THE ABILITY OF CERTAIN COMMON TREES TO WITHSTAND DROUGHT IN SOUTHEASTERN SOUTH DAKOTA

Harold I. Maggrett
Sioux Falls High School

The trees found growing in most parts of South Dakota are few in number compared to other sections of our nation. One reason for this is that the climate of our state is such that the trees in general will only grow when they receive the maximum of care. To make the matter still worse South Dakota has drought years when only the most hardy drought resistant trees have a chance to survive. Two of these drought years of more than average intensity occured during the years 1934 and 1936. Many of the trees died as a result of these two drought years and an excellent opportunity presented itself for an ecological study to determine which trees could successfully withstand severe drought conditions in South Dakota.

The field survey was taken over a period of five years from 1934 to 1939 and included twelve of our most common species of trees as listed in Table 1. Because of the expense involved this study was limited to Southeastern South Dakota and included all or part of the following counties: Bon Homme, Turner, Yankton, Clay, Lincoln, Gregory, Charles Mix, Brule, Aurora, Douglas, Hutchinson, Davison, and Union. These counties were chosen for study because three entirely different group habitats were present in most of the territory covered and therefore the ability of the trees to withstand drought could be studied under the most adverse conditions as well as the most favorable conditions.

The three types of habitats that were covered in this survey are the lowland, valley, and upland regions found in the different counties. The lowlands offered the best advantages for tree growth in that the water table was closer to the surface of the ground, there was less exposure to the wind, and in most cases the soil was very fertile. The valley regions had in most cases a water table that was closer to the surface and less wind exposure than the uplands which offered few advantages for tree growth. The factors considered when out in the

field taking the survey were: Water table, exposure of the trees to the wind, temperature and humidity, age of the trees, care of the trees, insect infestations, number of living trees, number dead, crop conditions, types of soil, annual rings of tree cross sections and root systems of the trees.

The Southeastern section of South Dakota was covered by this survey. The western part of this area offers very few opportunities for tree growth compared to the eastern counties covered in this survey. The trees that were examined in the western counties were almost without exception inferior to the trees found in the eastern counties. This was always true in the upland regions where the water table was not near the surface. The trees were smaller in diameter, and were stunted in every respect. Many of the trees did very well in certain regions of the western counties but this was due to the fact that the roots of the established trees extended as far down as the water table and did not have to depend upon the natural rainfall of these counties for their moisture supply. It is interesting to note that there is a gradual reduction in the annual rainfall as one goes westward. The smaller amount of annual precipitation is responsible for the above mentioned differences in the ability of certain trees to withstand drought in southeastern South Dakota.

Another noticeable feature of tree growth in the western counties was the small number of trees that were found there. In fact, in much of the land found in the western counties, not a single tree of certain species that were native in certain eastern counties could be found. The Kentucky coffee bean, and the basswood or linden trees were examples of this situation. The common soft maple, while probably not a native tree, is quite common in the eastern counties where this survey was taken. However, not one soft maple was found in some of the western counties.

Information as to the depth of the water table was compiled from two different sources. Well drillers were interviewed as to the depth that they found water, and farmers and city property owners were asked about the depths at which water could be found. The water table varies considerably as to depth over the entire thirteen counties. Wells were found

in Union county that were only 8 feet from the surface while in the same county one farmer had to go to depth of 60 feet in order to get water. In general, however, the upland regions were found to have a lower water table than the valley habitats. Water was found to be closer to the surface in the lowlands than in either the valleys or the uplands.

The depth of the water table makes a big difference in the ability of the trees to survive drought periods. Sixty per cent of the trees in a walnut grove found between Platte and Geddes in Charles Mix County were found to be living. This was far above the survival percentages for walnut trees in this section and in fact better than survival percentages for walnut trees on the uplands of the eastern counties where the annual rainfall was greater. Upon investigation the roots of the trees were found to extend down as far as the water table. This is one example of many that plainly shows the value of planting trees in a location where the water table is near the surface.

Exposure of the trees to the wind is one of the factors that makes the upland regions of southeastern South Dakota an extremely hard region in which to grow trees. The prevailing direction of the winds in southeastern South Dakota is from the northwest in the winter and from the south or southeast in the summer.[1] However, there are southwest winds which occur at intervals which are very damaging because of their dryness and the resulting heating that results from them.[2] The rate of the wind movement, relative humidity and the temperature of the wind controls the rate of evaporation.[3] Therefore more water is lost by evaporation during hot, dry, swift, drought winds than during normal conditions. This is especially harmful as the rainfall is less during these drought periods and the trees have less available moisture than usual and yet they give off more water by evaporation.

[1]Possibilities of Shelterbelt Planting in the Plains Regions, the Lake States Forest Experiment Station, United States Forest Service, U. S. Government Printing Office, Washington, D. C., (1935), pp. 83-85.
[2]Ibid., p. 83.
[3]Ibid., p. 101.

Both young and old trees were included in this survey. The young trees were found to be better able to survive the drought years than the older trees. One reason for this was that the early settlers planted the fast-growing but short-lived trees and the trees in many of the windbreaks were reaching an age when they could not be expected to live any longer. Another reason was the increased knowledge of tree planting now in the hands of citizens of this state.

Table 1 shows the survival percentages for each of the twelve species of trees covered in this survey. Since the survival percentages vary from 55 to 97 per cent, it is apparent that some species of trees are very drought resistant compared to others. This same variation is also apparent in the study conducted by E. R. Ware. The percentages vary somewhat but this is to be expected as his study was taken during a different year and in a different territory.[4] It should be mentioned, however, that planting drought resistant trees is not a "cure-all" solution to successful tree plantings. The care given to the trees is equally important as well as the selection of the seed and planting sites. Some of these factors that should be considered are as follows: Seedlings grown from native seeds have the best survival percentages, trees will do better if they are planted where the water table is near the surface of the ground, proper cultivation of the ground and the storage of water in the soil before the trees are planted is also very necessary, and over grazing by stock and girdling of the trees by rabbits will cause the death of many trees.

The death of trees due to insect infestations was slight compared to the death of trees due to drought conditions. The trees suffered most from insects during the drought years and in the regions where there was slight rainfall.

In general, the trees that were planted on sandy soils did better than the trees planted in the clay soils. The reason for this is that the surface run-off was much less in the sandy soils than in the clay soils. In the sandy soils most of the

[4]Ware, E. R, Planting and Care of Trees in South Dakota, S. D. Agricultural Experiment Station Bulletin 356 (1936).

rainfall sinks deep down into the soil and encourages the growth of a deep and extensive root system.

The trees that are the most drought resistant have the deepest root systems with few exceptions. This is because the trees can get water from the underground water table when there is a little or no available precipitation. Some of the trees have root systems that extend 10 to 20 feet down in the ground such as the hackberry, ponderosa pine, honey-locust, and bur oak. These four trees are all drought resistant but some of the medium rooted trees are just as drought resistant, if not more so, than the deep rooted drought resistant tree.

Lack of space will prevent the printing of tables for each of the twelve species of trees included in this survey, but the recommendations for planting in the different sections of southeastern South Dakota given in Table 2 will in reality be conclusions reached from the study of these tables and other material pretaining to the subject.

The average survival for all twelve species of trees is 76 per cent. This is a good survival considering the fact that this survey was taken after two of the most severe droughts ever to visit South Dakota. It is also indicative of the fact that trees can be raised in South Dakota, even under the most adverse conditions, if drought resistant trees are selected and they are given proper care.

TABLE I

STATISTICS CONCERNING TREES COVERED IN THIS SURVEY

Common Names	Scientific Names	Number Trees Examined				Trees Living	Per Cent Trees Living
		Upland	Valley	Lowland	Total		
Red Cedar	Juniperus virginiana, L.	400	530	580	1510	1464	97
Chinese Elm	Ulmus pumila, L.	850	150	200	1200	1150	97
Hackberry	Celtis occidentalis, L.	450	125	500	1075	1033	96
Ponderosa Pine	Pinus ponderosa, Doug.	700	350	500	1550	1428	92
Honey Locust	Gleditsia triacanthos, L.	415	50	100	565	499	88
Bur Oak	Quercus macrocarpa, Michaux	100	175	425	700	593	85
American Elm	Ulmus americana, L.	100	900	1400	3000	2375	79
Cottonwood	Populus monilifera, Ait.	1400	750	1200	3350	2375	78
Green Ash	Fraxinus lanceolata, Borkh.	640	250	1200	2090	1325	63
White Willow	Salix Alba, L.	350	300	400	1050	664	63
Boxelder	Acer negundo, L.	625	525	750	1900	1075	56
Black Walunt	Juglans nigra, L.	395	35	225	655	365	55
					18,645	14,346	76

TABLE II

RECOMMENDED PLANTING ZONES FOR CERTAIN TREES IN SOUTHEASTERN SOUTH DAKOTA

	EASTERN COUNTIES				WESTERN COUNTIES			
	Uplands		Lowlands		Uplands		Lowlands	
	Sandy Loam Soils	Fine Textured soils	Sandy Loam Soils	Fine Textured soils	Sandy Loam Soils	Fine Textured soils	Sandy Loam Soils	Fine Textured soils
Red Cedar	E	E	E	E	E	E	E	E
Chinese Elm[1]	E	E	E	E	E	E	E	E
Hackberry	E	E	E	E	E	E	E	E
Ponderosa Pine	E	E	E	E	E	E	E	E
Honey Locust	E	E	E	E	G	G	E	E
Bur Oak[2]	E	E	E	E	E	G	E	E
American Elm	F	F	E	E	—	—	G	G
Cottonwood	—	—	E	G	—	—	G	F
Green Ash	G	F	E	E	F	—	E	G
White Willow	—	—	G	F	—	—	F	—
Boxelder	—	—	F	—	—	—	F	
Black Walnut	—	—	F	G	—	—	F	F

Note: In the above table E stands for excellent, G for good, F for fair, and — for not recommended.

[1] The chinese elm is very drought resistant but splits easily at the crotches and is reported to be short-lived.

[2] Acorns should be planted in place as there is no successful method of transplanting the bur oak.