2006 PROGRESS REPORT
To
North Carolina Sweetpotato Commission

TITLE: Sweetpotato Grower-Participatory Breeding Project 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, quality, and disease and insect resistance characteristics; 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

Extension Personnel	Growers
Mark Seitz	Kendall Hill
William Little	Mike Hocutt
Allan Thornton	Terell and Johnny Williams

Project Summary:
The Grower-Participatory Breeding Project has been in existence for nine years and we have two primary research objectives. First, we grow and select first-year seedlings on commercial farms. Second, we evaluate 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. Covington, released 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 29 advanced lines that are in various stages of evaluation, and eight breeding lines that are being used in our polycross breeding nurseries.

Roughly 30% of the true seed grown in our breeding program during 2006 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, 204 were selected for further evaluation, a rate of 1.4%, right at our long-term average. 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 varieties Beauregard and Covington.

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 2007 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 we planted 21 clones and 3 check lines at each location in unreplicated 50-100-hill plots 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. Covington performed well across all of our GPBP trials.

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 Covington, only three of the advanced clones performed reasonably well in all grower locations. Their descriptions are as follows:

NC99-026 A moderately smooth, light copper-rose skin, orange fleshed clone that produces 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. Moderately susceptible to soil rot.

Status: Used in 2006 polycross nursery. Dropped from variety consideration but will continue to evaluate as a parent. Strengths as a parent: good shapes and size distribution.

NC99-573 This clone produces smooth skinned, rose-colored roots that are attractively shaped. Yield is high. Growing season is about two weeks longer than Beauregard. Lenticels are fairly prominent in wet conditions and it is susceptible to root-knot nematodes. May have rows of moderately prominent eyes. Shapes and appearance very similar to Beuaregard.

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

Status: Virus indexed plants were used for the first time in 2006, and they performed well. In 2007 this clone will go into 1-3 small-scale grower production trials. It is an entry into the National Collaborators Trial. NC99-573 is a very good parent and we will continue to use it in our 2007 nurseries.

NC02-423 This is a rose-skinned, orange-fleshed offspring of Hernandez that is a product of the GPBP. It has a number of the strengths of Hernandez, uniformity of size and shape, without some of the weaknesses - the pimples and field sprouting. It can be short under cold conditions. It is an excellent plant producer in beds.

Disease Resistances: Resistant to root knot nematodes and soil rot, moderately resistant to fusarium wilt.

Status: Further trialing in 2007 on station and on-farm. Will be used in nurseries again in 2007.

Please see the Variety Development Report for yield trial results of these clones and performance of other advanced clones in the program. Many other lines performed well in only one or two of the sites (Table 6), an indication that they are not broadly adapted.

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.

In addition to evaluating tablestock material in the on-farm trials, this year we included two high dry matter lines, two white-fleshed clones and four purple-fleshed clones. None performed well across all trials, so while we have made progress in these groups we still have considerable work to do to bring them to the level of yield and appearance of the tablestock lines. On-farm 3 had an additional nine purple-fleshed clones, most of which were late to very late but with good color. Notes collected here will help us decide which to use as parents for the next generation of crosses.

Our emphasis in 2007 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

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Table 1. Number of sweetpotato seedlings planted and number selected over successive years (1998-2006) 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
2006	15000	204	----	----	----	----
2005	15000	330	37	----	----	----
2004	15000	186	18	8	----	----
2003	15000	157	24	11	9	2
2002	18000	251	10	7	3	4
2001	15000	153	22	5	1	0
2000	15000	303	24	7	5	1
1999	24000	260	47	10	7	1
1998	24500	358	22	9	4	2
Totals	156,500	2202	204	57	29	8

Table 2. Number of sweetpotato seedlings selected per female parent on-farm in 2006.

Maternal parent	# selections	Maternal parent	# selections
Williams, seed from the 2004 SSR, 2005 Elite and 2005 SSR nurseries			
2004 SSR nursery		*2005 SSR nursery*	
NC97-433	7	NC00-720	5
W250	3	NC01-362	6
		NC02-459	6
2005 Elite nursery		Bienville	3
L99-35	5	L99-35	22
Ruddy	3	Ruddy	16
		Tib 4	16
		Total	**92**
Tull Hill Farms, seed from 2004, 2005 Elite and SSR Nurseries			
2004 Elite nursery		*2004 SSR nursery*	
NC99-524	4	Tib 4	12
Ruddy	2		
2005 Elite nursery		*2005 SSR nursery*	
NC01-214	8	NC1880	3
NC01-351	3	NC96-61	1
L99-35	6	NC97A-45	11
Ruddy	1	NC99-088	4
W250	4	NC99-573	19
		Total	**78**
Hocutt Farms, seed from 2004 SSR and 2005 Elite Nursuries			
2004 SSR nursery		NC97-166	3
NC C58	2	NC97-433	6
2005 Elite nursery		NC98-076	2
NC93-50	4	NC99-524	2
NC97A-04	6	NC99-573	9
		Total	**34**
		On Farm Grand total	**204**

Table 3. 2006 On Farm 1 Trial, Wilson 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
NC99-026	M	6	2.5	cu rs	sm	2.75	7	7	3,2	4	4	~GR, ~T, ^MSH
NC99-573 G2	E	8	2	rs	sm	3	8	8	2,3	6	6	short. RND
NC99-573 BRD	E	8	2	rs	sm	3 ycr	7	8	6,3,2	5	6	short, RND
NC00-720	E	7	1.5	rs	sm	3	7	6	1,2	6	2	^^CR, v RND
NC01-351	E	7	2	clr	sm	3	8	8	2,3	4	3	^^CR (50%), T, 2^{o}R
NC01-362	EM	7	3	rs	s flk	3	8	8	3,7	3	3	^MSH, ^L CRK
NC02-350	E	7	1.5	rs	ms	3	8	6	2,3	5	4	^2^{o}R, ~VN
NC02-423	M	7	1.5	rs	sm	3	8	7	2,3	5	5	^CR, ^RND
NC03-054	EM	7	2	rs	s flk	3	8	8	2	6	5	^ESC,~2oR, RND
NC03-089	M	7	2.5	red	ms	3	9	9	3	5	6	~ESC, ~T, ~MSH
NC03-114	ML	5	2.5	dk rs	ms	3.25	8	8	3	5	3	^^ESC, ^air CR
NC03-239	E	7	1.5	red	s flk	3	8	6	2,3	5	4	^T,~VN,~SPR,^LT,^RND,^LE
NC03-380		2										no roots!?
B94-14 G2 Grower	EM	7	3	rs	ms	2.75	8	7	3,7	4	3	~ESC,^MSH,~2oR
Covington G2	EM	5	2	rs	ms	3	7	7	6,3	6	5	~ESC, ~2oR
Hernandez G2	EM	7	2	or	s flk	3.25	6	7	3,2	5	6	~PI, ~SPR
L99-35	E	7	2	cu rs	s flk	3.5	8	7	2,3,6	6	5	
NC03-007	E	8	2	cr	s flk	1.5	8	6	2,3	6	5	^T
NC03-035	L	4	3	w	s flk	1.5w/o	8	7	3,7	4	3	^MSH, low yld, ^CRK
DM02-180	M	6	2.5	w	ms	1	7	7	2,3	4	4	~T, ~2^{o}R, ~LAT
FTA94	ML	3		w	ms	1			3,7	3	3	~ESC
NC413 #7M G2	L	5	3.5	p	s flk	P3	7	8	3	5	4	~ESC, L
Pur04-078	M	4	3	p	ms	P2	7	6	3,7		3	~CRK, ~flats
Pur04-123	L	1		p		P4			7			almost no roots
B94-14 G2 Sand Hills	E	8	3	rs	s flk	3	8	7	3,6	4	4	~ESC, ^MSH, ^SG

Comments: Field was accidentally treated with Treflan prior to planting. This pre-plant herbicide treatment made made everything look very rough, but we decided to evaluate the trial anyway with the hope that we could use the information to select herbicide resistant clones. Hernandez and NC99-573 had the best overall appearance though they were unusually short.

Table 4. 2006 On Farm 2 Trial, Lenoir 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
NC99-026	EM	6	2.5	rs	sm	2.75	7	7	6,3	7	7	~SPR, ~CRK
NC99-573 G2	EM	6	3.5	rs	sm	3	6	7	6,3	7	6	low #roots, a bit long
NC99-573 BRD	M	6	3.5	rs	sm	3	6	7	6,4	7	6	~v L, ~VN, some rots
NC00-720	EM	7	2.5	rs	sm	3.5	7	7	5,3	5	4	^OV, ^L
NC01-351	EM	6	3	clr	sm	3.25	6	7	3,4	6	5	~CR,~RT, ~L ~SPR,~MSH,
NC01-362	LM	5	4	rs	sm	3	7	7	3,4,7	3	2	^L IRR, few No.1's, D
NC02-350	M	7	3	rs	s flk	3.25	8	7	3,6	6	6	BRD-IR, ~STR, rough skin
NC02-423	M	6	2.5	rs	sm	3	8	8	6,3	8	7	~PI, ~SPR, ^vn roots, ~CR
NC03-054	EM	8	3.5	cu rs	sm	3	7	7	4,3	6	3	~PI, ~SPR, too L?
NC03-089	ML	7	4.5	red	flk	3	8	7	4,7	5	2	too L, v late
NC03-114	L	5	3.5	dk rs	s flk	3.25	7	6	4,3	7	2	^L SG
NC03-239	ML	5	3	cu rs	ms	3	8	7	3,4	7	5	~RT,~SPR,~STR, shallow VN
NC03-380	M	5	2.5	rs	sm	3	7	8	3	6	3	v low set, L AT, low yld,~CR
B94-14 G2	E	6	3	rs	sm	3	8	7	3,6,7	4	3	~GR, ^MSH, ^L IRR
Covington G2	ML	6	3	rs	ms	3	7	8	6,3	8	7	~RT, late set, g sh + sz var
Hernandez G2	LM	6	3.5	cu or	ms	3.25	6	7	3,4	7	5	^PI, ~ESC
L99-35	LM	6	3	rs	sm	3.5	7	7	3,7	3	3	^MSH, ^L, L AT, L CRK
NC03-007	ML	7	3.5	cr	ms	2	7	7	3	7	4	^CRK(10%), ~SPR
NC03-035	L	5	4.5	cr	sm	2 w/o	8	8	4	7	2	^^L, low yld, late
DM02-180	ML	3		cr	ms	1			3		2	low set,L AT, low yld
FTA94		1		cr	ms	1.5					2	low yld, low set
NC413 #7M G2	LM	4	3.5	p	ms	P3	6	7	4	6	3	low set, 2oR, v L
Pur04-078	M	3	4	p	ms	P2	6	7	3	6	3	^L AT, v low yld, low set
Pur04-123	L	2	4.5	p	sm	P4			4	6	2	v low yld

Comments: Very sandy site, suffered severe drought stress. Deep sandy soils resulted in long roots and low yields. Hard to judge yield because of buried roots at harvest.

Table 5. 2006 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
NC99-026	ML	7	3	cu rs	sm	3	7	8	3,6	7	7	v slight GR
NC99-573 G2	L	7	4	rs	sm	3	9	9	4	7	6	too many roots?
NC99-573 BRD	M	7	4	rs	sm	3	8	8	6,3	7	6	L TP roots, no color var.
NC00-720	M	7	3.5	dk rs	ms	3.5	9	9	3,6	6	5	too L?, ~T
NC01-351	ML	7	3	clr	ms	3	9	9	3,6	7	6	^T, BRD
NC01-362	L	7	4.5	rs	ms	3	8	9	4	6	4	too L, D, ~CRK
NC02-350	L	6	4	rs	ms	3.25	7	9	3,4	6	4	Var size, ^^roots, ~2^{o}R, BRD
NC02-423	EM	7	2.5	rs	ms	3	9	9	6,3	7	7	~T, too long?
NC03-054	EM	8	3	rs	s flk	3.25	9	7	3	5	4	^ESC, T, var sh, g raw flavor
NC03-089	L	7	4.5	red	ms	3.25	9	9	4	7	4	too L + too late
NC03-114	L	4	3	dk rs	s flk	3.25	9	9	3	6	3	RC?
NC03-239	E	7	3	lt rs	ms	3.25	9	8	3	6	6	~VN, ~SPR,~T, g size
NC03-380	ML	7	3	rs	sm	3	8	8	3	6	5	BRD(MS line), ~TP,~T,~IRR
B94-14 G2	M	7	4	rs	ms	3	9	9	6,7	6	5	^MSH, CV
Covington G2	M	7	2.5	rs	ms	3	8	9	6,3	8	8	~CV/ staining
Hernandez G2	M	7	3.5	cu o	ms	3.5	7	8	3,6	7	6	~SPR,~EY,~PI, ~GR, ~CRK
L99-35	M	7	4	rs	ms	3.5	9	9	4	6	5	L, ~SG, ~MSH
NC03-007	L	5	3	y	sm	2	7	8	3	7	6	late but nice
NC03-035	ML	5	4.5	y	sm	2w/o	8	6	4	6	4	
DM02-180	L	3	3	w	ms	1			3,4	5	3	BRD
FTA94	M	4	3	w	ms	1	8	8	3	4	3	
NC413 #7M G2	L	5	4	p	ms	P3	8	8	4,7	6	5	v L, late
Pur04-062	ML	3	3	p	h flk	P3	7	7	3	5	3	^GR, ~ESC,~CRK
Pur04-078				p		P3					2	low set, OK sh, ~VN, D
Pur04-079	ML	6	3	p	ms	P2	7	7	3	5	5	low set, OK sz
Pur04-118	M	6	3	p	m flk	P3	7	8	3,4	6	5	OK pur, ~TP, g yld for pur
Pur04-123	VL	2		p		P4			4		2	BRD, exc clr, no roots
Pur05-027	LM	5	2.5	P	h flk	P3	8	8	3	5	4	^VN, ~SPR, B
Pur05-054												D
Pur05-072	M	6	3	P	s flk	P4	9	8	3,6	6	6	low set, ~L AT, best purple
Pur05-073	L	5	3.5	P	h flk	P2	8	7	3	6	4	
Pur05-080	ML	5	4	P	ms	P3	8	8	7,4	3	3	L AT, g color
Pur05-089	L	4	3	P	m flk	P4	7	7	3	7	6	^air CR, nice set, ~GR, BRD

Comments: The trial was harvested a couple of weeks early making many appear long. Covington had the best appearance in the field, considerably nicer than Beauregard and almost everything else in the trial.

Table 6. 2006 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
Covington G2	**5**	**7**	**8**	**6.7**	**5**	**6**	**7**	**6.0**
B94-14 G2 SH	4	3	5	**4.0**	8	6	7	**7.0**
NC99-026	4	7	7	**6.0**	6	6	7	**6.3**
NC99-573 G2	6	6	6	**6.0**	8	6	7	**7.0**
NC99-573 BRD	6	6	6	**6.0**	8	6	7	**7.0**
NC00-720	2	4	5	**3.7**	7	7	7	**7.0**
NC01-351	3	5	6	**4.7**	7	6	7	**6.7**
NC01-362	3	2	4	**3.0**	7	5	7	**6.3**
NC02-350	4	6	4	**4.7**	7	7	6	**6.7**
NC02-423	5	7	7	**6.3**	7	6	7	**6.7**
NC03-054	5	3	4	**4.0**	7	8	8	**7.7**
NC03-089	6	2	4	**4.0**	7	7	7	**7.0**
NC03-114	3	2	3	**2.7**	5	5	4	**4.7**
NC03-239	4	5	6	**5.0**	7	5	7	**6.3**
NC03-380		3	5	**4.0**	2	5	7	**4.7**
Hernandez G2	6	5	6	**5.7**	7	6	7	**6.7**
L99-35	5	3	5	**4.3**	7	6	7	**6.7**
NC03-007	5	4	6	**5.0**	8	7	5	**6.7**
NC03-035	3	2	4	**3.0**	4	5	5	**4.7**
DM02-180	4	2	3	**3.0**	6	3	3	**4.0**
FTA94	3	2	3	**2.7**	3	1	4	**2.7**
NC413 #7M G2	4	3	5	**4.0**	5	4	5	**4.7**
Pur04-078	3	3	2	**2.7**	4	3		**3.5**
Pur04-123		2	2	**2.0**	1	2	2	**1.7**
Means	4.2	3.9	4.8	4.3	6.0	5.3	6.1	5.8

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; **BRD**=breeding only; **BSR**=bacterial soft rot; **CR**=cracking; **CRK**= crooked shapes; **CS**=circular spot; **CV**=skin color variation end to end; **D**=drop; **ESC**=Early season cracking; **EY**=deep eyes; **FB**=fleabeetle damage; **FS**=Fusarium root rot; **G**=Geotricum; **GR**=grooves; **HC**=horizontal constrictions; **ID**=unspecified insect damage; **IR**=insect resistance; **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; **RND**=round; **RSK**=rough skin; **RT**=rot; **SC**=scurf; **SD**=skin discoloration; **SF**=surface Fusarium; **SG**=string roots; **SH**=sheen; **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; **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