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FRUIT GROWING ON THE NORTHERN GREAT PLAINS

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HORTICULTURAL EXPERIMENTS AT THE MANDAN FIELD STATION.

EXPERIMENTAL WORK in horticulture was begun at the Northern Great Plains Field Station, Mandan, N. Dak., in 1913. The nature of the problems is such that the definite conclusions that can be drawn from the evidence of the experiments are as yet limited. It is not the intention in this circular to report on the experiments in detail, but merely to call attention to certain problems of fruit culture in this area and to point out some of the experiments being undertaken for their solution and those phases of experimental work that from the evidence at hand appear most promising.

CLIMATE OF THE NORTHERN GREAT PLAINS.

The northern Great Plains is an arbitrary division based on natural conditions that, generally speaking, may be said to include the western half of the two Dakotas and those portions of Montana and Wyoming east of the Rocky Mountains.

From a horticultural standpoint the climate of this area is the most severe found in any of the agricultural regions of the United States. Some of the factors that make the climate horticulturally severe are low winter temperatures, often of long duration; sudden and extreme changes of temperature; cold and drying winds in winter and spring; lack of a snow cover in winter; a short summer season, with late spring and early fall frosts; hot days and cold nights in summer; hot winds in summer; scanty annual rainfall; a dry atmosphere and a high rate of evaporation; and hailstorms.

These factors occur in many and complex combinations, creating conditions very trying to horticultural plants; for example, the extremely long period during which the soil and roots are frozen during the winter virtually amounts to a protracted drought. The limiting climatic factors have their most important horticultural effect in winterkilling and drought. In the Black Hills conditions are comparatively much more favorable than on the Plains, and the statements in this circular are not wholly applicable to that region.

SMALL FRUITS.

Strawberries do well when given winter protection if there is enough water to mature the crop. The demand of the crop for water at fruiting time is heavy, and in a dry season watering is necessary for the best results. Winter mulching is essential. Growing the plants in narrow matted rows or in hills appears to be the most promising method. Promising varieties are South Dakota, Senator Dunlap, and the everbearing varieties Progressive and Minnesota No. 1017.

Red raspberries bear only in favorable wet years. The adoption of the hill system and wide spacing are essentials for a crop. An extensive planting made at the Mandan station in 1913 has produced only one good crop in the five years since that time. That was in the third year, 1916. In both 1917 and 1918 the crop was a total failure, owing to the lack of sufficient water at fruiting time. All varieties require winter protection, such as laying down and covering with soil, or mulching. Some promising varieties are Sunbeam, Loudon, King, and Minnesota No. 4.

Black raspberries can not be recommended, as it is very difficult to secure a stand.

Currants are the best of all the small fruits. Many varieties, however, are not hardy. The ordinary named black varieties are not worth planting. The hardiest and most productive varieties of red currants are North Star and London Market.

Gooseberries have been only moderately successful at the Mandan field station. Even such hardy varieties as Houghton, Downing, and Carrie suffer winter injury some years if unprotected. Covering with soil is hardly practicable when the bushes are large. The Houghton is the most promising variety.

Blackberries and dewberries have been total failures, and should not be planted on the northern Great Plains.

Grapes sometimes do well in town lots or other well-protected places. In such places the hardy variety Beta will bear fruit some years without a winter covering. In repeated trials since 1914 at the Mandan field station all varieties have died from winter injury,

even when the plants were protected with soil. For well-protected places the most promising varieties are the hardy hybrids Beta, Monitor, Dakota, and Suelter.

The named sand cherries bred and introduced by Prof. N. E. Hansen have given excellent results. The Sioux has proved exceptionally successful. At the Mandan field station in 1918 nine 3-year-old plants produced 28 pounds of cherries of good quality. The bushes were hardly more than 2 feet tall. The fruit was ripe August 1. The Tomahawk and Hansen's No. 5 are about 10 days later than the Sioux and yield almost as well.

All the native fruits are hardy and worthy of a place in every garden or farmstead. The list includes strawberries, currants, gooseberries, sand cherries, grapes, June berries, bullberries (or buffalo berries), chokecherries, pin cherries, plums, high-bush cranberries, black haws, thorn apples (or hawthorns), and hazelnuts.

ORCHARD OR TREE FRUITS.

Because of the greater length of time required for experimentation with tree fruits there is less conclusive evidence on them than on the small fruits, but it is a matter of general knowledge that on the whole they have been far from successful on the northern Great Plains.

Three important lines of experimentation or investigation must be considered as offering possibilities for the more successful growth of tree fruits in this area and the reduction of failures to a minimum. These are all fairly distinct but nevertheless dependent upon one another. These three lines of work may be stated as follows:

1. The breeding of desirable hardy varieties for this area.
2. The determination of the best methods of propagation and the adoption of such methods by the commercial propagators who supply the planters in this area.
3. The determination of the planting and cultural systems and methods best adapted to the severe conditions of the area.

BREEDING DESIRABLE HARDY VARIETIES.

Breeding hardy varieties is logically the fundamental and most important phase of the three lines of work, as an inherent lack of hardiness can at best be only partially overcome by methods of propagation and growth. The necessity for this work is clearly shown by a survey of the field and by the failures that have attended horticultural efforts.

So far as is known the Hibernian is the hardiest of the present list of apples, but even this is not absolutely hardy under all conditions. A few of the crabs, including Transcendent, Virginia, and Lyman Prolific, are practically hardy, but just how fruitful and desirable

these varieties of apples and crabs may be under either the ordinary methods or any new methods that may be evolved remains to be determined.

Practically none of the plums usually sold in this area has proved successful. The most common faults of such varieties are lack of hardiness and lateness of ripening.

Sand-cherry hybrids in the trade up to the present time have not proved very satisfactory.

No desirable hardy varieties of the cherry, pear, apricot, peach, or of any of the native tree fruits are available for this area.

The Mandan field station has under way extensive experiments in the breeding of all tree fruits that appear possible of adaptation to the

FIG. 1.—The ordinary high-headed nursery tree which has proved a failure on the Northern Great Plains.

area. This work follows two distinct lines. One is the effort to create desired combinations of characters by means of crossing or hybridizing. In this work a large number of crosses are made under glass each year and the resulting crosses or hybrids of known parentage are tested for hardiness and other characters. The other line is the growth and selection of seedlings. Large numbers of seedlings are grown each year from seeds gathered from native groves or other sources throughout the area. These seedlings are planted in testing orchards, from which the best individuals are selected when they fruit. The first selection of seedling plums was made in 1918 from an orchard started from seed in 1914. The selections were based mainly on hardiness, early maturity, and productiveness.

METHODS OF PROPAGATION.

Under methods of propagation are included the determination and use of hardy and congenial stocks for the several tree fruits and the

determination of the form and shape of tree best adapted to this area.

By far the hardiest stock for apples and crab apples is the true Siberian crab (*Pyrus baccata*). Other desirable stocks are seedlings of the hardiest named crabs, such as Red Siberian, Yellow Siberian, Virginia, and Transcendent. At present, such stocks or seeds are difficult to obtain in commercial quantities and consequently are not as generally used as they should be. French crabs and the so-called Vermont stocks are worthless for this section. Trees of the hardiest varieties when on such stocks are likewise worthless unless they have produced sufficient scion roots to support the tree when the stock root succumbs.

On account of their extreme hardiness the seedlings of *Pyrus baccata* are very desirable for budding or for making piece-root or whole-root grafts. If these stocks have a somewhat dwarfing effect, as is claimed, they appear even more desirable, as the most promising cultural methods are those which require bushy dwarf trees.

Experiments are under way to determine the value of the native June berry and thorn apple as grafting and budding stocks for apples and crabs. These stocks are very hardy and also are likely to have a dwarfing effect.

Seedlings from native trees of *Prunus americana* have proved very successful stocks for plums and hybrids both when used as budding stocks and for whole-root grafts.

The native sand cherry (*Prunus besseyi*) has proved a very successful budding stock for plums, hybrids, apricots, and peaches. It also can be utilized successfully in the production of whole-root or piece-root grafts of plums and hybrids. It makes an exceptionally congenial stock for the sand-cherry hybrids, especially the Compass cherry. The usual objection to the use of this stock is that the trees produced are inclined to become top-heavy. This is true more especially of budded trees and can be remedied by deep planting. This

FIG. 2.—A high-headed apple tree with a long, exposed trunk, which is being killed by sun scald.

objection, however, is entirely eliminated when the trees are grown in bush form or with extremely low heads, which are the most desirable forms for this area.

Pears can be budded on seedlings of the native thorn apple (*Crataegus* sp.), which is, of course, perfectly hardy. They can also be grafted on the June berry (*Amelanchier*). On June-berry stock they produce dwarf trees.

Mainly on account of a lack of sufficiently hardy varieties, very little experimental work in the propagation of cherries has been done. In the fall of 1918, however, a considerable number of buds of cherries were inserted on such stocks as *Prunus besseyi*, *P. penn-*

sylvanica, and *P. virginiana*, in order to test these stocks.

Apricots and peaches can be budded successfully on native plum and sand-cherry seedlings.

Various methods of budding and grafting are being tested to determine which are best for this area. Excellent success has been met in winter grafting plums on both sand-cherry and plum roots.

Under propagation tion must also be

FIG. 3.—A low-headed compact tree ready for planting.

considered the form and shape or type of tree as produced in the nursery. The ordinary high-headed tree, such as is shown in figure 1, has not proved a success on the northern Great Plains and has been a decided failure in the rather extensive experimental plantings at the Mandan field station. Figure 2 shows a high-headed apple tree being killed by sun scald. To prevent this scald a special effort has been made to grow a number of bushy, trunkless trees and very low headed trees of the several tree fruits. The production of such trees in the nursery, both from grafts and buds, has proved a simple, practical, and entirely successful undertaking by the practice of summer pinching.

Two general types of trees have been produced: The central-axis tree with a stout main trunk supplied with well-developed branches

from the bottom up (as shown in fig. 3) and the real bush tree, which has a number of main branches starting from the crown, producing a type of structure similar to that of a currant bush. Figure 4 shows a crab apple of bush type ready for planting. Some varieties will no doubt do better when grown as central-axis trees, while others may perhaps be more successful when in the real bush form.

These types of trees were grown for the purpose of making a number of experiments, as described under the following head.

PLANTING AND CULTURAL SYSTEMS.

From all experimental evidence and from many observations the conclusion has been reached that the exposure of the individual trees due to high heading and the open system of planting, as illustrated in figure 5, contributes in no small degree to the failures encountered, and that mutual protection of the trees by themselves and the other trees within the orchard may be the key to a more successful system of fruit growing in this area.

For the purpose of determining how much such mutual protection may contribute to the chances of success, three more or less distinct methods or systems of planting are being tested thoroughly in comparison with the ordinary orchard-planting systems usually practiced.

In these experimental plantings the hardiest varieties are used. These are grown on the hardiest stocks and are trained to the desired form from the start in the nursery.

The first of these systems has been designated the "self-protecting combination fruit patch." The chief characteristics of this system are the use of bush-form trees, such as are shown in figure 6, planting in rows running north and south and 16 or 20 feet apart, and spacing

FIG. 4.—An excellent crab-apple tree of bush form ready for setting out.

the trees 4 or 6 feet apart in the row. The three rows on the west are planted to the hardiest native fruits, and one such row runs across both the north and the south ends of the patch. The trees are cut back somewhat at planting time, to induce bushiness. There is to be no further pruning except a certain amount of summer pinching, to induce bushiness and fruit spurs.

Such a system will develop low, bushy, dense, dwarfish, and compact trees, and the rows will soon have somewhat the appearance of a hedge. Plum trees growing under this system are shown in figure 7. The first few years, while the plants are too small and open to hold

FIG. 5.—Under the usual system of orchard planting, as shown here, the trees furnish no protection to each other, and the high-headed trees furnish no protection to themselves.

the snow, either corn, oats, or some other snow-holding crop is grown between the rows, but this is not sown until midsummer.

It is also likely that the bush and cane fruits can be grown between the tree rows the first six or eight years, but such small fruits should be spaced 8 feet in the rows and kept in hills.

The advantages of this system of planting and culture include mutual protection against cold, wind, sun scald, evaporation, hail, hot soil,

and rabbits. It is also conducive to the catching and holding of snow. The low hedgelike form of growth should facilitate such operations as spraying, cultivation, summer pinching, and harvesting.

The second system which is being tested can be referred to as the "group-orchard method." In this system bushy or low-headed trees are planted in groups of four or six trees each, spaced 2 feet apart within the group and the groups spaced 12 by 16 feet for plums and 16 by 25 feet or less for apples and crabs. The trees are to be kept low and bushy by summer pinching for the first two or three years. A snow catch crop is to be planted between the rows the first few years. Each group is to be treated as a unit, like a single tree in the ordinary

planting. The advantages sought by this system are similar to those of the first.

The third system may be styled the "dwarf-orchard method." The trees of each fruit are propagated on dwarf stocks. They are then planted in a closely spaced orchard, 6 by 8 feet or slightly farther apart. The trees are kept low and compact. This system should afford in considerable degree the same protection as the other methods described.

Experimental work is now well under way to test these methods thoroughly. All that can be said at present is that they are being tested in the hope that they may overcome at least some of the causes of failure in the growth of tree fruits. They are directly in accord with principle in view in this area. Mutual protection has been the fundamental principle in view in devising these three general methods.

The thick planting necessary for mutual protection is, of course, contrary to the generally accepted idea of thin planting for drought resistance. It has been the endeavor to overcome this objection as far as possible by providing snow-holding power, by shading the ground to reduce the direct evaporation from the soil, and by keeping the plants low and small in order to reduce the total transpiration from their leaf surfaces.

FIG. 6.—A fine specimen of a crab-apple tree of bush form. The branches start at the ground. No danger of sun scald here.

RECOMMENDATIONS FOR PRACTICE.

With our present information and taking into consideration the present-day commercial practices, the following recommendations can be made to those who desire to grow apples, crabs, and plums on the northern Great Plains:

Buy trees of the hardiest varieties obtainable. Ask for 1-year-old or 2-year-old budded trees or 2-year-old grafted trees, with apples on Siberian crab roots and with plums on native seedling roots. The

trees should be obtained with all branches from the bottom up, and when planted they should be pruned so as to induce a low, bushy, compact tree. Plant in rows 16 or 20 feet apart, with the plums spaced 4 feet apart in the row and the apples and crabs 6 feet. Plant on the east side of an established windbreak, or plant two or three rows of hardy native fruits on the west side as a part of the planta-

FIG. 7.—“Bush” plum trees planted close and kept low and bushy. These trees catch all the snow possible. Each row protects the other.

tion. Practice summer pinching in order to induce bushiness, and keep the trees as low as possible. Give good cultivation and apply a top-dressing of well-rotted manure every second or third year. All indications are that this method of planting will be more successful than the old system of planting high-headed trees 20 by 30 or more feet apart.