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THE SHELTERBELT PROJECT

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Few proposals in the entire history of the country have provoked so much general interest and comment as the proposed Shelterbelt Project. Its presentation in a memorandum from the President to the Forester on August 19, 1933, came at a time when many new and unusual proposals of the New Deal were being made. An analysis of most of these proposals raised scientific, social, and political controversies, yet of all of the controversies, few so completely captured the imagination and interest of the general public as did the controversy over the proposed planting of a belt of trees across the great plains region.

The proposal immediately became news and was almost universally discussed. The average citizen is interested in trees and tree planting and this was to be tree planting extraordinary; on a scale never undertaken before and in an unusual place. Feature writers and columnists had a new subject for their columns which was of real interest to their readers. In these first news stories, the opinions on the practicability of the project were chiefly based on preconceived notions rather than on any definite knowledge. It opened up to scientists and pseudo-scientists a new controversy. Will the trees grow, and if they grow, will they do any of the things which have been so widely claimed for them? If, as some publicity experts claim, all publicity is good publicity, the project is in debt to all of these commentators for many thousands of dollars worth of publicity.

In June 1934, an executive order of President Roosevelt set aside $15,000,000 for the initiation of the project. At about the same time a prospectus of the proposed project prepared by Dr. Raphael Zon, Director of the Lake States Forest Experiment Station, and assistants was completed. The prospectus contained summaries of the results of experimental shelterbelt planting in Russia, and of the limited experimental planting in the region under consideration. Its principal purpose was the presentation of a general picture of the proposed shelterbelt in relation to the environment of the area rather than a finished plan of procedure.

The popular concept of the project was of a gigantic tree belt, made up of 100 shelterbelts about 8 rods wide and spaced one mile apart in parallel rows. This belt was to traverse the short-grass plains of western Dakotas, Nebraska, Kansas and the panhandle regions of Oklahoma and Texas, uninterrupted by variations in topography, soil or climatic conditions. The belt was to constitute a barrier, protecting the farms and cities of the central and eastern part of the Mississippi basin from hot winds and dust storms originating farther west. The function of local protection within the borders of the extensive shelterbelt area was almost entirely overlooked in the popular concept.

In September 1934, the sum of $1,000,000 was released by the Comptroller of the Currency for the initiation of the project. Following this announcement, a form letter was sent out by the President of the Society of American Foresters to foresters and other scientific workers in related fields. In the letter was this paragraph: "The announcement of the President's western tree-planting program about a month ago, has, by reason of its scope, the publicity it has received and the very serious question raised as to its probable success, caused widespread apprehension among professional foresters within and without the region affected. Quiescent acceptance of this project without questioning either its technical soundness or its administrative efficiency might damage the reputation of foresters and forestry for decades."

A round-table discussion of answers to this letter was presented in the December (1934) number of the Journal of Forestry. On the whole, these responses were not as biased on one side or the other as were the first statements from scientists and others which had found their way into print. They were based on very few specific, applicable, scientific data because very little scientific research had been undertaken for the purpose of determining the practicability of shelterbelt planting in the region under consideration. However, some important questions were raised and some valuable suggestions were made.

At present the apprehension caused in certain groups by the initiation of this project seems to have subsided. This fact is evidenced by the changed attitude of most of the scientists, as they have noted the application of research methods to the many scientific problems basic to the project.

As soon as money for the project was made available, research and administrative staffs were organized. The research staff was made a part of the organization of the Lake States Forest Experiment Station at St. Paul, Minn., of which Dr. Raphael Zon is the Director. Carlos G. Bates, Senior Silviculturist at the station, is in immediate charge of shelterbelt research and responsible for the summarization and interpretation of the meteorological data of the area. A complete set of maps and charts is nearing completion and plans have been made for an investigation during the summer of 1935 of the effects of shelterbelts on environmental factors and resulting plant response.

Soils research is in charge of Frank A. Hayes of the Bureau of Chemistry and Soils who has prepared a soils map of the shelterbelt area, based on soil surveys of the counties completed, on published and unpublished survey data and on his own recent reconnaissance survey. J. F. Kaylor was in charge of research on the survival of existing shelterbelts within the area. Ernest Wright is making a study of any plant diseases of trees and shrubs which would interfere with the planting of any particular species or variety. The speaker is in charge of botanical research as related particularly to the native vegetation of the region.

The administrative staff is established at Lincoln, Nebraska, with Paul H. Roberts, acting director in charge. This organization is responsible for the personnel, equipment and materials to be used in the actual planting of and caring for the trees.

Even an incomplete organization of past research data on the conditions for tree growth in the shelterbelt zone and of research data collected since the inauguration of the project, would seem to offer a basis for agreement on some of the more debatable questions pertaining to the establishment of the shelterbelt.

1. The location of the shelterbelt as it is now mapped by those in charge of the project shows a very close correlation to the position of the mixed-prairie zone within the grassland of central United States. This zone occupies a strip about 100 miles wide, lying between the prairie region on the east and the short grass plains on the west and encroaches about equally on both areas as they are represented on the Shantz and Zon map included in the Atlas of American Agriculture.

2. Even within this zone there is much flat land which generally is not suitable for the planting of extensive shelterbelts because of the superficial character of the water supply. This classification (about 36 percent of the entire area) includes all but the eastern portion of the fine-textured soils of the zone.

3. Throughout the entire shelterbelt zone, however, it seems possible and would probably be advisable to establish individual shelterbelts around permanent farmsteads for protection to farm buildings, small gardens, and in some places to small farm orchards.

4. Within the zone there are areas of good agricultural land (about 48% of the area) made up of some fine-textured soils in the eastern portion and of favorable, porous soils elsewhere on which belts of trees would make good growth under favorable cultural conditions.

5. In and closely bordering the sand areas within the zone and in selected areas of broken land bordering drainages, there is an aggregate of many thousands of acres of land in which the roots of planted trees would come into contact with surplus available water sufficient for adequate tree growth. Water from these sources, unavailable to crops because of the roughness or the sandy nature of the land, would support a sufficient growth of trees to cause the transpiration into the atmosphere of large quantities of water which would otherwise be subject to more or less rapid drainage.

6. The local protection induced by these three classes of tree planting; general homestead planting, shelterbelts limited to the areas of good farm land and larger plantations of trees on sandy and broken land; would seem to justify them without assuming any general climatic effects from shelterbelt planting.

The most important contribution which a study of existing native vegetation of the area under consideration can make to the entire shelterbelt project is through the indicator significance of these native plant communities. There is a definite reason for their presence; they fit in with the complex of environment in the particular habitats where they occur. Therefore a study of the native vegetation and its component plants gives us an insight into the characteristics of the region as it relates to future plant development.

The grassland formation of central United States which will be traversed by the shelterbelt may be divided from north to south into two almost equal-sized units, the prairie on the east and the short-grass plains on the west. The transition zone, lying between these two divisions is made up of a mixture of tall and short grasses in which the available soil moisture-transpiration balance favors plant growth for about 2½ months each growing season.

The aim of those responsible for the location of the shelterbelt has been to place it as far west as conditions for tree growth are favorable and yet to keep it within the permanent farming belt. The immediate botanical question concerned possible correlation of this westward extension of permanent farming with any portion of the grassland formation. On a map, delimiting the mixed prairie zone on the basis of all available data, this zone almost exactly coincides along its western border with the western border of the area devoted to agriculture as shown on the recent Land Use Map of the United States. Furthermore, minimum habitat requirements of dryland forms of our native trees correspond quite closely to those of the more favorable portions of the mixed prairie zone. For these reasons, there is seen to be a quite definite correlation between the mixed prairie and the final location of the shelterbelt zone. Additional quantitative investigation of the native grassland cover and its correlation with the capabilities of the several soil types for the growth of trees is planned.

Native trees and shrubs within the shelterbelt zone are indicators of modified physiography which results in an increase in available soil moisture, a decrease in transpiration rate or in a combination of the two. More important than the distribution of species of woody plants in the shelterbelt zone is the location and the ecological value of each species in the definite plant communities. Quantitative data of these plant groups include: dates studied, exact locality and boundaries, altitude, topographic position, soil, density of stand, height of stand, degree of development and for the individual species, height of plant, diameter breast high, crown diameter, society layer, abundance, age and month of greatest seed dissemination. On the basis of the foregoing characteristics and of the species lists, the woodland communities of the shelterbelt zone were separated into six divisions, three from north to south and two from east to west. The ecological significance of the important species in these communities was studied.

A list of 140 species and varieties of trees and shrubs was compiled from the herbaria of state colleges and from the collection list of the speaker. This list did not include a few species and varieties of rare occurrence in the zone and a few of doubtful identity.

The distribution of 73 of the most important trees and shrubs was mapped. The chief interest in this mapping has been in the corrections which were necessary in most of the older distribution maps and in the application of these distribution data to the selection of trees for shelterbelt planting. However, the type of habitat in which a plant is growing is of greater significance than the mere presence of the plant in a given location. For example, the presence of the persimmon in the Texas panhandle does not indicate its ability to grow in the average shelterbelt there but only that an extremely moist and protected habitat on the lower floodplain of the Canadian river is comparable to a typical persimmon community in eastern Oklahoma.

With the exception of a very limited area bordering streams and lakes, where trees and shrubs naturally grow, the shelterbelt zone is largely potential mixed prairie. However, toward the ends of many dry runs and ravines several western forms of eastern trees are growing in habitats which show very little improvement over typical prairie or mixed prairie sites. Without a doubt the trees to be planted in the shelterbelt should be selected from this pioneer stock instead of from forms of trees and shrubs grown under conditions widely removed from the planting sites.

Although plant development is determined by internal conditions, these conditions may in turn be altered by external factors. When plant development has thus been indirectly altered by environmental (ecological) conditions of sufficient effect to materially change the appearance and physiology of the plant, the new forms may be recognized as ecotypes. The western forms or ecotypes studied give evidence of being more drought resistant than representatives of the same species growing under more favorable moisture conditions farther east.

Because of its apparent adaptability to environmental conditions in the shelterbelt zone and its wide variation in form and behavior, the native green ash was selected at the outset for special study. Comparison of the eastern with the western forms of this species is complicated because of the recognition of the prairie ash by some authorities as a separate species, *Fraxinus campestris* Britt. and by others as a variety and by others as an ecotype. Additional work is necessary before even an approximately satisfactory classification of the western ashes can be made. The speaker at the present time, is disposed to classify the western forms as ecotypes rather than as a separate species or variety.

An investigation of the variation in structure and behavior of the ash trees of the region has been initiated. Specimens of twigs, leaves and fruits have been collected from 83 pistillate ash trees and specimens of twigs and leaves from 36 staminate trees and type drawings have been made for comparison. The trees have been marked and their locations mapped so they may again be examined.

Wide variations in time and percent of germination show that germination figures for the trees of one form or location will not apply to others. Drought resistant studies in the greenhouse and field combined with a study of gross morphological differences may result in a method of selection in the field on the basis of gross morphological differences, of those trees, the progeny of which will prove highly drought resistant.

The adaptation of trees and shrubs to alkali is an important problem in connection with research on selection of trees and shrubs for shelterbelt planting because throughout much of the shelterbelt zone there is present on some horizon of the soil profile a zone of alkaline salt accumulation. Trees and shrubs growing on the western edge of the shelterbelt zone are as a rule more alkali-resistant than those farther east because where the depth of penetration of water is less the zone of alkali accumulation is nearer the surface. The reaction of these western forms of trees and shrubs to alkalinity is to some extent comparable to the reactions to dry conditions. However, the response to alkali is more complex because of the wide variations in the chemical reactions involved. Variations in the quantity of each compound in the soil solution cause different responses in the plant. Very weak solutions of many alkali salts increase the rate of water absorption but the presence of any appreciable quantity of alkali salts in the soil solution results in a decrease in the rate of water absorption. In the case of neutral salts, the rate of absorption is chiefly decreased because of the lowered diffusion gradient of water into the plant.

The selection of trees and shrubs for general shelterbelt planting should be made from those western forms which show at least slight modification toward alkali resistance. More definitely alkali resistant trees as the western soap-berry and mesquite should be planted in areas of higher alkalinity, but which may be modified by plant growth into more favorable sites. The examination should be made of the pH of the soil under alkali resistant trees of numerous sites to determine the alkali resistance of the species under different habitat conditions.

Within the shelterbelt zone extreme variations exist both in soils and climate. If the area were divided into extremely small units, even as small as one square mile or less, no two units would be alike as to all environmental conditions. By the combined efforts of those studying soils, climatic conditions, native vegetation and existing shelterbelts, correlations may be obtained which will make possible the division of the area into large units of similar capabilities for shelterbelt planting.

On a basis of length of growing season the area, which has a growing season of 200 days at the southern border and 110 days at the northern border, may be classified into four almost equal divisions by lines running in a general east-west direction. This will also serve as a broad classification based on extreme temperatures. An east and a west division may be made on a basis of rainfall. In table I the eastern divisions are numbered (from north to south) one to four consecutively and the western divisions (in the same direction) five to eight. These recommendations for planting in the eight divisions of the shelterbelt zone are based entirely on distribution and growth data pertaining to native tree and shrub species in their natural habitats.

TABLE I. NATIVE TREES AND SHRUBS RECOMMENDED FOR PLANTING IN THE EIGHT ECOLOGICAL DIVISIONS OF THE SHELTERBELT ZONE

Most important tree and shrub species of the area	Divisions of the shelterbelt zone							
Trees	1	2	3	4	5	6	7	8
1. *Pinus ponderosa* Laws.	P	P	—	—	P	P	—	—
2. *Juniperus scopulorum* Sarg.	—	—	—	—	F	F	F	F
3. *J. virginiana* L.	F	F	F	F	F	F	F	F
4. *Populus sargentii* Dode	F	F	F	F	F	F	F	F
5. *Juglans nigra* L.	—	P	P	P	—	—	—	—
6. *Juglans rupestris* Engelm.	—	—	—	P	—	—	—	P
7. *Hicoria ovata* (Mill.) Koch	—	P	P	P	—	—	—	—
8. *H. pecan* (Marsh.) Britt.	—	—	P	P	—	—	—	P
9. *Quercus macrocarpa* Michx.	F	F	F	F	P	P	P	—
10. *Q. stellata* Wang.	—	—	P	P	—	—	P	P
11. *Ulmus americana* L.	F	F	F	F	F	F	F	F
12. *Celtis occidentalis* L.	F	F	F	F	F	F	F	P
13. *Celtis reticulata vestita* Sarg.	—	—	F	F	—	—	F	F
14. *Morus rubra* L.	—	F	F	F	—	F	F	F
15. *Toxylon pomiferum* Raf.	—	—	F	F	—	—	F	F
16. *Prosopis juliflora glandulosa* (Torr.)	—	—	—	F	—	—	—	F
17. *Gleditsia triacanthos* L.	—	F	F	F	—	F	F	F
18. *Sapindus drummondii* H. and A.	—	—	—	F	—	—	—	F
19. *Bumelia lanuginosa* (Michx.) Pers.	—	—	—	P	—	—	—	P
20. *Fraxinus campestris* Britt.	F	F	F	F	F	F	F	F
Small trees and shrubs								
21. *Juniperus communis* L.	F	F	F	F	F	F	F	P
22. *Q. stellata parviloba* Sarg.	—	—	—	P	—	—	—	P
23. *Physocarpus opufolius intermedius* Rydb.	F	F	—	—	P	P	—	—
24. *Rubus idaeus aculeatissimus* (C. A. Mey.) R. & T.	F	F	F	—	P	P	P	—
25. *Rubus occidentalis* L.	F	F	F	F	P	P	P	P
26. *Rosa pratincola* Greene	F	F	F	F	F	F	F	F
27. *Amelanchier humilis* Wieg.	F	F	—	—	F	F	—	—
28. *Crataegus mollis* (T. & G.) Scheele	F	F	F	P	P	P	P	P
29. *Prunus angustifolia* Marsh	—	—	F	F	—	—	P	P
30. *P. besseyi* Bailey	—	P	P	P	—	P	P	P
31. *P. virginiana melanocarpa* (A. Nels.) Sarg.	F	F	F	P	F	F	F	P
32. *Xanthoxylum americanum* Mill.	P	P	P	P	—	—	—	—
33. *Rhus glabra* L.	F	F	F	F	F	F	F	F
34. *R. trilobata* Nutt.	F	F	F	F	F	F	F	F
35. *Vitis longii* Prince	—	—	—	F	—	—	—	F
36. *V. vulpina* L.	P	P	P	P	P	P	P	P
37. *Cornus asperifolia* Michx.	—	P	P	P	—	P	P	P
38. *Symphoricarpos occidentalis* Hook.	F	F	F	—	F	F	F	—
39. *S. orbiculatus* Muench.	—	F	F	F	—	F	F	F

P. Only on porous soils of the division.
F. On fine-textured soils as well as on porous soils.