

DRY LAND <sup>R</sup>ABORICULTURE.

GRADUATING THESIS.

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The growing of trees without irrigation in regions having a limited rain fall is known as arid or dry-land arboriculture. In such regions, where dry farming is practiced, the annual rain fall ranges from eight to twenty-eight inches.

Government records give the average rainfall for western Kansas for the last ten years as 19.78 inches, and classifies the climate as subhumid or semiarid. The chief characteristics are those common throughout the Great Plains. As a rule the average precipitation is sufficient for paying crops. The summer rains come mostly from local thunder storms, whose course may or may not overlap. As a result of which one locality often receives sufficient rain during a season, while another but a few miles distant will suffer from drouth.

The average annual rainfall at Hays, Kansas is 20.9 inches, while that at Wallace, due west of Hays and nearer the Colorado line, is but 16.1 inches. For the last thirty-five years a Weather Bureau record has been kept at Dodge, Kansas, and during that period the precipitation of the driest year was 10.1 inches, while the wettest year had 33.7 inches. This gives an average precipitation at Dodge of about 20 inches, and this if well distributed is sufficient for the growth of many tree species. This same fluctuation as shown by the Dodge records, prevails throughout the plain region of western Nebraska, Kansas, eastern Colorado, the Territory and northern Texas.

While the greater part of the rainfall comes at the time of greatest need, it also comes at the time of the greatest evaporation,

between April 1st and October 1st.

High winds increase the evaporation. Government records and experiments show that a wind with a velocity of ten miles per hour causes three and <sup>eight-tenths</sup> times the evaporation from a water surface that there is in a calm. With an average velocity of twelve miles per hour the wind causes about four times the evaporation there would be in a calm. During the early part of spring the velocity is considerably greater, averaging from fifteen to twenty miles per hour for weeks at a time, and often for several days in succession, reaching as high as forty miles per hour.

In humid regions it is estimated that fifty percent of the rainfall runs off in the streams. On the same basis it is estimated that ten percent of the rainfall of the semiarid regions runs off in the streams. The greater part of this consists of storm water. Springs are few and but few streams run water throughout the season. If the rainfall be eighteen inches and the loss by surface drainage be ten percent, about sixteen inches of rain will have entered the soil. For the most part, the soil of the Plain regions is loam of exceptional fertility, when sufficiently watered. But for the loss by evaporation this sixteen inches would saturate the soil to a depth of five to six feet, but this is not the case, as it is only during exceptionally wet seasons that dry soil cannot be found within three to four feet of the surface. As water is not readily taken up by dry soil there is needed but a means of stopping the evaporation from the surface after showers to conserve this moisture for the use of plant growth, and in this is the need of special methods of soil cultivation, commonly known as dry farming.

#### Soil Management As A Preparation For Tree Planting.

When sod is to be broken, this should be done during the summer

months, May, June, and July, using a sod plow in order that the sod may be turned over in even and thin slices, to facilitate the rotting. Slices more than three inches thick will not rot in time to permit the use of the stirring plow in the fall, at which time a four horse team and a single plow should be used, and the plow run as deep as possible. By plowing deep in the fall, the weathering of the soil during the fall and winter gives it a desirable texture, and puts the plant food in an available condition for the next season's crop. Deep plowing will assist the water of fall rains and winter snows to percolate to lower depths, and so increase the water holding capacity of the soil, a most important element in dry land farming.

In case old fields are to be planted to trees, the deep plowing may be done during the summer, but the plow should be followed by the harrow each day before leaving the field, to pulverize the soil and conserve the moisture. If not harrowed after each day's plowing, the hot, dry winds dry out the soil so rapidly that hard baked clods are formed. Ground that is harrowed first lengthwise with the plowing, will retain its moisture better since it regularly and evenly fills the openings at the bottom edge of each furrow slice. As soon as possible after harrowing the subsurface pacer, a tool designed especially for dry land farming, should be used in order to firm the soil in the lower portion of the furrow slice, thus restoring the capillarity interrupted by the plow.

In cases of the sod land being planted to trees, the deep fall plowing should be followed in early spring by the disc harrow, and the disc by the smoothing harrow. The turning plow has no place in the spring working of land for tree planting if fall plowing has been properly done. Too deep working of the soil in early spring results in losing moisture that is needed at planting time to support the

trees until the spring rains begin.

As the dry subsoil is much nearer the surface, under sod, it is very important that sod ground be farmed in field crops for two or three seasons before planting to trees, preferably some cultivated crop as corn or cowpeas. By this method the ground is kept free from weeds and in the best condition for the holding of what moisture it may receive, thus deepening the moisture and placing the subsoil in a better condition for the penetration of the tree roots.

When ground is summer plowed, summer fallowing should be used instead of cultivated crops. In this case the surface is kept in a good cultivated condition by the use of the disc, acme or smoothing harrow, some one of these being used after every shower in order to break up the crust formed and hold the moisture received.

The dust mulch is the best medium to conserve the moisture already in the ground and to keep the surface in condition to absorb the next rain. Owing to the strong winds, care must be taken that the dust mulch is not too fine, or it will blow away. This may be prevented by working the land across the direction of prevailing winds. Where fields commence to blow, they can generally be stopped by going onto them with a cultivator that leaves small ridges and cultivating cross ways of the wind.

#### Planting.

Next in importance to the proper preparation of the soil for tree planting, is the planting, which includes the plan, selection of species, and method of planting. The soil may be in the best of condition, but if a mistake is made in the selection of the species or carelessness permitted in the planting, all previous work will be a loss.

Before the selection of species is made, the planter must decide what he wants, and make a plan, whether for a wind break, wood lot,

post timber, fruit orchard, or general forestry planting, for each of these plantings require separate plans and species.

#### Windbreaks.

The most important function of the windbreak in the semiarid section is the saving of soil moisture within the protected area. This area is about ten times the height of the trees in the belt. Any species that is adapted to the region and suits the taste of the planter, may be used for a windbreak. Evergreens are of course the most desirable owing to their affording better winter protection than the deciduous species. The greatest objection to the evergreens being their slow growth. The Austrian and Scotch pines are the quickest growers among the evergreens, and do very well in many sections of the semiarid country. For windbreaks consisting of several rows, the evergreens may be used to a good advantage in the outside rows, with quick growing deciduous species as the cottonwood, honey locust, and catalpa for the inside rows. A windbreak of a single row, to be effective, should be of a densely growing type that branches close to the ground. To this class belong the Russian mulberry and Osage orange.

For a windbreak consisting of several rows of deciduous trees, the combination used at the Hays station consists of two rows of cottonwood for the center, one row of honey locust on each side of the cottonwoods. Next to the locust, the Osage and for the outside rows the Russian mulberry. Such a break when several years old, will present a wedge formed top. In cases of the protection for buildings or lots, the tall growing species should be next the buildings or lots, and the low growing ones on the outside row.

#### The Woodlot.

Trees that grow rapidly and at the same time produce good wood are preferable, but in this section where the species that can stand the adverse conditions that they meet, are few, the list to select

from is small. Fortunately those species that do well here are all among the best for the woodlot. The Osage and black locust head the list; the green ash, Russian mulberry, and hardy catalpa are also suitable to a place in the woodlot. A mixture of species is of advantage. The difference in their habit of growth assists in the development of trees of good form, and enables the grower to have both the fast and the slow growing trees, and a wide choice of timber for varying needs.

#### Fence Post Trees.

While fence posts are an important commercial article throughout the semiarid section, it is not necessary to make a special planting for post timber. For the few species of trees that have been able to stand the semiarid condition are mostly species that would be selected for post timber. The forest plantation throughout the district can easily be made to serve for several purposes; shelter-belt, woodlot, and fence posts. By thick planting and a thinning out of the poorest trees for wood, those left will produce better posts. The species best suited for posts are the Osage orange, black locust, and Russian mulberry. The green ash and honey locust are not as durable, but owing to the borers bothering and often making it impossible to grow the black locust, and the requirement of a deep fertile soil with considerable moisture for the hardy catalpa, it is often necessary to grow the ash and honey locust in their stead. These two species seemingly making the semiarid region their home. With average care they do well. As a proof of this, tree claims consisting almost wholly of these species may be found scattered throughout the region. But few having had any care after planting. As a third choice the Russian mulberry has its place. While quite durable, its habit of freely branching at the ground requires constant pruning to produce post timber.

### Orchard Planting.

Owing to the late spring frosts, and late summer or early fall drouths, prevalent throughout the semiarid section, there can be little hope of ever producing fruit on commercial scale, yet with all these adverse conditions, evidences are numerous of thriving home fruit gardens. From the sand hill district of northwest Nebraska, to the staked plains of Texas, I have found thriving orchards of tree and bush fruits, that produce an abundance of fruit. In studying the conditions at such places, the same climate and soil are found, but in each case the planter has guarded against the drying winds and lack of rainfall by the planting of an ample windbreak entirely around the orchard, and the working of the soil to the best advantage to conserve what moisture is available.

With fruit trees, owing to the damage that may be caused at blooming time, the preventing of the blooms from being fertilized, the loss due to strong winds causing the fruits to drop, and the lack of moisture to develop the fruit after having formed, the least damage is more noticeable than with timber trees, for in them the grower seldom cares for the seeds, and so long as a reasonable growth is made, he is well pleased.

The windbreak about an orchard or garden should be arranged so that the taller and quickest growing species are next to the orchard. The entire planting should be in an oblong if more than of five acres, in order that the best protection may be secured by placing the longest way cross ways with the prevailing wind. The depth of the windbreak on each side of the orchard should be  $\frac{1}{3}$  to  $\frac{1}{2}$  that of the orchard, and in order to give protection to the fruit trees from the time of their planting, the belt should be planted at least two years in advance of the fruit trees.



The species and varieties of fruits that may be profitably grown where protection is given are more numerous than those of the timber trees. Of the apple, the Arkansas or Mammoth Black Twig, Bailey Sweet, Baldwin, Ben Davis, Benonts, Chenango Strawberry, Cooper, Early Cooper, Early Harvest, Fallowater, Fall Jennetin, Fall Pippin, Fameuse, Gano, Grimes' Golden, Haas, Hubbardston, Ingram, Jefferies, Jonathan, Late Strawberry, Lawver, Limbertwig, Missouri Pippin, Northwestern Greening, Oldenburg, Pewaukee, Red June, Rome Beauty, Wealthy, Wine-sap, Yellow Transparent, and York Imperial, have all been reported as doing well.

Of the other fruits we have the following: Crabs:- Hyslop and Transcendent leading with Whitney, Montreal, and Elgin reported favorably.

Apricots have not done very well, but Moorpark, Orange, Peach and Royal have furnished a few fruits in places.

Cherries:- Dyehouse, Large Montmorency, Late Duke, May Duke, English Morello, Olivet, and Richmond.

Peach:- Alexander, Blood Cling, Champion, Crosby, Early and Late Crawford, Elberta, Heath Cling, Mountain Rose, Stump, and Old Mixon Cling and Free.

Pears:- Duchess, Garber, Lincoln, Bartlett, Clapp, Flemish Beauty, Le Conte, Seckel, and Tyson.

Plums:- Forest Garden, Hawkeye, Weaverm Wolf, Wyant, of the Americana; Polawattamie of the Angustifolia; Lombard Saratoga, Shropshire Damson, and Yellow Egg of the Domestica; and Miner, Golden Beauty, Charles Downing, Wildgoose of the Hortulana.

#### Bush Fruits.

Blackberries:- Early Harvest, Snyder, Taylor, and Wilson,

Raspberries:- Columbia, Reliance, and Shaffer.

Currants:- Black Crandall Jelly, Fay, Victoria.

Gooseberries:- Champion, Downing, Houghton, and Red Jacket.

Grapes:- Delaware, Agavsm, Brilliant, Concord, Moore Early, Niegra, Green Mountain, Worden, Elvira, and Canada.

The foregoing list of tree and bush fruits has been reported as doing well from various localities of the semiarid belt. Local conditions will to some extent vary the list and perhaps add a few to each species.

While all of the above list are not being tried at the Hays station, a large number of them are; as yet but a few peaches and grapes have produced fruit.

#### Season,

Following the making of the plan and selection of the species and varieties to be planted, the season or time of planting must be decided. The best time to plant young trees is in the spring just before growth starts, at which time they are likely to receive the least injury. Evergreens can be successfully transplanted at any season of the year, providing sufficient care is taken, as they transpire only one-tenth to one-sixth as much water as the deciduous trees, and consequently their roots are not called upon to furnish such great quantities of water to the leaves before getting established.

Pines and cedars do not require pruning back when set and hence the time of year is less important, still as deciduous trees, the best time for transplanting is during the dormant season.

Owing to the dry cold winters throughout the semiarid belt, spring has been found to be the best season for planting all the trees. The fall planted trees generally being winter killed because of lack of moisture.

How to Plant -- Methods.

The common practice of opening furrows with a plow and then placing the trees in the furrow to be covered by the plow, is the cause of many of the failures reported throughout the semiarid belt. Such practice may do in the humid sections, but here where there is seldom a day without the drying winds, it is an extravagant method. If pains have been taken to prepare the ground and select the species, equal pains must be taken with the planting. All trees whether of the evergreens or deciduous species, should be planted with the least possible exposure of the roots. The root hairs, or feeding cells on the roots of any plant, will shrivel up and perish if exposed to the dry atmosphere for even a few minutes. The roots of the conifers are particularly sensitive, so that they require more careful attention in transplanting than the deciduous trees. Some of the deciduous species may have their roots dried out and shriveled, yet with proper attention revive and live, but with all evergreens when once dried they never regain their vitality.

To insure the life of an evergreen that is to be transplanted, a frozen ball of earth should be removed with the tree to its new location. If moved when the frozen earth cannot be had, the staves from a nail keg or flour barrel will answer the purpose of the frozen earth if properly placed about the tree as dug. If the trees are to be shipped from a distant nursery an agreement should be made before shipping, that each tree shall have a reasonable sized ball of earth about the roots.

In the planting of the ordinary timber trees, the yearlings or two year old trees are used. With these there are but few roots, and they are generally pruned back considerably before planting. Instead of using a plow to open up a furrow, a marker that would work out the position of the rows should be drawn back and forth across the field,

locating every row. The trees being set behind a spade. By inserting the spade into the ground on the line, and pulling the handle to the worker at the same time giving it a short shove down with the foot, and then holding it at the depth shove the handle away from the worker, an opening is made behind the spade large enough to receive the roots of the tree. On removing the spade the soil will fall back into its place, and can be quickly pressed firmly about the roots with the feet or a few tamps with the reversed end of the spade. Care should be taken that the surface dirt close to the tree be left loose and not packed. With proper care to keep the roots moist by emersion in a bucket or barrel or thin mud until needed, every tree will be sure to find itself in contact with moist soil, and can withstand very weather for sometime after planting.

The spade method while not quite as rapid as the plow method, is surer. The advantage and economy gained by the straight rows of the spade method over that of the crooked rows of the plow method, and the greater percent of living trees, at the end of the season, will overbalance the first cost of difference in method.

In case the trees have more roots than can be inserted behind a spade, such as is usually the case with most fruit trees, holes should be dug for each tree and owing to the hard subsoil, these holes should if possible, be dug sometime before the time of planting that they may catch any moisture that may fall. It is preferable that they be dug in late fall or early winter. This method has proven especially valuable with evergreens about the grounds of the Hays station.

#### Spacing.

The spacing of trees is an important item throughout the semiarid belt. Owing to the dry sweeping winds, trees must be planted close enough to give protection to each other. The wide planting of humid

sections must be replaced by close planting in the semiarid section.

While planting for protection is made, the method of cultivation should be kept in mind. The planting of windbreaks and timber plots on the station has been from six to eight feet with the trees three to five feet in the row. With six feet rows only single horse cultivators can be used, while with rows eight feet apart, two horse cultivators can be used to a good advantage, as the disc and acme harrows.

Close planting in the rows will force the trees in a straight growth, and requires less pruning to form good trees. As far as possible the trees in the rows should be set so as to form a compact group, and not leave broad lanes running in the direction of the prevailing winds.

Fruit trees are planted in rows ten to thirty-two feet apart, throughout the semiarid belt. The distance depends on the specie and variety and method of planting. Apples range from sixteen to thirty-two feet, while peach, plums, cherries, and pears, from twelve to sixteen feet. When fillers are used, the apples should be not less than thirty-two feet. This will place the fillers at sixteen feet. By the use of the hexagonal system in planting, economy of ground and the best management for wind protection is secured.

#### After Cultivation.

In the east, the prime object in cultivation is to kill weeds; in the semiarid belt, the weeds take the second place and conservation of moisture the first place in all tree planting work.

The first cultivation should be immediately after planting is completed. If the ground is free from weeds, a one section harrow or the twelve tooth harrow, will put it into good condition. If the rows are wide enough apart for team work, the acme harrow will be better for it will at the same time pulverize the surface and destroy any

scattering weeds. If the ground has been properly prepared the stirring plow will have no place in the after cultivation. Following the cultivation, the ground should be gone over at least once every two weeks, throughout the season, with such tools as give shallow surface workings, and keep down the weeds. Of the seasons cultivation, the most important are those that follow immediately after each shower of sufficient amount of rainfall to encrust the surface or place moisture deep enough to be conserved. Allowing a crust to form, the moisture of the shower will evaporate, and take with it moisture of previous showers.