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Herbicide Trial in Delta Drill-Seeded Rice – 2021

By: Michelle Leinfelder-Miles, Delta Farm Advisor

Introduction:

Weeds are important pests of California rice systems, and weed management presents agronomic, economic, and regulatory challenges for growers (Al-Khatib et al., 2019; Espino et al., 2021; Rosenburg et al., 2021). Integrated weed management considers cultural and chemical practices to limit the impact of weeds. Herbicides are important tools, but it is becoming increasingly important to incorporate practices to stave off herbicide resistance, including rotating chemistries.

From 2019-2021, we conducted trials to evaluate the efficacy of a new herbicide product called Loyant (florpyrauxifen-benzyl; group 4 herbicide; Corteva Agriscience) in drill-seeded rice in the Sacramento-San Joaquin Delta region. Loyant is registered in rice growing states in the southern US but would be a new chemistry in California. Previous work by the company indicates that Loyant provides good control of broadleaf weeds (e.g. ducksalad, redstems), smallflower umbrella sedge, and ricefield bulrush. Results from 2019 and 2020 Delta trials indicate that Loyant has efficacy on grass weeds in the drill-seeded system, like watergrass and barnyardgrass (*Echinochloa* spp.). The objective of the 2021 trial was to assess the efficacy of Loyant on yellow nutsedge (*Cyperus esculentus*), which can be problematic in the Delta system (Fig. 1).

Figure 1. The most prevalent weeds in the 2019 and 2020 trials were A) watergrass and barnyard grass (*Echinochloa* spp.) and B) sprangletop (*Leptochloa fusca*). The most prevalent weed in the 2021 trial was C) yellow nutsedge (*Cyperus esculentus*).

Methods:

The trial took place on a Kingile muck soil. This soil classification is characterized as having upwards of 40 percent organic matter in the top foot of soil, and approximately 27,000 acres in the Delta are

classified as the Kingile series. On these soils, the typical practice is drill-seeding. Water-seeding, which is the typical practice in the Sacramento Valley, is not successful in the Delta because the soil particles can go into suspension when establishing the flood and then bury the seed too deeply, causing poor germination.

The rice was drill-seeded around April 15th with variety M-206. After planting, but before rice emergence, glyphosate herbicide was applied to manage weeds, primarily grasses, that had already emerged. Treatments (Table 1) were applied on May 18th when the rice was at approximately the 4 leaf stage. The trial was in a different location from previous years, in a field where we had identified a sedge problem the year before. The only weed species present at the time of application was yellow nutsedge, which had 3-5 leaves at the time of application. Applications were made using a CO_2 backpack sprayer, using flat fan nozzles, with an output volume of 20 gallons per acre. At the time of application, environmental conditions were approximately as follows: air temperature 73 degrees F, relative humidity 35 percent, and wind speed 2 mph. The permanent flood was applied about seven days after herbicide application.

The experimental design was a randomized complete block design with four replicates. Plot size was 20 feet by 20 feet. Since this was a commercial field, we did not have completely untreated plots because weed pressure would have been severe. Instead, we considered the Prowl treatment as the "control". We made crop injury observations on 7-day intervals from 7 to 42 days after treatment (DAT). We estimated percent weed control compared to the control on 7-day intervals from 14 to 35 DAT. We did not collect yield in 2021.

Table 1. Herbicide treatments in the 2021 drill-seeded rice trial.

Materials	Rate (unit of product/acre)	Herbicide Program denoted as
Loyant, Prowl H2O, MSO	1.33 pt, 5.5 pt, 0.5 pt	Loyant
Loyant, Clincher, Prowl H2O, MSO	1.33 pt, 15 fl-oz, 5.5 pt, 0.5 pt	Loyant/Clincher
Loyant, Granite SC, Prowl H2O, MSO	1.33 pt, 2.8 fl-oz, 5.5 pt, 0.5 pt	Loyant/Granite
Loyant, RebelEX CA, Prowl H2O, MSO	1.33 pt, 20 fl-oz, 5.5 pt, 0.5 pt	Loyant/RebelEX
Regiment, Sandea, Prowl H2O, SuperWham, MSO, UAN-32	0.2 oz, 0.8 oz, 5.5 pt, 6 qt, 16 fl-oz, 2%	Grower standard
Prowl H2O	5.5 pt	Prowl/control
Loyant, Prowl H2O, SuperWham, MSO	1.33 pt, 5.5 pt, 6 qt, 16 fl-oz	Loyant/SuperWham

Additionally, we had a non-replicated demonstration site where we evaluated Loyant alone and in tank mixes with other products in a post-flood application. The demonstration site was on a different farm, on a Rindge muck soil, but it had the same variety (M-206) and pre-flood herbicide program as the Grower Standard treatment of the replicated trial (Table 1). The post-flood treatments (Table 2) were applied on June 28th to evaluate efficacy on grasses that had escaped the pre-flood grower treatment. Many of the grasses were already heading at the time of application. Plot size was 20-ft by 100-ft.

Table 2. Herbicide treatments in the 2021 post-flood demonstration site.

Materials	Rate (unit of product/acre)	Herbicide Program denoted as
Loyant, MSO	1 pt, 0.5 pt	Loyant-low
Loyant, MSO	1.33 pt, 0.5 pt	Loyant-high
Loyant, Clincher, COC, UAN-32	1 pt, 15 fl-oz, 2.5%, 2%	Loyant/Clincher-high
Loyant, Clincher, COC, UAN-32	1.33 pt, 10 fl-oz, 2.5%, 2%	Loyant/Clincher-low
Loyant, Regiment, MSO, UAN-32	1 pt, 0.8 oz, 0.5 pt, 2%	Loyant/Regiment-high
Loyant, Regiment, MSO, UAN-32	1.33 pt, 0.4 oz, 0.5 pt, 2%	Loyant/Regiment-low
Loyant, SuperWham	1.33 pt, 6 qt	Loyant/SuperWham

Results and Discussion:

In the replicated trial, crop injury observations were characterized as leaf tip burn/necrosis (Table 3). We observed noticeable tip burning in the grower standard and Loyant/SuperWham treatments at 7 DAT, but some tip burning was observed in all treatments. While we observed leaf curling in the Loyant treatments in previous years, we did not observe any leaf curling in 2021. In company trials, leaf curling has been associated with environmental stress conditions, like heat, cold, or drought. Crop injury symptoms were no longer observed after 14 DAT. We observed no stunting, stand reduction, or differences in heading among treatments.

Table 3. Crop injury on 7-day intervals starting at 7 days after treatment (DAT). By 14 DAT, injury symptoms were no longer observed.

Herbicide Program (Treatment)	Necrosis/Tip Burn	
	7 DAT	14 DAT
Loyant	Some Effect	None
Loyant/Clincher	Some Effect	None
Loyant/Granite	Some Effect	None
Loyant/RebelEX	Some Effect	None
Grower standard	Noticeable Effect	None
Prowl/control	Some Effect	None
Loyant/SuperWham	Noticeable Effect	None
	No severe effect observed	

In terms of weed control, the best treatment for yellow nutsedge in this trial was the grower standard program. That tank mix included Sandea, which is an effective herbicide for yellow nutsedge. Several Loyant treatments performed statistically similar to the grower standard herbicide program and better than the Prowl ("control") treatment (Table 4). These included Loyant tank mixes with Granite, RebelEX, and SuperWham. Loyant alone performed statistically worse than the grower standard program in this trial. While Loyant is registered for yellow nutsedge in other states, lack of moisture

can impact efficacy. The delay in establishing the permanent flood may have affected its efficacy in this trial. The Loyant/Clincher treatment was the only tank mix that performed worse than the grower standard; however, since Clincher is a grass herbicide, we would not expect it to perform well at this yellow nutsedge site. At 64 DAT, we observed that *Echinochloa* grasses had grown in the Prowl treatment, but they were controlled with the other treatments. The observations agree with the 2019 and 2020 trial results, where Loyant and Loyant tank mixes showed good efficacy on *Echinochloa* spp.

Table 4. Percent weed control, as plot area, was estimated on 7-day intervals from 14 days after treatment (DAT) to 35 DAT. An untreated area of the field had about 1-4 sedges per square foot.

Herbicide Program (Treatment)	Weed Control (%)			
	14 DAT	21 DAT	28 DAT	35 DAT
Loyant	53 bc	34 bcd	34 b	34 bc
Loyant/Clincher	46 c	27 cd	13 bc	19 c
Loyant/Granite	84 ab	79 a	76 a	71 a
Loyant/RebelEX	80 abc	71 ab	68 a	66 ab
Grower standard	97 a	97 a	98 a	91 a
Prowl/control	0 d	0 d	0 c	0 c
Loyant/SuperWham	66 abc	58 abc	68 a	66 ab
Average	61	52	51	50
Coefficient of Variation (%)	10	13	13	13
Significance of treatment effect (P value)	<0.0001	<0.0001	<0.0001	<0.0001

Since the post-flood demonstration site was not a replicated trial, no data are presented, but we made crop injury and weed control observations at 7 and 14 DAT. No crop injury was observed with any treatments. Weed control was compared to a non-treated area outside of the demonstration area. All treatments had efficacy on grasses, but the Loyant/Clincher treatments appeared to work best. While Loyant alone has not generally been efficacious on large watergrass in previous company trials, at this site, it did improve weed control at both rates compared to the untreated area.

Conclusions:

The purpose of this trial was to learn the efficacy and crop tolerance of Loyant (florpyrauxifen-benzyl) for weed control in drill-seeded rice in California, with the specific objective in 2021 to evaluate efficacy on yellow nutsedge. We observed slight but transient tip burning in all treatments but no other injury symptoms. The best treatment for yellow nutsedge control in this trial was the grower standard program, which included Sandea. Loyant, alone, was not efficacious on yellow nutsedge but performed well in tank mixes with other products. At a post-flood demonstration site, Loyant alone and in tank mixes observably suppressed grasses that had escaped the grower standard pre-flood treatment.

Three years of results trialing Loyant in the Delta drill-seeded system indicate that it could be used in herbicide program tank mixes, providing a different chemistry for herbicide resistance management.

The aforementioned information on products and practices is for educational purposes only and does not constitute an endorsement or recommendation by the University of California.

Acknowledgments:

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Herbicide Trials in Delta Drill-Seeded Rice – 2019 and 2020

By: Michelle Leinfelder-Miles, Delta Farm Advisor

Introduction:

Weeds are important pests of California rice systems, and weed management can account for roughly 17 percent of total operating costs (Espino et al., 2016). Integrated weed management uses cultural and chemical practices and considers the following:

- Prevention (e.g. using certified seed, equipment sanitation, maintaining roads and levees)
- Cultural practices (e.g. land leveling, crop rotation, tillage, winter flooding, drill-seeding)
- Fertilizer placement and management
- Water management
- Monitoring
- Herbicides

Herbicide are important tools. Certain conditions in California rice production systems, however, increase the likelihood of developing herbicide resistance, or the ability of certain weed biotypes to survive certain herbicide treatments when the weed species is usually killed by that herbicide (Al-Khatib et al., 2019). Such conditions include, but are not limited to, lack of crop rotation, the efficacy of certain herbicides on certain weeds causing them to get frequently used, and not having diverse chemistries available.

In 2019 and 2020, trials were conducted to evaluate the efficacy of a new herbicide product called Loyant (florpyrauxifen-benzyl; group 4 herbicide; Corteva Agriscience) in drill-seeded rice in the Sacramento-San Joaquin Delta region. Loyant is registered in rice growing states in the southern US but would be a new chemistry in California. Corteva Agriscience expects to have CA registration in time for the 2021 use season. Previous work by the company indicates that Loyant provides good control of broadleaf weeds (e.g. ducksalad, redstems), smallflower umbrella sedge, and ricefield bulrush. It has some activity on *Echinochloa* species (e.g. barnyardgrass, watergrass). The objective of the trials, by assessing different rates and treatment combinations, was to understand the efficacy and crop tolerance of Loyant for weed control in drill-seeded rice in California.

The trials took place in the Delta region on a Kingile muck soil. This soil classification is characterized as having upwards of 40 percent organic matter in the top foot of soil, and approximately 27,000 acres in

the Delta are classified as the Kingile series. On high organic matter soils in the Delta, the typical practice is drill-seeding. Water-seeding, which is the typical practice in the Sacramento Valley, is not successful in the Delta because the soil particles can float and move too easily, causing seed to get buried too deeply and germinate poorly.

Methods:

In 2019, the rice was drill-seeded on May 15th, and in 2020, seeding took place on April 13th. In both years, the variety was M.206. After planting, but before rice emergence, glyphosate herbicide was applied to manage weeds, primarily grasses, that had already emerged. Treatments are shown in Tables 1 and 2 (2019 and 2020, respectively). Applications were made using a CO_2 backpack sprayer, using flat fan nozzles, with an output volume of 20 gallons per acre. Since this was a commercial field, we did not have completely untreated plots and considered the Prowl treatment the "control". The permanent flood was applied within five days of herbicide application.

Table 1. *Herbicide treatments in the 2019 trial. Treatments were applied on June 9th, when rice was approximately at the 5-6 leaf stage. Applications were slightly delayed due to windy conditions in the week prior to application. Environmental conditions at application were as follows: air temperature 63 degrees F, relative humidity 54 percent, and wind speed 3 mph.*

Materials	Rate (unit of product/acre)	Herbicide Program denoted as
Loyant, Prowl H2O, MSO	1.37 pints, 5.5 pints, 0.5 pints	Loyant-high + Prowl
Loyant, Prowl H2O, MSO	1.024 pints, 5.5 pints, 0.5 pints	Loyant-low + Prowl
Loyant, MSO	1.37 pints, 0.5 pints	Loyant-high
Regiment, Sandea, Prowl H2O, SuperWham, MSO, UAN-32	0.2 ounces, 0.8 ounces, 5.5 pints, 6 quarts, 16 fluid ounces, 2 gallons/100 gal	Grower standard
Prowl H2O	5.5 pints	Prowl
Regiment, Sandea, Prowl H2O, Loyant, MSO, UAN-32	0.2 ounces, 0.8 ounces, 5.5 pints, 1.37 pints, 16 fluid ounces, 2 gallons/100 gal	Grower substitute

Table 2. *Herbicide treatments in the 2020 trial. Treatments were applied on May 8th, when the rice was approximately at the 3 leaf stage. Environmental conditions at application were as follows: air temperature degrees 78 F, relative humidity 47 percent, and wind speed 0-2.5 mph.*

Materials	Rate (unit of product/acre)	Herbicide Program denoted as
Loyant, Prowl H2O, MSO	1.37 pints, 5.5 pints, 0.5 pints	Loyant
Loyant, Clincher, Prowl H2O, MSO	1.37 pints, 15 fluid ounces, 5.5 pints, 0.5 pints	Loyant/Clincher
Loyant, Granite SC, Prowl H2O, MSO	1.37 pints, 2.8 fluid ounces, 5.5 pints, 0.5 pints	Loyant/Granite
Loyant, RebelEX CA, Prowl H2O, MSO	1.37 pints, 20 fluid ounces, 5.5 pints, 0.5 pints	Loyant/RebelEX
Regiment, Sandea, Prowl H2O, SuperWham, MSO, UAN-32	0.2 ounces, 0.8 ounces, 5.5 pints, 6 quarts, 16 fluid ounces, 2 gallons/100 gal	Grower standard
Prowl H2O	5.5 pints	Prowl
Loyant, Prowl H2O, SuperWham, MSO	1.37 pints, 5.5 pints, 6 quarts, 16 fluid ounces	Loyant/SuperWham

The experimental design was a randomized complete block design with four replicates. Plot size was 20 feet by 20 feet. We made crop injury observations on 7-day intervals from 7 to 42 days after treatment (DAT). We made weed density observations on 7-day intervals from 14 to 42 DAT. The most prominent weeds in the field were *Echinochloa* species (i.e. watergrass, barnyardgrass), but we also observed sprangletop (*Leptochloa fusca*) and sedges that we believed to be a flatsedge, like redroot flatsedge (*Cyperus erythrorhizos*) (Fig.1). The 2019 trial was harvested on November 1st, and the 2020 trial was harvested on September 29th. We measured grain yield from a 10.8-ft^2 (1-m^2) quadrat per plot.

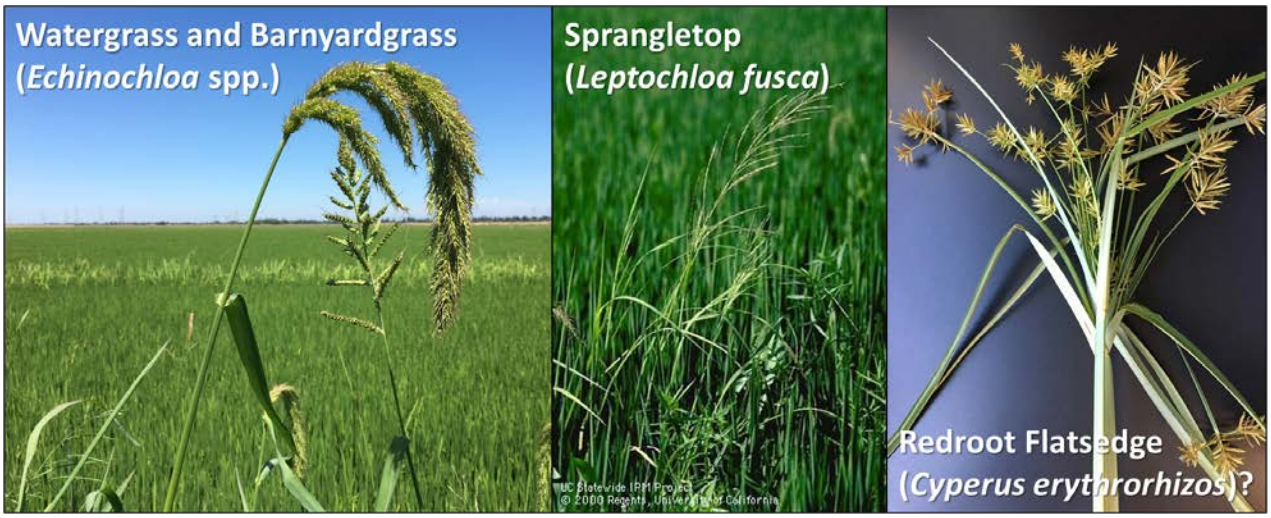

Figure 1. *Weeds present in the trial: watergrass, barnyardgrass, sprangletop, and sedges. Sprangletop was only observed in 2019. Photos by M. Leinfelder-Miles and UC IPM.*

Results and Discussion:

Crop Injury

Crop injury observations were characterized as crop chlorosis, tip burn, and leaf curling. In 2019 (Table 3), we observed noticeable crop chlorosis and tip burning in the grower standard treatment at 7 DAT, and slight effects in the grower substitute treatment. We observed slight to noticeable leaf curling in the Loyant treatments 14 DAT. Crop injury effects in all treatments were not observed by 21 DAT. In 2020 (Table 4), we did not observe crop chlorosis, but we did observe tip burning in several of the treatments. We also observed leaf curling in the Loyant treatments, which persisted longer into the season in 2020 compared to 2019. Corteva Agriscience has observed this symptom with Loyant in other trials where environmental stressors impact crop health, such as extreme cold or heat, drought, or poor fertility. We observed this symptom on the side of the plots closest to the field edge.

Table 3. *2019 crop injury on 7-day intervals from 7 days after treatment (DAT) to 14 DAT. Injury symptoms had disappeared by 21 DAT.*

Herbicide Program (Treatment)	Crop Chlorosis 7 DAT	Necrosis/Tip Burn 7 DAT	Crop Chlorosis 14 DAT	Leaf Curling 14 DAT
Loyant-high + Prowl	None	None	None	Noticeable Effect
Loyant-low + Prowl	None	None	None	Noticeable Effect
Loyant-high	None	None	None	Some Effect
Grower standard	Noticeable Effect	Noticeable Effect	Some Effect	None
Prowl	None	None	None	None
Grower substitute	Some Effect	Some Effect	None	Some Effect
	No Severe Effects Observed with any Program.			

Table 4. *2020 crop injury on 7-day inervals from 7 DAT to 42 DAT. Tip burn symptoms were no longer observed by 21 DAT; whereas, leaf curling persisted until 56 DAT.*

Herbicide Program (Treatment)	Necrosis/Tip Burn 7 DAT	Necrosis/Tip Burn 14 DAT	Leaf Curling 14 DAT	Leaf Curling 21 DAT	Leaf Curling 28 DAT	Leaf Curling 35 DAT	Leaf Curling 42 DAT
Loyant	Slight Effect	None	Some Effect	Some Effect	Some Effect	Noticeable Effect	Noticeable Effect
Loyant/Clincher	Slight Effect	None	Some Effect	Slight Effect	Slight Effect	Slight Effect	Slight Effect
Loyant/Granite	None	None	Some Effect	Slight Effect	Slight Effect	Some Effect	Some Effect
Loyant/RebelEX	None	None	Some Effect	Slight Effect	Slight Effect	Slight Effect	Slight Effect
Grower standard	Some Effect	None	None	None	None	None	None
Prowl	Slight Effect	None	Slight Effect	None	None	None	None
Loyant/SuperWham	Noticeable Effect	Some Effect	Some Effect	Slight Effect	None	None	None
	No Severe Effects Observed with any Program.						

We observed no stunting, stand reduction, or differences in heading with any treatments in either year. In 2019, heading occurred at approximately 87 days (Aug 15th, approximately 1894 growing degree days), and in 2020, it occurred at approximately 109 days (July 31st, approximately 1893 growing degree days).

Weed Control

Treatment efficacy is shown in Tables 5 and 6. In 2019, all treatments had similar weed control with the exception of the Prowl treatment, which had statistically higher weed counts in many circumstances. Loyant does not control sprangletop, so that was the weed most commonly observed.

In 2020, overall weed pressure was lower than in 2019. While we observed approximately four weeds per square foot in an untreated strip of the field in 2019, we only observed about 1 weed per square foot in untreated strip in 2020. We also did not observe any sprangletop. There was a trend for the Prowl treatment to have the highest weed counts, but those counts were generally not statistically higher than counts in the Loyant plots. The treatments that had the best weed control were the grower standard and Loyant/SuperWham herbicide programs.

Table 5. *2019 weed counts on 7-day intervals from 14 days after treatment (DAT) to 42 DAT. Data were transformed for analysis. Arithmetic means are presented. Data represent number of weeds in the entire 400-ft^2 plot.*

Herbicide Program (Treatment)	14 DAT	21 DAT	28 DAT	28 DAT (excluding sprangletop)	42 DAT	42 DAT (excluding sprangletop)
Loyant-high + Prowl	0 b	2 b	10 b	4	10 b	4
Loyant-low + Prowl	0 b	5 b	12 ab	2	11 b	2
Loyant-high	1 b	2 b	6 b	2	8 b	2
Grower standard	0 b	6 b	13 ab	1	16 ab	1
Prowl	13 a	21 a	29 a	10	36 a	15
Grower substitute	2 b	6 b	14 ab	2	18 ab	6
Average	3	7	14	4	17	5
Coefficient of Variation (%)	56	44	36	53	34	58
Significance of treatment effect (P value)	<0.0001	<0.0001	0.015	0.0584	0.0036	0.0787

Table 6. *2020 weed counts on 7-day intervals from 14 DAT to 42 DAT. Data were transformed for analysis. Arithmetic means are presented. Data represent number of weeds in the entire 400-ft^2 plot.*

Herbicide Program (Treatment)	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT
Loyant	3	5	2ab	3 ab	4 c
Loyant/Clincher	2	3	1ab	3 ab	5 bc
Loyant/Granite	4	3	1 b	9 ab	15 ab
Loyant/RebelEX	2	3	1ab	4 ab	9 abc
Grower standard	1	1	1 b	2 b	4 c
Prowl	3	0	8a	15 a	21 a
Loyant/SuperWham	1	2	1 b	2 b	3 c
Average	2	2	2	5	9
Coefficient of Variation (%)	113	74	154	119	95
Significance of treatment effect (P value)	0.1757	0.2314	0.0191	0.0085	0.0011

Yield

We found no differences in yield or seed moisture at harvest in either year (Table 7 and 8). In 2019, yield averaged 8965 pounds per acre averaged across treatments, and seed moisture averaged 13.7 percent. In 2020, our measured yields were uncharacteristically high for the region. Our explanation of the data is that we did our hand harvest in the early morning hours when there was a heavy dew. Because variability across the replicates was low, as indicated by the low coefficient of variation, we believe the data demonstrate relative comparability of herbicide programs, even though absolute values are high. While not statistically significant, there was a trend for the grower standard and the Loyant/SuperWham herbicide programs to have higher yields, which corresponds to the lower weed pressure in those treatments. We did not observe lodging in either year.

Table 7. *2019 harvest results. Yield was adjusted to 14 percent moisture.*

Herbicide Program (Treatment)	Seed Moisture (%)	Yield (lbs/ac)
Loyant-high + Prowl	13.8	9251
Loyant-low + Prowl	13.8	9122
Loyant-high	13.8	8632
Grower standard	14.0	8896
Prowl	13.8	8896
Grower substitute	13.1	8994
Average	13.7	8965
Coefficient of Variation (%)	5	3
Significance of treatment effect (P value)	0.0566	0.5748

Table 8. *2020 harvest results. Seed moisture as reported by the grower was 18.5 percent. Yield was adjusted to 14 percent moisture*.

Herbicide Program (Treatment)	Yield (lbs/ac)
Loyant	12575
Loyant/Clincher	12431
Loyant/Granite	13064
Loyant/RebelEX	12210
Grower standard	13438
Prowl	12335
Loyant/SuperWham	13534
Average	12798
Coefficient of Variation (%)	8
Significance of treatment effect (P value)	0.3755

Conclusions:

The purpose of these trials was to learn the efficacy and crop tolerance of Loyant (florpyrauxifen-benzyl) for weed control in drill-seeded rice in California. We tested Loyant at different rates (2019) and in combination with other products (2020). We observed Loyant to have good activity on the *Echinochloa* species but not on sprangletop, which was expected based on previous company trials. We observed Loyant treatments to have similarly low weed counts compared to the grower standard, and a Loyant/SuperWham herbicide program appears to provide comparable weed control to the grower standard. Tank mixes will be needed to manage sprangletop. We observed leaf rolling symptoms with the Loyant treatments which has been associated with stressed rice in prior testing. The Loyant label in review at the CA Department of Pesticide Regulation includes a statement about crop stress or environmental factors potentially impacting efficacy and crop tolerance. We did not, however, observe that the leaf rolling impacted yield. There were no significant differences in yield among the treatments in either year. These results demonstrate that Loyant could be used in drill-seeded rice herbicide programs, providing a different chemistry for herbicide resistance management.

The aforementioned information on products and practices is for educational purposes only and does not constitute an endorsement or recommendation by the University of California.

Acknowledgments:

We thank the following individuals for their support on this trial: Eugene Muzio for hosting the trials; Albert Giannecchini (PCA, Wilbur-Ellis); Whitney Brim-DeForest, Luis Espino, and Ray Stogsdill (UCCE); and Stephen Colbert (Corteva Agriscience).

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