SEED STRATIFICATION

by

Homer Ward

As our main interest here in the Pacific Northwest is Douglas fir, I have stayed primarily within the limitations of stratifying Douglas fir seed, but the methods and results of stratification are applicable to all seed.

Stratification is not a new method of breaking the prolonged dormancy of seed held in storage over long periods of time, but was commonly used as far back as 1890 and quite possibly much earlier than that time, but only in the last two or three decades has there been much progress made with forest tree seed.

Stratification is a modification of Nature's method of after ripening seed. Naturally sowed seed and seed that is fall sowed in nurseries is subjected to rain and snow, alternately freezing and thawing. In spring sowing, it is sometimes desirable to quicken germination by artificial means in order to have a longer growing season, resulting in a crop of larger and more uniform seedlings.

The name "stratification" as applied to nursery practices stems from the old method of placing alternate layers of sand and seed in shallow boxes or flats and leaving them outdoors exposed to the winter elements. If a large quantity of seed was to be stratified, it was done in shallow pits or trenches. In modern stratification the seed is mixed with moist sand in boxes, and placed in cellars or refrigerators where the temperature and the moisture can accurately be controlled.

Of several stratifying media, peat moss is generally conceded to be superior due to its moisture-holding and aeration qualities, but it is difficult to separate from the seed prior to sowing. Sand has the advantage of being easily separated from the seed by washing through a screen, but much care is needed to keep the moisture evenly distributed, as it tends to settle in the bottom of the boxes, allowing the seed at the top to become dry.

The procedure employed by the Capitol State Forest Nursery is to sterilize sand by heat and, while still dry, it is screened through a size 18 mesh screen, moistened and mixed with seed at the rate of six to eight pounds of seed to one cubic foot of sand in boxes 12"x12"x18". It is then placed in a refrigerated cold room and held at a constant temperature of 35 degrees Fahrenheit for a period of six weeks. Adding water and thoroughly stirring it every week will provide aeration, will tend to check any mold which might appear, and will keep the moisture uniform throughout the boxes. The moisture content should be just below the point where free water can be squeezed from the material.*

Before sowing, the seed is recovered by washing it through a size 16 mesh screen bucket. (A five-gallon paint bucket provided a suitable frame.) Free moisture is air dried from the seed by spreading a thin layer on a drying tray made of screen for that purpose. Very careful attention is needed to prevent the seed from getting too dry, as this may induce secondary dormancy which is very difficult to overcome. The seed should be sowed as soon after removal from the stratifying media as possible, although recleaned stratified seed held in the moist, cold room for five days showed no ill effects.

*Forest Planting in the Douglas Fir Region, by Kummel, Rindt and Munger.

Stratified seed may be sowed either by hand or machine. It has been sown successfully by using nursery seed drills, direct seeding planters in the field and by the disseminating machines used in airplanes for aerial seeding.

Germination of stratified Douglas fir should be apparent in the seed beds after 14 days and germination is often complete within 28 days.

Tests being made at the Capitol State Forest Nursery to determine the minimum and maximum length of beneficial stratification, while being incomplete, indicate that 12 days will improve the germination of Sitka spruce, while 28 days appear to be the optimum stratification time. Substantial increase in the germination of Douglas fir was noticed after 21 days of stratification and showed very little change after 49 days of stratification. Tests of other species were too irregular to be of value.

Some interesting results of these tests so far show that:

1. Douglas fir seed extracted in the fall of 1941

   Untreated - germinated 34% in 35 days

   Stratified - 49 days germinated 64% in 10 days

2. Douglas fir seed extracted in the fall of 1948

   Untreated - germinated 20% in 35 days

   Stratified - 49 days, germinated 80% in 10 days

3. Ponderosa pine seed extracted in the fall of 1948

   Untreated - germinated 32% in 35 days

   Stratified 49 days, germinated 94% in 10 days

These tests were made from one sample from each lot of seed, so they should not be considered conclusive, but they do show that stratification is an effective method of after ripening fresh seed and of breaking the dormancy of seed that has been held in storage for a number of years.

Chapin: Have you had any trouble with seed sprouting at these temperatures?

Ward: Yes, we have had some trouble with some species. But the gain we have experienced in better germination and quicker establishment of the seedlings has far out-weighed any trouble we have had.

Lanquist: We had some trouble with a temperature of 37°. Some of the seed had sprouts 1½ inch long.

Chapin: We do not stratify conifers. But we do have to stratify the deciduous seed. We had to keep a periodic watch on the seed and make our own decision at the time. We hold our temperature at 38°. There seems to be a great variation in the same seed of hardwoods. Does anyone know why the seed sprouts at a certain time one year and another year it will not sprout at all?

Chairman Webster: Mr. Lanquist, did you find that one species would sprout at that 37° F. or all species?

Lanquist: The red fir was the only species that we had that trouble with. We found that we cannot stratify red fir under 25 days.

Chairman Webster: Do you stratify all your seed?

Lanquist: No, we don't. We stratify only our spring sown seed.

Augenstein: We sow in fall and spring. We do not stratify anything. In Douglas fir we get complete germination in two weeks. We sow in the fall to distribute the work. Some years we don't get our seed in because of the pressure of work.

Chairman Webster: You would be interested to see the uniformity and rapidity of germination in the stratified beds compared to unstratified beds which sometimes germinate all summer long. Some seed even comes the second year.

Lanquist: We do find that seedlings from stratified seed harden off sooner in the fall.

Chairman Webster: I think your season has something to do with that. We find that seedlings from stratified seed come up sooner and get much better established by fall. They are in better shape to combat damping off in the spring and frost damage the next fall.

Wells: We do not stratify - just in an experimental way. During the 18 crops that we have put in at our nursery, one was sowed June 7 and one June 9 and we get fast germination. So I think the climate and season has much to do with it.

Augenstein: At our place we have some delayed germination all summer.

McDaniel: We use seed stratification and like it very much. We plan to use it on all species.

Turner: How long do you stratify hemlock?

McDermitt: We have been successful in stratifying hemlock and spruce. Spruce is what the birds like. Stratified hemlock has advantages over sowing dry seed.

Turner: Our experience with hemlock is that it should be stratified because it is so slow growing. This helps to get away from frost heave in the fall and winter.

McDermitt: We stratify hemlock six weeks.

Lanquist: What percentage of germination do you get on hemlock?

McDermitt: Very low on hemlock. About 20 or 25%.

McWilliams: We get very poor germination and seed from hemlock. Another year we expect to get good germination from better tree seed.

Lanquist: The value of stratifying is showing in Sugar pine. During the winter we dug in the snow and the Sugar pine was germinating under the snow. We had a spell of warm weather which induced germination and followed by cold weather and we lost most of our sugar pine. It should be stratified and sowed in the spring to eliminate this trouble.

Barrett: What temperatures were involved in stratifying? Answer: 32° to 50° on most seed.

Barrett: When you want to arrest development, what temperature is used?

Chapin: Almost freezing. 32° F. would arrest development on most species.

Chairman Webster: Would freezing throw your seed back into dormancy?

Chapin: Seems that each species will not develop under like conditions and go back into second dormancy. It takes a long time to find out what time and temperature is best to use. We have adopted the policy of taking everything out of the box and mixing periodically during stratification, because it needs aeration.

Schroeder: Did you ever try soaking seed?

Ward: No, from what I could learn it is not as satisfactory as stratifying.

Schroeder: We did a little last year. We had some spruce not stratified. We soaked the seed and then sowed it with a helicopter.

Chapin: Some of the deciduous trees will definitely get quicker germination after soaking. Soaking time of four days gets the same results and requires less time than stratifying.

Ward: That, no doubt, is true with deciduous trees, but does not hold true with conifers.

Wells: We soaked cascara 48 hours and got good results.

Lanquist: We can get all this information from the Lake States Experiment Station. I believe they have a late publication on this.

Chairman Webster: I will write and try to get it.

Deffenbacher: Stratification is almost a necessity in our particular location. We have such a short period in the spring that we can work our soil and if we do not stratify our seed, we cannot use spring sowing methods successfully.

McDermitt: In our practice we stratify everything. We keep the temperature near 34°. We have never had any amount of seed that sprouted other than the true firs. We have had it in as much as 9 weeks.

Henderson: Experience in Idaho. Germination test was made on eight-year-old seed. The seed had a high germination test.

Ward: We have had some success with Douglas fir seed which was extracted in 1941 which is still germinating 64%. We ran tests on that same seed the last 4 years. In 1945 it run about 80% germination after being stratified. It held fairly consistent in 1946 and 1947 there was a drop to 54%, and it is now back to 64%. Douglas fir is very inconsistent in germination.

Chairman Webster: I do not think the germination test is a true indication of seed quality. It is only a guide.

Wells: We had seven-year-old seed germinate 75%.

Dill: What about the viability of the plants that you get from the old seed?

McDermitt: I think the viability is as good as the new seed. According to our experience, we have some very good stock from old seed.

Chairman Webster: When you get a good seed year, the germination is good and the opposite is true for a poor seed year.

Thank you, Mr. Ward. A subject not too common to some of us, who are producing nursery stock is that of Propagation of Hardwoods. This interesting topic will be presented by Vern McDaniel.

PROPAGATION OF HARDWOODS
by
Vern E. McDaniel

Introduction

The paper assigned me is "The Propagation of Hardwoods at the Oregon Forest Nursery." This nursery is located 7 miles north of Corvallis, Oregon, on Highway 99-W. The present nursery has an area of 20 acres of cleared land. It is planned to add 10 acres more for nursery practice.

The nursery is owned and operated by the Oregon State Board of Forestry with headquarters at Salem, Oregon. It was established in 1925 as a Clarke-McNary nursery. The first purpose of this nursery is to raise trees for the planting on Oregon farms. Both conifers and hardwoods are sold to the farmer and must be used for windbreak, shelter belt and woodland plantings. Several years later the State Board of Forestry purchased land near this nursery and raised conifer species to plant on their own state lands. The two nurseries were later given the name as the Oregon Forest Nursery.

Establishing the Nursery Site

The area to be cleared had been cut over by a cordwood buyer but the brush, trees, debris and stumps remained. After slashing and piling all debris, a careful plan of burning was used. The stumps were shot lightly and pulled by machine power, after which the ground was leveled, plowed and worked many times before it was ready for seedbed planting. Several tile lines were laid for better land drainage.