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HARDY VARIETIES OF APPLES
FOR
NORTHEASTERN COLORADO

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Commercial apple-growing in Northeastern Colorado is confined to the foothill area and to the river valleys before these emerge upon the plains. The foothill lands offer suitable sites in the way of protection against strong and drying winds and also in the matter of soil and air drainage. Winter killing is less frequent and damaging spring frosts are less apt to occur.

The planting of apples in these favorable areas began with the early settlement of the country some fifty years ago and many of the original plantings are still alive and producing fruit. With the development of irrigation and the settlement of the adjacent plains land, a few farmers planted orchards both for home use and for market. Most of these plantings have disappeared or are disappearing. A few orchards situated on favorable sites and given fair care are producing profitable crops. In moving eastward from the mountains onto the open plains, conditions become less favorable to apple growing, winter killing of trees occurs and destructive spring frosts are frequent; fewer farm orchards are met with and those found are in most instances unprofitable.

A few years ago the horticultural department made a survey of the orchards in Northeastern Colorado, and this survey revealed the fact that early plantings were made without reference to their adaptation to the soil and climate of the region. In favorable localities many of the eastern varieties survived, but on unfavorable sites they soon died. Like all pioneer plantings, too many varieties were grown and naturally the majority were more or less worthless. In most cases the planters bought what the nursery agent offered or recommended, with little regard to their hardiness or market value. Too often substitutions were made by the nurseryman and the planters never knew what they were growing until the trees fruited. The wonder is that so many trees survived. The apple survey showed more than 50,000 apple trees in commercial plantations in Larimer County and not less than fifty-eight varieties. So far as the number of varieties is concerned, Larimer County is second in the State; Fremont County heads the list with ninety varieties. It is safe to say that ten or possibly twelve varieties out of the fifty-eight are worthy of consideration in commercial planting in this section.

OUTLINE OF THE EXPERIMENTAL ORCHARD

In order to gain more accurate information on the question of hardiness and adaptability of the different varieties of apples, a trial orchard was planted on an open, exposed piece of land located about four miles and a half east of the foothills. The land had previously been used for various agricultural crops under a system of rotation. It was in a good state of fertility, medium-heavy loam, well drained and in general, so far as soil is concerned, well adapted to apples. The lay of the land is not the best, as the surrounding land is level and no protection is afforded in the form of natural or artificial wind-breaks. Since the object of the experiment was to determine the hardiness of a number of varieties of apples and not the development of commercial orchards, the site chosen was such as one might expect to find on most farms on the plains.

The land was fall plowed to a depth of eight or nine inches and left in a rough state during the winter. In the spring it was pulverized and marked out for planting. The trees were set in squares twenty feet by twenty feet. Yearling trees, that is one year from grafts, were set. The trees were obtained in the Northwest and in the Southeast. They were planted in the usual way and irrigated immediately after planting. Practically every tree grew. The list includes the standard commercial varieties that are grown in the West, together with a number of hardy varieties grown in the upper Mississippi Valley. The following varieties were secured for the experiment:

VARIETIES PLANTED

Gano, McIntosh, Red Astrakan, Jonathan, Grimes, Patton's Greening, King, Stayman, Rome, Delicious, Chenango, Wagner, Wealthy, Gravenstein, Spy, Wolf River, W. W. Pearmain, Hyde's King, Ben Davis, Alexander, Sheriff, and Northwestern Greening.

The planting was done in the spring of 1914 and the trees were given intensive culture thruout the growing season. During the middle of May, 1915, an inventory was taken of the orchard to determine the percentage of dead trees, with the following results:

	Percent.		Percent.
Gano	40	Wagner	90
McIntosh	37	Wealthy	0
Red Astrakan	35	Gravenstein	45
Jonathan	40	Spy	60
Grimes	65	Wolf River	0
Patton's Greening	25	W. W. Pearmain	80
King	33	Arkansas Black	60
Stayman	80	Hyde's King	50
Rome	90	Black Ben Davis	40
Delicious	50	Alexander	55
Chenango	40	Sheriff	35
		Northwestern Greening	30

The percentage is based upon the number of trees killed to the ground either above or below the graft. Where the die-back was below the graft the trees were removed. Where the killing was above the graft, they were permitted to remain and in almost every case a new tree was produced during the growing season. In every instance the roots were found to be alive, the injury being entirely confined to the tops. The dead trees were removed and new ones substituted. An inventory was taken in May, 1916 with the following results, based upon the percentage of dead trees of the original planting:

	Percent.		Percent.
Gano	45	Wealthy	10
McIntosh	40	Gravenstein	50
Red Astrakan	50	Spy	100
Jonathan	50	Wolf River	20
Grimes	100	W. W. Pearmain	100
Patton's Greening	40	Arkansas Black	70
King	100	Hyde's King	60
Stayman	100	Black Ben	50
Rome	100	Alexander	65
Delicious	60	Sheriff	45
Chenango	55	Northwestern Greening	35
Wagner	100		

During the summer of 1916 the trees again made a satisfactory growth, tho considerable injury resulted from sun scald on the west and southwest sides of the trees. Some damage was also done by the strong northwest winds to which the trees were freely exposed.

In the spring 1917 an inventory was again taken of the orchard, with the following results, based upon the total number of trees dead of the original planting:

	Percent.		Percent.
Gano	50	Wealthy	20
McIntosh	45	Gravenstein	65
Red Astrakan	60	Spy	100
Jonathan	55	Wolf River	45
Grimes	100	W. W. Pearmain	100
Patton's Greening	60	Arkansas Black	95
King	100	Hyde's King	70
Stayman	100	Black Ben	60
Rome	100	Alexander	55
Delicious	65	Sheriff	50
Chenango	70	Northwestern Greening	40
Wagner	100		

As in previous years, the winter killing extended only to the top. In cases where the winter killing did not extend below the graft, new trees had developed from sprouts and made considerable growth during the summer, but only to be killed again during the following winter. A number of trees that had repeated this process for three or four years developed a gnarly

trunk at the base, which, due to the numerous cut-backs, did not form a satisfactory trunk, and were to all intents and purposes worthless for commercial orchards and were counted as dead.

In the replanting of 1916 two-year-old trees were used to test their hardiness in comparison with one-year-old trees as used in the original planting. The result of this comparison will be discussed later.

No replanting was done after 1917 but the orchard was maintained and cared for in the usual manner until the spring of 1922 when a final inventory was made.

Percentage of live trees from the original planting:		Percent.	
	Percent.		Percent.
Gano	45	Wagner	0
McIntosh	55	Wealthy	75
Red Astrakan	35	Gravenstein	30
Jonathan	45	Spy	0
Grimes	0	Wolf River	50
Patton's Greening	30	W. W. Pearmain	0
King	0	Arkansas Black	5
Stayman	0	Hyde's King	20
Rome	0	Black Ben	35
Delicious	30	Alexander	40
Chenango	25	Sheriff	45
		Northwestern Greening	45

The death rate after the third winter was relatively small, the losses being in many cases due to sunscald and to frost injuries received during the first two years after planting. There is little doubt but what a windbreak of some kind would have materially reduced the losses.

CONCLUSIONS

An analysis of the results shows that winter killing is most severe during the first year after planting, the losses being relatively small during the subsequent years. The high mortality of the first year should be attributed to the succulent condition of the wood which offered less resistance to the dry winter weather. The varieties which survived after 1918 continued to grow and a few fruited during the season of 1917 and 1918 but no record was kept of the fruiting. After the trees had survived the second and third year, the mortality was small and in general comparable to the average mortality that occurs in commercial planting on the better sites. Winter examination of the trees showed conclusively that the killing was due to dry winter weather so common to the plains area. The branches and twigs were in many instances badly shriveled and dry. These would plump up during a spell of moist weather.

A study of climatological conditions during the period of this experiment showed some difference both in precipitation and temperature but not enough to warrant a conclusion that

weather conditions during this period were unusual or that the mortality of the trees was due to unusual weather conditions. In fact the winter temperatures were not lower than in many of our commercial apple-growing sections where many of the more tender varieties are grown successfully. The precipitation on the plains during the winter is, however, small, and bare winters are frequent. The atmospheric humidity is low and drying and severe winds are frequent.

In no case did the winter killing extend to the roots of the trees and the question of hardy stock does not enter into the problem. The experiments show conclusively that the main cause of winter killing of apple trees on the plains is due to the drying effect of our winter climate.

It is evident that yearling trees generally used in planting commercial orchards are more apt to winter kill during the first winter than older trees.

In the replanting of 1916, two-year-old trees were used, the object being to test the relative hardiness of these as compared with yearling trees. **The results show conclusively that the two-year-old trees are better able to withstand the dry winters and the mortality among them was fifty percent less than the yearlings.** The wood is harder and more mature and thus better able to survive the first winter and only on very favorable sites should yearling trees be planted.

SUGGESTIONS FOR GROWING APPLES ON THE PLAINS

Commercial apple-growing on our eastern plains should not be encouraged. The planting should be confined to the home orchard and on the most favorable sites obtainable. Only the hardier varieties should be planted. Where natural shelter in the form of hills is not obtainable, windbreaks, planted at least two or three years before the planting of the orchard, should be used. The windbreak will greatly modify the effect of our strong winds and protect the trees from their effect. Where irrigation is not possible, a heavy mulch should be provided so as to retain all the available moisture in the soil for the use of the trees.

Two or three-year-old trees should be planted instead of yearling trees. The wood on such trees is more mature and harder and better able to survive the first winter after planting. Care should be taken in selecting trees that have a well-formed head and are headed low. Low branching will protect the trunk from sunscald. Low-headed trees are preferable to high headed; they are easier to spray and it is more convenient to pick the fruit.

The trees should be set at the same depth that they were in the nursery, at most not more than one inch deeper if the soil is light. A thoro preparation of the land before planting

is important. The land should be fall plowed to a depth of ten inches and left in the rough during the winter. A thoro harrowing is all that is necessary in the spring before setting the trees and the trees should be set in squares twenty-four feet by twenty-four feet. Closer planting is not advisable.

The holes in which the trees are set should be sufficiently large to accommodate the roots without crowding and all broken or torn roots should be cut off. If the soil is dry, irrigation should follow immediately. This will settle the soil around the roots and hasten the growth of the trees.

After planting, the tops must be pruned to correspond with the greatly reduced root area. From one-half to two-thirds of the previous year's wood should be removed but care should be taken to keep the tree in balance. Subsequent pruning should consist in heading back the top to keep the bearing wood as low as possible. The general practice of pruning from the bottom upward should be reversed.

Cultivation should alternate with some cover crop to keep the soil supplied with vegetable matter and keep the trees in a healthy growing condition. Liberal applications of barnyard manures should be applied during the period of clean cultivation. It should be applied in the fall of the year and plowed under before winter, followed by clean cultivation during the following summer. In general a crop of biennial sweet clover should be planted the following year and cut and left on the ground. The second year the first crop should be cut and left on the ground and the second crop plowed under in the fall while still green. This will make a four-year rotation, two in clean cultivation with a dressing of stable manure between and two years in sweet clover. The orchard should not be used as a pasture for livestock.

Systematic pruning, thoro cultivation, careful spraying and irrigation are essential for profitable production. Most farmers manage to grow apple trees for shade but few make any serious attempts at raising apples.

Irrigation.—The trees should be given two or more thoro irrigations during the summer, particularly during the fore part. Irrigation should cease in August so as to slow up the wood growth and enable the tree to mature the wood before winter. If irrigation is continued late into the fall the young trees will continue to grow until killed by frost, resulting in soft and succulent wood, which is more easily injured by the subsequent dry weather. Where water is available in late fall or early winter, the trees should be given a thoro irrigation after the leaves have fallen and the trees entered into a dormant stage. This will fill up the soil as well as the trees with moisture, thus enabling the trees to go through the winter in a better condition than if left dry.

The following varieties have proved the hardiest and are well adapted for planting both in more or less exposed situations, as well as in more favorable ones:

Summer apples	{	Yellow Transparent Duchess
Fall apples	{	Wealthy Northwestern Greening
Early Winter apples	{	McIntosh Jonathan Delicious
Winter apples	{	Smith Cider Black Ben Sheriff

For exposed places it is not advisable to plant the Jonathan and Delicious, but with windbreaks of some kind, they will prove a success.

The following supplementary varieties have succeeded but are not recommended unless for strictly family use:

Red June	Wolf River
Red Astrakan	Walbridge
Alexander	Geniton

The list could be further extended, but nothing is gained in planting a large number of varieties.