An Improved Method for Packing Sugar Beet Roots to Be Stored for Breeding Purposes

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Introduction

In most sugar beet breeding programs the rigid selection of roots usually results in a relatively small number being saved for seed increase. It is highly important, therefore, that all or as many as possible of the selected roots be carried through the required thermal induction period, in storage, in a condition to produce satisfactory yields of seed. Pack (1)[2] studied methods of storing sugar beet roots in field silos or pits in Utah, where the winters are comparatively cold, and preferred storing the roots in moist sand to other materials tried. Such methods of storing sugar beet roots in silos are not feasible in southern California where the winters are so mild that the roots do not acquire sufficient thermal induction for normal seed yields. It is necessary, therefore, to pack the roots in containers and store them *in* a room maintained at a constant temperature which is optimum for thermal induction. This has led to the testing of packing materials and methods to meet the somewhat specialized requirements.

Methods and Results

The method previously used for packing sugar beet roots at the U. S. Sugar Plant Field Station at Riverside, California, was as follows: Sphagnum moss was submerged in water until it became saturated. Part of the free water was removed by hand pressure. A layer of the moss was then placed in the bottom of an orange field box 24 inches x 12 inches x 12 inches lined with two sheets of heavy waxed paper. The boxes were filled with alternate layers of wet moss and roots, the top layer being moss. The ends of the paper were then tucked into the ends and sides of the box which completed the packing process. Usually, the sugar beet roots are stored at 40° F., the length of the storage period depending upon the time of year selections are made and upon the time required for the roots to acquire sufficient thermal induction to induce bolting.

With the above method of packing, the length of time the roots would remain sound at 40° F. was highly unpredictable. It has been observed many times that the amount of rot occurring in different boxes of roots packed at the same time varied greatly. A large variation in the amount of rot even in different layers of the same box of roots was found to occur. In one test a large number of roots was packed by the above method in several boxes and stored. The roots in part of the boxes remained in storage for 130 days with only small losses. In other boxes 50 to 80 percent of the roots were lost in a period of 90 days.

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[2] Numbers in parentheses refer to literature cited.

It was observed that in almost all instances where early and excessive rot occurred the moss was so wet that with little effort one could squeeze water from it at the end of the storage period. It may be, therefore, that if beets were packed in moss with a uniform and favorable moisture content losses could be reduced below those which have been encountered. However, in practice it probably would be necessary to resort to the use of a mechanical press in order to reduce the moisture content of the moss to a sufficiently low level for best results.

Sawdust and pine shavings were tested as packing material to replace sphagnum moss. Sawdust was abandoned after preliminary tests because of the excessive amount of water it held and the limited amount of air space it afforded. The favorable water-holding capacity of pine shavings and the fact that they are clean and relatively sterile make them appear to be highly suitable as a packing material. Numerous tests have been made with 'pine shavings in which they were compared with sphagnum moss.

The method used in packing beets in pine shavings is as follows: A small stream of water from a garden hose is allowed to run into the top of a bag of the shavings until they are completely saturated. The shavings are allowed to drain one to two hours or until little or no water drips from the bag. They are then spread out on a concrete floor and approximately ten percent (by volume) of dry shavinsg mixed with the wet shavings with the aid of a scoop shovel. The dry shavings take up the remaining free water. Orange field boxes, lined with two sheets of heavy brown waxed paper placed at right angles to each other, are filled with alternate layers of the prepared shavings and sugar beet roots until the box. is full. A layer of the prepared shavings approximately two inches thick is placed in the bottom of the box and over the last layer of roots. The ends of the inside paper are folded over while the ends of the outside paper are tucked into the sides of the box, making a complete envelope of wax paper for the pack.

In some of the tests which have been made, beets of like size and from the same sources were packed in sphagnum moss and in pine shavings and their condition compared after various periods of storage. The method of packing the roots was the same for both materials used except that the moisture content of the pine shavings was adjusted to approximately 90 percent of saturation, while the usual procedure was followed (that of expressing part of the free water from the moss by hand pressure) in packing the roots in sphagnum moss. The packed roots were stored at 40° F. and received no further attention until they were examined at the end of the storage period.

In Table 1 are compiled data on the number of roots showing decay and the extent of the damage at the time the roots were removed from storage. The tests are arranged according to the number of days the roots were in storage before being examined.

It is seen from the table that by the end of 180 days of storage more than 800 roots, packed in moist shavings, had been examined and none

showed obvious decay. When the storage period had reached 243 days, however, some of the roots showed small decayed spots, but all were turgid. It was not until the roots had been stored for 300 days that the amount of decay on the roots became more than small superficial spots.

The roots packed in sphagnum moss on 11-5-49 were from the same lot of roots as those packed in moist pine shavings on the same date. Roots stored for 134 days in sphagnum moss showed extensive decay. Few if any of these roots if planted in the field would have survived. Representative samples of beets stored in moss for 134 days are shown in Figure IB. These may be compared with roots stored in pine shavings for 167 days, shown in Figure 1A.

Table 1.—Amount of Decay on Sugar Beet Roots Stored at 40° F. for Various Periods in Sphagnum Moss* Compared with Those in Pine Shavings.

Packing material	Date packed	Storage period	Boxes used	Roots stored	Roots showing rot at end of test			Total roots showing decay
					Slight	Medium	Severe	
		Days	No.	No.	No.	No.	No.	No.
	9-19-49	60	7	150	0	0	0	0
Pine	1- 5-50	66	3	70	0	0	0	0
shavings	4-14-49	97	1	15	0	0	0	0
	3-23-49	118	1	15	0	0	0	0
	11- 5-49	128	10	128	0	0	0	0
Sphagum	11- 1-48	130	35	1,500	.	.	260	...
moss	11- 5-49	132	1	20	6	5	9	20
	11- 5-49	134	1	25	5	7	13	25
	11- 5-49	134	10	300	0	0	0	0
	11- 5-49	148	4	80	0	0	0	0
	11- 5-49	150	1	100	0	0	0	0
Pine	5-11-50	191	4	166	1	0	0	1
shavings	11- 5-49	243	2	55	3	0	0	3
	11- 5-49[1]	243	1	22	11	0	1	12
	3-11-50	254	3	46	9	0	2	11
	11- 5-49	296	1	27	3	0	1	4
	6-14-50	355	1	13	2	0	0	2
	11- 5-49[1]	367	1	22	7	0	1	8

[1] Same lot of roots. Decayed spots were cut away before repacking after 243 days of stor-

Another interesting comparison between moss and pine shavings may be cited, in which part of the roots were first packed in moss and later repacked *in* pine shavings. *In* this test *66* roots were packed in seven boxes in the usual manner, using wet sphagnum moss as the packing material. At the same time four other root selections, comprising a total of 457 roots, were packed in moist pine shavings. The moisture content of the shavings was adjusted to approximately 90 percent of saturation by the mixing of dry shavings with those saturated with water. The roots were stored at 40° F.

After a period of 60 days all roots were removed from storage and examined. Of the 457 roots stored in shavings none showed rot. These roots were repacked for shipment. However, all 66 roots packed in sphag-

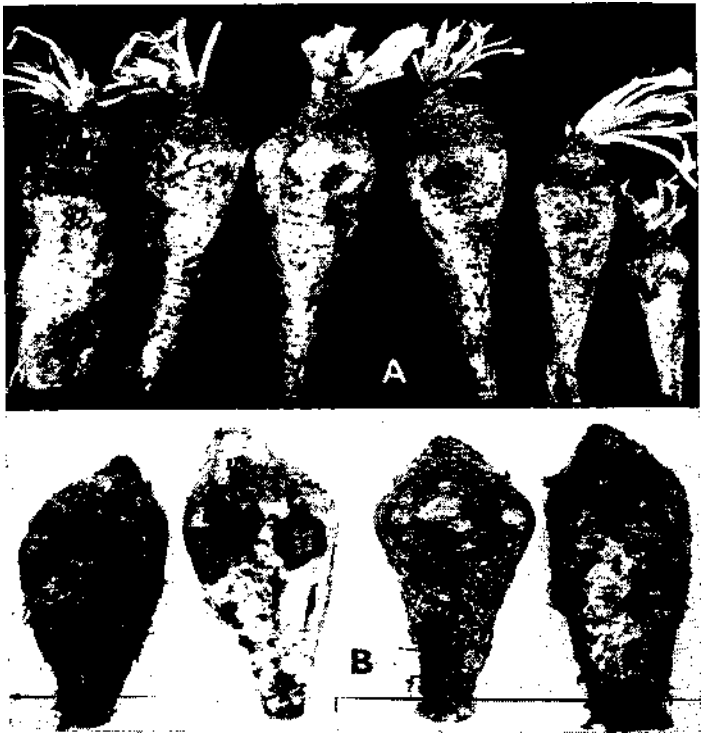

Figure 1.—A. Sugar beet roots after being stored 167 days at 40° F. in pine shavings (90 percent saturation). B. Sugar beet roots after being stored 134 days in wet sphagnum moss.

num moss showed decay varying from small superficial spots to almost complete invasion. Thirty five of the roots were discarded. The remaining 31 roots were trimmed to remove all the decayed tissue, allowed to stand overnight to permit the cut surfaces to dry, then packed in moist pine shavings and stored at 40° F. for an additional 190 days. At the time these roots were transplanted in the field, after a total of 250 days in storage, none of the repacked roots had to be discarded due to excessive decay, although some of them showed decayed spots.

It was observed that in nearly all cases of decay, occurring in roots stored in pine shavings, the decay started at the tip of the roots or on bruised areas caused by injury in digging. The amount of decay occurring on roots stored for long periods of time can be greatly reduced if the roots are prepared properly before they are packed. The roots should be dug and handled carefully to prevent bruising. The leaves should be trimmed off as closely as possible without destroying the buds and the root, then washed thoroughly. Bruised spots, if any, should be trimmed off and the tails removed at a point where they attain approximately one-half inch in diameter. The roots should then be allowed to remain in the open, preferably overnight, in order to allow the cut surfaces to dry before they are packed. By using the above precautions, roots stored up to 200 days have shown practically no decay and they have remained turgid for 250 days (in one instance 355 days) without repacking, or the addition of moisture. If the roots are to be stored longer than 250 days it may be necessary to repack them in moist shavings in order to keep them turgid. Attempts to moisten the pack by the addition of water to the top resulted in losses because of the fact that the water was slow to distribute itself throughout the shavings in the pack. As a result, the roots in the top of the box remained drenched for a time.

Pine shavings seem to have several advantages over sphagnum moss as packing material for storage of sugar beets. They are usually readily available at a very low cost from any planing mill or cabinet shop. They are relatively, free of dirt and probably of microorganisms which produce rot. They are easily brought to any desired moisture content relative to saturation. Furthermore, they give up moisture to the roots to such an extent that the roots were still fresh and turgid even though the shavings had lost more than 80 percent of the moisture held at packing time.

Summary

Rots occurring in sugar beet roots, stored at a temperature suitable for thermal induction (40° F.), were found to be greatly accelerated by the presence of free water in the packing material. Moist pine shavings were found to be superior to sphagnum moss as packing material.

Roots packed in pine shavings having a water content equal to 90 percent of saturation showed no obvious rot at the end of a storage period of 180 days at 40° F. and showed very little rot after 243 days. Pine shavings gave up moisture to such an extent that roots stored 250 days and even for longer periods at 40° F. were still fresh and turgid although the shavings had lost more than 80 percent of the moisture held at packing time.

Literature Cited

(1) PACK, DEAN A.
1924. The storage of sugar beets. Facts About Sugar. Vol. 19, Nos. 8, 9, 10 and 11.