

TECHNICAL NOTES

U. S. DEPARTMENT OF AGRICULTURE SOUTH DAKOTA SOIL CONSERVATION SERVICE

Woodland No. 25

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Row Spacings in Windbreaks

The distance between the rows in a windbreak planting is one of the most controversial topics in windbreak design. This is difficult to understand since both research and observations of older plantings show that narrow row spacing (8 to 16 feet) have an advantage over wide row spacings (16 to 24 feet.) This technical note reviews the research and records applicable to South Dakota.

Research on windbreaks plantings in South Dakota started in 1916 with the Cooperative Shelterbelt Project. This project was headquartered at the Northern Great Plains Research Station, Mandan, ND. For the period 1916-42, a total of 4,670 plantings were made and evaluated. The area of the project included roughly the western halves of North and South Dakota, eastern and central Montana, and northeastern and north central Wyoming.

Cooperative Shelterbelt Project

E. J. George, Silviculturist at the Northern Great Plains Station reports the following on spacing, "A distance of 12 to 15 feet between rows gives very satisfactory results and permits cultivation with ordinary farm machinery for the first two or three years. Row spacings wider than 15 feet should not be used; very few species will ever develop sufficient crown spread to close the canopy if planted in rows so far apart. A distance of six to eight feet between trees in the row permits normal growth without a high degree of suppression."

Prairie States Forestry Project

Farm Forestry For The Northern Great Plains, published in 1946, has the following recommendations and information on spacing:

SPACING BETWEEN ROWS MAY VARY BETWEEN 6 AND 12 FEET.
THE SPACING OF TREES IN THE ROW MAY BE FROM 4 TO 8
FEET AND FOR SHRUBS 2 TO 3 FEET.

Spacing Between Tree Rows

Since the average cultivation period varies between three to five years, it becomes necessary, therefore, to use a spacing that will permit the trees to close, or very nearly close, within that time. In view of these facts, we have found that the maximum spacing that can be used on the better sites where trees make their maximum growth is 12 feet. On the more difficult sites, the spacing should be narrower.

Results from Wide and Narrow Spacing

The research branch of the Forest Service carefully examined and measured, during the summer of 1944, 900 Prairie States Forestry Projects, Soil Conservation Service, and private windbreaks and shelterbelts that have been planted in the Great Plains during the last ten years. The partially completed analysis of these measurements shows that the growth and survival are directly dependent upon the amount of cultivation that the planting has received prior to the time the crowns close. The studies show that a spacing of 12 feet is too wide for some sites where growth is slow. In some belts, where cultivation was carried on for but three years, growth has been slowed to the point where (even with favorable precipitation for the past five years) it will probably take 12 to 15 years for the trees and shrub rows to close. All were spaced less than 12 feet. If we have a severe drouth before this occurs, at least a portion of these belts will probably fail.

Wide Spacing With Continuous Cultivation Not Recommended

Where the planting site is extremely difficult and cannot be improved by contour planting, terraces, water spreading, or by providing feeder zones as indicated above, it is best to face the actual facts and admit the impossibility of planting trees.

Some have recommended a wide spacing 14 to 20 feet for such situations but with continuous cultivation between each row. Such a practice is questionable for the following reasons:

1. The wide spacing produces a wide-crowned tree which transpires large quantities of moisture because of its excessive leaf surface.
2. Each tree is exposed to wind movement from all sides and the full influence of the sun's rays which further increases transpiration.
3. The surface of the soil is exposed to direct sun and air movement which increases evaporation from its surface.
4. Continuous cultivation exposes the tree's roots and trunks to mechanical injury which encourages attaches of fungus and insects. This practice eliminates the natural accumulation of forest litter and the development of natural forest soil conditions.
5. A plantation cared for in this manner seldom lives longer than a closely spaced planting.
6. Continuous cultivation places a tremendous burden upon the owner and in the final analysis there are few farmers or ranchers who will cultivate continuously. The elimination of cultivation for but one or two years in wide spacing plantings usually result in such rank weed growth that severe competition quickly weakens the trees.

Spacing Studies South Dakota State University

In 1954, P. E. Collins initiated a spacing study at Brookings. Average heights of four tree species planted at 8 foot, 16 foot and 24 foot row spacings after 17 growing seasons are given below:

Spacings

1970	8 Feet	16 Feet	24 Feet
Green ash	28.6	28.0	26.7
Hackberry	27.7	27.0	24.7
Siberian elm	32.5	31.9	32.8
Ponderosa pine	15.6	15.6	10.7

Narrow row spacings have an advantage in early height growth for all species, except Siberian elm. For Siberian elm there is no statistical difference in the three row spacings. The 8 feet and 16 feet row spacings have a canopy cover to shade out weeds, while the 24 feet row spacings do not have a closed canopy.

The January 1983 issue of TREE TALK reported the following measurements on the same spacing study:

Spacings

	8 Feet	16 Feet	24 Feet
Green ash	37.3	36.9	37.6
Hackberry	33.5	35.0	31.8
Siberian elm	41.7	44.4	44.2
Ponderosa pine	30.6	28.6	24.9

In analyzing these figures, it becomes apparent that only Siberian elm benefits from planting rows more than eight feet apart. The height of Siberian elm in rows spaced 16 feet apart was essentially the same as the height in rows 24 feet apart. For Hackberry, the difference between 33.5 feet and 35.0 feet height in 8 feet and 16 feet row spacings was not statistically significant.

There are three other good reasons to keep between row spacings to 16 feet or less:

- 1) Less years of cultivation, because of earlier crown closure.
- 2) A windbreak with rows planted 12 feet apart occupies half the acreage of land as one planted with rows 24 feet apart.

- 3) Windbreaks with narrow rows are usually no wider than 100 feet and all rows benefit from the moisture released from stored snow. Studies have shown the 80-90 percent of the snow stored in a windbreak is within 85 feet of the windward most row.

The same issue of TREE TALK reported on a planting at the Antelope Range Station in Harding County. A 20-year-old spacing study on Siberian elm planted at 12 feet x 24 feet spacing had an average height of 21.5 feet while Siberian elm planted at 12 feet x 12 feet spacing averaged 20.5 feet. Statistical analysis again indicated that this one foot difference in height was more likely due to chance than to the difference in row spacing.

Summary

Moisture is the most limiting factor for tree growth in South Dakota. There are three ways to provide moisture to trees; 1) control weeds, 2) trap snow, and/or 3) irrigate. Weed control and trapping snow are two advantages that a windbreak with narrow row spacing has over one with wide row spacing. A narrow row spacing requires less years of weed control and will canopy to shade the ground for long term weed control. A windbreak with narrow row spacings occupies less space and there is a better chance that all the rows in the windbreak will store snow and benefit from the additional moisture.

Literature cited:

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- 4) Collins, P. E., Effect Of Spacing On The Survival Growth And Effectiveness Of Windbreaks In South Dakota. From 1979 Progress Report (CRIS.)
- 5) Helwig, L. & Baer, N., TREE TALK, Vol. X, No. 1, January, 1983.



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