

Sweet Potato Culture in Missouri

J. T. ROSA, JR.



Although Missouri is located on the northern edge of the region adapted to the commercial production of the sweet potato, the present annual planting of this crop in the state is approximately 8,000 acres with an average yield about 100 bushels to the acre. In the growing of sweet potatoes, furthermore, there is increasing interest due to greater demand on the part of consumers, good prices, especially during the winter months, and the recent development of improved storage methods. Sweet potatoes have been grown on the grounds of the Agricultural Experiment Station at Columbia for several years and certain cooperative experiments have been conducted on the farms of growers in other parts of the state. This circular has been prepared therefore, to bring together the results of these observations and to point out some of the more essential considerations in the successful culture of this crop in Missouri.

SOILS

The sweet potato is particularly adapted to light sandy soils, which, if not too poor in plant food and organic matter, may grow large crops of sweet potatoes. Furthermore, the grade of the product is superior when grown on light sandy soils, the roots being smooth, free of cracks, clean and easily harvested. There are in the state considerable areas of light, well-drained sandy loam soils which are well adapted to sweet potato growing. The type of soil known as "Missouri Loess," which borders the Missouri River across the state, is also well adapted to growing sweet potatoes of good quality. Even the black silt loam soils, if well drained and not too rich, will produce fair crops of certain varieties. As a rule, heavy soils, poorly drained soils of any type, and soils comparatively rich in plant food should be avoided for this crop. On such soils the sweet potato plant is likely to make excessive vine growth without satisfactory yield of roots. And such potatoes as may be produced on these unfavorable soils are likely to be poor in quality.

MANURING

The grower of sweet potatoes should be very cautious in applying animal manures to land preparatory to growing this crop. On soils that are distinctly poor, moderate applications of barnyard manure have been found to be very beneficial, increasing the yield very markedly. On the other hand, in the case of soils of average to good fertility, animal manures had better be withheld, as their use just previous to the growing of a crop of sweet potatoes usually results in rank vine growth without corresponding root production. Since Missouri is on the northern edge of the sweet potato belt, anything which increases vegetative growth excessively, is likely to do so at the expense of root formation and the maturity of the crop.

COMMERCIAL FERTILIZERS

Since commercial fertilizers have been found to influence very markedly the yield and growth of Irish potatoes, tomatoes and other vegetable crops in this state, there might be some reason to expect sweet potatoes to respond to fertilization. Experiments in several Southern states, notably Texas, Florida, Georgia and Virginia, have shown very good results from the use of commercial fertilizers on the sweet potato crop. Recent results¹ along this line secured in experimental work with sweet potatoes in Southern Illinois are worthy of consideration by Missouri growers. In these experiments the yield of sweet potatoes and the percentage of marketable potatoes was increased markedly by use of barnyard manure, steamed bone meal and complete fertilizer, in the order mentioned. It was shown, also, that the effects of any fertilizer on the crop were greater when it was applied in the row rather than broadcast.

A rather extensive test of commercial fertilizers was conducted on

¹Methods of Fertilizing Sweet Potatoes. Illinois Agricultural Experiment Station Bulletin 188.

the Experiment Station farm at Columbia during the season of 1920. The soil was a light clay loam of the loess type, of fairly good fertility, and the growing season was quite favorable for sweet potatoes. The various fertilizers were applied at the rate of 200 pounds per acre, drilled into the rows before the ridges were thrown up for plant-setting. During the growing season no difference could be observed in the vegetative growth of plants on the plots receiving different fertilizer mixtures and those receiving no fertilizer of any sort. The crop was dug soon after the vines had been killed by frost, October 1. The yields of potatoes varied only slightly on the plots to which had been applied various fertilizers and on the check plots which received no fertilizers. Positive conclusions should not be drawn from one year's test of this sort; but these results are at least suggestive, that commercial fertilizers are not especially needed by sweet potatoes when grown on land of fair fertility in Missouri.



FIG. 2.—Sweet potato plants in hotbeds. The plants are ready for transplanting. The glass sash have been removed in order to harden the plants.

PLANT GROWING

The only practical method of propagating sweet potatoes for Missouri growers is by means of sprouts or slips forced out by small roots bedded in a hotbed or glass-covered coldframe. The hotbed method of plant production is the most satisfactory, although the coldframe method may be used successfully with certain precautions, especially in the southern part of the state. The hotbeds are sometimes covered with boards; but beds protected with glass sash give best results.

Preparation of the Hotbed. This should be prepared about five weeks before the date of the first transplanting of plants to the field. In Central Missouri in a normal season the first batch of plants should be set in the field about May 10, so the hotbed should be made up soon after April 1.

Fresh, hot manure should be used, making a layer 10 to 12 inches deep in the hotbed pit after it has been packed well by tramping. Over this about 4 inches of clean soil or sand is placed. The bed should then be covered for a day or two to permit it to warm up. Standard hotbed glass sash should be used if available. A heavy grade of unbleached muslin cloth if waterproofed with hot, raw linseed oil will serve very well for covering the bed. Since this material lasts only two or three years it may be more expensive in the long run than glass sash.

Bedding the Seed. This should be done on a warm, sunshiny day if possible, as chilling of the seed potatoes is very undesirable. The potatoes should be placed carefully over the leveled surface of the bed, leaving about a finger's width between them. At this time a very careful inspection should be made of each root, so that diseased or frosted seed potatoes can be culled out. The Black rot disease is most likely to be observed at the stem end of the seed, as a coal-black decay. If suspicious looking tips are snapped off, the apparently healthy flesh near the diseased spot will turn light green after exposure to the air for a few minutes if infested by the Black rot fungus. As each section of the bed is filled it should be covered promptly. Clean soil or sand should be placed over the seed, the best practice being to cover about 1 inch deep at this time, adding 2 inches more when the sprouts begin pushing through the first shallow covering. A total covering 3 inches in thickness over the seed is necessary to secure stocky plants with good root development.

Management of the Plant Bed. The bed should be kept covered carefully most of the time from bedding of the seed until the sprouts are well through the second covering of soil. The temperature of the bed should be about 80°F. during the day. The soil sometimes becomes dry, necessitating a thorough soaking and prompt re-covering of the bed. After the sprouts have pushed well through the soil, the bed should be kept just moist enough to keep the plants growing vigorously. Excessive moisture, together with lack of ventilation, will cause the plants to make weak, succulent growth and may lead to a loss of plants by the "damping off" disease. Ventilation of the beds should be given every day when outside temperatures permit it without chilling the plants. As the plants approach transplanting size they should be toughened or "hardened off" by removing the covering from the bed entirely and at the same time withholding water. The plants should be 5 to 8 inches high when pulled for transplanting. After the first batch of plants has been removed, the bed should be covered again to force out another crop of plants. The plant bed should produce at least three crops of plants, a week or ten days apart.

Sanitary Precautions. The plant bed may be the center of infection and distribution of several serious sweet potato diseases. Therefore it is very important that conditions in and around the plant bed be kept as sanitary as possible from the standpoint of these diseases. An important point which should be emphasized in this connection, is the advisability of removing the old soil from the beds at the end of each season, and using fresh soil in preparing the beds the next year. It is well to disinfect the interior of the woodwork of the bed with formaldehyde as

the first step in preparing the plant-bed in the spring. Diseased potatoes which are sorted out at bedding time should be carefully removed from the vicinity, otherwise they are likely to introduce disease into the bed at a later date. A safe way to dispose of such diseased roots is to boil them and then feed to stock. These precautions become all the more important when sweet potatoes are grown year after year, as diseases then are likely to become more troublesome.

Sand vs. Earth. It has been the general practice in bedding sweet potatoes to use ordinary garden soil in preparing and covering the bed. It has been found, however, that clean sand as a bedding medium has several advantages over garden soil. Since the sprouts draw the necessary food from the mother potato, it is not necessary to use rich earth. Where sand is used for bedding sweet potatoes, the sprouts come through several days earlier, root development is much more extensive and the roots are not torn off so badly in pulling the plants. Consequently the chances of survival and subsequent quick growth are greater. Another advantage of sand is that diseases, especially "damping off," are less likely to appear. Where it is not possible to obtain sand, fresh soil of as light a texture as possible should be secured from a spot where contamination with sweet potato diseases is unlikely, such as woodland.

SEED TREATMENT

In line with sanitary measures to prevent diseases of sweet potatoes, disinfection of the seed potatoes before bedding should be mentioned. Several diseases, especially Black rot, are transmitted by the seed potatoes to the plants, which may be killed in the hotbed or after being transplanted to the field. Sorting out all roots showing rot, combined with the sanitary precautions mentioned, will go a long way toward insuring the production of healthy plants and a healthy crop. The spores of Black rot, however, and several other sweet potato diseases are likely to be carried on the surface of apparently sound potatoes. Seed treatment designed to disinfect such apparently healthy seed is one of the most important steps in disease control. The treatment consists of soaking the seed eight to ten minutes in a solution made by dissolving one ounce of bichloride of mercury (corrosive sublimate) in 10 gallons of water. The powdered form of this chemical should be used, as it costs only 25 to 30 cents per ounce. The powder should be dissolved in a little hot water, then added to the proper amount of cold water in a wooden tub or barrel. This solution should never be placed in a metal vessel. Three lots of seed may be treated in the solution, then a fresh solution prepared if it is necessary to treat more seed. Upon removal from the disinfecting solution the seed are bedded at once, without rinsing or further treatment. When placing the seed in the hotbed after being soaked it is easy to detect any potatoes which may have a small amount of rot, and which escaped the first sorting. Such potatoes should be removed. Besides disease prevention, this seed treatment seems to advance the growth of the plants a day or two, and it is helpful in preventing loss of bedded seed by Soft rot, which sometimes happens if the seed are severely chilled or bruised.

Serious loss to the sweet potato crop from Black rot was reported in Newton and St. Louis counties in 1918. Demonstrations of control measures were made in the spring of 1919, sorting and disinfecting the seed at bedding time, and carrying out the other sanitary precautions as far as possible. In a demonstration on a farm near Neosho, Mo., a small percentage of the seed potatoes were found to be infected with Black rot. These were sorted out and the sound seed tested. Inspection of the plants at transplanting time, and later of the crop in the field as it was nearing maturity, showed no Black rot. The previous year about 25 per cent of the plants had died of this disease in the field.

Another demonstration was made on a farm at Afton, Mo. About 30 per cent of the seed was found to be infected with Black rot. The seed was sorted, treated and bedded in clean sand. Practically all of the plants were healthy at transplanting time, but about 2 per cent showed disease in the field later in the season. The previous season the loss from Black rot had been over 50 per cent. The seed treatment was repeated in the spring of 1920, and about $\frac{1}{4}$ of one per cent of the plants showed disease in the field by August.

In the spring of 1920 six demonstrations of sanitary bedding and seed treatment were given around Oakville, and Jefferson Barracks, in St. Louis County. Many of the growers in this section made the seed treatment for themselves this year. Reports from these growers indicate successful control of Black rot, whereas the infection of some sweet potato fields the preceding year had been so severe that they had been plowed up without harvesting. A demonstration on a farm in St. Louis County where careful observations were made during the summer showed excellent results from the seed treatment and sanitary bedding of the seed. In a field of $3\frac{1}{2}$ acres, which had been set with plants grown in a fresh hotbed from sorted and treated seed, only twenty-two plants were found to be infected with Black rot. At the same place, one-half bushel of untreated seed was bedded for comparison. Only 200 plants were obtained from this seed which were fit for transplanting to the field, as the Black rot disease killed most of the plants before they reached transplanting size. All but twenty of these plants died in the field before harvest time, showing that even the apparently healthy plants from untreated seed were infected.

PLANT SETTING

Importance of Early Setting.—This should be emphasized under Missouri conditions, for it is necessary that the plants make a good start under the favorable growing conditions of spring and early summer. The greater the development of the plant before summer drouth comes on, the better the yield, as a rule. Therefore the sweet potato plant bed should be planted so that the first batch of plants is ready for transplanting to the field as soon as danger of frost is over. Transplanting may continue safely until the middle of June, unless the soil becomes so dry that successful transplanting is impossible. The yield from very late settings is inferior, as a rule, and it becomes increasingly difficult to secure a good stand as the season advances.

Preparation of Soil. Sweet potato land should be broken quite deeply in early spring, and disked once or twice to get it in fine physical condition for plant setting. Immediately before plant setting, the rows should be laid off about $3\frac{1}{2}$ feet apart and if commercial fertilizer is to be used, it should be drilled into the row. A ridge is formed over the row by throwing up a furrow from each side, as shown in figure 3. This provides fresh soft soil in which to set the plants. If a transplanting machine is to be used, the ridges should be leveled slightly with a plank drag. High ridges are undesirable, but a slight ridge as described above has the advantages of facilitating cultivation, and making it easier to harvest the crop.



FIG. 3.—Sweet potato ridges prepared for plant setting. Figures 3 and 5 by courtesy Virginia Truck Experiment Station.

Setting the Plants. One of the chief items of expense in growing a crop of sweet potatoes is the setting of the plants. Where setting by hand is practiced the acreage is limited by the amount of hand labor available. The type of transplanting machine drawn by 2 horses, requiring a driver and 2 plant-droppers, can set three times the acreage per day that the same number of men could set by hand, and with much less discomfort. There are several good machines of this general type on the market. Of course, these machines cannot do good work in stumpy or very rocky ground.

Precautions in Plant Setting. To secure a good stand and prompt vigorous growth, several points may be considered. The plants should be well "hardened off" by withholding water for several days before transplanting. Just before the plants are pulled from the bed, it should be soaked with water, so that the plants will be turgid, not wilting quickly upon transplanting, and the roots will not be stripped off in pulling. Plants should not be pulled until the field is ready for setting, and they should

not be exposed to the sun any more than necessary. If not set promptly they may be kept fresh in a cool, shaded place by placing the roots in water. If the soil is somewhat dry when setting plants in the field, the chances of the plants' surviving are increased by "muddying" the roots. A thin mud of soil and water is made in which the plant's roots are dipped just before setting.

CULTIVATION

Thorough cultivation until the vines cover the ground is essential. One hand-hoeing, given shortly after the plants are set, should be all the hand-cultivation necessary. The object of this is to break the crust around the plants, draw up the soil to support the stems slightly and destroy small weeds in the row. A corn-cultivator serves very nicely for row cultivation while the plants are small, with the shovels set to throw the



Fig. 4.—Sulky cultivator with shovels arranged to cultivate sweet potato ridges.

soil toward the plants somewhat, as shown in figure 4. As the plants commence vining out it is a good practice to turn the vines into alternate row-middles and continue cultivation in the rows left open. If vine growth becomes excessive by late summer it is a good practice to loosen the vines between the rows, where they have formed rootlets. The practice of cutting back the vines, however, is probably of no value. Experiments in the Southern states have shown that such vine pruning lessens the yield of sweet potatoes.

HARVESTING

A small portion of the sweet potato crop in Missouri may be harvested before fully mature in order to sell the product for good prices on the early market. Growing conditions, however, and the shortness of the

growing season limit the production of early sweet potatoes in this section. The bulk of the sweet potato crop should be allowed to grow as late in the fall as possible, without danger of injury by cold. The development of the roots takes place most rapidly in the early fall. Blackening of the leaves by a light frost does no harm to the roots and there seems to be no reason for believing that the prompt removal of the vines after frosting is necessary. However, the period of bright warm weather which usually follows the first frost in fall is a very advantageous time for completing the sweet potato harvest. The first step is removal of the vines from the center of the row. After removal of the vines the sweet potatoes can be turned out with a 2-horse plow, setting the plow deeply to avoid cutting the large roots. The next step is to pull the roots out of the furrow slice by hand. They should be allowed to lie on the ground for several hours so that free moisture on the surface of the roots may dry out. This causes the loose soil to fall off when the roots are gathered up, the appearance and keeping quality being greatly improved. Warm, sunny weather and a rather dry soil at harvesting time are very desirable. The work should be planned so that the forenoon is occupied with vine cutting, and plowing out the roots, and the afternoon is spent in gathering up the roots and removal to storage.

Precautions in Harvesting. A few points should be mentioned in this connection which have a great influence on the keeping quality of the crop. Sweet potatoes should not be exposed to heavy frosts in the field, especially after the vines have been stripped off, since the tips of the roots extending through the surface of the soil are easily injured by frost, giving a bitter flavor to the whole potato and often resulting in speedy decay. In gathering, every precaution should be observed to prevent bruising or cutting the roots, for every bruise gives an opportunity for rot-causing fungi to enter. If sweet potatoes are to be stored in bulk in bins, padded crates may well be used for gathering the roots in the field. If they are to be stored in barrels or baskets, the roots should be placed directly in these storage containers when gathered in the field to avoid the necessity of rehandling later, with the consequent bruising. Furthermore, the seed-size roots and the over-sized roots should be gathered separately from the market grade. This avoids the necessity of sorting when the market grades are sold during the winter. It has been found that rot in storage increases greatly as a result of a single sorting during the winter. The fact is worth noting that the "tails" on the ends of the roots should not be snapped off in harvesting, as this creates a fresh wound through which rot fungi may enter.

STORAGE

Too generally the sweet potato is considered to be difficult to keep for any length of time in storage. It may be stated emphatically here that if the proper precautions are taken and suitable storage conditions provided, sweet potatoes can be kept easily in perfect condition throughout the winter. The need of winter storage for this crop is evident, since only a small portion of the crop can be consumed during the harvest season in

ture, from 50 to 55° F., during the storage period; fourth, good ventilation of the storage place; fifth, no handling, sorting or disturbance of any sort during the storage period. These conditions can be provided usually fall; and if all growers attempt to sell their crop at that season, the market is over-supplied, resulting in unsatisfactory prices. The variation in price per bushel for sweet potatoes during the fall and winter is illustrated by Chart 1. The higher prices secured in winter indicate that the grower may obtain much more satisfactory returns from his crop if it is marketed from storage during the winter.

Requirements for Storage. The essential requirements for successful storage of the sweet potato are: first, careful handling as mentioned under foregoing precautions in harvesting; second, preliminary drying out or "curing" at the beginning of the storage period; third, suitable tempera-

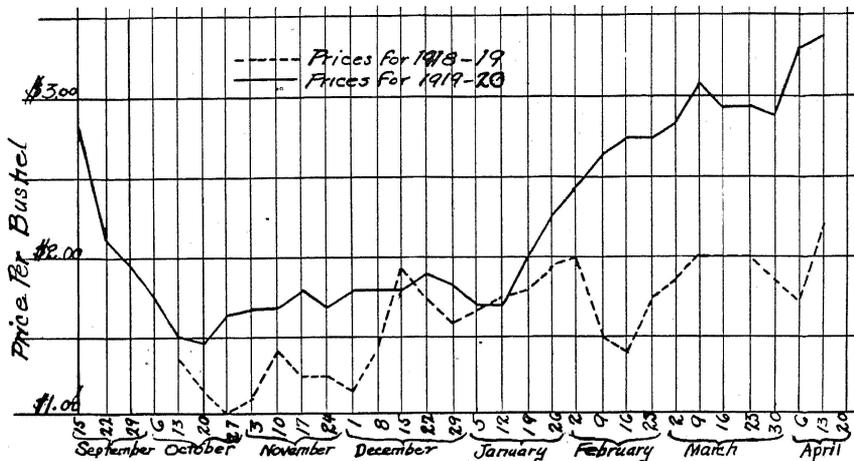


CHART 1.—Average price per bushel for Nancy Hall sweet potatoes on St. Louis wholesale market each week from September 15 to April 15, 1918-19 and 1919-20.

without difficulty for storing the home supply. For storage on a large scale a special storage house, intelligently handled, is necessary.

Home Storage. The most satisfactory way to store sweet potatoes for home use is to gather them in slatted crates or baskets at digging time and place these containers in a dry, warm, well ventilated place. This may be a shed or outbuilding where the sweet potatoes are placed for a few days to become thoroughly air-dry, after which they should be removed to the house basement or to a partially heated room in the house. A warm, dry basement affords excellent storage conditions for sweet potatoes. The crates or baskets of sweet potatoes may be conveniently and safely stored on shelves near the furnace. Temperatures in the sweet potato storage place must never be allowed to fall below 40° F.; otherwise a bitter flavor or Soft rot will develop quickly. Such practices as burying sweet potatoes in sand and wrapping the roots in paper are unnecessary.

Commercial Storage. During the past few years a number of modern sweet potato storage houses have been erected, with capacities ranging

from a few hundred bushels to a hundred thousand bushels each. Persons interested in the construction of such storage houses can obtain full details as to their construction and management in Farmers Bulletin 970, obtainable free of charge from the United States Department of Agriculture, Washington, D. C. The main principles involved in construction of a modern sweet potato storage house are good ventilation and convenient, uniform heating. A large house of this type could be built and used cooperatively by several small growers. It is possible, also, to remodel an old outbuilding to serve the purpose. The main features of successful management of a sweet potato house are to have the temperature in the

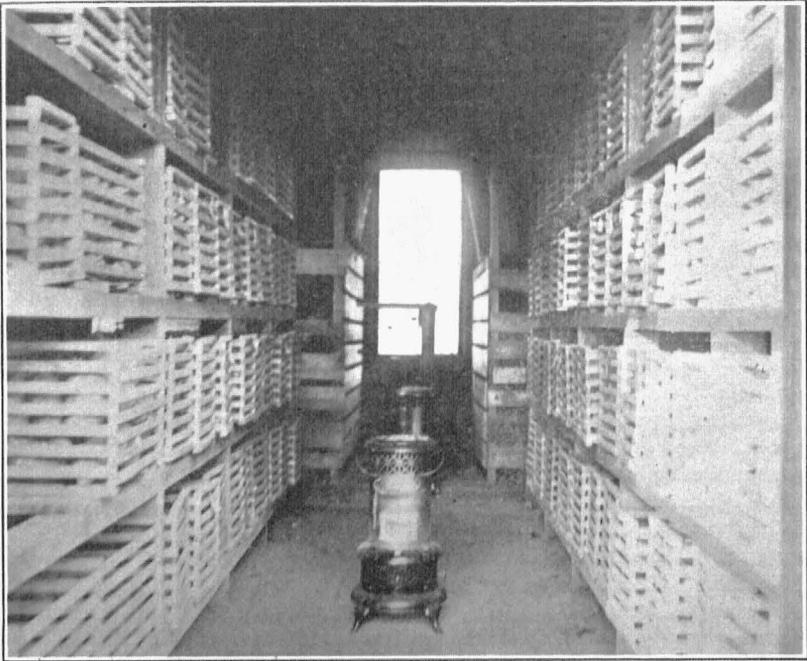


Fig. 5.—Interior of small sweet potato storage house, heated with oil stoves.

house about 80 to 85°F. during the time the sweet potatoes are being placed in the house and for one week afterwards. At the same time, full ventilation should be given, so that excess moisture is driven off, and the roots become "cured." After this curing period the house should be kept at 50 to 55°F. with limited ventilation. Coal stoves are used in heating large houses. Kerosene stoves will serve very well to heat small houses.

VARIETIES

The leading varieties of sweet potatoes have been grown on the Experiment Station farm at Columbia for the past three years. In 1920, the variety tests were laid out in duplicate; one series being fertilized with

acid phosphate at the rate of 200 pounds per acre, the other series being unfertilized. Four varieties yielded somewhat more on the fertilized plot, while seven varieties yielded more on the unfertilized plot. The averaged results from the variety tests are given in Table 1.

TABLE 1.—SWEET POTATO VARIETY TEST—1920

Variety	Bushels per acre			Per cent of total yield graded No. 2 or "Seed size"	Average wt. of No. 1 potatoes
	No.1	No.2	Total		
Strassburg	498.0	48.7	546.7	8.9	16.6 oz.
Red Bermuda	383.0	106.8	489.8	21.8	13.6
Southern Queen	366.4	94.8	461.2	20.8	13.3
Nancy Hall	320.8	126.2	447.2	28.3	10.6
Triumph	349.3	76.9	426.2	18.0	10.8
Porto Rico	317.4	98.4	415.8	23.6	11.0
(From Bettrand, Mo.)					
Porto Rico	238.2	103.7	341.9	30.3	10.2
(Station stock)					
Yellow Jersey	214.3	141.2	355.8	40.0	9.0
(Big Stem type)					
Yellow Jersey	152.9	112.7	265.7	43.6	7.9
(Little Stem type)					
Red Nancemond	110.4	126.8	237.2	52.1	6.4

One outstanding result of this test is the relatively low yield of varieties of the Jersey type, and the high percentage of No. 2 or "seed-size" roots in these varieties. This point is of especial interest in view of the fact that the Yellow Jersey and Red Nancemond are now being grown extensively in some parts of the state. On the other hand, the three highest yielding varieties listed here are not always desirable, because of rather poor quality from the food standpoint and the roughness and large size of the roots. These points apply especially to the Red Bermuda and in a lesser degree to the Strassburg and Southern Queen. These extremely vigorous-growing varieties may be well adapted for use where sweet potatoes are grown on very poor soil or under otherwise unfavorable conditions. The Nancy Hall variety, while producing a good yield, has smooth, uniformly medium sized roots which are of desirable market grade. The high quality of this variety from the food standpoint should also be mentioned. The Porto Rico variety is somewhat richer in color and more juicy in texture than the Nancy Hall, although observations made at several points in the state indicate that this variety is somewhat inferior to the Nancy Hall in productivity. The Porto Rico variety, however, is worthy of trial for home use.

The varieties of sweet potatoes mentioned here keep well under good conditions of storage. When storage conditions are not of the best, however, as may be the case in home storage, the Nancy Hall, Porto Rico, and other varieties of the sweet, juicy type, as a rule do not keep quite as well nor through so long a period as some of the more hardy varieties such as Southern Queen and the Yellow Jersey.