2004 PROGRESS REPORT
To
North Carolina Sweetpotato Commission

TITLE: Sweetpotato Grower-Participatory Breeding Project Support

LEADERS: G. C. Yencho and K. V. Pecota

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. The specific objectives of the Grower-Participatory Breeding Project (GPBP) are to work collaboratively with growers, Extension Agents and Specialists to evaluate seedlings, and preliminary and advanced selections of our most promising breeding lines on-farm with the goal of rapidly selecting and developing new varieties.

Project Cooperators

Researchers	Extension	Growers
Mr. Bill Jester	Mr. William Little	Mr. Jim Jones
Dr. Jonathan Schultheis	Ms. Tiffany Wells	Mr. Timothy McLamb
Dr. Zvezdana Pesic-VanEsbroeck	Mr. Allan Thornton	Mr. Roger Lane and Pride of Sampson

Project Summary:
The Grower-Participatory Breeding Project has been in existence for seven years and we now have two primary research objectives. First, we are continuing our efforts to grow and select first-year seedlings on commercial farms. Second, we are evaluating our most promising advanced lines on-farm so that growers can provide input on their commercial potential. Those that perform well can be rapidly increased by growers, and evaluated for field, storage and packing traits on a larger scale. NC98-608, which we plan to release as Covington in 2005, is our first “graduate” of this system of breeding.

This collaborative effort has been very successful in that it has increased information exchange between growers, researchers and extension personnel. From a breeding perspective, it has also enabled us to better define our breeding goals and prioritize these based on input from growers. For growers, it has allowed us to demonstrate and explain how new cultivars are developed.

Table 1 provides a summary of the number of clones the GPBP has screened on-farm as part of the GPBP. To date, this project has resulted in the development of 17 advanced lines that are in various stages of evaluation, and four breeding lines that are currently being used in our polycross breeding nurseries.

Thirty percent of the true seed grown in our breeding program during 2004 were grown on three farms with the cooperation of growers, Extension Agents and Specialists. Field sites were located within commercial fields and the trials were treated in the same fashion as the commercial fields (fertilizer, pest control etc., except spacing) (Table 2). From 15,000 seedlings planted, 186 were selected for further evaluation, a rate of 1.2%, slightly lower than the long-term average of 1.5%. Growing conditions varied from site to site, which is one of the strengths of this project. All sites yielded selections that had better appearance than the check variety Beauregard. This year we also included NC98-608 as a check variety

on the same three-foot spacing as the seedlings. We noticed that NC98-608 produces much better shapes and more uniform sizes than Beauregard does on a similar wide spacing.

Selection at harvest was based on the following subjective visual criteria: shape, flesh color, skin texture, relative yield, size distribution, root number, earliness, and observable diseases or defects. These selections will be planted in Clinton and Kinston in 2004 as unreplicated 20-hill plots for the second cycle of selection.

The second component of the GPBP is to evaluate promising breeding lines under commercial conditions. This year eleven clones and three check lines were grown in unreplicated 100 foot plots and evaluated at each location where the seedlings were grown. Notes on how they performed at each location are shown in Tables 3-5. These observations are combined with research station trial data and disease screening data to determine the potential of each as a cultivar. Our most promising clone, NC98-608 was the best clone in these trials. In addition to these evaluations it was grown by at least ten growers in 2004 in small- to medium-sized commercial trials with over 100 total acres planted. A full description of this line can be found in the Cultural Management Report.

Performance of the different clones varied significantly from farm to farm (Tables 3-6). Indeed, observing differences in clonal "performance" from site to site has been very useful for our breeding efforts because it allows us to select those clones that are most stable from site to site, and season to season. For an example of this see Table 6 which compares the yield and appearance ratings of all the clones tested across each of the three sites. Besides NC98-608 only three of the advanced clones performed reasonably well in all grower locations. Their descriptions are as follows:

NC99-026 Moderately smooth copper-rose skin, orange flesh, elliptic to blocky shapes, lenticels a little prominent, generally short length/diameter ratio that makes for nice sized No.1 roots, early to mid season. Good size distribution and earliness.

Disease Resistances: Resistant to Fusarium wilt and root-knot nematodes.

Status: Advanced tests in 2005 and on-farm trials. Needs further testing for Streptomyces resistance. Skin color may be too light. Use in 2005 polycross nursery.

NC99-573 This clone produces smooth skinned, rose-colored roots that are attractively shaped. Yield is high. Growing season about two weeks longer than Beauregard. Lenticels are fairly prominent in wet conditions and it is susceptible to root-knot nematodes. Needs further evaluation.

Disease Resistances: Resistant to Fusarium wilt and Streptomyces soil rot, susceptible to root-knot nematodes.

Status: Entered into MPU for virus cleanup. Test clean plants in 2005 if ready. Used in 2004 nurseries.

NC00-748 This is a white skinned, cream fleshed clone that would fit the same niche as O'Henry. Appearance has been as good or better than Beauregard in most trials. However, it sets more roots than Beauregard and needs a considerably longer growing season, probably 20 days longer than Beauregard. The dry matter is 28% and it has a drier texture when baked, more like some of the old white cultivars, many of which are being replaced by O'Henry.

Disease Resistances: Moderately resistant to fusarium wilt, resistant to root knot nematodes, and it appears to have moderate resistance to soil rot. None of the older, drier whites have resistance to soil rot.

Status: In advanced tests and on farm trials in 2005.

Please see the Variety Development Report for yield trial results of these clones.

Many other lines performed well in only one or two of the sites (Table 6), an indication that they are not

broadly adapted. And, we observed fairly significant differences between Beauregard obtained from the Sandhills versus G2 grower Beauregard's. We are not sure why these differences are present, but suspect that it has to do with transplant quality.

When we are limited to testing on the research stations alone we typically do not see as many varied environments per season. Thus, the GPBP has enabled us to evaluate the performance of clones under a variety of stresses (e.g. drought, flooding, insect, disease and weed pressure) in a single year. If only a single evaluation site is available this process takes a few years, and we have to carry and increase lines that have serious weaknesses and this lengthens the time to release. Our emphasis in 2005 will be on expanding the number of advanced materials evaluated in multiple locations so we can identify widely adapted materials and advance them as quickly and under as many environmental conditions in a single year as possible. We will also be adding more specialty-types in these evaluations as they become available.

Acknowledgements

The continued support of the NC SweetPotato Commission is gratefully acknowledged. The exceptional technical expertise and assistance of Cindy Pierce and Mark Clough, Research Technicians with the sweetpotato and potato breeding programs, respectively is acknowledged. Thanks also to Newell Hancock for his hard work and dedication to the program. We also thank the research station staff at the HCRS, CCRS and CRS, and Christina Rowe, Jennifer Swift and Amanda Kroll our summer helpers for excellent support, and Graduate Students Adam Bruckner, Jim Carlos Cervantes and Per McCord, for their assistance during the year.

Table 1. Number of sweetpotato seedlings planted and number selected over successive years (1998-2004) from on-farm GPBP tests.

Year	No. of true seed planted	No. of seedlings selected	No. of original seedlings remaining after 2nd year	No. of original seedlings remaining after 3rd year	No. of original seedlings at advanced evaluation stage	No. of original seedlings Retained for breeding
2004	15000	186	----	----	----	----
2003	15000	157	24	----	----	----
2002	18000	251	10	7	----	----
2001	15000	153	22	5	1	----
2000	15000	303	24	7	5	1
1999	24000	260	47	10	7	1
1998	24500	358	22	9	4	2
Totals	126,500	1668	149	38	17	4

Table 2. Number of sweetpotato seedlings selected per female parent on-farm in 2004.

Maternal parent	# selections	Maternal parent	# selections
Timmy McLamb Farm, seed from the 2003 Elite nursery			
NC1528	1	Bienville	1
NC96-27	3	Hernandez	6
NC97A-04	5	L96-117	1
NC98-576	7	Ruddy	13
NCC58	11	W250	8
		Total	**56**
Jones Farm, seed from 2003 SSR Nursery			
NC93-50	8	NC98-342	1
NC97A-45	12	NCC58	9
NC97-079	5	Bengal	5
NC97-433	11	Bienville	9
NC98-175	6	Hernandez	3
		Total	**69**
Pride of Sampson			
2003 Elite nursery		*2003 SSR nursery*	
NC1528	6	NC93-50	10
2003 Dry Matter nursery		NCC58	9
NC93-11	1	L96-117	4
NC96-27	3	Tib 4	12
Bienville	10	W250	2
Tib 4	4		
		Total	**61**
		On Farm Grand total	**186**

Table 3. 2004 On Farm 1 Trial, Johnston Co. - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	YLD	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2 GH plants	EM	7	2.0	rs	sm	3	8	5	6,2	7	6	~CS,~SO in low area
98-608 G2 fld plants	EM	7	2.0	rs	sm	3	8	5	6,2	7	6	very short, blocky
99-026	M	6	2.5	rs	sm	2.75	8	5	6,3	7	6	~TP, nice size
99-031	ML	6	2.5	rs	sm	3.25	8	7	6,3	7	6	^^roots, too many?
99-088	ML	4	3.5	rs	sm	3	8	7	3,7	5	3	DROP
99-573	ML	5	3.0	rs	sm	3	8	7	3,6	6	5	^^ roots
00-101	M	6	2.5	lt cu	sm	3.25	8	6	3	5	5	^IRR
00-677	M	7	2.5	rs	ms	3.25	8	6	3	5	5	^IRR, SPR
00-748	ML	6	3.0	w	sm	1.5	8	6	3,6	6	5	~SO, O'Henry better?
B94-14 G2 GH plants	EM	7	2.5	rs	sm	2.75	8	6	6,3	6	6	~IRR, TP
B94-14 G2 fld plants	EM	7	2.5	rs	sm	2.75	8	6	6,3	6	6	~IRR, TP
B94-14 G2 grower	M	6	3.0	rs	sm	3	8	6	6,3	4	4	^IRR

Comments: Field was dry midseason, and wet late season.

Table 4. 2004 On Farm 2 Trial, Nash Co. - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	YLD	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2	EM	8	2.5	cu rs	sm	3	8	7	6,3	7	8	~CV, nice size dist
99-026	EM	7	2.5	lt cu	sm	3	8	6	3,6	7	7	nice size dist
99-031	L	6	3.0	rs	sm	3.5	7	8	4	6	5	too many roots?
99-088	L	6	3.5	rs	sm	3.25	8	8	4	6	4	^L, poor shapes
99-573	M	7	3.0	rs	sm	3	7	7	3,6	6	6	~VN, MSH
00-101	M	6	2.5	lt cu	sm	3.5	7	7	3,6	5	5	
00-541	M	6	2.5	lt cu	sm	3	7	7	3,2	5	5	
00-677	ML	8	3.0	rs	s flk	3.25	8	8	3	6	6	^L, ~curves
00-720	M	5	2.5	rs	ms	3	8	8	3,2	5	5	
00-748	L	6	3.5	w	sm	1.5	7	8	4	7	6	^roots, ^Late
B94-14 G2 Sandhills	EM	6	3.0	rs	sm	3	8	7	3,6	4	5	~strings, pale skin
B94-14 grower	ME	7	3.0	rs	sm	3	8	8	6,3	4	5	
Hernandez	ML	7	3.0	cu org	ms	3.25	6	7	6,3	6	6	~PI's, SPR, ^small

Comments: 98-608 stood out for appearance and size distribution.

Table 5. 2004 On Farm 3 Trial Sampson Co. - Trait Data. Please see Keys to Tables section at the end of this report for descriptions to the abbreviations.

CLONE	MAT	YLD	L/D	SKC	SKT	FL	EYE	LEN	SH	SHV	APP	Comments
98-608 G2	EM	7	2.5	rs	sm	3	8	7	6,3	6	7	<1% SO, ~CV
99-026	EM	6	2.5	cu rs	sm	3	7	7	3,6	6	5	~RT
99-031	ML	6	3.5	rs	sm	3.25	7	7	3,4	6	4	~RT, ^^L
99-088	ML	6	3.5	rs	sm	3	7	7	3,4	5	4	^CR, ~RT, ^^L
99-573	M	7	3.0	rs	sm	3	7	7	3,6	6	6	^CR, ~IRR
00-101	EM	4	3.0	lt cu	sm	3	7	8	3	5	3	few roots, ^bad hills, L att
00-541	M	4	3.5	cu o	sm	3.25	7	7	3,2	4	3	few roots, ^bad hills, ~PI
00-677	E	8	3.0	rs	sm	3.5	8	8	5,3	5	4	~IRR, ~VN, drop
00-720	M	5	3.0	rs	sm	3	7	7	3,5,,7	3	3	^SPR, AT, drop
00-748	M	7	2.5	w	sm	1.5	7	7	3,6	6	6	~RT
B94-14 G2 Sandhills	E	8	3.0	rs	sm	3	8	7	6,3	5	6	~poor flesh, ~crooks
B94-14 G2 Grower	L	4	3.5	rs	sm	2.75	8	8	3,7	3	3	^^ poor hills, ^strings
Hernandez	ML	6	3.0	cu o	sm	3.5	8	8	3	7	6	

Comments: Overall shapes and appearance only fair. Some clones, including one Beauregard had poor shapes and appearance.

Table 6. 2004 On Farm Trial Appearance and Yield ratings for all three sites.

	Appearance rating				Yield rating			
CLONE	Farm 1	Farm 2	Farm 3	Avg	Farm 1	Farm 2	Farm 3	Avg
98-608 G2	**6**	**8**	**7**	**7.0**	**7**	**8**	**7**	**7.3**
99-026	6	7	5	**6.0**	6	7	6	**6.3**
99-031	6	5	4	**5.0**	6	6	6	**6.0**
99-088	3	4	4	**3.7**	4	6	6	**5.3**
99-573	5	6	6	**5.7**	5	7	7	**6.3**
00-101	5	5	3	**4.3**	6	6	4	**5.3**
00-541		5	3	**4.0**		6	4	**5.0**
00-677	5	6	4	**5.0**	7	8	8	**7.7**
00-720		5	3	**4.0**	6	5	5	**5.3**
00-748	5	6	6	**5.7**		6	7	**6.5**
B94-14 G2 Sandhills	**6**	**5**	**6**	**5.7**	**7**	**6**	**8**	**7.0**
B94-14 G2 Grower	**4**	**5**	**3**	**4.0**	**6**	**7**	**4**	**5.7**
Hernandez		6	6	**6.0**		7	6	**6.5**

Keys to Tables

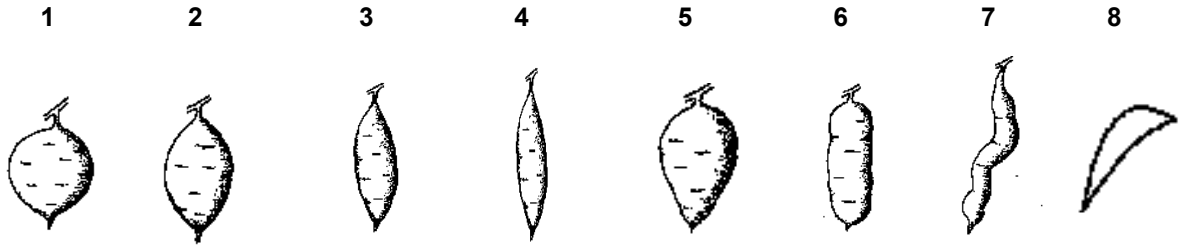
Storage root data: **MAT**=maturity E=early, M=mid and L=Late; **DM**=percentage dry matter; **L/D**=length/diameter ratio; **SKC**=skin color clr=clear cu=copper, lt=light, or=orange, pi=pink, pu=purple, rd=red, rs=rose, tn=tan wh=white; **SKT**= skin texture, m fl= moderate flakiness of skin, l fl=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