Sweetpotato Research Progress Report 2017

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Sweetpotato Collaborators Trial -- 2017

Scott Stoddard, UCCE Merced County

This year's sweetpotato evaluation was with Quail H Farms, south of Livingston, CA. Soil type was Delhi sand, slightly saline.
Conventional field, fumigated with metam-K prior to planting. Drip irrigated, water quality marginal - high salts & alkalinity.
Wet winter and spring rains, delayed planting, very hot summer after mid-June with 26 days over 100 F.
Two row plots, machine harvested and sorted by grower crew. Excellent overall yields, especially Covington. Only 2 reps of L-14-15P.

Rep	Var#	Variety Name	Skin Color	Skin Text	Flesh color	Eyes	Lents	Shape	Shape Uniform	Overall App	Comments
1	1	Beauregard	Rose-Cu	7	3	7	9	3	7	9	YCR, some eyes
2				9	2.5	9	9	3, 8	9	7	mostly smooth, good shape
1	2	Covington	Rose	9	3	9	9	3, 6, 8	7	7	LG, some eyes, YCR
2			Rose Cu	9	3	7	9	3, 6	7	8	smooth skin, little chunky
1	3	Orleans	Rose	7	3	5	7	3, 6, 8	5	6	RC, YCR, WW
2			Rose	9	3	7	7	3, 6, 8	7	7	LG, RKN, eyes, lumps
1	4	Burgundy	Maroon	7	4	9	7	2,6	7	7	smooth skin, color not red enough
2			Maroon	9	4	9	7	2, 5	6	7	dull color, some chunky
1	5	Bellevue	Orange	9	3	9	9	3, 8	7	8	slight YCR, very smooth
2			orange	9	4	9	8	3,8	7	9	1 with veins, no eyes.
1	6	NC04-531 (G2	Red	7	3	7	7	4, 5, 8	7	7	some veins, lents, eyes, nice color
2			Red to Cu	9	3	9	5	4, 5, 8	7	8	CV, some pimples, latex stain
1	7	NC05-198 (G3	Rose	7	3	7	7	2, 3, 6	7	6	RKN cracks and bumps
2			rose	6	3	8	7	2,3	7	5	scratches easily
1	8	NC09-122 (G2	purple	9	4	9	7	4,8	7	7	smooth, long, asymetric shape
2			purple	8	4	9	5	4,8	8	8	good flesh color, no eyes, resists scratching
1	9	L-13-81 (G3)	purple	9	4	7	7	3, 4, 6	7	8	Nice color, resistes scratching
2			purple	9	4	7	7	3,4	7	9	some tails, smooth, attractive
1	10	L-13-84 (G3)	orange	9	4	7	7	3,4,8	7	8	slight eyes, slightly more rose than Bellevu
2			orange	8	4	7	9	3,4,8	7	9	little long. Almost as pretty as Bellevue
1	11	Diane	Red	7	4	7	7	3,4,8	5	7	good color, smooth skin
2			Red	7	4	7	5		5	7	variable shape, sprouts
1	12	Bonita	cream	7	1	5	7	2,6	7	6	veins, CV, slightly pink
2			*buff*	7	1	5	7		7	7	smooth skin, long shape
1	13	NC08-553	tan	5	1	7	7	3	7	7	latex staining, SD
2			tan	7	1	6	7	2,3	7	5	bruising stains
1	14	L-14-15P	*purple*	3	purple	7	5	3,5	5	5	LG, rough skin, dull color

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

All ratings made on #1 roots.
YCR = yellow cortical ring
RC = Russet Crack
RKN = root knot nematode
LG = longitudinal grooves
Culls = main reason for culls

NATIONAL SWEETPOTATO COLLABORATORS SUMMARY OF DATA

2017

STATE AND LOCATION REPORTING: Livingston, CA
DATE TRANSPLANTED: 6/8/2017. DATE HARVESTED: 10/26/2017. No. GROWING DAYS: 140
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.

	SELECTION	CLASS	------- lb box/A ------- US #1's	40 Medium	Jumbo	MKT YIELD	BINS/ A	% US #1's	% CULLS
1	Beauregard (G2)	yam	648	152	250	1050	42.0	61.9%	4.3%
2	Covington (G3)	yam	838	232	253	1324	52.9	63.4%	0.8%
3	Orleans (G3)	yam	693	212	225	1130	45.2	61.3%	2.5%
4	Burgundy (G2)	red yam	631	125	222	978	39.1	64.7%	4.7%
5	Bellevue (G3)	yam	582	195	209	985	39.4	59.3%	3.1%
6	NC04-531 (G2)	red yam	635	170	161	967	38.7	65.8%	2.6%
7	NC05-198 (G3)	yam	738	143	256	1137	45.5	65.1%	2.0%
8	NC09-122 (G2)	red yam	663	187	247	1097	43.9	60.5%	1.7%
9	L-13-81 (G3)	yam	659	196	157	1012	40.5	65.3%	1.2%
10	L-13-84 (G3)	red yam	708	198	133	1039	41.6	68.5%	3.4%
11	Diane	red yam	702	203	222	1127	45.1	62.3%	4.8%
12	Bonita	sweet	657	181	125	964	38.6	68.4%	5.0%
13	NC08-553	sweet	621	163	113	896	35.9	69.3%	1.9%
14	L-14-15P *	purple	587	203	177	967	38.7	60.8%	1.0%
	Average		675.1	181.3	198.0	1054.3	42.2	64.3%	2.9%
	LSD 0.05		71.9	43.6	74.9	131.6	5.3	5.7	ns
	CV, %		7.4	16.8	26.4	8.7	8.7	6.1	91.2

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 22 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.
LSD 0.05	Least significant difference. Means separated by less than this amount are not significantly different (ns).
	* L-14-15P not included in statistical analysis
CV, %	Coefficient of variation, a measure of variability in the experiment.

SCORE SHEET FOR EVALUATION OF SWEETPOTATO SPROUT PRODUCTION - NSPCG TRIAL

Date bedded: 2/27/17 Location: Robin Rd, Livingston CA next to packing shed

Date Evaluated: 4/10/17 Type of bed: cold bed

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	Beauregard	yes	4	4	3		just trimmed
2	Covington	yes	3	3	2		
3	Orleans	yes	4	4	3		
4	Burgundy	yes	1	1	1	some rot	
5	Bellevue	yes	3	2	2		clumpy emergence, deep purple
6	NC04-531	yes	3	3	2		
7	NC05-198	no	5	5	3		lots of plants
8	NC09-122	yes	2	2	1		
9	L-13-81	yes	4	5	3		good plant production
10	L-13-84	yes	3	3	2		light purple foliage
11	Diane	yes	5	5	3		
12	Bonita	yes	4	4	3		
13	NC08-553	yes	3	2	2		
14	L-14-15P	no	3	4	2		all green, lacy leaf

(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) indicates 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.

Sweetpotato ALT 2017

Scott Stoddard, UCCE Merced County

Cooperator: Dave Souza of D&S Farms. Llocated on NE corner of Steinberg and Longview Rds, west of walnuts. The 2016 selections were cut on May 24 and received and transplanted on May 26. No irrigation water for about 3 weeks before harvest on Oct 11. Trial was harvested with the help of Don La Bonte and Steve Meyers. No yield estimate was taken.

Variety	root description (skin/flesh color, shape, smoothness)	**for 2018** keep/drop
175 (Burgundy) 175 VINE CUTTING	Good production	
L-11-119	Long, but big yield. Smooth skin.	keep
L-11-119	Red/orange. Smooth skin. Good set. Long	keep
L-11-119	Red/orange Big Yield	keep
L-13-160	Red/ lt. orange Variable shape and set	drop
L-13-160	ped/orange. Rough skin. Blanks low yield	drop
L-13-81	Good shape, good set. Smooth Purple/ orange	keep
L-13-81	smooth Purple/orange, no lateral roots, but some fine feeder roots	keep
L-13-84	Orange/orange, similar appearance as bellevue. Good set	keep
L-14-11	Purple/ orange. Eats well raw. Good set smooth skin.	keep
L-14-11	Red/ orange. Long. Smooth. Good set-2 totes	keep
L-14-145	Purple/orange 2x skin fluting long	drop
L-14-145	Purple/orange Long. Fluting. Eyes.	drop
L-14-15P	Just ok. Not as attractive as last year. Rough skin	drop
L-14-31	Purple/Orange. Variable shape. Smooth	keep
L-14-31	Purple/ orange. Mostly long. Variable shape. Smooth	keep
L-14-31	Purple/orange. Shape variable. Smooth skin yld ok	keep
L-14-31	Purple/orange. Variable shape. Move up	keep
L-15-18	Light purple/white flesh. round. Growth cracks	drop
L-15-39		drop
L-15-39	Purple/white, smooth skin, but a lot of jumper cables, misshape	drop
L-15-39	Purple/white. Long. Misshape. Lots skips. Yld low	drop
L-15-39	Red/white. Variable set. Misshape. Lumps and veins	drop
L-15-41R	light tan/orange. Jumbos. Pimpling. Good yield	drop
L-15-42	buff/white. Round rough skin. Cracks	drop
L-15-57	Rose/orange	keep
L-15-60	Purple/orange. Good shape and skin color, light yield mostly mediums	drop
L-15-69	tan/orange. Long. Only a few plants	

Variety	root description (skin/flesh color, shape, smoothness)	for 2018 keep/drop
L-15-73	tan-rose/white skin stripes	drop
L-15-73	Tan-pink/white flesh. Some veins. Good set	drop
L-15-74	Red/white 1 tote yield low	drop
L-16-122	Red/white. Smooth. Fluting	drop
L-16-144	Purple/white few plants	
L-16-145	reddish purple/white mosty smooth. Not purple enough	drop
L-16-158	Cu/orange. Skin ok, shape ok, set ok	drop
L-16-166	Purple/white horizontal roots	keep
L-16-278	Red/whitte. Long. Smooth skin. 2 totes yield ok	keep
L-16-298	purple/white. Lots of jumbos. Fairly smooth	keep
L-16-91	Purple/white. Low yield	drop
L-16-95	Tan/orange. Lumpy,misshape. Growth cracks	drop
NC-10-104	Dk/red orange, variable set and shape. Smooth skin	
NC-10-104	purple/orange. Mostly smooth. Large, little long	
NC-12-745	Red/orange. Little variable shape. Eyes smooth	
NC-12-745	red/Orange. Smooth, but some lents. Some jumper cables	
NC-12-910	Purple/orange smooth. Good shape and set. Latex good yield	
NC-12-910	Red/orange. Smooth skin. Good set, but small . Good shape	
NC-13-151	purple/orange smooth. Many long	
NC-13-151	Purple/ orange Bleeder. Good set lots med	
NC-13-604	Tan/white. Lots mediums. But still good set. Latex	
NC-13-604		

SCORE SHEET FOR EVALUATION OF SWEETPOTATO SPROUT PRODUCTION - ALT

Date bedded: 3/1/17 Location: Cressey Ranch, south of Atwater
Date Evaluated: 4/10/17 Type of bed: cold bed

Evaluated by: S. Stoddard

	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	175-1	no	1	1	1		Almost no emergence
2	175-LSU	no	1	1	1		almost no emergence
3	NC12-910	yes	4	5	2		
4	L-13-84	yes	3	3	2		
5	L-14-15P	yes	4	4	3		all green, lacy
6	NC13-151	yes	5	4	3		
7	L-14-145	yes	3	3	2		
8	NC12-745	yes	2	2	1		
9	NC13-604	yes	4	4	3		tallest
10	L-15-73	yes	3	3	3		mostly purple
11	NC10-104	yes	4	4	1		small but uniform
12	L-14-11	yes	3	3	2		
13	L-13-160	yes	3	3	2		
14	L-11-119	yes	2	2	1		
15	L-15-39	yes	2	3	3		few plants but tall
16	L-14-31	yes	3	4	3		few plants but tall
17	Diane	yes	5	5	3		

(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.

Replicated lines in the 2017 Advanced Line Trial yield results (n = 4).

	Var Name	TMY lbs/A	40 lb box/A No. 1's	Meds	Jumbos	adjusted TMY box/A	bins/A	No. 1's #1%	Culls cull%
1	L-14-15p	46935.0	357.0	157.5	518.0	1032.6	41.3	34.6%	0.0
2	L-13-84	50926.0	562.7	295.3	262.3	1120.4	44.8	50.2%	0.0
3	L-13-81	43514.9	518.7	194.8	243.9	957.3	38.3	54.3%	0.0
4	Covington	41849.8	511.9	224.2	184.6	920.7	36.8	55.6%	0.0
5	175 vine cut	65946.7	510.6	153.8	786.4	1450.8	58.0	35.4%	0.0
6	LSU175 bed	53714.2	460.5	140.3	581.0	1181.7	47.3	39.0%	0.0
7	175 bed FPS	50730.1	467.6	239.2	409.2	1116.1	44.6	41.9%	0.0
	Average	50516.7	484.1	200.7	426.5	1111.4	44.5	0.4	0.0
	LSD 0.05	ns	147.6	ns	119.9	ns	ns	11.5	---
	CV, %	10.9	16.1	31.4	20.5	10.9	10.9	12.7	---

cv 175 (Burgundy) was not included in statistical analysis.

Evaluation of new nematicides on sweetpotatoes in California.

C. S. Stoddard*and A. Ploeg
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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), *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 can limit the amount of Telone used in any year to 17% - 50% of demand. Novel new nematicides offer the potential for effective alternatives for areas where Telone is restricted, and in buffer zones where no fumigation at all is allowed.

Methods.

Trials were conducted in 2017 within the buffer zone in commercial sweetpotato fields in Merced County as well as the UC South Coast Research and Extension Center in Irvine, CA, evaluating Nimitz (fluensulfone, Adama), Velum (fluopyram, Bayer Crop Science) and Salibro (fluazaindolizine, duPont) nematicides on RKN control and sweetpotato yield and quality. Treatments were designed to test different methods of application, timing, and rates. Metam (as metam K or metam Na) and untreated control plots were used for comparison. Nimitz, Velum, and Salibro were evaluated at different treatment timings (pre-plant, at-plant, 3 – 6 weeks post plant), rates, and methods of application (with transplant water, in-furrow, and drip). Application rates were typically 3.5 and 5 pints/a for Nimitz, 32 and 64 oz/A for Salibro, and 6.84 to 13.6 oz/A for Velum. Due to application error, the transplant water application rate of Nimitz, Velum, and Salibro was 4x the label rate (treatments 4, 5, 6, 7, and 12). In Merced County, Nimitz and Vellum were also tested at 3.5 and 5 pints/A with a shank application to a depth of 9" on 9" centers 10 days before planting using the same application equipment to apply metam potassium by Crop Production Services. The metam tanks were drained, filled with water, and then Nimitz or Velum was added. Target application rate was 42 gpa and controlled by a Raven unit in the cab. Treatment design for all trials was a randomized block with four replications. Means separation was performed using Fisher's protected LSD at P=0.05. Nematode samples were taken in early June to and again at the end of the season. Varieties used were O'Henry, Diane, Covington, and Bonita depending on location.

Plot background information for the Merced County locations is shown in Table 1. Methods for the trial by Dr. Ploeg are outlined in a separate report.

Results.

In the small-plot nematicide trial in Merced County (the Target field, due to its proximity to the store in

Atwater), the nematicides applied at transplanting were applied at 4x label rates by accident. Nimitz applied in the transplant water at 14 and 20 pints/A caused significant crop injury and decreased yield compared to all other treatments and the untreated control, whereas both Velum and Salibro were safe at all rates evaluated. The Nimitz plots were replanted 2 weeks later, but high levels of material were still in the soil and most of the replants also died. As a result, both treatments had significantly less yield than the other treatments.

Yield results by size and total marketable yield are shown in Table 2 and Figure 1. There were few significant differences between any of the treatments and the untreated control. Most of the Salibro treatments improved yield over the UTC, and Salibro applied via drip had best overall yield of 1236 boxes per acre. Only the over-application of Nimitz at transplanting (treatments 4 & 5) caused had any significant culls.

Despite not being fumigated and using nematode susceptible Diane cultivar, no RKN was found in any plot at the first sampling date on June 28 at the Target location. Fall RKN counts were highly variable and were not affected by nematicide treatment (Table 2).

At the shanked application trial in Merced County, applications of Nimitz slightly improved total yield compared to the untreated control; the 5.0 pints/A rate was similar to the standard metam potassium treatment (Table 3 and Figure 1). However, there was no statistical difference between any of the nematicide treatments and the untreated control. As with the Target nematicide trial, no RKN was found in the June samples, and there was no correlation with soil RKN counts in the fall to the treatments (Table 4).

At the South Coast Research and Education Center in Irvine, both O'Henry and Bonita were used to evaluate efficacy of Salibro and Nimitz at different rates (31 & 62 fl oz/A; 3.5, 5, and 7 pints/A) with both preplant and drip applied treatments. Some crop phytotoxicity was observed from the drip applied treatments with Bonita. Soil incorporated Nimitz and Salibro treatments increased total and marketable yields and reduced the amount of nematode damaged roots, but this was not significant compared to the non-treated control. Considerable cracking and misshapen roots occurred with cv 'Bonita' that was not correlated with nematicide treatment. At harvest, high numbers of RKN were observed in the roots of O'Henry but not Bonita. The lack of response may have occurred because the treatments were applied only 1 day before transplanting, rather than 10 as has been done in previous years.

Complete results are available from Dr. Ploeg.

Summary.

Results with new novel nematicides have shown significantly increased root yield and quality with pre-plant applications in multiple test sites in California, however, the method and timing of application was

very important to realize these benefits. Results from the trials in Merced County have shown that Nimitz is most effective at 5 pints/A when applied as a shank treatment 10 – 14 days before application, but that treatments 1 day before or at planting can cause significant crop injury. Both Velum and Q-80/Salibro appear to have a high level of crop safety and have the potential to be applied in the drip system.

Table 1. Trial background information.

Sweetpotato Nematicide Trial 2017
Scott Stoddard, UCCE Merced County

Location:	Just south of Target, off Applegate Rd, in Atwater, CA		
	Continuous sweetpotatoes >4 years, buffer zone no fumigation		
Soil:	Atwater sand		
Cooperator:	Robert Silveria, Classic Yam, and Lonnie Slaton, Simplot		
Variety:	Diane		
Transplant:	11-May-17	Replant treatments #3 & #4 on May 26	
Irrigation:	surface drip		
Harvest:	19-Sep-17	131 growing days	App date:

Treatments:	1	UTC	---	
	2	Nimitz 3.5 pints/A PPI	9-May	
	3	Nimitz 5.0 pints/A PPI	9-May	
	4	Nimitz 14 pints/A at planting	11-May	
	5	Nimitz 20 pints/A at planting	11-May	
	6	Q-80 8 pints/A in furrow at planting	11-May	
	7	Q-80 16 pints/A in furrow at planting	11-May	
	8	Q-80 31 fl oz at plant inc.	11-May	
	9	Q-80 62 fl oz 3 weeks post plant inc	2-Jun	
	10	Q-80 8 pints/A at planting + 31 fl oz via drip at 4 weeks	11-May	16-Jun
	11	Q-80 31 fl oz via drip at 4 and 6 weeks post plant	16-Jun	26-Jun
	12	Velum One 55 fl oz in furrow at planting	11-May	
	13	Velum One 6.84 fl oz via drip at 4 and 6 weeks post plant	16-Jun	26-Jun
	14	Movento foliar 5 oz/A at 4 and 6 weeks post plant	19-Jun	26-Jun
	15	Metam potassium 42 gpa (standard field treatment), PPI	15-Apr	
	16	Nimitz 3.5 pints side drizzle at planting	11-May	
	17	Nimitz 5.0 pints/A side drizzle at planting	11-May	

plot size: 1 bed x 30 ft replicated 4x in RCBD
only 3 reps of treatments 6,7,10,12
at plant treatments 4,5,6,7,10 and 12 rates incorrect: all applied at 4x target rate
ran out of Q80 and did not apply treatment 9 on May 11 as planned
RKN sampling on June 28 and Aug 30, 2017
Harvest: 1 row digger, field separation by size and culls

Nimitz injection trial
Scott Stoddard, UCCE Merced County

Location:	2nd Ave and Nelander Rd, in Stevinson, NE corner of field
soil:	Hilmar loamy sand, slightly saline-alkalai
Cooperators:	Matt Alvernaz and rodney Ratzlaff with CPS
Variety:	Covington
Application:	24-May-17 soil dry at time of application
Transplant:	7-Jun
Irrigation:	surfact drip
Nematode:	June 26 and Sept 27, 2017
Harvest:	24-Oct-17 139 growing days

Treatments:

1. UTC
2. Vellum One 14 oz/A
3. Nimitz 3.5 pts/A
4. Nimitz 5.0 pints/A
5. K-pam 42 gals/A (grower std)

Applications made by CPS on 5/24
using metam K bar at 42 gpa
(products mixed with water)

Plots 75 ft long x 25 ft wide
data taken from center bed of each plot
Harvest: 1 row digger, field separation by size and culls

Table 2. Sweetpotato (cv 'Diane') yield and RKN results as affected by nematicide treatment, Merced County 2017.

	Treatment	TMY lbs/A	40 lb box/A No. 1's	Mediums	Jumbos	adjusted TMY boxes/A	bins/A	No. 1's #1%	Culls cull%	Aug 30 RK #/100 g
1	UTC	47728.8	469.3	337.6	243.1	1050.0	42.0	44.8%	6.7%	138.4
2	Nimitz 3.5 pints/A PPI	41742.3	453.8	246.6	217.9	918.3	36.7	49.3%	5.5%	253.6
3	Nimitz 5.0 pints/A PPI	46749.2	512.4	343.6	172.4	1028.5	41.1	49.9%	4.9%	170.8
4	Nimitz 14 pints/A at planting	32816.9	275.4	129.3	317.3	722.0	28.9	38.4%	11.8%	21.2
5	Nimitz 20 pints/A at planting	23129.7	131.7	64.7	312.5	508.9	20.4	26.5%	27.2%	460.8
6	Q-80 8 pints/A in furrow at planting	46731.0	485.3	263.4	279.4	1028.1	41.1	47.4%	1.1%	76.8
7	Q-80 16 pints/A in furrow at planting	51966.1	515.0	244.8	383.5	1143.3	45.7	45.1%	2.9%	120
8	Q-80 31 fl oz at plant inc.	50275.8	511.6	344.2	250.2	1106.1	44.2	46.3%	4.9%	337.4
9	Q-80 62 fl oz 3 weeks post plant inc	51572.1	521.6	323.3	289.7	1134.6	45.4	46.0%	1.2%	79.6
10	Q-80 8 pints/A at plant + 31 fl oz via drip at 4 weeks	50446.3	510.8	259.6	339.4	1109.8	44.4	45.9%	3.4%	508.6
11	Q-80 31 fl oz via drip at 4 and 6 weeks post plant	56165.4	600.9	274.6	360.1	1235.6	49.4	48.9%	2.8%	133.8
12	Velum 55 fl oz in furrow at planting	43973.6	442.2	268.2	257.0	967.4	38.7	46.3%	4.6%	117.2
13	Velum 6.84 fl oz via drip at 4 & 6 weeks post plant	45007.6	470.5	293.3	226.3	990.2	39.6	47.8%	4.0%	48.8
14	Movento foliar 5 oz/A at 4 and 6 weeks post plant	46585.9	492.1	238.3	294.5	1024.9	41.0	48.0%	3.9%	107.6
15	Metam potassium 42 gpa (standard field), PPI	---	---	---	---	---	---	---	---	54
16	Nimitz 3.5 pints side drizzle at planting	44626.7	415.5	241.9	324.5	981.8	39.3	42.1%	3.3%	374.4
17	Nimitz 5.0 pints/A side drizzle at planting	45388.6	517.2	253.8	227.5	998.5	39.9	51.8%	3.4%	70.8
	Average	45220.0	456.8	257.7	280.4	994.9	39.8	45.2	5.8	181
	LSD 0.05	9469	93.4	75.5	114	180	7.2	5.9	5.7	---
	CV, %	12.7	12.4	17.8	24.7	12.7	12.7	7.9	58.8	---

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 22 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).

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

Table 3. Sweetpotato (cv 'Covington') yield results from the CPS shank applied treatments, Merced County 2017.

		TMY	40 lb box/A			adjusted TMY			
	treatment	lbs/A	No. 1's	Mediums	Jumbos	boxes/A	bins/A	No.1's %	cull%
1	UTC	40138	328	311	244	883	35	37.2%	5.4%
2	Vellum One 14 oz/A	36401	283	278	240	801	32	35.2%	2.8%
3	Nimitz 3.5 pts/A	41615	443	292	180	916	37	48.3%	4.0%
4	Nimitz 5.0 pints/A	44105	363	313	295	970	39	37.5%	1.4%
5	K-pam 42 gals/A	48101	394	380	284	1058	42	37.5%	4.9%
	Average	42072	362	315	249	926	37	39.1%	3.7%
	LSD 0.05	5800	80.2	54.9	ns	127.6	5.1	7.2	ns
	CV, %	8.9	14.4	11	30.9	8.9	8.9	11.9	89.4

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 22 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.

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.

Table 4. Root knot nematode soil sampling results.

		26-Jun	27-Sep
	treatment	# J2s/100g	
1	UTC	0	19.8
2	Vellum One 14 oz/A	1	96.8
3	Nimitz 3.5 pts/A	0	26.5
4	Nimitz 5.0 pints/A	0	80.8
5	K-pam 42 gals/A	ND	ND
	Average	0.25	56
	LSD 0.05	ND	ns
	CV, %	ND	125

LSD 0.05 Least significant difference at the 95% confidence level.

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

ND not determined ns = not significant

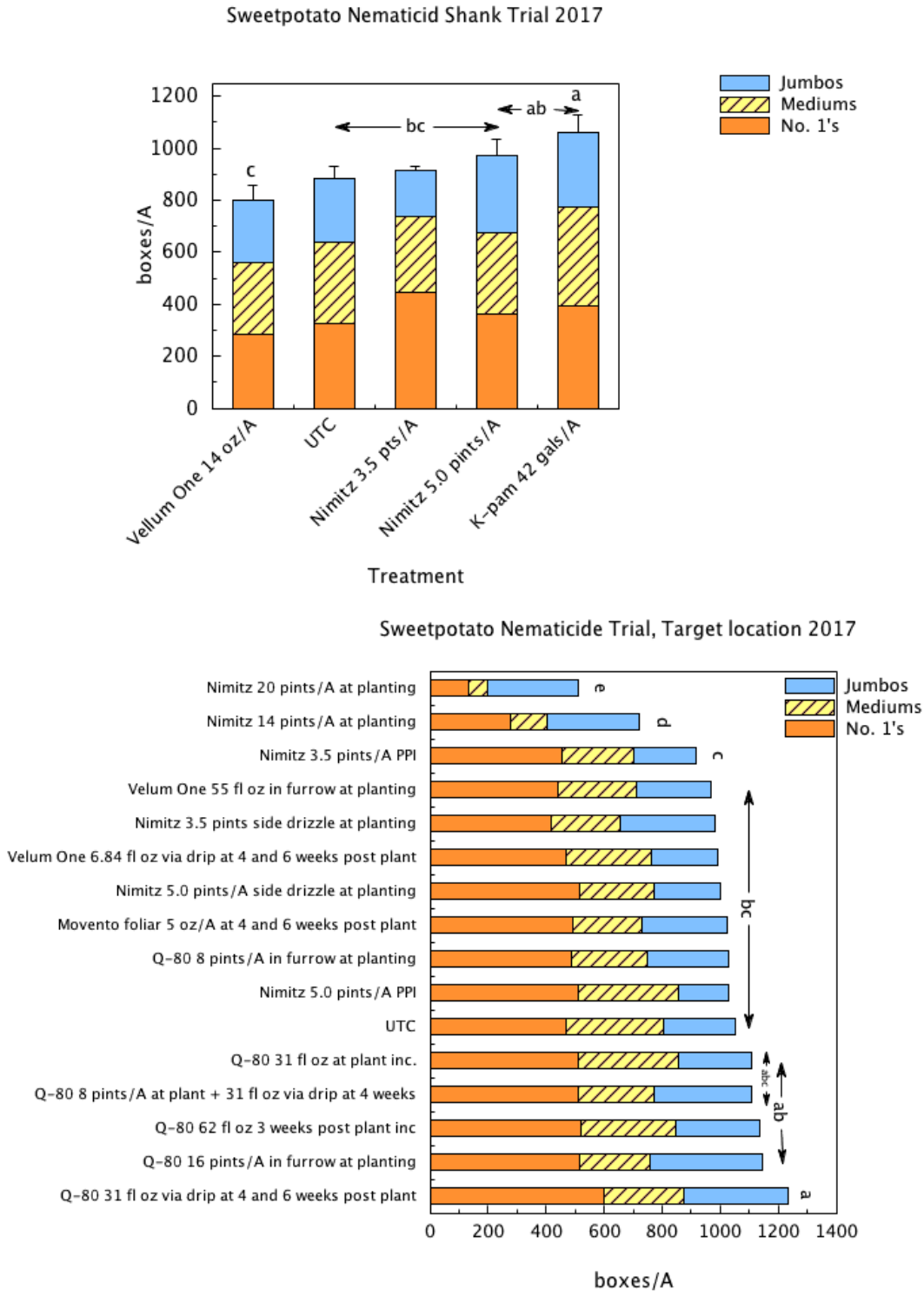

Figure 1. Yield results for the shanked nematicide trial (above) and the Target nematicide trial (below).

Efficacy of Pic Plus and Dominus soil fumigants on field production of sweetpotatoes in California.

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Introduction

Preplant soil fumigation is in integral component of pest management for commercial sweetpotatoes in California. Soil fumigation is done both in the fall and spring to suppress root knot nematodes (RKN), *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 that can be used on a township basis (one township is 640 acres) to 136,000 lbs a.i. (prior to 2017 this was 92,500 lbs a.i.) These restrictions can limit the amount of Telone used in any year to approximately 17 - 50% of demand. In response, growers have used reduced Telone application rates (from 12 gpa to 10), and are using shanked applications metam sodium (Vapam) and metam potassium (K-Pam).

Currently, the Merced County Agriculture Commissioner allows metam sodium (Vapam) and metam potassium (K-Pam) to be applied as a shank application prior to transplanting. The material is applied at 3", 6", and 9" depth on 9" centers to a clean, cultivated field with good soil moisture. Typical volumes are 42 – 46 gallons product per acre, and the soil surface is sealed with a ring roller to minimize off-gassing.

In numerous field research plots since 2001, yield increases from soil fumigation have been very consistent: yields significantly improved as compared to the untreated control in all treatment years. Shanked Metam at 50 gpa was nearly as effective as Telone. Combining Telone with metam improved the performance of both products, and results suggest that reduced rates of Telone can be effective when combined with metam.

The objective of this trial was to evaluate Pic Plus and Pic Plus combinations with Telone and Dominus on commercial sweetpotato production in California.

Methods.

A trial was conducted in 2017 in a commercial sweetpotato field in Merced County,CA, evaluating Dominus (allyl isothiocyanate, Isagro-usa), Pic Plus (chloropicrin 85.5%), Pic Chlor 80 (20% 1,3-D and 80% Pic), Telone, and Metam K combinations on RKN control and sweetpotato yield and quality. Treatments were designed to test different rates and application volume both alone and in various combinations. Metam (as metam K at 41 gpa) and untreated control plots were used for

comparison. In total, 10 treatment combinations were evaluated. Plot background information for the Merced County locations is shown in Table 1; field location is shown in Figure 1.

All treatments except metam were applied using Tri Cal fumigation equipment equipped with a Noble plow to deliver product at soil depth of 12" on April 12, 2017 (Figure 2). Metam-K was applied using the shank method with a Crop Production Services tool bar at 41 gpa, followed by surface sealing with a light disk and ring roller. Treatment design was a randomized block with four replications; plots were 25 feet wide and 100 feet long. Plots were sufficiently wide to include 3 to 4 beds (sweetpotatoes are planted in 2-row, 80" beds), however, all sampling was done only from the center bed within each plot.

Sweetpotato cultivar 'Bonita' was transplanted on 12" in-row spacing into the plot area on June 7, 2017, using standard methods with grower equipment. The field was drip irrigated, and standard growing practices were used for the entire season. Nematode samples were taken in June and again at the end of the season by taking 10 soil cores 0 – 12" from within each plot, compositing, then sending 500 g to a commercial lab and UCR nematode labs for analysis. Harvest occurred on Oct 30 - 31, 2017, using a 2-row harvester and the grower's crew to separate roots into #1's, mediums, and jumbo size categories; culls caused by root knot nematodes or insect damage were also weighed. Means separation was performed using Fisher's protected LSD at P=0.05.

Table 1. Tri-Cal fumigation sweetpotato treatments and trial background information.

application date:	12-Apr-17	for all treatments but metam	
	4/15/17	Metam-K	
Location:	east of Griffith, between Bell and Longview Rds		
	N 37 20.920'	W 120 48.467'	
Soil:	Hilmar loamy sand		
Cooperator:	Aaron Silva, Doreva Produce; Mike Stanghalini, Tri-Cal		
transplant date	6/7/17		
variety	Bonita		
Harvest	10/30/17	145	growing days
treatments:	1. UTC		
	2. Telone II at 10 gpa		
	3. Pic Plus at 10 gpa		
	4. Pic Plus at 6 gpa		
	5. Pic-Clor 80 at 10 gpa		
	6. Pic-Clor 80 at 6 gpa		
	7. Dominus Telone 50/50 at 10 gpa		
	8. Dominus Pic 67/33 at 10 gpa		
	9. Metam K (applied by CPS) 41 gpa		
	10. Telone 6 gpa fb metam K		Telone over application by 10%
	Plots 25 ft by 150 ft long		
	RCBD with 4 reps		
	total area = 3.03 acres		
	Noble plow shanks ~ 10-12" depth		

Figure 1. 2017 Trial location.

Results

No plant parasitic nematodes were found in the initial June nematode samples in any plot (Table 2). As the analyses were performed by a commercial lab, additional samples were taken from the field and sent to Dr. Antoon Ploeg at UC Riverside for additional testing. The results were the same: no root knot nor stubby root nematodes were found. However, at the October sampling, Root knot nematode counts ranged from 26 – 321 J2s per 500 g of soil, with Telone, metam K, and Pic-Clor 80 with significantly lower nematode counts than the other treatments. The only treatment with Telone that did not show suppression of RKN was the Dominus + Telone treatment (#7).

Highest total marketable yields occurred in the standard metam K treatment at 1063 boxes per acre (Figure 3); metam K, Dominus + Telone, Telone fb metam, Pic Clor 80, and Telone II all had significantly higher yields than the untreated control (Table 3). The percentage of #1's was not significantly different between treatments, but the total yield of #1's and medium sized roots was significantly greater in the same treatments as compared to the others in this test. The number of culls was significantly higher in the UTC plot as compared to all other treatments (Table 3), but there was little correlation between fall RKN counts and culled roots (Figure 4). While the untreated control did have high counts and high cull%, the Dominus + Telone treatment had the lowest cull rate of any treatment in this trial.

All of the fumigation treatments in this trial increased yield by an average of 17% as compared to the untreated control, with significantly higher yields (23% greater TMY) in those treatments containing Telone or metam K at 41 gpa. Previous trials have shown that low rates of Telone, e.g. 6 gpa, by itself is mostly ineffective. The results of this trial suggest that the use of Pic or Dominus to increase the efficacy of low rates of Telone, and thus increase the number of acres that can use Telone under the cap, has potential.

Acknowledgements. Many thanks to Aaron Silva and Mike Stanghellini for their support and cooperation with this test.

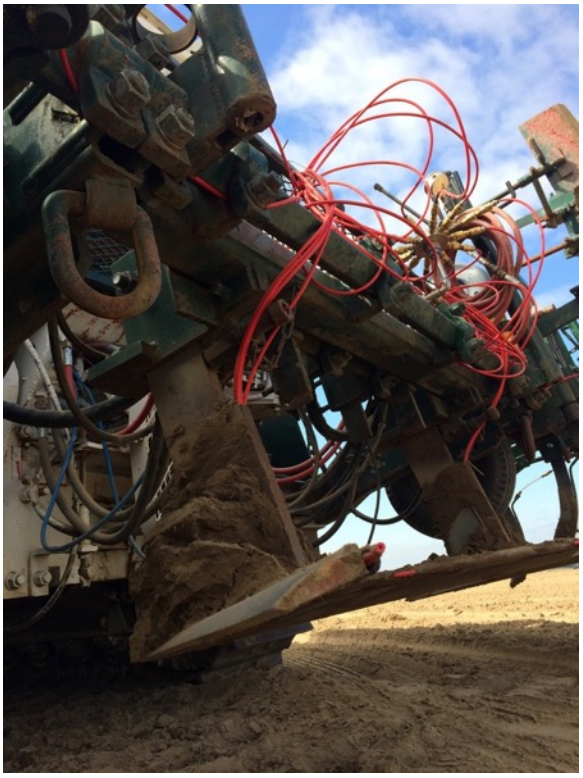


Figure 2. Noble plow shanks and emitters.

Table 2. Soil nematode analyses, June and Oct., 2017.

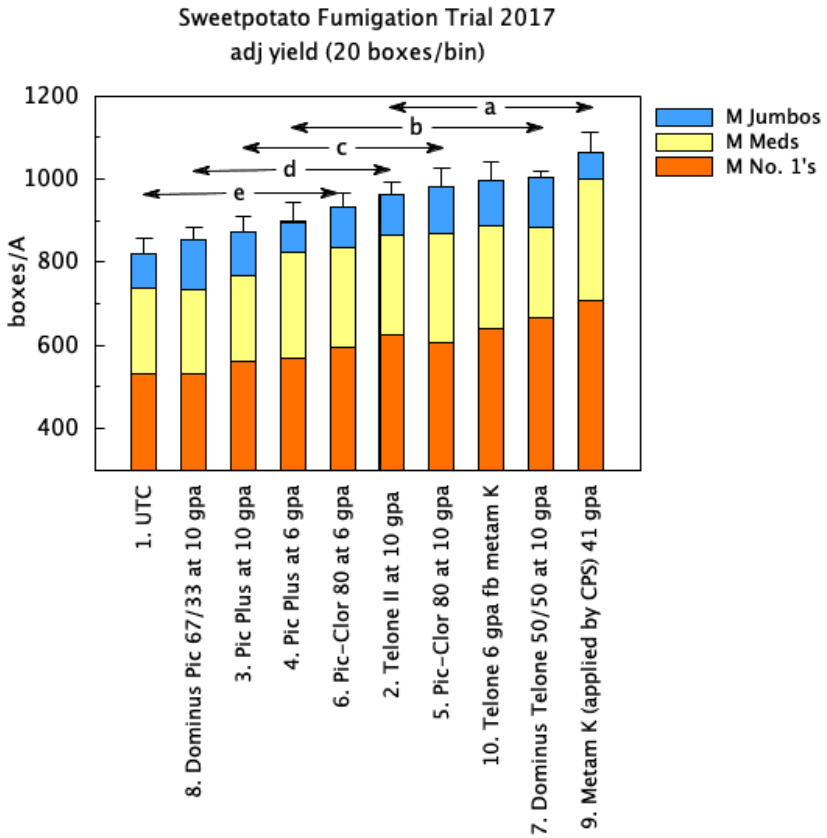
	6/28/17 # per 500 g		10/19/17 # per 500 g	
treatment	Root Knot *Meloidogyne*	Stubby Root *Paratrichodorus*	Root Knot *Meloidogyne*	Stubby Root *Paratrichodorus*
1. UTC	0	0	231	17
2. Telone II at 10 gpa	0	0	180	52
3. Pic Plus at 10 gpa	0	0	321	20
4. Pic Plus at 6 gpa	0	0	162	16
5. Pic-Clor 80 at 10 gpa	0	0	90	32
6. Pic-Clor 80 at 6 gpa	0	0	121	29
7. Dominus Telone 50/50 at 10 gpa	0	0	314	54
8. Dominus Pic 67/33 at 10 gpa	0	0	246	37
9. Metam K (applied by CPS) 41 gpa	0	0	35	62
10. Telone 6 gpa fb metam K	0	0	26	109
11. Telone 12 gpa CPS application	---	---	---	---
Average	0	0	173	43
LSD 0.05	---	---	164	not determined
CV, %	---	---	65.3	not determined

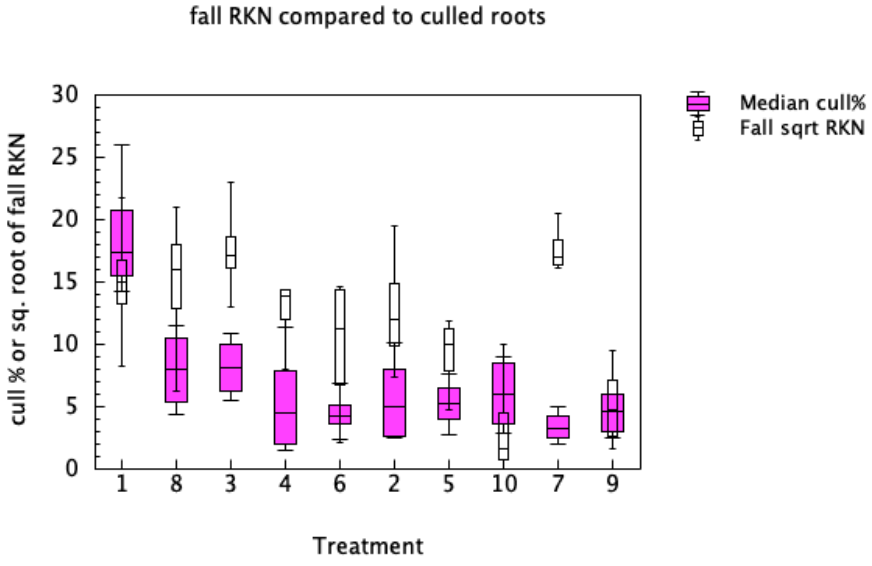
0 - 12" soil sampling, 10 cores per plot
Analyzed by Nematodes, Inc., Selma, CA
LSD 0.05. Least significant difference. Means separated by less than this amount are not significantly different (ns).
CV, %. Coefficient of variation, a measure of variability in the experiment.

Table 3. Sweetpotato yield and size as affected by fumigation treatment, Merced County 2017.

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%	28-Jun # RKN J2s/ 500 g soil	18-Oct	18-Oct sqrt corr	TMY % of UTC
1. UTC	40995.3	529	208	83	820	32.8	64.7%	18.7%	0	246.0	14.95	---
2. Telone II at 10 gpa	48088.1	623	240	99	962	38.5	64.7%	5.6%	0	180.0	12.69	1.19
3. Pic Plus at 10 gpa	43605.9	562	206	104	872	34.9	64.4%	8.1%	0	320.5	17.56	1.07
4. Pic Plus at 6 gpa	44806.4	570	253	73	896	35.8	63.6%	5.4%	0	162.0	12.47	1.09
5. Pic-Clor 80 at 10 gpa	48954.5	606	262	111	979	39.2	61.8%	5.2%	0	90.0	9.11	1.21
6. Pic-Clor 80 at 6 gpa	46585.2	595	242	95	932	37.3	64.0%	4.4%	0	121.0	9.78	1.14
7. Dominus Telone 50/50 at 10 gpa	50217.5	664	219	121	1004	40.2	66.2%	3.3%	0	314.0	17.65	1.23
8. Dominus Pic 67/33 at 10 gpa	42684.4	529	203	121	854	34.1	62.0%	7.9%	0	246.0	14.75	1.05
9. Metam K (applied by CPS) 44 gpa	53172.4	706	293	64	1063	42.5	66.6%	4.4%	0	34.5	5.07	1.30
10. Telone 6 gpa fb metam K	49791.2	638	249	108	996	39.8	64.2%	5.9%	0	26.0	3.47	1.23
Average	46890.1	602	238	98	938	37.5	64.2%	6.9%	0.0	174.0	11.7	1.17
LSD 0.05	5780	77.3	15.4	ns	116	4.6	ns	4.70%	---	165	6.5	0.15
CV, %	8.5	8.8	15.2	42.2	8.5	8.5	5.5	47.4	---	65.3	38	9.0

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.
TMY Total marketable yield is the sum of the above three categories.
bins/A bins/A are estimated based on market box yield assuming 22 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.
RKN Root knot nematode, Meloidagyne spp.
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.





Figures 3 (top) and 4 (bottom). Sweetpotato yield results as affected by fumigation treatment; relationship between fall RKN (square-root corrected) in the soil and the percentage of culled roots. Merced County 2017.

IR-4 diaquat herbicide trials on sweetpotatoes in California

Scott Stoddard
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SUMMARY
Two trials were conducted in commercial sweetpotato fields in 2017 to evaluate crop response and weed control from pre and post plant applications of various herbicides and to generate data to support the registration of diquat for sweetpotatoes. At the Weimer Farms location, diquat herbicide was applied 1 day preplant at 2 & 4 pints/A both with and without flumioxazin at 3 oz/A. At the Quail H Farms location, diquat herbicide was applied both 1 and 7 days preplant at 2 & 4 pints/A, and at 1 day preplant with flumioxazin at 3 oz/A. Herbicides were applied to weed-free, preformed beds with a backback sprayer at 50 gpa equivalent water volume. Additional post-plant applications of napropamide (4 lbs/A), metoachlor (1 pt/A), and glufosinate (32 and 64 fl oz/A) were also evaluated. The trials used a randomized block design with 4 replications; means comparison tests were done with Fisher's Protected LSD at $p < 0.05$. At both locations, initial weed counts at 2 weeks after transplanting (WAT) were significantly ($p < 0.05$) less in the treatments that included flumioxazin as compared to those treatments where no herbicide had been applied. However, by 6 WAT weed control in these same treatments was poor, about 50% of the hand weeded check, and significantly less than POST glufosinate treatments and where napropamide was applied at layby. Very little crop injury was observed, and mainly occurred in the glufosinate treatments applied 30 days after transplanting. At the Weimer Farms location, total marketable yields were significantly less in the diquat treatments where poor weed control occurred as compared to the other treatments and the hand weeded check; the Quail H Farms location had far fewer weeds and there were no significant differences in yield. Under the conditions for these trials, diquat caused no significant crop injury to sweetpotatoes when applied 1 or 7 days before transplanting, but provided no residual weed control. Flumioxazin gave early weed control that faded as the season progressed.

Introduction
Weed control methods in commercial sweetpotatoes in California are characterized by the use of pre-plant weed management coupled with a limited number of registered herbicides, cultivation, and hand hoeing when appropriate. Pre-plant fumigation, especially with metam – Na or metam – K products, can also reduce overall weed populations and can be an important component of an overall weed management plan. However, pre-plant or pre emergent herbicides are rarely used in commercial production fields, as the registered materials need water incorporation to be effective (Valor, Dual Magnum), or efficacy is improved (Devrinol, Dacthal) following water incorporation. As a result, post emergence herbicides, cultivation, and hand hoeing are the main methods used to control weeds. Post-plant applications of glyphosate (Roundup) with hooded sprayers are used, and while still effective, concerns about herbicide 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 diquat herbicide on sweetpotatoes.

Methods

Two studies were conducted in a commercial sweetpotato fields near Livingston, CA, to evaluate different diquat rates (2 or 4 pts/A), timings (1 day or 7 days before transplanting), and tank mix combinations with flumioxazin (Valor) on crop response and weed control. Additional treatments included a hand-weeded check, napropamide (Devrinol) 4 lbs/A applied at lay-by, glufosinate (Rely 280), and metoachlor (Dual Magnum). Because sweetpotato beds are not typically made until the day of transplanting, only 1 location had the 7 day PPI treatment. Diquat herbicide treatments were applied to a clean, cultivated field 1 to 7 days before transplanting at Quail H Farms, and 1 day preplant at Weimer Farms. Herbicides were applied with a CO_2 backpack sprayer at 40 psi using TeeJet 8004 flat fan nozzles and calibrated to 50 gpa equivalent. No adjuvants were used, nor were the herbicides incorporated. Trial locations and herbicide treatments are listed in Table 1.

At the Weimer location, 'Bellevue' sweetpotato cultivar was transplanted on May 3, while at the Quail H location cultivar 'Muraskai' was transplanted May 10. At both locations the planting was performed with the grower's mechanical transplanter on raised beds 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.

Metolachlor (Dual Magnum) and napropamide (Devrinol) POST treatments were applied 2 weeks and 1 month after transplanting, respectively, using the backpack CO_2 sprayer as before at each site and incorporated by hand to a depth of about 2". Applications were made using a directed spray to both sides of the plant row and to the middle of the bed to minimize contact with foliage. POST applications of glufosinate (Rely 280) were made June 2 and June 20 by banding the product down the center of the bed and shielding the plants on both sides to minimize drift and overspray contact to the crop (Figure 1). 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).

Plot size was 1 bed (2 rows) 6.67 ft wide x 30 ft long. Experimental design was a RCB with 4 replications; means separation was done using Fisher's Protected LSD at 95% confidence level. Data collected included visual crop injury and weed control using a subjective scale (0 = no injury or no control, 6 = 100% crop death and complete weed control) determined at 2, 4, and 6 weeks after planting (WAP). Weed-free check plots were maintained weed free through light cultivation and hand removal. Photos were taken of the plots at the evaluation dates (Appendix 1). All plots were hand weeded after the final evaluation date on June 26 at the Weimer location; no weed removal occurred at the Quail H location because the trial was accidentally weeded by a contract hoeing crew. Yields were measured at both locations using a commercial 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 diquat and glufosinate treatments were separated into their own bins and later destroyed to meet the crop destruct requirements for this project (Figure 2).

Table 1. Field site and herbicide treatments for diquat efficacy trials in sweetpotatoes, Livingston CA, 2017.

	Weimer Farms	**Quail H Farms**		
Location	NE corner of Steinberg and Longview Rds, in Merced County, CA	NE corner of Steinberg and Longview Rds, near Delhi in Merced County		
Variety and plant date	Bellevue, May 4, 2017	Murasaki, May 10, 2017		
Plot size and plant spacing	1 bed (80") by 30 ft,4 reps, 9" spacing	1 bed (80") by 30 ft, 9" spacing		
Irrigation	Surface single line drip	Surface single line drip		
Herbicide incorporation	2" for Devrinol and Dual	2" for Devrinol and Dual		
Weed evaluation	2, 4, 5, 7, 8 WAT	2, 4, 6 WAT		
Harvest	29-!ul 2017	17-Oct 2017		
days	116	160		
Weimer Farms	Herbicide Treatment	Timing	Application dates	
1	UTC hand weed	as needed	---	---
2	diquat 2 pts/A PRE	1 day preplant	2-May	---
3	diquat 4 pts/A PRE	1 day preplant	2-May	---
4	diquat 2 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	2-May	12-Jun
5	diquat 4 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	2-May	12-Jun
6	Devrinol 4 lbs/A layby	layby	---	12-Jun
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	2-May	---
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	2-May	---
9	Rely 280 32 oz/A PRE	1 day preplant	2-May	---
10	Rely 280 32 oz/A POST	POST 30 days	---	2 June
11	Rely 280 64 oz/A POST	POST 30 days	---	2 June
12	Dual Magnum 1 pt/A POST	POST 14 days	18 May	---
	POST applications of Devrinol and Dual were mechanically incorporated			
Quail H Farms	Treatment Name	Application timing	Application	dates
1	UTC hand weed	as needed	---	---
2	diquat 2 pts/A PRE	1 day preplant	8-May	----
3	diquat 4 pts/A PRE	1 day preplant	8-May	----
4	diquat 2 pts/A	1&7 days preplant	3-May	8-May
5	diquat 4 pts/A	1&7 days preplant	3-May	8-May
6	Devrinol 4 lbs/A layby	PPI and layby	3-May	12-Jun
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	8-May	---
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	8-May	---
9	Rely 280 32 oz/A PRE	1 day preplant	8-May	---
10	Rely 280 32 oz/A POST	POST 30 days	---	20-Jun
11	Rely 280 64 oz/A POST	POST 30 days	---	20-Jun
12	Dual Magnum 1 pt/A POST	POST 14 days	31-May	---
	POST applications of Devrinol and Dual were mechanically incorporated.			

Figure 1. Pre-plant diquat applications were broadcast across the entire bed with a 4-nozzle boom (left); POST glufosinate applied as a banded application down the center of the bed using a single nozzle wand (right). Sweetpotatoes were shielded to minimize contact from drift.

Figure 2. Test plot harvest.

Results

At the Weimer Farms location, the 14-day preplant diquat treatment could not be made as requested in the protocol because the earliest the beds could be pulled was 1 day prior to transplanting. In California, sweetpotato growers rarely make beds more than 1 day in advance of expected transplanting to minimize risk of blowing sand from high winds that commonly occur in the spring. Instead, a layby application of Devrinol was added to the 2 and 4 pints/A diquat treatments (treatments #4 and #5). Because the 14-day preplant applications could not be made, the Quail H Farms site was added for this trial by special request to pull beds 7 days prior to transplanting, and applications of diquat were made at 7 days and 1day before planting. Unfortunately, the plots were hand-weeded by contract labor two times during the season, and therefore there was only one weed rating for this location.

Weed and crop phytoxicity ratings for the Weimer location are shown in Table 2. Weed pressure was very high at this location, and included purslane, yellow nutsedge, pigweed, malva, black nightshade, puncture vine, spurge, lambsquarters, and barnyard grass. At 2 WAT, there were no significant ($p < 0.05$) differences in the subjective weed rating scores (average 0.9), however there were significantly fewer weeds in the diquat + Valor treatments as compared to those plots where no herbicides had been applied (Figure 3). At 4 WAT, only treatment #7 (2 pts diquat + 3 oz Valor) and treatment #12 (Dual Magnum) had significantly better weed control, about 80% (Figure 3). Valor was obviously providing weed control for the diquat + Valor tankmix; the reduction of weeds in the Dual Magnum plot occurred as a result of the cultivation and mechanical incorporation needed to activate this herbicide.

By 8 WAT, however, all of the preplant-only treatments had low weed control ratings, ranging from 40 – 60% as compared to the hand weeded check plot (Figure 3). The addition of Devrinol at layby and the POST applications of Rely 280 significantly improved weed control, especially for broadleaf weeds, to 80 – 90% control. No crop injury was observed in this trial, other than some slight injury from herbicide drift in the Rely 280 treatments (Table 2).

Total marketable yield and Number 1 yield were significantly less in the preplant-only diquat treatments (both 2 and 4 pints) as well as the Rely preplant treatment (Table 3). These were the same treatments with the poorest weed control. Thus, the reduction in yield was a result of poor weed management and not crop injury. Best No. 1 yields occurred in those treatments were Devrinol was applied layby, 730 to 818 boxes per acres, and with Rely 280 at 64 oz/A applied POST, at 762 boxes per acre. The percentage of culled roots was not significantly different among treatments.

Weed and yield results for the Quail-H Farms location are shown in Tables 4 and 5. There were very few weeds at this location at any evaluation date, a consequence of not being able to keep a contract hoeing crew out of the plot area despite signs and marking tape. Treatment differences were apparent on June 1, with the pre-plant application of Valor significantly reducing the number of weeds, but all treatment affects were gone by June 12 (Figure 4). No significant yield differences were observed except for medium size roots, with total market yield between 420 to 640 boxes/A. As with Weimer Farms, very little crop injury was ever observed, and then only on the first evaluation date.

Conclusions

Two trials were conducted in commercial sweetpotato fields in 2017 to evaluate crop response and weed control from pre and post plant applications of various herbicides. At the Weimer Farms location, diquat herbicide was applied 1 day preplant at 2 & 4 pints/A both with and without flumioxazin (Valor) at 3 oz/A. At the Quail H Farms location, diquat herbicide was applied both 1 and 7 days preplant at 2 & 4 pints/A, and at 1 day preplant with flumioxazin at 3 oz/A. Herbicides were applied to weed-free, preformed beds with a backback sprayer at 50 gpa equivalent water volume. Additional post-plant applications of napropamide (Devrinol), metoachlor (Dual Magnum), and glufosinate (Rely 280) were also evaluated. At both locations, initial weed counts 2 WAT were significantly ($p < 0.05$) less in the treatments that included flumioxazin as compared to those treatments where no herbicide had been applied. However, by 6 WAT weed control in these same treatments was poor, about 50% of the hand weeded check, and significantly less than POST glufosinate treatments and where napropamide was applied at layby. Very little crop injury was observed, and mainly occurred in the glufosinate treatments applied 30 days after transplanting as a result of minor overspray to some vines. At the Weimer Farms location, total marketable yields were significantly less in the diquat treatments where poor weed control occurred; the Quail H Farms location had far fewer weeds and there were no significant differences in yield. Under the conditions for these trials, diquat caused no significant crop injury to sweetpotatoes when applied 1 or 7 days before transplanting, but provided no residual weed control. Flumioxazin gave early weed control, but this effect faded as the season progressed.

Acknowledgements

Many thanks to Mr. Bob Weimer and Mr. Adam Shaner for their help and cooperation with this test. Funding for this project was provided by USDA-IR-4 program: IR-4 Project P11889.

Table 2. Weed pressure and crop injury at ~ 2, 4, 5, 7 and 8 weeks after transplanting as affected by herbicide treatment at the Weimer Farms location, Merced County 2017.

Treatment			18-May	0 - 6 rating scale		2-Jun		9-Jun		20-Jun	0 - 6 scale			26-Jun	0 - 6 scale		
#	herbicide rate and timing		# Weeds	Weed Rating	Phyto	Weed Rating	Phyto	Weed Rating	Phyto	Grass	BL weeds	Nutsedge	Phyto	Grass	BL weeds	Nutsedge	Phyto
1	UTC hand weed	as needed	0.0	0.00	0	0.00	0	0	0	0.50	0.00	0.00	0.0	0.00	0.00	0.00	0
2	diquat 2 pts/A	1 day preplant	86.5	1.00	0	2.25	0	---	---	4.00	2.50	1.25	0.0	2.75	1.50	2.00	0
3	diquat 4 pts/A	1 day preplant	127.0	1.00	0	2.25	0	---	---	3.50	2.75	1.25	0.0	2.00	2.75	2.25	0
4	diquat 2 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	132.8	0.75	0	2.25	0	---	---	1.75	0.75	0.75	0.0	1.50	0.25	0.75	0
5	diquat 4 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	78.5	0.75	0	2.25	0	---	---	1.25	0.75	0.75	0.3	1.00	0.25	0.75	0
6	devrinol 4 lbs/A layby	layby 6 WAT	127.8	1.00	0	2.00	0	4	0	1.25	1.00	0.75	0.0	1.00	0.50	0.50	0
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	42.3	1.00	0	1.25	0	---	---	3.00	2.00	1.25	0.0	2.25	2.00	1.50	0
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	49.8	0.75	0	2.00	0	---	---	4.00	2.00	0.75	0.0	2.75	2.00	1.75	0
9	Rely 280 32 oz/A	1 day preplant	141.3	1.00	0	2.75	0	---	---	3.25	3.50	1.00	0.0	1.75	3.25	1.75	0
10	Rely 280 32 oz/A	POST 4 WAT	119.0	1.00	0	2.50	0	1.5	0.75	1.75	1.25	1.00	0.0	1.00	1.50	1.25	0
11	Rely 280 64 oz/A	POST 4 WAT	77.5	1.00	0	2.00	0	1	1.25	1.25	0.50	1.00	0.0	0.75	0.75	1.00	0
12	Dual Magnum 1 pt/A	POST 14 days (May 18	82.5	1.00	0	1.25	0	2.5	0.75	1.75	2.75	1.25	0.0	1.50	2.75	1.50	0
		Average	96.8	0.9	0.0	2.1	0.0	2.3	0.7	2.4	1.8	1.0	0.0	1.7	1.6	1.4	0.0
		LSD 0.05	53.6	ns	---	0.83	---	1	0.7	1.1	1.1	ns	---	1.2	1.4	1.1	---
		CV, %	38.4	27.7	---	27.9	---	27.7	60.6	31.3	41.3	66.5	---	48.8	60.8	53.3	---

Herbicide timing: Preplant on May 2, POST on June 2, layby on June 12. Clethodim for grass control on Jun 20.

Weeds: BL = broadleaf weeds: purslane, nutsedge, pigweed, malva, nightshade, puncture vine, spotted spurge, fileree, and lambsquarters

Grass = barnyard grass

Scale: Severity scores based on a 1 - 6 scale: 0 = no phyto or weeds, 1 = <10%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 90%, 6 > 90% weeds/crop phyto.

June 9: 1 week after treatment of Rely 280 POST applications

LSD 0.05 Least significant difference. Means separated by less than this amount are not significantly different (ns). Treatment #1 not included in analyses. --- = not enough data to calculate.

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

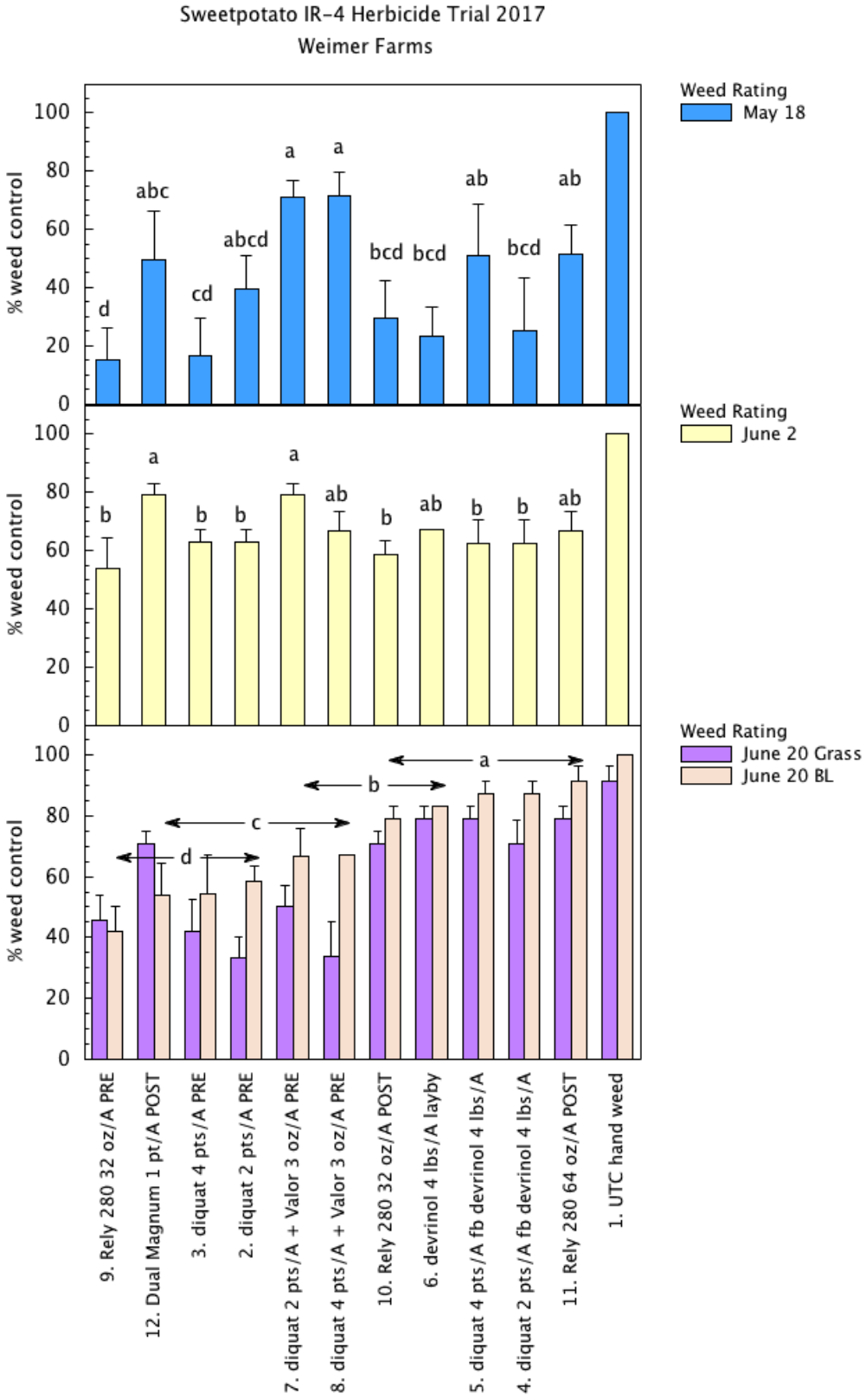

Sweetpotato IR-4 Herbicide Trial 2017
Weimer Farms
% weed control
Weed Rating
May 18
June 2
June 20 Grass
June 20 BL
d
abc
cd
abcd
a
a
bcd
bcd
ab
bcd
ab
b
a
b
b
a
ab
b
ab
b
b
ab
c
d
b
a
9. Rely 280 32 oz/A PRE
12. Dual Magnum 1 pt/A POST
3. diquat 4 pts/A PRE
2. diquat 2 pts/A PRE
7. diquat 2 pts/A + Valor 3 oz/A PRE
8. diquat 4 pts/A + Valor 3 oz/A PRE
10. Rely 280 32 oz/A POST
6. devrinol 4 lbs/A layby
5. diquat 4 pts/A fb devrinol 4 lbs/A
4. diquat 2 pts/A fb devrinol 4 lbs/A
11. Rely 280 64 oz/A POST
1. UTC hand weed

Table 3. Sweetpotato ('Bellevue') yield results at the Weimer Farms location, Merced County 2017.

		TMY	40 lb box/A			adjusted TMY			
	treatment	lbs/A	No. 1's	Mediums	Jumbos	box/ A	bins/ A	%No. 1's	%culls
1	UTC hand weed	56231	619	135	484	1237	49.5	50.2%	4.3%
2	diquat 2 pts/A PRE	48722	734	120	218	1072	42.9	68.5%	4.1%
3	diquat 4 pts/A PRE	42411	589	127	217	933	37.3	63.5%	4.4%
4	diquat 2 pts/A fb devrinol 4 lbs/A	50317	730	127	250	1107	44.3	66.0%	5.6%
5	diquat 4 pts/A fb devrinol 4 lbs/A	55920	812	133	285	1230	49.2	66.2%	3.6%
6	devrinol 4 lbs/A layby	54423	818	148	232	1197	47.9	68.2%	4.7%
7	diquat 2 pts/A + Valor 3 oz/A	49751	669	138	288	1095	43.8	60.9%	3.3%
8	diquat 4 pts/A + Valor 3 oz/A	49931	732	123	243	1098	43.9	67.1%	3.8%
9	Rely 280 32 oz/A PRE	45139	667	128	198	993	39.7	67.2%	4.4%
10	Rely 280 32 oz/A POST	48787	652	126	296	1073	42.9	60.6%	5.2%
11	Rely 280 64 oz/A POST	55811	762	122	344	1228	49.1	62.1%	3.2%
12	Dual Magnum 1 pt/A POST	49206	665	137	280	1083	43.3	61.5%	5.8%
	Average	50554	704	130	278	1112	44.5	63.5%	4.4%
	LSD 0.05	7220	129.5	ns	130.6	158.8	6.4	8.2	1.5
	CV, %	9.9	12.8	20.4	32.6	9.9	9.9	8.9	24.3

No. 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.
TMY	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 22 boxes per bin.
% No. 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.

Table 4. Weed pressure and crop injury at 2, 4, and 6 WAT as affected by herbicide treatment at the Quail H Farms , Merced County 2017.

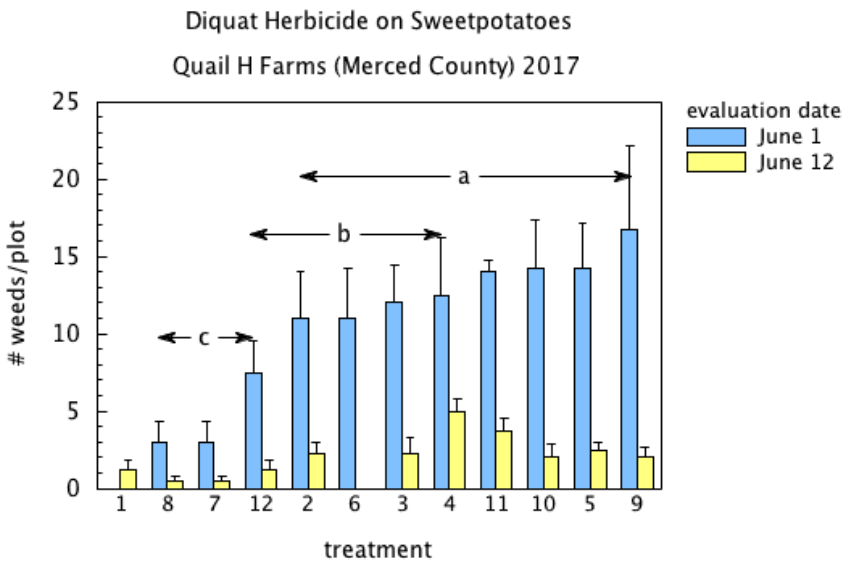
Treatment #	herbicide rate and timing		1-Jun # Weeds	Weed Rating	crop phyto	12-Jun # Weeds	Weed Rating	crop phyto	20-Jun # Weeds	crop phyto	June 1 weed control %
1	UTC hand weed	as needed	0.0	0	0	1.3	0	0	0	0	100.0%
2	diquat 2 pts/A	1 day preplant	11.0	1	0	2.3	0	0	0	0	35.2%
3	diquat 4 pts/A	1 day preplant	12.0	1	0.25	2.3	0	0	0	0	29.2%
4	diquat 2 pts/A	7 days preplant	12.5	1	0.25	5.0	0	0	0	0	27.0%
5	diquat 4 pts/A	7 days preplant	14.3	1	0	2.5	0	0	0	0	15.8%
6	devrinol 4 lbs/A layby	PPI and layby	11.0	1	0	0.0	0	0	0	0	36.1%
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	3.0	1	0	0.5	0	0	0	0	82.7%
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	3.0	1	0	0.5	0	0	0	0	81.7%
9	Rely 280 32 oz/A	1 day preplant	16.8	1	0	2.0	0	0	0	0	2.5%
10	Rely 280 32 oz/A	POST 6 WAT	14.3	1	0	2.0	0	0	0	0	---
11	Rely 280 64 oz/A	POST 6 WAT	14.0	1	0	3.8	0	0	0	0	---
12	Dual Magnum 1 pt/A	POST 14 days	7.5	1	0	1.3	0	0	0	0	56.2%
		Average	9.9	0.9	0.0	1.9	0.0	0.0	0.0	0.0	
		LSD 0.05	5.9	---	---	1.96	---	---	---	---	
		CV, %	37.9	---	---	70.2	---	---	---	---	

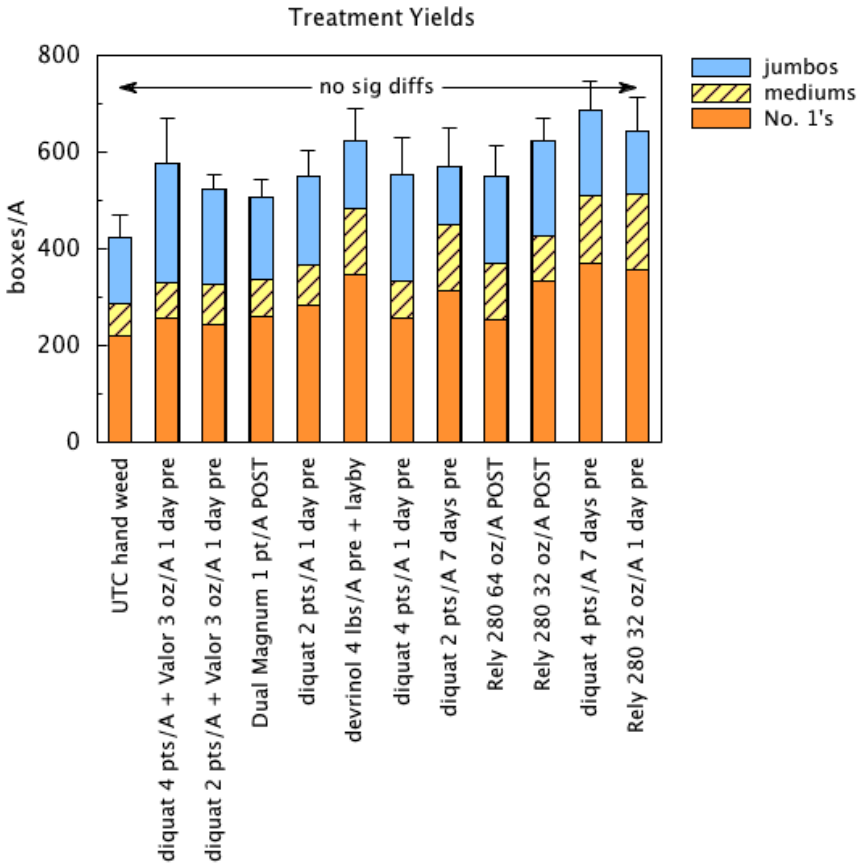
Weeds: Almost no weeds at this location: redroot pigweed, puncture vine, barnyard grass. June 20 all plots hand weeded before rating.
Scale: Severity scores based on a 1 - 6 scale: 0 = no phyto or weeds, 1 = <10%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 90%, 6 > 90% weeds/crop phyto.
LSD 0.05 Least significant difference. Means separated by less than this amount are not significantly different (ns). Treatment #1 not included in analyses.
CV, % Coefficient of variation, a measure of variability in the experiment.
--- not enough data to evaluate

Table 5. Sweetpotato ('Murasaki') yield results at the Quail H Farms location, Merced County 2017.

TRT	herbicide rate and timing		TMY 40 lb box/A lbs/A	No. 1's	Mediums	Jumbos	adjusted TMY box/A	bins/A	%No. 1's	%culls
1	UTC hand weed	as needed	19,112	218	68	134	420	16.8	51.5%	6.6%
2	diquat 2 pts/A	1 day preplant	24,938	282	83	184	549	21.9	51.5%	4.7%
3	diquat 4 pts/A	1 day preplant	25,156	254	79	220	553	22.1	45.2%	9.7%
4	diquat 2 pts/A	7 days preplant	25,809	310	139	119	568	22.7	54.6%	4.7%
5	diquat 4 pts/A	7 days preplant	31,200	368	140	178	686	27.5	54.1%	6.1%
6	Devrinol 4 lbs/A layby	PPI and layby	28,314	346	137	140	623	24.9	55.7%	5.0%
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	23,740	241	84	198	522	20.9	45.7%	5.7%
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	26,136	254	74	247	575	23.0	45.3%	4.3%
9	Rely 280 32 oz/A	1 day preplant	29,131	355	157	129	641	25.6	55.1%	3.4%
10	Rely 280 32 oz/A	POST	28,314	333	92	198	623	24.9	53.4%	4.7%
11	Rely 280 64 oz/A	POST	24,938	252	119	178	549	21.9	46.9%	5.1%
12	Dual Magnum 1 pt/A	POST 14 days	23,032	258	77	172	507	20.3	50.8%	8.0%
		Average	25,818	289	104	175	568	22.7	50.8%	5.7%
		LSD 0.05	ns	ns	50	ns	ns	ns	ns	ns
		CV, %	22.5	25.5	33.4	37.4	22.5	22.5	13.0	70.3

No. 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.
TMY Total marketable yield is the sum of the above three categories.
bins/A bins/A are estimated based on market box yield assuming 22 boxes per bin.
% No. 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.


Diquat Herbicide on Sweetpotatoes
Quail H Farms (Merced County) 2017
weeds/plot
25
20
15
10
5
0
a
b
c
1
8
7
12
2
6
3
4
11
10
5
9
treatment
evaluation date
June 1
June 12


Treatment Yields
boxes/A
800
600
400
200
0
no sig diffs
jumbos
mediums
No. 1's
UTC hand weed
diquat 4 pts/A + Valor 3 oz/A 1 day pre
diquat 2 pts/A + Valor 3 oz/A 1 day pre
Dual Magnum 1 pt/A POST
diquat 2 pts/A 1 day pre
devrinol 4 lbs/A pre + layby
diquat 4 pts/A 1 day pre
diquat 2 pts/A 7 days pre
Rely 280 64 oz/A POST
Rely 280 32 oz/A POST
diquat 4 pts/A 7 days pre
Rely 280 32 oz/A 1 day pre

Appendix 1. Treatment weed and crop growth 5 WAT (June 9, 2017) at Weimer Farms.

1. Hand weeded check

2. diquat 2 pts/A 1 day PRE

3. diquat 4 pts/A 1 day PRE

4. diquat 2 pts/A fb napropamide 4 lbs/A at layby

5. diquat 4 pts/A fb napropamide 4 lbs/A at layby

6. napropamide 4 lbs/A at layby

Appendix 1 (cont.)

7. diquat 2 pts/A + flumioxazin 3 oz/A 1 day PRE

8. diquat 4 pts/A + flumioxazin 3 oz/A 1 day PRE

9. glufosinate 32 oz/A 1 day PRE

10. glufosinate 32 oz/A 30 days POST

11. glufosinate 64 oz/A 30 days POST

12. metoachlor 1 pt/A POST 14 days

IR-4 glufosinate herbicide trials on sweetpotatoes in California

Scott Stoddard
UC Cooperative Extension

SUMMARY
Unfortunately, very few pre-emergent herbicides are registered for sweetpotatoes in California, and are frequently not used as they require water incorporation from rain or sprinklers to be effective. As a result, California growers frequently use glyphosate with spray hoods for post-plant weed control. While not yet observed in commercial fields, glyphosate resistant pigweeds are one of several common weeds in California documented to have developed resistance to this herbicide, and therefore glyphosate alternatives need to be evaluated for their efficacy and safety in sweetpotatoes. In 2017, USDA IR-4 field trials evaluated the herbicides Rely (glufosinate), Roundup (glyphosate), and Suppress (capric + caprylic acids) applied to pre-formed beds prior to and after transplanting in three locations. Post-plant applications were made as a banded application down the center of bed using a shielded sprayer to minimize contact with the crop at 32, 48, and 64 fl oz/A. Devrinol (napropamide), Dual Magnum (S-metolachlor), and Valor (flumioxazin) were used for comparison, and the tests included both weedy and hand-weeded controls. Sweetpotato cultivars 'Bellevue', 'Murasaki', and 'Diane' were mechanically transplanted in commercial fields using standard equipment and practices. The experimental design was a randomized complete block (RCB) with 4 replications, and plot size was 2 rows by 35 feet at each location. Data collected included visual crop injury, weed control, and yield. The sweetpotatoes were drip irrigated throughout the season, and grower managed irrigation, fertilizers, and pest management with the exception of weed control. Pre-plant applications of glufosinate had minimal efficacy for post-plant weed control; efficacy was significantly ($p < 0.05$) improved with the addition of flumioxazin and napropamide. Post-plant applications of glufosinate at 4 to 6 weeks after transplanting significantly reduced both grassy and broadleaf weeds as compared to the untreated control plots, and had the highest weed control, 80.2%, of all the treatments at 64 oz/A. Napropamide 4 lbs/A applied at lay-by had similar weed control. Pre-plant applications of glufosinate caused no crop injury, however, some crop phytotoxicity was observed for POST applied glufosinate regardless of rate. Injury attenuated as the season progressed, but at one location may have significantly reduced yield.

Introduction

Weed control methods in commercial sweetpotatoes in California are characterized by the use of pre-plant weed management coupled with a limited number of registered herbicides, cultivation, and hand hoeing when appropriate. Pre-plant fumigation, especially with metam – Na or metam – K products, can also reduce overall weed populations and can be an important component of an overall weed management plan. However, pre-plant or pre-emergent herbicides are rarely used in commercial production fields, as the registered materials require water incorporation to be effective (Valor, Dual Magnum) or efficacy is improved (Devrinol, Dacthal) with water. As a result, post emergence herbicides, cultivation, and hand hoeing are the main methods used to control weeds. Post-plant applications of glyphosate (Roundup) with hooded sprayers are

commonly used after transplanting and before canopy closure, usually 2 – 4 weeks after transplanting.

With the exception of yellow nutsedge, annual weeds dominate in production sweetpotato fields, especially redroot pigweed and Palmer amaranth. 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, 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.

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

Three studies were conducted in a commercial sweetpotato fields near Livingston, CA, during the 2017 growing season to evaluate different rates (0, 32, 48, 64 fl oz/A) and timings (1 day pre-plant and 30 days post plant) of glufosinate (Rely 280) herbicide in commercial production fields. Roundup (glyphosate), Success (capric+caprylic acids), and Devrinol (napropamide) were also included for comparison. Dual Magnum (S-metalochlor) was included at two of the three test sites. Trial locations and herbicide treatments are listed in Table 1.

Pre-plant glufosinate herbicide treatments were applied to clean, cultivated plots 2 - 3 days before transplanting with a CO_2 backpack sprayer at 40 psi with a 4-ft boom using 4 TeeJet 8004 flat fan nozzles and calibrated to 50 gpa equivalent (Figure 1). Spray swath was measured at 78" when held ~ 18" above the soil surface at the time of application. At the Tucker Farms location, the herbicide was incorporated with 0.25" water by applying 25 gallons of water per plot after transplanting, using 5 gallon buckets applied over the plants and down the plant row.

Metolachlor (Dual Magnum) and napropamide (Devrinol) POST treatments were applied to specific plots and incorporated by hand to a depth of about 2" at 2 – 4 WAT. POST applications of glufosinate (Rely 280), glyphosate, and Suppress were made using the same CO_2 backpack sprayer, but with a hand-held wand with 1 TeeJet 8004 flat fan nozzle to spray between the plant rows (center of double-row bed) to simulate a banded application. 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 1). 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 cultivars (Bellevue, Murasaki, or Diane, depending on location) were transplanted 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 other than weed

control were performed by the grower using industry standard methods. At the Quail H Farms location, hand hoeing crews inadvertently went through the plots twice, effectively eliminating all weed ratings at this location.

Plot size was 1 bed (2 rows) 6.67 ft wide x 35 ft long. Experimental design was a RCB with 4 replications; means separation was done using Fisher's Protected LSD at 95% confidence level. Data collected included visual crop injury and weed control using a subjective scale (0 = no injury or no control, 5 = 100% crop death and complete weed control, determined at 2, 4, and 6 weeks after planting (WAP). A nontreated weedy check (Tucker Farms) and a hand-weeded weed-free check (all locations) were included for comparison. Weed-free check plots were maintained weed free through light cultivation and hand removal. Photos were taken of the plots at the evaluation dates (Appendix 1). All plots were hand weeded after the final evaluation date approximately 8 WAT at the Weimer Farms and Tucker Farms locations; no weed removal occurred at the Quail H location because the trial was accidentally weeded by a contract hoeing crew. Yields were measured using a commercial 2-row harvester and hand graded by the harvest crew into standard size grades (No. 1's, mediums, and jumbos) (Figure 2). 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.

Table 1. Field site and herbicide treatments for glufosinate efficacy trials in sweetpotatoes, Livingston CA, 2017.

	Weimer Farms	**Quail H Farms**	**Tucker Farms**
Location	NE corner of Steinberg and Longview Rds, in Merced County	NE corner of Steinberg and Longview Rds, near Delhi in Merced County	South of Hwy 140 and Howard Rd, in Merced County
Variety and plant date	Bellevue, May 4, 2017	Murasaki, May 10, 2017	Diane, June 2, 2017
Plot size and plant spacing	1 bed (80") by 30 ft,4 reps, 9" spacing	1 bed (80") by 30 ft, 9" spacing	1 bed (80") by 30 ft, 9" spacing
Irrigation	Surface single line drip	Surface single line drip	Surface single line drip
Herbicide incorporation	2" for Devrinol and Dual	2" for Devrinol and Dual	2" for Devrinol
Weed evaluation	2, 4, 5, 7, 8 WAT	2, 4, 6 WAT	2, 4, 6 WAT
Harvest	29-!ul 2017	17-Oct 2017	27-Oct-2017
days	116	160	147

Weimer Farms	Herbicide Treatment	Timing	Application dates	
1	UTC hand weed	as needed	---	---
6	Devrinol 4 lbs/A layby*	layby	---	12-Jun
9	Rely 280 32 oz/A PRE	2 days preplant	2-May	---
10	Rely 280 32 oz/A POST	POST 30 days	---	2 Jun
11	Rely 280 64 oz/A POST	POST 30 days	---	2 Jun
12	Dual Magnum 1 pt/A POST*	POST 14 days	18 May	---

Quail H Farms	Treatment Name	Application timing	Application dates	
1	UTC hand weed	as needed	---	---
6	Devrinol 4 lbs/A layby*	PRE and layby	3-May	12-Jun
9	Rely 280 32 oz/A PRE	2 days preplant	8-May	----
10	Rely 280 32 oz/A POST	POST 30 days	---	20-Jun
11	Rely 280 64 oz/A POST	POST 30 days	---	20-Jun
12	Dual Magnum 1 pt/A POST*	POST 14 days	31-May	12-Jun

Tucker Farms	Treatment Name	Application timing	Application dates	
1	UTC weed free	As needed	---	---
2	Rely 280 32 oz/A PRE	3 days preplant	30-May	
3	Rely 280 32 oz/A POST	POST 20 days	20-Jun	
4	Rely 280 48 oz/A POST	POST 20 days	20-Jun	---
5	Rely 280 64 oz/A POST	POST 20 days	20-Jun	
6	Roundup 48 oz/A POST	POST 20 days	21-Jun	
7	Suppress 4% POST	POST 20 days	21-Jun	
8	Devrinol 4 lbs/A Layby	Early layby	22-Jun	
9	UTC weedy	---	---	

** POST applications mechanically incorporated.*

Figure 1. Pre-plant glufosinate applications were broadcast across the entire bed with a 4-nozzle boom (left); POST glufosinate, glyphosate, and Suppress were applied as a banded application between the rows using a single nozzle wand (right). Sweetpotatoes were shielded to minimize contact from drift.

Figure 2. Machine harvested root yields were separated and weighed by size.

Results

Weimer Farms and Quail H Farms tables include results for diquat treatments that were part of the other IR-4 project (IR-4 Project P1189). Only the treatments included in the methods above are discussed here.

Weed control ratings for the Weimer location are shown in Table 2. Weed pressure was very high at this location, and included purslane, yellow nutsedge, pigweed, malva, black nightshade, puncture vine, spurge, lambsquarters, and barnyard grass. At 2 WAP, only the pre-plant Rely treatment had been applied, and therefore weed control ratings were not made for the POST Rely treatments. Not surprisingly, pre-plant Rely had virtually no weed control, ~14% . At 4 WAP, treatment #12 (Dual Magnum) had significantly better weed control, about 80%, than the Rely PRE or POST treatments. The reduction of weeds in the Dual Magnum plot occurred as a result of the cultivation and mechanical incorporation needed to activate this herbicide.

By 7 WAP, the addition of Devrinol at layby and the POST applications of Rely 280 significantly improved weed control, especially for broadleaf weeds, from 79.2 – 91.7%. No crop injury was observed in this trial, other than some slight injury from herbicide drift in the Rely 280 treatments (Figure 3). This effect was temporary and symptoms could no longer be observed by harvest.

Total marketable yield and Number 1 yield was significantly less in the Rely preplant treatment (Table 3), which had poor weed control. Thus, the reduction in yield was a result of weed competition and not crop injury. Best No. 1 yields occurred in those treatments were Devrinol was applied at layby, 730 to 818 boxes per acres, and with Rely 280 at 64 oz/A applied POST, at 762 boxes per acre. The percentage of culled roots was not significantly different among treatments.

Weed and yield results for the Quail-H Farms location are shown in Tables 4 and 5. There were very few weeds at this location at any evaluation date, a consequence of not being able to keep a contract hoeing crew out of the plot area despite signs and marking tape. No significant yield differences were observed except for medium size roots, with total market yield between 420 to 640 boxes/A. As with Weimer Farms, very little crop injury was ever observed, and then only in the POST glufosinate treatments on the first evaluation date.

AT the Tucker Farms location, redroot pigweed dominated the weed spectrum; other weed specied included purslane, barnardgrass, nutsedge, malva, nightshade, Russian thistle, puncture vine, and shepherd's purse. As with the other two locations, the pre-plant application of glufosinate had no significant weed control, nor was any crop phytotoxicity observed with this treatment (Table 6). Weed control improved as the POST glufosinate rates increased from 32 to 64 oz/A, however, crop injury also increased. Crop injury peaked at 4 weeks after transplanting (~ 2 weeks after treatment), then gradually attenuated over the course of the growing season. Crop injury with the 64 oz rate of glufosinate was similar as 48 oz of glyphosate (Figure 4). Best overall weed control was observed with the highest rate of glufosinate and the layby application of Devrinol, at 75 and 80%, respectively. The Devrinol treatment also resulted in the highest overall yields of the herbicide treatments, at 883 boxes/A, while the Roundup treatment had significant less yield (732 boxes/A) and more culls, 18.2% (Table 7). The lower yield in the

Roundup treatment appeared to be a result of the crop injury as a result of drift onto the foliage during application. The weedy plots yielded well at this location because these plots were handweeded after the final evaluation date at 6 WAT.

Conclusions

Pre-plant applications of glufosinate had minimal efficacy for post-plant weed control; efficacy was significantly ($p < 0.05$) improved with the addition of flumioxazin and napropamide. No crop injury was noted from pre-plant glufosinate even when watered into the soil after application. Post-plant applications of glufosinate at 4 to 6 weeks after transplanting significantly reduced both grassy and broadleaf weeds as compared to the untreated control plots, and had the highest average weed control, 80.2%, of all the treatments at 64 oz/A. Napropamide 4 lbs/A applied at lay-by had similar weed control (76%), with no noticeable impact on the crop. While pre-plant applications of glufosinate caused no crop injury, some crop phytotoxicity was observed for POST applied glufosinate regardless of rate. Injury attenuated as the season progressed, but at the Tucker Farms location may have significantly reduced yield. The results of these trials show glufosinate to be an effective post-plant, post emergence herbicide in sweetpotatoes provided it is applied in such a way as to minimize contact with the crop.

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Table 2. Weed control relative to the hand weeded plot in each rep at the Weimer Farms location, 2017.

Treatment #	herbicide rate and timing		18-May 2 WAT Weed control	2-Jun 4 WAT Weed control	20-Jun 7 WAT grass control	20-Jun BL control
1	UTC hand weed	as needed	100.0%	100.0%	91.7%	100.0%
2	diquat 2 pts/A	1 day preplant	38.9%	62.5%	33.3%	58.3%
3	diquat 4 pts/A	1 day preplant	16.5%	62.5%	41.7%	54.2%
4	diquat 2 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	24.8%	62.5%	70.8%	87.5%
5	diquat 4 pts/A fb devrinol 4 lbs/A	1 day preplant, layby	50.9%	62.5%	79.2%	87.5%
6	devrinol 4 lbs/A layby	layby	---	66.7%	79.2%	83.3%
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	71.0%	79.2%	50.0%	66.7%
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	71.6%	66.7%	33.3%	66.7%
9	Rely 280 32 oz/A	1 day preplant	14.9%	54.2%	45.8%	41.7%
10	Rely 280 32 oz/A	POST	---	58.3%	70.8%	79.2%
11	Rely 280 64 oz/A	POST	---	66.7%	79.2%	91.7%
12	Dual Magnum 1 pt/A	POST 14 days (May 18)	---	79.2%	70.8%	54.2%
		Average	41.2%	66.0%	59.0%	70.0%
		LSD 0.05	33.0%	14.0%	18.0%	18.0%
		CV, %	57.8	14.6	21.3	17.6

LSD 0.05 Least significant difference. Means separated by less than this amount are not significantly different (ns). Treatment #1 not included in analy

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

WAT Weeks after transplanting

Timing: Preplant on May 2, POST on June 2, layby on June 12. Clethodim for grass control on Jun 20.

Weeds: BL = broadleaf weeds: purslane, nutsedge, pigweed, malva, nightshade, puncture vine, spotted spurge, fileree, and lambsquarters
Grass = barnyard grass

Scale: Severity scores based on a 1 - 6 scale: 0 = no phyto or weeds, 1 = <10%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 90%, 6 > 90% weeds/crop phyto

Figure 3. Leaf symptoms from glufosinate herbicide contact.

Table 3. Sweetpotato ('Bellevue') yield results at the Weimer Farms location, Merced County 2017.

		TMY 40 lb box/A				adjusted TMY			
	treatment	lbs/A	No. 1's	Mediums	Jumbos	box/A	bins/A	%No. 1's	%culls
1	UTC hand weed	56231	619	135	484	1237	49.5	50.2%	4.3%
2	diquat 2 pts/A PRE	48722	734	120	218	1072	42.9	68.5%	4.1%
3	diquat 4 pts/A PRE	42411	589	127	217	933	37.3	63.5%	4.4%
4	diquat 2 pts/A fb devrinol 4 lbs/A	50317	730	127	250	1107	44.3	66.0%	5.6%
5	diquat 4 pts/A fb devrinol 4 lbs/A	55920	812	133	285	1230	49.2	66.2%	3.6%
6	devrinol 4 lbs/A layby	54423	818	148	232	1197	47.9	68.2%	4.7%
7	diquat 2 pts/A + Valor 3 oz/A	49751	669	138	288	1095	43.8	60.9%	3.3%
8	diquat 4 pts/A + Valor 3 oz/A	49931	732	123	243	1098	43.9	67.1%	3.8%
9	Rely 280 32 oz/A PRE	45139	667	128	198	993	39.7	67.2%	4.4%
10	Rely 280 32 oz/A POST	48787	652	126	296	1073	42.9	60.6%	5.2%
11	Rely 280 64 oz/A POST	55811	762	122	344	1228	49.1	62.1%	3.2%
12	Dual Magnum 1 pt/A POST	49206	665	137	280	1083	43.3	61.5%	5.8%
	Average	50554	704	130	278	1112	44.5	63.5%	4.4%
	LSD 0.05	7220	129.5	ns	130.6	158.8	6.4	8.2	1.5
	CV, %	9.9	12.8	20.4	32.6	9.9	9.9	8.9	24.3

No. 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.
TMY	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 22 boxes per bin.
% No. 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.

Table 4. Weed pressure and crop injury at 2, 4, and 6 WAT as affected by herbicide treatment at the Quail H Farms , Merced County 2017.

Treatment			1-Jun	Weed	crop	12-Jun	Weed	crop	20-Jun	crop	June 1 weed
#	herbicide rate and timing		# Weeds	Rating	phyto	# Weeds	Rating	phyto	# Weeds	phyto	control %
1	UTC hand weed	as needed	0.0	0	0	1.3	0	0	0	0	100.0%
2	diquat 2 pts/A	1 day preplant	11.0	1	0	2.3	0	0	0	0	35.2%
3	diquat 4 pts/A	1 day preplant	12.0	1	0.25	2.3	0	0	0	0	29.2%
4	diquat 2 pts/A	7 days preplant	12.5	1	0.25	5.0	0	0	0	0	27.0%
5	diquat 4 pts/A	7 days preplant	14.3	1	0	2.5	0	0	0	0	15.8%
6	devrinol 4 lbs/A layby	PPI and layby	11.0	1	0	0.0	0	0	0	0	36.1%
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	3.0	1	0	0.5	0	0	0	0	82.7%
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	3.0	1	0	0.5	0	0	0	0	81.7%
9	Rely 280 32 oz/A	1 day preplant	16.8	1	0	2.0	0	0	0	0	2.5%
10	Rely 280 32 oz/A	POST 6 WAT	14.3	1	0	2.0	0	0	0	0	---
11	Rely 280 64 oz/A	POST 6 WAT	14.0	1	0	3.8	0	0	0	0	---
12	Dual Magnum 1 pt/A	POST 14 days	7.5	1	0	1.3	0	0	0	0	56.2%
		Average	9.9	0.9	0.0	1.9	0.0	0.0	0.0	0.0	
		LSD 0.05	5.9	---	---	1.96	---	---	---	---	
		CV, %	37.9	---	---	70.2	---	---	---	---	

Weeds:	Almost no weeds at this location: redroot pigweed, puncture vine, barnyard grass. June 20 all plots hand weeded before rating.
Scale:	Severity scores based on a 1 - 6 scale: 0 = no phyto or weeds, 1 = <10%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 90%, 6 > 90% weeds/crop phyto.
LSD 0.05	Least significant difference. Means separated by less than this amount are not significantly different (ns). Treatment #1 not included in analyses.
CV, %	Coefficient of variation, a measure of variability in the experiment.
---	not enough data to evaluate

Table 5. Sweetpotato ('Murasaki') yield results at the Quail H Farms location, Merced County 2017.

TRT	herbicide rate and timing		TMY 40 lb box/A lbs/A	No. 1's	Mediums	Jumbos	adjusted TMY box/A	bins/A	%No. 1's	%culls
1	UTC hand weed	as needed	19,112	218	68	134	420	16.8	51.5%	6.6%
2	diquat 2 pts/A	1 day preplant	24,938	282	83	184	549	21.9	51.5%	4.7%
3	diquat 4 pts/A	1 day preplant	25,156	254	79	220	553	22.1	45.2%	9.7%
4	diquat 2 pts/A	7 days preplant	25,809	310	139	119	568	22.7	54.6%	4.7%
5	diquat 4 pts/A	7 days preplant	31,200	368	140	178	686	27.5	54.1%	6.1%
6	Devrinol 4 lbs/A layby	PPI and layby	28,314	346	137	140	623	24.9	55.7%	5.0%
7	diquat 2 pts/A + Valor 3 oz/A	1 day preplant	23,740	241	84	198	522	20.9	45.7%	5.7%
8	diquat 4 pts/A + Valor 3 oz/A	1 day preplant	26,136	254	74	247	575	23.0	45.3%	4.3%
9	Rely 280 32 oz/A	1 day preplant	29,131	355	157	129	641	25.6	55.1%	3.4%
10	Rely 280 32 oz/A	POST	28,314	333	92	198	623	24.9	53.4%	4.7%
11	Rely 280 64 oz/A	POST	24,938	252	119	178	549	21.9	46.9%	5.1%
12	Dual Magnum 1 pt/A	POST 14 days	23,032	258	77	172	507	20.3	50.8%	8.0%
		Average	25,818	289	104	175	568	22.7	50.8%	5.7%
		LSD 0.05	ns	ns	50	ns	ns	ns	ns	ns
		CV, %	22.5	25.5	33.4	37.4	22.5	22.5	13.0	70.3

No. 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.
TMY	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 22 boxes per bin.
% No. 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.

Table 6. Weed pressure and crop injury at ~ 2, 4, and 6 weeks after transplanting as affected by herbicide treatment at the Tucker Farms location, Merced Count

#	herbicide treatment	#	19-Jun 0 - 6 rating scale Weeds	Weed Rating	crop phyto	3-Jul 0 - 6 rating scale BL Weed	Grasses	crop phyto	weed control %	17-Jul 0 - 6 rating scale BL Weed	Grasses	Sedge	crop phyto	weed control %
1	UTC weed free		0.00	0.00	0.00	1.50	1.00	0.00	82.5	0.25	0.00	0.00	0.00	97.5
2	Rely 280 32 oz/A PRE		57.50	1.25	0.25	4.25	1.75	0.00	23.8	4.75	2.00	0.00	0.25	12.5
3	Rely 280 32 oz/A POST		---	---	---	0.75	1.50	1.00	82.5	2.75	2.25	0.25	1.00	56.3
4	Rely 280 48 oz/A POST		---	---	---	1.00	1.00	1.50	88.8	2.25	1.00	0.00	0.50	62.5
5	Rely 280 64 oz/A POST		---	---	---	0.50	0.00	2.25	95.0	2.00	0.25	0.00	0.75	75.0
6	Roundup 48 oz/A POST		---	---	---	1.50	1.75	2.25	78.8	2.50	2.25	0.00	0.75	56.3
7	Suppress 4% POST		---	---	---	2.75	1.25	0.00	53.8	2.75	2.75	0.00	0.25	50.0
8	Devrinol 4 lbs/A Layby		---	---	---	1.00	0.50	0.75	92.5	1.75	0.50	0.00	1.00	80.0
9	UTC weedy		53.00	1.50	0.00	4.50	1.50	0.00	17.5	1.50	0.75	0.00	0.00	6.3
	Average		55.25	1.38	0.13	2.03	1.16	0.97	66.6	2.53	1.47	0.03	0.56	49.8
	LSD 0.05		ns	ns	---	1.02	1.06	1.02	19.5	0.84	1.4	---	ns	20.8
	CV, %		29.7	25.7	---	34.2	62.3	71.8	19.9	22.7	64.6	---	125	28.4

Weeds: BL = broadleaf weeds: purslane, nutsedge, pigweed, malva, nightshade, Russian thistle, puncture vine, and shephards purse
Grass = barnyard grass
Sedge = yellow nutsedge

Scale: Severity scores based on a 1 - 6 scale: 0 = no phyto or weeds, 1 = <10%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 90%, 6 > 90% weeds/crop phyto.

LSD 0.05 Least significant difference. Means separated by less than this amount are not significantly different (ns). Treatment #1 not included in analyses.

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

Table 7. Sweetpotato ('Diane') yield results at the Tucker Farms location, Merced County 2017.

TRT	herbicide	TMY 40 lb box/A lbs/A	No. 1's	Mediums	Jumbos	adjusted TMY box/A	bins/A	%No. 1's	%culls
1	UTC weed free	40527.1	733.5	73.1	85.1	891.6	35.7	82.6%	13.3%
2	Rely 280 32 oz/A PRE	36481.5	681.6	57.5	63.5	802.6	32.1	84.8%	18.2%
3	Rely 280 32 oz/A POST	38060.6	687.6	64.7	85.1	837.3	33.5	82.1%	13.9%
4	Rely 280 48 oz/A POST	36971.6	712.8	67.1	33.5	813.4	32.5	87.5%	15.5%
5	Rely 280 64 oz/A POST	35555.9	666.0	65.9	50.3	782.2	31.3	84.9%	15.7%
6	Roundup 48 oz/A POST	33269.0	621.7	52.7	57.5	731.9	29.3	85.1%	18.2%
7	Suppress 4% POST	37298.3	700.8	80.3	39.5	820.6	32.8	85.6%	15.1%
8	Devrinol 4 lbs/A Layby	40129.7	715.1	77.9	89.8	882.9	35.3	81.1%	12.8%
9	UTC weedy	38931.8	712.8	80.3	63.5	856.5	34.3	83.2%	13.5%
	Average	37469.5	692.4	68.8	63.1	824.3	33.0	84.1%	15.1%
	LSD 0.05	4166	ns	ns	38.1	91.7	3.7	ns	3.8
	CV, %	7.6	8.3	26.2	41.4	7.6	7.6	4.0	17.0

No. 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.
TMY	Total marketable yield is the sum of the above three categories.
bins/A	bins/A are estimated based on market box yield assuming 22 boxes per bin.
% No. 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.

Figure 4. POST emergence applications of Rely (left) and Roundup (right) caused similar looking foliar injury symptoms on sweetpotatoes.

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