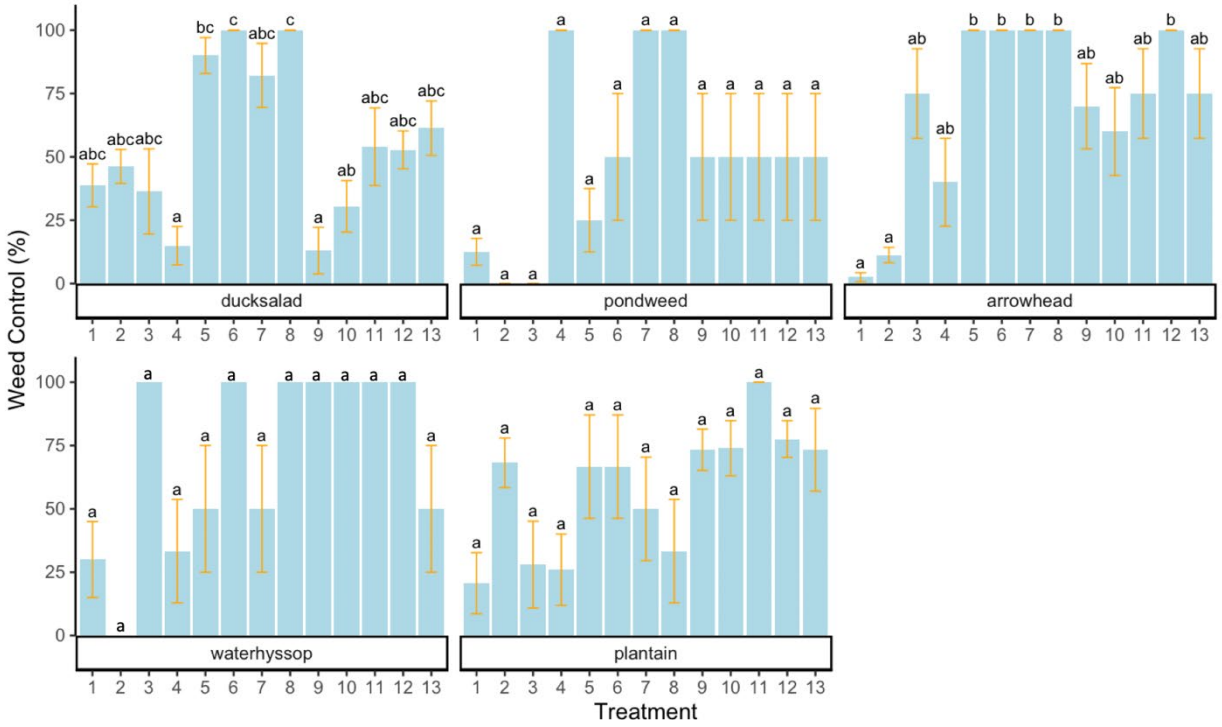

Figure 6. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 14 days after the initial herbicide application. Averages of the four treatment replications are reported, with different letters on the top of standard error bar indicative of differences (using a Tukey HSD 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).*

Table 10. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 21 days for the Shasta field/22 days for the Yolo field 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 HSD 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)	Ducksalad	Pondweed	Arrowhead	Waterhyssop	Plantain
1	Untreated Control	NA	37.5 abc	6.25 a	2.5 a	25 a	0 a
2	Untreated Control	NA	38.8 abc	7.5 a	0 a	15 a	0 a
3	Clincher CA + COC	15 fl oz	35.7 abc	0 ab	100 b	37.5 a	NA
4	Clincher CA + COC	30 fl oz	0 a	100 b	100 b	4.17 a	0 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	75 bc	50 ab	100 b	50 a	0 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	100 c	90 ab	100 b	100 a	NA
7	Granite SC + COC	2.8 fl oz	100 c	100 b	100 b	50 a	0 a
8	Granite SC + COC	5.6 fl oz	100 c	100 b	100 b	100 a	NA
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	46.8 abc	100 b	100 b	100 a	NA
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	62.6 abc	100 b	100 b	100 a	NA
11	SuperWham + COC	96 fl oz	36.4 abc	30 ab	0 a	100 a	NA
12	SuperWham + COC	192 fl oz	22.1 ab	50 ab	100 b	100 a	NA
13	Shark	7.5 oz	80.3 bc	0 ab	100 b	50 a	0 a

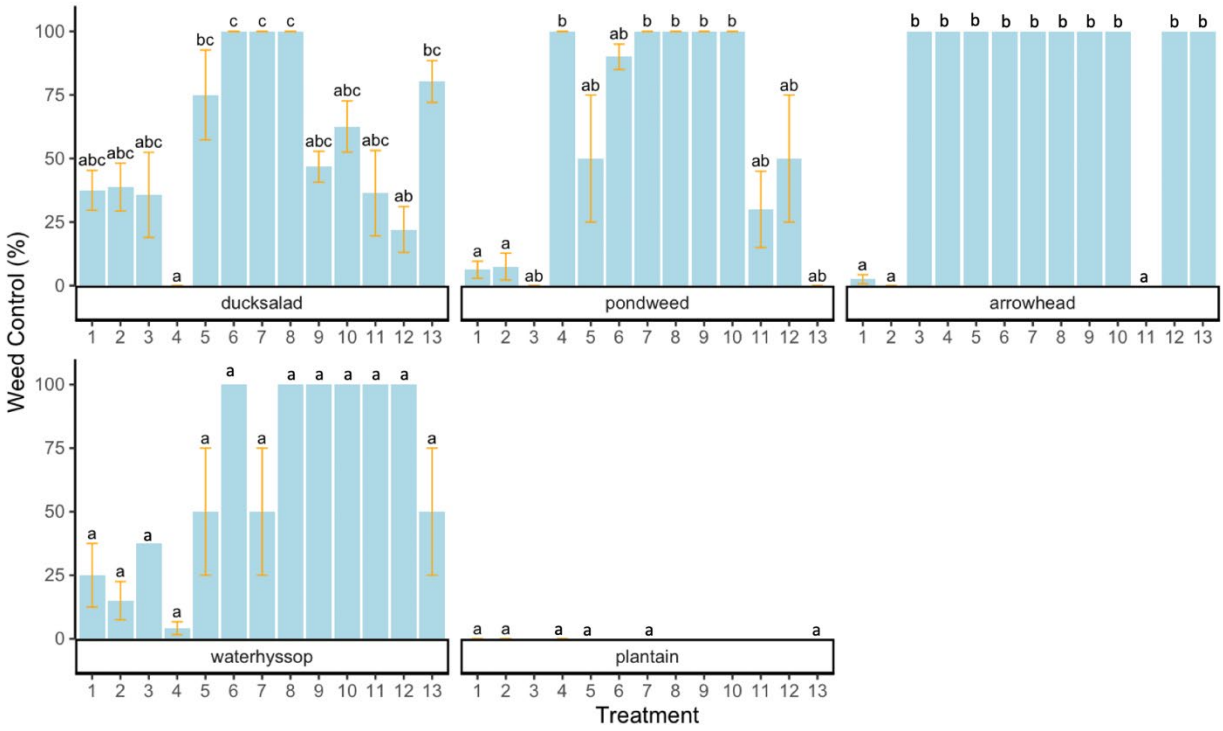

Figure 7. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 21 days for the Shasta field/22 days for the Yolo field after the initial herbicide application. Averages of the four treatment replications are reported, with different letters on the top of standard error bar indicative of differences (using a Tukey HSD 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).*

Table 11. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 28 days for the Shasta field/29 days for the Yolo field 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 % cover of each species per plot, and Treatments 3-13 are reported as % control (compared to the untreated controls).

	Treatment	Rate (per acre)	Ducksalad	Pondweed	Arrowhead	Waterhyssop	Plantain
1	Untreated Control	NA	30 a	3.75 a	3.75 a	5 a	0 a
2	Untreated Control	NA	35 a	7.5 a	2.5 a	30 a	0 a
3	Clincher CA + COC	15 fl oz	38.9 a	25 ab	100 b	0 a	NA
4	Clincher CA + COC	30 fl oz	16.7 a	100 c	66.67 b	0 a	0 a
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	78.8 a	30 ab	100 b	50 a	0 a
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	100 a	100 c	100 b	100 a	NA
7	Granite SC + COC	2.8 fl oz	100 a	100 c	100 b	50 a	0 a
8	Granite SC + COC	5.6 fl oz	100 a	100 c	100 b	100 a	NA
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	75.8 a	100 c	100 b	100 a	NA
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	100 a	100 c	100 b	100 a	NA
11	SuperWham + COC	96 fl oz	69.7 a	80 bc	100 b	100 a	NA
12	SuperWham + COC	192 fl oz	37.4 a	100 c	100 b	100 a	NA
13	Shark	7.5 oz	83.3 a	0 a	100 b	50 a	0 a

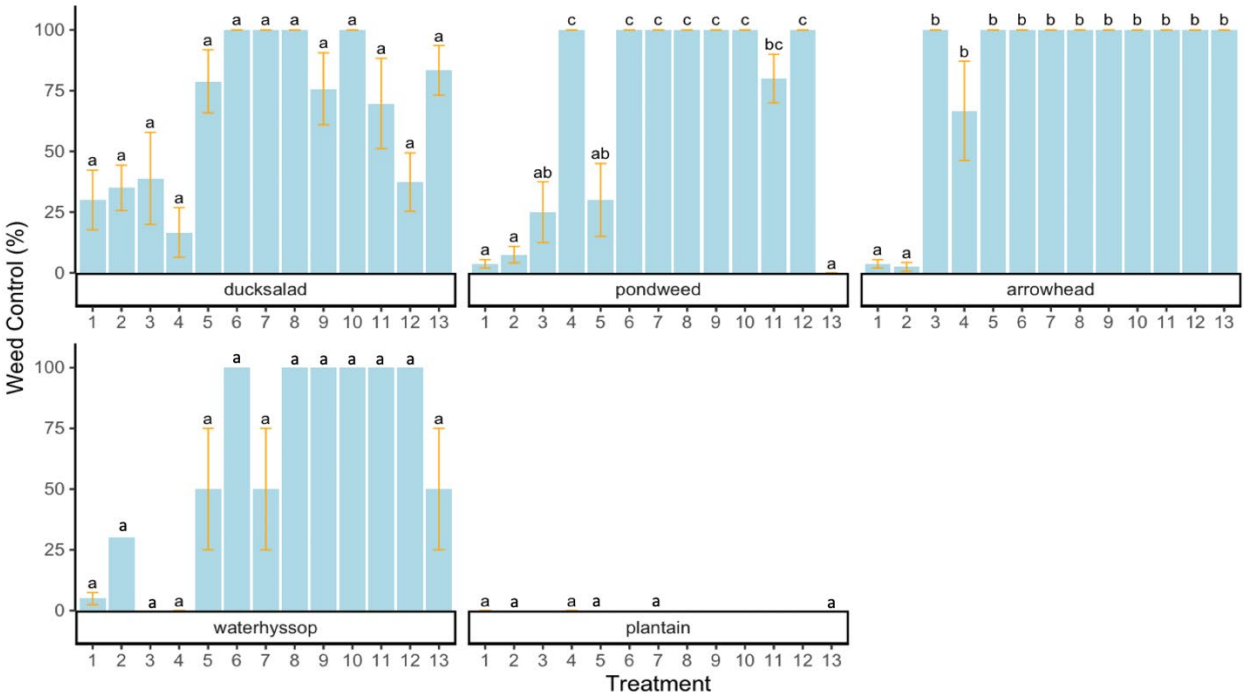

Figure 8. *Evaluations of weed control (in comparison to the untreated controls: Treatment 1 and Treatment 2) at 28 days for Shasta field/29 days for Yolo field after the initial herbicide application. Averages of the four treatment replications are reported, with different letters on the top of standard error bar 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).*

Yield.

The highest yield was in the lower rate of Loyant treatment. Yields from the Shark H2O treatment, SuperWham treatments, Clincher treatments, and the higher rate of Loyant, as well as the lower rate of Grandstand CA, were slightly lower but not significantly different from those of the lower rate of Loyant treatment. Both Granite SC treatments resulted in poor yields, nearly approaching zero, while the higher rate Grandstand treatment yielded lower than the untreated controls.

Table 12. *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 HSD test).*

	Treatment	Rate (per acre)	Yield (lbs/A)
1	Untreated Control	NA	1311.5 bc
2	Untreated Control	NA	1631.7 bc
3	Clincher CA + COC	15 fl oz	1438.4 bc
4	Clincher CA + COC	30 fl oz	1427.6 bc
5	Loyant + MSO fb Loyant + MSO	21 fl oz fl 21 fl oz	1906.4 c
6	Loyant + MSO fb Loyant + MSO	42 fl oz fl 42 fl oz	1710.2 bc
7	Granite SC + COC	2.8 fl oz	258.1 a
8	Granite SC + COC	5.6 fl oz	72.6 a
9	Grandstand CA + COC fb Grandstand CA + COC	16 fl oz fl 16 fl oz	1641.6 bc
10	Grandstand CA + COC fb Grandstand CA + COC	32 fl oz fl 32 fl oz	857 ab
11	SuperWham + COC	96 fl oz	1658.6 bc
12	SuperWham + COC	192 fl oz	1600 bc
13	Shark	7.5 oz	1822.9 c

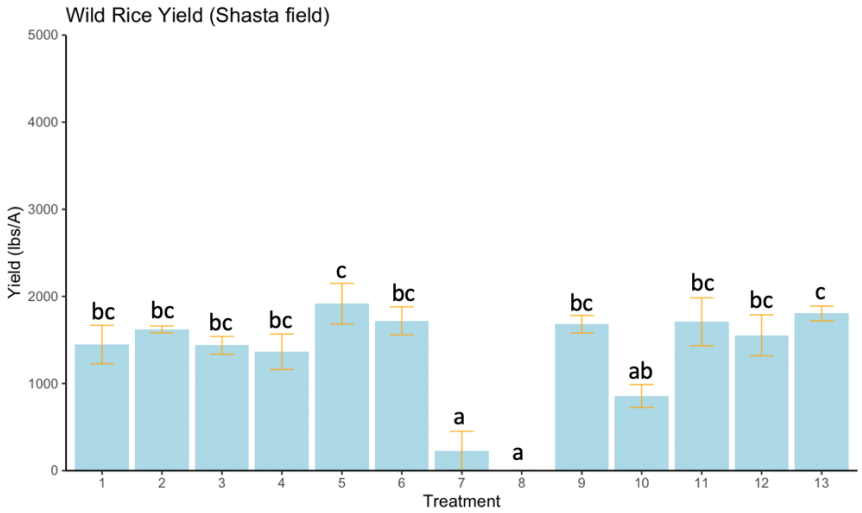

Figure 9. *Yields (lbs/A) adjusted to 14% moisture. Averages of the four treatment replications are reported, with different letters on the top of the standard error bars indicative of differences (using a Tukey HSD test).*

Discussion and Future Recommendations:

Granite SC appears to be very phytotoxic to wild rice, yet it exhibits effective control over a wide range of weed species. Despite causing notable lodging, Grandstand proves effective in managing pondweed, arrowhead, and waterhyssop. Among the herbicides tested, Loyant emerges as the most promising option due to its minimal phytotoxic effects, exceptional weed control, and high yields. SuperWham and Clincher also show promise with low phytotoxicity, satisfactory weed control, and high yields.

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 and Granite SC as well, if rates can be re-evaluated.