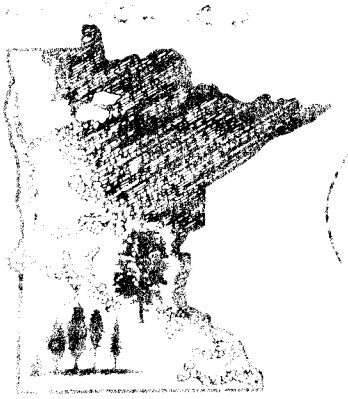

Minnesota Forestry Research Notes

No. 252
July 15, 1974

Early Performance of Ponderosa Pine Seed Sources in Minnesota[1/]

Charles G. Tauer, Carl A. Mohn and William H. Cromell[2/]

Ponderosa pine (Pinus ponderosa Laws.) is widely used as a tall conifer in protection plantings in the prairie region of Minnesota, and it has potential for use in all parts of the state. However, low initial survival, winter injury and slow early growth are frequently encountered when planting this species. Identification and use of those seed sources which are well suited to Minnesota's conditions may substantially reduce these problems. In order to identify suitable origins of ponderosa pine for Minnesota, testing of a variety of sources was initiated in 1968. Survival 3 to 5 years following field planting and heights at eight years from seed are reported below for four of these plantings.

The Minnesota plantings contain seedlings derived from 75 of 80 seed collections assembled by the Rocky Mountain Forest and Range Experiment Station, USDA. Each collection contained the bulked seed from 10 to 20 dominant or codominant trees at a specific location. Collection points were concentrated in the eastern part of the species range, i.e. from the high plains west to the foothills of the Rocky Mountains. In this discussion the 75 collections are classified as belonging to one of 11 regional groups. Regional groups (see Table) contain seeds derived from between 3 and 11 collections and, with the exception of group 12, represent a relatively limited geographic area. Groups 2 - 11 are made up of essentially the same collections in all Minnesota tests. Group 12 contains widely scattered collections from the western part of the species range and the composition of this group in the test plantations is not comparable.

In 1968 2-1 seedlings were received from U. S. Forest Service nurseries in North Dakota and Nebraska. That spring two plantings were established in the prairie region of Minnesota at the University's West Central Experiment Station at Morris (45.6°N, 95.9°W) and Southwest Experiment Station at Lamberton (44.2°N, 95.3°W). At the same time a third planting was established at the Cloquet Forestry Center, (46.8°N, 90.7°W), in the northeastern, forested region of the state. Surplus stock was lined out in a nursery and used for replacements in the Morris and Lamberton plantation in the fall of 1968 and at Morris and Cloquet in the spring of 1970. In May of 1970 the remaining stock, which was then 2-1-2, was used to establish a fourth planting at the University's North Central Experiment Station at Grand Rapids (47.2°N, 93.5°W). Replacements were made at Grand Rapids in the spring of 1971. The allocation of sources to the four plantations is given in the table.

1/Carried out in conjunction with the regional forest tree improvement project, NC-99 (Forest Tree Improvement through Selection and Breeding). Project was initiated by the Rocky Mountain Forest and Range Experiment Station, USDA Forest Service.

2/Respectively, Research Assistant and Associate Professor, College of Forestry, Univ. of Minn. and Assistant Professor, North Central Experiment Station, University of Minnesota, Grand Rapids, Minnesota.

All four test plantations were planted in a randomized complete-block design. Each collection was represented by a 4-tree row plot in each replication. Spacing was 8 x 8 feet and all trees were planted by hand. The Morris, Lamberton, Cloquet and Grand Rapids planting had six, nine, five and three replications, respectively.

Site preparation varied among the plantings. The Morris, Lamberton and Cloquet plantings were on agricultural lands. At Morris and Lamberton the sites were plowed the fall before planting, harrowed in the spring just before planting and sown with mixed grasses after planting. At Cloquet continuous 12 inch strips of sod eight feet apart were removed and the trees planted in the strips. The Grand Rapids site was forest land, primarily birch and aspen, which had been cleared the year previous to planting. Stumps were not removed from the site but sprouting was controlled with chemicals during the growing season prior to planting.

Post planting treatment has also varied. At Morris and Lamberton grasses are controlled by mowing and periodic treatment of a circle approximately two feet in diameter around each tree with chemicals. At Grand Rapids spot treatments with chemicals is being used to control woody sprouts. No treatment has been applied at Cloquet since planting.

Survival and height to the nearest centimeter were taken in the spring of 1973. These data, taken at eight years from seed, are summarized by plantation and regional groups in the table. Heights reported in the table are the means of all surviving trees in a group and survival percentages are based on the total number of trees planted, including replacements.

Survival of trees planted in the prairie region of the state, i.e. Morris and Lamberton, was poor (45 and 37 percent, respectively). Mortality was particularly high during the first growing season after planting reaching 42 percent at Lamberton and 25 percent at Morris. An early summer drought in 1968 contributed to the heavy early losses, but there was substantial additional mortality among both original trees and replacements. In the forested zones, where moisture stress is less, survival to 1973 was satisfactory: 82 percent at Cloquet and 80 percent at Grand Rapids.

There is evidence of differential survival among regional groups. Survival, as summarized in the table, has been below average for the southern and far western collections (groups 10, 11 and 12) and for the Bighorn Mountain Source (group 5) in all plantations. On the basis of early survival, materials from these areas should be avoided in Minnesota.

In all plantations differences among mean heights of regional groups were statistically significant (.05 level). Comparisons between groups within plantations were made using Duncan's Multiple range test. Heights, in percent of the plantation mean, of those groups which were not significantly different from the tallest group in a plantation were:

Group Nr. and Location	Plantation Morris	Lamberton	Cloquet	Grand Rapids
3. So. Montana	115	111	124	121
4. Missouri Plateau	113	106	---	---
7. Pine Ridge and Niobrara River	107	105	---	---
2. No. Central Montana	100	---	---	110
6. Black Hills	---	104	---	---

Table . Origin, height and survival of Ponderosa pine in four Minnesota plantings (spring, 1973)

No. and Regional Group	Origin: Latitude (°N)	Origin: Longitude (°W)	Origin: Elevation (100 ft.) Range	Origin: Elevation (100 ft.) Mean	Origin: Nr. Collections Represented[1]	Mean Height (cm): Morris	Mean Height (cm): Lamberton	Mean Height (cm): Cloquet	Mean Height (cm): Grand Rapids	Survival (%): Morris	Survival (%): Lamberton	Survival (%): Cloquet	Survival (%): Grand Rapids
2. No. Central Montana	46.8-47.8	106.9-111.8	34-47	40.8	7	60.8	75.4	53.7	65.6	58	47	90	84
3. So. Montana	45.6-46.1	106.0-109.0	29-38	35.0	5	70.5	84.3	62.1	72.1	49	42	97	74
4. Missouri Plateau	45.5-47.0	103.1-105.2	25-38	31.0	8	69.1	80.6	50.7	56.4	50	48	85	89
5. Bighorn Mts. Wyoming	44.1-44.9	106.8-107.4	51-70	59.7	3	52.8	62.1	36.9	54.6	35	21	63	76
6. Black Hills	43.6-44.7	103.3-105.5	39-63	48.8	9	60.3	78.9	49.8	62.4	50	39	88	83
7. Pine Ridge & Niobrara River	42.7-43.3	99.8-105.1	23-52	37.5	11	65.4	79.3	55.9	58.0	49	43	90	80
8. No. Platte River & Lodgepole Creek	41.1-42.6	100.0-105.7	29-69	48.0	9*	60.5	73.8	47.3	56.7	65	37	77	83
9. Front Range, Colorado	39.1-41.2	103.7-105.6	53-84	70.5	9	53.7	65.2	43.0	55.0	51	41	90	86
10. Front Range, Colorado & North New Mexico	35.4-37.9	104.3-105.3	64-88	70.9	6**	49.0	63.5	40.4	54.4	25	25	72	65
11. So. New Mexico	32.1-33.3	104.7-105.6	58-73	65.0	3***	38.5	55.3	33.8	41.0	6	9	24	36
12. Far West	35.1-48.3	111.7-121.3	16-70	----	5****	45.1	55.3	47.5	57.9	19	20	75	63
All Sources					75	61.0	75.7	49.9	59.1	45	37	82	80

[1] Origins or collection numbers assigned to groups available from authors on request

*8 in Cloquet test

**5 in Morris and Lamberton tests

***1 in Grand Rapids test

****3 in each plantation but not always the same collection

The Southern Montana group (nr. 3) was the tallest in all plantations with its superiority most clearly expressed in the Cloquet and Grand Rapids planting. In the prairie region, at Morris and Lamberton, a number of sources performed nearly as well as the Southern Montana source. In general materials originating north of the 43rd parallel did well (see Table). The exception was the Bighorn Mountain material, group 5, which is from relatively high altitudes. As indicated by the data in the table, the southern sources (groups 8-11) and the far western sources were below average in height growth. In all plantations most regional groups which grew poorly had low survival.

To date there has been little winter injury noted in the plantations. As trees get larger and the protection provided by snow cover is lost, the relative performance of groups may change and recommendations must be tentative. On the basis of survival and growth to date, the southern Montana area (group 3) seems the most suitable source for materials to be planted in all areas of Minnesota. In the prairie regions Missouri Plateau (group 4) and the Pine Ridge-Niobrara River (group 7) sources appear to be reasonable alternatives. In northern Minnesota material from north central Montana (group 2) might also be considered. In all parts of the state materials from south of 43°N and northern sources from higher altitudes should be avoided.

Published as Misc. Jour. Ser. No. 1545 of the University of Minnesota Agricultural Experiment Station