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Longevity of Stored Seed of Sweet Potato[1,2]

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Abstract. **Viability studies were conducted on 18 lots of seed of sweet potato (*Ipomoea batatas* (L). Lam.) spanning a 21 year storage period. For the last 10 years, these seeds had been stored at 18° C and 45–50% relative humidity, but prior to that storage conditions varied. Weight per 100 seeds ranged from 1.7 to 2.4 g. No effect of seed age was found on germination (radical protrusion), which averaged 90% after sulfuric acid scarification, or on emergence which averaged 72%. The condition of the seed prior to storage seemed to have more effect than how long they were stored.**

Because the sweet potato is vegetatively propagated commercially, there has been little interest in, or study of, seed storage. Recently, there has been an increased interest nationally and internationally in germplasm collection, evaluation, and preservation. Information regarding the viability of stored sweet potato seed is necessary to plan for conservation of its genetic resources. Each sweet potato seedling is genetically different from all others and seedlings from the same parent vary considerably. This is due to the complex inheritance of the species ($2n = 90$). For this reason a wide range of genetic variability can be preserved efficiently and at low cost by storage of "true" seed (as opposed to "seed" roots). It is generally considered that sweet potato seed can be stored for long periods (1) but there is no data in the literature to support this contention.

Sweet potato breeders have long been concerned with seed production and have studied some problems which may be related to seed viability. Jones and Jackson (4) found about 33% of green seed produced on outside trellises to be infected with fungi, primarily *Fusarium moniliforme* (Sheldon) Emend. Snyd. & Hans. Fungicidal treatment reduced the infection rate to 5–14%. Later studies (5) showed cultivar differences in response to systemic fungicides, indicating a genetic component in reaction to seed infection. Pesticides applied to plants in the seed increase nursery were also found to increase seed set and seedling emergence, and thus viability. We have observed fungal growth from surface-sterilized seed on many occasions. Also, a seed weevil (*Megacerus impiger* Horn.) which can reproduce during storage frequently infests seed produced in the Charleston environment. Therefore, both diseases and insects can be expected to affect viability of stored sweet potato seed. Martin and Cabanillas (6) found that seed of large size (15.1 to 31.0 mg) germinated more readily than those of smaller size. Those with weights above 23.1 mg germinated 100%. Thus, seed weight might be expected to affect storage life.

Sweet potato seed germination is restricted by a hard seedcoat which delays imbibition and is overcome in breeding programs by mechanical or chemical scarification. Generally, seed are soaked in concentrated sulfuric acid for 30 to 45 min and rinsed in water as suggested by Steinbauer (8). Martin (7) concluded that while this method was best with large lots of seed, mechanical abrasion may be used to advantage with small lots of seed, especially if high germination is desired. He obtained germinations of 78 and 84% with seed 90 days and 4 years old following acid scarification. Yen (9) germinated seed stored for 5 years in an uncontrolled environment but did not report the germination percentages. In various quantitative genetic studies, the authors have used remnant seed up to 5 years old with excellent results. In a study of the usefulness of seed, seedling, and maternal characters in selection indexes, average seedling emergence was 79% following hand scarification (2).

In 1980 (3), we conducted viability studies of 18 lots of seed harvested between the years of 1959 and 1980 (Table 1). During the last 10 years, all seed had been stored in our Charleston facilities at 18°C and 45 to 50% relative humidity. Prior to that time, seed had been held at Tifton, Ga. in less precisely controlled conditions due to faulty equipment set at 5°. To protect them from the high humidities that periodically occurred the 1963 through 1970, seed lots were stored in sealed glass bottles and remained in those containers after transfer to Charleston. Seeds harvested after 1970 were kept in paper seed envelopes. The 1959 seeds were from the program of Dr. C. E. Steinbauer (USDA retired) and were produced by hand-pollination in the greenhouse in Beltsville, Md. We received them in 1968 and kept them in the original seed envelopes thereafter. We do not know the conditions of storage prior to 1968. The 1963 seed resulted from hand-crosses made in the greenhouse in Tifton. All other seed lots were from open pollination under field conditions. Seeds for 1964 through 1969 were produced in Tifton. The 1970 seeds were produced in Mayaguez, Puerto Rico by Dr. F. W. Martin

Table 1. Viability of sweet potato seed after various storage periods.

Year harvested	Wt/100 seed (g)	Sound seed (%)[z]	Germination (%)[y]	Emergence (%)[x]	Seedlings/100 sound seed
1959	2.34 a[w]	99 a[w]	94	77	72
1963	2.41 a	100 a	90	72	65
1964	2.08 bc	97 a	88	65	58
1965	2.01 bcd	96 a	92	70	65
1966	1.94 bcd	95 a	87	70	61
1967	2.12 b	96 a	95	85	81
1968	1.69 e	87 b	92	72	65
1969	1.95 bcd	87 b	88	64	56
1970	1.93 bcd	75 c	91	73	67
1971	1.89 cdc	65 d	83	71	59
1972	1.84 cde	98 a	90	72	65
1973	1.88 cde	97 a	87	69	60
1974	2.03 bcd	100 a	84	69	58
1975	1.79 de	98 a	90	66	59
1976	1.93 bcd	97 a	96	69	65
1978	1.94 bcd	100 a	87	75	65
1979	2.05 bc	78 c	94	73	68
1980	1.80 de	96 a	98	76	74
Mean	1.97	92	90	72	65
Significance level	1%	1%	NS	NS	NS

[z]Those that sank in water plus surfactant.
[y]Of sound seed
[x]Of germinated seed placed in Jiffy Mix
[w]Mean separation within columns by Duncan's multiple range test, 1% level.

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(USDA). Seed for 1971 through 1980 was produced at Charleston. We noted signs of seed weevil infestations in the 1968 and 1969 samples, but no live weevils were observed. Severe preharvest fungal infection was noted on seed of the 1971 lot. From 1972 to 1978, low density seeds were floated off in water prior to storage. Low density seed had not been floated off in the 1979 lot prior to these tests. The 1980 seeds were freshly harvested and were considered the control treatment.

Three samples of 100 seeds were taken from each of the 18 lots, except for the 1959 entry which was represented by three samples of 50 seeds. The 3 samples, considered replications, were germinated at 3 different times. Each sample was weighed to obtain the weight per 100 seeds (Table 1). In order to achieve some degree of standardization in the germination tests, we floated off low density seed in water and conducted our tests with seeds that sank (considered sound), separately from those that floated. Percentages of seeds sinking were determined. Germination (radical protrusion) percentages were obtained from seeds held on moist filter paper in Petri dishes at 30°C after acid scarification (8). Seeds that failed to imbibe were mechanically scarified by pricking the seed coat and were returned to the germination chamber. Germination counts were made daily and germinated seed planted in 28 × 56 × 5-cm plastic trays filled with Jiffy Mix. The trays were well drained and were placed on plastic to prevent contamination from below. Holes were pressed in the planting medium of each tray with a template containing 10 × 20 rows of 10-mm round pegs 25-mm-long spaced on 2.5-cm centers. After placing seed in the holes, the holes were carefully covered with additional media. Emergence was determined daily, and after 3 weeks the tests were terminated.

There were differences in seed weights and the percentages of sound seed, but no relationships to seed age was apparent (Table 1). No effect of seed age on germination, emergence, or the number of seedlings obtained was detected. We observed no reduction in seedling vigor due to storage duration. A total of 417 seeds floated in water, of which 52 germinated and only 3 emerged to produce healthy seedlings. Apparently there was a reduction in vigor associated with low density seed that germinated, but the numbers were too small for statistically valid conclusions. The 1971 fungal-infected seed contained 106 floaters of which 10 germianted and none emerged. Obviously, fungal infections are an important cause of low seed quality.

This study demonstrates that sweet potato seed stored for as long as 21 years maintains germination similar to that of freshly harvested seed. One can reasonably extrapolate that seed could be stored for considerably longer periods, especially if better control of the temperature and humidity regimes were provided. It appears that the condition of the seed when put into storage was more important than the time they were stored or the conditions of storage. Floatation in water containing a surfactant was an effective way to remove nonviable seed after which germination was about 90%.

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Infiltration and Movement of ^{45}Ca into Potatoes

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Abstract. **Immediately following vacuum infiltration of ^{45}Ca into 'Katahdin' potatoes (*Solanum tuberosum* L.) the label was distributed within the tuber in the following manner: 45%, 20%, and 35% in the stem end, bud end, and middle section, respectively. Initially, the bulk of the radioactive calcium was localized 0–5 mm below the periderm layer. However, over a 60-day period, the calcium moved toward the center of the tuber. Temperature had no effect on this process.**

Recently, it has been shown that calcium infiltration of 'Katahdin' potato tubers causes an inhibition of chlorophyll synthesis when tubers were stored in the light (1). Calcium is involved in many physiological plant processes involving cell walls, membranes, and enzyme activation (3), but tubers contain very low levels of calcium (unpublished data). Calcium is involved in respiration of apples (2), and it has been suggested that low calcium apples mature or age faster as a result of the higher respiration rates. It is my hypothesis that if a reduction in respiration can be achieved through calcium infiltration one can slow the rate at which potatoes senesce. Most of the data on penetration of calcium has dealt with fruits such as apples (2, 5). To our knowledge, no calcium penetration work has been reported with potatoes aside from our earlier work (1).

Experiments were conducted with potato tubers to investigate: (a) the rate of penetration of ^{45}Ca into the skin and deeper layers; (b) the area of major uptake (stem end, bud end, or middle); and (c) the influence of storage temperature on the movement of ^{45}Ca toward the center of the tuber.

'Kathahdin' potatoes were grown at Rock Springs Horticulture Farm, The Pennsylvania State University. Following harvest, tubers were allowed to cure for 30 days at 24°C and a relative humidity of 95% prior to treatment. Tubers were washed thoroughly and allowed to air-dry before they were infiltrated in a vacuum desiccator containing 2 liters of aqueous solution of 2% $CaCl_2$ and 150 µl of $^{45}CaCl_2$ (174 µCi/ml). After 30 min under vacuum (−0.9 atmospheres), the vacuum was slowly restored to atmospheric pressure and tubers were allowed to soak an additional 15 min. Tubers were rinsed in 2% $CaCl_2$ solution minus radioactive calcium for 2 min followed by a 2-min rinse with distilled water than allowed to air-dry for 24 hr prior to storage. Three replications of tubers were stored at 24, 13, 10, and 4.5° at 95% relative humidity. Tissue plugs 9 mm in diameter

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