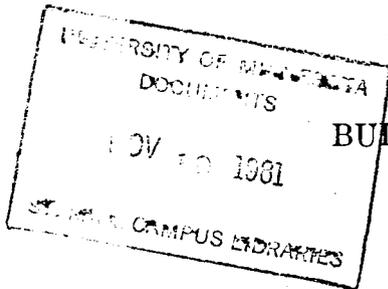


UNIVERSITY OF MINNESOTA.

Agricultural Experiment Station.



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HORTICULTURAL DIVISION.

JUNE, 1901.

**PRAIRIE FORESTRY AND HORTICULTURE
AT COTEAU FARM.**

ST. ANTHONY PARK, RAMSEY CO., MINNESOTA.

UNIVERSITY OF MINNESOTA.

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INTRODUCTION.

Coteau Farm is the name given to the home of O. C. Gregg, Superintendent of our State Farmers' Institutes. It is carried on by Mr. Gregg in order to keep himself in close touch with, and to assist in solving, the problems that present themselves to Minnesota farmers. It is located at Lynd, Lyon County, on high rolling prairie. The soil is a rich, open clayey loam, and representative of the soils of that section.

The University Experiment Station wished to make some experiments in Southwestern Minnesota where, on account of the scanty rainfall it seemed that such work would be especially helpful to farmers, and Mr. Gregg kindly put a considerable portion of his farm, without expense, at the disposal of the state for this purpose. In carrying out the work here the agricultural experiments have been in charge of Professor W. M. Hays, and the horticultural and forestry experiments in charge of Professor Samuel B. Green.

The experiments in forestry and horticulture, to which this bulletin is devoted, have been very successfully carried on and attracted a great deal of favorable comment from the many visitors who have seen them in progress. They have been continued for seven years and have now reached a stage where it seems desirable that a report of progress should be made.

In considering the results presented, it should be borne in mind that the portion of Minnesota here referred to has been regarded as exceedingly trying for agricultural crops and horticulture or forestry has been generally thought out of the question. These misapprehensions as regards agriculture have in previous reports been shown to have been due to the lack of a system of agriculture especially adapted to

this section. Professor Green shows in this bulletin that the same is measurably true of the horticultural and forestry lines of work and that while this section is not especially adapted to horticulture or forestry, yet the intelligent farmer need not deny himself a good measure of success in both lines.

WM. M. LIGGETT,

Director.

PRAIRIE FORESTRY AND HORTICULTURE AT COTEAU FARM.

THE FOREST GARDEN.

SAMUEL B. GREEN.

The object in establishing a Forest Garden at Coteau Farm was (1) to determine what trees were hardy, (2) the best kinds of mixed plantings to use in order to secure the best soil cover, (3) the rate of growth of different trees.

The land taken for this purpose is high prairie, sloping gradually to the north. The soil is a good open clayey loam, typical of a large area in this section. It is forty rods long and fifteen rods wide and was divided into two series of plats which were planted in every case in rows eight feet apart. The soil was kept cultivated as long as a horse cultivator could go between the rows, after which it has been left to itself except as noted.

Methods of Cultivation.—No experiments were attempted in the matter of cultivation, as the evidence seemed to me then, as it does now, to show conclusively that the rows for general prairie planting should be eight to ten feet apart and the trees planted two feet apart in rows, and the soil kept constantly cultivated in the growing season to keep out grass and weeds and to preserve a dust blanket on its surface until the trees shade the soil. More prairie plantings have probably failed from planters trying to plant so close that the trees would shade the ground sufficiently to keep out weeds and prevent evaporation, than from any other cause. It should be more generally known that trees need much greater care as they approach the limits of their growth than in more humid sections where they easily outstrip the herbaceous vegetation. The vegetation of the prairies is such as has the power

to greatly resist drouth; much more so than the vegetation of the forests. It is on this account that it is so very necessary to continually cultivate prairie plantings to assist the trees in overcoming adverse conditions.

Trees will grow in any of the prairie sections of this state provided they are aided in their struggle with the herbaceous vegetation, while if left to themselves they are almost sure to be overcome by it in the long series of years.

The obstacles in the way of getting the first start in prairie planting are often very considerable and it is exceedingly important that the planter have a good idea of the difficulties which he is liable to meet. Among the worst of these to contend with is the blowing out of the young plants before they are established. This often takes place in very exposed places and especially where the soil is sandy. It is not uncommon in such places for soil to blow away immediately around the plant until the roots stand 3 or 4 inches out of the soil. Where such is liable to be the case it is a good plan to mulch the plants until they have become established and formed a windbreak after which cultivation may be started or the mulching continued. As a rule, however, it is far better to depend on cultivation than on mulching. After a good windbreak has been started it is a very easy matter to grow trees on the land which it protects if reasonable attention is paid to keeping the soil cultivated after the plants have got started, but there is very little use in trying to grow any but the most hardy kinds until this has been done. After this has been done, however, it will be found that many plants are hardy under its protection which before were quite tender. This is only another illustration of the fact that trees are most hardy when growing in groups. Thus the sugar maple which in the more humid climates of New York and New England, makes a grand tree in the open ground, in Northern Minnesota where it approaches the northern limits of its range, it seldom attains great size except where it is grouped either with others of its own species or different kinds.

The Mulch for a prairie windbreak may consist of any litter such as is ordinarily found around prairie farms, the rotted straw and chaff from the bottom of straw stacks is perhaps as good as anything. It should be put on to the depth of one foot in order to do much good and should be renewed frequently enough to always keep it as thick as it was when it was first put on. Such a covering not only protects from wind but also from drouth. The worst objection to it is that it may harbor insects, mice or other vermin which will destroy the trees or become a nuisance elsewhere on the farm.

The cultivation of a prairie grove should commence as soon as the plants are planted and be repeated as often as may be necessary to keep a dust blanket on the land in dry weather. It is a good plan to keep out weeds, but it is not necessary to go to any great expense to do so by hand hoeing, since if the space between the rows is kept carefully tilled the few weeds which cannot be reached in the middle of the rows will not do any great harm, although they may look unsightly. One of the best implements for stirring the soil about newly planted groves is some such implement as Breed's weeder which will stir all the soil between the plants as well as in the rows and this may be used until the plants are so large that they will not pass under it. The ordinary corn cultivator is also a very good implement for this purpose. After the plants have become so large they will no longer pass under such implements, cultivation should still be continued and for this purpose perhaps there is nothing better than a one-horse cultivator.

A Fuel Supply and Shelterbelt can often be combined in the same planting. For this purpose we should use some tree that sprouts readily from the roots, but other trees may be used providing they are planted so thick that the thinnings can be taken out for a number of years. In the latter case, however, there will come a time when the grove should be renewed by under-planting. Where such a practice is desired, however, there is probably no tree that lends itself to the pur-

pose as well as the common white willow of this section. This tree is not only hardy but is easily grown from cuttings which are readily obtained in every section of this state and also renews itself quickly and vigorously from sprouts for many generations without any diminution of vitality. The wood from it is well adapted to the purposes of summer fuel, when dried makes good fence posts and yields straight light poles that are well adapted to many farm purposes. From a number of careful observations I am convinced that on average land, one acre planted in white willow and well cared for will produce an annual yield of about three cords and in very favorable conditions as much as five cords per acre will often be produced.

Our experiments at Coteau Farm are not of such a nature as will give us much data along this line, but a willow wind-break there forty rods long and now about seventeen years old which was planted by Supt. Gregg and has been grown on the mulching plan, has been estimated to contain merchantable cord wood at the rate of twenty-six cords per acre, or an annual average increase of one and one-half cords per acre per year. In this estimate the land reckoned as belonging to the trees is a strip thirty feet wide, although the grass is cut to within eight feet of the trees on each side and if grown in a solid block the trees would undoubtedly do as well with rather less land than we have allowed for them. Since such wood is worth about three dollars per cord standing, it is fair to figure that land in such trees will earn an annual net income of about four and a half dollars per acre. Such land could be cut over about once in ten years; therefore, if ten acres were to be planted at the rate of one acre per year for ten successive years, it would be entirely practicable to begin at the end of that time and cut one acre clean each year and continue the same amount of cutting indefinitely. The growth from sprouts of willows under this plan would make as much wood in ten years as the original cuttings would in a much longer time. I think it fair to estimate the annual returns

per acre from good land under such conditions at about three cords of wood worth \$9.

The nursery stock used in this experiment was nearly all grown in this state. Some of it, however, was grown here from seed purchased in other sections. In the following notes is given the source and condition of the stock in detail:

Black Ash—Only a small quantity of this tree was planted. It came from the forest garden at the University Farm where it had been growing for several years; was about three feet high. It is a very slow growing tree, but is healthy and hardy.

Green Ash—Stock from Minnesota seed. Generally called White Ash, but much hardier than that species and far better for prairie planting. Quite difficult to distinguish some of its many forms from White Ash into which it seems to run. For all practical purposes there is but this one species of the White Ash class in this state. True White Ash does not occur in this state, anyway not in Western Minnesota.

White Ash—It is extremely doubtful if this species occurs in this state. Green Ash, the form above noted, is what is almost universally meant here when this species is referred to. The true White Ash is not nearly so hardy or desirable as the Green Ash for this section.

Basswood—Stock from this section and is what is known as true American Basswood. This is one of our hardiest trees but it is not well adapted to planting in very dry locations, as it is very liable to sunscald in such places. The European Basswood is not nearly so good a tree as this, although it is quite hardy in fairly good locations in this state.

Black Walnut—Stock from Minnesota seed planted where it now grows. Is well protected by other trees and has made a satisfactory growth. It is probably not hardy enough for general planting in severe locations, but can be used in a small way in protected places to give variety to shelterbelts.

Butternut—Of about the same degree of hardiness as the Black Walnut, but does not resist drouth as well.

Russian Mulberry—This has proven rather too tender for good results. It has made some progress, however, and

has produced fruit almost every year since old enough to bear. But it has killed back more or less every winter and while it has sprouted from the roots and largely overcome this injury, yet the trees are left unsightly.

Bur Oak—Stock from University Farm, most of which was three years old when transplanted and had tap roots about three feet long, which were cut off at eighteen inches, but much to our surprise these have recovered and made a very satisfactory growth. Seed has also been sown and has done very well.

White Elm—Stock pulled from the woods of Eastern Minnesota, has made a very satisfactory growth. This tree will probably stand more hardships, and is generally better adapted for the purposes of a street tree than any other tree.

Slippery Elm—Minnesota stock, has made a fairly satisfactory growth, but does not have the power of the White Elm to withstand drought, and cannot be advised for planting on dry prairie soil.

Hackberry—The stock for the first planting of this came entirely from seed obtained in New York, and out of some five thousand seedlings which were grown there are none left. Some four years ago seedlings were grown from Minnesota seed obtained in the Red River Valley and Hennepin county, and these have proven to be exceedingly hardy. This experience would seem to show that there is quite a difference in the hardiness of this tree, due to the climatic conditions under which seed of it has been grown.

Wild Black Cherry—Grown from Minnesota seed. Not especially adapted to Southwestern Minnesota, where it is liable to kill back in severe winters, but where somewhat protected, perfectly hardy. Too liable to the attacks of borers and leaf destroying insects and too slow in growth to make it very desirable.

Mountain Ash—Both the European and American Mountain Ash have been grown in this collection, and they have both done fairly well, making a rapid growth and producing

flowers and fruit. They seem to be especially at home where the trunk is protected by shrubs, as they are very liable to sunscald and to break off in the trunk where not protected from the sun's rays. On this account it does especially well when grown as a shrub with several stems. The European Mountain Ash is to be preferred to the American on account of its more rapid growth, and it seems to be more hardy.

European White Birch—Grown from seed from Europe and has made a strong, vigorous growth and formed very pretty trees. Perfectly hardy, and of much value in furnishing variety to shelterbelts. Not, however, a long-lived tree and liable to fail on upland in about fifteen years.

Buckthorn—This is the true English Buckthorn and was grown from seed gathered in Minnesota. The plants are hardy in every way, and perhaps there is nothing hardier. Makes a tree about twenty feet high, but is especially adapted for purposes of a low hedge (three to five feet high), as it stands pruning well. Fruits abundantly.

Russian Olive—A small tree from Russia which is especially valuable for ornamental purposes. It is compact in habit and has light green foliage which makes it valuable for occasional use on lawn and for enlivening shrubberies, at the background of which it can often be planted to advantage. It produces an abundance of small fruit each year, which is made up of one large oval seed covered with thin mealy flesh. Easily propagated from seed; perfectly hardy.

Horse Chestnut—The stock for this was obtained from one of our local nurseries and probably came from Ohio or New York seed. The plant is, however, altogether too tender for our conditions and will seldom stay by us more than a few years, but the Ohio Buckeye is much hardier and makes a good small tree in favorable locations.

Yellow Locust—Grown from Minnesota seed. This has made the most rapid growth of any tree planted, attaining a height of eight feet in three years. While this tree is a rapid grower and a native of Eastern Minnesota, yet in very severe winters it will occasionally kill back to the ground, although

it sometimes forms trees a foot or more in diameter where grown in the protection of other trees. It never kills out, however, as it sprouts quickly from the roots. It is very liable to attacks of borers. The wood is very heavy, hard and durable in contact with the soil.

European Larch—Grown from European seed. Trees quite tender where fully exposed to the wind, but when protected make a fairly satisfactory growth. But it is not to be specially recommended for this section.

Cottonwood—A very few Cottonwoods have been introduced into this plantation, as previous experience has shown that they are not well adapted to high prairie land; that they take a large amount of moisture out of the soil, while they do not afford much shade, and grass is very liable to come in under them. However, on moist soil the Cottonwood is a long-lived tree. Quite a number of yellow leaved Cottonwoods have been planted to give variety. This is a form known as Van Gert's Golden Poplar, and is cultivated in parks for its yellow foliage. It seems to be fully as hardy as our native Cottonwood, but I do not know that it has any greater value for forest plantings. It has made a very vigorous growth, however, in fact, almost too vigorous for the other and better species which were planted with it.

Carolina Poplar—This is a form of the common Cottonwood which has been returned to us from Europe, where it has been selected as being especially vigorous and desirable. I am inclined to think it freer from disease than our native Cottonwood and rather more desirable, but it is only a Cottonwood at best and should not be planted to any great extent except for immediate effect and where the soil is moist. Its chief value is for quick effects in prairie planting and landscape gardening. I am afraid that it is liable to be too largely planted.

Russian Poplar—Under the name of Russian Poplar several trees are sold in this section. Most commonly the kind sold is the Certinensis Poplar. We have made careful trials

of all the Russian Poplars which have been introduced into cultivation in this country and have sent out many for trial. About ten years ago we were rather enthusiastic over them, but the great increase of borers which attack these trees has ruined our collection, and we find this complaint to be a pretty general one. The best of them is the *P. Certinensis*, but it is not nearly so reliable as the Cottonwood.

Silver Poplar—This is the form known as snowy white leaved and not the common kind. Of very rapid growth and its white foliage lends variety to tree plantings. It is, however, such a spreading grower, and makes so little shade on the ground, that it is difficult to cultivate around and is not generally very satisfactory, although quite hardy. For the first few years, until a sufficient growth was formed to give it some wind protection, it occasionally killed back in the winter, but now that it is well established and somewhat protected, it seems perfectly able to hold its own. It is valuable for introducing into forest plantations in a small way. The common Abele form known as the Abele Poplar is not so pretty.

Balsam Poplar—This species is of very little value for planting as it suffers more from drouth than the Cottonwood and should be planted only on moist soils, and then not to any great extent, as the wood is very inferior and the tree does not make a dense shade.

White Willow—The standard willow for prairie planting. It is of European origin and seems better adapted for planting here than any of our native kinds. There is no more certain tree for general planting in the prairie sections of this state, and it does wonderfully well even on very dry land.

Britzensis Willow—A form of the White Willow which is distinguished from the Golden Willow by its conical shaped top. The twigs are rather more salmon colored than yellow and especially conspicuous in spring. As hardy as the Golden Willow.

Russian Golden Willow—This is the form of the White Willow that makes a round top tree. It is distinguished by

this characteristic, and also by its twigs which are a bright golden yellow in early spring. The catkins, too, are yellow in color and produced abundantly. One of the most ornamental of our hardy willows. Perfectly hardy here and well adapted for the purpose of a shelterbelt, to which it gives variety. Easily grown from cuttings.

Laurelleaf Willow—This is a small European tree of compact habit and only moderate growth. It is conspicuous for its large, glossy leaves, which shine as if they had been varnished. It is easily grown from cuttings and is generally very popular where known. The chief objection to planting it in large quantities is that occasionally it is subject to a blight resembling very much the common fire blight of apples. In this location, however, it has proven entirely free from this disease and less subject to leaf eating insects than any other willow.

Basket Willow—A form of this, known as *Salix purpurea* has made a very satisfactory growth, and produced nice rods well adapted to basket making. It is perfectly healthy and could undoubtedly be raised at a profit for basket making under favorable conditions.

Willow Saw Fly.—All the above mentioned species of willows have been more or less subject to the attacks of the larvae of the Willow Saw Fly, which eats the leaves and has frequently destroyed windbreaks in this section. It is, however, an insect that is easily destroyed by the same remedies that are used for the potato bug. As a rule its injuries are allowed to continue until they are very serious, and then an effort is put forth to check them, while if the effort to check them had been made in the beginning, they could have been prevented from doing serious injury at very little expense. Where a willow windbreak is seriously infested with this pest, it is desirable to have a force pump and twenty or thirty feet of hose for applying Paris green and water. For this purpose the force pump should be mounted upon a good barrel and in using the material put the barrel in a wagon and, if

desirable, elevate it on a framework. This being done, it is quite an easy matter to drive close to the windbreak and reach the tops of the trees. As a rule, the damage from this saw fly is localized and may be easily prevented by early attention. For this purpose Paris Green should be used of the same strength as for potato vines.

Box Elder—One of the best trees for prairie groves. It is perfectly hardy in almost any situation. It is easily obtained and grows very rapidly when young and easily takes on a close, compact form with a little pruning; makes one of the best large hedge plants for this section and will stand close pruning well. In addition to this it grows well in the shade of other trees and makes a dense shade on the ground, which is a most important quality in a good shelterbelt tree.

Sugar Maple—Plants pulled from the woods of Ottertail County. Almost sure to kill back where fully exposed to the winds, but when grown among other trees has stood very well. It is not especially adapted to this section, however, and should be used only in a small way, if at all.

Soft Maple—Very hardy and fairly well adapted to this section, but liable to become weak in the crotches at any time, and especially so after a series of dry years, when they are very liable to break in the wind. The breakage from wind may be greatly lessened by shortening the main branches. Not so good as the Box Elder for general planting here.

Norway Maple—Tree fairly vigorous and healthy when well established in favorable locations, but of slow growth and not well adapted for planting on dry prairie soils. Will stand more drought than the ordinary Hard Maple.

Tartarian Maple—A dwarf maple from Central Asia; grows to the height of ten feet and forms a bush rather than a tree; perfectly hardy; flowers conspicuous and pretty, followed by red seeds which retain their color for two months; of no special value in forest plantings, but valuable for ornamental purposes. It is easily grown from its seeds which ripen in autumn.

Ginnala Maple—(*Acer Ginnala*). A form of the Tartarian Maple that has a prettier habit and more reddish foliage than the species. Grows to about ten feet high and is more of a bush than tree. Stands pruning well and makes a very ornamental hedge. Perfectly hardy and desirable. Easily grown from seed which it produces in abundance.

All the coniferous evergreens, with the exception possibly, of the Bull and Dwarf Pine and Red Cedar are tender at Coteau Farm, if fully exposed, but with a reasonable amount of protection from the wind all those referred to as hardy will make a satisfactory growth.

Scotch Pine—Making a very satisfactory growth. Hardy.

White Pine—Too tender even in protected situations, but a few specimens still remain in the forest plantation.

Austrian Pine—Hardy and doing well.

Bull Pine—A coarse, vigorous pine from the Rocky Mountains, well adapted to severe locations and doing especially well here. It is said to be the only pine that is able to endure the dry climates of the Eastern foothills of the Rocky Mountains.

Dwarf Mountain Pine—A dwarf shrubby pine from the mountains of Europe, where it is found at high altitudes. One of the hardiest of our pines and valuable for using about the edges of tree groups for ornamental effect.

Red Cedar—Perhaps the hardiest of our native evergreens; of rather quick growth when young, but of slow growth after reaching the age of ten years. Especially desirable for hedges and low windbreaks. It stands pruning very well.

Arbor Vitae—Altogether too tender for this section of the state. It needs more moisture in the soil than we have here.

White Spruce—Very satisfactory where well protected and undoubtedly one of the best evergreens to plant in this section. The form from the Black Hills is hardier than the Eastern form.

Norway Spruce—Nearly as hardy as the White Spruce, but rather more apt to have its foliage burned in winter. Holding on well.

Colorado Blue Spruce—This Rocky Mountain Evergreen is especially distinguished by the beautiful light blue color of the foliage of some of the specimens. It varies greatly in this respect, however, and when grown from seed, not more than one specimen in ten will have the color for which it is so highly esteemed. About the same degree of hardiness as the Norway Spruce, but not so rapid a grower nor so good for general planting.

Douglas Spruce.—This is another Rocky Mountain tree which is standing fairly well in this section, but is not so promising as the White Spruce.

Englemann Spruce—Of about the same degree of hardiness as the Colorado Blue Spruce and resembling it in the color of its foliage, but the needles are shorter and blunt pointed and generally not of so bright a color. Not especially desirable.

Balsam Fir—Altogether too unreliable for this section. It needs more water at the root than we have here.

THE PLOTS IN DETAIL.

The original planting was made of the species mentioned in the following paragraphs describing each plot. Some losses occurred the first season and for several years afterwards. These were supplied to some extent by replanting with cuttings of Golden Willow, Silver Poplar and by seedlings of Elm and Cottonwood.

Plot No. 1.—The White Elm, Box Elder, White Willow, White Ash and Black Ash have all made a satisfactory growth and while they are now crowding one another so that some of them should be removed, it is in very satisfactory condition.

Plot No. 2.—The Box Elder, Green Ash and Red Elm are in very good condition, but the Mulberry is scrubby from repeated freezing back, and the New York Hackberry has

died out, as well as most of the European Larch; but the few Larch remaining are standing very well since the other trees became large enough to protect them from the wind. For the first few years after it was set out it looked as though the larch would die out entirely.

Plot No. 3.—The Scotch Pine are doing very well but are so crowded that they must have some special attention, or they will be seriously injured. The Mountain Pine and Balsam Fir have been shaded out by the strong growth of the White Willow. The Red Elms have done well and are fast taking on an upright form.

Plot No. 4.—The Mountain Pine and Colorado Blue Spruce were severely injured the first few years after planting, but the few remaining specimens are doing very well under the protection of surrounding trees. The Scotch Pine is doing well, but the White Willow is beginning to crowd it too much. The Siberian Artimesia makes a very vigorous growth, but is too upright in form for a good soil cover. The Mulberry has considerable dead wood in it, due to its dying back almost every year, but it is still vigorous and producing some fruit.

Plot No. 5.—The Engelmann Spruce has nearly all died out, as has likewise the White and Mountain Pine. The Bull Pine and Scotch Pine, however, are in good condition. The White Willow has done well, but this plot seems to have suffered from not having more good nurse trees, and the injury to the evergreens came in the first and second years after planting, before the Willows were large enough to afford any protection.

Plot No. 6.—The Scotch and White Pines have done fairly well, but the Bull Pine failed to start well, and the Engelmann Spruce seems not to have had sufficient protection during its early years. The New York Hackberry has died out entirely here, as in other plots. The Wild Plum seedlings have proven a conspicuous success in this plot; they now make a good soil cover and are bearing a considerable quantity of fruit. The Elms, which were put in later, are

making a good growth, and somewhat crowd the other trees, but not very seriously as yet.

Plot No. 7.—The few specimens of Colorado Blue Spruce in this plot are doing very well. The Scotch Pine, Green Ash, Box Elder and Elm are all making a good growth, and the ground is well covered. The White Pine and Arbor Vitae are nearly all dead.

Plot No. 8.—The Douglas Spruce has nearly failed owing to its not having sufficient protection from the wind during its early years, but is now doing fairly well with protection. The same is true of Scotch Pine and European Larch. The Elm, Box Elder and Green Ash in this plot make a good soil cover.

Plot No. 9.—The White and Scotch Pines have nearly failed; Box Elder and Green Ash are in good condition. Most of the Wild Black Cherry have died, and the remaining ones are in poor condition although vigorous.

Plot No. 10.—The Green Ash, European Larch and Box Elder are in good condition; Basswood has suffered severely; the few Red Pine here are also in good condition, Scotch Pine is doing fairly well.

Plot No. 11.—The Box Elder, Cottonwood and Scotch Pine doing well; Mulberry and White Pine poorly.

Plot No. 12.—Box Elder and Red Elm doing well. Mulberry poorly.

Plot No. 13.—Black Ash, European Mountain Ash, Wild Plum, Silver Poplar, Box Elder and Redtwig Dogwood doing well. A few Black Walnut, American Mountain Ash and Rock Maple are also doing fairly well under the protection of other trees. The Redtwig Dogwood shows wonderful power of withstanding shade, and shows itself well adapted to the purpose of a good ground cover. The Wild Plum seedlings have produced several good crops of fruit, and are this year again heavily loaded with fruit.

Plot No. 14.—Black Ash, American Mountain Ash, Wild Plum and Balm of Gilead have made satisfactory growth and

cover the ground well. The Sand Cherries have been shaded out. The Balm of Gilead has made such a strong growth that it should at once be cut out, in order to give room for other and more valuable trees. The Wild Plum seedlings have borne considerable fruit and made a good soil cover.

Plot No. 15.—The Black Ash and Wild Plum have covered the ground in a fairly satisfactory shape, but it would have been better to have had something that would have made a thicker shade on the ground. The few Rock Maple planted in this plot have done exceedingly well.

Plot No. 16.—The Wild Plums have done as well in this as in the three preceding plots and have produced fine crops of fruit. The Cork Elm and Bur Oak are making a very satisfactory growth, and the Buckthorn is exceedingly healthy and vigorous.

Plot No. 17.—The White Spruce and Buckthorn in this plot are in excellent condition; have begun to crowd slightly and part of the Buckthorn has been removed or trimmed out so as to give the Spruce a fair chance.

Plot No. 18.—White Spruce in excellent condition; the Bur Oak, Black Ash and Buckthorn have also done well. The few plums and apples in this plot have made a very satisfactory growth, and, especially in the case of the apples, show the great value of wind protection in this section.

Plot No. 19.—Planted with Bur Oak, Black Ash, Buckthorn, Certinensis Poplar and Tamarisk. All the trees in this group are in good condition, excepting the Russian Poplar, which is beginning to fail. The Tamarisk is poorly adapted for such plantings, as it is impatient of shade; it has about died out.

Plot No. 20.—This was set out with some inferior apple trees of hardy varieties, intermixed with Box Elder. It is now in very good condition, the apple trees having made a very satisfactory growth under protection of the Box Elder. This plot shows the great value of wind protection for fruits.

Plot No. 21.—The Goldenleaf Cottonwood has made

such a vigorous growth that it has injured the Red Cedar, but the latter is holding on well and will soon recover, when a part of the Cottonwoods are taken out. The Basswood is doing fairly well and seems to be favored by the protection of the Cottonwoods.

Plot No. 22.—The Basswood has been killed back slightly and seems to be poorly adapted for this location. The Wobsky Poplar made a very satisfactory growth when young, but is now beginning to fail from the attacks of the Poplar borer. The Box Elder is doing well and makes a fine shade. The Black Cherry has failed. The ground is well covered, but some of the Cottonwood, Golden Willow and Silver Poplar should be thinned out in order to make room for more durable and better trees.

Plot No. 23.—White Ash, Golden Willow and Box Elder in good condition. The remaining Scotch Pine are doing fairly well, except where too severely crowded by the Silver Poplar, which latter should have been cut out several years ago. The ground is well protected. The Black Cherry is in poor condition and should be removed.

Plot No. 24.—The Scotch Pine has been nearly killed out by the shade of other trees, which have made a vigorous growth. The Black Cherry is failing and should be removed, as should likewise most of the Silver Poplar and Golden Cottonwood to make room for the Box Elder. The Basswood are doing fairly well under the protection of the faster growing trees.

Plot No. 25.—The Scotch Pine have been almost killed out by the other trees. The plot has too many trees upon it, and especially too many of the Silver Poplar and Certinensis Poplar, which should be removed to make room for the Box Elder and Elm. The European Birch has made a satisfactory growth and affords a very good cover for the ground.

Plot No. 26.—Scotch Pine were killed out by the shading of other trees; Basswood doing fairly well; Green Ash, Box Elder and White Elm are in sufficient quantities to cover the

soil, but would be benefited by the removal of the Soft Maple and Basswood.

Plot No. 27.—Scotch Pine crowded out; Box Elder and Buckthorn make a very close growth, which affords excellent shade for the ground. The Green Ash is doing well. The Silver Poplar should have been removed several years ago, to give the other and more durable trees a fair chance.

Plot No. 28.—Bull Pine mostly shaded out. Scotch Pine doing fairly well. Black Cherry failing. Buckthorn, Green Ash and European Birch making a good growth.

Plot No. 29.—The Red Currants have produced several crops of good fruit, but the crowding of the trees about them now is rather too much, and little more can be expected from them in the way of fruit. On account of their upright habit, they are not well adapted for a soil covering. The Wild Plums have produced several large crops of fruit. The White Elm, Box Elder and Cottonwood are making a vigorous growth. The few European Larch are standing very well on account of the protection afforded by other trees. Mulberry failing.

Plot No. 30.—New York Hackberry dead; Currants in the same condition as in Plot 29; Box Elder vigorous, and the few plants of Scotch Pine, Bull Pine and Red Pine doing very well.

Plot No. 31.—Box Elder and Green Ash make a good soil covering; Black Cherry failing; Scotch Pine doing fairly well.

Plot No. 32.—The Box Elder and Silver Poplar have crowded out most of the Scotch Pine, and there are only seven remaining. A few Bur Oak and Plum are able to hold on against the crowding of the more vigorous species. The Dogwood cuttings have made large, vigorous bushes, which seem to thrive under the shade of the Box Elder and Silver Poplar, and make a most excellent ground covering.

Plot No. 33.—Box Elder and European Birch in excellent condition, Basswood doing fairly well; Wild Plum extra

good and has borne several good crops; Black Cherry failing. The ground is well covered and a good covering of leaf mold is beginning to form on the soil.

Plot No. 34.—The White Elm, Silver Maple and Black Cherry are all doing well, although the latter is beginning to fail. The Scotch Pine in this group is very promising and seems able to care for itself, there having been no fast growing, dense foliated trees crowding it as in some other groups.

Plot No. 35.—Norway Maple have killed out entirely, but the Box Elder and Basswood are doing exceedingly well, while the Mulberry is in rather scrawny condition as in other plots.

Plot No. 36.—All the trees are doing well except the Black Cherry, which is beginning to fail. The few apple trees are prospering under the protection of the other trees. The trees are too thick, and some of the Black Cherry and Silver Maple should be removed, while the Elm should receive a little pruning.

Plot No. 37.—Horse Chestnut and New York Hackberry all dead; Green Ash, Plum, Black Cherry and Mulberry cover the ground fairly well. This plot would undoubtedly have been improved had it been planted partly with Box Elder which would have shaded the ground.

Plot No. 38.—All species in this plot including Box Elder, Red Maple, White Elm and Scotch Pine are in excellent condition, and while they are beginning to crowd a little, yet none of them are suffering severely. The ground is well covered, and a leaf mold is beginning to form on the soil.

FRUITS.

Fruits in the Forest Garden.—In this planting a number of fruits have been introduced for the purpose of determining the value of the protection which would be afforded them by the surrounding forest trees. The kinds planted included Apples, Plums, Buffalo Berry, Currants, Juneberry and Sand Cherries. Of these the apple and plum have greatly profited

by the protection which they have had from the surrounding trees. These fruits have not been successful without protection in this location, but in the forest garden they have made a very satisfactory growth. This is especially true of the Plums.

Wild Plum.—Our native Wild Plum is a tree which should be commonly used in prairie plantings. The stock here used was grown at University Farm from seed of named cultivated sorts, and was only one year old when planted out. Such plants can be bought for a mere trifle. It has made a very satisfactory growth in every plot into which it has been introduced; made a good nurse tree and given good soil protection; besides this it has produced a large amount of fruit, which, while not nearly so good in quality as some of our best cultivated sorts, has been readily eaten by all who have had access to them, and has made most excellent preserves when properly cooked. It seems to be very much at home in such positions as we have given it here and has fruited with a regularity heretofore unknown in the plum groves of this section. This is probably due to the flowers being protected by surrounding trees from late frosts which so often kill them.

Apples have not proven a great success at Coteau Farm except where protected from wind. With the purpose of testing the value of our hardiest kinds as forest trees one plot was planted to Box Elder and some of our hardiest apples. This planting has done very well and promises to produce satisfactory results when the trees are large enough to bear. The hardiest varieties of apples planted in regular orchard style, in a protected location at Coteau Farm have also done well, while those planted on the open prairie have failed with the exception of a few very hardy crabs. The varieties of apples that have succeeded best are the following: Of the large apples Hibernial, Duchess, Peterson's Charlamoff, Patten's Greening. Of the crab apples the Minnesota, Martha, Pride of Minneapolis, Transcendent, Virginia and Sweet Russett.

Some Minnesota crab trees on the farm must be twenty years old and are in very good condition.

Raspberries have done very well but have been tried only in a small way, but the success attained shows very plainly that they can be successfully grown here if reasonable attention is given to the selection of the hardiest varieties and to the use of good winter protection and summer mulching for both of which purposes the abundant straw resources found here are well adapted. The best varieties are Turner and Loudon of the red fruit kinds and Kansas and Nemeha of the black kinds.

Blackberries have not been a great success as they have been severely injured in winter, but with the use of heavy winter mulching I am confident that they can easily be grown in sufficient quantities for home use. The best varieties are Ancient Briton and Snyder.

Strawberries have succeeded at Coteau Farm although they are generally a failure in this section. Success has attended the efforts here and not those of neighboring farmers, owing largely to the fact that we have protected our beds during the winter with a heavy covering of straw; preferring for this purpose to have it at least twelve inches thick. This has protected the plants from severe freezing, which is very often a cause of severe loss. In addition to this we have followed the plan of allowing the straw to remain between the rows after it was removed from over the plants in the spring, so that it could be put over the plants should frost threaten when the plants were in flower. It often happens that growers of strawberries fail of getting a crop after having grown the plants to perfection owing simply to the flowers being frozen during one or two nights when the plants were in flower. By having this matter in mind the flowers may be easily protected by covering them with a few inches of straw which may be left over them for two nights, if it seems desirable, but which may be put on for several successive nights, if removed during the day time. Straw is so abun-

dant in this section that it has no money value; and the use of some of it for this purpose to secure a supply of strawberries for home use is very important. The best variety for beginners is Beder Wood.

An interesting fact has been brought out in connection with the heavy covering of strawberries. In 1899 strawberries were very seriously injured in every section of this state and in spring the plants were generally seriously discolored in the fleshy part of their stems. Evidently as a result of this we had an exceptionally large amount of deformed fruit known as "nubbins," but the plants in this plantation were exceptionally vigorous and good crops of fruit were produced although in a section where nubbins are a most common source of failure.

Buffalo Berry—Stock from Dakota. This is one of the hardiest of the plants native to this section. It is common in parts of Dakota, Montana and Wyoming, where it produces fruit in great abundance, which is sought after by the settlers for culinary purposes. It makes a large shrub or small tree, frequently attaining a height of fourteen feet. The plants are staminate and pistillate, so that there are many plants that produce no fruit.

It is doubtful if the fruit would be highly esteemed in sections where the Red Currant does well, but where it is uncertain the Buffalo Berry will be found a very desirable substitute for it. It is generally liked for jelly where it has been tried, and resembles the Currant jelly in quality, but is not so clear. The fruit is ripe in August and September, but hangs on the bushes into early winter, and the quality for eating out of hand is much improved after the first frost. The birds, however, are fond of it and eat it greedily in late autumn. The plant is well adapted for low windbreaks and hedges, and will bear pruning as well as any of our hedge plants. Its value for these purposes has been very much overlooked. It is easily grown from seed, which should be sown early in the spring. It also sprouts from the

roots, by which means it may be propagated. It is quite an easy matter to distinguish the fruitful from the barren plants by the form of the buds, after a little experience, and in taking up the sprouts care should be taken to know from what form of plants they come. The first lot of plants received at this station were twenty-six in number, and when they became old enough to fruit, it was found that they were all of the barren sort. It is probable that the parties sending them to us had taken them up from around a plant of this sort. Of the seedlings about one-half will be fruitful. Of course, for the purposes of a hedge it does not matter, although the fruit, which is a bright red in color, rather adds to the appearance of the plants in autumn. It will not endure shade, and consequently is not adapted to planting among trees or other shrubs. It does well, however, when planted in large groups by itself.

Sand Cherry—Grown from Minnesota seed. Very productive on dry soil. On moist soil, or where somewhat shaded the fruit is very likely to rot. Perfectly hardy, even in dry situations and well worth growing in dry and severe locations.

High Bush Cranberry—Perfectly hardy here, producing some fruit, but the soil is rather too dry for the development of its best fruiting qualities. It is, however, a nice ornamental shrub which is especially pretty when in flower. The red fruit which follows the flower is also ornamental. There is quite a demand for the fruit of this plant in various markets, but it is doubtful if it could be profitably raised for fruit on soil as dry as that on which they grow here, although it is undoubtedly susceptible of great improvement.

Currants and Gooseberries have done well. The hardiest and best sorts for this section are the Red Dutch and White Grape currants and the Houghton and Downing gooseberries.

Juneberries have done fairly well when planted by themselves, but are not especially valuable in the forest garden. The best variety to plant is a dwarf kind known as "Success,"

which bears an abundance of large fruit. Perfectly hardy. The objection to it as a fruit plant is that the birds are so very fond of the fruit that they are liable to get most of it.

Mulberries have done rather poorly. They have generally held on well where planted, but have frequently been killed back which has given them an unsightly appearance, but they have generally produced some fruit each year, and this has been such an attraction to the birds that they have not seriously injured the strawberries. The mulberry is too tender for best results in this section.

These fruits have attracted the birds which have destroyed more or less, but they have well repaid us for this by their helpfulness in destroying noxious insects and by their joyous singing and happy life. This has added much to the interest of the place.

SHRUBS.

In a somewhat sheltered place, but removed at least twenty-five feet from any windbreak were planted a collection of our most desirable shrubs. This location was selected in preference to a fully exposed place on account of my belief that the grounds about every prairie home in this section should have wind protection before anything was attempted in the way of ornamentation. The following notes on the shrubs tried may be of interest to planters in the more severe sections of this state.

Siberian Artemesia—(*Artemesia abrotans*.)—A form of "Old Man" that grows to the height of six feet. It is recommended as a hedge for protection on account of its great hardiness and the ease with which it grows from cuttings. While it may be valuable for making a beginning in severest situations, yet it is so unsightly and low that it is far better to use Box Elder or White Willow, which are larger and better in every way.

Caragana, or Siberian Pea Tree—A rather large shrub belonging to the pea family, but never making a tree. It has very pretty foliage and yellow flowers in early spring, which are followed by an abundance of bean like pods. Later in the season the foliage turns brown, and by the middle of August it is very rusty in appearance. It is also liable to fail and die near the ground from the attacks of borers. It is useful in giving variety to shrubberies and perhaps in some cases might do for a hedge plant, but it is so unsightly in the autumn months as to make it rather undesirable for such a purpose, especially as we have so many more desirable plants for this purpose, such as Buckthorn and Buffalo Berry. Both of which take on a much better hedge form and are ornamental throughout the whole growing season. Easily grown from seed which ripens in July.

Dogwood or Red Osier—This is common along the borders of our woods, and is a shrub that stands shade very well. It seems to be especially adapted for growing in forest plantations for the purpose of securing a good ground cover. It grows easily from cuttings made up in the ordinary way, as for White Willow cuttings. The Siberian form, which has dark red bark, seems to be fully as well adapted for planting, as our native kind, which has bright red bark.

Missouri Currant—An old favorite shrub, producing yellow flowers in early spring. Perfectly hardy here.

Van Houtte Spirea—Probably the most popular shrub offered in our nurseries. Of graceful habit at all times, but especially delicate and pretty when loaded with its abundance of white flowers, as it is every spring.

Tartarian Honeysuckle—The many varieties of this are among the most hardy and vigorous of the ornamental shrubs, and a general favorite.

Lilacs—These are perfectly hardy everywhere and need no description here of their value. The common forms have

been greatly improved upon in some of the newer varieties. The nurserymen now offer a large number of named sorts, some of which bloom fully a month later than these; among these may be mentioned the Josikea Lilac, which is exceedingly hardy.

Snowball—Perfectly hardy here and producing its snowball-like clusters of flowers in abundance each year.

Redberry Elder—Our native elder, and very satisfactory in places where a large, coarse shrub can be used. It produces an abundance of white, snowball-like flowers very early in the spring, and these are followed by clusters of scarlet berries.

Hydrangea—The hardy Hydrangea has proven a great success in this section, although in some portions of Western Minnesota, where it is rather exposed to the wind, it is liable to kill in our severe winters when the ground is bare of snow. It is easily protected, however, by a little mulch in winter, and the great white panicles of flowers which it produces in August will well repay any little extra trouble of this sort.

Rosa rugosa—This is a single rose from Japan. The most remarkable thing about it is its fine, vigorous foliage, which is ornamental throughout the growing season and is seldom injured by insects. The flowers are produced in considerable abundance in June, and then at intervals throughout the growing season, and again abundantly in autumn, and are followed by bright scarlet hips (fruit). Perfectly hardy without protection.

Tamarix amurensis.—This is a plant of very pretty, delicate habit, and well adapted to giving graceful effects to shrubbery. At the University Farm it generally kills back a little every winter, and occasionally kills nearly to the ground, but as it is the new growth that is most beautiful this killing back rather improves it than otherwise. It has blue flowers in catkin-like clusters and these are produced more or less all summer. In this section of the state it is

not quite hardy, but this has probably been due to its being exposed to drying winds and to severe weather without snow protection. It should have a little extra mulch put around its roots for winter protection, when it will be very satisfactory.

Ornamental Vines.—The best of these for porches is the common Virginia Creeper, but the climbing Bitter Sweet does well. For a coarse vine the wild native grape is excellent. For covering walls the form of the Virginia Creeper known as the Englemann is excellent and clings to rough stones or bricks without much care.

SUMMARY.

As we advance on the prairies westward, trees require additional care in the matter of cultivation to prevent their being overcome by the herbaceous vegetation; this is due to the diminishing rainfall. It is very important to keep the soil well cultivated to protect from drouth injury.

On our prairies windbreaks should generally precede ground ornamentation.

Fuel supply and shelter belt may often be combined and for this purpose probably the White Willow is better adapted for this section than any other tree.

An acre of good land well covered with White Willow, will produce about three cords of wood per acre per year. In exceptionally good locations as much as five cords per acre per year has been produced.

The best trees for general prairie planting are White Willow, Golden Willow, Green Ash, White Elm, Box Elder, Soft Maple, Buckthorn, Wild Plum.

The Cottonwood is a poor tree for dry prairie soils, but in some retentive soils it is quite satisfactory. The cotton nuisance may be avoided by taking cuttings from male trees.

The tree known as Carolina Poplar is an improved form of the cottonwood. It seems to be especially free from leaf fungus, and is well worthy of trial, but it should not be used

in large quantities, and planters should not forget that in spite of its name it is only a Cottonwood.

Some of the Russian Poplars were formerly regarded as being of great promise for windbreaks and ornamental purposes, but while they did well for perhaps six or eight years after they were introduced, the most of them have now failed, owing partly to the attacks of borers, to which they are much more subject than our common Cottonwoods. This failure has been so general that their planting should not be encouraged further.

The common Basket Willow (*Salix purpurea*) has proven hardy here, and has made a very satisfactory growth; it could undoubtedly be easily grown here for basket purposes.

None of the evergreens are safe in Southwestern Minnesota without wind protection. The hardiest and most desirable evergreens are: Red Cedar, White Spruce, Bull Pine Scotch Pine and Mountain Pine.

The best mixtures in the plots of the forest garden are: Box Elder and Green Ash,—Box Elder, Wild Plum and Redtwig Dogwood.—Buckthorn and White Spruce.

Judging from the results of these experiments an ideal mixture for a prairie grove in Southwest Minnesota would consist of a mixture of Box Elder, Green Ash and Wild Plum. These should be planted out in succession, two feet apart in rows eight feet apart. Another good plan would be to plant only one or two kinds of trees in each row, using White Willow for one row and Green Ash and Wild Plum for the next row and so on repeating such alternation of kinds until the whole is planted.

The Box Elder, on account of its dense shade is very valuable as a soil cover and soon shades the ground so completely that no grass or weeds can grow under it. It is especially adapted to mixing with other trees that are more open in habit, such as Elm, Ash and Cottonwood. It also makes a most excellent large hedge.

Redtwig Dogwood endures considerable shade, and

makes an admirable soil cover and is especially desirable as a soil cover under such trees as Green Ash and White Elm, which are generally lacking in this respect on dry soil.

Among the best shrubs for Southwestern Minnesota and for general planting throughout the state are: Van Houtte Spirea, Missouri Currant, Lilacs of various kinds, Snowball, Tartarian Honeysuckles of various kinds, Siberian Pea tree, Hardy Hydrangea and Rose Rugosa.

The best hedge plants for division lines and for ornamental purposes generally are: The common English Buckthorn and Buffalo Berry. The former is probably the best, and both are hardy, but these plants are not well adapted for pasture fences. In fact, we have no plant that is adapted to this purpose in this state, and our best farmers are opposed to such fences, as they are difficult to maintain and generally unsatisfactory. For a high hedge for purposes of a screen and one that endures trimming nicely, there is nothing quite so good as the Box Elder. This tree can be easily made into a hedge sixteen or more feet high and not more than seven feet thick, and is easily kept in this form by two trimmings each year.

The Buffalo Berry is well adapted to this state and is desirable for hedges, ornamental planting and for its fruit, which is produced regularly and abundantly and is nearly equal to the currant for general culinary purposes. In some sections it is much more reliable than the currant.

Bur Oak seedlings have been transplanted successfully when four years old having a tap root five feet long, which was shortened to sixteen inches.

In locations where the soil is liable to blow badly it is a good plan to use a heavy mulch around the first plantings, to keep the soil in place. Such treatment is not so good as thorough cultivation for tree plantings, but will give very good results if properly used.

The larvae of the Willow Saw-fly may be kept in check by the use of Paris green and water in the same proportions

as is used for the potato bug. In applying it, it will be found convenient to have a good force pump set on a barrel, some garden hose and a good spray nozzle. If the trees are very high it will be found convenient to have the barrel containing the mixture in a wagon or perhaps elevated on a platform in it.

The Wild Plum has been overlooked by planters on our prairies. It is well adapted to forming a very important constituent of prairie groves, where it not only produces an abundance of fruit, but makes a most excellent soil cover. In the Forest Garden at Coteau Farm Wild Plum Seedlings have given most excellent results under a great variety of conditions, and have proven more productive and reliable than have varieties grown under ordinary orchard management.

Apples have made a most satisfactory growth in the Forest Garden at Coteau, but while they can undoubtedly be grown successfully in this way, yet it is probably best to grow them in this section in rather closely planted small orchards surrounded by windbreaks or else in rows alternating with Box Elder or other low growing hardy trees with the rows running east and west. The best hardy large kinds tried are: Hibernial, Patten's Greening, Duchess, Peterson's Charlamoff Of Crab Apples, the best tried are Minnesota, Martha, Pride of Minneapolis, Transcendent, Virginia and Sweet Russett.

Strawberries have succeeded when heavily mulched with straw in winter. For this purpose the straw should be at least six inches thick when it has settled down. Heavy mulching with straw will often prevent the formation of "nubbins."

Raspberries and strawberries will do well when heavily mulched in addition to the regular covering of earth but earth covering alone is not sufficient to insure against winter injury in this section, in dry severe winters of little snowfall.

Some of the straw of this section which is annually burned in large quantities should be used in the cultivation of garden fruits.

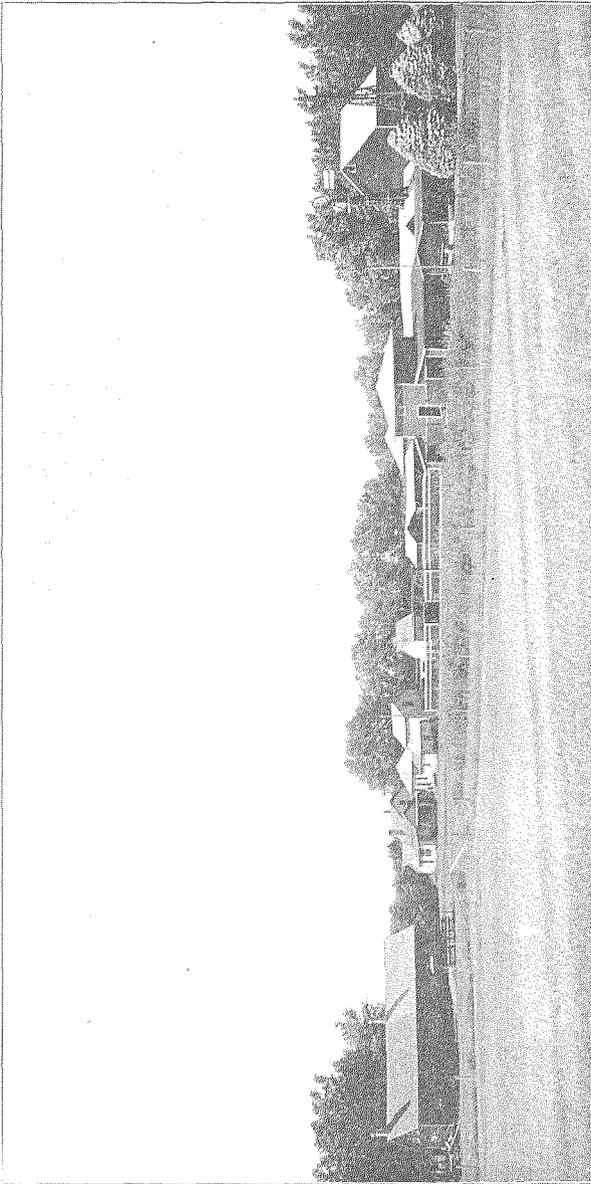


Fig. 201. Coteau Farm Buildings.

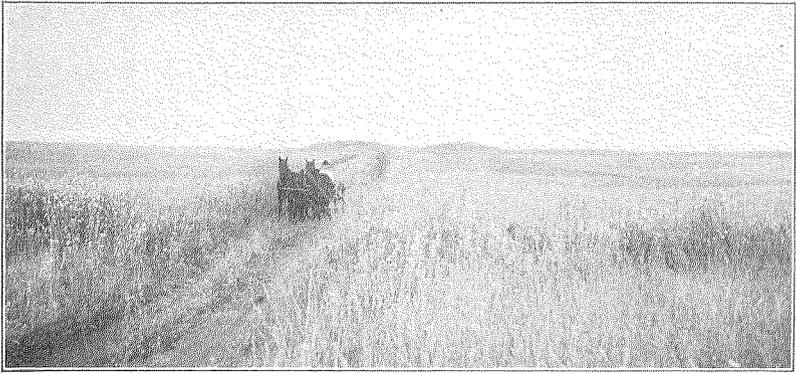


Fig. 202. A typical scene in the vicinity of Coteau Farm. Entirely treeless.

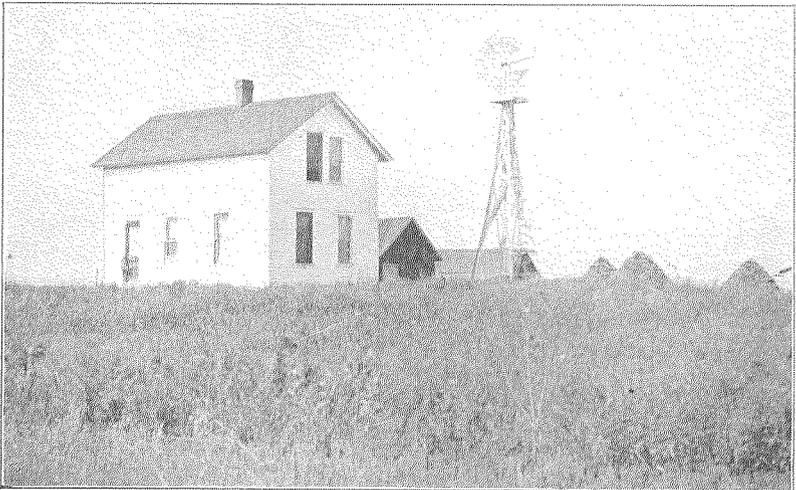


Fig. 203. New prairie home. Windbreak just started.



Fig. 204. The middle alley in the Forest Garden. Box Elder and Black Ash in the foreground.

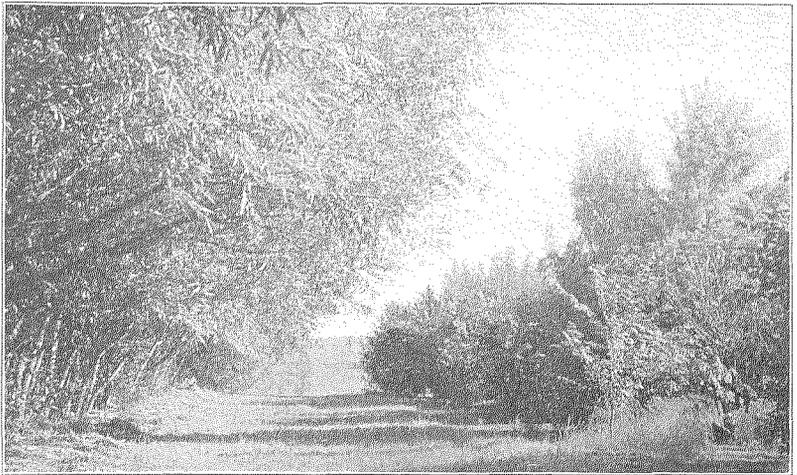


Fig. 205. An end alley in the Forest Garden. Eighteen year old willow windbreak on left.



Fig. 206. Old Cottonwood windbreak under-planted with plums. The Cottonwood's should be removed.



Fig. 207. Box Elder in natural condition, branches closely cover the ground and prevent its drying out and the growth of grass.



Fig. 208. Forest Garden Plot containing plum seedlings. Recently pruned.



Fig 209. Wind breaks two years old. Those on the left cultivated, on the right grown by mulching.



Fig 210. Young apple orchard fully exposed to north and west winds. Only a few of the very hardiest crabs survive.



Fig. 211. Young apple orchard in protected location. Very thrifty.



Fig. 212. An old grove of Box Elder and Cottonwood. Too open at the bottom for best results. Has been pastured and is sod bound.



Fig. 213. The Common Buckthorn grown in hedge form.