Sweetpotato Research Progress Report 2020

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Sweetpotato Collaborators Trial -- 2020

Scott Stoddard, UCCE Merced County

The first of two screening trials. This location was with Quail H Farms, south of Livingston, CA. Soil type was Hilmar loamy sand, slightly saline (pH 6.8, EC 2.08, Na 7.7% base sat). Conventional field, fumigated with metam-K prior to planting. Drip irrigated, water quality marginal. Dryer than normal winter with no major spring weather problems, average summer temperatures.
Two -row plots, machine harvested and sorted by grower crew. Nematode and wireworm damage in some plots.

Rep	Var#	Variety Name	Skin Color	Skin Text	Flesh color	Eyes	Lents	Shape	Shape Uniform	Overall App	Comments	L:D ratio	4-month Loss%
1	1	L-13-81	purple	7	4	7	5	2, 3, 8	5	7	lents. Some side roots. Some RKN	3.1	7.7
2													
1	2	L-14-31	red-purple	3	4	7	5	5,6	5	2	RKN, lents, off color, bumpy	3.0	8.8
2													
1	3	NC-09-122	purple	6	3	7	5	3,8	7	7	scratches easily	3.1	5.1
2													
1	4	NC11-0234	Red	5	4	8	3	2, 3, 6	5	3	Dark lents. CV. Rough	2.6	11.4
2													
1	5	Covington	Rose Cu	7	3	5	3	3,6	7	5	YCR, dark lents, CV	3.1	10.2
2			Rose Cu	7	3	7	2	3,2	7	7	Lents, good shape, LG		
1	6	Orleans	Rose	5	3	5	5	2,6	7	6	rough skin, lents	2.5	8.4
2			Cu	5	3	7	5	2, 6, 8	8	7			
1	7	Beauregard (G5)	Rose	4	3	5	5	3, 6, 8	5	5	RC, RKN	2.4	10.9
2			Cu	5	3	7	4		5	4	eyes, lents, off color		
1	8	Bellevue	Orange	9	4	9	7	2, 8	7	7	WW, grub	2.9	10.0
2			Orange	9	4	9	7	6	7	8			
1	9	Bonita	tan	9	1	5	5	4, 5, 8	5	6	some veins	3.5	11.5
2			buff	9	1	7	5	4	6	5	some pink, lents, long		
1	10	Diane	red	9	4	5	6	3, 4	7	7	nice color and shape	3.3	12.6
2				9	4	6	7	3, 4	9	7	long, some RKN necrosis		
1	11	Burgundy	burgundy	9	4	7	7	1, 2	6	7	bally, brown not red, smooth	2.2	11.0
2			maroon	9	4	9	7	1, 2	7	8	good skin set		
1	12	NC-13-604	Cream	7	1	5	7	3, 6	7	7	good shape	2.6	7.9
2			Buff	8	1	6	7	6	8	7	some latex staining		
1	13	NC-13-151	purple	8	3	9	7	2, 5	7	9	good shape and color	2.5	16.6
2			purple										
1	14	NC09-119	red	6	4	5	5	2, 6	5	6	skin like Burgundy, but eyes	2.4	10.0
2			maroon	5	4	4	4		6	7			
1	15	NC10-0118	Cu orange	3	4	3	3	4, 7	3	3	dark lents, rough skin	3.8	11.9
2			Cu orange	5	5	5	5	5, 8	3	3	side roots, long		
1	16	NC15-0185	Rose Cu	3	4	5	5	4, 7	3	3	side roots, veins, LG	2.8	11.8
2			Rose Cu	5	4	5	7	2, 6	3	4	lents, CV		
1	17	L-14-11	purple	9	3	9	7	2, 3	9	8	smooth, good shape	3.0	14.6
2			red purple	7	3	7	7	3, 8	7	9	very nice		
1	18	L-17-171	Red	5	3	7	7	7, 8	5	5	LG, veins, side roots	3.2	15.4
2			purple	7	3	5	5	4, 7	3	3	not pretty, long		

Skin color:	Skin Texture:	Flesh Color:	Eyes:	Lenticels:
cream (Hanna)	1 = very rough	0 = white	1 = very deep	1 = very prominent
Tan	3 = moderately rough	1 = cream	3 = deep	3 = prominent
copper (Jewel)	5 = moderately smooth	2 = yellow	5 = moderate	5 = moderate
Rose (Beau)	7 = smooth	3 = orange	7 = shallow	7 = few
Purple (Garnet)	9 = very smooth	4 = deep orange	9 = very shallow	9 = none
		5 = very deep orange		

Shape:	Shape Uniformity:
1 = round	1 = very poor
2 = round-elliptical	3 = poor
3 = elliptic	5 = moderate
4 = long elliptic	7 = good
5 = ovoid	9 = excellent
6 = blocky	
7 = irregular	
8 = asymmetric	

Overall Appearance:	
1 = very poor	
3 = poor	**All ratings made on #1 roots.**
5 = moderate	**YCR = yellow cortical ring**
7 = good	**RC = Russet Crack**
9 = excellent	**RKN = root knot nematode**
	LG = longitudinal grooves
	CV = color variation end to end
	WW = wireworm damage

NATIONAL SWEETPOTATO COLLABORATORS SUMMARY OF DATA 2020

STATE AND LOCATION REPORTING: Livingston, CA
DATE TRANSPLANTED: 6/2/2020. DATE HARVESTED: 10/21/2020. No.
GROWING DAYS: 141
DISTANCE BETEEN ROWS (in): 40. DISTANCE IN ROW (in): 9
PLOT SIZE: NO. OF ROWS: 2 LENGTH (ft): 40 NO. OF REPS: 4
IRRIGATION: drip irrigation. 1.5 to 2 inches per week during summer, total 30".
FERTILIZER: PPI 60 gpa 8-8-8 followed by drip applied 10-0-10. About 175-50-175 N-P2O5-K2O.

			-------	40	lb box/A adj	-------	total	%	%	
#	SELECTION	CLASS	US #1's	Medium	Jumbo	MKT YIELD	BINS/A	US #1's	CULLS	L:D
13	NC-13-151	red yam	753	283	133	1169	58.5	64.3%	5.1%	2.5
18	L-17-171	red yam	679	207	145	1031	51.5	65.5%	10.6%	3.2
10	Diane	red yam	675	263	116	1054	52.7	64.1%	10.6%	3.3
5	Cov.	yam	672	217	95	984	49.2	68.3%	10.0%	3.1
3	NC-09-122	red yam	592	143	215	949	47.5	62.3%	14.5%	3.1
15	NC10-0118	yam	545	224	177	947	47.3	57.5%	27.0%	3.8
1	L-13-81	red yam	540	247	64	851	42.5	63.2%	13.5%	3.1
4	NC11-0234	yam	519	148	411	1079	53.9	48.6%	14.6%	2.6
9	Bonita	sweet	519	161	103	783	39.1	66.0%	18.6%	3.5
2	L-14-31	red yam	513	139	216	869	43.5	59.2%	8.9%	3.0
14	NC09-119	red yam	510	165	244	919	46.0	55.6%	31.3%	2.4
16	NC15-0185	yam	508	189	73	771	38.5	66.0%	14.8%	2.8
8	Bellevue	yam	499	221	87	807	40.4	62.1%	24.3%	2.9
6	Orleans	yam	428	184	109	720	36.0	59.8%	26.8%	2.5
12	NC-13-604	sweet	401	276	30	707	35.4	56.7%	15.1%	2.6
17	L-14-11	red yam	396	120	46	561	28.1	70.2%	18.6%	3.0
11	Burgundy	red yam	352	154	121	628	31.4	56.2%	18.1%	2.2
7	Beauregard	yam	303	116	108	527	26.4	58.9%	42.9%	2.4
	Average		522.5	192.2	138.5	853.1	42.7	61.4%	18.1%	2.87
	LSD 0.05		97.8	55.5	81.9	141.9	7.1	7.4	8.8	0.52
	CV, %		13.2	20.3	41.7	11.7	11.7	8.5	34.3	20.6

US #1's	Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.
Mediums	Roots 1 to 2 in diameter, 2 to 7 inches in length.
Jumbos	Roots that exceed the size requirements of above grades, but are marketable quality.
Mkt Yield	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 20 boxes (17.6 Bu) per bin.
% US #1's	Weight of US #1's divided by total marketable yield.
% Culls	Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.
L:D	Length to diameter ratio (10 root sample)
LSD 0.05	Least significant difference. Means separated by less than this amount are not significantly different (ns).
CV, %	Coefficient of variation, a measure of variability in the experiment.

SCORE SHEET FOR EVALUATION OF SWEETPOTATO SPROUT PRODUCTION - NSPCG TRIAL

Date bedded: 2/27/20 Location: Bear Creek Ranch, south of Hwy 140

Date Evaluated: 4/22/20 Type of bed: cold bed (no gin trash)

Evaluated by: S. Stoddard Botran & Devrinol at bedding

	Selection	Roots presprouted yes/no	Plant Production 1-5 (1)	Uniformity of Emergence 1-5 (2)	Earliness 1-3 (3)	Root Conditions 1-5 (4)	Remarks (5)
1	L-13-81	yes	5	4	3	5	purple new growth
2	L-14-31	yes	4	4	3		dark green new growth
3	NC09-122	yes	5	5	3		regular green
4	NC11-0234	yes	3	4	2		all green
5	Covington	yes	3	3	2		purple new growth, dk green
6	Orleans	yes	5	4	3		ready to plant
7	Beauregard G5	yes	4	4	3		green
8	Bellevue	yes	3	4	2		purple
9	Bonita	yes	5	5	3		crinkle, green
10	Diane	yes	5	5	3		no southern blight
11	Burgundy	yes	4	3	2		clumpy, dark green, sl purple
12	NC13-604	yes	5	5	3		high plant production
13	NC13-151	yes	5	3	2		hi production, clumpy
14	NC09-119	yes	3	3	2		dk green, purple new growth
15	NC10-0118	yes	2	2	1		all green
16	NC15-0185	yes	5	4	3		dk green, purple new growth
17	L-14-11	yes	3	3	1		purple new growth, dk green
18	L-17-171	yes	4	4	3		all green

(1) Plant production rated from 1 – 5 based on observation during pulling season.
A rating of 1 indicates low plant production, while 5 indicates good plant production.

(2) Uniformity of emergence rated from 1 - 5. One (1) indicates poor uniformity
while 5 indicates the highest degree of uniformity of emergence.

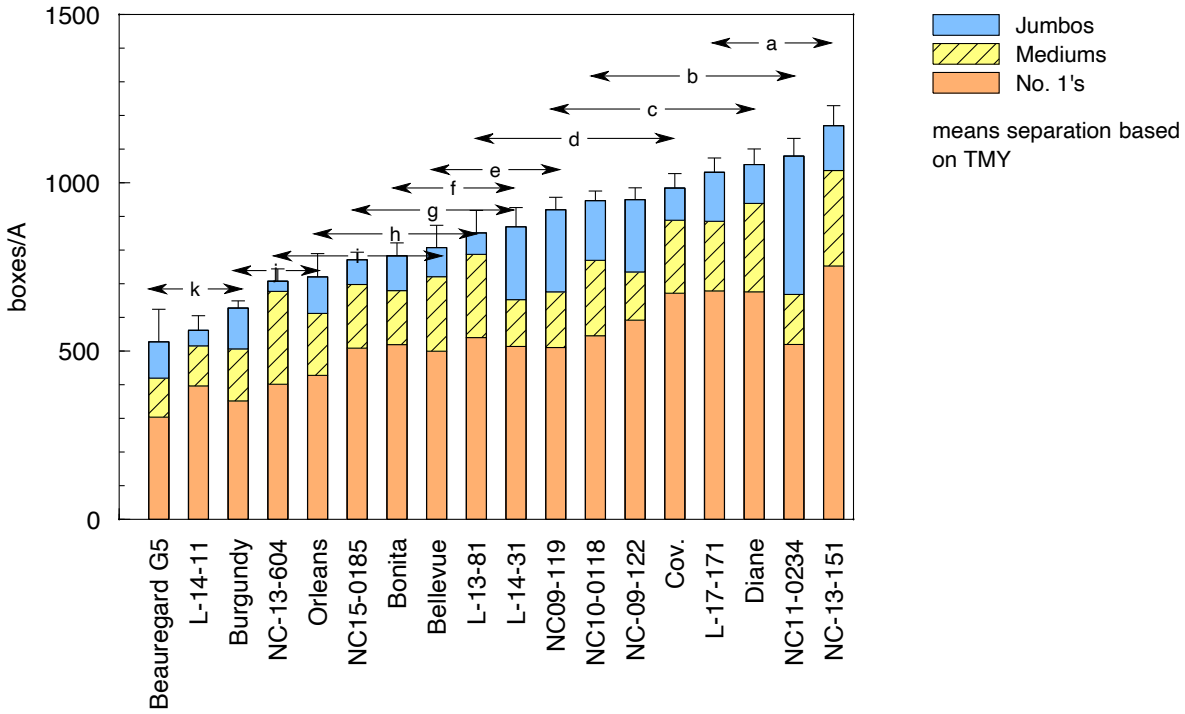
(3) Earliness of plant production is rated form 1 – 3. One (1) indicated late emergence
while 3 indicates early production.

(4) Root conditions six weeks after first pulling, rated 1 – 5. One (1) indicates complete
rotting, while 5 indicates perfectly sound conditions.
Mostly not applicable as beds were disced shortly after transplanting.

(5) Notes on size of root, decay in beds, etc.

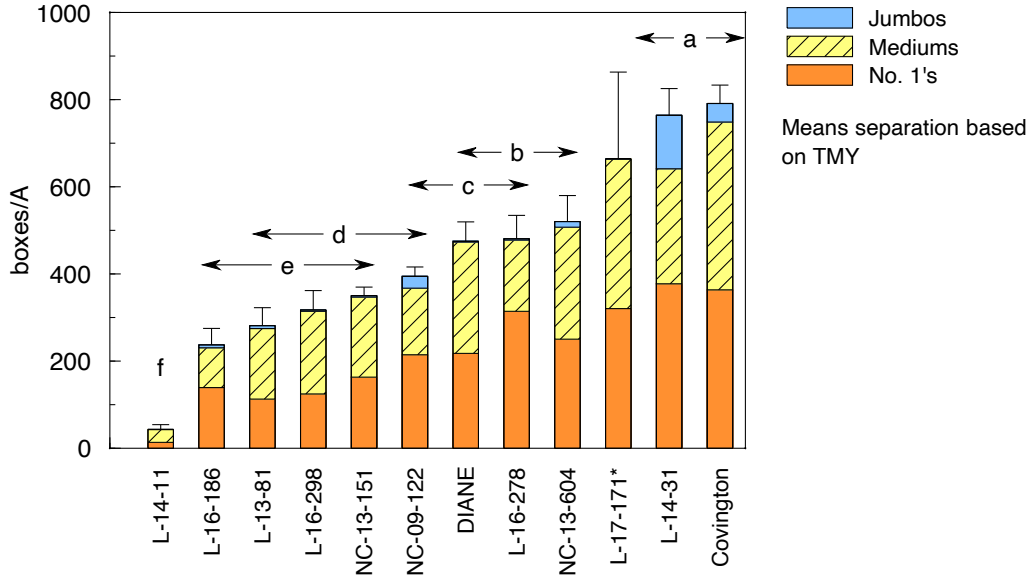
National Sweetpotato Collaborators Trial

Merced County 2020



Sweetpotato Collaborators Trial

Kern County 2020



Advanced Line Trial 2020

Location: Atwater Jordan, between Bert Crane and Hull Rds, near Atwater
Cooperator: Dave Souza
Bedded: 2/28/20
Transplant: 5/20/20
Harvest: 10/12/20
Days" 145

Table 1. Replicated lines in the 2020 Advanced Line Trial yield results (n = 4).

#	Var Name	market class	TMY lbs/A	40 lb box/A No. 1's	Meds	Jumbos	adjusted TMY box/A	bins/A	No. 1's #1%	Culls cull%	harvest comments	L:D Ratio
1	L-13-81	red	52,427	335	233	481	1049	41.9	32.0%	0.0%	some side roots. Good color and skin	2.67
2	L-14-11	red	69,727	422	242	730	1395	55.8	30.3%	0.0%	good skin and shape, smooth	
3	L-16-298	Japanese	43,926	351	339	188	879	35.1	40.2%	0.3%	Long, rough skin, good production	
4a	L-17-171	red	64,863	388	183	726	1297	51.9	29.9%	2.2%	good color and skin smoothnes	3.08
4b	L-17-171	red	91,146	484	236	1103	1823	72.9	26.6%	2.5%	shape issues, too many jumbos	
5	L-18-161P	purple	28,817	233	145	198	576	23.1	40.8%	1.6%	deep purple flesh, lumpy	
6	L-18-165P	purple	16,308	143	111	72	326	13.0	43.4%	1.4%	lumpy with attached feeder roots	
	Average		52,459	337	213	500	1,049	42.0	34.8%	1.1%		
	LSD 0.05		8,428	71.7	66.8	149.1	168.7	6.7	6.9	ns		
	CV, %		10.8	14.3	21.2	20.1	10.8	10.8	13.4	177		

Table 2. Advanced Line Trial (ALT) 2020 yield results (n = 2).

#	Var Name	skin/flesh color	TMY lbs/A	40 lb box/A No. 1's	Meds	Jumbos	adjusted TMY box/A	bins/A	No. 1's #1%	Culls cull%	harvest comments	L:D Ratio
	Covington	copper/orange	47,468	378	406	166	949	38.0	39.9%	0.0%	smooth, grooves	2.24
	Diane	red/orange	60,952	320	348	551	1,219	48.8	25.1%	0.0%	good shape	2.44
	L-14-31	red/orange	45,713	268	253	393	914	36.6	29.9%	0.0%	good shape, but skin burgundy & rough	
	L-15-39	purple/white	57,981	403	189	568	1,160	46.4	34.7%	0.0%	some lents, smooth	
	L-16-26P	purple/purple	27,781	258	143	154	556	22.2	46.9%	0.0%	long, dark purple flesh w/some orange	
	L-16-173	copper/orange	49,580	369	199	424	992	39.7	37.0%	0.0%	similar to Beauregard. Good shape, skin	2.78
	L-17-158A	red/orange	45,966	212	161	546	919	36.8	23.0%	4.2%	dusty red, lents	
	L-17-180	orange/orange	36,478	273	217	240	730	29.2	37.0%	1.1%	similar to Bellevue, more variable shape	
	L-17-182	purple/orange	56,836	465	239	433	1,137	45.5	40.9%	0.0%	smooth skin, good #1s	
	L-17-189	red/orange	31,931	216	211	211	639	25.5	33.3%	0.0%	good skin color, sl. Lumpy	
	L-17-215	red/orange	38,182	158	274	332	764	30.5	20.6%	0.0%	dusty red, rough skin	
	L-18-178W	purple/orange	42,576	329	284	238	852	34.1	38.6%	0.0%	long, venins, and lents	
	NC 13-151	purple/orange	58,183	421	266	477	1,164	46.5	36.2%	0.0%	nice skin, color, and shape. Latex	
	NC 13-604	gold/yellow	42,151	269	301	274	843	33.7	31.8%	0.0%	pale yellow flesh, good shape. Latex	2.41
	Average		45,352	302	240	365	907	36.3	33.5%	0.5%		

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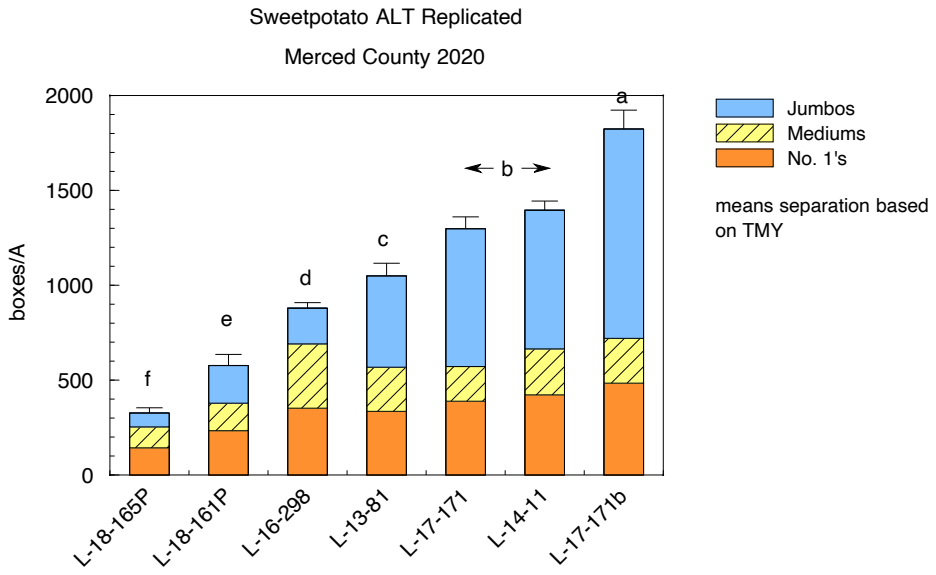
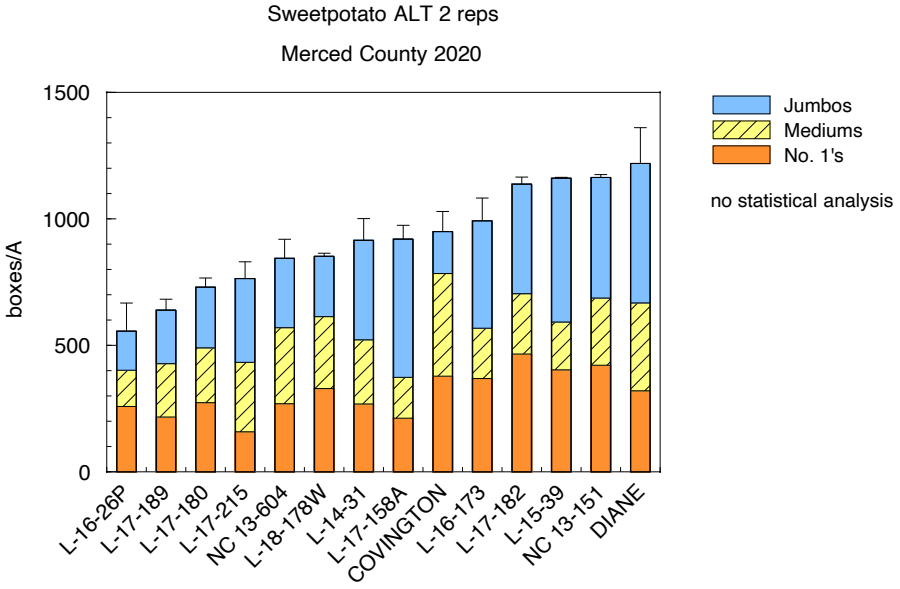
Mediums — Roots 1 to 2 in diameter, 2 to 7 inches in length.
Jumbos — Roots that exceed the size requirements of above grades, but are marketable quality.
Mkt Yield — Total marketable yield is the sum of the above three categories.
bins/A — bins/A are estimated based on market box yield assuming 20 boxes (16 Bu) per bin.
% US #1's — Weight of US #1's divided by total marketable yield.
% Culls — Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.
LSD 0.05 — Least significant difference. Means separated by less than this amount are not significantly different (ns).
CV, % — Coefficient of variation, a measure of variability in the experiment.


Sweetpotato ALT Replicated
Merced County 2020
boxes/A
2000
1500
1000
500
0
a
b
c
d
e
f
L-18-165P
L-18-161P
L-16-298
L-13-81
L-17-171
L-14-11
L-17-171b
Jumbos
Mediums
No. 1's
means separation based on TMY


Sweetpotato ALT 2 reps
Merced County 2020
boxes/A
1500
1000
500
0
L-16-26P
L-17-189
L-17-180
L-17-215
NC 13-604
L-18-178W
L-14-31
L-17-158A
COVINGTON
L-16-173
L-17-182
L-15-39
NC 13-151
DIANE
Jumbos
Mediums
No. 1's
no statistical analysis

ICL Fertilizer Trial on Sweetpotatoes, 2020

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Introduction

The objective of this trial was to evaluate ICL's coated sulfate of potash (SOP, 0-0-48) and coated calcium nitrate fertilizer (13-0-0) on plant and yield response of sweetpotatoes in a commercial field.

METHODS

This trial was established in a commercial field near Livingston in Merced County, California. The soil is classified as Delhi sand 0 – 3% slope, slightly acidic (pH 6.7), with low fertility (CEC 5.9 meq/100 g). At this location, composite soil samples ranged from 50 to 100 ppm K. Composite soil sample results are shown in Appendix 1. The fertilizer program for this field included chicken manure compost, sidedress shanked applications of a complete NPK fertilizer blend containing humic acid and micronutrients, and additional fertilizer through the drip tape. The chicken compost was applied as a surface band in the middle of the bed between the rows, made just before transplanting, at 5 tons/A. The field was sidedressed with 50 gallons/A of 6.6 – 6.6 – 6.2 liquid blend 2 weeks after transplanting, on June 23. Additional fertilizer included liquid calcium nitrate -KCl blend (12-0-8) through the drip tape during the growing season to supply additional N and K. Total N-P_2O_5-K_2O applied was about 165-35-120 lbs/A, not including contributions from the compost.

This test had two trials at the same location. The large plot trial consisted of the grower's standard program with the addition of 500 or 1000 lbs/A of 0-0-48 coated SOP. Plots were 20 ft wide x 620 feet long (the length of the field) and were arranged in a randomized complete block design with 4 replications. For this test, coated SOP applications were made to beds using a large fertilizer spreader that shanked dry material 10" to each side of the drip tape at about 4 – 6" depth. For the small plot trial, coated SOP was compared both by itself and as a blend with straight SOP 0-0-50 at varying rates. Plots were 1 bed (2 rows) by 50 feet, and were also arranged as an RCB design with 4 reps. In the small plot trial, the SOP treatments were applied to the center of the bed by hand under the drip just after transplanting. Additionally, the small plot trial included 2 ICL coated calcium nitrate treatments at 350 and 500 lbs/A. These were applied over the top of the compost

applications to provide an additional 45 or 65 lbs of N per acre. Sweetpotato variety 'Diane' was transplanted on 8-June and harvested on 27-Oct, 2020. Diane is a high yielding, red skin, orange flesh variety and represents about 30% of the sweetpotato market in California.

Plot background information and a listing of the treatments for both trials are shown in Table 1.

Table 1. Trial background and treatment information, ICL fertilizer trial, Merced County 2020.

Cooperators:	Aaron Silva, Ilan Oliver			
Location:	Olive and Yamato Rds, north of Livingston, CA			
	Latitude: 37° 24' 11.772" N	Longitude: 120° 40' 58.47" W		
Variety:	Diane			
Transplant:	6/8/20			
Plot size:	Large plot trial: 3 beds (20 ft) x 620 ft. Small plot: 1 bed by 50 ft.			
Irrigation:	surface drip			
Fertilizer:	Grower program:			
	Simplot 6.6 - 6.6 - 6.2 @ 50 gpa sidedrress on June 23, 2020			
	12 - 0 - 8 at 10 gpa applied 10 times during the season			
	5 tons/A compost			
Sampling:	Leaf: July 22 and Aug 7			
	Soil: Sept 18			
Harvest:	10/27/20	Harvest center bed from each plot		
Days:	141			
LARGE PLOT TRIAL:				
	Treatments:	1 grower fertilizer program	120 lbs K2O/A	
		2 500 lbs/A ICL 0-0-48 coated	360	
		3 1000 lbs/A ICL 0-0-48 coated	600	
		applied June 11, 2020, with grower equipment		
		shanked 10" off-center, 4" deep on both sides of tape		
		June 11, 2020		
SMALL PLOT TRIAL:			lbs K2O/A	lbs N/A
	Treatments:	1 grower fertilizer program	120	165
		2 200 lbs/A SOP 0-0-50	220	165
		3 400 lbs/A 75% Agrocote + 25% SOP	320	165
		4 500 lbs/A 60% Agrocote + 40% SOP	365	165
		5 400 lbs/A SOP	320	165
		6 500 lbs/A SOP	365	165
		7 350 lbs/A CN 13-0-0	120	215
		8 500 lbs/A CN	120	235
		application date: June 11. Applied by hand		

Leaf and petiole samples were taken from all plots on July 22 and August 7, 2020. Leaves with petioles were taken from the 6th leaf from the growing tip from 20 plants within each plot. Samples were air dried and submitted to Denele Labs in Turlock, CA, for NPK analyses. Late season soil samples were taken at 0-12" depth from each plot in the large plot trial, and from treatments 2, 3, and 4 in the small plot trial using a standard 7/8" diameter soil probe and 10 cores per plot. Samples were taken from the center of each plot below the drip tape. Yields were estimated by weighing both rows in each plot using a standard 1-row harvester and the growers crew to separate the roots into #1's, mediums, jumbos, and culls.

Results.

Large plot trial. Leaf and soil sampling results for the large plot trial are shown in Table 2. Leaf K was significantly increased in treatment #3, 1000 lbs of 0-0-48, as compared to the grower standard program, but the changes were rather subtle considering the large amount of potassium that was added to this plot. The August sampling showed no significant differences between any of the treatments. Soil K was significantly increased from 61 to 89 ppm as fertilizer rates increased.

Harvest results are shown in Table 3. Both additional potassium treatments slightly increased yields, but this increase was not significant for any size category or total marketable yield. Average yield was 838 boxes per acre. Furthermore, there was no correlation between soil K and marketable yield (Figure 1). The lack of a yield response was probably due to this field being adequately supplied with K during the growing season by the application of 12-0-8 through the drip tape.

Small plot trial. Leaf and soil results for the small plot trial are shown in Table 4. Like the large plot trial, a significant response to applied fertilizers was only observed at the first sampling date on July 22. The addition of coated calcium nitrate significantly increased leaf N as compared to some of the treatments. Likewise, this occurred with leaf K with the potassium treatments. However, this effect was not observed in the August sampling, and there were no significant differences observed between K rate or potassium blend. And while average soil K increased from adding potassium fertilizer, this increase was not significant because of the tremendous variability in the data.

Harvest results are shown in Table 5. The grower's standard fertilizer program had the best total marketable yield, at 828 boxes/A. As in the large plot trial, there was no correlation between the soil K levels and observed yield (Figure 2).

Acknowledgements: Many thanks to Arron Silva (Doreva Produce), Aaron Beene (Simplot), and Ilan Oliver (ICL) for their help and participation with this trial.

Table 2. Sweetpotato large plot K trial leaf and soil analyses results, Merced County 2020.

	July 22 leaf samples			Aug 7 leaf samples			Sept 18 Soil
Treatment	%N	%P	%K	%N	%P	%K	ppm K
1 grower fertilizer program	5.67	0.61	3.60	3.56	0.24	2.11	61.50
2 500 lbs/A ICL 0-0-48 coated	5.67	0.63	3.71	3.72	0.26	2.04	77.03
3 1000 lbs/A ICL 0-0-48 coated	5.91	0.67	3.91	3.39	0.23	2.03	89.28
Average	5.75	0.64	3.74	3.56	0.24	2.06	75.9
LSD 0.10	ns	ns	0.25	ns	ns	ns	22.5
CV, %	4.5	6.2	3.8	6.9	11.4	8.3	17.1

Grower program: 6.6-6.6-6.2 at 50 gpa sidedress then 12-0-8 at 100 gpa in-season through drip tape

ICL shanked 10" OC at 4" deep

LSD 0.10 = Least Significant Difference at 90% confidence level. NS = not significant.

CV = coefficient of variation

Table 3. Sweetpotato large plot K trial yield as affected by fertilizer treatment, Merced County 2020.

Treatment	lbs K2O/A	TMY lbs/A	40 lb box/A No. 1's	Jumbo	Med	adjusted TMY box/A	bins/A	No. 1's #1%	Culls cull%
1 grower fertilizer program	120	39406	523	69	196	788	39.4	66.2%	7.1%
2 500 lbs/A ICL 0-0-48 coated	360	43248	592	66	207	865	43.2	68.6%	8.1%
3 1000 lbs/A ICL 0-0-48 coated	600	43095	597	66	199	862	43.1	69.2%	9.0%
Average		41916	571	67	201	838	41.9	68.0%	8.1%
LSD 0.05		---	ns	ns	ns	ns	ns	ns	ns
CV, %		---	15.5	16.4	12.1	13.5	13.5	2.6	49.3

Grower program: 6.6-6.6-6.2 at 50 gpa sidedress then 12-0-8 at 100 gpa in-season through drip tape

ICL shanked 10" OC at 4" deep

Adj TMY = adjusted total marketable yield at 80% packout (20 boxes per bin)

LSD 0.05 = Least Significant Difference at 95% confidence level. NS = not significant.

CV = coefficient of variation

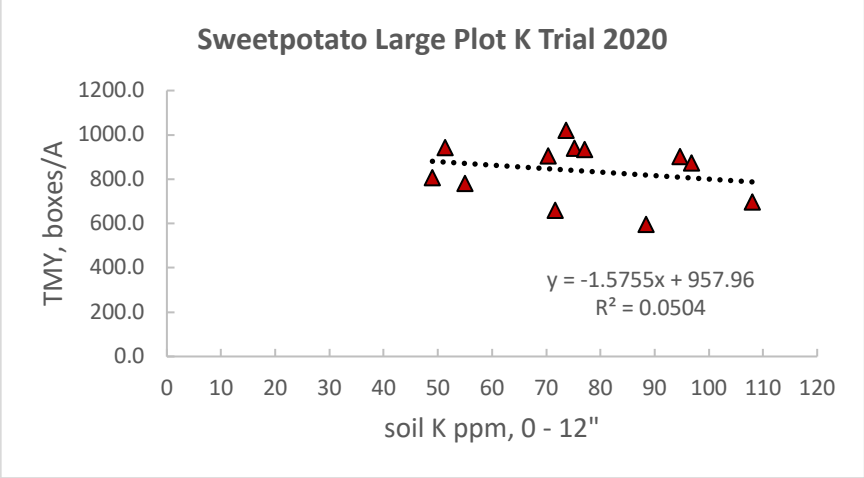

Figure 1. Correlation between soil K and total marketable yield (TMY) was not significant for the large plot trial.

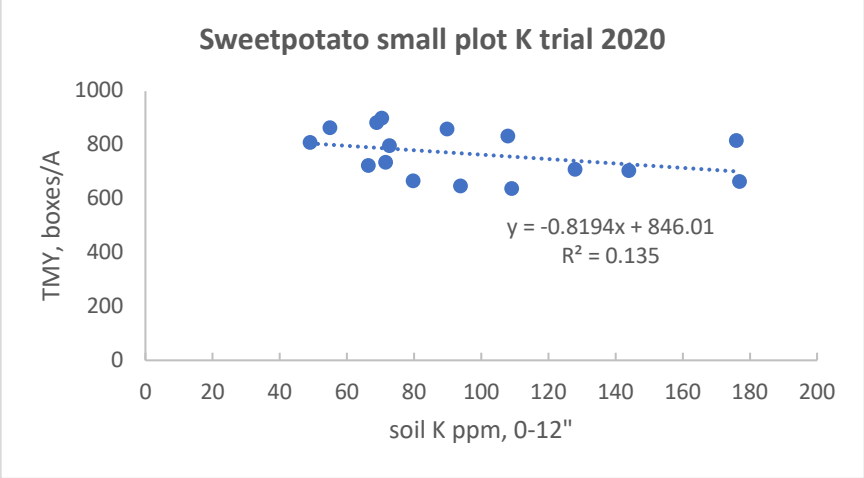

Figure 2. Correlation between soil K and total marketable yield (TMY) was not significant for the small plot trial.

Table 4. Sweetpotato small plot K trial leaf and soil analyses results, Merced County 2020.

	July 22 leaf samples			Aug 7 leaf samples			Sept 18 Soil
Treatment	%N	%P	%K	%N	%P	%K	ppm K
1 grower fertilizer program	5.70	0.66	4.14	3.62	0.25	1.90	61.50
2 200 lbs/A SOP 0-0-50	5.82	0.71	4.15	3.59	0.25	1.75	96.15
3 400 lbs/A 75% Agrocote + 25% SOP	5.44	0.61	3.82	3.63	0.25	1.80	119.30
4 500 lbs/A 60% Agrocote + 40% SOP	5.96	0.74	4.47	3.70	0.26	1.95	112.85
5 400 lbs/A SOP	6.27	0.88	4.87	3.76	0.26	1.96	---
6 500 lbs/A SOP	5.70	0.67	4.35	3.49	0.23	1.76	---
7 350 lbs/A CN 13-0-0	5.95	0.73	4.31	4.09	0.29	1.89	---
8 500 lbs/A CN	6.00	0.77	4.34	3.96	0.28	1.92	---
Average	5.85	0.72	4.30	3.73	0.26	1.87	97.45
LSD 0.10	0.45	0.14	0.57	ns	ns	ns	ns
CV, %	5.2	13.1	9.0	10.3	14.4	7.8	15.5

Grower program: 6.6-6.6-6.2 at 50 gpa sidedress then 12-0-8 at 100 gpa in-season through drip tape

All fertilizers applied as a surface band under the drip tape.

LSD 0.10 = Least Significant Difference at 90% confidence level. NS = not significant.

CV = coefficient of variation

Table 5. Sweetpotato small plot K trial yield as affected by fertilizer treatment, Merced County 2020.

	applied fertilizer		TMY	40 lb box/A			adjusted TMY		No. 1's	Culls
treatment	lbs K2O/A	lbs N/A	lbs/A	No. 1's	Jumbo	Med	box/A	bins/A	#1%	cull%
1 grower fertilizer program	120	165	41381	576	31	220	828	41.4	69.7%	11.6%
2 200 lbs/A SOP 0-0-50	220	165	38682	538	20	215	774	38.7	69.5%	11.6%
3 400 lbs/A 75% Agrocote + 25% SOP	320	165	36920	502	35	202	738	36.9	68.2%	17.7%
4 500 lbs/A 60% Agrocote + 40% SOP	365	165	36251	494	42	189	725	36.3	68.2%	17.1%
5 400 lbs/A SOP	320	165	35145	465	52	186	703	35.1	66.0%	21.1%
6 500 lbs/A SOP	365	165	37423	483	45	221	748	37.4	64.4%	17.9%
7 350 lbs/A CN 13-0-0	120	215	33340	464	21	181	667	33.3	69.7%	23.0%
8 500 lbs/A CN	120	235	28886	419	18	141	578	28.9	72.2%	26.1%
Average			36004	493	33	194	720	36.0	68.5%	18.3%
LSD 0.10			---	ns	ns	41.6	126.3	6.3	3.7	ns
CV, %			---	15.5	73.7	17.6	14.4	14.4	4.5	43.5

Grower program: 6.6-6.6-6.2 at 50 gpa sidedress then 12-0-8 at 100 gpa in-season through drip tape

All fertilizers applied as a surface band under the drip tape.

LSD 0.10 = Least Significant Difference at 90% confidence level. NS = not significant.

CV = coefficient of variation

Denele Analytical, Inc.

Agricultural and Environmental Analysis

Certified By:
ELAP Certificate No. 2714
Manure Analysis Proficiency (MAP)
North American Proficiency Testing (NAPT)
National Forage Testing Association (NFTA)
Family Farms Alliance (FFA)

Soil Analysis

Date Received: 7/2/2020
Submitted By:
Lab ID: T0184034C
Sample ID: SPK Trial 0-12"

Crop: Fallow
Variety:
Present Yield:
Proposed Yield: 1 Ton(s)/acre
PCA:

Purchase Order:
Report Date: 7/10/2020
Approved By: Josh Huot
Order Number: T0184034
Grower:

Scott Stoddard
2145 Wardrobe Ave
Merced, CA 95341

Analyte	Result	Units	Optimal	Very Low	Low	Normal	High	Very High
pH (Water)	6.7	Units	6.45					
pH (Soil)	6.8	Units	6.45					
Electrical Conductivity	1.45	mmhos/cm	1.05					
Soluble Salts	928	mg/L	672					
Nitrate Nitrogen	11.0	ppm	35					
Phosphorus (Olsen Method)	20.0	ppm	26					
MicroNutrients								
Boron	0.891	ppm	0.6					
Zinc	1.68	ppm	12.5					
Iron	9.96	ppm	60					
Copper	3.63	ppm	7					
Manganese	0.913	ppm	22					
Sulfate	71.0	ppm	38.5					

	Exchangeable Cations	Base Saturation Acetate Extraction					Water Extraction		
	Result	Your %	Optimal %	Low	Normal	High	Result	% Total	Extraction Ratio
Potassium	201 ppm	9.5 %	3 - 7				2.35 meq	18.2 %	45.72 %
Calcium	722 ppm	65.9 %	64 - 78				3.88 meq	30 %	10.94 %
Magnesium	101 ppm	15.4 %	12 - 20				2.45 meq	19 %	29.5 %
Sodium	113 ppm	9.1 %	< 3				4.25 meq	32.8 %	86.37 %

Plant Nutrient Recommendations

Nitrogen	0 Lbs/Acre	Sulfur *	
Phosphorus	0 Lbs/Acre	Boron	0 Lbs/Acre
Potassium	0 Lbs/Acre	Zinc	7.3 Lbs/Acre
Copper	0 Lbs/Acre	Manganese	0 Lbs/Acre

* If fertilizer recommendation exceeds 600 lbs (0.3 tons), multiple applications recommended
Note: All Results are on a Dry Basis
To convert ppm to lbs / acre (6 in. of surface soil weighing 2,000,000 lbs.), multiply by 2

Total Nitrogen	ESP	SAR	C:N	Ca:Mg
Bray Phosphorus	8.3	2.4		7.1
Ammonia Nitrogen		CEC	5.9 meq/100g	
Free Lime		Carbonates	Low	
Nitrogen Holding Capacity	36.1 Lbs/Acre	Percolation	High	

Denele Integrated Ratios	Sodium	NO3	Potassium	Phosphorus
	143.9	-20.6	87.8	19.6

Boron	Zinc	Iron	Copper	Manganese	Sulfate
57.5	-77.4	-59.6	2.1	-280.4	74.7

Soil Amendment Recommendations

Gypsum (18%) Calcium Supplement
Gypsum (18%) Sodium Reduction 1.2 Tons/Acre

The micronutrients recommended are in lbs/acre on a broadcast elemental basis. If micronutrients are banded, divide the recommended value by 3. If chelated fertilizers are used, divide the recommendation by 4. Research has shown that optimum yields are obtained with nitrogen split into 2 to 4 applications. Recommended nitrogen is based on 90% efficiency of application. Highest losses of nitrogen occur with winter applications. Early spring to late summer is the optimum time to apply nitrogen.

If QC is required for this sample, please contact lab.

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Appendix 1. Soil sample results from the ICL test plot location, Merced County 2020.

Sweetpotato Nematicide Trial 2020

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Introduction.
In California, soil fumigation is done both in the fall and spring in commercial sweetpotato (*Ipomea batatas*) fields to suppress root knot nematodes (RKN), predominantly *Meloidogyne incognita*, and soil insects such as wireworms (*Limonius* spp) and grubs (*Diabrotica* spp, *Phyllophaga* spp). Telone (1,3-D), metam (methyldithiocarbamate), and chloropicrin (pic) are registered for use. Unfortunately, the availability of the preferred fumigant, Telone, is insufficient to meet the needs of the industry because California restricts Telone by implementing "use caps" for the entire state. These caps limit the amount of Telone used in any year to 136,000 lbs a.i per township (640 acres). In 2020, there were at least 10 townships in Merced County which hit this cap, a result of strong demand by both sweetpotatoes and orchard replanting. In response, the industry has resorted to greater use of metam potassium, usually shank applied before transplanting.

Regardless of material, all fumigants require a fumigation management plan to be filed with the Agriculture Commissioner prior to an application. These plans are time intensive and must be done by a certified PCA. In addition to rate restrictions, Telone and metam are also subject to numerous other regulations, including restrictions on timing, application method, and buffer zones. New nematicides offer the potential for effective alternatives for areas where fumigation is restricted, and in buffer zones where no fumigation at all is allowed.

Previous research on timing and method of application of nematicides in sweetpotatoes evaluated preplant, at-plant, and post plant applications. Preplant broadcast applications were shanked or shallow incorporated, at-plant were delivered in the transplant water or as an in-furrow drench immediately after transplanting, and post-plant applications have been made using surface drip tape and sidedressing with fertilizer shanks. The most effective method, timing, and rate is different depending on the nematicide. Nimitz, for example, is limited to preplant incorporated methods because of its potential phytotoxicity to the crop, while Salibro works well as a sidedress application through the drip tape. Velum has shown efficacy both as a preplant shank application and through the drip tape 4 to 6 weeks after transplanting.

The objective of this trial was to evaluate nematode control and crop response to drip sidedress applications of Velum, Salibro, Grandevo, and Avodigen on sweetpotatoes grown in commercial fields in California.

Methods.
This trial was conducted in 2020 in a commercial sweetpotato field in Merced County, CA, in the buffer zone where no fumigant was used. The field had been in continuous sweetpotato production for 10 years. Treatments included Velum (fluopyram, Bayer Crop Science), Salibro (fluazaindolizine, Corteva Agriscience), Grandevo bioinsecticide (*Chromobacterium subtsugae*, Marrone Bio Innovations), and Avodigen biological nematicide (*Bacillus licheniformis* + *Bacillus subtilis*, FMC) nematicides on root knot nematode (RKN) control and sweetpotato yield and quality. Treatments were designed to test different rates of material, with one Velum

treatment also testing timing of application. Untreated control plots were used for comparison.

Nematicide treatments were applied at 3 to 8 weeks after transplanting (WAT), depending on product use guidelines, by injecting into surface drip tape positioned between two rows of sweetpotatoes. Sweetpotatoes were planted 2 rows to a bed, 20" off-center. All products were first diluted into 2 gallons of water, then injected into a second drip line running down the center of the plot while the field was being irrigated. Injection time was about 10 minutes per plot and was followed by 4 or more hours of surface irrigation. RKN sampling was performed in late June and July from all plots. Samples were taken from the center of each bed to 12", 4 cores per plot. Sweetpotato variety 'Diane' (RKN susceptible) was transplanted on April 28 and harvested on October 2. Harvest was done using the growers mechanical digger and crew to separate roots by size (#1's, mediums, jumbos) and grade (culls). Drip plots were 1 bed x 115 feet with 4 replications. Treatment design was a randomized block with four replications. Means separation was performed using Fisher's protected LSD at P=0.05.

Treatment details and site information are shown in Table 1.

Results

There were no significant differences in RKN counts between any of the treatments after the July sampling (Table 2). Nematode pressure was very high at this location, with an average of 379 J2's per 250 cc soil at the July sampling, equivalent to ~ 750 per pint. Samples from the adjacent area of the field treated with Telone were only 2 J2's/250 cc soil. However, there were significant differences in yield between treatments. All of the nematicides increased TMY as compared to the untreated control, except for Avodigen and the low rate of Grandevo (Table 3). Best overall yields occurred with the split application of Salibro (30 fl oz + 30 fl oz), followed by Velum at 14 fl oz and Gransdevo at 4 lbs/A (Figure 1). Yield from the Telone treated area was not measured, as this was outside of the plot area. Both Salibro and Velum reduced the number of culls, as a percentage of the marketable yield, compared to the UTC treatment. However, there was no significant difference in the cull % between any of the treatments (15.8%), even though nematode pressure was high and most of the culled roots were a result of nematode damage (cracking, pimples, poor skin color).

Overall, drip applications of Salibro and Velum have increased yields of sweetpotatoes in 7 out of 8 treatment-years as compared to the untreated check plots in an unfumigated buffer area (Table 4), with increases ranging from 12 to 60%. In general, high rates improve performance. These yield increases occurred even though nematode sampling has not shown a significant decrease in nematode numbers in mid – to late season sampling. Salibro has shown a greater crop response, with significantly increased yield in every year from 2017 - 2020.

Acknowledgements: many thanks to Robert Silveira and foreman Flocco for his help and cooperation with this trial.

Table 1. Sweetpotato nematicide trial information and treatments, Merced County 2020.

Location:	Directly south of Target in Atwater, off Applegate Rd			
	37. 20' 27.84" N 120. 36' 48" W			
	Continuous sweetpotatoes > 5 yrs, buffer zone no fumigation			
Soil:	Atwater sand			
Cooperator:	Robert Silveira, Classic Yam			
Variety:	Diane			
Transplant:	28-Apr-20			
Harvest:	2-Oct-20			
days:	157			
	Machine harvest, grower crew sorted by size and grade			
Sampling:	Soil RKN nematode sampling on 25 Jun & 23-July			
Application	injection into secondary drip line, using rates calculated for that plot (6.67 x 115 ft)			
	during normal irrigation			
	10 minute application time followed by 4 hours irrigation			
Dates:	1st app	5/23/20	=	25 days
	2nd app	6/9/20	=	42 days
	3rd app	6/18/20	=	51 days
Plot Design:	RCBD with 4 reps			
	Plots 1 bed (6.67 ft) x 115 ft			

	Treatments:	Applications		
1	UTC	---	---	---
2	Salibro 20 oz/A @ 6 and 8 WAT	---	9-Jun	18-Jun
3	Salibro 30 oz/A @ 6 and 8 WAT	---	9-Jun	18-Jun
4	Grandevo 2 lbs/A @ 3 and 6 WAT	23-May	9-Jun	---
5	Grandevo 4 lbs/A @ 3 and 6 WAT	23-May	9-Jun	---
6	Velum 14 fl oz/A @ 3 WAT	23-May	---	---
7	Velum 7 fl oz/A @ 3 and 6 WAT	23-May	9-Jun	---
8	FMC Avodigen 13.5 fl oz/A at 3 and 6 WAT	23-May	9-Jun	---

WAT = Weeks after transplanting (target dates)
All treatments diluted in water prior to application.

Table 2. Nematode sampling results, sweetpotato nematicide trial, Merced County 2020

		June: # J2's per 250 cc soil		July: # J2's per 250 cc soil		
		Root Knot	SR	Root Knot	Ring	SR
	treatment	Meloidogyne	Paratrich.	Meloidogyne	MX	Paratrich.
1	UTC	232	101	372	28	0
2	Salibro 20 oz/A @ 4 and 6 WAT			380	68	17
3	Salibro 30 oz/A @ 4 and 6 WAT			290	85	8
4	Grandevo 2 lbs/A @ 2 and 4 WAT			326	47	15
5	Grandevo 4 lbs/A @ 2 and 4 WAT			324	118	5
6	Velum 14 fl oz/A @ 4 WAT			479	72	22
7	Velum 7 fl oz/A @ 4 and 6 WAT			356	69	4
8	FMC Avodigen 13.5 fl oz/A at 4 and 6 WAT			504	285	3
9	Telone 12 gpa (1)	0	183	2	0	61
	Average	232	101	379	97	9
	LSD 0.05	---	---	ns	ns	ns
	CV, %	---	---	94	119	138

Ring MX (Mesocriconema xenoplax)

SR (Stubby Root - Paratrichodorus)

Root knot - Meloidogyne incognita

1) Telone values omitted from AOV and are shown for comparison only

Table 3. Sweetpotato root yield by size as affected by nematicide treatment. Merced County 2020.

		40 lb box/A adj			adj TMY	total	No. 1's	Culls
	Treatment	**No. 1's**	**Meds**	**Jumbos**	**box/A**	**bins/A**	**#1%**	**cull%**
1	UTC	355	191	81	627	31.4	56.8%	18.3%
2	Salibro 20 oz/A @ 4 and 6 WAT	332	223	74	629	31.5	52.8%	13.1%
3	Salibro 30 oz/A @ 4 and 6 WAT	384	225	125	734	36.7	52.5%	13.9%
4	Grandevo 2 lbs/A @ 2 and 4 WAT	309	185	57	551	27.6	56.1%	18.9%
5	Grandevo 4 lbs/A @ 2 and 4 WAT	356	209	81	646	32.3	55.0%	12.2%
6	Velum 14 fl oz/A @ 4 WAT	384	223	96	703	35.2	54.5%	15.8%
7	Velum 7 fl oz/A @ 4 and 6 WAT	392	203	96	691	34.5	57.0%	15.5%
8	Avodigen 13.5 fl oz/A at 4 and 6 WAT	328	191	76	595	29.8	55.2%	18.7%
	Average	355	206	86	647	32.4	55.0%	15.8%
	LSD 0.05	52.5	ns	ns	97.6	4.9	ns	ns
	CV, %	10.0	13.2	32.5	10.3	10.2	5.4	32.5

US #1's	Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.
Mediums	Roots 1 to 2 in diameter, 2 to 7 inches in length.
Jumbos	Roots that exceed the size requirements of above grades, but are marketable quality.
Mkt Yield	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 20 boxes (17.6 Bu) per bin.
% US #1's	Weight of US #1's divided by total marketable yield.
% Culls	Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.
L:D	Length to diameter ratio (10 root sample)
LSD 0.05	Least significant difference. Means separated by less than this amount are not significantly different (ns).
CV, %	Coefficient of variation, a measure of variability in the experiment.

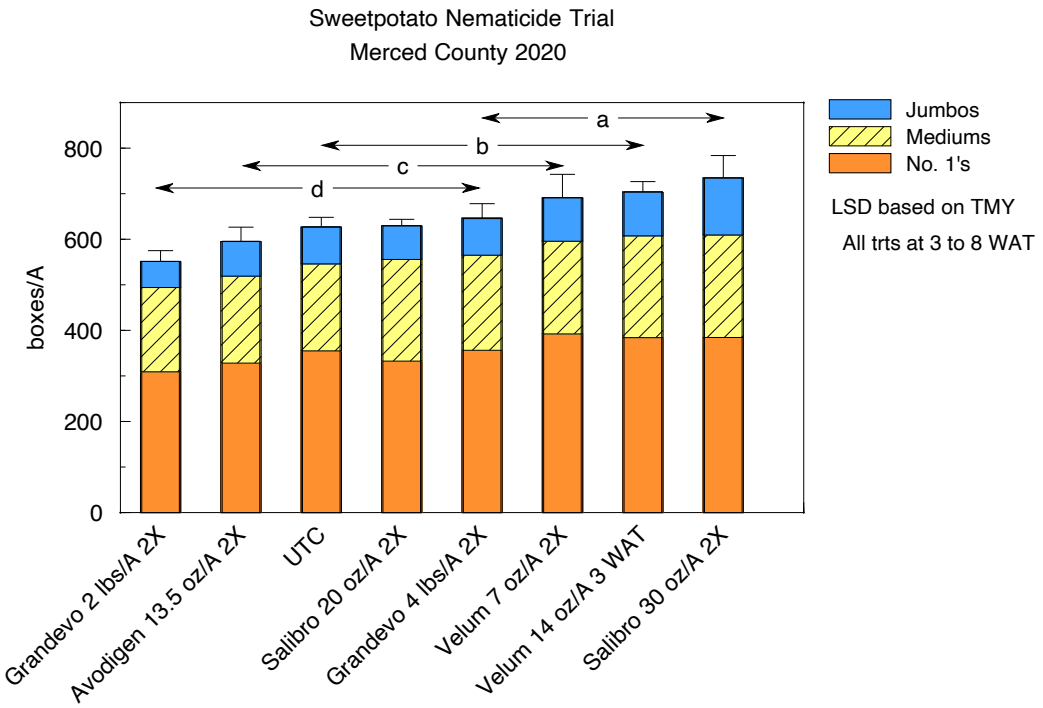

Figure 1. Sweetpotato yield as affected by nematicide treatment, Merced County 2020.

Table 4. Yield differences between drip applications of Velum and Salibro nematicides in commercial sweetpotato fields, Merced County 2017 – 2020.

Year	UTC TMY bins/A	Salibro drip TMY bins/A	Velum drip TMY bins/A	Salibro p=0.05	Velum p=0.05	Salibro vs UTC, %	Velum vs UTC, %
2017	42.0	49.4	39.6	*	ns	17.6%	-5.7%
2018	25.7	41.1	32.0	*	ns	59.9%	24.5%
2019	16.1	22.3	20.4	*	*	38.5%	26.7%
2020	31.4	36.7	35.2	*	ns	16.9%	12.1%
					AVERAGE	**36.8%%**	**15.5%**

TMY = Total Marketable Yield

Untreated (UTC) compared to split application of Salibro (60 fl oz/A) or Velum (14 fl oz/A).

* significant difference at the 95% confidence level. NS = not significant.

Evaluation of fungicides for the control of southern blight in sweetpotato hotbeds, 2020

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SUMMARY. The objective of this trial was to evaluate the efficacy of several different commercial fungicides on the control of southern blight (*Sclerotium rolfsii*) in sweetpotato hotbeds. 7 fungicides plus and untreated control were evaluated using a randomized block design with 4 reps, with applications starting at the time of bed establishment on March 3, 2020. The hotbed was established using conventional grower practices (no gin trash, medium sweetpotatoes), and used microjet irrigation. Plots were 8 ft x 6 feet long. The variety was Diane that had been pre-sprouted since late February and showed no obvious sign of disease. Initial applications of fungicides were applied with a backpack CO2 hand sprayer using the equivalent of 120 gpa after bedding but prior to covering with soil. Post emergence applications were started when there was about 3 - 5% emergence of plants, on March 17. Fungicides were applied using a 2 gallon watering can, using 2 gallons for 4 plots followed by an additional 2 gallons of plain water to incorporate and push the fungicides into the soil. No adjuvants were used. Post emergence fungicides were applied 4 times with 7 days between applications. Subjective disease evaluations were made on April 8, 14, and 21. Plots were harvested May 1 by cutting all plants within a 2 ft x 2 ft square and separating into "infected" and "clean" plants based on visual observation of disease symptoms. 40 plants from each plot were cut above the soil line and transplanted into field plots on May 1 using an RCB design. Trial harvest was done with grower crew and equipment on Sept 22, 2020.

Disease incidence was strongly impacted by bin source, with some bins having extremely high rates of infection (> 75%), while others were almost nothing. Since treatments went across bin source, there was a strong block effect in this trial, and very high variability. Therefore, it was very difficult to determine fungicide efficacy. In general, the treatments that used Quadris Top and Rhyme had lower disease incidence early and reduced number of infected plants at plant harvest (Table 1). Infected plants were reduced from 66% in the untreated control to about 25% where these fungicides were used. There was no significant difference in plant production from any plot. Nor was there any difference in plant stand 3 weeks after transplanting.

No significant yield or size differences occurred between any of the treatments (Table 2). In one plot, some of the cull roots showed circular spot infection. These were confirmed to be *S. rolfsii* in pathology testing by UC Plant Pathologist Cassandra Swett at UC Davis.

In summary, the significant bin affect masked fungicide effects in this trial. However, it does show that seed stock can be a significant source of disease inoculum even in bins where southern blight/circular spot does not appear. The lack of any significant affects in the field suggests that cutting plants is an effective way to use plants from beds where this disease is a problem.

Table 1. Trial background information and treatments, Southern blight fungicide trial 2020.

Grower	Bob Weimer, Weimer Farms						
Location	Hotbeds: Westside Blvd and Cressey Way						
	Field: NE corner of Steinberg and Bell						
Variety	Diane bedded 3/3/2020						
Treatments and application dates		**3-Mar**	**17-Mar**	**24-Mar**	**31-Mar**	**8-Apr**	
1	UTC	---	---	---	---	---	
2	Botran 5F 5.73 fl oz/3500 sq ft seed spray only	X	---	---	---	---	
3	Botran 5F + Quadris Top 1 fl oz/ 1000 sq ft seed + foliage	X	X	X	X	X	
4	Kphite 4 qts/A then 9 qts/A post emergence	---	X	X	X	X	
5	Quadris Top 1 fl oz/1000 sq ft post	---	X	X	X	X	
6	Fontelis 30 fl oz/A post	---	X	X	X	X	
7	Aprovia Top 13.5 fl oz/A post	---	X	X	X	X	
8	Rhyme 16 fl oz/A post	---	X	X	X	X	
	Botran applied directly to seed before covering						
	Post emergence treatments in 2 gals water						
	Post treatments watered in with irrigation						
	Plots 6 ft long, 8 ft wide, RBD with 4 reps						
Plant harvest	# per 4 sq ft on May 1						
Transplant	1-May						
	12" spacing, 1-row plots						
Harvest	22-Sep						
Days	144						
	RBD with 4 reps, 40 plants per plot						

Table 1. Southern blight disease on Diane sweetpotatoes as affected by fungicide treatment, Merced County 2020.

	0 - 10 disease rating			21-Apr	1-May plant harvest, #/4 sq ft			infected		5/22/20
treatment	8-Apr	14-Apr	21-Apr	Disease %	Infected	clean	total	infected, %	arcsin corr.	plant stand
1 UTC	3.0	4.3	4.8	46.3%	117	76	193	66.0%	55.6	37.0
2 Botran 5F 5.73 fl oz/3500 sq ft seed spray only	2.8	3.3	4.0	41.3%	63	112	175	53.5%	50.7	36.5
3 Botran 5F + Quadris Top 1 fl oz/ 1000 sq ft seed + foliage	1.3	0.8	1.5	10.0%	70	175	244	30.0%	30.4	39.5
4 Kphite 4 qts/A then 9 qts/A post emergence	3.0	3.5	3.8	32.5%	84	130	214	55.1%	49.6	36.5
5 Quadris Top 1 fl oz/1000 sq ft post	1.3	1.8	2.5	19.3%	52	199	251	24.0%	24.7	38.5
6 Fontelis 30 fl oz/A post	3.3	3.5	4.0	36.3%	97	84	181	57.5%	49.6	36.5
7 Aprovia Top 13.5 fl oz/A post	2.5	3.0	3.8	34.4%	55	137	192	36.4%	33.1	36.3
8 Rhyme 16 fl oz/A post	1.0	2.0	3.0	24.4%	40	175	216	19.3%	20.3	33.5
Average	2.3	2.8	3.4	30.5%	72.2	135.9	208.0	42.7%	39.3	36.8
LSD 0.05	1.4	2.0	ns	ns	---	---	ns	ns	ns	ns
CV, %	41.3	48.8	39.5	54.7			34.1	59.8	47.4	9.5

0 - 10 subjective score: 0 = no disease, 5 = 50% of plants, 10 = 100% of plants

Disease % based on score ratings.

LSD 0.05 = Least significant difference at the 95% confidence interval. NS = not significant.

CV = coefficient of variation

plant stand: # per 40 feet

Table 2. Sweetpotato yield as affected by hotbed treatment, southern blight trial 2020.

Treatment	40 lb box/A adj No. 1's	Meds	Jumbos	adj TMY box/A	total bins/A	No. 1's #1%	Culls cull%
1 UTC	651	248	200	1099	54.9	59.2%	18.5%
2 Botran 5F 5.73 fl oz/3500 sq ft seed spray only	632	271	177	1080	54.0	58.5%	16.1%
3 Botran 5F + Quadris Top 1 fl oz/ 1000 sq ft seed + foliage	630	251	195	1076	53.8	58.5%	13.6%
4 Kphite 4 qts/A then 9 qts/A post emergence	624	268	229	1121	56.0	56.2%	19.6%
5 Quadris Top 1 fl oz/1000 sq ft post	697	263	169	1129	56.5	61.9%	10.7%
6 Fontelis 30 fl oz/A post	628	294	183	1105	55.2	57.1%	13.0%
7 Aprovia Top 13.5 fl oz/A post	700	307	204	1211	60.5	58.5%	16.1%
8 Rhyme 16 fl oz/A post	663	237	264	1164	58.2	56.7%	11.3%
Average	653	267	202	1123	56.2	58.3%	14.9%
LSD 0.05	ns	ns	ns	ns	ns	ns	ns
CV, %	12.9	15.2	35.3	9.4	9.4	9.2	34.8

US #1's — Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.

Mediums — Roots 1 to 2 in diameter, 2 to 7 inches in length.

Jumbos — Roots that exceed the size requirements of above grades, but are marketable quality.

Mkt Yield — Total marketable yield is the sum of the above three categories.

bins/A — bins/A are estimated based on market box yield assuming 20 boxes per bin.

% US #1's — Weight of US #1's divided by total marketable yield.

% Culls — Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.

LSD 0.05 — Least significant difference. Means separated by less than this amount are not significantly different (ns). *Hand weeded plots not included in statistical analysis.

CV, % — Coefficient of variation, a measure of variability in the experiment.

Performance of paraquat on sweetpotato propagation beds
IR-4 Project: P12869

January 21, 2021

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Objective:
The purpose of this research was to collect data to support registration of paraquat on sweetpotato propagation beds for post-emergence weed control and transplant uniformity.

Introduction
Sweetpotatoes are vegetatively propagated, using plant cuttings from propagation beds, called hotbeds in California. Hotbeds are the nursery area where medium-sized roots are used to produce plants for the production fields. The installation of hotbeds typically begins in mid-February, when the roots are placed on the ground and then covered with a thin layer of soil. Plastic tunnels are used to provide warmth, and sprinklers are used for irrigation. Cuttings from the hotbeds are transplanted into prepared beds from mid-April through the end of June. Cuttings are typically 9 – 12" in length, and require from 8 – 12 weeks to grow.

Hotbeds are a distinct and separate part of the whole production system in sweetpotatoes, and as such require different management techniques for weeds as compared to the production fields. Unless preventative measures are taken, weeds are the main pest in sweetpotato hotbeds. Weeds can be effectively controlled with the fumigant metam sodium or with the use of registered herbicides applied shortly after bedding the roots.

Pre-emergent herbicides are a good potential alternative to fumigation for chemical weed control. Registered herbicides include napropamide (Devrinol) and flumioxazin (Valor/Chateau), applied pre-emergent to the weeds or crop after covering the roots. A one-time application should be made at label rates just prior to the first irrigation, so the herbicides will be incorporated with water. Sweetpotatoes are moderately sensitive to flumioxazin, and rates should be adjusted downward to 1.0 to 1.5 oz per acre to minimize the potential for crop phytotoxicity.

Even with fumigation and herbicides, hand weeding remains an important component of hotbed weed management. Nonselective foliar herbicides (glyphosate, pelargonic acid) can be used postemergence on weeds before crop emergence, but great care should be exercised as there is a chance of leaching through the coarse shallow soil layer covering the roots, affecting sweetpotato plant production. Annual grasses can be effectively controlled with postemergence grass herbicides such as fluazifop (Fusilade), sethyoxydim (Poast), and clethodim (Select).

Methods

This trial began 18-Mar-2020 in a commercial sweetpotato hotbed location near Atwater, CA. The beds were installed 8 days prior using sweetpotato cultivar 'Diane' to a non-fumigated portion of the field and had received 1 irrigation. No pre-emergent herbicides or hand weeding had occurred prior to the initiation of this project. Treatments were Gramoxone (paraquat) herbicide applied at 0.25, 0.5, and 1.0 lbs a.i. per acre, plus an untreated control. Additional treatments also included for comparison were Rely 280 (glufosinate), Suppress (caprylic + capric acids), and Roundup (glyphosate). All treatments included 0.25% Latron-B 1956 non-ionic surfactant (NIS); the Roundup and Suppress treatments included 1% acidifier (50% citric acid) in addition to the NIS. The trial location and herbicide treatments are shown in Table 1.

All treatments were applied prior to crop emergence but post weed emergence. Most emerged weeds were at the cotyledon to 2-leaf stage at the time of application. Herbicides were applied with a CO_2 backpack sprayer at 38 psi with a 4-ft boom using two Tee Jet 8002 flat fan nozzles and two 8002 OC nozzles on the ends, calibrated to 26.8 gpa equivalent. Spray swath was 60" when measured ~24" above the soil surface (Figure 1).

Figure 1. Application of herbicides.

In the hotbed, plot size was 4 ft wide x 8 ft long. Experimental design was a RCB with 4 replications; means separation was done using Fisher's Protected LSD at the 95% confidence level. Data collected included visual crop injury and weed control using a subjective scale (0 = no injury or no control, 10 = 100% crop death/complete weed control, determined at 7, 14, 21, and 28 days after application. Weed counts were also taken using a 5.5"x5" frame randomly placed within each plot. A nontreated weedy check and a hand-weeded weed-free check were included for comparison. Weed-free check plots were maintained weed free through light cultivation and hand removal, while the weedy check was hand weeded after the 14-day evaluation on April 1. Photos were taken of the plots at the evaluation dates. All plots were hand weeded after the final evaluation date and kept weed-free until transplanting. Plant production was measured by cutting plants at the soil line from a $2ft^2$ area from the center of each plot on May 11 and 12, 2020.

A 50-plant sample from each plot was transplanted into a commercial field on May 13, 2020, using the growers crew and equipment. Plot size was 1 row by 40 ft; in-row spacing was about 10" with between row spacing of 40". The trial was drip irrigated. Irrigation, fertilizer, and pest management other than weed control were performed by the grower. Yield was determined using a commercial 1-row harvester and hand graded by the harvest crew into standard size grades (No. 1's, mediums, and jumbos). Cull roots were also weighed. Marketable yield was calculated as the sum of No. 1, mediums, and jumbos grades.

Table 1. Field site and herbicide treatments, IR-4 paraquat trial Merced County 2020.

cooperator	Craig Arnold, Arnold Farms			
hotbed location	SE corner of Grove and Fruitland, near Atwater, CA			
field location	west of Franklin Rd and Dan Ward Rd, near new MID building			
	37° 19' 56" N 120° 32' 32.5" W			
Soil	Atwater loamy sand			
Variety	Diane			
Irrigation	Beds: microjet sprinklers		Field: drip irrigation	
bedded	3/10/20			
plant harvest	May 11 and 12, 2020			
transplant	5/13/20			
field harvest	10/14/20			
days	154			
				application
Treatments:		1	UTC	18-Mar
(hotbed only)		2	Gramoxone 3 SL 0.25 ai/A + NIS 0.25%	
		3	Gramoxone 3 SL 0.50 ai/A + NIS 0.25%	
		4	Gramoxone 3 SL 1.0 ai/A + NIS 0.25%	
		5	Suppress 9% + acidifier 1%	
		6	Rely 280 48 oz/A + NIS 0.25%	
		7	Roundup 2% + 1% acidifier	
		8	Hand weeded control	26-Mar
			All plots hand weeded following April 7 evaluation	
Plot size (bed):	8' x 4', RCBD with 4 replications			
Plot size (field):	1 row x 50 plants			
	3.33 x 40'			
	Diane on 8" spacing			
Data	Beds: crop injury and weed control at 7 & 14 days after application, # plants			
	Field: crop stand & crop injury at 7 and 14 days after transplanting, yield			

Results

There was no crop injury in any of the treatments at the first evaluation date, as there was no plant emergence at that time. At 14 days after treatment, crop emergence was about 5%, and some slight injury could be observed (Figure 2a and 2b). However, there was no consistent injury from any of the treatments, and no observed crop injury after this date (Table 2).

Figure 2a. Paraquat injury.

Figure 2b. Glufosinate injury.

Weed control ratings are shown in Table 2. Weed pressure was very high in all untreated plots, and varied from broadleaf weeds dominating in some locations and grasses in others. The dominant weeds were pigweed (*Amaranthus* spp, most likely redroot pigweed), lambsquarters (*Chenopodium album*), puncture vine (*Tribulus terrestris*), and purslane (*Portulaca oleracea*). The dominant grassy weed was barnyardgrass (*Echinochloa spp*). All herbicide treatments significantly reduced the number of weeds at 7, 14, and 21 days after application as compared to the untreated control. All three paraquat rates were equally effective, giving 87 – 98% weed control (Figure 3). This was significantly better than the Rely 280 or the Suppress treatments at 21 days after application, which had 84% to 61% weed control, respectively. Suppress had the lowest weed suppression, as by 21 days after initial application many of the weeds, especially the grasses, had resprouted.

There was no significant difference in weed control for any of the treatments at 28 days after application, as all the treatments were hand weeded by that date. Plots were kept weed free until plant harvest on May 11 – 12. There were no significant differences in the number of plants per plot or plant quality at the time of cutting (Table 2).

Yield results are shown in Table 3. Yield differences between treatments were subtle. There were no significant differences between treatments in the economically important #1 category. Average yield across all treatments was 769 boxes per acre. Total marketable yield was greatest in the plots using untreated plants, whereas lowest yield occurred with plants from the 0.25 a.i./acre paraquat and Roundup treatments (Figure 4). While the number of culls was high, average of 26.6% mostly from wireworm and soft rots, there were no significant differences between treatments. Plant stand was similar for all plots.

Conclusions

Paraquat herbicide applied prior to crop emergence of sweetpotatoes in the hotbeds effectively controlled emerged broadleaf and grassy weeds for 21 days after application. The most effective rate at this location was 0.5 lbs a.i. per acre (1.3 pints/A Gramoxone 3SL) which had 97.5% weed control

at 21 days after application, though this was not significantly different than the other two rates. Glyphosate also worked very well, with 93% control. Suppress, a contact-only OMRI approved herbicide, initially worked as well as all the other herbicides in this test, but had significantly less weed control after 21 days. No significant crop injury was observed, and plant production was similar across all of the treatments. In the production field using treated transplants from the hotbed, the #1 yield was similar across all treatments, however the untreated plot had the highest total marketable yield at 1082 boxes per acre. No significant differences were observed for crop stand or culled roots.

Acknowledgements
Many thanks to Mr. Craig Arnold for his help and cooperation with this test. Funding for this project was provided by USDA-IR-4 program: IR-4 Project P12869.

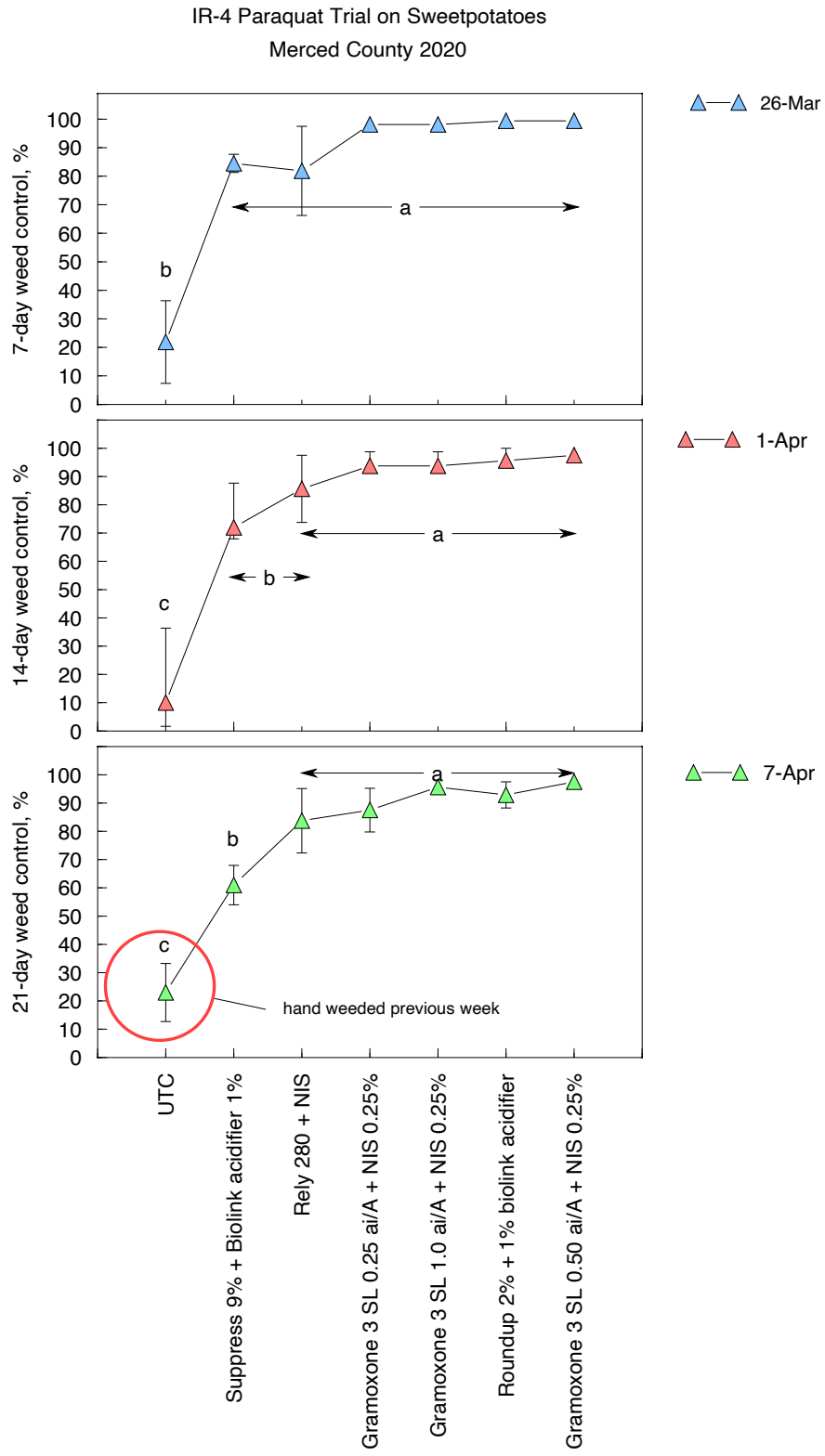

Figure 3. Weed control in the hotbed as affected by herbicide treatment.

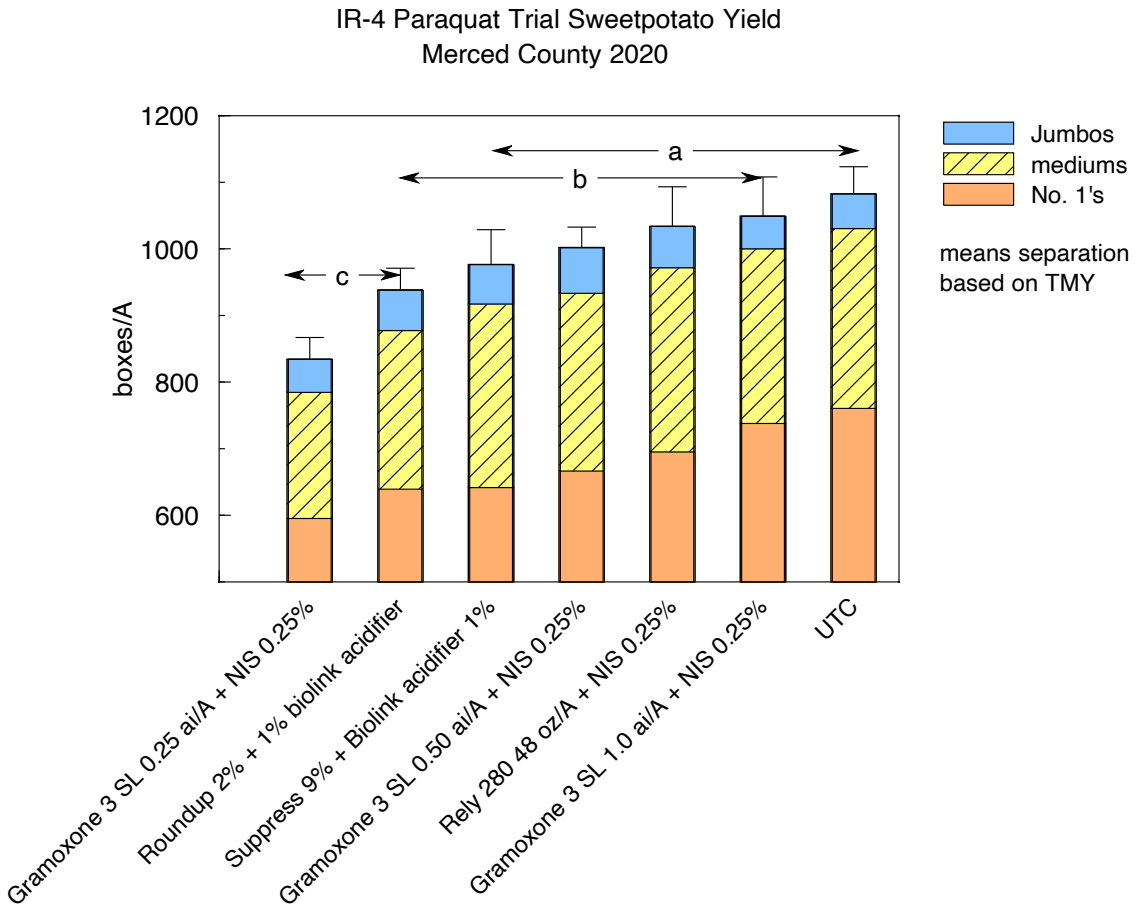

Figure 4. Sweetpotato total marketable yield (TMY) and size separation of harvested roots.

Table 2. Weed control, crop phyto, and plant production in sweetpotato hotbeds as affected by herbicide treatment. IR-4 paraquat trial, Merced County 2020.

		26-Mar	0 - 10 scale		%	1-Apr	0 - 10 scale		%	7-Apr	0 - 10 scale		%	15-Apr 0 - 10 scale		5/11/20
	treatment	weeds/2 sq ft	weeds	crop phyto	control	weeds/2 sq ft	weeds	crop phyto	control	weeds/2 sq ft	grass	BL	control	grass	BL	# plants/2 sq ft
1	UTC	197	7	0	21.9	267	9	0	10.0	139	7	6	23.0	2	0	137
2	Gramoxone 3 SL 0.25 ai/A + NIS 0.25%	6	1	0	98.1	47	2	1	93.8	81	2	1	87.5	1	0	122
3	Gramoxone 3 SL 0.50 ai/A + NIS 0.25%	0	0	0	99.4	3	1	0	97.5	8	1	1	97.5	1	0	160
4	Gramoxone 3 SL 1.0 ai/A + NIS 0.25%	5	1	0	98.1	10	2	0	93.8	21	1	1	95.6	1	0	149
5	Suppress 9% + Biolink acidifier 1%	26	3	0	84.5	58	4	1	72.0	96	4	0	61.0	3	0	128
6	Rely 280 48 oz/A + NIS 0.25%	25	2	0	81.9	47	2	1	85.6	85	2	2	83.8	2	0	134
7	Roundup 2% + 1% biolink acidifier	11	0	0	99.4	26	1	1	95.6	39	2	1	92.9	1	0	143
9	Hand weeded control *	9	2	0	93.8	37	3	0	79.0	37	4	4	72.0	1	0	131
	Average	39	2.0	0	83.3	65	2.8	0.5	78.3	67	2.7	1.7	77.3	1.5	0.2	139
	LSD 0.05	142	1.9	---	23.5	154	1.5	ns	16.5	ns	2.6	1.3	26.3	ns	ns	ns
	CV, %	124	63	---	19.00	79	36.7	136	14.2	83.5	67.1	54.5	21.1	112	220	13.2

Untreated control plots (UTC) were hand weeded after the 1-Apr evaluation. All other treatments hand weeded after 7-Apr evaluation.

* Hand weeded control plots were weeded weekly. Not included in statistical analysis.

0 - 10 scale. Subjective scale.
- 0 = no weeds/no crop phytotoxitity
- 1 = 2.5%
- 2 = 10%
- 3 = 21%
- 4 = 35%
- 5 = 50%
- 6 = 65%
- 7 = 79%
- 8 = 90%
- 9 = 97.5%
- 10 = all weeds/total crop loss

Main grass weed: barnyardgrass

Main broadleaf (BL) weeds: pibweed, lambsquarter, puncturevine, purslane, and nutsedge

Sweetpotato plant harvest on May 11, number of good transplants per 2 sq ft.

LSD 0.05 = Least significant difference at the 95% confidence level. Means within each evaluation date separrated by less than this amount are not significantly different (ns).

CV% = coefficient of variation

Appendix 1.

Table 3. Sweetpotato (cv 'Diane') root yield for each hotbed herbicide treatment, IR-4 herbicide trial Merced County 2020.

	treatment	TMY lbs/A	40 lb box/A No. 1's	Meds	Jumbos	adjusted TMY box/A	bins/A	No. 1's #1%	Culls cull%	plant stand #/plot	crop phyto
1	UTC	57475	760	270	52	1082	43.3	70.3	15.2%	49.8	0
2	Gramoxone 3 SL 0.25 ai/A + NIS 0.25%	43471	595	189	50	834	33.4	71.4	33.2%	47.5	0
3	Gramoxone 3 SL 0.50 ai/A + NIS 0.25%	51822	666	267	69	1002	40.1	66.5	27.7%	49.5	0
4	Gramoxone 3 SL 1.0 ai/A + NIS 0.25%	54657	738	262	49	1049	42.0	70.2	21.8%	49.0	0
5	Suppress 9% + Biolink acidifier 1%	52815	641	276	59	976	39.0	65.5	23.0%	49.5	0
6	Rely 280 48 oz/A + NIS 0.25%	55159	695	277	62	1034	41.4	67.4	16.2%	49.3	0
7	Roundup 2% + 1% biolink acidifier	50082	639	238	61	938	37.5	68.1	32.5%	49.3	0
8	Hand weeded control *	58374	769	252	114	1135	45.4	67.7	26.6%	49.5	0
	Average	52212	676	254	57	988	39.5	68.5	24.2%	49.1	0
	LSD 0.05	7647	ns	48.2	ns	130	5.2	ns	ns	ns	---
	CV, %	9.9	10.7	12.7	51.7	8.9	8.9	4.6	44.3	2.1	---

US #1's Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.

Mediums Roots 1 to 2 in diameter, 2 to 7 inches in length.

Jumbos Roots that exceed the size requirements of above grades, but are marketable quality.

Mkt Yield Total marketable yield is the sum of the above three categories.

bins/A bins/A are estimated based on market box yield assuming 20 boxes per bin.

% US #1's Weight of US #1's divided by total marketable yield.

% Culls Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.

LSD 0.05 Least significant difference. Means separated by less than this amount are not significantly different (ns). *Hand weeded plots not included in statistical analysis.

CV, % Coefficient of variation, a measure of variability in the experiment.

Figure 1. Weed growth in treatment 1 (UTC) with broadleaf weeds dominating at 14 days.

Figure 2. Weed growth in other UTC plots where grasses dominated at 14 days.

Figure 3. Paraquat 0.25 lbs a.i./A 14 days after application.

Figure 4. Paraquat 0.50 lbs a.i./A 14 days after application.

Figure 5. Paraquat 1.0 lbs a.i./A 14 days after application

Figure 6. Suppress herbicide initially provided good weed control, but efficacy was reduced after 7 days compared to the other treatments.

Performance of glufosinate on sweetpotato IR-4 Project: P10558
and
Performance of glufosinate in sweetpotato row middles IR-4 Project: P12905

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Summary: In 2020, USDA IR-4 field trials evaluated the herbicide Rely (glufosinate) applied prior to and after transplanting in a commercial sweetpotato field for weed control and crop safety. Pre-plant Rely at 86 and 172 fl oz/A was applied to a clean, weed-free area 1, 7, and 14 days before transplanting. Treatments were not mechanically incorporated, however, the 7-day PRE treatment received a pre-plant irrigation, approximately 4". Post-plant Rely at 86 and 172 fl oz/A was banded at 14 and 28 days after transplanting down the center of bed using a shielded sprayer to minimize contact with the crop. A hand weeded untreated control was used for comparison; additionally, post-transplant herbicide treatments included Shark (carfentrazone), GlyStar (glyphosate) and Suppress (capric + caprylic acid) applied to row centers at 28 days after transplanting. Sweetpotato cultivar 'Covington' was mechanically transplanted 3-Jun-2020 using standard equipment and practices. The experimental design was a randomized complete block (RCB) with 4 replications, plot size for the 7 and 14-day PRE treatments was 20 ft x 40 ft; all other treatments were 2 rows by 40 feet. Data collected included plant stand, visual crop injury, weed control, and yield. The sweetpotatoes were drip irrigated throughout the season, and the grower managed irrigation, fertilizers, and pest management. Because the emphasis of these trials was crop safety, all treatments were cultivated with standard equipment and maintained mostly weed free throughout the season. Both the main effects of rate and timing for the pre-plant treatments were significant, with greater stand loss and crop injury at all evaluation dates at 172 fl oz as compared to 86 fl oz, and at 1-day pre as compared to 7 or 14 days pre-plant. The rate x timing interaction was significant, with substantially more crop injury at 172 fl oz applied 1 day before transplanting as compared to the other treatments; over 61% of the plants in this treatment exhibiting stunting, chlorosis, and death at both 14 and 28 days after transplanting. As compared to the untreated control and the other treatments, crop yields were significantly reduced at both rates of Rely when applied 1 day before transplanting. Post-plant applications of Rely had far less impact on the crop, and neither rate nor timing were significantly different between treatments or the untreated control on most evaluation dates. However, #1 yield was significantly more when applied at 28 days after transplanting. Since applications were made using a shielded sprayer, injury was caused by herbicide drift. Greater crop injury was observed at 86 fl oz/A on the first evaluation date 2 weeks after application, and the 14-day POST application caused slightly more injury than the 28-day POST application. Glyphosate and carfentrazone caused more injury and had greater yield impact than any of the Rely treatments. These trials show that pre-plant applications of high rates of Rely can cause significant crop injury to sweetpotatoes if there is less than 14 days between application and planting, but with post-plant applications injury is limited to herbicide drift.

Objectives:

- Ccollect data to support registration of glufosinate herbicide on sweetpotatoes for field production by evaluating the effect of different rates and timings of pre-emergent glufosinate applications on crop injury and yield,
- Collect data to support registration of glufosinate for POST applications to row-middles in sweetpotatoes.

Introduction

Typical weed management practices in commercial sweetpotatoes in California include the use of pre-plant weed management coupled with a limited number of registered herbicides, cultivation, and hand hoeing when appropriate. Registered pre-emergence herbicides include Devrinol (napropamide), Dacthal, and Chateau/Valor (flumioxisin), however, because they require sprinkler irrigation or rainfall to incorporate, they are rarely used. Post emergence herbicides, cultivation, and hand hoeing are the main methods used to control weeds. Post-plant herbicide applications are limited to glyphosate (Roundup) with hooded sprayers, used after transplanting and before canopy closure. Other herbicides include the OMRI certified organic burndown product Suppress.

With the exception of yellow nutsedge, annual weeds dominate in production sweetpotato fields, especially *Amaranthus* species. The main method of irrigating sweetpotatoes is with surface drip tape placed between the plant rows. While very effective in providing uniform water and fertilizer delivery, this practice also creates a near ideal environment for summer annual weeds. Sweetpotatoes compete poorly with the vertical growing habit of pigweeds, lambsquarters, and nightshades, and if left unmanaged, will quickly outgrow and shade the crop, causing significant yield losses. Based on IR-4 trials in 2016, I reported yield declines of 75% when pigweeds were left unmanaged for the first 60 days after transplanting. In 2017, additional weed management trials showed yield losses up to 25% when weeds were not controlled at 6 weeks after transplanting. In 2018, pre-plant applications of Rely herbicide at 24 & 48 fl oz/A provided poor weed control and yields were reduced 36% in these treatments compared to the hand weeded treatments.

While still effective, concerns about weed resistance to glyphosate, especially with *Amaranthus* species, necessitate continual evaluation of weed management options in sweetpotatoes. The purpose of this research was to collect performance data in California to support registration of glufosinate herbicide on sweetpotatoes.

Methods

Two studies were conducted in a commercial sweetpotato field near Livingston, CA, during the 2020 growing season to evaluate high rates (0, 86, 172 fl oz/A) and timings (1, 7, and 14 days pre-plant and 14 and 28 days post plant) of glufosinate (Rely) herbicide on sweetpotato crop injury and yield. Post-transplant herbicide treatments also included Shark (carfentrazone), GlyStar (glyphosate) and Suppress (capric + caprylic acid) for comparison, applied to row centers at 28 days after transplanting. Trial locations and herbicide treatments are listed in Table 1.

Pre-plant glufosinate herbicide treatments were applied to clean, cultivated plots 1, 7, or 14 days before transplanting with a CO_2 backpack sprayer at 40 psi with a 4-ft boom using 4 TeeJet 8002 flat fan nozzles and calibrated to 30 gpa equivalent (Figure 1). Spray swath was measured at 78” when held ~ 18” above the soil surface at the time of application. For the 7-day pre-plant treatment, the herbicide was applied immediately before a pre-plant irrigation from sprinklers (about 4 – 5” water). The 14- and 7-day treatments were applied before bedding, and therefore the plots were 20 ft wide. The 1-day pre-plant treatment was applied after bedding, and plots were 80” wide. Neither the 14- nor the 1-day treatment received additional incorporation.

Table 1. Field site and herbicide treatments, IR-4 glufosinate trials Merced County 2020.

Cooperator	Randy Jantz
field location	Sunset and Steinberg, in Merced County
	37˚ 20' 17" N 130˚ 29' 39" W
Soil	Atwater Sand
Variety	Covington
Transplant	6/3/20
harvest	Oct 30 – 31, 2020
days	149

Treatments:	#	Herbicide		Timing	Rate, oz/A	AMS, lbs/A	Date applied
Glufosinate PRE	1	UTC	untreated	---	0	0	---
	2	Rely	glufosinate	1 day PRE	86	0	2-Jun
	3	Rely		7 days PRE	86	0	28-May
	4	Rely		14 days PRE	86	0	21-May
	5	Rely		1 day PRE	172	0	2-Jun
	6	Rely		7 days PRE	172	0	28-May
	7	Rely		14 days PRE	172	0	21-May
POST	8	Rely		14 days POST	86	3	18-Jun
	9	Rely		14 days POST	172	6	18-Jun
	10	Shark	carfentrazone	14 days POST	8	3	18-Jun
	11	Rely		28 days POST	86	3	2-Jul
	12	Rely		28 days POST	172	6	2-Jul
	13	Shark		28 days POST	8	3	2-Jul
	14	Gly-Star	glyphosate	28 days POST	256	3	2-Jul
	15	Suppress	caprilic acid	28 days POST	12%	0	2-Jul

Plot size	20 ft x 40 ft for 7 and 14-day pre-plant treatments, 6.67 x 40 ft for all others
	RCBD with 4 reps
Data:	plant stand at 14 and 21 days after transplanting
	crop injury 14 and 28 days after transplanting for PRE treatments
	crop injury 7, 14, and 28 days after POST treatments
	harvest yield
	All plots were maintained weed free during the experiment (cultivation + hand weeding)

Post-emergence applications of glufosinate were made using the same CO_2 backpack sprayer, but with a hand-held wand with 1 TeeJet 8002 flat fan nozzle to spray between the plant rows (center of double-row bed) to simulate a banded application. Rely treatments included ammonium sulfate at 3 and 6 lbs/A equivalent; glyphosate and carfentrazone included AMS + NIS at 0.25%. The herbicides were applied by banding the product between plant rows and shielding the plants on both sides to minimize drift and overspray contact to the crop (Figure 2). The band width was 2 feet, and therefore rates were adjusted accordingly for the width of the band relative to a broadcast application (24”/80” = 0.30).

Sweetpotato cultivar 'Covington' was transplanted 3-June,2020, using the grower's mechanical transplanter at 9" in-row spacing with between row spacing of 40". Plants were set with transplanter water (3000 gpa) and then irrigated using surface drip tape for the remainder of the season. Irrigation, fertilizer, and pest management were performed by the grower. Because the emphasis of this project was crop tolerance, weeds were controlled using standard cultivation methods and hand crews, and therefore no weed data were collected.

Plot size was 20 feet (3 beds) x 40 ft for the 14- and 7-day pre-plant treatments; all other treatments were 1 bed (2 rows) 6.67 ft wide x 40 ft long. Experimental design was a RCB with 4 replications; means separation was done using Fisher's Protected LSD at 95% confidence level. Rate and timing of the Rely treatments were treated as separate factors in the ANOVA. Data collected included crop stand and visual crop injury using a subjective scale (0 = no injury or no control, 10 = 100% crop death), determined at 14, 21, and 28 days after planting for the pre-plant trial, and 7, 14, and 28 days after treatment for the POST treatments. These subjective scale ratings were then converted to %injury using the arcsin transformation. A nontreated check was included for comparison. Most of the plots were maintained weed free through light cultivation and hand removal. Photos were taken of the plots at the evaluation dates. Yields were measured using a commercial 1-row harvester and hand graded by the harvest crew into standard size grades (No. 1's, mediums, and jumbos). Cull roots were also weighed. Marketable yield was calculated as the sum of No. 1, mediums, and jumbos grades. Whole plot yields were taken for this trial, and the glufosinate treatments were separated into their own bins and later destroyed.

Figure 1. Pre-plant Rely applications at 7 and 14 days (left) were made before pulling the beds, while the 1-day PRE application was made to the bed (right).

Figure 2. Post-plant Rely application at 14 days after transplanting.

Results

Stand counts taken 14 days after transplanting were significantly less in the 172 fl oz applied 1 day prior to transplanting (average 50 plants per plot, about 47% reduction) compared to all other treatments; at 21 days after transplanting, most treatments had reduced stand compared to the untreated control (Table 2). The 1-day pre-plant application had the greatest overall plant loss, and the rate x timing interaction was significant for this effect.

Because the emphasis of these trials was crop safety, all treatments were cultivated with standard equipment and maintained mostly weed free throughout the season. No significant differences in weed pressure were noted between herbicide treatments at any time during this trial.

Overall crop injury continued to increase at subsequent evaluation dates. Both the main effects of rate and timing for the pre-plant treatments were significant, with greater stand loss and crop injury at all evaluation dates at 172 fl oz as compared to 86 fl oz, and at 1-day pre-plant as compared to 7 or 14 days pre-plant (Table 2). The rate x timing interaction was significant, with substantially more crop injury at 172 fl oz applied 1 day before transplanting as compared to the other treatments; over 61% of the plants in this treatment exhibiting stunting, chlorosis, and death at both 14 and 28 days after transplanting (Figure 3).

Post plant applications included Shark as a treatment, applied at both 14 and 28 days. Post-plant applications of Rely had far less impact on the crop, and neither rate nor timing were significantly different between treatments or the untreated control on most evaluation dates (Table 3). The initial post-plant application of Rely and Shark caused substantial crop injury (30 – 49%) even though a crop shield was utilized. These were not statistically different, and the plants slowly grew out of this injury as the season progressed. Note that the untreated control was not included in these statistical comparisons, as these plots were given subjective scores of 0. The glyphosate treatment was the most injurious of all the treatments evaluated, with 42% crop injury at 42 days after transplanting (Figure 4).

Yield

Sweetpotato yield results as effected by the pre-plant herbicide treatments are shown in Table 4. As compared to the untreated control and the other treatments, #1's and total marketable yield were significantly reduced, while % culls were significantly increased, at both rates of Rely when applied 1 day before transplanting (Table 4). The application rate x timing interaction was significant only for #1's (Figure 5). Rely applied at 172 oz/A 1-day before transplanting had a significant impact on crop yield, whereas there was little effect from the 14-day pre-plant application.

Post-plant applications of Rely had far less impact on the crop, and neither rate nor timing were significantly different between treatments or the untreated control for total marketable yield, which was about 1050 boxes/A (Table 5). However, #1 yield was significantly more when applied at 28 days after transplanting as compared to 14 days (Figure 6). Since applications were made using a shielded sprayer, injury was caused by herbicide drift. Glyphosate and carfentrazone caused more injury and had greater yield impact than any of the Rely treatments. Suppress herbicide, which has no systemic action, caused no significant yield loss.

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Table 2. Sweetpotato crop injury ratings 14, 21, 28, and 35 days after transplanting as affected by pre-plant Rely treatment, Merced County 2020.

Treatment	app date	18-Jun stand	18-Jun injury	25-Jun stand	25-Jun injury	2-Jul injury	9-Jul injury	0 - 10 rating phyto	0 - 10 rating weeds
1. UTC	---	94	0.0%	95	0.0%	0.8%	1.1%	0.3	0.50
2. Rely 1 day PRE transplant at 86 oz/A	2-Jun	84	10.9%	83	16.5%	17.0%	19.9%	3.3	0.50
3. Rely 7 days PRE at 86 oz	28-May	86	9.8%	83	12.0%	15.7%	17.3%	3.0	0.75
4. Rely 14 days PRE at 86 oz	21-May	93	2.7%	91	4.0%	5.3%	8.0%	1.5	0.75
5. Rely 1 day PRE transplant at 172 oz/A	2-Jun	50	47.1%	52	51.1%	61.7%	61.7%	6.8	1.00
6. Rely 7 days PRE at 172 oz	28-May	82	13.6%	77	15.2%	19.7%	20.2%	4.5	0.50
7. Rely 14 days PRE at 172 oz	21-May	91	3.7%	85	3.7%	6.9%	9.8%	2.0	1.00
LSD 0.05		15.6	17.2	10.4	20.0	18.1	17.7	2.8	ns
Rate: Rely 86 oz/A		87	7.8	86	10.8	13.0	15.1	2.6	0.7
Rely 172 oz/A		74	21.5	71	23.3	29.6	30.6	4.4	0.8
p-test		*	*	***	*	**	**	*	ns
Timing: 1 day PRE		67	29.0	68	33.8	39.4	40.8	5	0.8
7 days PRE		84	11.7	80	13.6	17.7	18.8	3.8	0.6
14 days PRE		92	3.2	88	3.9	6.9	8.9	1.8	0.9
LSD 0.05		11.9	12.1	7.4	14.1	12.8	12.5	2.0	ns
Rate x Timing LSD		*	*	**	*	**	**	*	ns
Average		80.7	14.6	78.5	17.1	21.3	22.8	3.5	0.8
CV, %		13.8	77.9	8.8	77.8	56.3	51.4	52.8	66

stand = number of live plants per plot

crop injury = # plants with herbicide symptoms as a % of UTC. UTC values not included in statistical analysis and were used for reference only.

crop phyto = subjective crop phytoxicity score for entire plot, 0 = no injury and 10 = all plants with herbicide symptoms/stunting

0 - 10 scale (subjective)
- 0 = no weeds/no crop phytotoxitity
- 1 = 2.5%
- 2 = 10%
- 3 = 21%
- 4 = 35%
- 5 = 50%
- 6 = 65%
- 7 = 79%
- 8 = 90%
- 9 = 97.5%
- 10 = all weeds/total crop loss

*, **, *** p-test significant at 0.05, 0.01, and 0.001 respectively

LSD 0.05 = Least significant difference at the 95% confidence level. Means within each evaluation date separrated by less are not significantly different (ns).

CV% = coefficient of variation

Table 3. Sweetpotato crop injury ratings 21, 28, 35, 42 and 47 days after transplanting as affected by post-plant Rely treatments, Merced County 2020.

Treatment			app	25-Jun		2-Jul	9-Jul 0 - 10 score		16-Jul		23-Jul
Product	timing	rate	date	stand	injury	injury	injury	phyto	injury	phyto	phyto
1. UTC	---	---	---	95	0%	0.8%	1.1%	0.3	6.4%	0.5	0.0
8. Rely + 3 lbs/A AMS	14 days POST	86 oz/A	18-Jun	85	48.4%	52.3%	41.2%	5	25.2%	2.5	0.5
9. Rely + 6 lbs/A AMS	14 days POST	172 oz/A	18-Jun	90	39.8%	36.1%	29.5%	3.75	30.3%	1.8	0.8
10. Shark + AMS + NIS 0.25%	14 days POST	8 oz/A	18-Jun	82	29.9%	22.2%	18.3%	3	14.6%	3.3	1.8
11. Rely + 3 lbs/A AMS	28 days POST	86 oz/A	2-Jul	91	0.3%	3.6%	21.4%	2.75	15.4%	1.8	0.5
12. Rely + 6 lbs AMS	28 days POST	172 oz/A	2-Jul	90	0.0%	8.4%	21.9%	2.75	15.1%	1.3	0.3
13. Shark + AMS + NIS 0.25%	28 days POST	8 oz/A	2-Jul	87	0.0%	8.7%	29.8%	1.75	12.4%	1.0	1.3
14. Gly-Star + AMS + acidifier	28 days POST	8 qts/A	2-Jul	84	2.1%	7.5%	51.2%	6.5	42.0%	5.5	4.3
15. Suppress + acidifier	28 days POST	12%	2-Jul	92	0.3%	11.8%	13.5%	1.25	6.6%	1.0	0.5
	LSD 0.05			ns	ns	19.6	21.6	1.9	17.5	1.5	1.5
			Note: LSD only for treatments 8, 9 and 10.				*LSD values to compare all POST treatments*				
Rate (Rely only):	Rely 86 oz/A			88	48.4	52.3	31.3	3.9	20.3	2.1	0.5
	Rely 172 oz/A			90	39.8	36.1	25.7	3.3	22.7	1.5	0.5
	p-test			ns	ns	*	ns	ns	ns	ns	ns
Timing (Rely and Shark only):	14 days post			86	---	---	29.6	3.9	23.4	2.5	1.0
	28 days post			89	---	---	24.4	2.4	14.3	1.3	0.7
	LSD 0.05			ns	---	---	ns	*	ns	*	ns
	Rate x Timing LSD			---	---	---	ns	ns	ns	ns	ns
	Average			88.3	39.3	36.6	27.0	3.2	18.8	1.9	0.8
	CV, %			7.3	43.8	30.8	55.2	44.6	68.00	59.5	110

stand = number of live plants per plot

crop injury = # plants with herbicide symptoms as a % of UTC. UTC values not included in statistical analysis and were used for reference only.

crop phyto = subjective crop phytoxicity score for entire plot, 0 = no injury and 10 = all plants with herbicide symptoms/stunting

0 - 10 scale (subjective)
- 0 = no weeds/no crop phytotoxitity
- 1 = 2.5%
- 2 = 10%
- 3 = 21%
- 4 = 35%
- 5 = 50%
- 6 = 65%
- 7 = 79%
- 8 = 90%
- 9 = 97.5%
- 10 = all weeds/total crop loss

*, **, *** p-test significant at 0.05, 0.01, and 0.001 respectively

LSD 0.05 = Least significant difference at the 95% confidence level. Means within each evaluation date separrated by less are not significantly different (ns).

Rate x Timing LSD for Rely treatment comparisons only

CV% = coefficient of variation

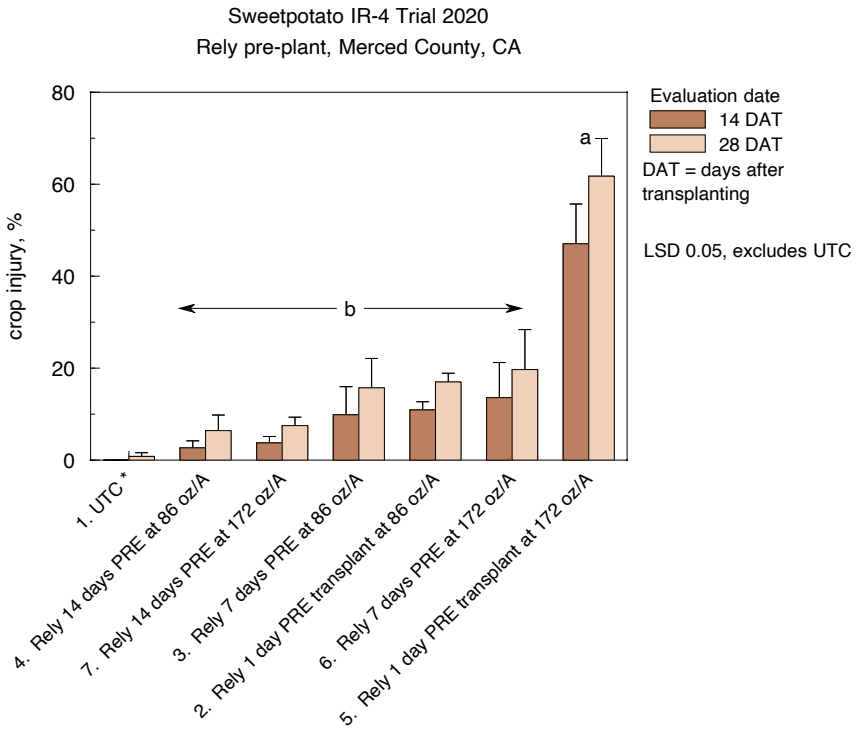


Figure 3. Sweetpotato crop injury at 14 and 28 days after transplanting (DAT) as effected by pre-plant herbicide treatment.

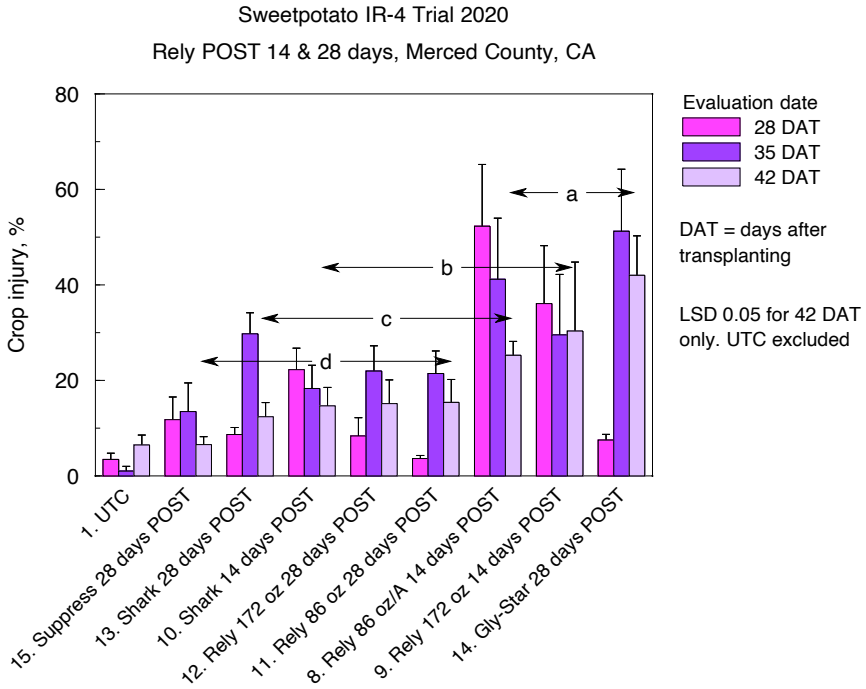


Figure 4. Sweetpotato crop injury at 28, 35, and 42 days after transplanting as effected by post-plant herbicide treatment.

Table 4. 'Covington' sweetpotato yield as affected by pre-plant Rely herbicide treatments, Merced 2020.

		boxes per plot			adjusted TMY			
Treatment		**#1's**	**Jumbo**	**Medium**	**boxes/A**	**bins/A**	**% #1's**	**CULLS, %**
1. UTC		639	290	166	1096	43.8	58.4%	6.3%
2. Rely 1 day PRE transplant at 86 oz/A		471	250	148	870	34.8	54.1%	12.8%
3. Rely 7 days PRE at 86 oz		537	396	135	1069	42.7	50.1%	7.8%
4. Rely 14 days PRE at 86 oz		535	356	162	1054	42.2	50.7%	6.9%
5. Rely 1 day PRE transplant at 172 oz/A		303	356	90	749	30.0	39.3%	20.5%
6. Rely 7 days PRE at 172 oz		481	321	127	929	37.2	52.0%	15.4%
7. Rely 14 days PRE at 172 oz		688	268	158	1114	44.6	61.9%	7.2%
	LSD 0.05	132.9	ns	ns	196.0	7.7	9.3	6.7
Rate:	Rely 86 oz/A	514	335	149	997	39.8	51.6%	9.2%
	Rely 172 oz/A	491	315	125	931	37.3	51.1%	14.4%
	p-test	ns	ns	ns	ns	ns	ns	*
Timing:	1 day PRE	387	303	119	809	32.4	46.7%	16.6%
	7 days PRE	509	359	131	999	39.8	51.1%	11.6%
	14 days PRE	612	312	160	1084	43.4	56.3%	7.1%
	LSD 0.05	101.5	ns	ns	153	6.0	6.9%	4.9%
	Rate x Timing p-test	*	ns	ns	ns	ns	**	ns
	Average	522	320	141	983	39.3	52.3	11.0
	CV, %	17.1	25.6	28.5	13.2	13.2	11.9	40.9

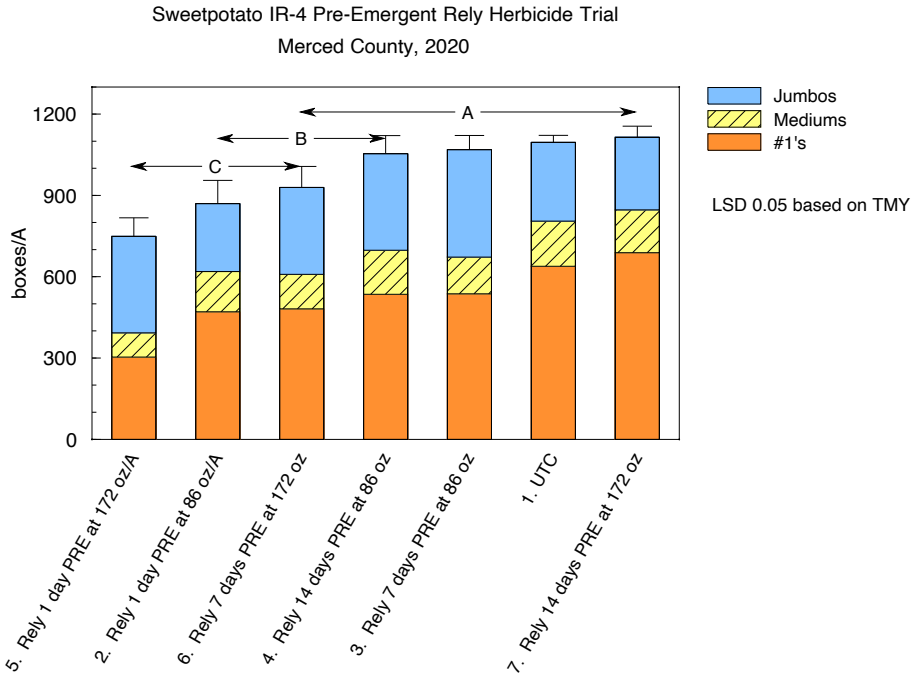
Table 5. 'Covington' sweetpotato yield as affected by POST applied herbicide treatments, Merced CA 2020.

Treatment			**app**	boxes per plot			adjusted TMY			
Product	**timing**	**rate**	**date**	**#1's**	**Jumbo**	**Medium**	**boxes/A**	**bins/A**	**% #1's**	**CULLS, %**
1. UTC	---	---	---	639	290	166	1096	43.8	58.4%	6.3%
8. Rely + 3 lbs/A AMS	14 days POST	86 oz/A	18-Jun	551	337	142	1029	41.2	53.6%	6.5%
9. Rely + 6 lbs/A AMS	14 days POST	172 oz/A	18-Jun	560	272	148	980	39.2	57.4%	10.7%
10. Shark + AMS + NIS 0.25%	14 days POST	8 oz/A	18-Jun	508	364	119	991	39.6	51.5%	6.8%
11. Rely + 3 lbs/A AMS	28 days POST	86 oz/A	2-Jul	666	287	145	1099	44.0	61.0%	13.0%
12. Rely + 6 lbs AMS	28 days POST	172 oz/A	2-Jul	623	341	142	1106	44.2	56.4%	10.2%
13. Shark + AMS + NIS 0.25%	28 days POST	8 oz/A	2-Jul	609	346	140	1095	43.8	55.5%	6.2%
14. Gly-Star + AMS + acidifier	28 days POST	8 qts/A	2-Jul	356	419	105	881	35.2	40.2%	14.1%
15. Suppress + acidifier	28 days POST	12%	2-Jul	613	258	146	1016	40.7	60.4%	11.5%
	LSD 0.05			94.4	ns	ns	ns	ns	5.5%	ns
Rate (Rely only):	Rely 86 oz/A			608	312	144	1064	42.5	57.3%	9.7%
	Rely 172 oz/A			591	307	145	1043	41.9	56.9%	10.5%
	p-test			ns	ns	ns	ns	ns	ns	ns
Timing (Rely and Shark only):	14 days post			540	324	136	1000	40.0	54%	8%
	28 days post			633	324	142	1100	44.1	58%	10%
	LSD 0.05			55	ns	ns	ns	ns	3.2	ns
	Rate x Timing p-test			ns	ns	ns	ns	ns	ns	ns
	Average			569	323.9	139.3	1032	41.4	54.9	9.5
	CV, %			11.4	21.5	17.6	11.0	11.0	6.9	45.8

US #1's	Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.
Mediums	Roots 1 to 2 in diameter, 2 to 7 inches in length.
Jumbos	Roots that exceed the size requirements of above grades, but are marketable quality.
Mkt Yield	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 20 boxes per bin.
% US #1's	Weight of US #1's divided by total marketable yield.
% Culls	Roots greater than 1" in diameter that are so misshapen or unattractive as to be unmarketable.
LSD 0.05	Least significant difference. Means separated by less than this amount are not significantly different (ns).

*, **, *** p-test significant at 0.05, 0.01, and 0.001 respectively

CV, %	Coefficient of variation, a measure of variability in the experiment.



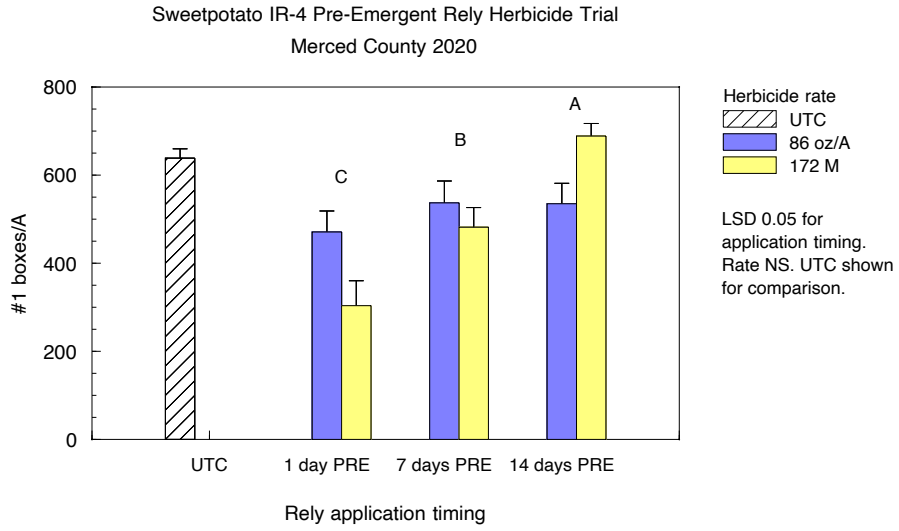


Figure 5. Total yields by pre-plant herbicide treatment (top) and the rate x timing interaction for #1 yields.

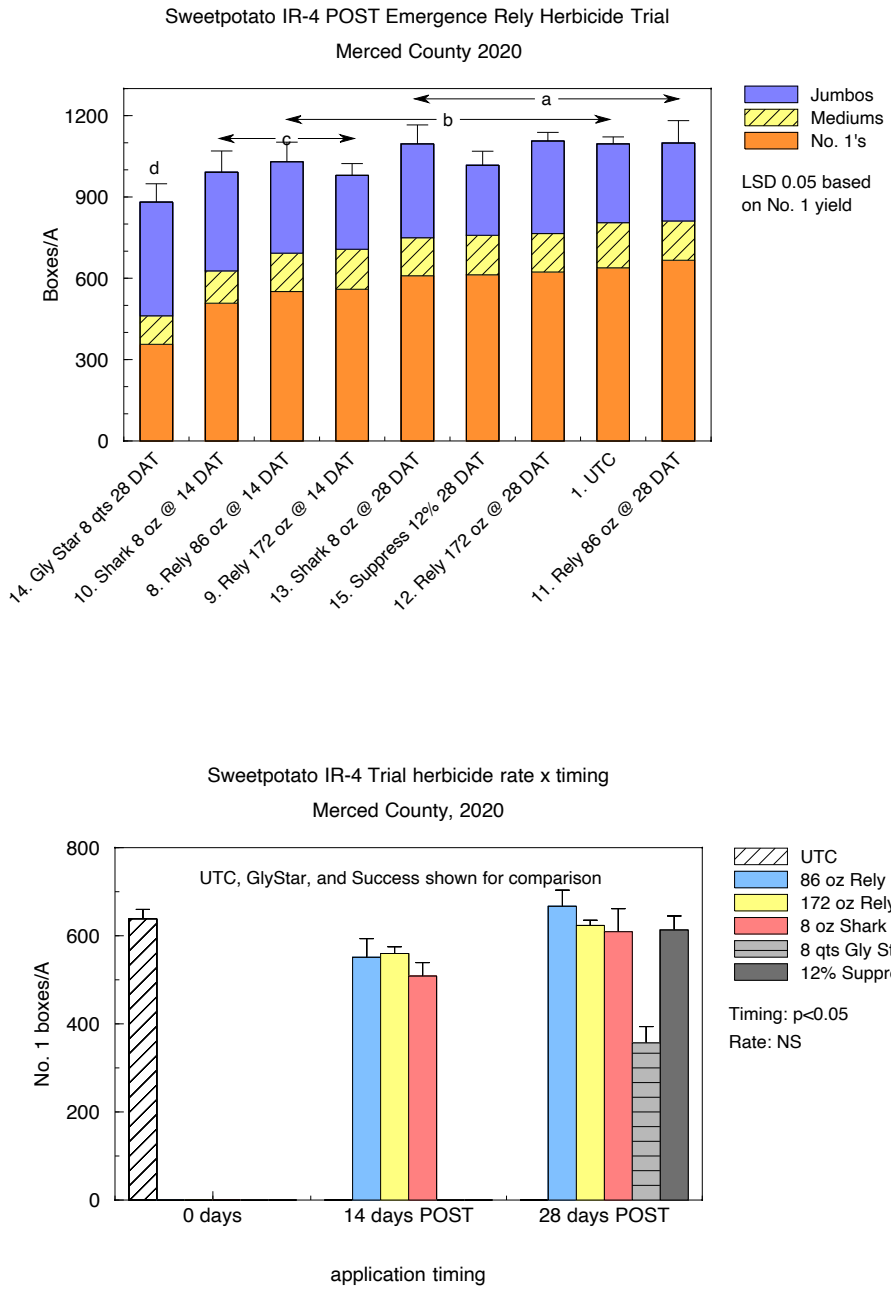


Figure 6. Total yields by post-plant herbicide treatment (top), and the rate x timing interaction for #1 yields. UTC, Gly-Star, and Suppress shown for comparison.

Appendix. Treatment photos.

Treatment 1: UTC 14 DAT

Treatment 5. Rely 1-day pre at 172 oz/A at 14 DAT

Treatment 1: UTC at 28 DAT

Treatment 5 at 28 DAT

Treatment 8: Rely 14 days post at 86 oz/A at 28 DAT

Treatment 12: Suppress 12% 28 days post at 28 DAT

		
Treatment 1 at 6 weeks after transplanting (WAT)	Treatment 2 at 6 weeks after transplanting.	Treatment 3 at 6 weeks after transplanting.
		
Treatment 4 at 6 weeks after transplanting.	Treatment 5 at 6 weeks after transplanting.	Treatment 6 at 6 weeks after transplanting.

		
Treatment 7 at 6 WAT	Treatment 8 at 6 WAT.	Treatment 9 at 6 WAT.
		
Treatment 10 at 6 WAT.	Treatment 11 at 6 WAT	Treatment 12 at 6 WAT
		
Treatment 13 at 6 WAT	Treatment 14 at 6 WAT	Treatment 15 at 6 WAT

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