

2003 PROGRESS REPORT
To
North Carolina Sweetpotato Commission

TITLE: Sweetpotato Breeding and Variety Development Support

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DEPARTMENT: Horticultural Science

REPORT:

Project Objective(s): The objectives of the Sweetpotato Breeding and Genetics Program are: 1) to develop sweetpotato varieties for North Carolina growers that possess exceptional yield, appearance and quality characteristics, and are resistant to diseases and insects; and 2) to conduct basic and applied breeding and genetics studies focused on identifying and incorporating traits of economic importance into sweetpotato germplasm and new cultivars.

Project Summary

Funds provided by the North Carolina Sweetpotato Commission supported all aspects of the breeding program's work. Highlights of our 2003 activities are listed below. A detailed description of the overall activities of the breeding program, and commentaries and tables presenting the results of our advanced and preliminary yield trials, and the National Sweetpotato Collaborators Trial follow the project summary.

1. We planted 44,000 true seed and made 629 new seedling selections. We keep records of the number of clones selected per female parent and use this information to determine each parent's relative worth as a progenitor to develop improved nurseries and, from them, superior varieties.
2. We conducted 9 replicated yield trials of preliminary and advanced clones at the Horticultural Crops Research Station (HCRS), Clinton and the Cunningham Research Station (CRS), Kinston.
3. We completed our sixth year of the Grower-Participatory Breeding Project (GPBP) in which first-year seedlings are selected at three on-farm sites with the assistance of growers, Extension Agents and Specialists.
4. We evaluated 10 advanced or preliminary lines in unreplicated trials at our three GPBP sites. This signals a shift in the focus of the GPBP in that we are increasing our emphasis on advanced lines in the program. Information gathered on the advanced lines on-farm will help us to rapidly identify and advance superior clones for variety release. Our most advanced clone, NC98-608, is a direct result of this effort.
5. We conducted our sixth season of *Streptomyces* soil rot (SSR) field screening evaluating 120 clones for field resistance to SSR. This long-term project provides us a critical tool for assessing the suitability of material for NC growing conditions. These clones were also screened for *Fusarium* wilt and root-knot nematode resistance and in greenhouse trials.
6. We collaborated with Dr. Bryon Sosinski, Director, CALS Genome Research Laboratory and Research Assistant Professor in Horticultural Science on a sweetpotato applied genomics project to address long-term breeding needs in sweetpotato and develop new breeding tools. As part of this project, Mr. Jim Carlos Cervantes, a PhD student working with the program, planted two of the largest field trials ever conducted by the program. His project is focused on developing a molecular genetic map of sweetpotato to identify genes for yield, resistance to sweetpotato feathery mottle virus and root knot nematodes, dry matter content and beta-carotene production in sweetpotato.
7. We collaborated with the Dr. Sylvia Blankenship to evaluate NC98-608, our

- most advanced clone, for resistance to skinning.
8. We collaborated with Dr. Jonathan Schultheis to evaluate our most promising clone NC98-608 in replicated research station and on-farm yield trials to determine the optimal spacing and harvest date for this potential variety.
 9. We worked with the Specialty Crops Program to develop specialty-type sweetpotatoes to promote new marketing opportunities for sweetpotato growers.
 10. We collaborated with Dr. Zvezdana Pesic-VanEsbroeck on the MPU project to provide Nuclear Seed of NC98-608 for experimental grower evaluations, and evaluate MPU materials in on-farm trials. We also assisted with the design and evaluation of the "seed source" tests conducted at the CRS.
 11. With additional support from the NC Crop Improvement Association and the NC Certified Sweetpotato Seed Growers, Inc., we continued a long-term project to identify and develop sweetpotatoes more resistant to soil insects.

Project Cooperators

<u>Researchers</u>	<u>Extension</u>	<u>Growers</u>
Dr. Charles Averde	Mr. William Little	Mr. George Wooten
Dr. Sylvia Blankenship	Mr. Milton Parker	Mr. Jim Jones
Dr. Gerald Holmes	Mr. Allan Thornton	Mr. Roger Lane and
Mr. Bill Jester	Mr. Mike Wilder	Pride of Sampson
Dr. Zvezdana Pesic-VanEsbroeck		
Dr. Jonathan Schultheis		
Dr. Bryon Sosinski		

2003 Polycross Breeding Nurseries

We established three polycross nurseries in 2003. The **Elite Nursery**, located at the Central Crops Research Station (CCRS) in Clayton, is designed to produce materials with the potential to become varieties. In this nursery, cultivars and near-commercial clones that are outstanding for particular characteristics, such as yield, appearance, and disease and insect resistance are combined and crossed. The **Streptomyces Soil Rot (SSR) Nursery**, also located at the CCRS, is dedicated to developing parents with high levels of soil rot resistance. These nurseries are composed primarily of breeding material developed by NCSU, LSU, and the USDA sweetpotato breeding projects. The USDA lines are primarily used for disease and insect resistance. Table 1 provides results of the seed harvests per maternal parent for the Elite and SSR nurseries. The third nursery, our **High Dry Matter Nursery**, located at the HCRS, is designed to develop lines with high levels of dry matter suitable for industrial purposes including the production of bio-based products in sweetpotato. More than sufficient seed was obtained for next year.

First-Year Seedling Selections

Research Station Trials

Over 44,000 true seed from the 2002 polycross nurseries were grown in the Horticultural Department greenhouses starting in February. Most of the seedlings from the 2002 Elite Nursery (ca. 23,000) and 2002 SSR nursery (ca. 14,000) were evaluated for storage root color prior to field transplanting in May. Only those seedlings with a uniform orange, or a pure white flesh color were planted. This step, combined with losses from non-germinating seed, reduced the seedling population by almost 50%. In the field, the seedlings

were planted three feet apart so they remained as distinct hills at harvest. Selection at harvest was based on relative yield, shape, flesh color, skin texture, size distribution, root number, earliness, and observable diseases or defects.

Table 2 contains a list of the selections made by nursery and maternal parent at the CRS. Of the nearly 22,000 seed planted from the SSR or Elite nurseries 268 were selected for further evaluation, representing a 1.2% selection rate. This is slightly lower than our long-term average of 1.5%, but 2003 was a cooler and wetter than normal season. Thus, our 2003 selections may represent selections that tolerate cooler temperatures and resist souring, an important consideration for NC varieties.

The selection percentage from the dry matter nursery was much higher at 2.9%. However, these lines still have to undergo a dry matter screening which will eliminate about half the lines. Selection criteria, especially appearance and shape are also less important in an industrial-type.

On-Farm Trials

As part of the Grower-Participatory Breeding Project, three on-farm sites were used to evaluate seedlings from 15,000 of the true seed listed above. The parents and selections are shown in Table 3. Cooperators involved in this project were:

<u>Researchers</u>	<u>Extension</u>	<u>Growers</u>
Jonathan Schultheis	Milton Parker	George Wooten
Dennis Adams	William Little	Jim Jones
	Allan Thornton	Roger Lane and
	Mike Wilder	Pride of Sampson

Field sites were located within commercial fields and the trials were treated in the same fashion as the commercial fields (fertilizer, herbicides, etc.) except for the three-foot in-row spacing. Selections were made in cooperation with extension personnel and growers. Growing conditions varied from site to site, but all sites yielded selections that had better appearance than the check variety Beauregard. These selections will be planted at the HCRS and CRS in 2004 as unreplicated 20-hill plots for the second cycle of selection. It is very useful for us to select under commercial conditions to identify material adapted to actual growing conditions. Selection percentage over all on farm tests was 1.0%.

During 2002, we established a second component to the GPBP and began evaluating promising breeding lines under commercial conditions. In 2003 eleven advanced breeding lines and three check lines were grown and evaluated at each location as single-row, 100-hill plots. Notes on how they performed at each location were taken and these are combined with research station data to determine the potential of each as a variety.

Second-Year Selections

In 2002, we made 540 first-year table-stock seedling selections. A few of these rotted in storage or did not sprout in the spring. The remainder (ca. 500) were planted in 20-hill plots at the HCRS and CRS in 2003. Selection criteria were essentially the same as for the first-year single-hill selections, but having a row instead of a hill allows for a better idea of shape and size consistency, and relative yield. From these, 13 selections were made at the CRS and 11 at the HCRS. Four selections were chosen at both sites, thus 20 selections remain. This number is roughly half that of what we normally select percentage-wise, but 2003 was a difficult year for

sweetpotatoes.

Third-Year Selections

The 62 second-year selections made in 2002 were planted as unreplicated 100-hill plots at the HCRS and CRS in 2003. We selected 11 of these for further evaluation with only one being selected in both locations. Our evaluation criteria remain the same as our second-year selections, but we become stricter for any flaws in appearance, yield and disease susceptibility, etc. at this stage. Next season these clones will go into replicated yield tests in multiple locations. The most promising will be entered into the on-farm trials for a more rapid assessment of their adaptability across environments.

Advanced Selection Trials

Seventeen advanced selections were evaluated this year. Half have been dropped, three have been designated as breeding lines, and the remainder will be tested again in 2004. The two most promising clones are described below.

NC98-608 has been elevated to advanced status based on its performance over the last three years (see summary table below). It is similar to Beauregard in appearance, but has been more uniform in shape and has packed out quite well. It is less prone to making jumbo's than Beauregard, averaging 8% jumbo's vs 15% for B94-14 G2, and producing fewer culls, 7% vs 14% for Beauregard averaged over 17 yield tests (3 in 2001, 7 each 2002 and 2003). We have not seen russet crack in NC98-608, and the generations used in the 2001 and 2002 yield tests are G4 and G5, respectively. This year we compared G1, G2 and G6 as unofficial entries in the National Collaborator trial. There were no differences for marketable yield or % No.1's, but G6 had more canners and fewer jumbo's, a reflection of a higher length to diameter ratio. In three out of four other trials where both G2 and G6 were present, we saw this same trend, G6 was longer and thinner than G2. In none of these was the %No.1 roots affected, but in one trial G6 had more canners and fewer jumbo's. Shapes have held up very well, which is one of its strengths. NC98-608 tends to size its roots fairly evenly, like Hernandez, and has the potential to produce a reasonably high percentage of number one roots. The yield tests listed below were typically harvested when Beauregard was ready. If NC98-608 is given an additional one to two weeks we think it will size more canners into the No. 1 class, but relatively few No.1's will become jumbo's further enhancing its productivity. In two locations this year root skin color was noticeably lighter from the stem to distal end. The Beauregard check lines showed some of this effect in the same tests, but not as much. Both trials were very wet. In terms of disease resistance, NC98-608 has tested resistant to Fusarium wilt, and moderately resistant to Streptomyces soil rot and southern root-knot nematodes.

Average performance of NC98-608, B94-14 G2 Beauregard, and Hernandez G2-3 over 3 yield tests in 2001, 7 in 2002 and 7 in 2003.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		Bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
NC98-608	731	682	116	124	60	26	8	7
B94-14 G2	767	662	100	114	52	20	15	14
HernandezG2-3	657	589	95	100	52	33	5	10

SUMMARY DESCRIPTION - NC98-608

Plants:

Vine: Trailing, dense canopy
 Leaves: Heart-shaped to slightly lobed, green
 Sprout production: Good, but short internodes make it late
 Transplant survival: Good

Storage roots:

Shape: Blocky to Fusiform, stays short
 Skin color: Rose
 Flesh Color: Moderately deep orange, uniform
 Skin Surface: Smooth

Characteristics

Yield: High
 Season: Mid to early
 Fusarium stem rot: Resistant
 Pox: Moderately resistant, but needs further screening
 Root-knot nematodes: Moderately resistant, but needs further screening
 Storability: In commercial storage this winter
 Consumer quality: Good baking quality, very good taste, canning quality being tested

Remarks: Desirable attributes include highly attractive, short roots and high packout. It is very similar to Beauregard in appearance. Showed some color variation, darker at the stem end and lighter at the distal end, in a couple locations this year.

Yield Trial Data: see table above
 Disposition: Will consider for release depending on sprouting and field performance in 2004. Will be entered into the 2004 National Collaborators trial.

NC99-573

This clone produces attractively shaped, smooth skinned, rose-colored roots. Yield is high with a growing season about two weeks longer than Beauregard. Lenticels are fairly prominent in wet conditions and it is susceptible to root-knot nematodes. Worth further evaluation.

Average performance of NC99-573, B94-14 G2 Beauregard, and Hernandez G2, G3 over two yield tests in 2002 and 4 in 2003.

CLONE	Total Yield		Marketable Yield		Size Distribution by Class (% of total yield)			
	bu/A	bu/A	%Beau	%Hern	No.1's	Canners	Jumbo's	Culls
NC99-573	769	691	119	135	52	28	9	11
B94-14 G2	760	665	100	122	48	23	16	12
HernandezG2-3	602	529	89	100	49	35	4	12

SUMMARY DESCRIPTION - NC99-573

Plants:

Vine: Trailing, dense canopy
 Leaves: Heart-shaped to slightly lobed, green
 Sprout production: Good
 Transplant survival: Good

Storage roots:

Shape: Blocky
 Skin color: Rose
 Flesh Color: Moderately deep orange, uniform

Skin Surface: Smooth

Characteristics

Yield: High
Season: Mid to early
Fusarium stem rot: Resistant
Pox: Resistant, but needs further screening
Root-knot nematodes: Susceptible
Storability: Has not been stored commercially yet
Consumer quality: Good baking quality, canning quality unknown
Remarks: Desirable attributes include highly attractive, smooth skinned blocky roots. Disease resistance need further testing.
Yield Trial Data: see table above
Disposition Will be extensively trialed in advanced and on-farm trials during 2004.

In addition to NC98-608 and NC99-573, 15 additional advanced clones are still being evaluated. Many clones that fall short of becoming a named variety are used as parents based on the multiple tests gathered for release potential. The results of yield tests that included these clones and other promising selections are presented in Tables 4-10. The comment codes used in the tables are described in the Comment Codes Section after the tables. All yields are reported as 50 lb. bushels per acre units.

Disease Resistance Screenings

In addition to the selection and yield evaluation trials, we screened 121 advanced, preliminary, and parental lines for resistance to Fusarium wilt. Of these, 47 of the lines were resistant, 22 had moderate resistance, 23 were moderately susceptible and 29 were rated as susceptible. Susceptible lines were discarded. 72 of these lines were also screened for resistance to southern root-knot nematode with 38 resistant, 8 moderately resistant, 13 moderately susceptible and 13 testing susceptible.

The establishment process continues for our field SSR screening nursery, having completed its sixth year. This was a bad year for SSR, which thrives in dry conditions. Disease incidence was lower than we saw last year when the dry conditions were ideal. All 121 lines in the Fusarium test were in this field screening, but the overall level of disease was too low for a good rating. We will continue to maintain conditions favorable for SSR and use this site to evaluate materials, but it looks like the strength of the rating will depend largely on the weather. The set of 72 lines that were screened in the nematode trial were screened for Streptomyces in the greenhouse, but this test also showed few symptoms and is currently being re-run. In years with high disease pressure, we will use this field to measure yield reduction caused by SSR on advanced clones being considered for release. This field screening is an asset to the program because it allows us to evaluate a large number of lines for resistance to SSR under field conditions. Further, we get an idea of how much yield is reduced and if SSR is able to form lesions on the storage root. Our greenhouse test, while very useful, doesn't give us storage root lesion data. Soil rot may affect primarily fibrous roots, storage roots or both depending on the clone and knowing this will help us in developing clones resistant to both.

2003 National Sweetpotato Collaborator Trial

Tables 4a and 4b present the results of the 2003 National Sweetpotato Collaborator Trial. Rainfall was frequent and often heavy during July, August and September with relatively few clear sunny days. Number of roots set per plant was higher than normal affecting packout, which resulted in fewer jumbo's and more canners than normal, delaying harvest. Fertilizer was leached by the rain and by mid-August plants began to show signs of nutrient stress. Root shapes were fair overall, with many round shaped roots, especially in Jewel and Hernandez. Jewel and MSK39 showed severe cracking, and MSK39 showed significant levels of russet crack. Insect damage was minimal. Overall appearance was rated using a subjective 0-9 scale with 0 = very poor, 3= poor, 5=fair, 7=good and 9= excellent. Appearance ratings such as a 6 mean that a clone, in our opinion, was a little bit better than fair (6), but still not good (7).

Description of Official Entries

Beauregard (B94-14 G2) - Rose skin, orange flesh, moderately smooth skin, fusiform shapes, mid to early season. Many round roots. Overall appearance = 7.

Beauregard (B63 G2 LSU) - Rose skin, orange flesh - slightly lighter than B94-14, moderately smooth skin, fusiform shapes, but many crooks, mid to early season. Overall appearance = 6.

L99-35 - Rose skin, deep orange flesh, slightly flaky skin, elliptic to round-elliptic shapes, mid season. Shapes tended toward round. Overall appearance = 6.

MSK39 - Rose skin, orange flesh, slightly flaky skin, elliptic shapes, mid to early season, relatively few but large roots, significant air cracking and russet crack. Overall appearance = 4.

Unofficial entries in the 2003 National Sweetpotato Collaborator Trial for comparison:

Hernandez G3 - Copper-orange skin, deep orange flesh, slightly flaky skin, elliptic to round elliptic shapes, mid to late season. Many round roots. Overall appearance = 5.

Jewel G1 (J98-2) - Copper skin, orange flesh, moderately smooth skin, round-elliptic and ovate shapes, mid season, many growth cracks, grooving, many roots with root hairs still attached. Overall appearance = 3.

L96-117 - Rose skin, deep orange flesh, smooth skin, elliptic shapes, mid season, many long roots in a very short trial, moderate growth cracks and curved roots. Overall appearance = 7.

NC98-608 G1- Rose skin, orange flesh, moderately smooth skin, elliptic and round elliptic shapes, mid season, distal end lighter than stem end. Length/diameter ratio = 1.5. Overall appearance = 5.

NC98-608 G2- Rose skin, orange flesh, moderately smooth skin, elliptic and round elliptic shapes, mid season, distal end lighter than stem end. Shapes more uniform than G1. Length/diameter ratio = 2. Overall appearance = 6.

NC98-608 G6- Rose skin, orange flesh, moderately smooth skin, elliptic and round elliptic shapes, mid season, distal end lighter than stem end. Shapes more uniform than G1. Length/diameter ratio = 2. Overall appearance = 6.

Table 1. Sweetpotato True Seed Harvested in 2003.

Maternal Parent	No. Seed/Polycross Nursery		Total
	CCRS, Clayton		
	Elite	SSR	
NC1528	2337	---	2337
NC93-50	---	4906	4906
NC96-13	---	961	961
NC96-27	1149	---	1149
NC97A-04	1768	---	1768
NC97A-45	---	1686	1686
NC97-079	---	4557	4557
NC97-166	502	---	502
NC98-433	---	1073	1073
NC98-061	225	---	225
NC98-175	---	2173	2173
NC98-342	---	1756	1756
NC98-576	1279	713	1992
NC99-573	278	---	278
NCC58	1840	2074	3914
Beauregard	---	232	232
Bienville	3180	6015	9195
Hernandez	3508	3721	7229
L78-21	---	900	900
L80-62	628	1533	2161
L96-117	4980	3948	8928
MSK39	642	---	642
Ruddy	1292	---	1292
Tib 4	---	2962	2962
W250	2797	4125	6922
Totals	26,405	43,335	69,740

'--- line was not in this nursery.

Table 2. 2003 Sweetpotato seedlings selected at the CRS, Kinston.

Maternal parent	# selections	Maternal parent	# selections
<i>Seed from the 2002 Elite nursery</i>			
NC96-27	16	Goldstar	5
NC96-61	9	Hernandez	8
NC97A-04	8	L80-62	10
NC98-576	6	L96-117	9
NC99-299	10	MSK39	6
NCC58	11	Ruddy	11
Bienville	13		
Total			122
<i>Seed from the 2002 SSR nursery</i>			
NC92-08	4	Bienville	10
NC96-13	7	NCC58	19
NC97A-45	5	Hernandez	12
NC97-166	10	L78-21	3
NC97-433	23	L80-62	6
NC98-419	5	L96-117	5
NC98-576	5	Patriot	8
Beauregard	14	W250	10
Total			146
<i>Seed from the 2002 Dry matter nursery*</i>			
NC1880	15	BM85-42	27
NC90-10	1	HiDry	4
NCA88	1	Jishu 5	7
NCA193	6	Kogane Sengan	5
NCFT4-89	12	MDP217-84	10
NCFTA94	14	Minamiyutaka	13
NCPDM P4	21	Suwon 122	6
NCPDM P6	23	Tib 4	2
NCWB-16	16	Woksaken	14
BM83-4	7		
Total			204
Grand Total			472

*Selections from the dry matter nursery will be screened for dry matter percentage, with any clones below 30% discarded. This should eliminate about half of the selections.

Seedling Selections Continued on Next Page

Table 3. 2003 Sweetpotato seedlings selected on farm.

Maternal parent	# selections	Maternal parent	# selections
<i>Jim Jones Farm, seed from the 2002 Elite nursery</i>			
NC96-27	15	Bienville	23
NC97A-04	15	Hernandez	4
NCC58	12		
		Total	69
<i>Pride of Sampson</i>			
	<i>2002 Elite nursery</i>		<i>2002 SSR nursery</i>
NC96-61	10	Beauregard	4
NC98-576	8	Bienville	12
L96-117	7	NCC58	8
		L80-62	2
		Total	51
<i>Wooten, seed from the 2002 Elite nursery</i>			
NC96-61	8	Bienville	6
NC97A-04	10	Goldstar	4
NCC58	9		
		Total	37
		On Farm Grand total	157

Table 4a. 2003 National Sweetpotato Collaborators yield trial, HCRS, Clinton, NC Planted: 27Jun03; Harvested: 28Oct03; Days to Harvest: 123.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		Bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
NC98-608 G1*	611	524	113	111	52	17	18	13
NC98-608 G2*	626	559	122	122	56	19	16	10
NC98-608 G6*	551	493	107	102	56	29	6	10
B63 G2	532	440	98	96	61	13	9	17
B94-14 G2	541	458	.	99	60	18	7	14
Hernandez G3*	502	489	107	.	58	33	7	3
Jewel G1*	635	454	99	96	36	18	18	28
L96-117*	579	440	96	94	56	15	5	24
L99-35	599	580	126	123	64	24	10	3
MSK39	594	352	77	77	38	8	14	39
Grand Mean	577	479	105	102	54	19	11	16
CV (%)	19	19	19	17	14	36	55	32
LSD (p=0.05)	128	105	23	20	9	8	7	6

All trials are reported in 50 lb. bu.

*Not official entries

Table 4b. 2003 National Sweetpotato Collaborators Yield Trial at CRS, Kinston, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
NC98-608 G1	M	20	1.5	rs	ms	3.25	8	8	2,3	5	5	CV
NC98-608 G2	M	20	2	rs	ms	3.25	8	8	2,3	6	6	CV
NC98-608 G6	M	19	2	rs	ms	3	8	8	2,3	6	6	CV
B63 G2	ME	20	2.5	rs	ms	2.75	8	8	3	6	6	↑CRK
B94-14 G2	ME	18	2.5	rs	ms	3	8	8	3	7	7	↑round
Hernandez G3	ML	19	1.5	cu or l fl	3.5	6	8	8	2,3	5	5	↑round
Jewel G1	M	24	1.5	cu	ms	3	5	7	2	4	3	↑CR, ↑T, ~LG,MSH
L96-117	M	20	3	rs	sm	3.5	8	8	3	6	7	~CR, RC?, ~CRK
L99-35	M	19	2	rs	l fl	3.5	8	8	2,3	6	6	↑round
MSK39	ME	19	2.5	rs	l fl	3	8	8	3	6	4	RC, ↑air CR

Comments: Wet growing season, many culls for shape and cracking.

Table 5a. 2003 Advanced Yield Trial at HCRS, Clinton, NC. Planted: 12Jun03; Harvested: 28Oct03; Days to Harvest: 138.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
98-608 G2	515	479	128	125	69	18	6	7
98-608 G6	560	534	142	139	64	27	5	5
99-538	456	426	114	111	67	21	6	6
99-573	582	534	143	141	66	21	5	8
B94-14 G2	430	375	.	98	54	27	6	13
Hernandez G3	445	400	105	.	53	33	5	10
Grand Mean	498	458	126	123	62	24	5	8
CV (%)	14	19	13	12	12	29	54	50
LSD (p=0.05)	102	86	26	22	11	NS	NS	NS

Table 5b. 2003 Advanced Yield Trial at HCRS, Clinton, NC - Trait Data.
Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2	M	21	2	rs	l fl	3.25	8	7	6,3	6	6	CV, ~T
98-608 G6	M	21	2.5	rs	l fl	3	8	7	6,3	7	6	CV, shapes mostly good
99-538	M	20	1.5	rs	m fl	3	8	6	3,2	6	5	too short?, ovate
99-573	M	19	2.5	rs	l fl	3	7	6	3	6	6	LE prom, culls-RT
B94-14 G2 Beau.	M	19	2.5	rs	l fl	3	8	7	3,6	6	5	culls-MSH
Hernan. G3	M	20	2	or	l fl	3.5	7	7	3,5	5	5	↑T, ovate, culls-RT

Comments: Unusual test where Beauregard was the lowest yielding clone. 98-608 showed significant color variation getting lighter from the stem to the distal end.

Table 6a. 2003 Advanced Yield Trial at CRS, Kinston, NC. Planted: 10Jun03; Harvested: 30Sept03; Days to Harvest: 110.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
98-608 G2	1174	1080	98	162	67	15	10	8
98-608 G6	1059	1002	91	150	66	23	6	5
99-538	971	863	78	129	58	27	4	11
99-573	1056	920	83	137	52	28	7	13
B94-14 G2	1259	1109	.	166	59	14	14	12
Hernandez G3	828	669	61	.	48	29	4	19
Grand Mean	1058	940	82	149	58	23	8	11
CV (%)	8	10	11	11	7	15	36	32
LSD (p=0.05)	125	145	14	25	6	5	4	6

Table 6b. 2003 Advanced Yield Trial at CRS, Kinston, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
			2.2									
98-608 G2	M	20	5	rs	ms	3	7	7	6	7	8	
98-608 G6	M	20	3	rs	ms	3	7	7	6	7	7	↑CRK vs G2, longer-G2
99-538	M	20	2.5	rs	ms	3.25	7	5	6	6	6	~T,~VN,~CR L canners,
99-573	M	20	3	rs	ms	3.25	7	7	3	6	5	↑WW
B94-14 G2 Beau.	E	20	2.5	rs	ms	3.25	7	7	6	6	6	
Hernan. G3	ML	20	3	cu or	ms	3.5	5	7	3,6	6	5	↑T

Comments: A high yielding test with culls primarily for shapes. 98-608 stood out for shape quality and uniformity.

Table 7a. 2003 Preliminary 1 Yield Trial at HCRS, Clinton, NC. Planted: 05June03; Harvested: 06Oct03; Days to Harvest: 122.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
98-608 G2	412	394	205	168	50	42	5	3
98-608 G6	415	410	201	174	50	47	1	1
99-026	384	348	191	158	54	29	8	9
99-031	250	213	110	93	22	59	2	16
99-088	274	201	124	98	28	41	3	28
99-524	329	275	155	123	28	51	2	18
99-538	225	220	97	87	26	59	10	6
99-573	319	283	155	122	39	44	3	13
B94-14 G2	255	243	.	94	33	58	4	5
Hernandez G3	276	253	119	.	26	61	2	11
Grand Mean	314	284	151	124	35	49	4	11
CV (%)	26	26	28	28	45	25	123	54
LSD (p=0.05)	118	109	61	50	23	18	NS	9

Table 7b. 2003 Preliminary 1 Yield Trial at HCRS, Clinton, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2	M	20	2.5	rs	l fl	3.25	8	7	3	6	5	CV, ~T
98-608 G6	M	20	2.5	rs	l fl	3.25	8	7	3	5	5	CV
99-026	M	21	2	rs cu	l fl	3	8	7	6	5	5	~T, chunky late, ~CR, ↑roots
99-031	L	22	2.5	rs	sm	3.5	7	6	3	4	4	~ strings, RT
99-088	M	25	2.5	rs	sm	3	7	7	3	5	5	RT
99-524	M	20	2.5	dk rs	l fl	3.5	8	6	6,5	5	5	~CR
99-538	M	21	2	cu rs	l fl	3	8	5	3	4	4	~EY
99-573	M	18	2.5	rs	ms	3	8	7	3,6, 7	3	3	CV, ↑var shapes mixed shapes,
B94-14 G2	M	19	2.5	rs	l fl	3	8	7	3,6	5	4	late for B ↑T, ↑#roots,
Hernan. G3	ML	20	2.5	or	l fl	3.5	6	6	3	6	5	little size

Comments: This location was heavily leached and had poor shapes overall. No clones received better than a 5 (out of 10) for overall appearance.

Table 8a. 2003 Preliminary 1 Yield Trial at CRS, Kinston, NC. Planted: 12Jun03; Harvested: 30Sept03; Days to Harvest: 109.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
98-608 G2	944	930	94	108	70	20	9	1
98-608 BS	1007	998	100	115	66	27	6	1
99-026	902	862	85	101	61	22	12	5
99-031	1025	1003	102	115	55	37	6	2
99-088	979	944	96	109	62	22	12	4
99-524	995	936	95	108	54	36	4	6
99-538	833	815	82	94	70	22	6	2
99-573	1055	1031	105	118	59	31	8	2
B94-14 G2	1046	1011	.	118	66	19	12	3
Hernandez G3	894	869	88	.	64	31	2	3
Grand Mean	968	940	94	110	63	27	8	3
CV (%)	13	13	13	13	12	23	69	108
LSD (p=0.05)	NS	NS	NS	NS	11	9	NS	NS

Table 8b. 2003 Preliminary 1 Yield Trial at CRS, Kinston, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2	ME	20	2.5	rs	ms	3.25	8	6	3,6	6	7	~EY, g size dist
98-608 G6	M	20	3	rs	ms	3	8	7	3	8	8	uniform shape, size CV, ~T, g size dist, modest#rts
99-026	M	23	2.5	cu rs	ms	3	7	7	3	7	6	modest#rts
99-031	M	22	2.5	rs	ms	3.25	7	6	3,6	6	6	~VN, CRK
99-088	M	25	3	rs	ms	3	6	7	3	7	6	~T, L
99-524	M	20	3	dk rs	ms	3	7	6	3	7	7	↑ fibrous roots
99-538	M	20	2	rs	l fl	3	8	5	3,6	6	6	LE, chunky EY, g
99-573	EM	20	2.5	rs	sm	3.25	6	7	3	7	7	sizing ~junk but
B94-14 G2	ME	21	2.5	rs	sm	3	8	7	6	5	6	↑good
Hernan. G3	M	22	2	or	l fl	3.5	6	8	3,5	6	6	~PI

Comments: A nice test. Notice there were no differences in total or marketable yield, but there were differences in class distribution.

Table 9a. 2003 Preliminary 2 Yield Trial at HCRS, Clinton, NC. Planted: 05June03; Harvested: 07Oct3; Days to Harvest: 123.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
00-052	665	370	54	59	33	17	6	44
00-055	709	537	80	89	41	32	2	25
00-061	682	512	75	83	52	20	2	26
00-101	865	714	97	110	54	14	15	18
00-199	864	433	62	71	36	12	2	49
00-368	925	619	91	101	41	25	1	33
00-541	859	650	96	107	47	25	3	24
00-550	658	403	57	65	30	28	3	39
00-586	672	544	77	88	37	42	2	19
00-677	1072	689	98	112	51	12	4	34
00-720	892	732	104	116	53	22	7	18
00-748	655	517	74	84	56	21	2	21
98-608 G6	686	598	84	95	48	32	7	13
B94-14 G2	795	755	.	117	65	20	10	5
Hernandez G3	748	643	88	.	46	37	3	14
Grand Mean	783	581	81	92	46	24	5	25
CV (%)	17	19	18	19	14	23	81	34
LSD (p=0.05)	187	161	20	25	9	8	5	12

Table 9b. 2003 Preliminary 2 Yield Trial at HCRS, Clinton, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G6	M	20	2	rs	l fl	3	8	7	3	6	7	~T
00-052	M	20	2.5	cu	ms	3	8	7	6,3	6	4	↑↑CR, skin color=flesh
00-055	M	17	2.5	dk rs	l fl	3	8	6	3	5	5	LG,CV, ~T
00-061	M	20	2	rs	ms	3.5	8	7	3,6	6	5	CR
00-101	E	18	2	cu	l fl	3.5	7	7	3,6	5	6	Early, ~CR
00-199	ME	20	2.5	rs	ms		6	7	6	6	3	↑CR, deep LG, RT
00-368	M	18	2.5	rs	ms	3	7	7	3	5	4	CR, ↑culls
00-541	M	17	2	cu	ms	3.25	7	7	3	6	6	~CV, ↑v NS
00-550	M	18	2.5	rs	l fl	3.5	7	7	3	3	3	CR, MSH
00-586	M	20	3	red	m fl	3.25	7	7	6,3	5	5	CR, ~T, MSH
00-677	ME	17	2.5	rs	l fl	3.25	6	8	3,5, 7	3	3	CV, ↑T, ↑MSH, CR
00-720	M	21	2	red	l fl	3	7	7	3	7	7	↑NS, ~CV
00-748	M	29	2.5	cr	ms	1.5	6	7	6	4	5	VN, MSH, starchy
B94-14 G2	M	19	2.5	rs	l fl	3	8	7	6	6	7	NS
Hernan. G3	M	21	2.5	or	l fl	3.75	6	7	3	6	6	~T, ~CV

Comments: A tough test for shape and quality. Beauregard stood out for packout, largely due to early sizing. Most of these clones have been dropped.

Table 10a. 2003 Preliminary 2 Yield Trial at CRS, Kinston, NC. Planted: 12Jun03; Mowed: 30Sept; Harvested: 17Oct03; Growing Days: 110.

CLONE	Total Yield bu/A	Marketable Yield		Size Distribution by Class (% of total yield)				
		bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
00-541	1013	939	83	98	59	31	3	7
00-677	1206	1095	96	114	59	21	11	9
00-720	1135	1059	93	111	57	24	12	6
00-748	973	921	80	97	56	38	1	5
98-608 G6	1093	1061	93	112	69	26	2	3
B94-14 G2	1210	1155	.	123	53	12	31	4
Hernandez G3	1012	973	87	.	61	31	4	4
Grand Mean	1092	1029	89	109	59	26	9	6
CV (%)	14	13	12	12	11	26	57	57
LSD (p=0.05)	NS	NS	NS	NS	9	10	8	NS

Table 10b. 2003 Preliminary 2 Yield Trial at CRS, Kinston, NC - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	DM	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
00-541	E	15	2.5	cu rs	ms	3.25	7	7	3	5	5	Early, ^T, BR
00-677	EM	14	2.5	rs	l fl	3.25	8	8	3	5	5	RC?,g size+ attachment n finish
00-720	M	18	3	red	ms	3.25	8	8	3	6	6	but ~MSH
00-748	M	29	2.5	w	ms	1.5	7	5	3,6	7	7	~VN, LE
98-608 G6	ME	18	2.5	rs	ms	3	8	8	3,6	7	7	nice
B94-14 G2	E	19	3	rs	ms	3	7	6	3,6	6	5	shapes OK
Hernan. G3	ML	21	3	cu or	ms	3.5	5	7	3,6	6	7	

Comments: A high yielding test with significant insect damage. No differences in total or marketable yield but differences in distribution among the grades. Compare 98-608 G6 to B94-14 G2.

Keys to Tables

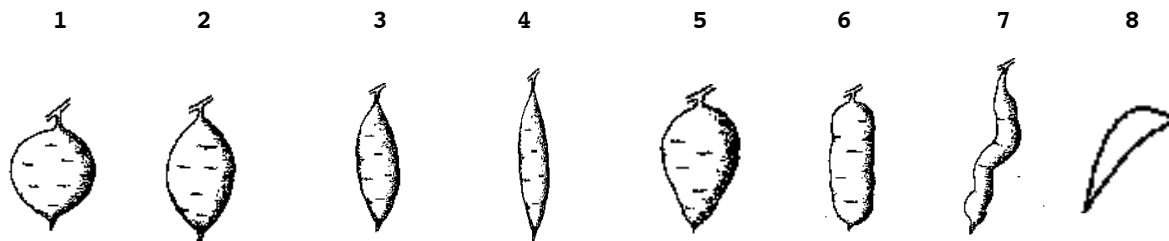
Storage root data: **MAT**=maturity E=early, M=mid and L=Late; **DM**=percentage dry matter; **L/D**=length/diameter ratio; **SKC**=skin color clr=clear cu=copper, lt=light, or=orange, pi=pink, pu=purple, rd=red, rs=rose, tn=tan wh=white; **SKT**= skin texture, m fl= moderate flakiness of skin, l fl= light flakiness to skin, ms=moderately smooth, sm=smooth; **FL**=flesh color (0-5 scale where 0=pure white, 1= cream, 2=yellow, 3= medium orange, 4=deep orange, 5= very deep orange; **EYE**=eyes(0-9); **LEN**= lenticels (0-9); **SH**=Shape (see diagram); **SHV**=shape variability(0-9); **APP**=overall appearance (0-9). All 0-9 scales go from low or poor to high or good.

Comment codes: **AT**=tough attachment; **B**=bumpy shapes; **BR**=breeding only; **BSR**=bacterial soft rot; **CR**=cracking; **CRK**= crooked shapes; **CS**=circular spot; **CV**=skin color variation end to end; **D**=drop; **EY**=deep eyes; **FB**=fleabeetle damage; **HC**=horizontal constrictions; **ID**=unspecified insect damage; **IRR**=irregular; **JL**=jumbo's for length; **L**=long; **LE**=lenticels; **LG**=longitudinal grooves; **LR**=Lateral rings; **LT**=latex; **MSH**=misshappen roots; **NS**=nice shapes; **OV**=ovate or pear shapes; **PI**=pimples (0-9); **PN**=pencil roots; **PP**=pulled plants; **R**=rodent; **RC**=russet crack; **RG**=restaurant grade; **RH**=root hairs; **RKN**=root-knot nematodes; **RSK**=rough skin; **RT**=rot; **SD**=skin discoloration; **SH**=sheen; **SG**=string roots; **SK**=skinning; **SO**=souring; **SPR**=sprouts; **SR**=soft rot; **SS**=stays short; **SSR**=streptomyces soil rot; **STR**=Striations; **T**=tails; **TP**=tapered roots; **VN**=viens; **SC**=scurf; **SF**=surface Fusarium; **WB**=whitefringed beetle; **WG**=white grub; **WW**=wireworm; **YCR**=yellow cortical ring; **YLD**=yield; **2°R**=secondary roots.

↑ = lots, ~ = moderate, ↓ = little or poor

(Rating scale: 0 = very severe to 9 = absent)

Shapes



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