

2002 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 2002 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 45,000 true seed and made 914 new seedling selections. Generally, we plant an equal number of seed from each of the previous year's parents and keep records of the number of clones selected per female parent. This information is used 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 fifth 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 our most advanced lines in unreplicated trials at the 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, which will be evaluated in large-scale (2-4 acre) trials by commercial growers in 2003 is a direct result of this effort.
5. We conducted our fifth season of Streptomyces soil rot (SSR) field screening evaluating 84 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. All 84 clones were also screened for Fusarium wilt resistance in greenhouse trials.
6. We collaborated with Dr. Zvezdana Pestic-VanEsbroeck and the Micropropagation Unit (MPU) by evaluating two MPU trials at the HCRS and CRS to select superior mericlones of Hernandez, Jewel, and other specialty varieties for release to NC growers. These new clones are now, or will soon be, available to growers for production.
7. 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 began a project to develop a molecular genetic map of sweetpotato focused on identifying genes in sweetpotato for resistance to sweetpotato feathery mottle virus and root knot nematodes, and for dry matter content and beta-carotene production.

8. We collaborated with the Dr. Sylvia Blankenship to evaluate NC98-608, our most advanced clone, for resistance to skinning.
9. We collaborated with Dr. Jonathan Schultheis to evaluate our most promising clones in replicated on-farm yield trials. NC98-608, our most advanced clone, was very attractive and yielded well in all of these tests.
10. We worked with the Specialty Crops Program to develop specialty-type sweetpotatoes to promote new marketing opportunities for sweetpotato growers.
11. With additional support from the NC Crop Improvement Association and the NC Certified Sweetpotato Seed Growers, Inc., we began 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. Kendall Hill
Dr. Sylvia Blankenship	Mr. Milton Parker	Mr. Jim Jones
Dr. Gerald Holmes	Mr. Allan Thornton	Mr. Johnny Williams
Mr. Wilfred "Bill" Jester	Mr. Mike Wilder	Mr. Terrell Williams
Dr. Zvezdana Pesic-VanEsbroeck		
Dr. Jonathan Schultheis		
Dr. Bryon Sosinski		

2002 Polycross Breeding Nurseries

We established three polycross nurseries in 2002. The **Elite Nursery**, relocated in 2001 to 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**, was 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 45,000 true seed from the 2001 polycross nurseries were grown in the Horticultural Department greenhouses starting in February. Most of the seedlings from the 2001 Elite Nursery (ca. 24,000) and 2001 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 20,000 seed planted from the SSR or Elite nurseries 233 were selected for further evaluation, representing a 1.2% selection rate. This is slightly lower than our long-term average of 1.5%. But, 2002 was a drier than normal season. Thus our 2002 selections may represent selections that are more drought tolerant, an important consideration for NC varieties.

The rate of selection at Clinton was 4.8%, which reflected a different approach to handling first-year seedlings. During 2002 at the HCRS we conducted a small experiment to compare the results of selection on a single-hill versus a four-hill basis. To do this, two duplicate seedling plantings were established. One was planted following the normal procedure of one plant per clone on a three foot spacing. The other plot contained duplicate clones, but each plot consisted of a four-hill plot. We then made selections in each plot and compared the results. Twenty-five selections were made in the 4-hill plots, while only 5 selections were made in the single-hills. Only one selection out of all of these selections overlapped. We will repeat this test in 2003.

The selection percentage from the dry matter nursery was much higher at 5.9%. 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 18,000 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	Wilfred R. Jester	Terrell Williams
Dennis Adams	William Little	Johnny Williams
	Allan Thornton	Kendall Hill
	Mike Wilder	Jim Jones

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 2002 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 1.4%.

During 2002, we also established a second component to the GPBP and began evaluating promising breeding lines under commercial conditions. Fourteen advanced breeding lines and six 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 2001, we made 392 first-year table-stock seedling selections. A few of these rotted in storage or did not sprout in the spring. The remainder (ca. 380) were planted in 20-hill plots at the HCRS and CRS in 2002. 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, 29 selections were made at the CRS, and 43 at the HCRS. Three selections were chosen at both sites, thus 62 selections remain. The Clinton site had moderate pox pressure allowing us to select for resistance to this disease.

Third-Year Selections

The 61 second-year selections made in 2001 were planted as unreplicated 100-hill plots at the HCRS and CRS in 2002. We selected 12 of these for further evaluation with 3 being selected in both locations, 1 only at the HCRS and 8 only at the CRS. 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

Eighteen advanced selections were evaluated this year. Two of our most promising selections over the past few years (**NC96-61** and **NC97A-04**) have been removed from variety consideration. NC96-61 and NC97A-04 both appear to have broad adaptability, good yield, Fusarium and soil rot resistance and good eating quality, but they each have important weaknesses. NC96-61, a very sweet line, does not sprout well, and is susceptible to russet crack, worse than Beauregard. We tested virus screened G2 NC96-61 material this year to see if the russet crack could be controlled through micropropagation. It did not control this problem as 15-20% of the roots had russet crack symptoms in all four of the G2 mericlones trialed. NC97A-04 showed some souring this season, and it has moderately prominent lenticels detracting from its appearance. It also has gotten longer and longer each year, with a length/diameter ratio of 4 in some tests, an unacceptable number. Both of these lines are being tested as parents.

NC98-608 has been elevated to advanced status based on its performance over the last two 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 9% jumbo's vs 17% for B94-14 G2, and producing fewer culls, 8% vs 18% for Beauregard averaged over 10 yield tests, 3 in 2001 and 7 in 2002. We have not seen russet crack in 98-608, and the generations used in the 2001 and 2002 yield tests are G4 and G5, respectively. 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 terms of disease resistance, this clone needs further evaluation. But, so far it has tested resistant to Fusarium wilt, moderately resistant to Streptomyces soil rot and moderately susceptible to root-knot nematodes.

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

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	705	648	109	116	59	25	9	8
B94-14 G2	751	615	---	112	50	17	17	18
Hernandez G2	647	573	96	---	53	31	5	11

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, stay 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 susceptible, but needs further screening
 Storability: Has not been stored commercially yet
 Consumer quality: Good baking quality, canning quality being tested
 Remarks: Desirable attributes include highly attractive, short roots and high packout. It is very similar to Beauregard in appearance. Disease resistance need further testing.
 Yield Trial Data: see table above
 Disposition: Will be extensively trialed in advanced and on-farm trials during 2003.

In addition to NC98-608, 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, with the comment codes used in the tables described after the tables described in the Comment Codes Section. 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 83 advanced, preliminary, and parental lines for resistance to Fusarium wilt. Of these, 34 of the lines were resistant, 11 had moderate resistance, 21 were moderately susceptible and 17 were rated as susceptible. Susceptible lines were discarded. This same set was tested in the greenhouse screen for SSR resistance: 13 lines tested resistant, 22 moderately resistant, 15 moderately susceptible and 31 susceptible.

The establishment process continues for our field SSR screening nursery,

having completed its fifth year. This was a good year for SSR, which thrives in dry conditions. Disease incidence was higher than we have seen in the past, including areas that were not inoculated this year. Because of the disease pressure, we will not inoculate this plot in 2003, but we will continue to maintain conditions favorable for SSR and use this site to evaluate materials. The set of 83 clones screened for resistance to SSR in the greenhouse was also screened in our SSR field plot. Results were similar to the greenhouse test with 20 clones rated as resistant, 17 as moderately resistant, 18 as moderately susceptible and 29 as susceptible. We also put in a yield test to see how pox affects the yields of parental lines and advanced clones, but deer damaged the plots for this purpose. 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.

Our routine root-knot nematode tests were not successful due to multiple failures of the nematode cultures. This problem has been addressed and we will continue with these screens this coming season.

2002 National Sweetpotato Collaborator Trial

Tables 4a and 4b present the results of the 2002 National Sweetpotato Collaborator Trial. Low rainfall in August (2.5") and September (1.3") delayed sizing. The percentage of number 1 grade roots would have been improved by delaying harvest until it rained. Root shapes were fair overall, with most culls due to poorly shaped roots. Insect damage was moderate. 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, early season. Considerable insect damage. Overall appearance = 6.

Beauregard (B63 G2 LSU) - Rose skin, orange flesh, moderately smooth skin, fusiform shapes, but many crooks, early season. Overall appearance = 6.

MSI52 - Light copper skin, orange flesh, moderately smooth skin, elliptic shapes, mid season, some veins. Shapes OK but not great. Overall appearance = 6.

MSK39 - Rose skin, deep orange flesh, moderately smooth skin, elliptic shapes, early season, relatively few but large roots, lots of pencil roots. Overall appearance = 5.

NC96-61 - Rose skin, orange flesh, smooth skin, elliptic shapes, mid season, moderate shallow veining, lots of russet crack. Overall appearance = 7. Nice except for russet crack.

NC97A-04 - Rose skin, orange flesh, smooth skin, long elliptic shapes, mid

season, some pimples, overall too long, considerable skinning and insect damage. Overall appearance = 4.

W365 - Copper-orange skin, orange flesh, moderately smooth skin, elliptic shapes, mid to late season, lots of secondary roots, variable shapes. Overall appearance = 5.

W366 - Dark rose skin, orange flesh, slightly flaky skin, elliptic and ovate shapes, late season, poor yield. Overall appearance = 3.

W372 - Copper skin, orange flesh, moderately smooth skin, elliptic to ovate shapes, mid to late season, bumpy and tapered shapes, no nice shapes. Overall appearance = 4.

W375 - Purple skin, orange flesh, moderately smooth skin, elliptic shapes, late season, moderate secondary roots. Overall appearance = 4.

Unofficial entries in the 2002 National Sweetpotato Collaborator Trial for comparison:

Hernandez G2 - Copper-orange skin, deep orange flesh, slightly flaky skin, elliptic shapes, late season. Overall appearance = 6.

Jewel G2 (J98-2) - Copper skin, orange flesh, moderately smooth skin, elliptic shapes, mid season, moderate veins. Overall appearance = 6.

NC98-061 - Dark rose skin, deep orange flesh, moderately smooth skin, elliptic and ovate shapes, mid to late season, very nice but low yield. Stays short, but some pear shapes. Overall appearance = 8.

NC98-608 - Rose skin, orange flesh, moderately smooth skin, elliptic shapes, mid season, some veins, some root hairs, very good shape uniformity. Overall appearance = 8.

Table 1. Sweetpotato True Seed Harvested in 2002.

Maternal Parent	No. Seed/Polycross Nursery		Total
	CCRS, Clayton		
	Elite	SSR	
NC92-08	---	154	154
NC93-50	---	1	1
NC96-13	---	2077	2077
NC96-27	3276	---	3276
NC96-61	4155	---	4155
NC97A-04	4861	---	4861
NC97A-45	---	485	485
NC97-166	---	710	710
NC97-433	---	858	858
NC98-419	---	12786	12786
NC98-576	2308	1475	3783
NC98-608	0	---	0
NC99-299	2123	---	2123
NCC-58	3644	1370	5014
Beauregard	---	1610	1610
Goldstar	7411	---	7411
Hernandez	1842	1334	3176
Jasper	211	46	257
L78-21	---	399	399
L80-62	1759	1680	3439
L94-96	7960	5535	13495
L96-117	1713	392	2105
MSK39	1618	---	1618
Patriot	---	425	425
Ruddy	2450	---	2450
W250	---	1870	1870
Totals	45331	33207	78538

'---' line was not in this nursery.

Table 2. 2002 Sweetpotato seedlings selected at the CRS, Kinston.

Maternal parent	# selections	Maternal parent	# selections
<i>Seed from the 2001 Elite nursery</i>			
NC92-08	6	Kumara Enea	8
NC97A-04	9	L80-62	11
NCC58	10	L86-33	10
Goldstar	7	W250	27
Hernandez	11	W271	8
Jasper	9		
Total			116
<i>Seed from the 2001 SSR nursery</i>			
NC92-08	7	Excel	2
NC93-50	10	Hernandez	25
NC96-13	3	Ihuanco	8
NC96-61	2	L78-21	13
NC97-433	19	L80-62	1
NC98-576	2	L86-33	6
Beauregard	4	L94-96	4
NCC58	6	W250	5
Total			117
<i>Seed from the 2001 Dry matter nursery*</i>			
NC1880	35	HiDry	6
NCA88	10	Kogane Genga	9
NCFT3-89	36	Kogane Sengan	17
NCFTA94	18	MDP217-84	21
NCWB-16	15	Minamiyutaka	29
394	10	Pelican Proc.	16
BM83-4	2	SPV73	13
BM85-42	35	Sumor	44
CIP420024	1	Suwon 147	43
CN1489-43	1	Whitestar	21
Costeno	4	Woksaken	43
Hebei 351	1		
Total			430
Grand Total			663

*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. 2002 Sweetpotato seedlings selected on farm and at the HCRS, Clinton.

Maternal parent	# selections	Maternal parent	# selections
<i>Williams Farm, seed from the 2001 Elite nursery</i>			
NC96-27	9	Goldstar	9
NC97A-04	16	Hernandez	21
NCC58	21	L94-96	16
		Total	92
<i>Jim Jones Farm</i>			
	<i>2001 Elite nursery</i>		<i>2001 SSR nursery</i>
NC96-27	8	NC93-50	8
NC96-61	11	NC97-433	10
		Beauregard	6
		Hernandez	9
		L86-33	4
		L94-96	18
		Patriot	6
		Total	80
<i>Tull Hill Farms, seed from the 2001 Elite nursery</i>			
NC97A-04	15	L86-33	1
Hernandez	10	L94-96	28
Jasper	19	W271	6
		Total	79
On Farm Grand total			251
<i>Horticultural Crops Research Station, seed from 2001 Elite</i>			
NCC58	13	96-61 OP	9
Goldstar	5	Beau X Hern	1
Hernandez	13		
W99	7		
		Total	48

Table 4a. 2002 National Sweetpotato Collaborators yield trial, CRS, Kinston, NC Planted: 13Jun02; Harvested: 01Oct02; 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
B63 G2 (LSU)	691	587	97	124	53	23	9	15
B94-14 G2	739	613	100	132	52	19	12	17
HernandezG2*	522	481	80	100	44	46	2	8
Jewel G2* (J98-2)	724	607	101	129	58	23	3	16
MSI52	648	580	96	124	49	38	3	11
MSK39	616	490	81	103	49	12	18	21
NC96-61	633	416	70	89	31	35	0	34
NC97A-04	629	522	87	111	33	43	7	17
NC98-061*	502	490	80	104	48	48	1	2
NC98-608*	655	611	102	129	62	26	6	6
W365	381	359	59	77	53	41	1	6
W366	388	368	61	78	28	67	0	5
W372	558	459	76	97	41	41	0	18
W375	385	353	57	78	31	61	0	8
Grand Mean	577	495	81	106	45	37	4	13
CV (%)	13	14	15	14	15	17	88	38
LSD (p=0.05)	94	87	15	19	9	8	5	6

All trials are reported in 50 lb. bu.

*Not official entries

Table 4b. 2002 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
B63 G2 LSU	E	20	2.5	rs	ms	3	7	7	3	5	6	MSH, ↑CRK
B94-14 G2	E	20	2.5	rs	ms	3	7	8	3	5	6	MSH, ↑ID
Hernandez G2	L	22	2.5	cu or	ltfl	3.5	6	7	3	7	6	MSH
Jewel G2 (J98-2)	M	22	2	co	ms	3	6	7	3	6	6	MSH, ~VNS, ↑ID
MSI52	M	20	3	lco	ms	3	7	7	3	6	6	MSH, ~VNS
MSK39	E	20	2.5	rs	ms	3.5	7	7	3	4	5	↓ID, ↑PN
NC96-61	M	20	2.5	rs	sm	3	8	8	3	7	7	↑↑RC, ~VN ↑MSH, ↑ID,
NC97A-04	M	22	4	rs	sm	3.25	7	6	4	6	4	↑SK
NC98-061	ML	20	2	dkrs	ms	3.5	7	7	3,5	8	8	SS, OV
NC98-608	M	20	2.5	rs	ms	3	6	7	3	8	8	~RH, ~VN
W365	ML	25	2.5	cu or	ms	3	7	7	3	5	5	~T, ~2°R
W366	L	20	3	dkrs	ltfl	3.25	7	7	3,5	4	3	MSH, ↓YLD
W372	ML	21	3	co	ms	3	7	7	3,5	4	4	MSH, TP, B
W375	L	22	3	pu	ms	3	7	7	3	5	4	MSH, ~2°R

Comments: Dry growing season, moderate insect damage throughout test.

Table 5a. 2002 Advanced Yield Trial at HCRS, Clinton, NC. Planted: 11Jun02; Harvested: 07Oct02; Days to Harvest: 118.

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
96-61 G2	870	691	118	103	56	16	7	21
98-061	623	562	96	85	66	12	12	10
98-608	741	619	106	94	49	15	20	16
B94-14 G2	835	593	100	90	48	10	14	29
Hernandez G2	730	668	115	100	64	17	10	9
Grand Mean	760	627	108	93	56	14	13	17
CV (%)	13	14	15	14	8	18	28	19
LSD (p=0.05)	156	NS	NS	NS	7	4	6	5

Table 5b. 2002 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
96-61 G2	M	21	2	rs	sm	3.5	8	7	3,6	8	7	RC, ~VN, ↓SO
98-061	M	21	1.5	rs	ms	3	6	5	3,5	6	5	T, ~SO
98-608	M	20	2	rs	ms	3.25	7	7	3,2	7	7	PP
B94-14 G2	E	21	2.5	rs	ms	3	8	6	3,7	4	4	MSH, ~SO
Hernandez G2	M	22	3	or	ms	3.25	6	6	3	7	6	

Comments: Only test where 98-608 produced more jumbo's than Beauregard, may be due to the use of pulled plants since that was all that was available at planting. Lots of culls for poorly shaped roots, especially in Beauregard.

Table 6a. 2002 Advanced Yield Trial at CRS, Kinston, NC. Planted: 10Jun02; Harvested: 01Oct02; Days to Harvest: 113.

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
NC96-61 B	716	579	101	114	44	33	3	19
NC97A-04	740	578	101	114	35	36	6	22
NC98-608	787	762	133	150	59	36	2	3
B94-14 G2	816	585	100	115	44	15	13	29
Hernandez G2	633	512	90	100	36	42	3	19
Grand Mean	738	603	106	123	44	32	5	18
CV (%)	6	9	6	7	11	11	55	26
LSD (p=0.05)	69	80	10	14	7	5	5	7

Table 6b. 2002 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
NC96-61 B	M	21	2.5	rs	sm	3	8	8	3	8	7	↑↑RC
NC97A-04	M	20	4	rs	sm	3.25	7	4	4	6	4	↑↑L, JL
NC98-608	M	22	2.5	rs	ms	3	6	7	3,6	8	8	NS
B94-14 G2	E	22	3	rs	ms	3	7	7	3,6	5	5	MSH
Hernandez					lt							
G2	L	23	3.5	cu or	fl	3	6	6	3,4	7	6	↑PI, L

Comments: Lots of culls for shapes in all clones except NC98-608 and NC96-61. NC96-61 was culled for russet crack. 98-608 stood out for shape quality and uniformity.

Table 7a. 2002 Preliminary 1 Yield Trial at HCRS, Clinton, NC. Planted: 29May02; Harvested: 24Sept02; Days to Harvest: 118.

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
97-024	631	420	55	69	40	16	10	34
97-075	714	467	60	76	40	13	13	34
97-166	672	522	68	87	45	13	20	22
97-539	613	543	70	90	64	17	7	11
97A-04	838	685	86	110	55	15	12	18
98-017	433	286	37	48	47	16	4	34
98-024	660	570	74	94	66	14	7	13
98-061	518	393	50	64	50	15	11	24
98-063	654	582	77	99	64	12	13	11
98-076	988	714	92	117	33	6	35	26
98-084	772	675	87	111	55	19	13	13
98-175	925	615	81	104	37	7	23	34
98-265	728	654	86	111	59	16	14	11
98-342	695	607	76	96	59	17	11	12
98-419	533	503	65	84	61	26	7	6
98-550	705	593	77	97	55	16	13	16
98-608	753	637	80	102	49	9	26	16
B94-14 G2	909	807	100	128	53	8	27	12
Hernandez G2	710	633	78	100	57	15	17	11
MSK39	694	488	63	81	40	6	25	29
Grand Mean	707	570	72	93	52	14	15	19
CV (%)	17	18	18	18	15	32	43	37
LSD (p=0.05)	169	144	18	24	11	6	9	10

Table 7b. 2002 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
97-024	M	17	3	cu rs	ms	3	8	6	3	6	5	SSR, ↑CRK
97-075	M	17	2	rs pi	sm	3.25	7	6	3	6	5	↑RT, g. raw
97-166	EM	17	2.5	rs	ms	3.5	7	6	3	6	5	MSH, ~VN
97-539	M	18	2.5	lt cu	sm	3	8	5	3,6	7	5	LE
97A-04	M	18	3.5	rs	ms	3	8	5	3,4	7	6	L, LE
98-017	M	16	2.5	cu	m fl	3	8	6	3	7	5	
98-024	EM	19	3	rs	ms	3.25	8	6	3	7	7	SSR, ~VN
98-061	M	18	1.5	rs	ms	3.25	7	6	3,2	5	5	SS, SSR?
98-063	ME	17	2.5	dk rs	ltfl	3	8	6	3	7	7	SSR?
98-076	E	18	3	rs	ms	3	7	7	3,4	6	6	~MSH
98-084	M	14	3	lt cu	ms	3	7	7	3	7		SSR, L,
98-175	M	17	2.5	cu	ms	3.25	7	7	3	6	5	CR, LG
98-265	M	18	3.5	rs	m fl	3	7	6	4	7	4	L
98-342	M	17	3	red	ms	3	8	7	3	7	6	↑RH, ~VN
98-419	M	24		lt cu	sm				3	7		BR
98-550	M	16	3	rs	sm	3	8	7	3	6	6	~SSR, ~VN, RC?, SD
98-608	EM	18	2	rs	ms	3	8	6	3	6	6	~LE, ↑RG
B94-14 G2	E	17	2.5	rs	ms	3	8	6	3,6	7	7	
Hernan. G2	M	18	3	or	ms	3.25	7	6	3,6	7	7	
MSK39	ME	17	2	rs	ms	3	7	7	3	5	5	RC?, MSH

Comments: Beauregard outperformed all clones in this trial.

Table 8a. 2002 Preliminary 1 Yield Trial at CRS, Kinston, NC. Planted: 10Jun02; Harvested: 30Sept02; Days to Harvest: 112.

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
97-166	998	727	123	142	29	19	26	27
97A-04	672	462	80	91	23	28	18	31
98-024	618	486	85	97	41	34	5	21
98-061	576	521	92	104	55	34	2	10
98-063	839	724	124	142	46	33	7	14
98-076	867	632	109	125	35	12	25	27
98-342	664	534	95	107	46	22	11	20
98-419	556	489	85	97	48	35	4	12
98-550	527	390	68	78	51	16	7	26
98-608	727	626	110	125	54	27	5	14
B94-14 G2	777	601	100	116	38	12	28	23
Hernandez G2	657	513	87	100	51	24	4	21
MSK39	734	586	102	117	42	7	30	20
Grand Mean	709	561	97	112	43	23	13	20
CV (%)	13	15	13	14	16	30	47	34
LSD (p=0.05)	136	120	18	23	10	10	9	10

Table 8b. 2002 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
97-166	EM	17	3	cu rs	ms	3.5	6	7	3	6	6	↑VN, ~CRK
97A-04	M	19	4	lt rs	sm	3	7	6	4	7	4	L
98-024	ML	23	3	dk rs	ltfl	3.25	6	6	3	7	6	RSK
98-061	M	21	2	rs	sm	3.25	5	6	3	7	6	SS, T
98-063	M	19	2.5	dk rs	ms	3.5	7	7	3	7	7	?C. Ruby replacement
98-076	VE	22	3	rs	sm	3	7	8	3	5	5	MSH, BR
98-342	M	18	3	rd	ms	3.25	7	7	3	8	7	↑RH, STR, CRK
98-419	M	26	2.5	clr	sm	3.25	6	6	3	7	6	BR
98-550	M	20	2.5	rs pi	sm	3	7	7	3	6	6	RC, SH
98-608	M	20	2	cu rs	sm	3	7	7	3	8	7	CV, ~VN
B94-14 G2	E	20	3	rs	sm	3	7	8	3,4	5	4	MSH
Hernandez G2	M	21	3	cu o	ms	3.25	6	7	3	6	6	~PI, ~SPR
MSK39	E	21	3	rs	ms	3	7	6	3	6	5	few but large roots

Comments: Three clones stood out for earliness; NC97-166, NC98-076 and MSK39, similar to Beauregard, and will be tested as parents.

Table 9a. 2002 Preliminary 2 Yield Trial at HCRS, Clinton, NC. Planted: 31May02; Harvested: 24Sept01; Days to Harvest: 117.

CLONE	Marketable Yield				Size Distribution by Class (% of total yield)			
	Total Yield bu/A	bu/A	%Beau	% Hern	No.1's	Canners	Jumbo's	Culls
99-009	628	492	79	95	50	11	16	22
99-012	867	786	124	150	52	17	22	9
99-026	778	715	114	139	52	9	31	8
99-031	638	557	90	108	55	28	4	13
99-064	731	674	107	131	60	20	12	8
99-068	806	729	116	140	62	11	17	10
99-088	575	489	79	90	59	18	5	18
99-253	511	358	55	66	40	19	10	31
99-299	712	520	82	94	45	15	12	28
99-371	862	822	129	158	54	17	24	5
99-392	723	657	106	129	49	17	25	9
99-415	656	541	85	102	49	24	10	18
99-431	489	320	52	62	39	20	5	36
99-501	640	566	89	110	51	28	9	12
99-538	485	460	74	88	64	25	6	5
99-573	743	672	107	130	53	17	21	10
B94-14 G2	813	639	100	121	42	10	27	21
Hernandez G2	579	536	84	100	61	22	10	7
Grand Mean	680	585	92	113	52	18	15	15
CV (%)	17	22	23	24	18	29	57	53
LSD (p=0.05)	168	179	30	39	13	8	12	11

Table 9b. 2002 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
99-009	ME	17	2	lt cu	sm	3	8	7	3	3	5	SSR?, ~LT, ~T
99-012	M	15	2.5	rs	ms	3	8	7	3,6	7	6	FW?
99-026	M	16	2	rs	m fl	3.25	8	6	3,6	6	6	Mix?
99-031	M	19	2.5	rs	sm	3.5	8	7	3	7	7	SSR?
99-064	M	14	2.5	rs	m fl	3.25	8	5	3	7	6	LE
99-068	M	14	2	rs	ms	3.5	8	7	3,6	6	7	
99-088	M	23	2.5	dk rs	ms	3	8	7	3	6	6	~RT
99-253	ML	17	3.5	rs	fl	3	7	7	3,4	4	4	D, L, IRR
99-299	M	14	2.5	cu	ms	3.25	7	6	3	6	5	CR, LG
99-371	ME	15	2	cu	ms	3	8	7	3,6	6	6	
99-392	M	17	3	lt cu	ms	3	8	7	3	6	5	VN
99-415	M	15	2.5	rd	ms	3.5	8	7	3	7	6	↑SSR
99-431	L	16	2.5	dk rs	m fl	3.5	6	7	3,4	4	4	D, ↑CRK
99-501	L	19	3	cu	ms	3.5	7	6	3,4	6	6	↑SK
99-538	M	17	2	rs	ms	3	8	6	3	7	7	RC?
99-573	ME	15	2.5	rs	sm	3.25	7	7	3	6	7	
B94-14 G2	E	15	2.5	rs	ms	3	8	7	3	5	5	
Hernandez G2	M	16	2.5	or	ms	3.25	7	7	3	7	6	

Comments: A few of the better performing lines from this test will go into our on-farm trials in 2003.

Table 10a. 2002 Preliminary 2 Yield Trial at CRS, Kinston, NC. Planted: 10Jun02; Harvested: 30Sept02; Days to Harvest: 112.

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	766	695	115	156	60	24	7	9
99-009	617	462	77	104	50	14	11	25
99-012	893	737	123	166	39	36	8	18
99-026	661	570	96	130	54	22	10	14
99-031	688	639	105	143	34	57	2	7
99-064	659	558	91	125	49	36	0	15
99-068	909	655	109	146	30	13	28	29
99-083	754	609	102	137	49	26	6	19
99-088	845	662	109	148	34	18	27	22
99-299	811	567	94	127	37	26	7	30
99-371	687	603	101	135	52	27	8	12
99-392	674	565	94	127	49	33	2	15
99-415	590	464	77	104	45	17	17	21
99-524	739	584	96	132	48	29	2	21
99-538	750	624	103	140	55	28	1	16
99-573	858	708	120	161	44	28	10	18
B94-14 G2	756	611	100	137	36	10	34	19
Hernandez G2	587	447	74	100	42	33	1	24
Grand Mean	736	598	99	136	45	26	10	19
CV (%)	12	16	16	16	20	25	75	42
LSD (p=0.05)	120	132	22	30	13	9	11	11

Table 10b. 2001 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
98-608	M	21	2	rs	ms	3	6	8	3	7	8	↑packout
99-009	M	23	2	cu	sm	3	8	8	3	6	6	~PI
99-012	ML	19	3	cu rs	ms	3	7	8	3,6	7	6	L
99-026	ME	23	2.5	cu rs	ms	3	7	6	3,6	7	7	SS, VN, LE
99-031	ML	22	2.5	rs	v sm	3.25	7	6	3	8	7	~VN, LE
99-064	M	18	2	cu rs	ltfl	3.5	7	7	3,6	7	7	~2 ⁰ R, ~PI
99-068	E	18	3	cu rs	ms	3.25	7	7	3,4	6	5	MSH, L
99-083	EM	20	2	cu rs	sm	3.25	7	7	3,5	5	6	SS
99-088	EM	26	4	cu rs	sm	3	7	7	3,4	7	5	↑L
99-299	M	19	4	cu	ltfl	3	7	7	4	7	4	↑CR, ↑L, ~RC, D
99-371	ME	21	2	cu or	sm	3	7	8	3	7	7	Skin/flesh color same
99-392	EM	21	2.5	lt cu	ms	3	5	7	3	8	5	VN, EY
99-415	M	19	3	rd	sm	3.25	7	7	3,6	7	6	L, ~STR
99-524	E	22	3	pu	sm	3.25	7	7	3	7	7	↑SK
99-538	M	21	2	rs pi	ms	3	7	7	3	8	8	SS, NS, ~RC, CR, PI
99-573	M	20	3	rs	sm	3	6	8	3,6	7	6	L, NS, EY
B94-14 G2	E	22	2.5	rs	ms	3	8	7	3,6	6	6	MSH
Hernand.G2	ML	24	3.5	cu or	ltfl	3.5	6	7	3	7	6	L, ~PI

Comments: NC98-608 and NC99-538 tied for best overall appearance largely for good, uniform and compact shapes.

Keys to Tables

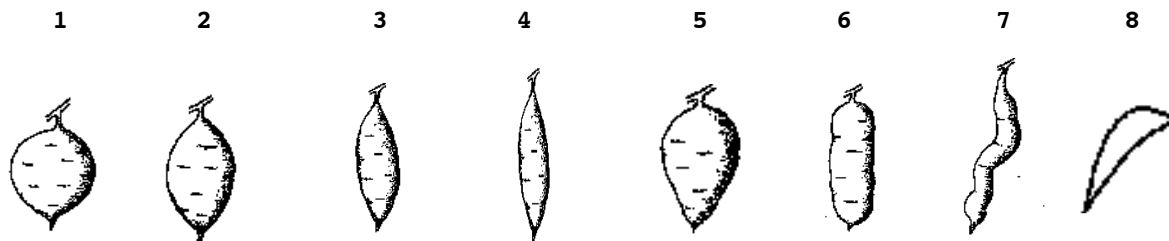
Storage root data: **MAT**=maturity E=early, M=mid and L=Late; **DM**=percentage dry matter; **L/D**=length/diameter ratio; **SKC**=skin color clr=clear cu=copper, lt=light, or=orange, pi=pink, pu=purple, rd=red, rs=rose, tn=tan wh=white; **SKT**= skin texture, m fl= moderate flakiness of skin, lt fl= 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



Acknowledgements

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growers.