NCSU SWEETPOTATO BREEDING PROGRAM

SUMMARY OF CULTIVAR DEVELOPMENT WORK

for

1999

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Project Objective(s): The objectives of the Sweetpotato Breeding and Genetics project are: 1) to develop new sweetpotato varieties, which are adapted to North Carolina's growing conditions, possess exceptional yield, appearance and quality characteristics, and have high levels of resistance to diseases and insects; and 2) to conduct sweetpotato breeding and genetics studies focused on identifying and incorporating traits of economic importance into sweetpotato germplasm and new cultivars.

Project Highlights

Funds provided by the North Carolina Sweetpotato Commission supported all aspects of the breeding program's work. Highlights of our 1999 activities are as follows.

1. We collaborated with the Micropropagation Unit (MPU) by planting seven trials at two sites (HCRS and CRS) to select mericlones of Beauregard, Jewel, Carolina Rose and Carolina Ruby for release to NC growers. Additionally we assisted in the evaluation of Hernandez mericlones for inclusion in the MPU program.
2. This was our third year of the Grower Participatory Breeding Project in which first year seedlings were selected on-farm with the assistance of growers, Extension Agents and Specialists. In addition some advanced lines were evaluated in unreplicated trials. Emphasis in 2000 will be on expanding the evaluation of advanced materials in many locations so we can rapidly identify widely adapted material.
3. We planted 61,000 true seed which resulted in 582 seedling selections. We planted seed from all parents and used the selection percentage to gain valuable information on the ability of the parents to produce superior clones. Using this data we can put together better nurseries and increase our odds of finding superior varieties.
4. This was our second year of our Streptomyces soil rot (SSR) field nursery. We screened 171 clones for field resistance to SSR. This long- term project will give us a critical tool for rapidly assessing the suitability of material for NC growing conditions.
5. We survived the hurricanes. Only a small portion of our lines were lost. Selecting under such severe conditions will help us develop material that can handle flood stress seasons.

A more detailed description of the breeding program's activities are detailed below.

1999 Polycross Breeding Nurseries

We established three polycross nurseries in 1999. The Elite Nursery, located at the Horticultural Crops Research Station in Clinton, is designed to produce materials with the potential to become varieties. In this nursery, varieties 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, located at the Central Crops Research Station in Clayton, is dedicated to developing parents with high levels of soil rot resistance. The Parallel Nursery, also at the Clayton station, is designed to develop parents with a combination of soil rot, root-knot nematode resistance, and high dry matter for use in the Elite and SSR nurseries. All nurseries are composed primarily of breeding material developed by NCSU, LSU, and the USDA sweetpotato breeding projects. Table 1 provides results of the seed harvests per maternal parent. Seed

rescued from the frost and finished in the greenhouse are not included in the totals for the SSR nursery.

First-Year Seedling Selections

Nearly 61,000 true seed from the 1998 polycross nurseries were grown in the Horticultural Department greenhouses starting in February. Seedlings from the Elite Nursery (ca. 27,000) and SSR nursery (ca. 24,000) 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%. Seedlings are planted three feet apart so they remained as distinct hills at harvest. Selection at harvest was based on the following criteria: shape, flesh color, skin texture, size distribution, root number, earliness, and observable diseases or defects.

The Parallel nursery is a recurrent selection nursery, where the next cycle parents are chosen from this cycles offspring. Here the focus is on soil rot and nematode resistance plus high dry matter, with flesh color being a secondary concern. Thus these seedlings are planted without being selected at planting. The primary objective of offspring from this nursery is to be parents that supply high levels of resistance to the two diseases and high dry matter.

Tables 2 and 3 contain a listing of the selections made by nursery and by maternal parent selected at the Horticultural Crops Research Station and the Cunningham Research Station respectively. From the nearly 61,000 seed 582 were selected for further evaluation. This is slightly less than 1% of the seed planted, somewhat lower than usual. Part of this is due to the difficult weather conditions this year. A cool spring was followed by a hot dry summer that minimized growth until the hurricane rains arrived. By selecting in these environments we are selecting for clones that perform well under adverse conditions, an important consideration in NC.

As part of the Grower Participatory Breeding Project, three on-farm sites were used to evaluate seedling from 24,258 of the true seed. The parents and selections are shown in Table 4. Cooperators involved in this project were:

Researchers	Extension	Growers
Craig Yencho	Wilfred R. Jester	Bruce Howell
Kenneth Pecota	William Little	Vick Farms
Jonathan Schultheis	Allan Thornton	Burch Farms

Field sites were located within commercial fields and the trials were treated in the same fashion as the commercial fields (fertilizer, 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 which had better appearance than the check variety Beauregard. These selections will be planted in Clinton and Kinston in 2000 as unreplicated 20 hill plots for the second cycle of selection. It is very useful for us to select under commercial conditions to rapidly identify material adapted to actual growing conditions.

Second-Year Selections

In 1998, we made 725 first-year seedling selections. This year they were planted in 15-20 hill plots at Clinton and/or Kinston. 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. A few clones rotted in storage or did not sprout in the spring. From these, 33 selections were made in Kinston, and 22 in Clinton. Three of the selections were chosen at both sites, for a total of 58 selections remaining. These clones are designated as 98-xxx, having been named when they were selected as single hills in 1998, 98-001 being the first seedling hill selected in 1998. Clones selected at both locations indicate a broader adaptation, it is somewhat disappointing to have so few selected in both locations, however this is only one season and the adaptation ability needs to be tested over many environments in many seasons.

Third-Year Selections

The 125 second-year selections made in 1998 were planted as unreplicated 100 hill plots at Clinton and/or Kinston. We selected 29 of these for further evaluation this year. Our evaluation criteria remained the same but we become stricter for any flaws. Also with more plants we get a better idea of the yield in comparison to the Beauregard check rows. 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

Of the advanced selections evaluated this year, two looked quite good, but it is too early to tell if they have the potential to replace Beauregard. A third clone has been in the National Collaborators Yield tests for four years now and will probably be dropped this year. The other two will be tested again next year both on farm and on the research stations. Twenty-four additional clones are still being evaluated. Many clones that fall just short of becoming varieties are used as parents based on the multiple tests gathered for release potential. The following are the best based on the last few years of testing:

93-17 Rose skin, similar to Beauregard in color and smoothness, deep orange flesh, rows of moderately deep eyes. Mid to late season, similar to or slightly later than Hernandez. Shapes are uniform, fusiform and stay fairly thin. Dry matter 19%. Very good eating and canning quality.
Disease reactions: Susceptible to soil rot; highly resistant to Fusarium wilt; susceptible to root-knot nematodes.
Yield: 107% of Beauregard in 44 tests. Has performed with mixed results in the National Collaborators test over the past three years. Ranked 1st for total yield in 1996 National Collaborators test, 4th in 1997.
Plant production: Similar to Jewel.
Status: Entered in the 1999 National Collaborators Trial, awaiting results. Deep eyes may make it unattractive to processors. This clones will probably be dropped due to lateness, lack of SSR resistance, deep eyes and lack of grower interest at field days.

96-61 Dark rose skin, orange flesh, smooth skin, consistent elliptic shapes, some shallow veins and striations, mid to late season, 21% dry matter. A very sweet baking line, though the baked flesh color is sometimes brownish. Easily picked out in taste tests.
Disease: Moderately resistant to soil rot, Fusarium wilt and root-knot nematodes.
Yield: 116% of Beauregard in 7 tests.
Plant production: Late sprouter, but a good number once it does sprout.
Status: Further evaluation in 2000, on stations and in on-farm trials.

97A-04 Rose skin, orange flesh, moderately smooth skin, good elliptic to slightly tapered shapes. Sometimes will produce raised lenticels. Dry matter 19%. Very good eating quality.
Disease: Resistant to soil rot and Fusarium wilt, moderately resistant to root-knot nematodes.
Yield: 121% of Beauregard in 3 tests.
Plant production: Late sprouter, but a good number once it does sprout.
Status: Further evaluation in 2000, on stations and in on-farm trials.

The results of yield tests that included these selected clones and other promising selections are presented in Tables 5-12.

Disease Resistance Screenings

In addition to the selection and yield evaluation trials, we screened 32 advanced, 123 preliminary selections and 13 parental lines for resistance to Fusarium wilt. Twenty-six of the advanced lines and 84 of the preliminary lines had moderate to high levels of resistance. All the advanced and 97 of the preliminary lines were screened in our Streptomyces soil rot field nursery in Clinton with two-thirds of them having moderate to high levels of resistance, suitable for field conditions.

The advanced and 50 of the preliminary lines were also screened for root-knot nematodes. Of these 83 total selections, 69 were at least moderately resistant (MR) to root-knot. Of the 80 lines screened for all three diseases, 23 had at least moderate resistance to all of them. We will eliminate several clones on the basis of these evaluations.

The field SSR screening is in its second year and has performed well. We will continue to inoculate next year to raise the levels of disease and make the screening more stringent. If after a few years the disease pressure is high enough, we will be able use this field to measure yield reduction caused by Streptomyces on advanced clones being considered for release. This screening is a significant asset to the program in that it allows us to evaluate a large number of lines under field conditions. We get an idea of how much yield is reduced and if SSR is able to form lesions on the root. Our greenhouse test, while very useful doesn’t give us 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.

1999 National Sweetpotato Collaborator Trial

A cool spring delayed plant growth in beds, and may have adversely affected sprouting in some clones. This was followed by a hot dry summer, which was ended by excessive rainfall from hurricanes Dennis and Floyd and the remnants of Harvey. Over 2 feet of rain fell between Sept 8 and 21st on these trials, more in other regions. One rep of the Clinton test was dropped due to flood damage, but not more than 10% of the other reps rotted. Root shapes and overall appearance were fair, with many culls due to shape defects in all clones. Flesh color was lighter than normal.

Description of Official Entries

Beauregard - Rose skin, orange flesh - some with a yellow band in the cortex, moderately smooth skin, blocky uniform shapes.

Jewel - Copper skin, light orange flesh, moderately smooth skin, elliptic and ovoid shapes, significant cracking and rotting.

NC93-17 - Rose skin, orange flesh, moderately smooth skin, elliptic to long-elliptic shapes.

W337 - Light copper to tan skin, orange flesh, moderately smooth skin, elliptic, long-elliptic and ovoid shapes, many roots too long, prominent lenticels, late.

W352 - Copper skin, orange flesh, smooth to moderately smooth skin, elliptic and ovoid shapes, prominent lenticels, late.

Unofficial entries in the test for comparison:

Beauregard B94-14 G1 - Rose skin, orange flesh, moderately smooth skin, blocky uniform shapes.

Carolina Rose - Rose skin, orange flesh, moderately smooth skin, elliptic to blocky shapes, significant lenticels and pimples, some cracking.

Carolina Ruby - Red skin, orange flesh, moderately smooth skin, elliptic and blocky shapes at Kinston, round elliptic in Clinton, prominent lenticels, significant cracking.

Hernandez - Copper-orange skin, very deep orange flesh, moderately smooth skin, elliptic, blocky and ovoid shapes, heavy pimpling.

L95-95 - Rose skin, orange flesh, moderately smooth skin, elliptic and blocky shapes, some prominent lenticels at Clinton, 2 reps at Kinston had severe russet crack.

Table 1. Sweetpotato True Seed Harvested in 1999.

	No. Seed/Polycross Nursery			
Maternal Parent	Clinton Elite	Clayton SSR	Clayton Parallel	Total
1528	1838	—-	—-	1838
91-09	—-	4513	—-	4513
91-14	1380	1754	—-	3134
92-08	71	0	—-	71
93-15	—-	12081	—-	12081
93-50	—-	4834	—-	4834
93-92	—-	4967	—-	4967
94-03	740	—-	—-	740
96-61	—-	1984	—-	1984
Beauregard	3139	7699	—-	10838
C-58	—-	2469	—-	2469
Car. Ruby	—-	5877	—-	5877
Eureka	—-	833	305	1138
Excel	521	1288	—-	1809
Goldstar	777	—-	—-	777
Hernandez	153	300	—-	453
L80-62	365	987	—-	1352
L84-74	4319	3557	—-	7906
L86-33	250	1454	—-	1704
L87-105	—-	1468	—-	1468
L94-96	795	—-	—-	795
L95-95	245	—-	—-	245
So. Delite	—-	1738	—-	1738
W271	2340	4854	—-	7194
W274	1039	1328	—-	2367
93-65	—-	—-	1831	1831
96-20	—-	—-	1766	1766
96-27	—-	—-	1625	1625
97-004	—-	—-	249	249
97-005	—-	—-	3793	3793
97-037	—-	—-	2828	2828
97-063	—-	—-	2022	2022
97-081	—-	—-	468	468
97-091	—-	—-	968	968
97-093	—-	—-	755	755
97-151	—-	—-	361	361
97-247	—-	—-	199	199
97-259	—-	—-	913	913
97-313	—-	—-	67	67
FT92-36	—-	—-	745	745
Golden Sweet	—-	—-	2	2
Sumor	—-	—-	1999	1999
W270	—-	—-	265	265
Total	17972	64015	21161	103148

‘—indicates that the line was not in this nursery.

Table 2. 1999 Sweetpotato seedlings selected at Clinton.

Maternal parent	# selections	Maternal parent	# selections
Seed from 1998 Parallel nursery			
93-11	36	Eureka	9
93-65	16	FT92-36	4
93-71	4	Hernandez	21
93-92	2	L86-33	29
A208	1	L87-95	2
DW8	1	Unknown	1
		Total	126
Seed from the SSR nursery surviving gh and field screenings			
Goldstar	1	L86-33	6
		Total	7
		Grand total	133

Table 3. 1999 Sweetpotato seedlings selected at Kinston.

Maternal parent	# selections	Maternal parent	# selections
Seed from 1998 Parallel nursery			
93-65	4	L86-33	7
		Total	11
Seed from 1998 SSR nursery			
92-08	1	Eureka	10
93-95	6	L84-74	6
93-50	2	L86-33	14
Beauregard	16	L89-110	5
		Total	60
Seed from 1998 Elite nursery			
1528	1	L84-74	12
91-09	3	L86-33	10
91-14	4	L89-110	7
93-11	1	L91-80	3
93-15	4	L91-189	9
Beauregard	5	Southern Delite	1
Car. Ruby	6	W230	1
Darby	2	W270	1
Excel	3	W271	5
Goldstar	7	W272	1
Hernandez	8	W274	3
L80-62	16	Total	113
Paired crosses			
Beau x Hern	1	Hern x Beau	4
		Total	5
		Grand total	189

Table 4. 1999 Sweetpotato seedlings selected on farm.

Maternal parent	# selections	Maternal parent	# selections
Seedlings selected at Burch Farms from 1998 SSR nursery			
92-08	11	Eureka	4
93-50	4	Hernandez	6
93-95	2	L86-33	6
Beauregard	10	L89-110	11
C58	4	Total	58
Seedlings selected at Vick Farms from 1998 SSR nursery			
91-09	1	L82-509	3
92-08	3	L84-74	8
93-50	4	L86-33	4
93-92	1	L87-104	3
93-95	4	L91-189	6
Beauregard	8	MD810	2
C58	6	W268	3
Car. Ruby	1	W271	4
Eureka	3	W274	2
Hernandez	7	W279	3
L80-62	5	Total	81
Seedlings selected at Howell Farms from 1998 Elite nursery			
1528	14	Hernandez	14
93-11	19	L84-74	5
93-15	16	L86-33	14
Beauregard	39	Total	121
		Grand total	260

Table 5. 1999 National Collaborators Yield Trial at Kinston.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	610	561	111	45	46	1	8
B94-14G0	501	430	88	62	19	4	14
Beauregard	607	520	.	60	18	7	15
Car. Rose	554	491	98	62	23	4	11
Car. Ruby	519	448	92	50	33	3	13
Hernandez	501	444	88	50	36	2	11
Jewel	464	317	65	36	32	0	32
L95-95	370	291	56	45	25	7	22
W337	336	280	57	36	48	0	16
W352	285	249	50	31	58	0	12
Grand mean	475	403	78	48	34	3	16
CV	20	22	22	18	32	134	47
LSD ($p<0.05$)	109	102	20	10	13	4	8

Table 6. 1999 National Collaborators Yield Trial at Clinton.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	531	480	82	56	34	1	10
B94-14 G1	640	601	—-	68	24	3	6
B94-14 GO	481	414	68	52	18	15	14
Car. Rose	578	478	83	55	10	15	20
Car. Ruby	568	407	68	47	13	8	31
Hernandez	444	407	71	63	25	2	10
Jewel	292	226	38	45	29	2	24
L95-95	510	471	80	65	21	7	8
W337	275	244	40	42	41	4	13
W352	249	232	41	41	52	1	6
Grand Mean	456	396	63	53	27	6	14
CV (%)	27	29	32	18	27	110	52
LSD (p=0.05)	158	151	26	13	9	5	10

Table 7. 1999 Advanced Yield Trial at Kinston.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	609	514	150	40	44	0	15
93-50	575	313	83	25	27	0	47
96-40	510	436	128	35	51	0	14
96-61	586	422	122	25	46	0	29
97A-04	481	430	125	37	51	1	11
Beauregard	531	369	.	49	17	3	31
Hernandez	454	387	109	46	36	2	16
Grand mean	525	417	120	34	45	1	20
CV	18	21	26	26	21	205	32
LSD (p<0.05)	107	102	36	10	11	2	7

Table 8. 1999 Advanced Yield Trial at Clinton.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	581	500	75	49	34	2	15
93-50	587	486	67	42	33	6	19
Beauregard	753	695	.	69	20	3	8
Hernandez	608	575	83	58	34	2	6
Grand Mean	624	550	75	50	33	3	14
CV (%)	22	25	35	17	17	142	47
LSD (p=0.05)	NS	211	NS	13	9	NS	10

Table 9. 1999 Preliminary 1 Yield Trial at Kinston.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
96-40	710	650	116	42	41	8	8
97A-04	675	637	112	40	46	8	6
97A-13	801	728	122	50	30	12	8
Beau B73	655	574	.	60	19	9	12
Hernandez	702	673	119	46	45	5	4
Jewel BS	564	427	76	44	31	0	25
Grand mean	619	547	95	41	42	5	12
CV	15	15	17	20	22	79	50
LSD (p<0.05)	110	102	20	10	11	5	7

Table 10. 1999 Preliminary 1 Yield Trial at Clinton.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
96-40	573	432	85	50	16	8	26
97A-04	686	642	128	64	24	5	8
97A-40	484	360	72	37	34	1	28
Beau B73	651	507	.	45	13	20	22
Hernandez	626	570	113	61	19	11	9
Jewel BS	561	422	83	51	19	5	25
Grand Mean	535	435	85	49	23	8	20
CV (%)	22	26	27	19	27	71	34
LSD (p=0.05)	150	144	29	12	8	7	9

Table 11. 1999 Preliminary 2 Yield Trial at Kinston.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	733	693	113	36	59	0	5
93-50	763	675	112	30	56	3	11
96-09	803	714	118	45	39	4	12
96-61	739	609	98	28	51	2	18
97A-45	529	482	80	56	34	1	8
B94-14 G1	664	623	.	52	38	4	6
Hernandez	606	594	98	48	42	8	2
Japanese	597	549	91	45	42	5	8
Jewel	598	485	82	37	44	0	19
Grand mean	663	599	98	39	49	3	9
CV	16	16	17	21	22	131	69
LSD (p<0.05)	123	115	19	9	12	4	7

Table 12. 1999 Preliminary 2 Yield Trial at Clinton.

				Size Distribution by Class (% of total yield)			
	Total Yield	Marketable Yield					
CLONE	bu/A	bu/A	% Beau	No.1's	Canners	Jumbo's	Culls
93-17	862	732	93	51	27	7	15
93-50	920	703	87	48	20	8	24
96-09	941	620	76	41	15	9	35
96-61	861	598	75	42	18	9	30
97A-45	566	501	66	60	16	13	11
Beau B73 G1	909	827	.	47	11	33	9
Hernandez	732	690	87	62	28	4	6
Jewel	530	266	31	28	14	7	51
Grand Mean	688	532	64	44	25	7	24
CV (%)	24	28	33	19	29	73	29
LSD (p=0.05)	191	174	24	10	8	6	8