Sweetpotato Foundation Programs Provide Sweetpotato Growers with High-quality Pathogen-free Seedstock

James M. Dangler

Several states have sweetpotato foundation programs or support similar efforts that provide services to sweetpotato growers. The objectives of these programs are to maintain seedstock quality by assuring that sweetpotatoes are free of serious pathogens and other serious pests and that they exhibit the characteristics of the variety. The quick distribution of new varieties is another way sweetpotato foundation programs benefit growers. These programs are necessary because most sweetpotato growers do not have the capital, technical expertise, and time needed to produce and maintain high-quality seedstock. Most sweetpotato growers take advantage of the seedstock available through foundation programs to maintain or upgrade the quality of their sweetpotatoes. Improved seedstock has been available to North Carolina sweetpotato growers since 1929 (Middleton and McGlaughlin, 1978). North Carolina also has the oldest foundation and certification program in the country, serving the industry since 1945.

Sweetpotato foundation and certification programs in North Carolina and other states maintain the characteristics of the variety by eliminating off-type plants and roots on the basis of appearance and inspection for the presence of insects and diseases. Plants exhibiting off-types in form or color in the field or the transplant production bed are rogued. Roots that are poorly shaped, have growth cracks or veins, or exhibit external or internal color mutations are also culled. The procedures for maintaining the desired varietal characteristics of sweetpotatoes are discussed in contributions from Alabama and Virginia. In Virginia, the quality of the 'Hayman' sweetpotato, a local gourmet item, has helped create an additional market for sweetpotato growers.

Several sweetpotato programs have aspects that are unique. In Mississippi, the appearance of small, light-colored spots (chimeras) in the flesh of 'Beauregard' has been examined through generations. The presence of chimeras is not permitted in sweetpotatoes for the fresh or canning markets. In California, where the "clean" seed program uses tissue-culture techniques, it may take 6 years for pathogen-free planting material to be distributed to sweetpotato growers. California is the only program that uses tissue culture and micropropagation to produce foundation sweetpotatoes. The North Carolina program, which presently does not use tissue culture, has provided data showing that the use of virus-free transplants obtained through tissue culture and micropropogation produce similar and sometimes higher yields of roots with greater color uniformity than plants from traditional sources. Reduced russet cracking of 'Beauregard' is another benefit of the use of these techniques. Efforts are being made to use tissue culture, virus indexing, and micropropogation in the North Carolina foundation sweetpotato program. Increased yields, however, have not been obtained through the use of meristem-tip culture in Louisiana (W.A. Mulkey, personal communication).

Several sweetpotato foundation programs or seedstock improvement systems are described in the following papers. Seedstock from these programs are not produced exclusively for growers in the respective state. Sweetpotatoes may be transported in tagged crates across state lines after inspection by a state agricultural authority.

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Alabama's Foundation Sweetpotato Program Maintains Root Quality

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Additional index words. *Ipomoea batatas* (L.) Lam., mutations, vegetables

Summary. Many sweetpotato growers produce their own transplants to control quality, assure timely availability, and reduce production costs. The Alabama Crop Improvement Association, Inc., maintains Foundation, Registered, and Certified stocks to provide sweetpotato producers with high-quality sweetpotatoes. These sweetpotato roots are available to growers in any state to improve the quality of their rootstock. Sweetpotatoes produced in the crop improvement program are examined in the bed and the field. They are inspected by the Alabama Dept. of Agriculture and Industries, stored in approved facilities, graded, and shipped in clean crates that are tagged prior to transport and delivery to producers. As a result of the program, sweetpotatoes are produced free of serious diseases and pests, and exhibit the characteristics of the variety.

Commercial sweetpotato transplants are produced from bedded storage roots. Growers frequently produce their own transplants to reduce costs compared to purchasing transplants. Having the desired variety available at planting time and minimizing disease and insect pests are also important. Although transplants

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Table 1. *Maximum tolerances for disease, insect damage, and internal quality of sweetpotato roots by category.*

Defect[z]	Maximum tolerance		
	Foundation	Registered	Certified
Blackrot	None	None	0.1%
Internal defects	None	No standard[y]	No standard[y]
Nematode	None	0.2%	0.5%
Other varieties	None	None	None
Scurf	None	None	0.1 %
Storage rot	None	None	None
Sweetpotato weevil	None	None	None
Wireworm	1.00%	2.00%	5.00%

[z]*When Streptomyces root rot, bacterial soft rot, or another disease or noxious pests are observed, the decision whether to certify is made according to the severity of the problem.*
[y]*Roots are not examined.*

appear vigorous and healthy, they may be off-type, contain mutations, or harbor diseases and insect pests from the transplant bed.

To produce high yields of roots in the field, growers must keep their rootstock free of pests. Maintaining the characteristics of the variety is another important function of a transplant producer. By growing true-to-type sweetpotatoes, the industry consistently presents an appealing product to consumers. The quality of roots that are bedded is therefore a very important consideration in the sweetpotato transplant-production system.

To help sweetpotato producers grow a quality product, certification standards have been developed by the Alabama Crop Improvement Assn., Inc. (ACIA, 1990). Standards include requirements for roots, root storage conditions, and transplants in the bed and the field. The root length of 3 to 9 inches, diameter of 1 to 3 inches, and the tolerances for defects are specified. Transplant packaging and transportation also have been specified.

Three categories of sweetpotato roots are produced in the program (Table 1). Foundation (first-generation) sweetpotatoes are the direct progeny of breeder's sweetpotatoes. Registered (second-generation) and Certified (third-generation) sweetpotatoes have greater tolerances for defects and the presence of pests than Foundation roots. Sweetpotato weevils, storage rots, or varietal mixtures are not permitted in any category. Avoiding varietal mixes, which occur when roots or transplants of two or more varieties are combined, is critically important.

Transplants for the production of Foundation sweetpotato roots must be produced from field vine cuttings or from sprouts cut—not pulled—from bedded storage roots. The requirements for Foundation and Registered transplants are the same. Fusarium, blackrot, scurf, and wilt and stem rot are not permitted in the plant bed. In the field, plants also must be free from Fusarium wilt or stem rot, serious viruses, other objectionable pests, and mixture with other varieties of sweetpotatoes. In plant beds, the requirements for transplants to produce Certified roots are the same as the other categories. In the field, however, wilt or stem rot and virus diseases each may affect up to 0.1% of the crop. When a pest affects the crop and there is no tolerance established for that pest, the decision whether to certify the crop is made by the association coordinator on a case-by-case basis. Off-type and diseased plants such as those illustrated in Figs. 1 and 2 are rogued from the field. Certified sweetpotatoes may be "recertified" only on an emergency basis; e.g., if a severe shortage of planting material exists.

Another important difference between the production of Foundation sweetpotato roots and the roots in the other categories is that the internal root quality of Foundation sweetpotatoes is better because they are not far removed from breeder's seed (first generation). Although the breeder has the primary responsibility to maintain the purity of a variety that is important to the industry, the Alabama Crop Improvement Assn., Inc. operates the selection program to carefully maintain the characteristics of the variety and makes these sweetpotatoes available to producers. Sweetpotatoes mutate and variations in root shape and external and internal flesh color occur frequently. This certification program was initiated in 1982 to minimize these problems and maintain the original characteristics of each variety. Vigilance and

Fig. 1. Plants exhibiting irregular growth, such as thick stems (below), are rogued in the field.

Fig. 2. Plants in the field or transplants are rogued if they produce leaves without chlorophyll.

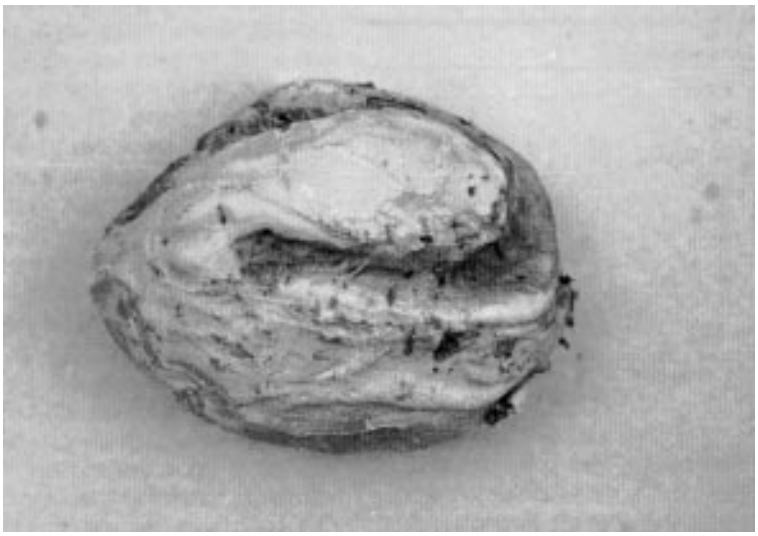

Fig. 3. Sweetpotatoes with irregular shapes, veins, or growth cracks are eliminated from lots of sweetpotatoes in a foundation program.

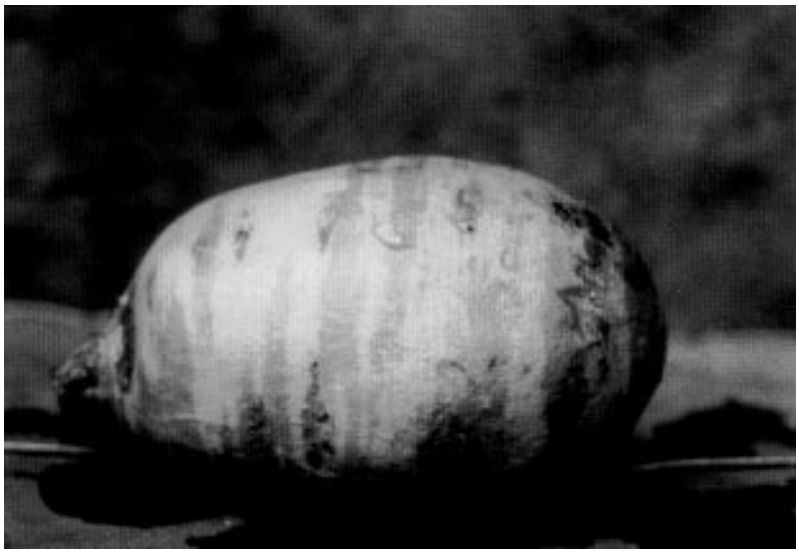

Fig. 4. Mutations in sweetpotato skin color occur frequently.

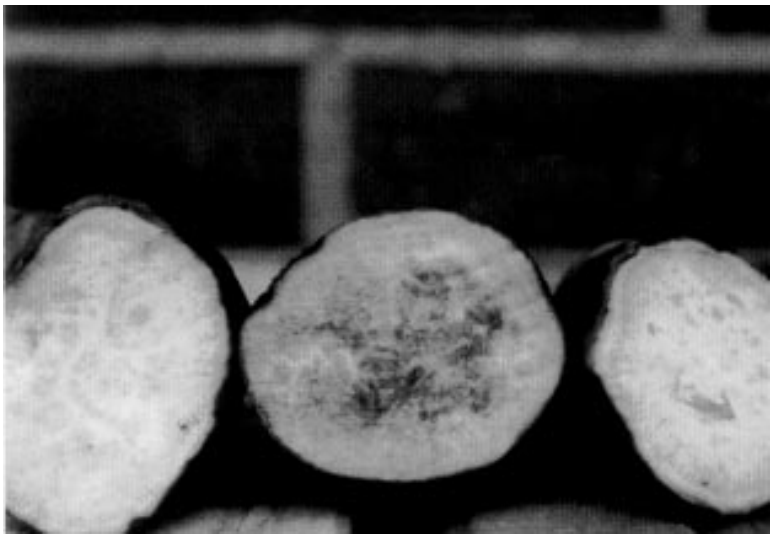

Fig. 5. Stored sweetpotatos develop pithy white areas of flesh (left), which may develop into cavities (right) as more water is lost. Defective 'Nugget' sweetpotatoes turn purple when cut (center).

strict adherence to good management practices are required throughout the program to maintain the desired characteristics because defects are transmitted to the next generation through transplants that usually do not express signs of the change(s). Certification programs also are conducted in Louisiana and North Carolina.

Sweetpotatoes with exterior defects are fairly easy to eliminate. Poorly shaped storage roots or those with growth cracks or veins are not appealing to the consumer (Fig. 3). 'Georgia Red' and 'Georgia Jet' frequently develop enlarged veins at the surface of the storage roots that are sometimes objectionable. Mutations in skin color occur less frequently, but such defects occur in all varieties (Fig. 4). Eliminating internal defects, however, is more difficult. To reduce the incidence of these defects, each root of Foundation seed is cut crosswise and examined for changes in internal flesh texture and color mutations (usually white). Only sweetpotatoes that exhibit the desired characteristics of the variety are used to produce transplants.

Sweetpotatoes that have been stored through the winter may exhibit white flesh, as sometimes develops in 'Jewel' (Fig. 5 left). When this spongy tissue desiccates during curing and storage, cavities may develop through the length of the root (Fig. 5 right) (Clark and Moyer, 1988).

Defective 'Nugget' roots turn purple within seconds after cutting (Fig. 5, center). This colored area becomes dark brown within minutes.

A white section or "wedge" of an orange-fleshed root may occasionally be observed (Fig. 6). Within a few generations, partial or total degeneration (white color mutation) may occur, resulting in sweetpotatoes with white flesh.

The Alabama Crop Improvement Assn., Inc. produces Foundation sweetpotato roots that are the progeny of breeders' sweetpotatoes. Foundation, Registered, and Certified roots are available to producers to improve the quality of their commercial sweetpotatoes. The roots produced in the program are relatively free of insects and diseases. In addition to keeping sweetpotatoes free of pests, varieties are screened to assure producers that the sweetpotatoes are true-to-type and that varieties are not mixed. As a result of this program, producers can obtain planting stock that will produce commercial sweetpotatoes with the characteristics consumers find desirable. With good management and the use of recommended cultural practices, producers can obtain high yields of quality sweetpotatoes.

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Fig. 6. Wedges of white tissue or white roots occur in many sweetpotato varieties.

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Meristem-tip Culture and California's Clean Foundation Sweetpotato Program

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Summary. For about 30 years, the Univ. of California has used advanced laboratory techniques in addition to traditional methods to produce pathogen-free and true-to-type sweetpotato seedstock. The effort continues with the varieties important in the marketplace today. This program serves as a model for the use of meristem culture by foundation sweetpotato programs in other states.

Additional index words. *Ipomoea batatas* (L.) Lam., vegetables, tissue culture

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California's "clean" sweetpotato seed program began during the 1960s in response to the russet crack disease (Fig. 1), which is caused by a strain of sweetpotato feathery mottle virus (SPFMV). At that time, the Jersey variety was one of the most important commercial sweetpotatoes. Seedstock free of virus had to be planted each year due to the severity of the disease. The virus was eliminated from plants through meristem culture. Once the sweetpotatoes were free of viruses, they were increased in an isolated area, then distributed to growers. Although the program was specifically designed to solve the russet crack problem, it is likely that other systemic pathogens also are excluded by meristem-tip culture. The bacterial soft rot pathogen, *Erwinia chrysanthemi*, and several fungal pathogens, including *Fusarium* species, are other disease-causing microorganisms that are most likely to be present in sweetpotatoes.

The procedure is still used today to provide sweetpotato growers with high-quality seedstock. It begins with the selection of the most-promising plants in the field (Table 1). Roots of individual

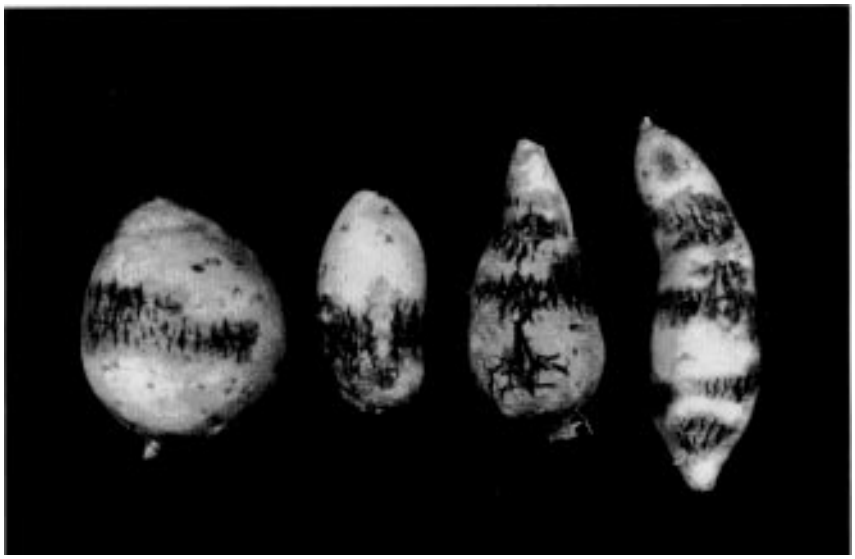

Fig. 1. Roots exhibiting typical symptoms of russet crack disease in sweetpotato (Jersey variety).