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# Harvesting and Storing Sweet Potatoes

By

J. C. C. PRICE

AGRICULTURAL EXPERIMENT STATION  
of the  
ALABAMA POLYTECHNIC INSTITUTE  
DAN T. GRAY, *Director*  
AUBURN

## SUMMARY

These experiments indicate rather definitely that:

1. The splendid keeping results reported in Bulletin No. 197 were due quite largely to the fact that potatoes were dug before vines were frosted and then stored and cured properly in a house.

2. Regardless of curing methods potatoes dug after vines are damaged by frost will not keep as well as they would if dug before vines are frosted.

3. The old belief, common among farmers, that "it is safe to delay harvesting until frost has killed the vines" is not only unsafe but will result absolutely in loss of potatoes even though harvesting is done immediately after vines are frosted.

4. Banked potatoes get pithy and lose their food value quicker than house stored potatoes.

5. The ultimate loss in eating, keeping, and germinating is increased in proportion as harvesting is delayed after vines are frosted.

6. Vines may be removed a few days before harvesting without causing loss to either eating or keeping qualities.

7. Lack of curing may cause discoloration without spoiling the product for food.

8. Properly harvested and well cured sweet potatoes will stand a lower temperature without damage than uncured potatoes.

9. Properly grown and cured potatoes do not require much ventilation when stored in houses.

10. Comparative weight loss of house stored potatoes over bank stored potatoes is not as great as is usually thought.

11. If potatoes are dug and placed in a storage house during curing it is better to fill each bin gradually rather than completely at one time. This will prevent over-curing near the ceiling.

12. Further investigation should be made to determine the chemical changes that take place in potatoes under different growing, harvesting, and storage methods with a view to improving present methods of handling this important crop.

## HARVESTING AND STORING SWEET POTAOES

By

J. C. C. PRICE\*

Previous to the fall 1917 it had been revealed by the Alabama Experiment Station that it is more economical to store sweet potatoes in houses than in pits, banks, or trenches, and that it is easier, cheaper, and less risky to market sweet potatoes from curing houses than from banks, pits, or trenches. These facts have been reported in Bulletin No. 197 of the Alabama Experiment Station.

During 1917 potatoes were grown to continue certain phases of work reported in Bulletin No. 197. On October 24th an unexpected frost killed practically all of the potato vines. The writer had evidence from previous work and observations, that potatoes from frosted vines would not keep well and were not satisfactory for human food. However, storage tests, as reported in Bulletin No. 197, were carried out with potatoes dug before vines were frozen which made it necessary to get, as nearly as possible, potatoes that were not damaged by the freeze. So, vines were removed with a hay rake on the morning of October 25th.

The crop was harvested October 30th to November 2nd and cured for five days in a curing house. At the end of the curing period, the temperature was running low on the outside of the house and it was closed tight. Examination on November 2nd showed rots and molds appearing on cut surfaces. For several days the ventilators were opened during the day and closed at night. This, apparently, stopped the molds. Toward the end of the month much rain fell and moisture collected on the inner walls of the storage house, causing it to appear as if sweating. Fires were built four times during December to correct this condition. During three days, from December 14th to 17th, inclusive, the temperature in the house went to and remained at 40 degrees F.

In January potatoes continued to sweat and upon examination were found to contain black streaks and pithiness, and when baked many of them were unfit for food. About fifty percent was sound enough to be used for seed.

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\*Now at Mississippi Agricultural and Mechanical College.

This very heavy loss and the storage behavior of the potatoes seemed to be so very important and so different from the common belief among farmers that "it is not necessary to dig potatoes until the morning following the first killing frost," that it seemed advisable to begin investigations immediately to determine the cause of such behaviour and suggest methods of avoiding such losses. The writer started tests in 1918 to determine whether or not this loss was caused from frosted vines, and if so, whether or not such losses could be prevented, (1) by digging immediately after vines were frosted; (2) by removing vines as quickly as they were damaged by cold; (3) or by removing vines before digging. Investigation was made also to determine whether or not insufficient curing, or low storage temperature could have caused the loss. It was convenient to conduct tests along with these experiments to secure some preliminary information on, (1) the effects of ventilation during storage periods on house cured potatoes; (2) loss by weight of house stored and banked potatoes; (3) variation of temperature at different elevations in storage houses during curing; (4) and general humidity and temperature behavior in banks and houses during curing and storage.

COMPARISON OF KEEPING AND EATING QUALITIES OF POTATOES DUG BEFORE AND AFTER VINES WERE FROSTED

To test the effect of frosted vines on the keeping and eating qualities of sweet potatoes, Triumph and Porto Rico varieties were planted at the same time, in the same field, in similar soils, and grown under similar cultural conditions. This assured uniformity of product. For this test, one lot of potatoes was dug before frost and cured in storage house. A second lot was dug before frost and banked in the regular way with pine straw. Five to ten days after the vines were frosted a third lot was dug and placed in the storage house and a fourth lot was dug and placed in banks. The third and fourth lots were treated as nearly like the first and second lots as possible. This treatment was as follows: Potatoes in storage were carried through a curing process ten to twelve days at a temperature varying from 80 to 90 degrees F, as outlined in

Bulletin No. 197, then lowered to a temperature of 50 to 60 degrees F, and kept as near this temperature as possible.

Preparatory to banking, potatoes were carefully sorted and piled on a thick layer of pine straw, covered carefully each night to keep off dew and prevent chilling, and uncovered each day to allow drying by the sun. This was done for three days, and the potatoes were then covered with a layer of pine straw 6 inches thick and 8 inches of soil as shown in Figure 1.

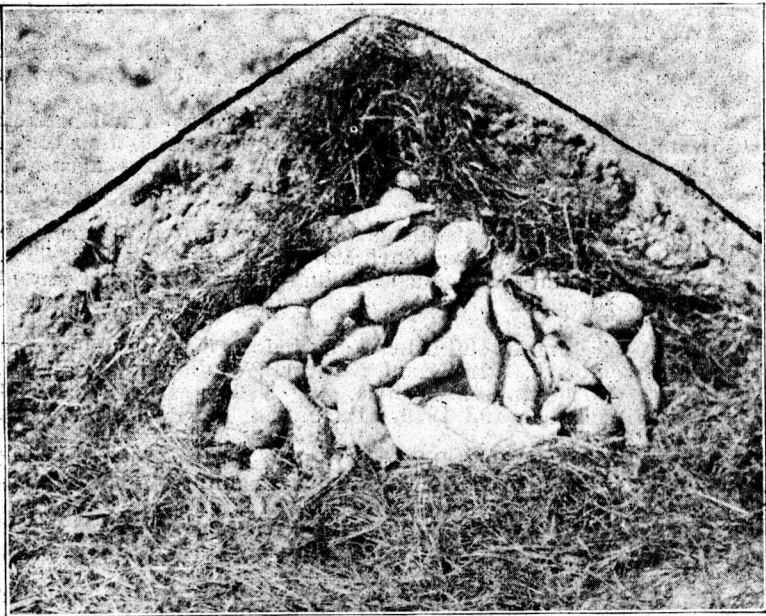


FIG. 1.—Showing How Potatoes Were Banked

A hole five inches in diameter was left in the top of the bank for ventilation. Pine straw was stuffed into the ventilator in the top of the bank during low temperature periods. A wooden box about 2 feet square was turned over the top to keep out rain. It was removed on warm, sunny days if the top of the bank had the appearance of sweating. Bank was not disturbed throughout the storage period. A thermograph was used for recording the temperature in the bank.

## RESULTS OF STORAGE TESTS

The following notes were taken on different lots of potatoes in storage:

Lot 1.—Triumph, 100 bushels, dug before frost and stored in bank November 15, 1918. Examined March 18, following. Loss 5%.

Lot 2.—Triumph, 10 bushels, dug before frost and stored in bank November 15, 1918. Examined March 18, following. Loss 5%.

Lot 3.—Triumph, 10 bushels, dug 10 days after frost and banked December 13, 1918. Examined March 18, following. Loss 85%.

Lot 4.—Triumph, 1 bushel, dug 10 days after frost and stored in house but not cured, December 13, 1918. Examined March 22, following. Loss 96%.

Lot 5.—Porto Rico, 50 bushels, dug before frost and stored in house November 7, 1918. Examined April 15, following. Loss .8%.

Lot 6.—Porto Rico, 10 bushels, dug before frost and banked November 15, 1918. Examined March 18, following. Loss .62%.

Lot 7.—Porto Rico, 10 bushels, dug 10 days after frost and banked December 13, 1918. Examined March 18, following. Loss 50%.

Lot 8.—Porto Rico, 1 bushel, dug after frost and stored in house but not cured. Examined March 22, following. Loss 75%.

Lot 9.—Triumph, 100 bushels, dug before frost and stored in house November 5, 1919. Examined April 12, following. Loss .4%.

Lot 10.—Triumph, 10 bushels, dug before frost and stored in bank November 5, 1919. Examined April 7, following. Loss .7%.

Lot 11.—Triumph, 5 bushels, dug 5 days after frost and banked December 19, 1919. Examined April 7, following. Loss 80%.

Lot 12.—Triumph, 4 bushels, dug 5 days after frost and stored in house December 19, 1919. Examined April 12, following. Loss 75%.

Lot 13.—Porto Rico, 100 bushels, dug before frost and stored in house November 5, 1919. Examined April 12, following. Loss .8%.

Lot 14.—Porto Rico, 10 bushels, dug before frost and banked November 5, 1919. Examined April 7, following. Loss 1.25%.

Lot 15.—Porto Rico, 5 bushels, dug 5 days after frost and banked December 19, 1919. Examined April 7, following. Loss 75%.

Lot 16.—Porto Rico, 6 bushels, dug 5 days after frost and stored in house December 19, 1919. Examined April 12, following. Loss 71%.

In addition to the above examination, potatoes that were dug before and after frost were taken from banks and house and baked with the following observations:

Triumphs dug before frost were in excellent condition, had no discoloration, were sweet, soft, uniform in texture, stringless, excellent in quality, good color, and free from lumps.

Triumphs dug five days after frost had killed the vines, showed discoloration and pithiness when cut. When baked they were lumpy, slightly stringy, and poor in quality. They showed dark streaks throughout. had a bad taste and odor, and were unfit for food.



FIG. 2.—Potato Damaged by Freezing. Note the Blackening of the Cambium from which Peeling Separates.

Porto Ricos dug before frost kept in good condition. When baked they were soft, sweet, juicy, tender, uniform in texture, and good in color, flavor, and quality.

Porto Ricos dug five days after frost had killed vines showed discoloration and pithiness when cut. When baked they showed air spaces and were stringy, lumpy, wet, poor in texture and flavor, and showed discoloration throughout. They were unfit for food.

Both varieties dug before frost appeared healthy and, when bedded, produced good sprouts in due time while those dug after frost and cured in house appeared dead and did not produce good sprouts. Those dug after frost and stored in bank had a tendency to sprout before the regular season. What might be termed a second growth took place, making the potatoes unmarketable. This was due to heating caused by the rapid decay of a large portion of the total lot as shown by notes on page 6.

### INFLUENCE OF TIME OF HARVESTING ON KEEPING AND EATING QUALITIES OF POTATOES FROM FROSTED VINES

To make this test potatoes were dug the day the vines were frosted and five and ten days after frost. Potatoes dug the day the vines were frosted lost 14% in banks and 10 percent in storage house. Some showed a trace of pithiness and were counted as loss, but when baked they had a good flavor and color. Potatoes dug five days after frost lost 50 to 85 percent by rot and the remainder that appeared sound were not fit for food when baked. These results are similar to those of 1917. Potatoes dug ten days after vines and foliage were frosted were a total loss. This is shown in Figure 3.



FIG 3.—Triumph Potatoes Dug 10 Days After Frost, 1918, and Stored in Bank; 85% Rotten and Remainder Worthless.

Potatoes dug eight days after 50 percent of foliage was killed appeared to be in good condition, but when cut they were found to be pithy and woody and contained black streaks. The loss in this lot by rot was 2 percent in house and 6¼ percent in bank. When baked these potatoes showed discoloration, air spaces, unattractiveness, and had poor flavor and color.



### EFFECT OF CUTTING VINES BEFORE DIGGING

Vines were removed from two lots October 22, 1919, and ends of the stems of potatoes were covered with soil to protect them from frost. One lot was dug fifteen days after vines were removed and the other lot thirty days after. There was no loss from potatoes dug before frost. Two crates of 50 pounds each were selected from each digging, cured and stored in storage house, and some of the thirty day lot was banked without curing when dug.

Those in the house were examined May 16th. Two potatoes of the fifteen-day period had rotten ends and showed traces of pithiness while the remainder, and the two thirty-day lots, were sound and in excellent condition. When baked these potatoes were free from lumps, stringiness, or discoloration. They were sweet, fairly juicy, and of excellent flavor and texture. The lot in banks was examined April 12th. A bushel contained one rotten and five with rotten ends, with 50 percent pithy. When baked, they had good flavor and color, but showed pithy streaks. The pithiness was evidently due to being placed in storage in an uncured condition as shown elsewhere.

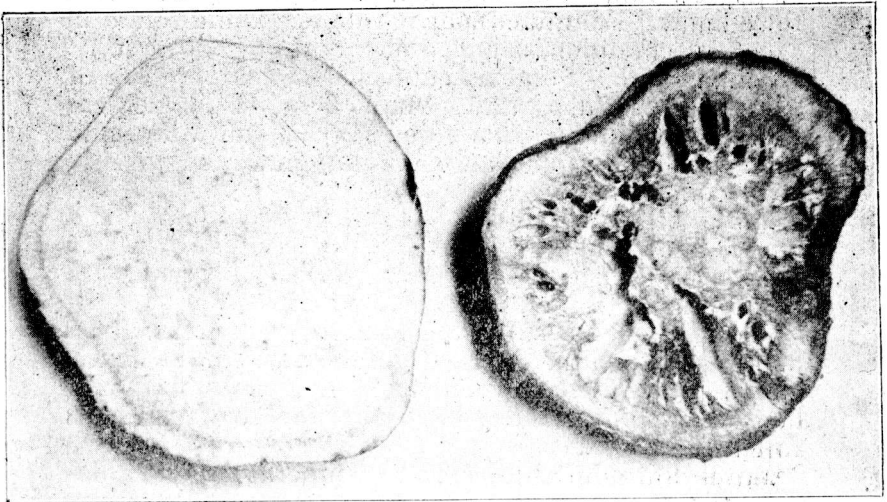


FIG. 4.—On Left Cross Section from Those Dug Before Frost; on Right Cross Section from Those Dug After Frost.

A lot of two hampers was dug before frost, cured in a storage house and removed to storage cellar or storage pit. A second lot was dug and placed in cement cellar immediately after digging. When examined in April the cured potatoes showed no discoloration or pithiness, while the uncured potatoes showed dark streaks and were pithy. When baked all were sweet, juicy, and of good flavor and texture.

EFFECT OF LOW TEMPERATURE WHILE IN STORAGE ON KEEPING QUALITIES

To determine whether or not low storage temperature of 1917 could have caused heavy loss a number of experiments were conducted to find the lowest temperature potatoes dug before frost and properly cured would stand without injury or loss by decay. Lots of 20 selected cured potatoes were placed in the weather shelter by a thermograph machine and the following observations made:

January 2nd.—Potatoes subjected to temperature of 36 degrees Fahr., and remained below 40 degrees Fahr. for ten hours. Examined May 5, following, and found in excellent shape, sound, juicy, and of good quality.

January 3rd.—Potatoes subjected to temperature of 32 degrees Fahr., and remained below 35 degrees Fahr. for 8 hours. Examined May 5, following, and found in excellent condition, sound, juicy, and of good quality.

January 5th.—Potatoes subjected to temperature of 29½ degrees Fahr., and remained below 32 degrees Fahr. for 6 hours. Examined May 5, following, and showed slight injury at cambium, but otherwise in good condition.

March 6th.—Lot subjected to 24 degrees Fahr. for 6 hours, and remained below 32 degrees Fahr. for 15 hours. Examined 25 days later. Seventy percent were rotten and the remainder in bad condition.

March 7th.—Lot subjected to 23 degrees Fahr. for 5 hours, remained below 32 degrees Fahr. for 12 hours, and night of 8th subjected to 20 degrees Fahr. for 1 hour and below 32 degrees Fahr. for 13 hours. All rotten 2 days later.

March 9th.—Lot subjected to temperature of 27 degrees Fahr. and returned to storage house in 24 hours below 32 degrees Fahr. for 9 hours. May 5th showed a slight leatheriness and discoloration when cut. All were sound.

The above results tend to show that properly cured potatoes will withstand a temperature near the freezing point without injury. However, such risks should not be taken. A temperature below 40 degrees Fahr. is not recommended. Triumphs were used in all of the above tests.

#### STORAGE WITHOUT VENTILATION

In order to determine the influence of little or no ventilation on house cured and stored potatoes one lot of potatoes was dug before frost in 1918, cured, and placed in a house that was kept closed tight throughout the storage period. The potatoes were examined in April, 1919, and found to be in excellent condition in every way. This indicates that potatoes dug before frost, and properly cured, do not require much ventilation in a house built of wood.

#### WEIGHT LOSSES IN HOUSE

In order to secure data on loss in weight in curing and storage 5 packages of 50 pounds each were selected, washed and weighed at regular intervals during period and at the end of storage period. Two packages were discarded in the 1918-19 experiment and



FIG. 5.—Triumph Potatoes Dug Before Vines were Frosted, 1919, and Stored in Bank; 99.3% Sound.

one package in 1919-20 because of decayed potatoes. The potatoes in the other 7 packages kept without loss in quality or color. In the experiment a No. 1 grade of potatoes was used. Losses in weight during the curing period and at the end of the storage period varied very little.

TABLE I.—LOSS IN WEIGHT OF POTATOES STORED IN HOUSE  
1918-1919

Date	Lot 1* Lbs.	Lot 2* Lbs.	Lot 3* Lbs.
Nov. 8 -----	50	50	50
9 -----	49.50	49.48	49.46
10 -----	49.27	49.25	49.22
11 -----	48.86	48.80	48.82
12 -----	48.67	48.65	48.65
13 -----	48.35	48.32	48.34
14 -----	48.10	48.05	48.10
15 -----	47.93	47.86	47.88
16 -----	47.85	47.80	47.82
17 -----	47.60	47.65	47.55
18 -----	47.40	47.55	47.35
March 22-19 -----	44.55	44.90	44.50

\*Triumph potatoes used.

Average loss 10.7%.

TABLE II.—LOSS IN WEIGHT OF POTATOES STORED IN HOUSE--  
1919-20

Date	Lot 1* Lbs.	Lot 2* Lbs.	Lot 3** Lbs.	Lot 4** Lbs.
Nov. 6 -----	50	50	50	50
7 -----	49.35	49.65	49.65	49.70
8 -----	48.65	49.00	49.00	48.80
10 -----	47.35	48.10	48.40	48.00
11 -----	47.10	48.05	48.20	47.85
12 -----	46.95	47.95	48.10	47.45
14 -----	46.50	47.55	47.50	46.90
15 -----	46.30	47.50	47.45	46.65
27 -----	45.50	46.50	46.35	45.40
May 16-20 -----	43.20	43.55	43.80	43.50

Average loss 12.97%.

\*Triumph variety used.

\*\*Porto Rico variety used.

### WEIGHT LOSS IN BANKS

One lot of potatoes was selected, numbered, weighed, and placed in a storage bank, November 15, 1918, and another lot was handled in the same way and stored in a bank November 5, 1919. The first lot remained in bank until March 18, 1919, and lost 4.15 percent of its weight. The second lot remained in bank until April 12, 1920, and lost 6.91 percent of its weight. In each case the bank remained closed until the potatoes were taken out and weighed. These losses are compared in Table III which follows.

TABLE III.—WEIGHT LOSSES IN HOUSE AND IN BANK

Date Storage Began	Ended Date Storage	Storage Method	Percent Loss
Nov. 8, 1918	March 22, 1919	House	10.7
Nov. 15, 1918	May 16, 1920	House	12.97
Nov. 15, 1918	March 18, 1919	Bank	4.15
Nov. 5, 1919	April 12, 1920	Bank	6.91

It should be observed that the average storage period in house was longer than in bank. The average loss of those stored in house was 11.83 percent and the average loss in banks was 5.53 percent.

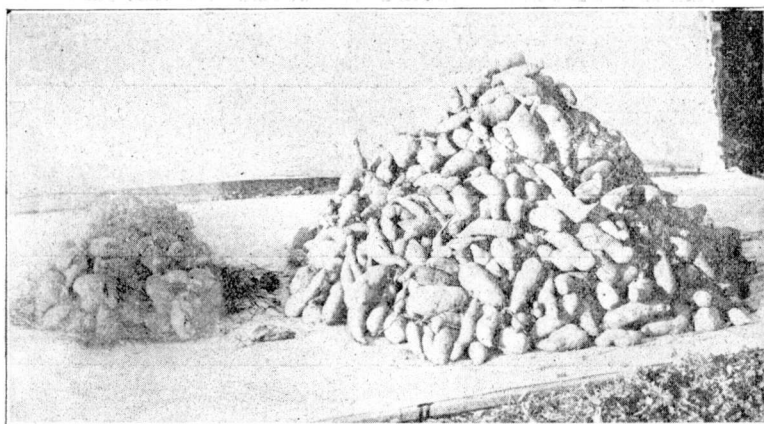


FIG. 6.—Triumph Potatoes Dug Before Vines were Frosted in 1918, and Stored in Bank; 5% Loss.

Table IV, below, shows thermometer readings at top of bin, at floor, and half way between. Before a fire was built all readings were the same. During the curing season there were variations of 7 to 29 degrees between top and bottom of bin.

TABLE IV.—TEMPERATURE OF ROOM DURING CURING

Date, 1918	Time	Temp. at	Temp. midway	Temp.
		top of bin	between floor	at floor
		and ceiling		
		Degrees F.	Degrees F.	Degrees F.
Nov. 5	7:00 A. M.	58	58	58
	9:00 A. M.	94	82	71
	2:30 P. M.	78	78	71
	4:00 P. M.	90	86	71
Nov. 6	7:00 A. M.	63	60	56
	9:00 A. M.	74	68	58
	12:00 M.	81	71	65
	3:30 P. M.	84	72	66
	4:30 P. M.	84	73	64
Nov. 7	7:00 A. M.	67	63	52
	9:00 A. M.	90	73	61
	2:00 P. M.	80	73	67
	5:00 P. M.	88	77	63
Nov. 8	7:00 A. M.	67	63	54
	1:30 P. M.	86	75	70
	5:00 P. M.	86	75	64
Nov. 9	7:00 A. M.	73	67	60
	10:40 A. M.	90	82	70
	3:30 P. M.	90	81	72
	5:00 P. M.	90	84	70
Nov. 10	7:00 A. M.	73	69	63
	4:30 P. M.	82	75	69
Nov. 11	7:00 A. M.	68	64	54
	9:00 A. M.	90	81	72
	2:00 P. M.	82	74	68
	5:00 P. M.	80	72	60
Nov. 12	7:00 A. M.	70	64	54
	8:30 A. M.	88	76	58
	2:00 P. M.	74	68	63
Nov. 13	7:00 A. M.	68	59	44
	8:30 A. M.	80	71	58
	6:30 P. M.	78	69	58
Nov. 14	7:00 A. M.	74	70	58
	9:00 A. M.	86	70	60
	3:00 P. M.	83	75	68
	7:00 P. M.	76	70	62
Nov. 15	9:00 A. M.	76	74	62
	5:00 P. M.	76	72	68
Average		76.9	72.6	62.8