Sweetpotato Research Progress Report 2007

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Sweetpotato Collaborators Trial -- 2007

Merced County

This year's sweetpotato evaluation was with Blain Yagi, near Livingston, CA. Soil type was Hilmar sand, slightly saline-alkali. Ground was fumigated with Telone. Field pre-irrigated, and soil moisture was excellent at planting. Warm, dry spring. Most seed from 2006 season for all varieties was lost to very cold temperatures in January, so many plants were from different hot beds. B63, B14, and L-02-32 arrived as cuttings after transplanting main trial, and were not included in the statistical analysis. Yields shown in Figure 1; taste test results in Figure 2.

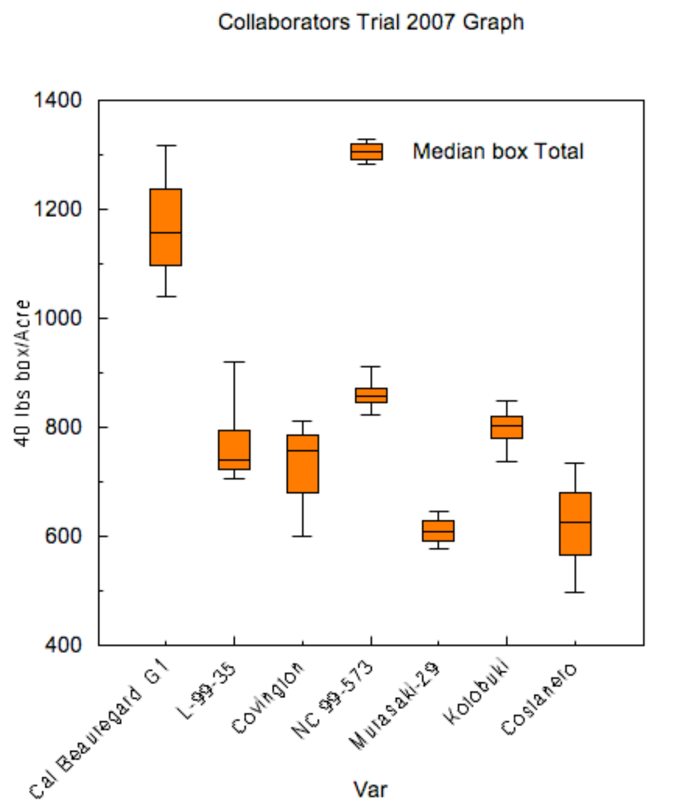
NATIONAL SWEETPOTATO COLLABORATORS SUMMARY OF DATA 2007

STATE AND LOCATION REPORTING: Livingston, CA
DATE TRANSPLANTED: May 18. DATE HARVESTED: 10/24/2007. No. GROWING DAYS: 159
DISTANCE BETEEN ROWS (in): 40. DISTANCE IN ROW (in): 9
PLOT SIZE: NO. OF ROWS: 2 LENGTH (ft): 50 NO. OF REPS: 4
IRRIGATION: pre irrigate + drip irrigation. 1.5 to 2 inches per week during summer, total 36".
FERTILIZER: 1 ton gyp, 3 tons compost, 500 lbs K2SO4 pre plant, CAN17 drip. About 180-60-375 NPK.

		-------	40 lb box/A		-------		%	%
	SELECTION	US #1'S	CANNERS	JUMBOS	MKT YIELD	BINS/A	US #1'S	CULLS
1	Cal Beauregard G1	521.3	158.4	490.0	1169.7	53.2	44.3	0.9
2	L-99-35	390.9	203.7	180.8	775.4	35.2	50.7	13.9
3	Covington	333.4	184.8	203.3	721.5	32.8	46.2	2.3
4	NC 99-573	386.0	126.1	348.6	860.7	39.1	45.0	1.2
5	Murasaki-29	283.0	237.7	88.8	609.6	27.7	46.3	0.6
6	Kotobuki	363.8	188.2	243.8	795.9	36.2	45.8	10.4
7	Costanero	255.9	131.4	232.4	619.8	28.2	40.7	5.0
*	L-04-178	398.8	124.6	265.0	788.4	35.8	50.6	4.5
*	L-04-175	392.8	143.7	374.6	911.0	41.4	43.1	1.0
*	L-04-148	546.2	89.1	160.0	795.4	36.2	68.7	0.0
**	L-02-32	not enough roots to evaluate.						
	Average	362.0	175.8	255.4	793.2	36.1	45.6	4.9
	LSD 0.05	110.5	NS	118.8	140.9	6.4	NS	6.6
	CV, %	17.9	30.1	27.6	10.4	10.4	12.3	74.2

US #1's	Roots 2 to 3.5 inches in diameter, length 3 to 9 inches, well shaped and free of defects.
Canners	Roots 1 to 2 in diameter, 2 to 7 inches in length.
Jumbos	Roots that exceed the diameter and length 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 amt are not significantly different (ns).
CV, %	Coefficient of variation, a measure of variability in the experiment.

* observation plots only, not included in the statistical analysis.
** 2006 seed chilled in Jan, 2007. Arrived as cuttings, limited number of plants, different location.



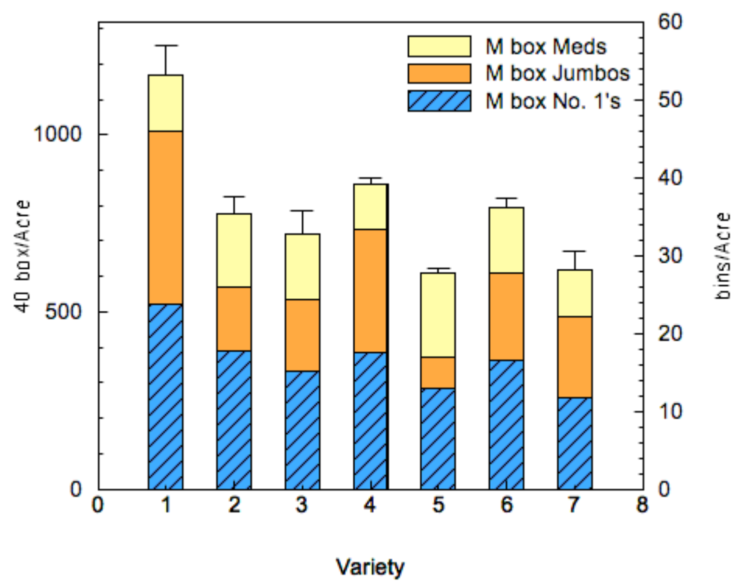


Figure 1. Total marketable yield (above) box-and-whisker plot shows yield variance for each variety; yield by size category for both boxes and bins per acre (below).

SCORE SHEET FOR EVALUATION OF SWEETPOTATO SPROUT PRODUCTION

Date bedded: 3/15/07 Location: D&S Farms

Date Evaluated: 4/9/07 Type of bed: hot bed, no gin trash

Evaluated by: S. Stoddard
Most seed lost to chilling injury; evaluation made on commercial beds
(except for observation varieties L-04 178, 175, 02-32)

	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	Cal Beauregard G1	no	3	4	2	5	light green, some light purple on new growth
2	L-99-35						used grower plants
3	Covington						used grower plants
4	NC 99-573	no	3	4	2	5	all light green
5	Murasaki-29	no	4	4	3	5	straight, tall, mostly green
6	Kotobuki						used grower plants
7	Costanero	no	1	1	2	3	roots chilled in winter, used mostly greenhouse plants
	L-04-178	no	4	4	2	5	dark green, purple new growth
	L-04-175	no	1	1	1	4	not healthy looking
	L-02-32						plants shipped from LSU

(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) indcates 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.

Sweetpotato Collaborators Trial -- 2007
Merced County

This year's sweetpotato evaluation was with Blain Yagi, near Livingston, CA. Soil type was Hilmar sand, slightly saline-alkali.
Ground was fumigated with Telone. Field pre-irrigated, and soil moisture was excellent at planting. Warm dry spring.
Plants were from different hot beds, B63, B14, and L-02-32 arrived as cuttings after transplanting main trial.
Seed from 2006 season lost to very cold temperatures in January.

Rep	Var	Variety Name	Skin Color	Skin Text	Flesh color	Eyes	Lents	Shape	Shape Uniformity	Overall App	Comments
1	1	Cal Beauregard	Rose-	9	3	9	9	2,3	7	7	Very smooth, mostly Cu color
2			copper	9	3	9	8		8	8	no RC
			All green foliage, no bean growth, mites.								
1	2	L-99-35	rose Cu	7	3	7	4	2,3	7	7	Lents numerous and prominent
2			rose Cu	8	4	7	5		6	7	nice color, shape, but fine cracks!
			Dark green foliage with purple new growth, upright, leaves slightly crinkled. Looks like Bienville.								
1	3	Covington	Rose Cu	8	3	5	5	2,6	7	8	good shape, slight fluting
2			Rose Cu	9	3	6	5		8	8	good color, size
			All green foliage, medium upright vine, slight crinkle to leaves, 3 prong leaf.								
1	4	NC-99-573	Rose Cu	7	4	7	7	3,6	8	8	Almost a red, v good uniformity
2				8	4	7	8		9	9	some pimples, fluting, early rot?
			Small plants all green.								
1	5	L 01-29	purple	5	0	7	5	3,8	8	7	skin texture more rough, dull
2			purple	7	white	8	7		8	7	small size but good shape
			All green foliage, smaller leaves, more upright bunch type growth.								
1	6	Koto Buki	purple	8	0	3	3	4,6	5	5	skin smooth with good sheen
2				8		3	3		5	6	long & block, lumpy & bumpy
			All green, large upright vine, spade lvs								
1	7	Costanero	dull purple	1	2	3	5	6,7,8	3	3	skin very rough, dull
2			red purple	2	2	3	5			3	lents, heavy pimpling, dull color
			Very large, vigorous plant. All green foliage, upright growth habit with large leaves.								
1		L-02-32	Cu	7	3	8	5	3,8	5	7	ok , but RC and poor yield
2											Grown for Collaborators
			similar to Beauregard, but slightly more upright vine, darker green, more crinkle.								
1		B63	rose	9	3	shallow	few	eliptical	good		G0 material grown for Collaborators
2											
1		B14	rose	7	3	7	7	3,7	5	6	Nice rose color.
2				8	3	7	9			7	Variable shape.
1		L-04-178	ruby red	7	2+	7	6	3,8	7	7	nice color, shape. Lents
2				8	3	8	7		7	7	too prominent. Fluting, YCR. '08?
			spade leaves with crinkle, all green								
1		L-04-175	Red	7	5	7	7	2,6	7	7	nice looking potato
2				8	4	7	8		6	8	Re-evaluate in '08
			Bunch to sprwling vine, large maple leaf, mostly all green								
1		L-04-148	dull red	3	4	9	7	2,3	7	6	skin dull color, rough
2				5	4	9	8		8	6	Looked better in '06, Weimer field
			leaf similar to Diane								

Skin color:	Skin Texture:	Flesh Color:	Eyes:	Lenticles:
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-eliptical	3 = poor	3 = poor
3 = eliptic	5 = moderate	5 = moderate
4 = long eliptic	7 = good	7 = good
5 = ovoid	9 = excellent	9 = excellent
6 = blocky		
7 = irregular		
8 = asymmetric		

All ratings made on #1 roots.

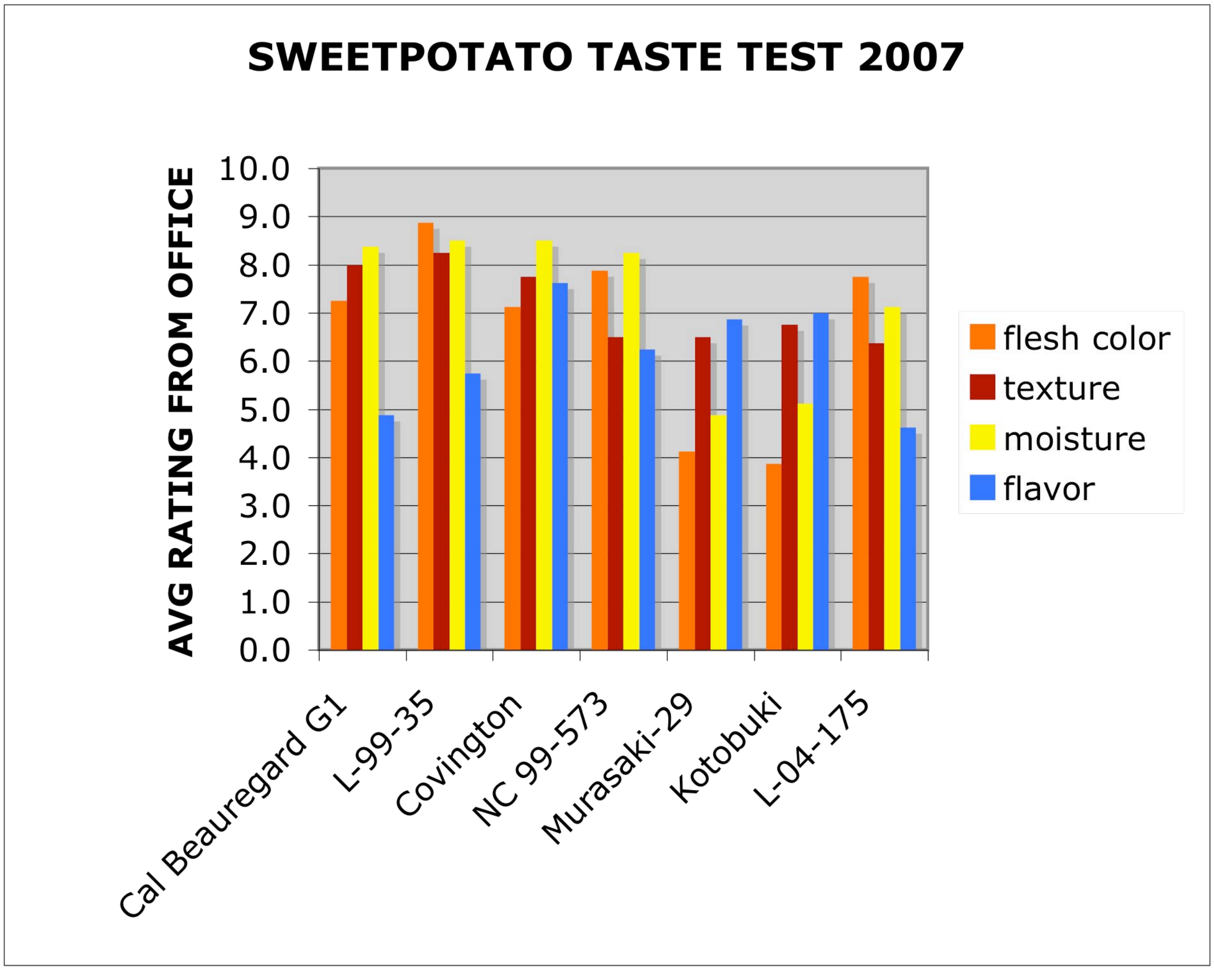


Figure 2. Taste test results based on scoring from UCCE office (n = 8). L-99-35 (Evangeline) had the highest overall score.

Louisiana Advanced Line Trial 2007

Scott Stoddard, Farm Advisor

Location: Weimer Farms commercial field, Robin Rd and River Road, near Livingston.

All varieties from Louisiana, Don LaBonte breeder.
Plot layout. 1 row plots, no replication. Length dependent on number of plants, but generally about 25 feet.

Bedded: not performed. All began as cuttings shipped from LA.
Transplanted: May 30, 2007.
Harvest: Oct 26, 2007. Used 2-row harvester. Field graded.

RESULTS

The Advanced Line Trial is a trial to evaluate potential new lines from LA prior to being put into the Collaborators trial. The trial is small, with only 1 or 2 reps, and the potatoes have not been fully evaluated but may fit certain markets in California. This year there were several with deep red/purple skin color and white or orange flesh (Table 1). Yield results are not shown, because they do not give a good indication of the variety's yield potential due to limited size and number of the plots.

An observation trial (one row and one rep) was also conducted adjacent to the Collaborators Trial, consisting of one-row plots, and featured many different types (Figure 1). Root descriptions are shown in Table 2.

Both of these trials provide the opportunity to view varieties on a limited basis before moving them up to the Collaborators Trial. L-04-178, L-04-175, L-04-148, and L-04-85 will be further evaluated in 2009.

Louisiana Advanced Line Trial - 2007 **Root Evaluation**

Merced County

An advanced line sweetpotato observation trial with varieties from Don LaBonte was conducted with Bob Weimer of Weimer Farms.
Ground was fumigated with Telone. Soil is Delhi sand, deep and uniform.
Planted on an 12" spacing down one row (40"), drip irrigated. All plants received as cuttings, about 40 per variety. Plant stand very good.
Plants cut May 28, received May 29, and transplanted May 30. Harvest Oct 26 2007 using mechanical harvester.

Variety	rel yield	Skin Color	Skin Text	Flesh color	Eyes	Lenticles	Shape	Shape Uniformity	Comments	2006
B-63	4	rose	9	3	shallow	few	eliptical	good	G0 material grown for Collaborators	
05-25	4	rose	7	4	shallow	7	long eliptic	good	good appearance, but veins	
05-111	4	Beau	7	3	6	7	eliptic	good	very similar to Beauregard	
04-175	3	burgandy	7	4	few, shallow	few	eliptic	ok	very nice appearance, deep orange flesh	X
04-178	3	burgandy	7	2.5	few, shallow	some (6)	eliptic	good	nice appearance, but YCR flesh color not uniform, pale orange	X
04-173	3	red	7	3	6	8	long eliptic	good	Long. Variable color.	X
05-29	3	tan	7	white	6	6	long eliptic	very good	very good appearance for a white flesh	
05-91	4	Rose Cu	6	2.5	5	5	6, 3	ok	appearance okay, eyes too prominent	
05-85	4	Cu, rose	rough	3	5	7	long eliptic	6	skin too rough, variable color. Nematode damage	
04-85	2	cream	7	white	4	8	eliptic	good	eyes too prominent	X
05-24	4	rose	7	4	9	7	round eliptic	very good	small, but overall good appearance	
05-64	3	Cu	7	white	7	5	long eliptic	6	appearance okay, Fusarium rot	
05-2	3	burgandy	7	4	7	6	long eliptic	very high	too long, tip rot	
02-32	1	Cu	7	3	8	5	3, 8	low	ok appearance, but RC and poor yield Grown for Collaborators	X
05-32	1	Cu	7	4	7	7	6, 3	good	similar to Beau in appearance, but poor production	
05-87	3	tan	5	cream	8	7	eliptic	ok	skin too rough	

Skin color:	Skin Texture:	Flesh Color:	Eyes:	Lenticles:
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:	relative yield:	All ratings made on #1 roots.
1 = round	1 = very poor	1 = very poor	1 = poor	
2 = round-elliptical	3 = poor	3 = poor	2 = fair	
3 = eliptic	5 = moderate	5 = moderate	3 = okay	
4 = long eliptic	7 = good	7 = good	4 = good	
5 = ovoid	9 = excellent	9 = excellent		
6 = blocky				
7 = irregular				
8 = asymmetric				

(shaded) = in Collaborators Trial

Table 2. Sweetpotato Collaborators Trial -- 2007

Observation lines

Grown adjacent to replicated lines, but used one row rather than 2 row plot.

Rep	Var	Variety Name	Skin Color	Skin Text	Flesh color	Eyes	Lents	Shape	Shape Uniformity	Overall App	Comments
5	11	L-04-173	Rose	8	4	7	7	4	8	6	color off, almost pale.
			lt red	7	4	8	8		9	7	too skinny
5	12	L-04-85	white	8	white	5	7	2	8	6	smooth skin, but eyes too
				9	cream	5	7		8	6	dark. Chunky.
5	13	L-04-178	ruby red	7	2+	7	6	3,8	7	7	nice color, shape. Lents
				8	3	8	7		7	7	too prominent. Fluting, YCR. '08?
5	14	L-04-6	pinkish	2	0	5	5	3	8	3	bad color - sick? Rough skin,
			brown	3	0	5	6	5	8	4	eyes prominent
5	15	L-04-87	Cu	7	3	6	6	2,6	6	6	eyes and lents too prominent
			Tan Cu	8	4	7	7		7	6	big yield, but veins on most roots
5	16	L-04-148	dull red	3	4	9	7	2,3	7	6	skin dull color, rough
				5	4	9	8		8	6	Looked better in '06, Weimer field
5	17	L-04-175	Red	7	5	7	7	2,6	7	7	nice looking potato
				8	4	7	8		6	8	Re-evaluate in '08

Figure 1. Collaborators Trial 2007 observation entries, arranged left to right: L-04-175, L-04-148, L-04-87, L-04-6, L-04-178, L-04-85, L-04-173.

Beauregard Clone Evaluation Trial 2007

Scott Stoddard, Farm Advisor
Merced County

In 2004, hill selections were made from various fields throughout Merced County to begin the process of selecting a new Beauregard clone for the sweetpotato industry in California. Selections of five different varieties are maintained by UC Davis Foundation Plant Services to provide clean, virus-tested seed stock that can be purchased by Sweet Potato Council of California members. The existing Beauregard selection was made around 2000 and has a "twining" characteristic, with slender vines that tend to grow upright and twist and twine around each other. This characteristic is particularly troublesome in the greenhouse, resulting in plants that become tangled.

In the fall of 2004, over 30 hills were selected, of which two were chosen by Council members for virus-testing and further evaluation. Difficulties with early micropropagation attempts (including an ant evasion that destroyed all early plants) delayed field evaluations until 2007.

In 2007, a replicated, randomized complete block trial was established in a commercial field to compare root yield and quality of the two new hill selections (#03 and #04) with the current Council selection (CA Beauregard). Limited seed production from 2006 allowed both G1 and G0 seed to be used, resulting in 6 treatments (3 clones x 2 age). Trial was located in a Diane field and left in the ground for 134 days, and was harvested past the ideal time resulting in a large number of jumbos. Trial details are shown in Table 1.

Table 1. Trial information.

Cooperator	Dave Souza, D&S Farms
Location	Hull & 140
Plant date	May 20, 2007
spacing	12" down the row, rows on 40" centers
Plot size	2 rows x 50 ft, replicated 4 times
Irrigation	Drip irrigation
Field evaluation	August 23, 2007
Harvest date	October 1, 2007
Storage evaluation	March 10, 2008

Results are shown in Table 2 and Figure 1. There were more jumbos than #1's for all three clones because harvest was delayed. Significant differences were found between clones for medium, Jumbo, and #1 size classes, total yield, and %#1; however, most of these diffences occurred in the G0 seed. When just G1 material was compared, only Jumbos were significantly different.

When averaged across age, both clones #3 and #4 produced significantly more #1's and had significantly higher % #1's than the current CA Beauregard. CA Beauregard did produce the highest total yield, though this was not significantly different than clone #3.

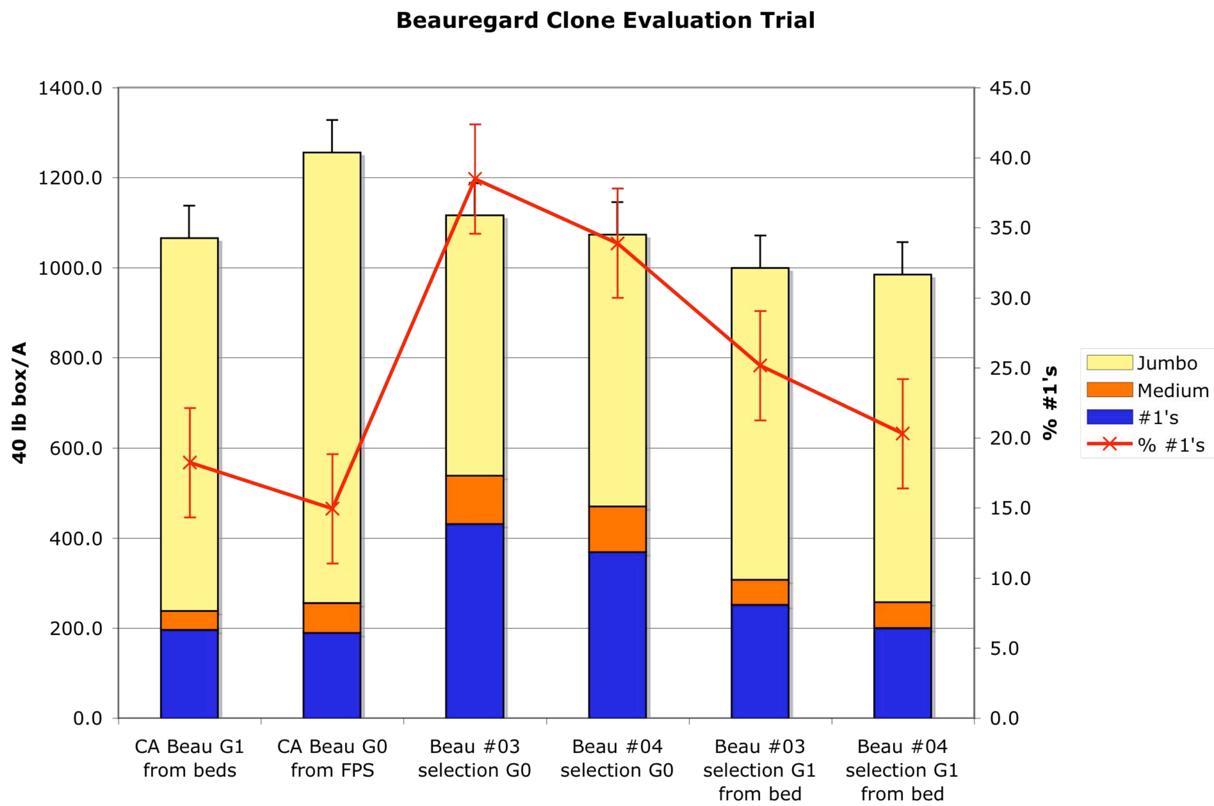
Neither clone #3 nor #4 displayed any twining characteristics during the growing season, whereas both G0 and G1 plants of CA Beauregard did. All three clones had similar storage qualities, and all were representative of Beauregard in general.

Clone #3 appears to be superior to both the other clones evaluated. Further work is planned in 2008 to compare #3 and #4 in multiple field sites before a decision will be made as to which one will become the next California Beauregard.

Table 2. Beauregard Clone evaluation 2007, Merced County CA.

Plot	Clone # and age		TMY lbs/A	40 lb box/A No. 1's	Meds	Jumbos	Market Total	Market bins/A	No. 1's %	Culls %	comments
1	CA Beau G1 from beds		42642	196	42	828	1066	48	18.2	0	Aggressive vine grows into adjacent beds
2	CA Beau G0 from FPS		50244	189	66	1001	1256	57	14.9	0	Purple new growth, twining
3	Beau #03 selection G0		44660	431	107	578	1117	51	38.5	0	Slightly less purple new growth, no twine
4	Beau #04 selection G0		42923	368	101	603	1073	49	33.9	0	no twining
5	Beau #03 selection G1 from bed		39991	252	55	693	1000	45	25.2	0	Slightly more compact growth. No twinin
6	Beau #04 selection G1 from bed		39403	200	57	728	985	45	20.3	0	no twining
	LSD 0.05			107.4	31.6	99.9	143.7	6.5	7.7		
	contrast G1 clones only			ns	ns	71.5	ns	ns	ns		
	CV,%			26.1	29.4	9.0	8.8		20.4		
	contrast G0 to G1	G0		329.6	91.5	727.5	1148.6	52.2	29.1	0	
		G1		216.0	51.2	749.8	1017.0	46.2	21.2	0	
				*	*	ns	*	*	*		
	contrast CA vs #03 vs #04	CA Beau		192.8	53.9	914.4	1161.1	52.8	16.6	0	
		Beau 03		341.4	81.0	635.7	1058.1	48.1	31.8	0	
		Beau 04		284.2	79.1	665.8	1029.1	46.8	27.1	0	
	LSD 0.05			84.0	22.1	79.2	ns	ns	5.9		
	Clone x age interaction			ns	ns	*	ns	ns	*		

TMY = total marketable yield (med + jumbo + #1's)
Market bins per acre estimated using 22 boxes per bin.
* = significant at 95% confidence level.
LSD 0.05 = least significant difference at the 95% confidence level. NS = not significant.


Beauregard Clone Evaluation Trial
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
40 lb box/A
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
% #1's
Jumbo
Medium
#1's
% #1's
CA Beau G1 from beds
CA Beau G0 from FPS
Beau #03 selection G0
Beau #04 selection G0
Beau #03 selection G1 from bed
Beau #04 selection G1 from bed

Sweetpotato Worm Control Trial 2007

Scott Stoddard, Farm Advisor
Merced County

Objective: foliar insecticide trial to evaluate efficacy of different rates of Rimon for control of armyworms in late season sweetpotatoes.

Cooperator: Jim Alvernaz
Location: Westside and Washington Rds, near Livingston, CA
Pest: Morning Glory Leafminer
Variety: O'Henry
Spray Date: 18-Sep-07
Evaluation: 25-Sep-07

Treatments:
1. UTC
2. Rimon 9 oz/A
3. Rimon 12 oz/A
4. Intrepid 8 oz/A

R11 surfactant added at 0.5% vol/vol
30 psi 8004 nozzles
50 gpa equivalent

Plot size 1 bed (2 rows) x 50 ft x 4 reps RCB design

Methods: Initially, 25 sweepnets for armyworm evaluation.
Then random leaf samples to look for Bedallia.
Scoring: # leaves out of 20 with live larvae after insecticide app.

Summary:
Test plot was originally set up to test efficacy of different rates of Rimon on Western Yellowstripe Armyworm in commercial sweetpotatoes, but this pest was too light in 2007 year to warrant treatment. However, the field site was badly infested with Morning Glory Leafminer (*Bedallia spp*), a late-season Lepidoptera pest specific to sweetpotatoes that can occasionally be a problem. Therefore, the trial evaluated the effect of Rimon on this pest. Intrepid was included to provide a standard comparison.

Relative to the untreated control (UTC) and Intrepid, Rimon significantly reduced the number of live larvae per leaf (Fig 1). There was no difference between the high and low rate (Table 1). Plots were scored by randomly selecting 20 leaves per plot and looking for live leafminer larvae after application.

This insect is usually not considered a pest because it becomes a problem so late in the season that control is usually not considered necessary. However, there may be summers where certain fields could benefit from sprays to manage this insect. Rimon may be the best choice to use for this. I plan to continue this work in 2008 on a larger scale by evaluating other products, timing, and yield impacts.

Table 1. Leaves (out of 20) with live larvae one week after treatment.

	Treatment	# leaves Of 20	std dev	
AVG	1. UTC	10.75	2.22	A
	2. Rimon 9 oz/A	3.25	0.50	B
	3. Rimon 12 oz/A	3.25	0.96	B
	4. Intrepid 8 oz/A	12.25	1.26	A
	LSD 0.05	2.3		
	CV, %	19.6		

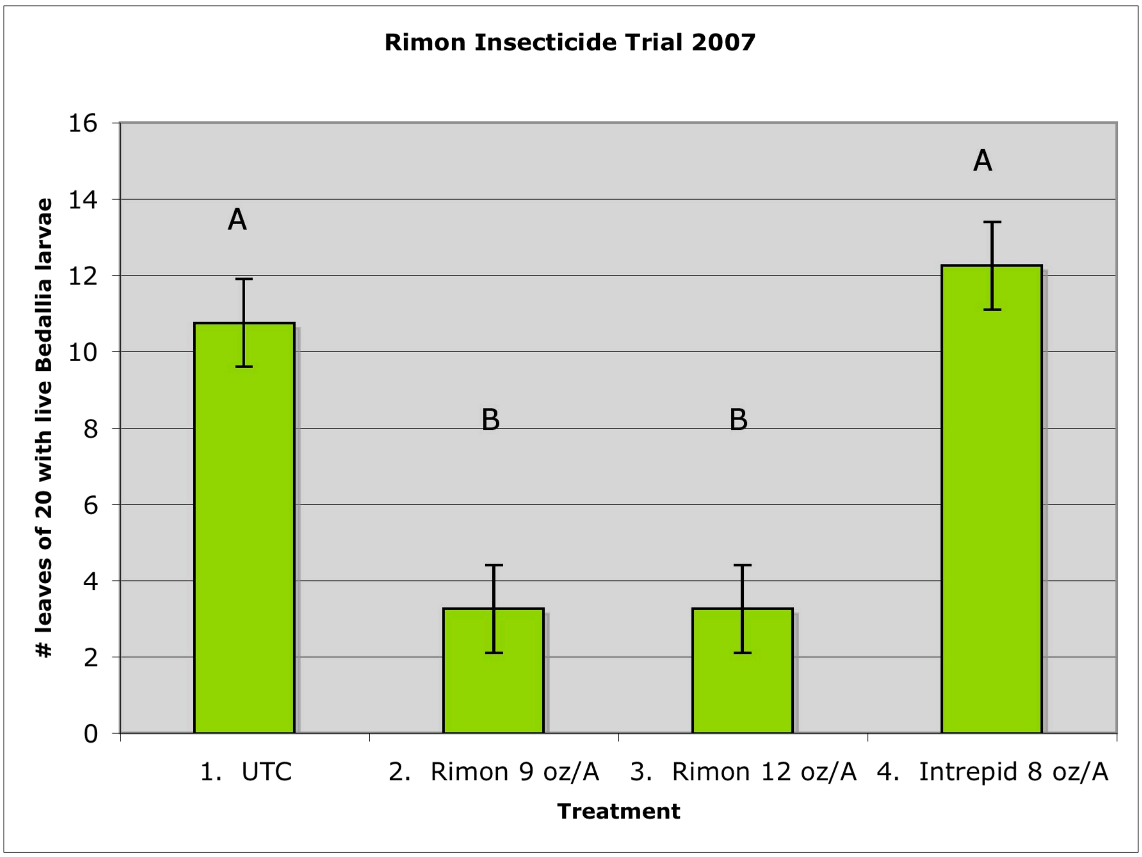


Figure 1. Results from the Rimon insecticide trial on sweetpotatoes, 2007.

Methyl bromide fumigation alternatives for sweetpotato hotbeds in California

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Progress report March 14, 2008. *Note: no data collected in 2007. Results in 2008 Progress Report.*

Project Proposal Summary: The purpose of the project is to evaluate alternatives to MeBr for sweetpotato hotbeds (the current standard practice) that are agronomically acceptable and meet regulatory approval. Project design is a randomized block split-plot with three replications, located adjacent to a commercial hotbed operation near Atwater, CA. Main plots consist of five fumigation treatments plus an untreated control. Split-plot treatments include two different herbicides and fungicides (Table 1). Hotbeds will be sampled for weeds, nematodes, disease, and plant production.

PROGRESS TO DATE:

- Solarization treatment. The project began June 26, 2007, with the installation of the solarization treatment on an area that had been pre-irrigated and cultivated numerous times to remove existing vegetation. Tri-Cal used 1.5 mil clear plastic tarp (standard grade without UV inhibitors), applied continuously as would be done with a standard tarped MeBr application. Drip tape lines were placed under the plastic to allow irrigation during the solarization period. Soil temperature probes were not installed because funding had not yet been secured for this project at this time. Tarp removed August 14. Plastic reapplied Aug 20 at same time as fumigation treatments, and removed Oct 20. Plot size 130 ft x 220 ft (plot size larger than needed to allow grower to install untreated beds in the area).
- Fumigation treatments. MeBr, Pic, and Pic + Telone (as Pic-Chlor 60) were applied to the site area August 20, 2007. Tri-Cal was again utilized as the applicator, and all treatments were tarped using standard PE plastic. Plot size 30ft x 220 ft.
- Fumigation treatment. At request of grower and Tri-Cal, the originally proposed Vapam only treatment was dropped in favor of a Vapam + Telone treatment, shanked, incorporated, and rolled with no tarp on Nov 12, 2007. Plot size 75'x 220'.
- Fungicide applications. Botran and Mertect were applied at bedding, February 28, 2008, using a back pack sprayer to apply the fungicides to selected plots within each main plot treatment. Potatoes were sprayed after they were put into the bed but before they were covered with soil, using 400 gallons per acre equivalent at label rates. Split-plot treatment size is 8 ft wide (the width of the planted bed) x 12.5 ft long (100 ft^2).
- Herbicide application. Valor and Devrinol were applied with a back pack sprayer on March 7, 2008. Plot size was the same as with the fungicide treatments. Application was made to clean soil prior to weed or crop emergence at 50 gallons per acre equivalent and at label rates. The herbicide were sprinkle incorporated on March 8.
- Sampling. A comprehensive nematode sampling of the main plot areas was performed on January 10, 2008. Initial weed control ratings were performed on January 15.
- Extension activities. I have made three presentations regarding this work: MBAO meeting in San Diego, Oct 30, 2007; Sweetpotato Collaborators Group annual meeting, Ashville NC Jan 20, 2008; Annual Sweetpotato Winter Meeting, Merced, Feb 14, 2008.

- Upcoming activities. Weed and crop phytotoxicity evaluations will begin the week of March 17 – 21 for all herbicide subplots and will be repeated twice more during the hotbed season. Disease and nematode evaluations are planned when plants are closer to harvest in April or May. A field day will be planned in April when treatment effects may be more easily observed.

Table 1. Project activities.

Main plot treatment	Dates	notes
1. Untreated control.	-----	Fallow ground, disced
2. MeBr + pic, shanked at 350 lbs/A and tarped in late fall (grower std).	Aug 20, 2007	Applied in conjunction with commercial application
3. PicChlor 60 (1,3-D + Pic) at 45 gals/A, shanked and tarped.	Aug 20, 2007	The old standard before MeBr
4. Vapam (metam sodium) at 75 gals/A + Telone at 20 gals/A, shanked, incorporated, and rolled (no tarp).	Nov 12, 2007	New rig from Tri-Cal, not been used before in sweetpotatoes
5. Pic alone (150 lbs), shanked and tarped.	Aug 20, 2007	
6. Flat solarization, no bed trench, no gin trash.	June 26, and Aug 20, 2007	Applied twice. Plastic removed after 8 weeks both times.
Split plot treatment		
1. Untreated.	-----	
2. Herbicide. Devrinol (Napropamide 4 lbs/A) applied after roots are covered but before emergence.	Mar 7, 2008	Applied to clean cultivated soil, 50 gpa water, sprinkler incorporated.
3. Herbicide. Valor (Flumioxizin 2 oz/A) applied after roots are covered but before emergence.	Mar 7, 2008	Federal label.
4. Fungicide. Botran (dichloro nitroaniline 3.5 lb per 14 gals per 1000 sq ft) applied to seed roots before covering	Feb 28, 2008	Plant bed spray, used 400 gpa equivalent (10 gallons/1000 sq ft)
5. Fungicide. Mertect (thiabendizole 30 fl oz per 14 gals per 1000 sq ft) applied to seed roots before covering (early February).	Feb 28, 2008	Plant bed spray, used 400 gpa equivalent
Sampling		
Nematode sampling, 0 – 12” in main plot treatments	Jan 10, 2008	Earlier sampling not possible due to dry soil conditions. Initial results show no RKN.
Weed evaluation made to main plot treatments.	Jan 15, 2008	Results show good weed control in all plots but the Pic-only and untreated control.

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Sweetpotato storage trial: varieties, fertilizer, and controlled storage
Final report Jan 8, 2009.

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Objective: Evaluate varieties, fertilizer source and timing, and storage conditions on sugar content and storability of orange-flesh sweetpotatoes grown in California for processed sweetpotato products.

Cooperator:	Bob Weimer, Weimer Farms
Location:	field located at corner of Robin and B St., just west of Livingston, CA
Project year:	May 2007 – May 2008
Budget total:	$14,500.00

Summary
In recent years, food processors have become buyers of California sweetpotatoes (*Ipomoea batatas*) to produce sweetpotato fries. Experience has shown that by February, raw product quality deteriorates as a result of sugar accumulation, increased fiber, and general breakdown that occur during long-term storage conditions typical for the area. Sugar accumulation in storage is problematic for processing because it creates darker colors and changes in texture, both undesirable in the finished product. Therefore, a multi-tiered project was conducted to observe the effect of varieties, in-season N and K management, and storage conditions (temperature, relative humidity, and CO_2) on storage loss and sugar levels in orange-flesh sweetpotatoes. Significant differences were found between the varieties tested in their cumulative long-term (180 days) weight loss in storage. Covington and Beauregard had the least amount of loss, at 8.2 and 8.4%, whereas Evangeline and Diane were highest, at 13 and 13.5%. Nitrogen and potassium fertilizer source did not significantly affect yield or long-term storage weight loss, but early applications of nitrogen tended to improve yields and significantly ($p \leq 0.1$) reduced cumulative weight loss after February as compared to applying nitrogen throughout the season. Long-term weight loss in controlled storage conditions was least (6%) when Beauregard roots were stored at 90% relative humidity; combining slight chilling stress (54° F) and low relative humidity (70%) produced significantly more weight loss than either alone (12%). Elevated CO_2 (3%) reduced weight loss and glucose accumulation in roots stored at 54° F. The results from the first year of this study suggest that improvements can be made in long-term root storage quality through variety selection, fertilizer management, and increased relative humidity in storage.

Background:

The effect of curing and storage on the sugar content and composition of sweetpotatoes has been well studied. In summary, roots should be kept at 14 °C ± 1° (57° F ± 2°) and 90% RH for best long-term storage. Airflow needs to be at least 1 cu ft per minute per bushel to prevent CO_2 accumulation. Storage temps > 19° C (67° F) results in considerable sprouting and loss of root quality due to weight loss and development of internal pithiness. RH at 60 - 70% results in weight loss two times faster than at 90%. Cultivars vary on their susceptibility to pithiness.[1]

In general, previous studies have shown that there is an increase in total sugars (both reducing and non-reducing) during curing and storage, but that curing causes a greater amount of change. Freshly harvested roots have been shown to have better color for chips and fries because they contain less sugar.

Less well known are the effects of fertilizer nitrogen and potassium on postharvest quality and sugar concentrations in the roots over time. In studies conducted in North Carolina, N rates below 90 lbs/A were not found to influence total sugars, but that rates over this increased storage weight loss and decreased dry matter content.[2] In North Carolina, however, recommended N rates are 30 – 60 lbs/A; in California, recommended N rates are > 125 lbs/A because of a much higher yield potential. Late season applications of N are known to increase the potential for storage problems, but this has not been documented.

In addition to potential storage effects, recent work from LSU[3] has shown that the timing of fertilizer application can affect storage root initiation and subsequent yield. Thus, proper rate and timing may have a double benefit for growers by positively impacting harvest yield and long-term storage potential.

In recent years, food processors such as Lamb Weston have become buyers of California sweetpotatoes (primarily orange-flesh type). The product is being used to produce primarily sweetpotato fries. Purchases have been made mainly during the harvest period (September) through the beginning of February. Experience has shown that the raw product quality deteriorates by this time. By February, sweetpotato roots have been in storage for 3 - 4 months and display sugar accumulation, increased fiber, and general breakdown. Sugar accumulation in storage is actually a benefit with sweetpotatoes intended for fresh market sales, but for processing it creates darker colors and changes in texture, both undesirable in the finished product.

A multi-tiered project was initiated in 2007 in Merced County to observe the effect of varieties, in-season N and K management, and storage conditions (temperature and relative humidity) on long-term storage loss and sugar levels in orange-flesh sweetpotatoes. This report summarizes the results from these treatments stored through May, 2008.

RESULTS AND DISCUSSION

1. Varieties. Eight different orange-flesh varieties were grown for evaluating their comparative long-term storage qualities:

1. CA Beauregard clone 4
2. Diane
3. Evangeline (L-99-35)

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[1] Kays, S.J., A.S. Bhagsari, and D.H. Picha. 1992. Physiology and Chemistry. Pp. 44 – 70. In A. Jones and J.C. Bouwkamp (ed.) Fifty Years of Cooperative Sweetpotato Research. Southern Cooperative Series Bulletin No. 39.

[2] Hammett, L.K., and C. H. Miller. 1982. Influence of mineral nutrition and storage on quality factors of 'Jewel' sweet potatoes. J. Amer. Soc. Hort. Sci. 107(6):972-975.

[3] A.O. Villordan, personal communication, Feb. 2008.

4. Covington
5. Bienville
6. L-04-87
7. NC-99-573
8. L-04-148

All varieties were grown in the same field so that production practices (water, fertilizer, cultivation) and environment were similar for each. Harvest was with a commercial harvester and root samples were stored in slotted plastic totes in a typical storage building with field-run bins. Initial weights for the root samples occurred two weeks after harvest. Temperature and relative humidity were monitored using six Hobo U12 Temp/RH data loggers placed on the walls of the building at 5 and 10 ft in height. Readings were taken every 15 minutes. Roots were monitored for storage weight loss by weighing monthly, and samples sent to Lamb Weston for sugar analysis. Weight loss estimates are for general shrinkage only, and do not include losses from rot or rodents (neither factor was a significant source of loss over the course of this trial at this storage building).

Monthly and total weight loss by variety is shown in Figure 1. On all sampling dates, Diane and Evangeline lost significantly more weight than the other varieties (Table 1). Covington and Beauregard had the least amount of total loss, at slightly more than 8%. Regression analysis on the rate of weight loss shows that Diane lost weight at a rate of 0.07% per day, as compared to 0.04% per day for Covington (Figure 2). Thus, the rate of moisture loss for Diane was 63% greater than Covington.

Between December and March 1, the average temperature in this storage room was relatively cool and stable (55.4° F +/- 2.04°), but there were several nights in February 2008 with readings below 52° F. Relative humidity was less ideal and more variable, averaging 67% with a standard deviation of 7.2%. From March 1 through May 9, the average temperature was 63° F with a RH of only 51%, and the variation for both increased substantially as compared to the winter period. Normally, such sub-optimal storage conditions would be expected to hasten weight loss in the roots, but that was not observed in these samples.

Samples were sent to Lamb Weston for sugar analysis in February, March, and April, 2008. Partial results are shown in Table 2. While full sugar profiles were run for all samples, problems with temperature and storage during the analyses make the results unreliable.

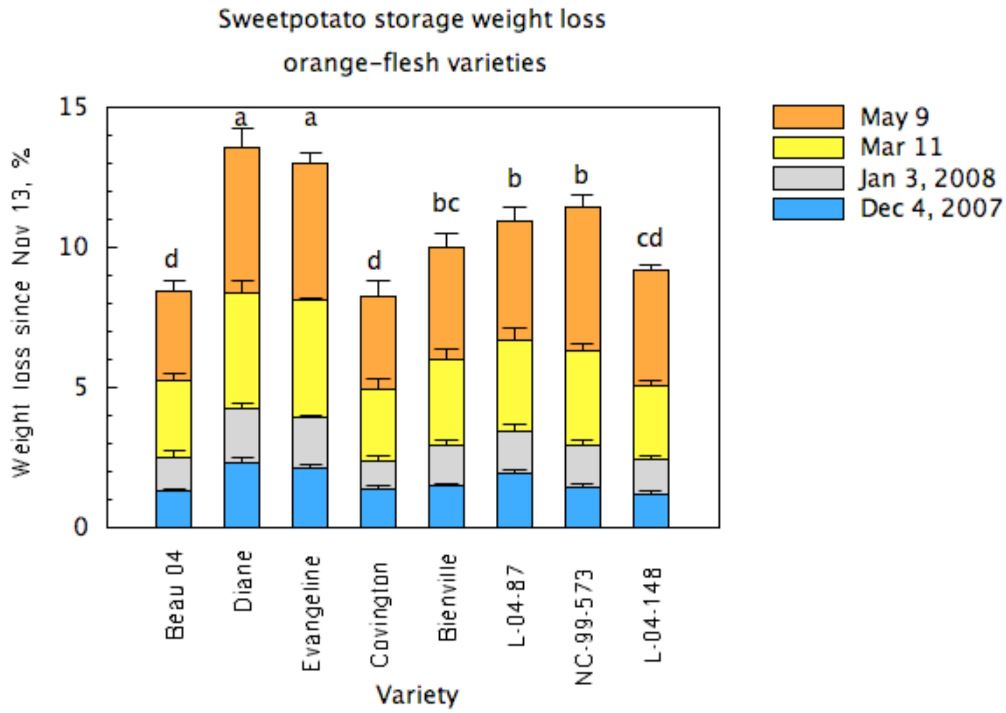


Figure 1. Weight loss by variety on Dec 4, 2007, Jan 3, Mar 11, and May 9, 2008 (May 9 represent total cumulative weight loss). May 9 weight loss was significantly higher for Diane and Evangeline than the other varieties (LSD 0.05; means with the same letter are not significantly different).

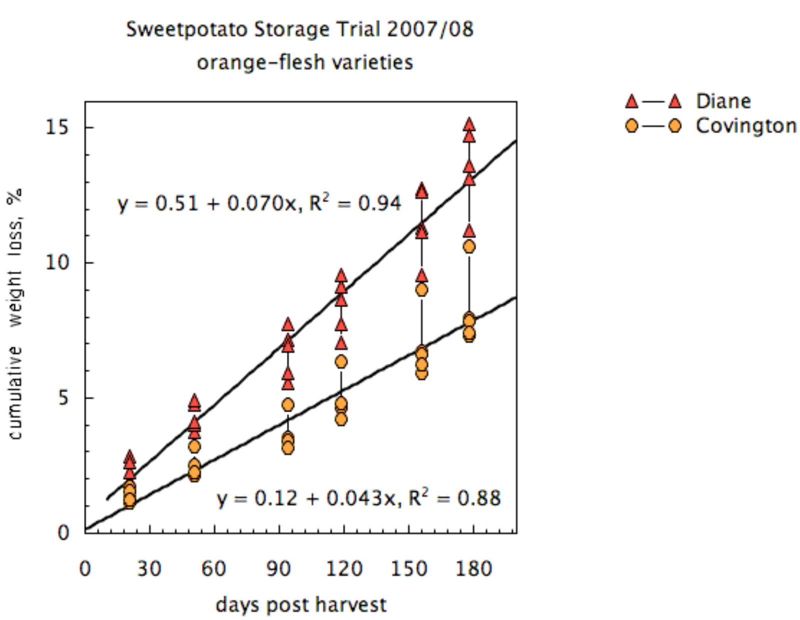


Figure 2. Regression analysis for cumulative weight loss in storage between Diane and Covington. The rate of weight loss of Diane was 63% more than Covington.

Table 1. Monthly cumulative weight loss in storage for the eight different sweetpotato varieties evaluated in this trial following the 2007 harvest.

		cumulative wt loss, % (1)					TOTAL
variety #	variety	4-Dec-07	3-Jan-08	13-Feb-08	11-Mar-08	17-Apr-08	9-May-08
1	Beauregard 04	1.25%	2.50%	4.05%	5.20%	7.22%	8.38%
2	Diane	2.29%	4.26%	6.62%	8.35%	11.43%	13.53%
3	Evangeline	2.11%	3.99%	6.45%	8.09%	11.06%	12.96%
4	Covington	1.36%	2.40%	3.63%	4.90%	6.89%	8.20%
5	Bienville	1.48%	2.97%	4.64%	6.00%	8.32%	9.97%
6	L-04-87	1.91%	3.51%	5.32%	6.70%	9.47%	10.95%
7	NC-99-573	1.46%	2.98%	4.82%	6.32%	9.23%	11.42%
8	L-04-148	1.17%	2.44%	3.83%	5.03%	7.79%	9.15%
	Average	1.63%	3.13%	4.92%	6.32%	8.93%	10.57%
	LSD 0.05	0.36	0.58	0.77	0.90	1.28	1.42
	CV, %	16.9	14.3	12.2	11.0	11.0	10.4

LSD 0.05 = Least significant difference at the 95% confidence level within each sampling date. Means less than this amount are not significantly different.

CV = coefficient of variation, a measure of variability in the data.

(1) Moisture loss only (does not include loss from rot, rodents) since Nov 13.

Table 2. Orange-flesh variety sugar analysis for March and April, 2008, samples.

		Sucrose, g/100 g		Solids, %	
variety #	variety	5-Mar-08	2-Apr-08	5-Mar-08	2-Apr-08
1	Beauregard 04	1.20	3.31	19.2	18.7
2	Diane	2.27	2.99	20.3	21.0
3	Evangeline	3.65	5.08	20.9	20.1
4	Covington	4.02	6.35	19.0	19.7
5	Bienville	3.15	4.01	19.6	21.2
6	L-04-87	1.99	2.55	17.7	18.4
7	NC-99-573	1.62	2.42	19.3	20.2
8	L-04-148	1.08	2.86	18.5	19.9
	Average	2.37	3.70	19.3	19.9
	increase		56%		3%

Lamb-Weston food science lab data from 8 potato subsample.
February samples omitted because of problems with procedure.

2. Controlled storage. Beauregard samples were picked up by Prof. Mikal Saltveit on December 10, 2007, and taken back to UC Davis for long-term weight loss monitoring and sugar analysis under controlled conditions. The updated treatments:

1.	59° F	90% RH	ambient CO_2 (0.3%) (ideal storage)
2.	54° F	90% RH	ambient CO_2 (reduced temp, good RH)
3.	59° F	70% RH	ambient CO_2 (good temp, low RH)
4.	54° F	70% RH	ambient CO_2 (reduced temp, low RH)

5 - 8. Repeat treatments 1 – 4 but with elevated CO_2 (3%)

Full report follows section 3 on page 13.

3. Fertilizer, N source, N timing, and K source evaluation. A field trial in a commercial field to evaluate the impacts of fertilizer source and timing on yield and storability of the roots.

Main Plot Treatments (N source and timing):

1. CAN17, 180 lbs N/A, applied weekly early to mid-season (early N application) in 5 applications, June 21 – July 19, 2007.
2. UAN32, 180 lbs N/A, same application dates
3. CAN17, 180 lbs N/A applied weekly mid through late season (late N application) in 10 applications, Jun 28 – Aug 29, 2007.
4. UAN32. 180 lbs N/A, same as treatment 3.

All plots received a pre-plant incorporated fertilizer that contained about 60 – 70 lbs/A of N and 225 lbs K_2O/A. Supplemental N was injected through the drip system beginning June 21 after a May 30 transplant date. Plots were harvested was on Oct 23, 2007.

Split Plots Treatments

1. 0 K
2. 100 lbs K_2O/A from muriate of potash (KCl) (supplemental to pre-plant)
3. 100 lbs K_2O/A from sulfate of potash (K_2SO_4) (supplemental to preplant)

Beauregard variety used for the fertilizer trial. Trial was a randomized block split-plot with four (4) replications. Plot size was 1 bed (2 rows) by 50 ft. Trial was conducted in a commercial sweetpotato field, but supplied with a separate irrigation system so that fertilizer inputs could be controlled. Harvest with a commercial digger and stored in a typical storage building along with field run bins.

Storage: Samples from each plot were placed in plastic totes and stored with other sweetpotatoes in a typical shed. Initial sample weight was approximately 30 lbs. Samples were weighed monthly from Nov 13 through May 9, 2008. Temperature and humidity data loggers were installed Dec 10, 2007, and removed May 9, 2008.

Soil sample results taken early in growing season are shown in Table 3. All indices are within normal ranges for proper crop development. P_2O_5 and K_2O levels are moderately low (below 25 and 150 ppm, respectively), such that a fertilizer response would be expected. Plant tissue samples are shown in Table 4. The effect of the N fertilizer treatments is obvious in the petiole samples for NO_3-N on the first sample date (6922 ppm vs. 963 ppm).

Yield and storage weight loss are shown in Tables 5 and 6. Overall, yields were very good (over 50 bins/A), but there were no significant differences in yield or size between any of the treatments.

Likewise, there was no significant difference in cumulative storage weight loss after six months between any of the treatments (Table 6). However, for both yield and cumulative storage weight loss, there was the trend for better total yield and reduced weight loss with the early N treatment (Figs 4 & 5). Performing a contrast analysis on the pooled data shows that the affect of N timing was significant at the $p \leq 0.10$ level from February onward. Additional K from SOP resulted in a slight increase in total yield, though this affect was not significant at the 95% confidence level (Fig. 3). K fertilizer source did not significantly affect weight loss in storage at any time.

Samples were sent to Lamb Weston for sugar analysis in February, March, and April, 2008. Partial results are shown in Table 7.

Shed monitoring results from one sensor are shown in Figure 6. In total, six sensors were used to recording temperature and relative humidity (RH) every 15 minutes. The data were almost identical for all sensors. Between December and March 1, the average temperature in this storage room was relatively cool and stable (55.4° F +/- 2.04°), but there were several nights in February 2008 with readings below 52° F. Relative humidity was less ideal and more variable, averaging 67% with a standard deviation of 7.2%. In general, relative humidity was too low in this storage building during the entire 6-month evaluation period. From March 1 through May 9, the average temperature was 63° F with a RH of only 51%, and the variation for both increased substantially as compared to the winter storage period.

In conclusion, one-year results of this trial suggest that large differences in storage characteristics occur between different orange-flesh varieties. Covington and Beauregard had the least cumulative storage loss of the lines evaluated in this study, and were significantly better than Diane. The results also suggest that fertilizer practices may also influence storage weight loss, with decreased losses occurring when the bulk of the nitrogen fertilizer is applied early in the growing season. In storage, relative humidity was the main factor influencing storage weight loss, with lowest losses occurring when the RH was maintained at 90%. Low temperature had greater impact on sugar accumulation than relative humidity.

Acknowledgements. Many thanks to those who helped with this trial: Bob Weimer, Alfonso Jimenez, Joe Rehder, Michelle McHargue, Daniel Brooks, and Larry Burrow.

Table 3. Soil sample results, sweetpotato fertilizer trial 2007.

DESC	SP [SOP 200] %	pH [SOP 205]	EC [SOP 215] dS/m	Ca (SP) [SOP 235] meq/L	Mg (SP) [SOP 235] meq/L	Na (SP) [SOP 235] meq/L	Cl (SP) [SOP 227] meq/L	HCO3 (SP) [SOP 220] meq/L	CO3 (SP) [SOP 220] meq/L	NO3-N [SOP 312] ppm	Olsen-P [SOP 340] ppm	X-K [SOP 360] ppm	Zn (DTPA) [SOP 380] ppm	Mn (DTPA) [SOP 380] ppm	Cu (DTPA) [SOP 380] ppm	Fe (DTPA) [SOP 380] ppm
Weimer 1 N	26	6.6	0.54	2.0	0.7	0.9	0.9	1.0	<0.1	7.3	18.2	96	4.3	7.6	1.0	31.9
Weimer 4 N	26	6.4	0.52	2.0	0.6	0.8	0.8	0.7	<0.1	5.1	18.4	100	4.7	6.8	1.0	26.9
Weimer 4 N		6.5	0.51	1.9	0.6	0.8	0.7	0.8	<0.1	5.1	17.8	96	4.6	7.1	1.0	27.2

0 - 12" sample depth, sampled June 28, 2007
composite sample from N treatments #1 and #4

Table 4. Sweetpotato petiole and leaf analysis for July 12 and Aug 19, 2007.

	N treatme	NO3-N ppm	NH4-N ppm	Petiole K %	PO4-P ppm	N (Total) %	P (Total) %	Leaf K %	S (Total) ppm	B (Total) ppm	Ca (Total) %	Mg (Total) %
average	(1) Early	6922	148	6.57	3192	5.82	0.43	3.84	4632	54	1.15	0.29
on July 12	(3) Late	963	55	6.74	3198	5.08	0.38	3.82	4558	62	1.00	0.29
average	(1) Early	347	147	4.82	2600	4.83	0.31	2.75	4177	57	1.20	0.31
on Aug 9	(3) Late	983	147	4.78	2443	4.94	0.31	2.65	4267	58	1.41	0.31

Table 5. Sweetpotato N and K fertilizer trial. Merced County 2007
Yield and grade results.

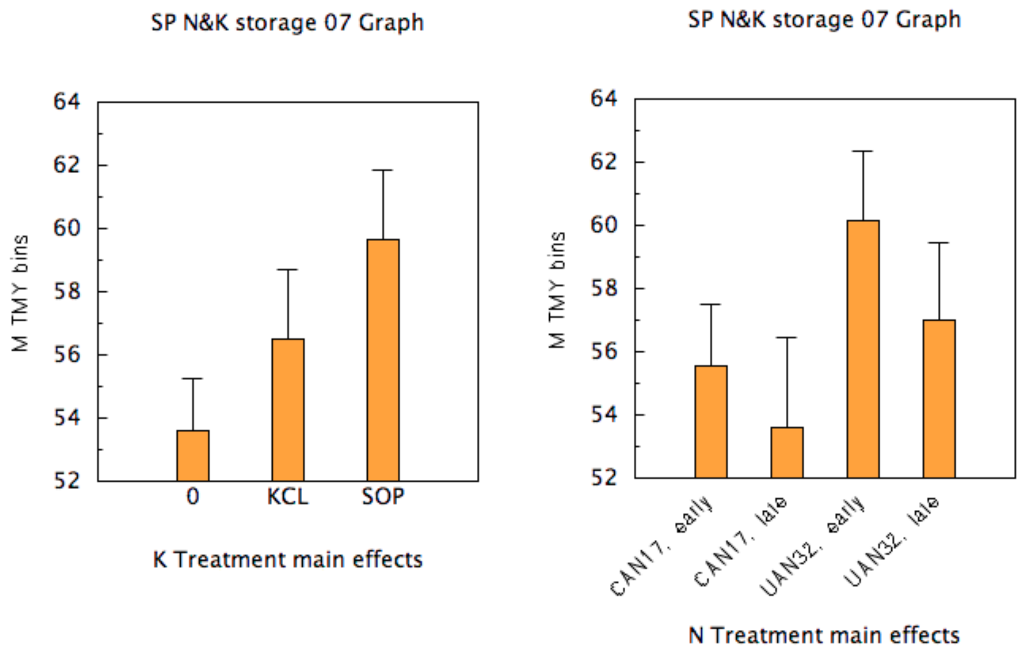
N Treatment	K treatment	No. 1s/A	40 lb box Jumbo/A	Med/A	TMY	TMY bins/A	#1 %	culls %
1. CAN17, early		472.9	528.6	220.2	1221.7	55.5	38.6%	3.2%
2. UAN32, early		456.0	694.1	173.1	1323.2	60.1	34.6%	3.4%
3. CAN17, late		429.0	524.4	225.7	1179.1	53.6	36.6%	2.7%
4. UAN32, late		487.5	541.0	224.5	1253.1	57.0	38.9%	2.7%
	1. 0	441.6	534.4	202.9	1178.9	53.6	37.5%	3.2%
	2. KCl	458.4	553.6	230.2	1242.2	56.5	36.9%	2.5%
	3. SOP	484.0	628.1	199.5	1311.6	59.6	37.1%	3.2%
N treatment LSD 0.05		ns	ns	42.3	ns		ns	ns
K treatment LSD 0.05		ns	ns	ns	ns		ns	ns
N x K LSD		ns	ns	ns	ns		ns	ns
Contrast: N source, p		ns	ns	0.10	ns		ns	ns
Contrast: N timing, p		ns	ns	0.06	ns		ns	ns
CV, %		25.8	21.7	25.2	13.8		17.5	80.8

LSD 0.05	Least significant difference at the 95% confidence level.
ns	not significant
N x K	Nitrogen by potassium interaction
p	statistical value showing significance of contrast tests.
CV, %	coefficient of variation
N Treatments	all N treatments received 180 lbs of N per acre, through the drip tape. Early: all N applied in 5 applications early in growth cycle (June 21 - Jul 19) Late: all N applied in 10 applications (June 28 - Aug 29)
K Treatments	SOP = sulfate of potash sidedressed after transplanting at 100 lbs K2O per acre. KCL = muriate of potatsh 0 = no additional potash (preplant only)
TMY	total marketable yield, sum of No 1, mediums, and jumbo classes

Table 6. Sweetpotato N and K fertilizer trial, Merced County 2007.
Cumulative storage weight loss after harvest.

		% weight loss since Nov 13					
N Treatment	K treatment	4-Dec	3-Jan	13-Feb	11-Mar	17-Apr	9-May
1. CAN17, early		1.30	2.61	3.80	4.69	6.46	7.65
2. UAN32, early		1.49	2.90	4.24	5.33	7.18	8.60
3. CAN17, late		1.60	3.18	4.83	6.08	8.01	9.33
4. UAN32, late		1.68	3.19	4.75	6.14	8.14	9.70
	1. 0	--	--	--	--	--	--
	2. KCl	1.46	2.91	4.25	5.36	7.14	8.36
	3. SOP	1.56	3.03	4.56	5.76	7.75	9.28
N treatment LSD 0.05		ns	ns	ns	ns	ns	ns
K treatment LSD 0.05		ns	ns	ns	ns	ns	ns
N x K LSD		ns	ns	ns	ns	ns	ns
Contrast: N source, p		ns	ns	ns	ns	ns	ns
Contrast: N timing, p		**ns**	**ns**	**0.07**	**0.05**	**0.07**	**0.07**
CV, %		30.8	25.4	25.0	24.8	23.3	23.6

LSD 0.05	Least significant difference at the 95% confidence level.
ns	not significant
N x K	Nitrogen by potassium interaction
p	statistical value showing significance of contrast tests.
CV, %	coefficient of variation
N Treatments	all N treatments received 180 lbs of N per acre, through the drip tape. Early: all N applied in 5 applications early in growth cycle (June 21 - Jul 19) Late: all N applied in 10 applications (June 28 - Aug 29)
K Treatments	SOP = sulfate of potash sidedressed after transplanting at 100 lbs K2O per acre. KCL = muriate of potatsh 0 K treatment not measured



Figures 3 and 4. Main effect of K and N treatments on total marketable yields (TMY). Yield differences are not significantly different at the p = 0.05 confidence level.

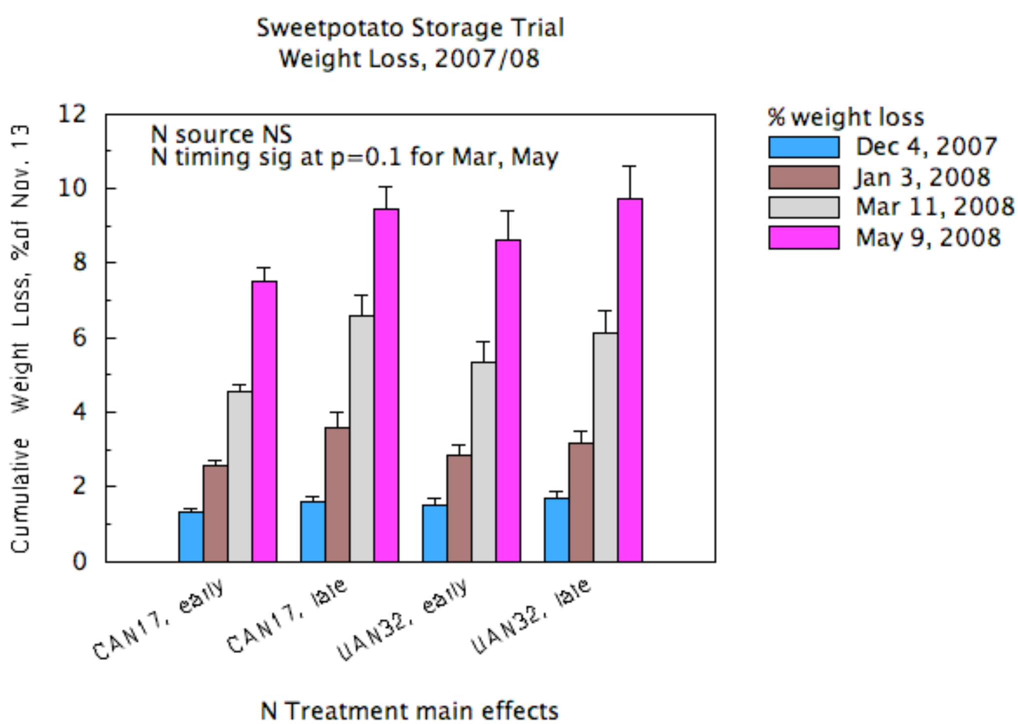


Figure 5. Main effect of N timing and source on cumulative weight loss in storage since November 13, 2007 (sweetpotatoes were harvested Oct 23).

Table 7. Fertilizer source and timing treatment sugar analyses on Beauregard sweetpotato roots for February, March, and April 2008.

Fertilizer Treatment		SUCROSE, g/100g			SOLIDS %		
Nitrogen	Potassium	6-Feb-08	5-Mar-08	2-Apr-08	6-Feb-08	5-Mar-08	2-Apr-08
N1	KCL	2.78	2.45	2.81	22.53	21.36	21.95
N1	SOP	2.92	1.38	3.45	21.80	21.22	21.53
N2	KCL	2.34	2.67	2.39	21.89	20.59	20.43
N2	SOP	2.18	2.24	2.52	20.97	20.51	20.81
N3	KCL	3.04	1.49	2.81	21.90	19.91	20.29
N3	SOP	2.53	1.82	2.43	21.43	20.41	19.68
N4	KCL	3.30	2.27	3.17	22.04	19.30	22.63
N4	SOP	2.73	1.71	2.49	20.67	19.91	20.49
	Average	2.73	2.00	2.76	21.65	20.40	20.98

1. CAN17, early
2. UAN32, early
3. CAN17, late
4. UAN32, late

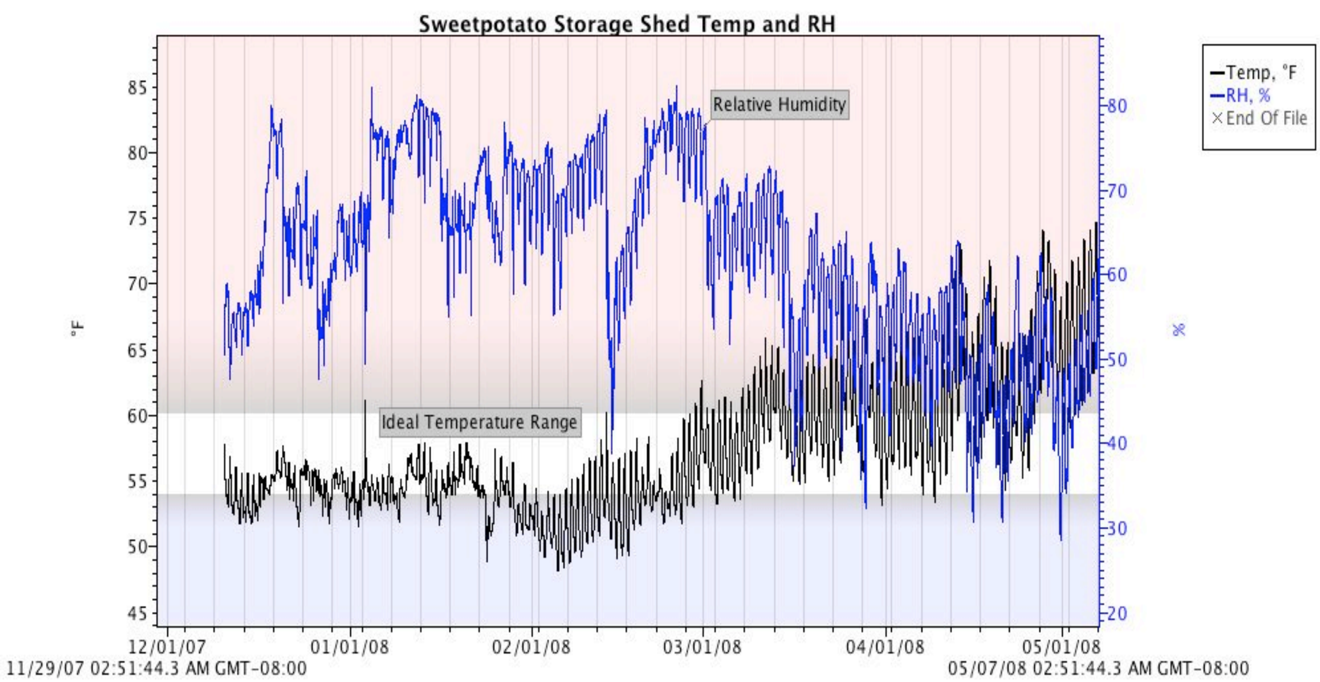


Figure 6. Storage room temperature and relative humidity from Dec 11, 2007 – May 9, 2008. Temperature and RH became problematic from March 1 onward.

Effect of temperature, relative humidity, and carbon dioxide levels on changes in fresh weight and glucose levels during storage of sweetpotato roots

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Introduction
Darkening of fried sweetpotato root tissue results from the Maillard reaction in which amino acids combine with reducing sugars (i.e., glucose and fructose) to form undesirable dark colored compounds. Glucose and fructose are formed in equal amounts from the breakdown of the disaccharide sucrose, which increases during storage as the result of starch hydrolysis. Darkening of fried sweetpotato root tissue is positively correlated with the content of reducing sugars. Therefore, measuring the content of glucose gives a good indication of changes in sugar content and composition during storage, and the quality of fried tissue.

Glucose can be easily measured using the same blood glucose test strips that diabetics use to monitor their blood glucose levels. Previous tests had confirmed that variable levels of fructose and sucrose do not interfere with the ability of the test strips to accurately measure glucose levels; although care must be taken to insure that the glucose levels are within the test strips linear range.

Weight loss during store is directly related to the relative humidity in the surrounding air; with 90% being the recommended storage humidity. Sweetpotato roots are chilling sensitive and exhibit symptoms of chilling injury when stored at non-freezing temperatures below 54 °F (12 °C); with 57 °F (14 °C) being the recommended storage temperature. Controlled-atmosphere storage of sweetpotatoes is not a commercial practice, and the feasibility of long-term storage in controlled atmosphere remains unclear. Research has shown storage in 2 to 3% carbon dioxide and 7% oxygen reduced decay and weight loss.

Materials and Methods
Twenty-four groups of 16 Beauregard roots each were randomly assembled and assigned to one of 8 treatments (see below). Each of the eight treatments had three replicates of 16 roots each. The roots were stored at either 54 °F (12.5 °C) or 59 °F (15 °C). A flow through system was used to produce atmosphere containing 0.03% (air control) or 3.0 ± 0.2% carbon dioxide. Relative humidity (RH) was maintained at 70% or 90%. The eight treatments were:

1. 0.3% CO_2 90% RH 59 °F
2. 0.3% CO_2 90% RH 54 °F
3. 0.3% CO_2 70% RH 59 °F
4. 0.3% CO_2 70% RH 54 °F
5. 3% CO_2 90% RH 59 °F
6. 3% CO_2 90% RH 54 °F
7. 3% CO_2) 70% RH 59 °F
8. 3% CO_2 70% RH 54 °F

The weight of each root was periodically measured, and samples taken for sugar analysis at monthly intervals. A 1-cm thick transverse slice of tissue (ca. 50 g fresh weight) was excised from the middle of a root. The slice was quartered and about 10 g was homogenized with 20 mL of deionized water. The homogenate was clarified by centrifugation and diluted to produce samples within the linear range of the blood glucose test strips.

Results and Discussion
Weight loss was fairly constant within each treatment over the 215 days of storage (Fig. 1). Temperature had little effect on weight loss of roots held at 90% RH, while roots held at the marginally chilling temperature of 54 °F experienced much greater weight loss than the roots held at 59 °F in the 70% RH atmosphere. The large standard deviation about each of the 54 °F, 70% RH data points reflects the greater incidence of decay in this treatment.

Elevated levels of carbon dioxide (i.e., 3%) had no effect on weight loss at either RH, but seemed to slightly reduce weight loss at the marginally chilling temperature (54 °F). When segregated into the three factors, it is obvious that the relative humidity had the greatest impact, followed by the temperature, and then the percent carbon dioxide (Fig. 2).

The glucose concentration remained relatively constant during the storage study for all relative humidity treatments and was only slightly increased at 54 °F (Fig. 3).

The data were reevaluated to examine the specific influences of temperature and atmospheric composition (Fig. 4). Glucose levels remained relatively constant at 59 °F, but increased significantly at 54 °F. The elevated 3.0% carbon dioxide atmosphere suppressed this rise in glucose, such that the glucose concentrations were similar in the 3.0% carbon dioxide treatments at both 54 and 59 °F.

Conclusion

Weight loss of stored sweet potato roots is primarily influenced by the relative humidity in the storage room. However, combining a slight chilling stress (54 °F) with low relative humidity (70%) produced significantly more weight loss that either alone. Increasing the carbon dioxide level did not significantly alter this effect, but it did appear that the 3.0% carbon dioxide atmosphere reduced slightly the increased weight loss at 54 °F. Elevated levels of carbon dioxide has a protective effect against chilling injury in some crops, and this may have been the cause of the reduced weight loss observed with the sweetpotato roots. Elevated levels of carbon dioxide did not reduce weight loss at either relative humidity at the non-chilling temperature (59 °F).

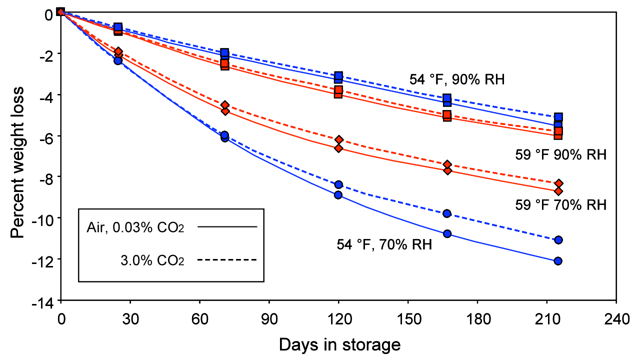

Figure 1. Weight loss of whole sweetpotato roots during 215 days of storage. Data points are means for each of the eight treatments: 70 or 90% relative humidity (RH), 54 or 49 °F, and 0.03 or 3.0% carbon dioxide (CO_2).

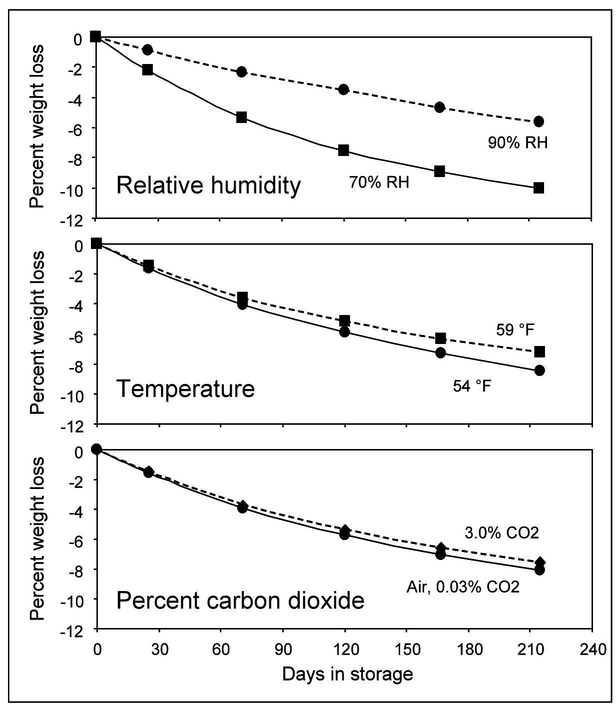

Figure 2. Weight loss of whole sweet potato roots during 215 days of storage. Points are the combined means of the relative humidity treatments (70 or 90% RH), the temperature treatments (54 or 49 °F), and the carbon dioxide treatments (0.03 or 3.0% CO_2).

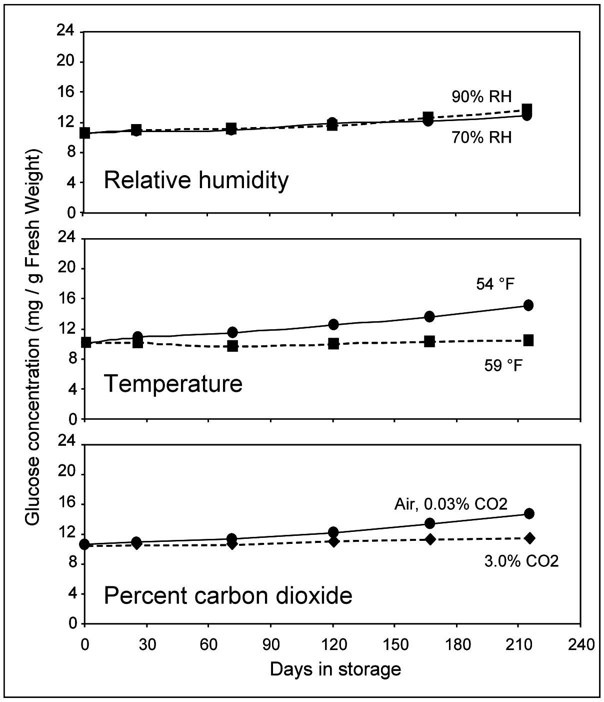

Figure 3. Glucose concentrations in sweet potato roots during 215 days of storage. Points are the combined means of the relative humidity treatments (70 or 90% RH), the temperature treatments (54 or 49 °F), and the carbon dioxide treatments (0.03 or 3.0% carbon dioxide).

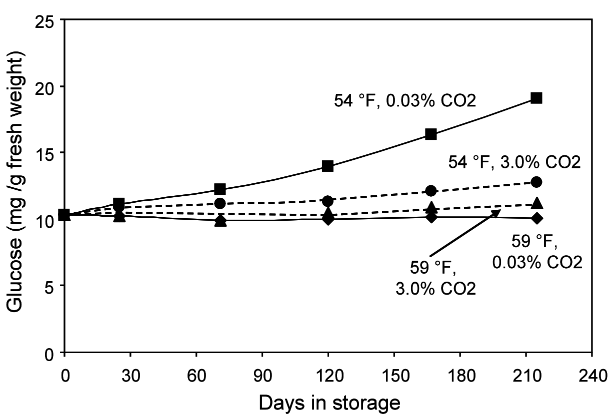

Figure 4. Glucose concentrations in sweet potato roots that were held at 54 or 59 °F in air (0.03% CO_2) or 3.0% CO_2 for 215 days.

Glucose levels increased slightly during the storage period. The greatest increase in glucose levels was observed in roots subjected to chilling (54 °F) in air (0.03% carbon dioxide). Roots stored at 59 °F, or in atmospheres containing elevated levels of carbon dioxide did not show this increase in glucose levels. Again, the elevated level of carbon dioxide may have mitigated the effect of increase glucose concentrations following slight chilling injury. Roots that were held at 59 °F did not exhibit large increases in glucose concentrations, nor did the elevated levels of carbon dioxide have any significant effect on glucose levels.

It appears that elevated levels of carbon dioxide may be able to reduce the increase in glucose that occurs in sweet potato roots that experience stress while in storage. Additional experiments would be required to identify the beneficial and optimal concentration of carbon dioxide.