DAMAGE IN OVERWINTER STORAGE CHECKED BY REDUCED MOISTURE

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The New York State Conservation Department has been interested in storing trees over winter for more than a decade. The main purpose of this project is to extend the spring planting season. Early in the season seedbeds contain frost that prevents lifting trees at a time when some planting areas are ready. Overwinter storage stock is available whenever the trees can be planted. These same storage facilities can be used to extend the later part of the planting season by holding back the new growth on the trees.

In the beginning, trees were heeled-in out of doors for the winter. This method proved unsatisfactory because of the lack of control of temperature and moisture during the period. The next method was storage of trees in moist sand, which covered the floor of concrete structures formerly used for ammunition storage. When the individual tree bundles of 50 or 100 trees were surrounded completely with the sand, the method was satisfactory. The structures prevented the freezing of the sand, and the sand controlled the moisture rather well. These structures were not entirely satisfactory for spring storage since the temperature rose too high, allowing new growth and the sand to dry out. The principal objections to this method were the extra work in placing the trees in storage properly and the extensive floor space needed for any reasonable number of trees. .

The next step was to find a method of artificial refrigerated cold storage where the trees could be stacked and temperature and moisture controlled. At first, small commercial facilities were tried, and then for 2 years a large commercial storage plant was used. In 1958 the State started its own refrigerated facilities. These were completed for the 1959 season. The facilities have a capacity of 10 to 12 million 2- and 3-year old seedlings, depending on size of stock. These buildings are concrete block structures with refrigerating units for temperature control (fig. 1). Humidity is provided by evaporation from the trees and the wet sphagnum moss to which moisture is periodically added. Temperature is maintained at about 33^0 F, and with the moisture sources mentioned gives a relative humidity of 90-95 percent. Air movement is provided by a fan on the refrigerating unit. The trees are stacked on wire shelves or placed in metal crates with the roots overlapping and the tops extending to the outside (fig. 2). Moist sphagnum moss is used as a layer on the bottom of each tree shelf and over the top of the stacked trees.

The only serious problem in overwinter storage in all these facilities has been the molding of the trees in storage. The damage to some species on certain occasions has been serious, causing losses when the trees were outplanted. The variability of this damage has caused much concern and has made the problem of its control more complex. There were variations, seasonal, at different nurseries, in species and class of stock. The white spruce trees were the most susceptible, and overaged stock was damaged more than normal stock. Compactness of the tree bundles seemed to be a factor; as a result the trees were not stored in paper rolls, but laid more loosely in individual bunches. The associated fungi were studied by several pathologists, and many tests were made with fungicides with no appreciable results. The fungi can be classed as those that grow well at near freezing temperatures.

Under conditions of excess moisture, the mold in the bunches started in the most compact areas. This is generally under the string-line. The first showing is a blackening of the stem and needles. This condition then spreads through the whole bunch, especially toward the tops of the trees. Later the affected bark becomes loose and slippery, and the

needles become grey colored and soft. The black area finally becomes grey to whitish. At least in white spruce, even a small amount of blackening appeared to create some toxic action, since many trees so affected failed to survive in the field. The roots are evidently affected most. Superficial mold on wet surfaces throughout the storage facilities, including the tree tops, is not necessarily damaging, but indicates local favorable conditions for mold and may be a source of infection. There was no evidence that the bunches heat before or after molding. The main factor that was found to reduce damage was a radical reduction in the moisture associated with the trees themselves.

Good nurserymen are always very careful to see that trees are well watered during packing and shipping. Such precautions proved generally detrimental in overwinter storage. For now it appears that the trees should be put in storage "field dry" and, when necessary during the period of storage, moisture should be carefully added only to the moss or generally to the storage facility to maintain the proper humidity. In other words, the trees are lifted in the nursery and moved soon after to storage, without adding any moisture directly to the trees. The actual moisture content of the trees with this handling is approximately 55-65 percent calculated on a field-moist basis. Some drying may take place, but the objective would be to maintain this same moisture content during storage. The trees, owing to their semidry condition, require thorough watering before packing and shipping. Some evidence indicates that trees that dry below 30-percent moisture will not survive in the field.

During the process of storing trees and the attempts to reduce damage, other contributory factors have appeared. In addition to the reduced moisture, the following conditions will further reduce the chances of damage:

1. If at all possible, trees should not be stored over winter more than 5 months (November through March). This means lifting stock for storage late in the fall and moving it out of storage early in the spring.

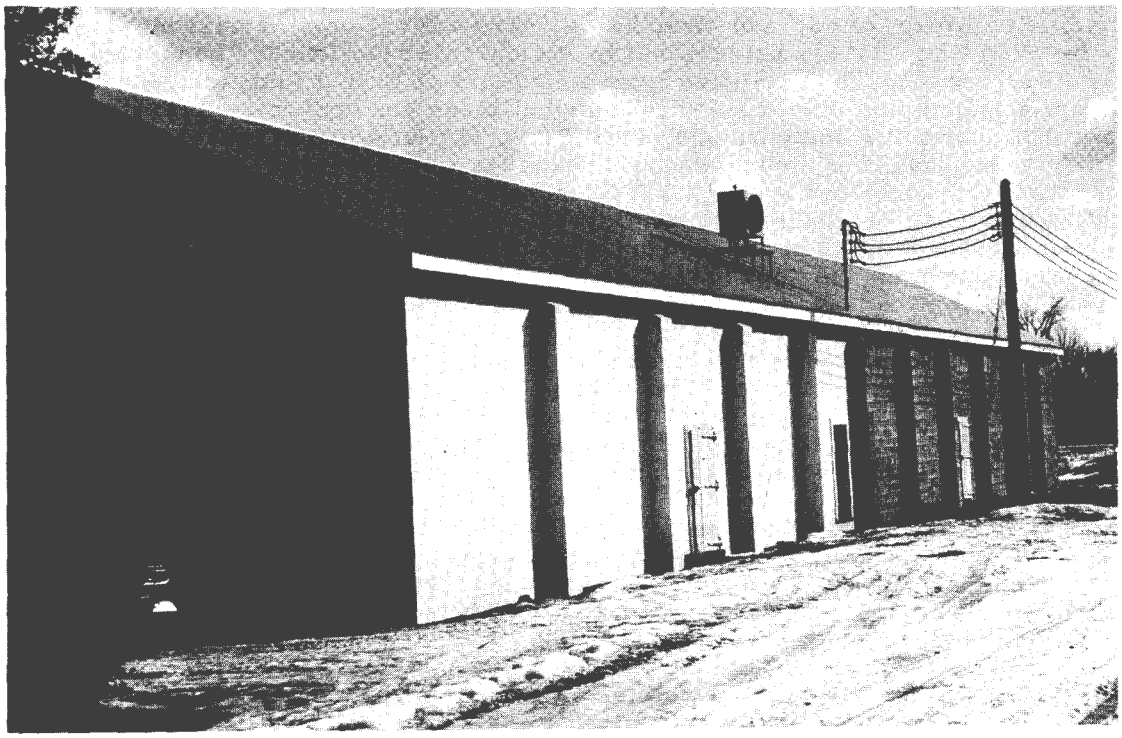

Figure 1.--Cold storage plant for overwinter storage of nursery stock.

2. Clean and healthy stock should be used. It should be free of dirt, dead trees, and other materials that carry various species of mold. Also clean packing material, like pure sphagnum moss, should be used.

3. Small bunches of trees store better than large ones, and should be tied in reasonably loose bunches in diameters up to 4 inches.

4. The better the grade of trees, the better results in storage. Trees with long stems pack too tightly for good internal ventilation.

5. Piles of tree bunches should not exceed 16-20 inches high on the shelves, otherwise the trees will become too compact from their own weight.

6. Some circulation of the air in the storage room should be maintained in order to evenly distribute the temperature, but should not be strong enough to cause unnecessary evaporation from the trees and moss.

Figure 2.--Nursery stock in overwinter cold storage stacked on wire shelves. (Note: Wooden box ends on racks have been replaced with metal.)