SOME POST-HARVEST PHYSIOLOGICAL STUDIES ON CULTIVARS OF SWEET POTATOES (*IPOMOEA BATATAS*)

by

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TABLE OF CONTENTS

INTRODUCTION

The sweet potato belongs to the genus Ipomoea of the Convolvulaceae family. It is an important food crop in tropical and subtropical regions of the world including Africa, Asia and tropical South America. Even in the southern part of the United States, the sweet potato is a standard article of food and is more important than the potato of the genus Solanum.

The name "yam" as it is sometimes called, especially in the Southern United States is a misnomer because true yams belong to the genus Dioscorea.

Unlike the potato, the sweet potato is not stored directly after harvest but is first cured. Curing is accomplished by keeping the sweet potatoes at 80-85°F and 90 percent relative humidity immediately after digging. The object of curing is to heal wounds quickly and hasten the thickening of the skin to give protection against rots.

Curing after digging was formerly thought to be important in removing excess moisture from sweet potato roots. It was largely considered a process of drying-out of the roots for better storage. The newer viewpoint has led to keeping the roots in a moist atmosphere during curing so as to aid healing and to prevent condensation of moisture.

At curing temperatures of 80-85°F and 90% relative humidity immediately after digging, healing will occur in 10-14 days. In fact, curing at 80°F for 4 days is usually

ample for some varieties.

The skin of an uninjured sweet potato consists of several layers of corky cells that reduce loss of water and effectively keep out rot fungi. When this protective covering is broken, new layers of corky cells to cover the wound are produced if the sweet potato is in a warm humid environment. Injury to a root is followed by an exudation of a milky fluid which dries and hardens. But this does not constitute healing. The walls of a few layers of the exposed cells in the wound next become thickened and hardened and help to prevent evaporation. Actual healing is due to the production of several layers of new cells just beneath the wound. These new cells develop into wound cork, and their outer layers become dry and corky resembling the cells of the original skin and serve as effectively in preventing water loss.

Since curing prevents water loss, a sweet potato which is not cured will shrivel thus reducing its keeping quality and obviously affecting the specific gravity of the root. Also it is conceivable that normal sound roots might lose some 5 percent in weight while curing, mostly as free water and partly as CO_2 in respiration.

The keeping quality of sweet potatoes has to be partly a function of the storage temperatures in that if the temperatures are too low, the roots suffer tissue breakdown called chilling injury. Excessively high temperatures cause the roots to rot. According to Thompson and Kelly (23), storing sweet potatoes 2 days at 32°F and 4 days at 40°F resulted in

injury. This being so, the storage temperature will undoubtedly have an effect on the sprouting efficiency of sweet potatoes.

Recent studies according to Kushman and Pope (11) have shown that at harvest, sweet potato storage roots contain as much as 10 millilitres of intercellular space per 100 millilitres of root volume and that during storage, intercellular space increases to the extent that it becomes visible. This is classified as pithiness or internal breakdown.

The objectives of the studies here therefore were:

(1) Evaluate freshly harvested sweet potato cultivars for intercellular space, tissue specific gravity and root specific gravity.

(2) Evaluate the effect of curing sweet potatoes for different time intervals after harvesting for intercellular space, root specific gravity and tissue specific gravity.

(3) To investigate the effect of different storage temperatures on the intercellular space, root specific gravity and tissue specific gravity of the Rose Centennial cultivar of sweet potato.

(4) Evaluate the effect of different storage temperatures on sprout efficiency of Rose Centennial cultivar of sweet potato.

REVIEW OF THE LITERATURE

Intercellular space and specific gravity of sweet potatoes are factors which may be used to determine the keeping quality of the roots.

As pointed out by Ezell and Wilcox (5), Ezell, Wilcox and Demaree (5) and Scott and Matthews (20), sweet potatoes lose weight during storage and gradually become pithy. This pithiness develops more rapidly at higher temperatures and lower relative humidity than under recommended storage conditions and develops more rapidly in some varieties than in others. Kushman, Pope and Monroe (13) stated that it is generally accepted that pithiness indicates poor quality and distinctly pithy roots are often described as showing internal breakdown.

Sweet potatoes contain considerable amount of carbohydrates but some float in water even at harvest giving an indication that some component of the root must be lighter than water. This component was suggested by Kushman et al (13) to be air in intercellular (or intracellular) spaces and, enlargement of these spaces eventually leads to a condition classified as pithiness.

Related perhaps to intercellular space is internal gas content which Kushman and Deonier (12) described as the factor most closely associated with poor keeping quality following late harvesting, high soil moisture or chilling in storage. They referred especially to a high level of carbon dioxide

in the roots, which logically is the reciprocal of oxygen level.

Hernandez et al (7) could not detect any difference in quality between Unit 1 Porto Rico roots which were high in specific gravity as compared to low specific gravity roots. Their studies also included the cultivars Goldrush, Unit 1 Porto Rico, L-240 and L8-24. Roots of all these cultivars that were high in specific gravity were always high in per cent dry matter. Sweet potato roots of the Unit 1 Porto Rico cultivar that were high in specific gravity were low in total sugars. The higher the specific gravity of Pelican Processor sweet potato roots, the higher the percentage of starch. The studies of Hernandez et al (7) showed that specific gravity of sweet potato roots were highest immediately after harvest and decreased with time in storage and varied in specific gravity among individual hills of Unit 1 Porto Rico cultivar.

Saini (19) in 1964 after Nissen (17) in 1955, worked out a relationship between percentage dry matter (y) and weight in water of potatoes as follows:

$$y = 278.\frac{Ww_{\%}}{Wa}$$

Where Ww is the weight of potatoes in water after they have been evacuated in a desiccator of water and Wa is the weight of the potatoes in air. Since there is a correlation between specific gravity of sweet potatoes and dry matter content

(7), the formula of Saini (19) above might be applicable to sweet potatoes in predicting percentage dry matter.

Apart from the healing of wounds of the sweet potato, curing also alters starch quality (24). In this regard, Barham and Wagoner (1) found that the regular cure of sweet potatoes lowers the extremes of the gelatinization temperature of the starch as well as the viscosity of its pastes, but not to the extent that the pasting curve approaches coincidence with that of tapioca starch.

Canned products from freshly dug sweet potatoes, because of their firmness are superior to those canned from cured stocks for the preparation of such dishes as candied sweet potatoes (3).

Cultivars differ in sugar-starch changes during storage at different temperatures but generally low temperatures cause an accumulation of sucrose in fresh potatoes (21). This sucrose accumulation is at the expense of starch (8). In specific storage tests by Hopkins and Phillips (8), there were wide differences in sugar accumulation between sweet potatoes stored at 55°F and 70°F in both cured and uncured lots. This indicates the existence of a critical temperature as in the storage of Irish potatoes between 35°F and 40°F (21).

The literature regarding changes in the carotene and the ascorbic acid content of sweet potatoes and the various factors affecting them has been rather confusing because of its

apparently conflicting nature (5). Some have reported an increase in carotene during storage (15), some a decrease (16), and others no significant change (22). However, the studies of Ezell and Wilcox (5) showed that storage temperature and cultivar are major factors determining the behaviour of the carotenoid pigments during storage. Nancy Hall cultivar decreased in carotene and total carotenoid pigments during storage at all temperatures. Other cultivars studied tended to decrease in these compounds when stored at 50°F, at 55°F there was little change, and at 60°F and 70°F the increases were appreciable and of nutritional significance.

Cold temperature injury to sweet potatoes occurs at temperatures near the freezing point of water (32°F). Price (18) 1923 reported that sweet potatoes of the Triumph cultivar exposed to temperatures ranging from 32°F to 40°F for periods not exceeding 10 hours were not injured. He recommended that the temperature in storage should not go below 40°F.

Lauritzen (14) worked on the effects of chilling temperatures on sweet potatoes. Using the Jersey cultivar, he found chilling injury other than the increased susceptibility to certain rot organisms when sweet potatoes were stored at -0.2° to 9.5°C (31.6° to 49.1°F). Signs of injury were not always evident after the chilling until the sweet potatoes were put back at a temperature favorable for storage. The injury was evidenced by internal browning of the tissue.

According to Kimbrough and Bell (10) in the case of severe chilling injury very little or no latex will be

present on the cut surface of a sweet potato and the cut surface does not look normal. Also after a lapse of time severe internal breakdown may be present in sweet potatoes.

MATERIALS AND METHODS

The sweet potatoes used for evaluating intercellular space, root specific gravity and tissue specific gravity immediately after harvest and at various curing times were acquired from the Horticulture Farm vegetable plots, at Kansas State University. The five cultivars and/or selections used were L4-73, Centennial, NC-240, Okla5-195 and Tanhoma.

Non-cured samples of sweet potato roots were evaluated after harvest on October 18th, 1968. Others were cured 80°F and 90 per cent relative humidity for one week, two weeks and three weeks. They were evaluated for these factors after curing.

Five bushels of Rose Centennial sweet potatoes were acquired from a local grower for the second portion of this study. Samples of these roots were evaluated fresh for intercellular space, root specific gravity and tissue specific gravity. The remaining roots were cured at 80°F and 90% relative humidity for nineteen days. These roots were then divided into three lots and stored at 38°F, 55°F and 72°F respectively for 38 days.

On December 18th, 1968, these roots of Rose Centennial cultivar were taken out of storage and specific gravity and intercellular space determinations were made on them. A portion of each of the sweet potatoes stored at 38°F, 55°F and 72°F was saved and used in sprouting test.

EXPERIMENTAL PROCEDURES

(A) Determination of specific gravity and intercellular space.

The method of Kushman and Pope (11) was used; except that at least six roots of each cultivar were used in each lot instead of single root lots. The sweet potato roots were washed, surface dried and all sprouts, rootlets and foreign matter removed. Each cultivar was divided into 5 replications, with each replication consisting of 6 roots. Each root was marked with a marking pencil for identification. The six roots of each replication were weighed in air on a scale accurate to the nearest 0.001 grams, and then weighed in water.

Each root was then cut in half (cross section) and evacuated under water for 20 minutes with a vacuum of 27 inches of mercury. The vacuum was then released and the roots held in water for 20 minutes. The water was then poured off and the root halves were reassembled to match up pieces originally in the same root. The re-assembled root halves of each replication were weighed in water again.

Calculations were then made as follows:

(a) Root specific gravity. This was calculated as weight in air divided by root volume.

(b) Tissue specific gravity. This was obtained by dividing weight in air by root tissue volume.

(c) Intercellular space per 100 millilitres of root

volume. This was computed as weight in water after evacuation minus weight in water before evacuation (buoyancy added) divided by root volume times 100.

Let weight in air = W_1; weight in water before evacuation = W_2 and weight in water after evacuation = W_3.

Root specific gravity = $\frac{W_1}{W_1 - W_2}$; ($W_1 - W_2$ = Root volume)

Tissue specific gravity = $\frac{W_1}{W_1 - W_3}$; ($W_1 - W_3$ = Root tissue volume)

Intercellular space per 100 millilitres of root volume

$$= \frac{W_3 - W_2}{W_1 - W_2} \times 100 \; ; \; (W_3 - W_2 = \text{air space})$$

The above procedure was adopted for all 5 replication of each of the five cultivars used.

The Rose centennial cultivar stored at 38°F, 55°F and 72°F had 8 replications for the fresh determination and 12 replications for the determinations after the temperature treatments.

(B) Sprouting Test

Eight roots each x 12 samples for each treatment of the storage temperatures 38°F, 55°F and 72°F were stored and planted in a randomized design in the greenhouse on December 18th, 1968.

Bottom heat of 75°F by means of thermostatically controlled

electric heating cables was applied throughout the bedding period from December 18th, 1968 to February 3rd, 1969. Records were kept as to the earliness of sprouting of the various storage temperature groups. The observations regarding these were made on January 3rd, January 8th, January 13th, January 18th and January 23rd, 1969.

The number of sprouts produced in all the sample beds for each of the storage temperature categories was recorded and the counting of these was done on January 24th and February 3rd, 1969.

STATISTICAL PROCEDURES

An analysis of variance was done on each of the factors; intercellular space, root specific gravity and tissue specific gravity for the curing treatment to get the F statistic. Fisher's LSD was computed for any of the sources of variance if the F statistic proved significant. Tables of means were computed accordingly for verification of differences as indicated by the significant F ratios.

In the case of the storage temperature study, the numbers of replications per treatment were unequal. So, the simplest analysis of variance method when the numbers per treatment are unequal was adopted.

In relating root specific gravity to intercellular space in the curing study a correlation coefficient was calculated and verified for significance.

Also, in attempting to predict intercellular space from values of root specific gravity, a coefficient of linear regression was computed. A 95% confidence interval (CI_{95}) was put on the slope (β) of the regression line.

A regression formula for predicting intercellular space from root specific gravity was developed.

PRESENTATION OF RESULTS

(A) Results of the length of curing studies

(a) The effect on length of curing time on intercellular space.

The analysis of variance for intercellular space (Table 1) showed significant F ratios for cultivar and interactions between curing time and cultivar. The F ratio for curing time was not significant however.

TABLE 1.--Analysis of variance for intercellular space as affected by length of curing time for five cultivars of sweet potatoes.

Source	DF	SS	MS	F Ratio
Cultivar	4	105.262586	26.315646	90.8**
Curing time	3	0.581401	0.1938003	0.07 NS
Cult. X curing	12	65.425376	5.452115	18.8**
Error	80	23.186789	0.289835	
Total	99	194.455852	1.964200	

The treatment means for curing time showed no significant difference in intercellular space values (Table 2). However, the interaction between cultivar and curing time which was significant is shown in Table 2. For example, the selection L4-73, which had the highest overall cultivar means also had the highest mean at harvest. But after curing two weeks

TABLE 2.--Means for intercellular space for five cultivars at harvest (fresh) and after 3 different curing times.

Cultivar	Curing time in weeks				
	0 (10/18/68)	1 (Cured to 10/24/68)	2 (Cured to 10/30/68)	3 (Cured to 11/5/68)	Cultivar Means
	ml/100 ml	ml/100 ml	ml/100 ml	ml/100 ml	ml/100 ml
L4-73	9.938	10.085	7.884	8.641	9.151
Centennial	8.359	7.925	7.616	8.213	8.028
NC-240	6.593	5.242	6.452	5.634	5.981
OKLA5-195	6.909	7.605	6.702	8.270	7.372
TANHOMA	6.567	6.612	9.731	7.352	7.565
Treatment means	7.685	7.494	7.677	7.622	7.619

LSD for cultivar = 0.337 at 5% level

LSD for cultivar x curing time = 2.124 at 5% level.

L4-73 had a significant reduction in intercellular space while Tanhoma, with a mean of 6.567 at harvest, had a significant increase in intercellular space (9.731) after curing two weeks. OKLA 5-195 with a mean value of 6.909 when freshly harvested against the 8.359 value of Centennial (also at harvest), had a mean value of 8.270 against a Centennial value of 8.213 when cured for about 3 weeks after harvest.

Fig. 1 shows that Centennial and NC-240 were the most consistent in their intercellular space values over the curing times.

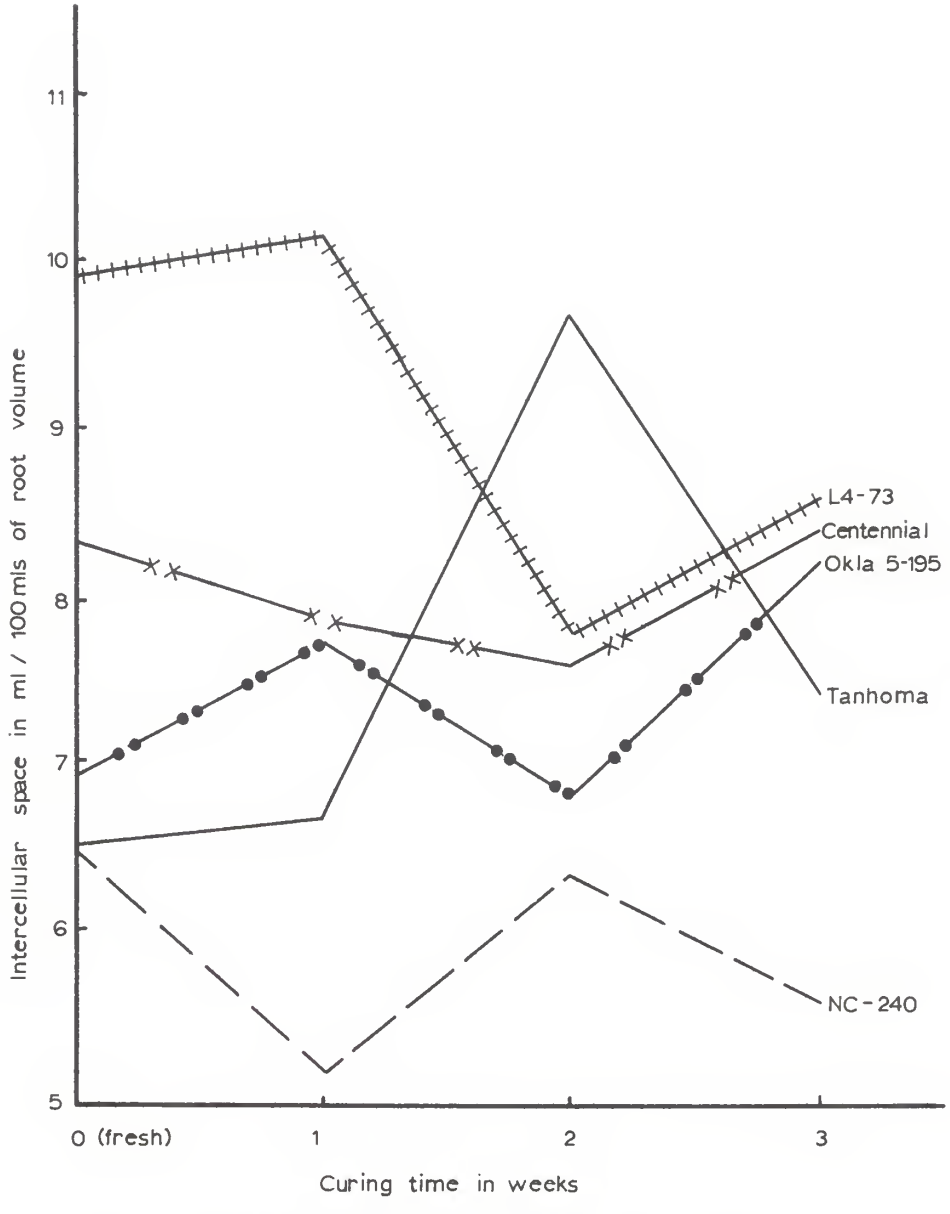

Figure 1. Pattern of change in intercellular space (means) of each cultivar of sweet potatoes with the curing times.

Comparing the cultivars, results from the table of means (Table 2) showed significant differences between the amount of intercellular space of L4-73 and NC-240; NC-240 having less intercellular space. This difference and those between other cultivars are shown more clearly by Table 3.

TABLE 3.--Ordered array of cultivar means obtained in determination of intercellular space at various curing times--and indication of significant differences among the means at the 5% level(*).

Cultivar	L4-73	Centennial	Tanhoma	Okla 5-195	NC-240
Means	9.151	8.028	7.565	7.372	5.981

LSD* = 0.337. Cultivars under the same drawn horizontal line are not significantly different; the others are with $\alpha = 0.05$.

(b) The effect of curing time on root specific gravity.

The analysis of variance for root specific gravity (Table 4) showed F ratios to be significant for cultivar and for curing time at the 5% level. Cultivar x curing time interaction was non significant at the 5% level F ratio.

Any pair of cultivars had a least significant difference between them (Table 5).

TABLE 4.--Analysis of variance for root specific gravity as affected by curing time for five cultivars of sweet potato.

Source	DF	SS	MS	F ratio
Cultivar	4	14.474	3.6185	42.3216**
Curing time	3	0.880	0.2933	3.4304*
Cultivar x Curing	12	1.414	0.1178	1.3778 NS
Error	80	0.684	0.00855	
Total	99	17.452	0.1763	
LSD for cultivar	0.002 at the 5% level (actual = 0.00183)			
LSD for curing	0.002 at the 5% level (actual = 0.00162)			

TABLE 5.--Cultivar means for root specific gravity in the curing effect study.

Variety	Means
L4-73	0.987
Okla 5-195	1.003
Centennial	1.010
Tanhoma	1.018
NC-240	1.020
LSD 0.002 at the 5% level	

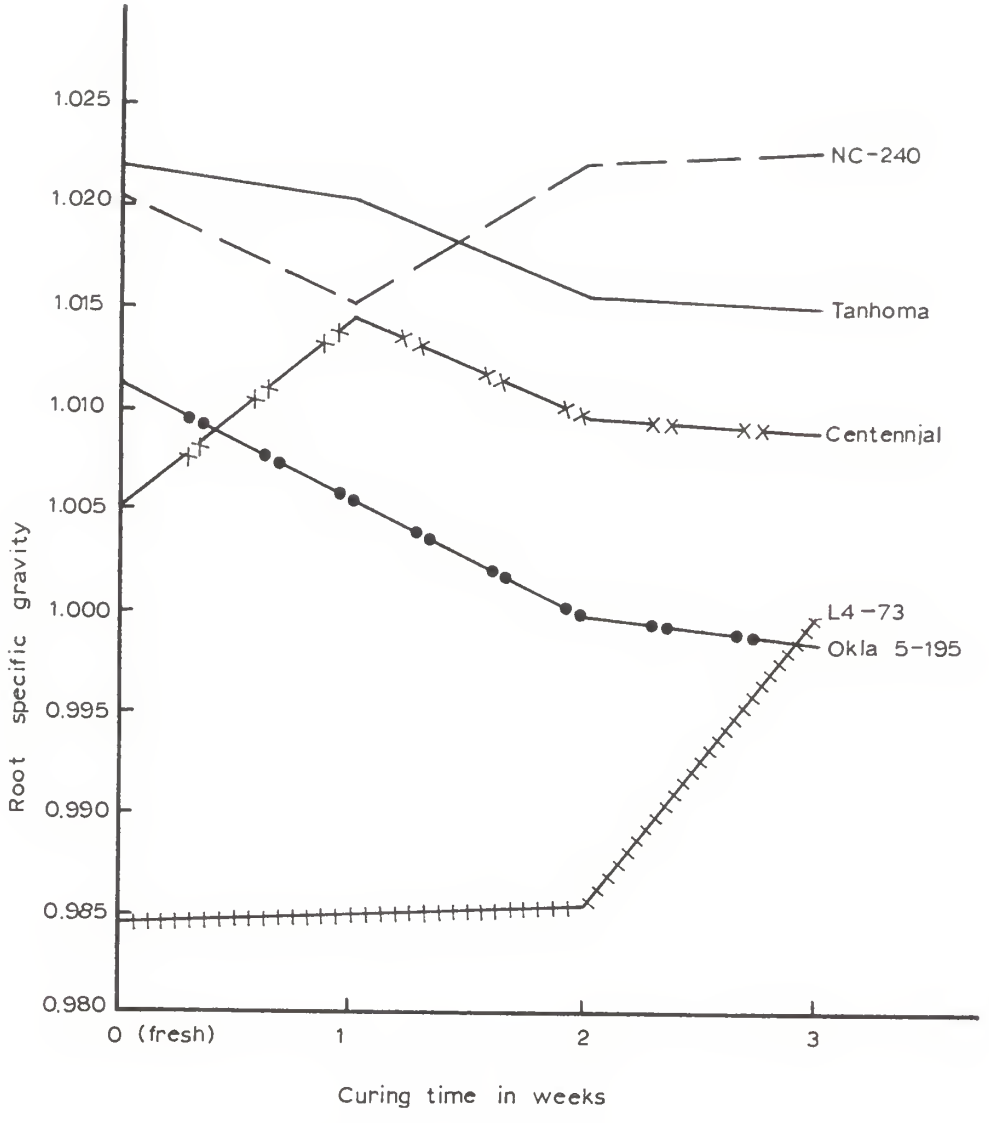

Figure 2. Graph showing the behavior of the cultivars with respect to their mean root specific gravities versus curing times.

Most of the cultivars tended to decrease in root specific gravity when cured for a week. A further decrease occurred when the roots were cured for 2 weeks. Further reduction in root specific gravity did not occur when the roots were cured for 3 weeks. Centennial and L4-73 were anomalous in behavior. Centennial unlike the others increased in root specific gravity value when cured for 1 week (Fig. 2). L4-73 increased in value from 0.984 after two weeks curing to 0.998 when cured 3 weeks.

(c) The effect of curing time on tissue specific gravity.

TABLE 6.--Analysis of variance for tissue specific gravity in the study of the effect of curing times on five cultivars of sweet potatoes.

Source	DF	SS	MS	F ratio
Cultivar	4	3.826	0.9565	13.3032**
Curing time	3	0.325	0.1083	1.5062 NS
Cultivar x Curing	12	7.789	0.6491	9.0278**
Error	80	5.752	0.0719	
Total	99	17.692	0.1787	

Significant differences occurred in tissue specific gravity among cultivars and the interaction between cultivar and curing time was also significant, both at the 5% level (Table 6).

Curing time values were insignificant at $\alpha = 0.05$. There were individual cultivar fluctuations in tissue specific gravity at the various curing times (Table 7).

TABLE 7.--Means for tissue specific gravity determinations on five cultivars of sweet potato cured for different times.

Cultivar	Curing time in weeks				Cultivar means
	0	1	2	3	
Okla 5-195	1.089	1.088	1.069	1.085	1.083
L4-73	1.091	1.094	1.070	1.093	1.087
NC-240	1.092	1.099	1.092	1.085	1.092
Centennial	1.085	1.100	1.093	1.102	1.095
Tanhoma	1.093	1.092	1.124	1.095	1.101

LSD for cultivar means = 0.005 at the 5% level

LSD for cultivar x curing time = 0.0105 at the 5% level.

(d) Relation between intercellular space and root specific gravity.

Correlation coefficient computation from intercellular space and root specific gravity data gave a value of -0.62. This was significant at the 5% level.

A linear regression equation of $\hat{Y} = a + (-64.9)X$ was obtained by the method of least squares. This gave a final prediction regression formula of $\hat{Y} = 73.17 - 64.9X$, where

$\hat{Y}$ = estimate of intercellular space and X = value of root specific gravity. (-64.9) = slope (β) of the regression line.

This regression equation was interpolated graphically in Fig. 3. A 95% confidence interval calculation for the slope of the regression line (β), gave values of β as being between -86.0 and -43.8. Or, CI_{95}: $-86.0 \leq \beta \leq -43.8$ and these confidence belts or confidence limits were designated on the regression line graph in Fig. 3.

(B) Results of the Storage Temperature Study

(a) The effect of storage temperature on intercellular space.

TABLE 8.--Analysis of variance for the effect of storage temperature on intercellular space of Rose Centennial sweet potatoes.

Source	DF	SS	MS	F Statistic
Temperature	3	35.954048	11.98468266	9.0814**
Error	40	52.787509	1.319687725	
Total	43	88.741557		

Significant differences did not occur between intercellular space of the freshly harvested roots and those kept at 38°F (Table 9). However, significant differences did occur among those stored at 72°F and those stored at 55°F and 38°F (Table 8).

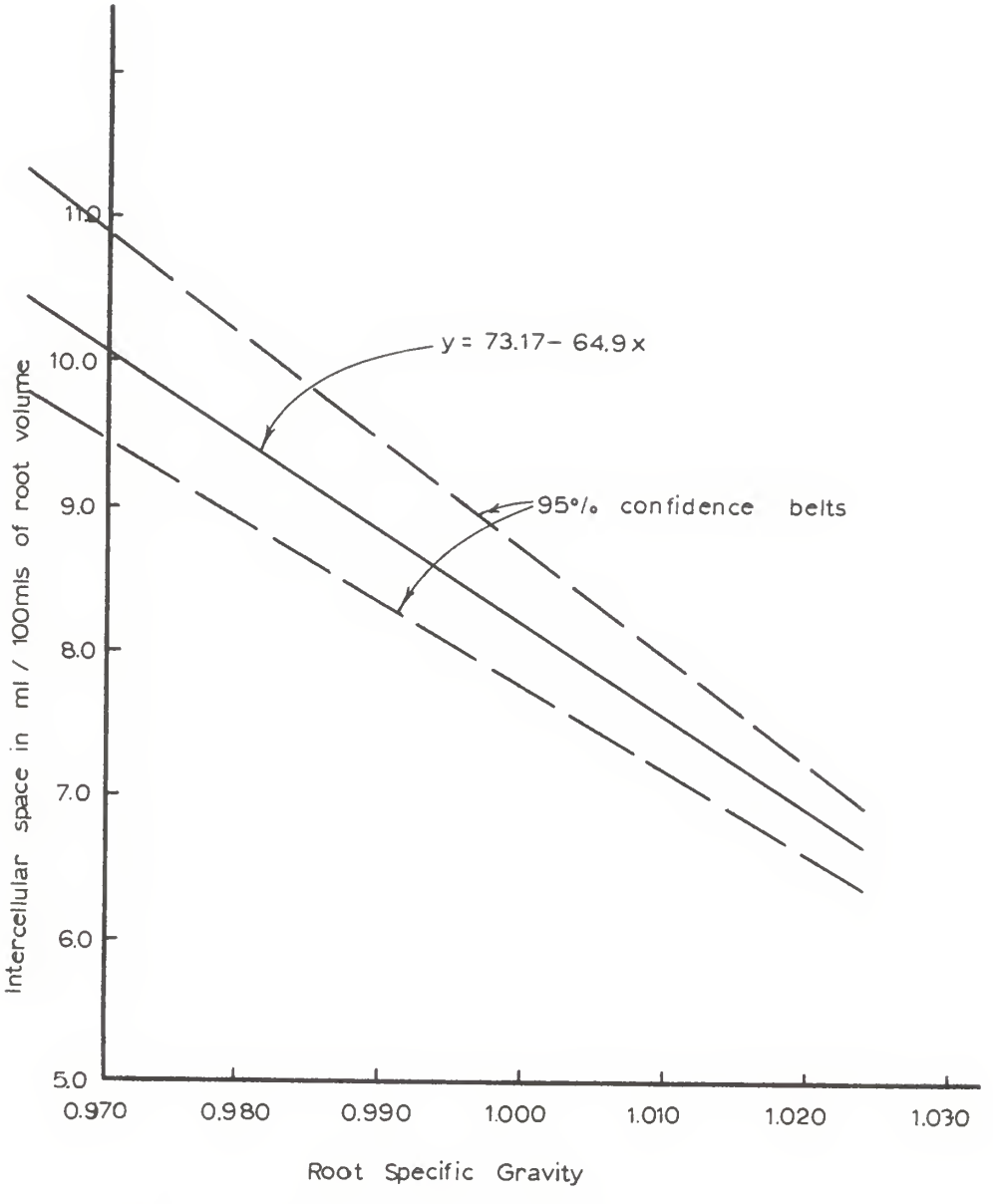

Figure 3. Regression line of intercellular space on root specific gravity with 95% confidence limits designated on the regression line.

Intercellular space increased in storage at 38°F and 55°F; the increase was greater at 55°F than at 38°F although not significant (Table 9).

TABLE 9.--Means for intercellular space values of Rose Centennial sweet potatoes stored at different temperatures.

Treatment	I.C.S. means
Fresh	9.886
38°F	11.600
55°F	11.638
72°F	9.611

LSD 0.05 = 0.928 for comparing the 3 temperatures

LSD 0.05 = 1.038 for comparing the 4 treatments

(b) The effect of storage temperature on root specific gravity of Rose Centennial.

The roots kept at 72°F had the highest root specific gravity followed by those kept at 55°F and then those kept at 38°F. Significant differences only occurred between those stored at 72°F and 38°F (Tables 10 & 11).

(c) The effect of storage temperatures on the tissue specific gravity of Rose Centennial sweet potatoes.

Significant differences did not occur in tissue specific

TABLE 10.--Analysis of variance for root specific gravity of Rose Centennial sweet potatoes stored at different temperatures.

Source	DF	SS	MS	F Ratio
Temperature	3	0.02531136	0.00843712	6.187**
Error	40	0.05454536	0.001363634	
Total	43	0.079856		

TABLE 11.--Means for root specific gravity values of Rose Centennial sweet potato stored at different temperatures.

Treatment	Root S.G. Means
Fresh	0.978
38°F	0.938
55°F	0.974
72°F	1.001

LSD 0.05 = 0.029 for comparing the 3 temperatures.

LSD 0.05 = 0.033 for comparing the 4 treatments.

TABLE 12.--Analysis of variance for tissue specific gravity of Rose Centennial sweet potato stored at different temperatures.

Source	DF	SS	MS	F Ratio
Temperature	3	0.00376967	0.0012565566	1.981 NS
Error	40	0.02536413	0.000634103	
Total	43	0.0291338		

gravity between freshly harvested roots and those cured and stored at different temperatures (Table 12).

(d) The sprouting test.

Roots stored at 55°F were the first to sprout. Sprout emergence occurred at 17 days after bedding in seven out of the twelve 55°F plots. No plots of the 72°F or 38°F treatments produced any sprouts at this date. After 22 days all plots of the 55°F treatment had emerged sprouts and only 1/3 of the plots from roots stored at 72°F had sprouted and none of the 38°F lots sprouted (Table 13).

TABLE 13.--Number of plots showing sprouting of the bedded sweet potato lots (Rose Centennial) by days.

Temperature	17 days	22 days	27 days	32 days	37 days	Total No. of plots producing sprouts
38°F	0	0	0	0	0	0
55°F	7	5	-	-	-	12
72°F	0	4	2	2	3	11

Note: Each plot contained 8 roots. The plots were replicated 12 times and were located at random.

See Plate I (A & B) for the pattern of bedding before sprouting and the pattern set by the differentially emerging sprouts.

Number of sprouts produced by each plot from each

EXPLANATION OF PLATE I

A. Photograph of bedded sweet potato roots. Each temperature lot contained 8 roots. The plots were replicated 12 times and were located at random.

B. Pattern set by the differentially emerging sprouts from roots stored at different temperatures.

PLATE I

A

B

storage temperature was counted on January 24th and February 3rd, 1969. The average sprout number per plot was 32 for 55°F, 10 for 72°F and 0 sprouts for 38°F.

The roots were pulled after 47 days. It was observed that all the roots of the 38°F storage group had rotted. One plot of the roots of the 72°F storage group also had rotted. All plots of the 55°F storage group produced sprouts and earlier than the 72°F group.

DISCUSSION

(A) Length of curing time studies.

(a) Intercellular space.

There were significant difference in the amount of intercellular space in each of the cultivars before curing and at different curing times. However, curing time did not appreciably change the amount of intercellular space as evidenced by the nonsignificant F ratio for curing time (Table 1). Therefore, curing time had little or no influence on the amount of intercellular space. This observation is in accord with the opinion of Kushman, Pope and Monroe (13) who stated that the curing period influenced the amount of intercellular space very little.

(b) Root specific gravity.

Curing time had an effect on the root specific gravity. Most of the cultivars decreased in root specific gravity values when cured for one week and decreased further when cured for 2 weeks. (Table 4 showed significant F ratio for curing time). This result is contrary to that of Kushman, Pope and Monroe (13) who reported that specific gravity of the roots changed very little during curing. (These workers cured the roots for 2 weeks at 85°F and at relative humidity near 85%. The cultivars they used were: Gem, Nugget, Calred, Goldrush and Centennial.)

It is conceivable that root specific gravity decreased during curing because of the respiration of the roots. This agrees with Kimbrough (9) 1928 when he stated that loss of solids due to respiration during curing is not a negligible amount.

There were no further decreases in root specific gravity values when roots were cured for 3 weeks. The value for L4-73 which increased after curing for 2 weeks from 0.984 to 0.998 after curing for 3 weeks was an abnormal case, probably attributable to some weighing error.

(c) Tissue specific gravity.

The tissue specific gravity changed very little during curing. This is to be expected if weight and volume losses during curing are similar as stated by Kushman, Pope and Monroe (13).

(d) Relation between intercellular space and root specific gravity.

It is clear that the amount of intercellular space in a sweet potato root will affect its root specific gravity--by the very definition of specific gravity. Therefore, it is to be expected that a root with a large amount of intercellular space will float in water and its specific gravity value will be less than any other root which has lower intercellular space. This fact is reflected by the significant correlation

coefficient obtained in the data of this experiment. Since a large intercellular space in a root will mean a relatively small root specific gravity and vice versa, it should be possible to predict intercellular space from root specific gravity values. Until now, intercellular space has been determined by using evacuation procedures. A prediction formula would help eliminate extra work required and help avoid the errors in the vacuum procedure. The regression prediction formula of $\hat{Y} = 73.17-64.9X$ must of necessity be applicable only within the limits of the size of the sample used in this experiment. The size of observations was 100 and at least 6 roots were used in each observation. The prediction formula should be useful in estimating intercellular space from root specific gravity values from zero to 1.025.

(B) The effect of storage temperature study.

(a) Intercellular space.

Intercellular space did not increase significantly during storage at any of the storage temperatures 38°F, 55°F and 72°F. This can be explained by earlier observation in this experiment that curing affected intercellular space very little. Since these roots were cured before storage at the various temperatures, it is conceivable that intercellular space remained relatively unaffected by storage temperatures for the time interval involved.

(b) Root specific gravity.

The specific gravities of the roots after storage at 38°F, 55°F and 72°F were 0.938, 0.974 and 1.001 respectively. The valuesfor the storage temperatures of 38°F and 55°F were lower than the value at harvest (Table 11). This resulted from the loss of weight during curing and storage in form of free water and carbon dioxide during respiration.

The increase in the specific gravity of the roots kept at 72°F from 0.978 (at harvest) to 1.001 after curing and storage probably was due to a loss of water more than a loss of carbohydrates from the roots.

(c) Tissue specific gravity.

Tissue specific gravity of the Rose Centennial roots changed very little during storage at different temperatures. The analysis of variance indicated nonsignificant F ratio for storage temperature (Table 12). This result is similar to the findings of Kushman, Pope and Monroe (13).

(d) The sprouting test.

Roots stored at 55°F sprouted earlier than those stored at 72°F. For example, twenty-two days after bedding cnly 1/3 of the plots from roots stored at 72°F had sprouted whereas all of the plots from roots stored at 55°F had sprouted. None of the roots stored at 38°F sprouted.

Number of sprouts produced by plots of roots stored at the various temperatures at the end of experiment averaged 32 for 55°F, 10 for 72°F and 0 for 38°F. The roots stored at 38°F rotted. This result is in agreement with those of Kimbrough and Bell (10) and Edmond (4). Kimbrough and Bell (10) showed that exposure to 40°F for 1 week or longer markedly lowers the keeping quality of the roots. Edmond (4) found that exposing seed stock of Porto Rico sweet potatoes to 40°F for 14 days caused a decreased yield of plants per bushel of roots.

The results here showed that the optimum storage temperature after curing is about 55°F. This is in agreement with the findings of Cooley, Kushman and Smart (3).

SUMMARY AND CONCLUSION

Five cultivars--L4-73, Centennial, Okla 5-195, NC-240 and Tanhoma--were cured for various lengths of time immediately after harvesting. The effect of the length of curing on intercellular space, root specific gravity and tissue specific gravity of the cultivar roots were determined. The method of Kushman and Pope (11) was used in these determinations except that six roots of each cultivar were used in each lot instead of single root lots. Amount of intercellular space was correlated with the value of root specific gravity.

The same method was also used to determine the effect of storage temperature on the intercellular space, root specific gravity and tissue specific gravity of Rose Centennial sweet potatoes. The effect of storing this cultivar at 38°F, 55°F and 72°F for 37 days after curing on the sprouting efficiency was investigated.

The following conclusions may be made:

(1) Curing time has little or no effect on the amount of intercellular space. But amount of intercellular space differs with different cultivars. For example: L4-73 had a mean value of 9.151 while NC-240 had 5.981.

(2) Root specific gravity tends to decrease with length of curing time.

(3) Tissue specific gravity does not change significantly with curing time.

(4) The negative regression slope in the regression prediction equation of $\hat{Y} = 73.17-64.9X$ shows that as root specific gravity value increases, intercellular space value decreases.

(5) Storage temperature after curing did not significantly affect the amount of intercellular space of Rose Centennial for the storage periods evaluated.

(6) Storage temperature after curing affected the root specific gravity of the Rose Centennial cultivar.

(7) Tissue specific gravity was not significantly affected by storage temperature.

(8) Optimum storage temperature for sweet potatoes is around 55°F. Temperatures of below 40°F or above 70°F reduce the keeping quality of sweet potatoes and lowers the plant producing capacity or sprout efficiency of the roots.

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SOME POST-HARVEST PHYSIOLOGICAL STUDIES ON CULTIVARS OF SWEET POTATOES (*IPOMOEA BATATAS*)

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ABSTRACT

The effect of curing time on the intercellular space, root specific gravity and tissue specific gravity of five cultivars of sweet potatoes was evaluated. The cultivars used were L4-73, Centennial, Okla 5-195, Tanhoma and NC-240. The effect of storage temperatures on these factors was also evaluated for the Rose Centennial cultivar. The method of Kushman and Pope for determining intercellular space and specific gravity was employed. However, instead of using one root lots, at least six roots were used in each lot.

The effect of storage temperatures on the sprouting efficiency of the Rose Centennial cultivar was evaluated.

It was found that:

1. Curing time had little or no effect on the amount of intercellular space. However, amount of intercellular space differed with different cultivars. For example: L4-73 had a mean value of 9.151 while NC-240 had 5.981.

2. Root specific gravity tended to decrease with length of curing time.

3. Tissue specific gravity did not significantly change with curing time.

4. Statistical computations produced a negative regression slope in the regression prediction equation of $\hat{Y} = 73.17 - 64.9X$ showing that as root specific gravity value increased, intercellular space value decreased. The regression was of intercellular space on root specific gravity.

5. Storage temperatures after curing did not signigcantly affect the amount of intercellular space of Rose Centennial cultivar for the storage period evaluated (38 days).

6. Storage temperature after curing affected root specific gravity of the Rose Centennial cultivar. Value for those stored at 72°F exceeded those at 55°F and 38°F.

7. Tissue specific gravity was not significantly affected by storage temperature.

8. Optimum storage temperature for the Rose Centennial sweet potato was around 55°F. Temperatures of below 40°F or above 70°F reduced the keeping quality of the sweet potatoes and lowered the plant producing capacity or sprout efficiency of the roots.