

Tree Planting in Semi-Arid America.

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Tree Planting in Semi-Arid America.

To see the prairie and the plains is to know their needs. To travel over them for a day will make one know their greatest want, the want of trees. Wind swept every day, every hour, the comparative^{calm} which even a row of trees creates, affords relief from the constant activity of the air beyond the influence of the wind break. Evaporation can hardly keep the rapid, ever moving atmosphere supplied with moisture; and many a rain has fallen to be at once evaporated and returned to the clouds.

The treelessness of the plains has been explained by the deficient rainfall and consequent arid condition of those localities, and until lately it has been doubted, and even now there are people who doubt the possibility of growing trees and forests in these localities, without irrigation. These doubts are not now shared by the larger number of authorities; nor do they believe the original aridity alone accounts for the condition in which we find this large region at present.

The fact that this region is not absolutely treeless goes far to show that it was not always forestless; and the mining of pine timber out of the sand hills of Nebraska proves the proposition beyond doubt, for that section at least. It is not the speculation of mere curiosity to enquire into the cause and absence of forests in this region. It is a practical question. For if we gain an insight into ^{conditions which produced them, we gain an insight into} the possibility of remedying them. The entire earth may be said to be a potential forest, i.e. if the interference of man and animal were excluded in the struggle for existence among the different forms of vegetable life, whenever sufficient depth for its roots exists, and winter cold does not preclude it, aborescent growth would ultimately prevail on account of the perennial character of this kind of vegetable life, and its power to shade out the lower forms. In a large part of the world this victory is seen to be obtained in a few years or at least in a life time. In other parts it may take geological ages to establish aborescent growth against the lower vegetation, and against unfavorable climatic conditions.

Such have a climate unfavorable in general - not necessarily deficient rain fall, but an unfavorable balance between the elements of conservation and dissipation of moisture. While deficient rain fall has been a potent cause in making forest extension difficult, farther extension would have taken place, if fire and the browsing and trampling of countless herds of buffaloes had not prevented it.

The forest creates its own favorable conditions of growth. It is not the single tree that has such an effect, nor a few trees. It is by the mass of trees, that the change of conditions under the forest cover is brought about. It is by the large areas distributed over vast expanse that the force of the wind is broken.

The idea must be impressed that it is the mass effect which we expect from the forest cover. Where the single tree perishes the forest may live.

Characteristic Features of the Plains.

(From Report of U. S. Division of Forestry.)

"The plains of the West comprise a strip of country of varying width extending from N. Dakota to Texas;

"all portions of which have the same characteristic features. The Eastern part of the country in contour is rolling, with numerous streams bordered by woods from which the surface rises to the open country. In the central, the slopes are gentle. Outcrops of lime stone appear here and there through Kans. Nebr. and OK. Farther south the area is more densely wooded. And again in Texas, Oklahoma and Arizona the tree growth is greatly reduced; until in Colo. arise the foot hills of the Rocky Mts. Aside from these conditions the State of Nebraska is crossed by a belt of sand hills, which condition makes it different from the other country under consideration. A like condition exists between the Arkansas and Smoky Hill rivers in Kansas.

The soil conditions over this region necessarily varies. The Dakotas and Nebraska outside the sand hills have a typical prairie soil, a deep clay loam underlaid with a subsoil of clay. One kind of subsoil is what is commonly known as "hard pan". The other having an admixture of sand is readily penetrated by moisture. The surface soil is black in color,

"and can be kept in good condition with favorable climatic conditions.

In Kansas and the southern country the loamy surface soil is found, and the subsoil is more of a calcareous nature, being underlaid with limestone. In Colo. the surface soil is black rather than brown, and has the characteristics of the subsoil of the northern region.

The vegetation throughout consists of grasses, composites, legumes, with a small number of other species, almost exclusively herbaceous, excepting in the immediate vicinity of streams. The only common woody plants are the low growing roses, cherry and false indigo. The soil cover is less luxuriant from East to West, and from the lower to the higher latitudes, being largely governed by the presence of moisture in the soil and atmosphere.

The annual prairie fires have prevented a large accumulation of humus as the grass crops would otherwise have made; but the soil is nowhere lacking in abundant supply of food elements for trees. There are undoubtedly places where the subsoil is too stiff to permit

"a good growth of trees; but these are exceptions as the soil is of sufficient depth and porosity to permit a growth of trees.

The mean annual rainfall gradually decreases from Kansas West to the Rocky Mts. The greater amount being in the Southeast portion, a gradual decrease being noticed North-west and westward. On the unbroken prairies the character of the soil and vegetation has much to do with the moisture conditions.

There is usually more or less rain in April, May and June. The rest of the summer the sun beating down on the compact earth tends to bake it, until it nearly resembles sundried brick. This condition varies as the amount of sand in the soil. As the greater part of the plains are covered with a clay loam they have become very hard and dry during the centuries that they have been exposed to the existing conditions."

Object of Planting.

The objects of tree planting from the standpoint of the planter are two: Protection from winds, and a supply of fuel. The great benefit of grove planting

in the West is the protection from winds. Hence the groves should be placed so as to afford the greatest shelter to farm buildings, feeding lots, garden and orchard.

Availability of Species.

The work of tree planting on the plains has been heretofore largely tentative. In the beginning there was no experience that could be used as a basis in the West, because deductions from plantings made under other climatic conditions proved almost valueless. The paramount condition which led to the choice of varieties was availability. The need of the wind break became so great that the settler sought the quickest solution of it, and took from the sparse woodland along the streams the species that seemed to grow the most rapidly. Hence throughout the West the cottonwood is the most generally planted tree, and it has well served the purpose which perhaps no other tree could fill. Next to the cottonwood the box elder, willow, and maple have been the most extensively planted; these being the most rapid growing during youth of the native species.

Attempted cultivation has taken place

throughout the West with varied success. Throughout eastern Kansas and Nebraska thrifty groves of black walnut, green ash, Osage orange and catalpa can be found. To a limited extent pines and spruces have been planted; but a lack of knowledge regarding their needs has resulted only in a small degree of success. Of the species most easily secured along streams may be mentioned the cottonwood, maple, willow, boxelder, green ash and hackberry. The cottonwood and willow may be regarded as the most available of these, as they are grown readily from cuttings as well as from seeds. The maples have a less general distribution, but they grow readily and rapidly from seeds, and are being largely planted. The ash and elm being slow growers, have not commended themselves to Western planters as their merits deserve, but are now being more extensively planted. The hardy catalpa is only available for the Southeast region; the tree can be grown with ease, and the seed is cheap. The value of the wood for posts and telegraph poles makes them of economic value. For the same reason the black locust

is also adapted to Kansas, Nebraska and Colorado. Among the Conifers the Scotch and Austrian pines and red cedars are yearly becoming cheaper, and hence are available to the planter.

Adaptability of Species.

The adaptability of a species is the power to adjust itself to different conditions in which it is placed. A great many failures have resulted from mistaking adaptability for availability. It does not follow that because cottonwoods growing along banks of streams will succeed equally well upon the intervening high lands. It seems to stand any degree of atmospheric dryness, but it must have a plentiful supply of moisture at the roots. This is not true of all arborescent species. The only species that grow along the Arkansas river is the cottonwood. This tree is much shorter lived on the upland especially where there is a stiff subsoil, and does not live as long when closely planted as when planted in rows, e.g. street trees with wide intervening spaces. The black walnut has been more extensively planted than any of the slow growing trees, with the possible exception of the green ash. The walnut succeeds best

in deep black soils of bottom and second bench lands, and in such localities there are many successful young groves in Kansas and Nebraska. On drier highlands it is much slower in growth, and often fails entirely. The Maple is extensively planted throughout South Dakota, where it kills back during its earlier years resulting in Coppice form that makes an acceptable soil cover but a poor tree.

The box elder succeeds well in Dakota, and the Russian mulberry attains a good size in the valley of the Arkansas river. The Hardy Catalpa is one of the most rapid growing trees in the Southeast portion, and thrives as far North as Omaha, Nebraska; but it kills back in the South line of the State, and will not grow in Dakota at all. The locust flourishes well in a more Western range, growing well under irrigation in Colorado.

Generally speaking our trees do not succeed on the highlands as well as in the valleys, and the reason is evident. Aside from the difference of soil moisture the lower lands have as a rule much deeper surface soil and the

atmosphere of the valley is measurably protected from the wind action, so that evaporation is less, a point second only in importance to the moisture supply.

(a) Objections to Single Species.

Pine planting is not be recommended on the plains for several reasons.

1. The trees being of same species have the same form and rate of growth. If any accident or insect injure them the soil is at once exposed and a weed growth takes possession of it.

2. The trees demand an equal amount of light, and this causes a crowding that will result in the premature death of many.

If the kind be a sparsely shaded sort, such as cottonwood~~s~~ and locust, a rank growth of weeds and grass take possession of the ground, ^{and} rob it of soil moisture, thus checking the growth. A pine grove even if successful will not be as valuable to a farmer as a mixed one.

Relative Shade Endurance, or Tolerance.

The relative shade endurance of the available species of the West would be about as follows:

1) Box elders, Russian Mulberry, Red Cedar, Douglas Spruce; 2) Black Wild Cherry; 3) Hackberry; 4) Silver maple; 5) Green Ash, Black Walnut; 7) Honey Locust; 8) Cottonwood.

At least two-thirds of the plantation must be of dense shading trees, while the light-demanding species should be planted singly, so that each tree will be surrounded by shade-enduring kinds. The special importance of completely shading the ground as soon as possible in Western tree culture, is the necessity of preventing grass growth. The prairie grasses are exceptionally vigorous growers, and once started it is difficult to eradicate them, and they seriously check the tree growth. The subject of light-requirement is of the first importance in forest tree culture.

Rate of Development.

The varieties to be obtained must also be chosen with reference to their period of development, or rate of growth. Shelter from the winds is the object to be obtained by most planters, and in order to accomplish this, rapid growers must be obtained. It seldom happens that

rapid growing species yield a timber valuable for economic uses. The Catalpa and Black Walnut being exceptions; and they can only be grown in a restricted territory. Cottonwood, Boxelder and Maple grow faster than any other species, but they are valueless for home uses except fuel, and very poor for that. The plantation however should be made up of the species interspersed here and there with trees of slow development. If one half or two-thirds of the plantation is boxelder for instance, at least one third of the remaining trees should be of the shade-enduring kind, that will continue to keep the weed growth down by keeping the soil shaded after the boxelders are thinned out.

How to Plant.

(a) Close Planting.

To establish forest conditions should be the first aim of the forester, consisting in dense undergrowth.

One of the principal causes of failure in semi-arid tree planting, has been in wide spacing. The wide spacing of rows requires long continued cultivation, otherwise the trees would soon be given over to the grasses, which rob them of the soil moisture

and eventually check their development.
Thin planting also results in the development of lateral branches resulting in very low trunks, which as the trees grow older form bad forks at the ground. It is true, that is, if trees are purchased, the first cost of material is greater, as also the cost of planting; but these items are more than balanced by the saving in cultivation, and the assurance of success. The best distance at which to plant trees is 3 ft x 3 ft; next to this 4 x 4 ft, the latter spacing being the widest that should be used. At 3 x 3 ft 4840 trees are required per acre. At 4 x 4 ft 2722 trees. (43560 sq. ft per acre, divide product of dimensions into it.)

For the Southern part of the region Russian Mulberry, Catalpa, Black Wild Cherry, Black Locust, Green Ash, Burr Oak, White Elm, Black Walnut, and Scotch Pine could be used in mixture according to the following diagram:

M. A. M. L. M. A. M. L. M. A. M. L.
C. M. C. B.C. C. M. C. B.C. C. M. C. B.C.
M. L. M. O. M. L. M. P. M. L. M. O.
C. B.C. C. M. L. B.C. C. M. C. B.C. C. M.
M. E. M. L. M. E. M. L. M. E. M. L.
C. M. C. B.C. C. M. C. B.C. C. M. C. B.C.

M. L.	M. W.	M. L.	M. P.	M. L.	M. W.
C. B.C.	C. M.	C. B.C.	C. M.	C. B.C.	C. M.
M. A.	M. L.	M. A.	M. L.	M. A.	M. L.
C. M.	C. B.C.	C. M.	C. B.C.	C. M.	C. B.C.

Expl: M. Mulberry; C. Hardy Catalpa; A. Green Ash;
E. White Elm; L. Black Locust; B. Burr Oak; W. Black
Walnut; P. Scotch Pine; B.C. Black Cherry.

The number of species required per acre would
be as follows:

Mulberry	1815,	Catalpa,	1210,	Burr Oak,	75,
Black Cherry	605,	Bl. Locust	605,	Green Ash	151,
White Elm	152,	Scotch Pine	152,	Bl. Walnut	75
					Total 4840.

An inspection of the above diagram will show
that the Mulberry, Catalpa and Black Cherry
constitute the shade-enduring trees, also three fourth
of the planting, leaving the remaining fourth to
light-demanding species. Black Locust makes
up one half of the light-demanding species;
Green Ash, White Elm and Scotch Pine each con-
stitute the rest. Catalpa and Mulberry alternate
with each other in the rows so that at thinning
time, if it is desirable to remove either, the other
will protect the soil. The Catalpa pushes late

in the spring, and its leaves drop with the first frost so that alone it is not a good nurse tree, but mixed with Mulberry which has an earlier, and more persistent foliage, the defect is measurably overcome. The Catalpa grovia close will make poles in from five to ten years, so that if at the first thinning this variety is removed, it will give an abundance of room for the other trees, admitting light to all trees in its vicinity, and will yield a good return in sticks large enough for pole fencing or stove wood.

For the Northern part of the plains the following mixture has been recommended by the Division of Forestry: The Douglas Spruce being substituted for the Catalpa, Boxelder for Mulberry.

B. Boxelder, A. Ash, C. Bl. Cherry, E. white
Elm, O. Burr Oak, L. yellow Birch.

[illegible]

In this mixture is used the earlier maturing, dense foliaged form, and constitutes three fourths of the trees. They are so placed that the alternate trees in the solid Boxelder rows, may be removed, and the more permanent kinds will still be surrounded by good shade making kinds. Should all the nurse trees be removed the Black Cherry constituting one half of the remaining kind, will become the dominant tree, being a shade-enduring kind would act relatively the same as the Boxelder. The Cherries are so placed that if the Boxelders are cut out, the lighter foliaged forms would all be surrounded by cherries. The Catalpa is not hardy North of Central Nebraska, and is available only over a small portion of the West. The Cottonwood is not recommended, as a better tree can be grown in its place. The Boxelder grows rapidly only during its youth, and within 10 or 15 years the remaining trees may be expected to overtop it; but where fuel is scarce on the plains, even the first Boxelder thinning may be useful. The important point to be observed is the necessity of having a good shade maker as the dominant tree in the beginning, and having a suitable distribution of light-demanding species among the permanent shade-enduring kind.

Conifers.

Of all the trees most suitable for Western planting are, beyond doubt the conifers, and especially the pines. There are two reasons why they should be chosen in preference to others.

1. They furnish not only a dense cover, laterally and vertically, but a cover the year around.
2. They require less water; from one sixth to one-tenth of what most deciduous trees transpire, and are therefore less liable to succumb to drought. In winter they will hold the snow more efficiently than the naked, leafless kind; preserving the moisture on the ground. Nature has given us indications in that direction. The driest soils every where are occupied by the pine, and the slopes of the Rocky Mountains, and the ^{interior} basins support only conifers, and especially pine and cedars. Experiments have been conducted in cultivation of conifers, but few have been attended with any measure of success. The few exceptions however seem to show that it is possible to make certain conifers live, and that they thrive where broad-leaved trees fail. The difficulty seems to lie in starting the plants, for the little seedlings are remarkably tender especially as regards light conditions. Under strong light their foliage transpires more moisture than their roots can supply. On the other hand if left in the nursery

until they have developed the strong root system, difficulty in transplanting is experienced, and the greatest pains must be taken not only to preserve the roots uninjured, but to bury them into the ground before they have a chance of drying out. The cone trees dry out rapidly, and if the roots are given a sun bath, the trees would fail to grow, while the deciduous trees would be none the worse for it.

As young conifers are dug up they should be plunged into mud until transplanted. In planting, nothing but moist soil should come in contact with their roots, and this should be tramped very firmly, so that the fine soil will be brought in contact with rootlets. The conifers do not start as quickly as the deciduous trees. They have as great a supply of stored food material but the roots do not seem to take hold of the soil so readily. New roots are not formed, and as a result the trees often perish after a seemingly excellent start has been made.

Tree planting on the plains at least under existing conditions can hardly be expected to assume proportions of forest planting; and hence the economic value of the wood of pines is of minor importance. They do not furnish a strong lumber as do Ash and Oak, and are not so durable

in contact with the soil as is the Catalpa, and Black Locust; hence for ordinary farm uses, the timber of Conifers is not especially desirable.

Planting in the Sand Hills.

An experiment in the planting of forest trees in the sand hills of Nebraska as described in the bulletin of the U. S. Division of Forestry seems to indicate that Conifers will be used, and the Banksian pine in particular.

The sand hills are composed of almost pure sand interspersed with grassy valleys; which are good for haying and grazing lands. The hills are covered with a sparse growth of grasses and weeds scarcely enough to bind the sands, which are frequently blown out in large areas, often making great holes a hundred yards in diameter, in the sides of the hills. Of the number of species tried by the Division of Forestry only one shows decided adaptability to this unfavorable locality. The Banksian Pine planted on the highest ridges in the heart of the sand hills seems thus far, well suited with its surroundings.

All the deciduous trees are dead, and only a few Ponderosa, and Scotch Pines remain. The land

was not plowed, for such a procedure would cause it all to blow away. Furrows two feet apart were turned, and the little trees six to ten inches high were planted in these furrows, so as to be slightly shaded by the ridges formed in making them. From the action of the other species of pine noted, it is safe to say that after the Banksian pines are a few feet high, and able to afford slight protection, other and more valuable species can be grown in their shade.

Other Considerations.

In the preparation of the soil, too much importance can not be attached to the depth of plowing. The Western plains, through long exposure to the elements, and the tramp of countless herds of buffaloes, have become very compact. Not only is the absorbing power of the soil increased by deep plowing, but the ability of the soil to retain moisture under proper care, is marked.

Land should be gradually prepared for the planting by increasing the depth of plowing during three successive years. The depth should be increased two or three inches at a time, until at the end of the third year the land may be plowed ten or twelve inches. In planting trees,

Careful alignment will save much labor in cultivation. It will pay to mark the land as carefully as for corn, when groves of ten acres are set, and to begin planting all rows from the same end of the field; as the slight deviation resulting from pressing the spade forward in planting, will thus bring all the trees in even cross rows.

It is also desirable to take all the trees to the plat to be planted, and heel them in where they can be easily reached. Special care should be taken to prevent the drying of the roots of conifers.

The amount of cultivation beneficial to young trees can not be determined by freedom from weeds, nor by the number of times the operation is performed. In seasons of prolonged drought frequent stirring of the soil is beneficial, as it will keep over the surface a thin layer of dirt, thereby preventing evaporation. After rain, stirring will prevent a crust from forming. Weeds and grass must of course be kept out. Cultivation should cease at midsummer, in order not to encourage too late growth, and consequent danger of winter killing. The weeds that grow after this do no harm, instead they are the gift of Providence for they hold the winter snows,

thereby increasing the moisture. The best implement for cultivating young trees is the harrow-toothed cultivator. During the first year a two horse cultivator may be used, but it should always work shallow. Two or three years, depending upon the seasons, should be sufficient for the cultivation of any carefully designed mixture of trees.

In a properly planned plantation very little pruning is necessary. If the tree of upright habit is found to be forked near the ground, one of the limbs should be cut away. If the shade-enduring kinds are found to be overtopping the light-demanding, the former must be headed in. It may often happen, as with oaks, that the more valuable species is seemingly harmed by its neighbors, when in reality it is making strong root growth, and is none the worse for the temporary overtopping. It is no advantage to prune young trees by the removal of their lower branches, when they reach a height of from ten to twenty feet. It is the very purpose of close plantations to prune themselves, and they can be depended upon to do this when it becomes necessary. It is seldom necessary to thin trees planted 3×3 feet, until five to seven years

after planting, and at the first thinning the removal of comparatively few trees will be desirable. It may be necessary to head in some of these trees by clipping their lateral branches at the intervals between thinning, but our Western soil should be able to carry the full stand, until from 5 to 18 years old; and the subsequent thinning should be at intervals of from seven to ten years. —
