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EXPERIMENTS ON WINTER PROTECTION OF THE PEACH TREE.

In most orchards in middle and northern Kansas, a fair peach crop is an occurrence so rare that most fruit-growers have ceased to plant peach trees. At the College, and our experience is the average of our latitude, we have had but two fair crops from budded trees in ten years. While the tree thrives as well as could be wished, there is always likely to come the cold snap during the winter, or failing this, the late frost in spring to end for the year our hope of peaches to eat and to sell.

Following the suggestion of the methods of protecting various ornamental and small-fruit shrubs, as the roses and the raspberries, several years since we undertook a series of experiments to protect the flower-buds of the peach, if possible, from the -20 degrees of winter, and the destructive late frost in spring.

Our trials were made on the trees that formed part of a nursery block of budded trees, standing where the seedlings were grown, in a stiff clay soil on a hill-slope facing the east. While the difference in altitude between the higher grounds on the College farm, and the river bottom in which lies the town of Manhattan, is sufficient in most years to give us superior immunity from the killing late frosts, yet the situation of the block of trees under con-

sideration is not such as to secure to them the greatest benefits of the higher location, lying as they do only half-way up the slope; and they were thus most favorably placed to show the advantage of the proposed protection, if such were found.

When the first attempt at their protection was made, the trees were three years old from the bud. In the fall of that year, 1887, the block was thinned out by removing some of the trees, leaving the remainder at irregular intervals, the alternate best trees with single unforked trunks being left standing wherever they occurred in the rows, with the result of an irregular alternate arrangement in which the trees stood perhaps from six to ten feet apart. The tops of a number of these trees were prepared for tying-up by the removal of any wide-spreading branches, and by the shortening-in of those remaining. After this pruning, the branches were drawn toward the main stem, held in place by ties of soft material to avoid the barking of the branches, and the entire tree-top thus prepared was surrounded by evergreen branches, mostly those of pine and red cedar, which happened to be it hand through certain changes in the evergreen plantations on the College grounds. Not only were these evergreen branches placed outside to some thickness, where they were held by cords wrapped around, but the spaces in the interior were filled with them as compactly as possible. To support this heavy mass of material, two or three stakes were driven alongside the tree in position to be wrapped in with the branches.

This attempt was followed by results but partially favorable. While the trees that had the advantage of protection showed more bloom than those alongside not so protected, the difference was not sufficiently marked to warrant the conclusion that this method could be made of practical benefit. It was found to be a matter of difficulty to retain the evergreen branches closely enough in and about the head of the peach tree to keep out the killing cold. Moreover, covering material of this kind could not be obtained in our State, except by accident, and some substitute must be found. As a cheaper, and, it is probable, a better material, we should have made a repetition of the trial with corn fodder, had we not been led by a stray suggestion to modify the method.

The following fall, 1888, the trees were in good condition for further trial. The shortening-in of some branches and the thinning-out of others had left abundant fruiting wood, favorably distributed and well covered with fruit-buds. Our plan was now to bend the trees downward, bringing them as near the earth as possible, and keeping them in this position, to be covered by a mass of hay or similar material thrown over the tops. To facilitate the bending-down of the tree, the earth was removed on the opposite sides of the trunk, preferably north and south, and on these sides the larger roots were cut off near the base, those on the right and left being allowed to remain as far as possible undisturbed, to keep the tree in unbroken connection with the soil. Now, as the tree-trunk was inclined toward the earth, the

lateral roots, by twisting slightly, offered no resistance to the operation. When the tree was sufficiently inclined, forked stakes were driven over the branches into the earth, to keep all in position. The soil was then heaped well over the roots and base of the trunk, to a depth sufficient to protect them thoroughly against drying out, and finally the entire tree was covered with whatever of suitable material was at hand. Not having enough of this covering material upon the grounds, we bought of a neighboring farmer the poor hay in the top and bottom of an old stack, at a nominal cost. This final covering was put in place in the last of November. To prevent the scattering of the hay by the wind, we soon after found it expedient to hold it in place by throwing upon the piles a lot of brush, grape prunings, and the trimmings of the orchard.

Early in the following April (the 2d and 3d), when the warm weather began to burst the buds, the covering was removed, the trees raised to an upright position, properly staked and tied, the blooming shoots again shortened-in where necessary, the earth replaced firmly about the roots, the ground leveled and the rubbish removed. The trees were now allowed to make whatever growth the season might afford.

The trees laid down were in all varieties found on uncovering to be in advance of their unprotected neighbors, and in several cases the flower-buds were expanded under the cover, the buds on standing trees being yet unblown. When all were in the best condition for an estimate of the proportion of bloom, a comparison of the trees that had been laid down with others of the same varieties exposed to the winter showed for the former proportions of full bloom varying from one-third in Ringgold to two-thirds in most varieties, exposed trees of the same showing only here and there scattering blooms. Hale's Early gave on exposed trees a third, and on protected trees three-fourths of a full bloom. Most of the trees set a large number of fruits, and prospects were good for a crop; but at the time of ripening a peculiar rot attacked all sorts alike, and of the whole not over a bushel of sound fruit was gathered.

The third trial, 1889, was conducted in all respects like the second. The trees had by the end of the summer recovered from the rather severe pruning necessary to bring them to place the previous fall, and were accordingly in good condition for the last attempt. Moreover, the growth of the unpruned side-roots had been such as to put the trees fairly into shape to do well without the roots at front and back, and when these were again uncovered they were found to be short but fibrous and their amputation no longer needed.

The result of the last trial, shown in the product of the summer just past, may be summed up briefly in these statements. The trees are now in good healthy condition. The bearing wood is in a compact head, with no long branches to be broken down by the fruit. The shoots and spurs are at this writing covered with plump fruit-buds. The lateral roots are strong,

while those at front and back are no longer an obstacle to the operation of laying down the trees. There was this year a full crop of fruit, and such fine Crawfords, Old Mixons, Smocks, Stumps, Elbertas, Columbias, Bonanzas and Ringgolds were not to be found in any orchard but our own in this locality, though in some favored stations outside the College farm certain seedling trees were in fruit in a limited way.

We sold most of the product readily on the spot at the rate of sixty cents per basket for the finest early, and fifty cents for the later fruit, the basket being the ordinary ten-pound grape package.

The cost of putting down seventy-one trees in the fall, including labor and hay bought, with the expense of replacing them in the spring, amounted to about twenty cents per tree, the labor being paid at the rate of ten cents per hour, and the hay costing two dollars. The average yield of the trees, accounting for fruit gathered and sold, and allowing by estimate for some stolen, was not far from one-half bushel each, leaving, at the prices obtained, a net return of not far from one and one-half dollars per tree.

NOTES ON THE GRAPES IN THE EXPERIMENTAL VINEYARD.

In the spring of 1888, there were planted on the Station grounds, as the beginning of an experimental vineyard, two vines each of sixty-four varieties of American grapes. Additional planting in 1889 and 1890 brought the number of varieties under trial to the present total of nearly one hundred cultivated sorts.

The site selected has a moderate slope to the east, and lies at a slight elevation above the general level of the lowlands, the soil being a clay loam of good quality, with a stiff clay sub-soil. This tract had been occupied, for several years previous to its present use, by a nursery plantation of various ornamental trees and shrubs. Before planting to vines the soil was put into thoroughly good condition, by plowing and sub-soiling, to the depth of a foot. The rows are seven feet apart, laid out north and south, the vines being nine feet apart in the row.

A few vines of the first planting, two years old when set, bore lightly in 1889, and in 1890 the greater number were in fruit with a moderate crop.

It is not proposed upon so short a trial, to offer conclusions, and the following notes are intended only as a record of the behavior of the several varieties up to the present, in this vineyard.

Agawan.—Vine of rank growth; leaves large and coarse; bunch large; berry large, of a handsome dark red; skin thick; flesh rich and sweet, but with a peculiar flavor not agreeable to every one. Season the first of September. Yield moderate.

Aminia.—Vine hardy and vigorous; bunch short, compact often shouldered; berry large, black with heavy bloom; flavor rich, sprightly; quality good. Season first to middle of August. Yield medium.

August Giant.—Vine very rank in growth; bunch large, long, rather loose; berry large, black; skin thick; quality good. Season latter half of August. Fairly productive.

Beauty.—Vine slender but vigorous; bunch small to medium, compact slightly shouldered; berry of medium size, slightly oval, deep red with a heavy bloom, and adhering firmly to the stalk; skin thick, tough, flesh solid, sweetish, but not rich. Fruit ripe the last of August, and remained on the vines in good condition until the middle of September.

Black Eagle.—Growth moderate and somewhat tender, doubtless needing winter protection here. Bunch large, long, rather loose, shouldered; berry medium to large, purplish black, with a heavy bloom. A grape of excellent quality, and a good keeper. Ripe by the middle of August, and still in good condition on the vines a month later.

Brighton.—Vigorous in growth, but not entirely hardy. Bunch long,

rather loose, shouldered; berry of medium size, deep red with a handsome bloom; skin rather tender. In quality scarcely excelled among the red grapes in this collection. Though ripe in mid-August, the fruit hung in good condition till the 20th of September.

Catawba.— The vines of this variety wintered well, and this season gave a heavy yield. The attractive bunches, the fine flavor, and the superior shipping qualities of this grape are important considerations in its favor. Ripe by the middle of September, the fruit hung in good condition till a month later.

Concord.— This may be assumed as the standard of comparison for the *Labrusca* grapes in the West. In hardiness, productiveness and general adaptability, under a great variety of conditions, it has yet to find a rival; and the quality of the fruit, while not the best, is good enough to commend it to most consumers. Ripens by the 20th of August.

Creveling.— The two vines of this sort made only a moderate growth, and did not stand the winter well, about half the buds failing to start in the spring. The bunch is medium to large, shouldered, usually rather loose; the berry large, slightly oval, deep purplish black, with thick bloom; the skin thick and tough. The fruit adheres firmly to the stem, and does not crack; it is juicy, rich, and pleasant—a grape of high quality.

Croton.— Vine of rather delicate growth, and decidedly tender; fruit in small, loose clusters; berry small to medium, oval, almost pointed, clear greenish yellow with white bloom; skin thin, but tough; flesh tender, sweet—This sort gave but a small yield, and showed traces of the black rot. Season from the 9th to the end of August.

Cynthiana.— The vines make a strong growth and the wood is very hard. The tender shoots are covered with a rusty red pubescence. This variety has so far been perfectly hardy, and gave a full crop of fruit this season, and a light crop the season before, the vines then three years of age. The bunch is medium in size, compact, heavily shouldered; the berry small, round, black, with a heavy bloom, the juice sharply acid until the fruit is well matured, then quite sweet, with a spicy, mild grape flavor. The fruit began to color early in August, but was not fairly eatable till a month later, showing no tendency to drop or crack.

Delaware.— For delicacy of flavor and for the other qualities that go to make up a delightful table fruit, this sort finds no superior among native grapes. The vines gave a moderate yield the past season, and evidently would admit of closer planting than that of our experimental vineyard.

Diana.— The vine vigorous in growth, but somewhat tender during winter. The yield was moderate, the clusters of uneven size, some large, compact and fine; the berry of middle size, light red, with a delicate bloom; the skin thick and tough; the flavor rich and pleasant, but with a slight foxiness. Season from the middle of August to the first of September.

Downing.— The two vines of this variety have so far been so tender and so subject to disease, as to incline us to declare it of no value in this locality.

Dracut Amber.— This well-known and hardy variety makes with us a strong growth, and produces heavy crops of the handsome, dark-red fruit. Its strong foxy odor and flavor, however; attract but few purchasers, though the grape handles and ships well. Season the middle of August, and for a month later.

Duchess.— Vine of strong growth, but too tender to stand our winters without protection. The fruit seems somewhat subject to attack from black rot. The bunches are long, rather slender, compact, shouldered; the berry of medium size, slightly oval, pale yellow, with white bloom; with a tough skin, and adhering firmly to the stem; flesh tender, sweet, excellent. In handling and keeping qualities this is a remarkable grape, when it can be secured in perfection.

Early Victor.— Vine moderate in growth, quite hardy; bunch of middle size, compact, shouldered; berry medium, round, black; flavor mild, pleasant. The vines under observation, now four years old, produced a good crop of grapes the present season, ripening from the first to the middle of August. This variety, being two weeks earlier than the Concord, promises to become valuable as a market grape.

Elvira.— Vine very strong in growth, branching freely, entirely hardy. Gave this year a heavy crop of fruit, often four bunches on one spur; bunches of medium size, very compact, shouldered; berry of medium size, round, clear yellowish green; skin thin and tender, cracking and handling badly; flesh tender, of considerable sweetness, but with the immature flavor which characterizes the class. Season from the last of August to the middle of September.

Empire State.— The vine strong in growth, but not hardy, ninety per cent. of the buds having failed during last winter. A few bunches of very fine fruit were obtained; the bunch large, long, compact, shouldered; berry medium to large, yellowish green, with white bloom; skin rather tough; flesh juicy, with little pulp, sweet, pleasant, with a peculiar and fine aroma. Season from the last of August to the tenth of September.

Eva.— Vine slender but vigorous; but about half the buds survived the past winter, and these gave but a light yield of fruit. Bunch and berry of middle size, though rather uneven; color greenish-yellow; skin tender; flavor mild, sweet, and lacking sprightliness. Season from the middle to the last of August.

Faith.— Vine of strong but slender growth, and quite hardy; yield light; bunch long, slender, loose; berry small, round, yellowish green, with white bloom; skin rather tough; flesh tender, sweet, and pleasant. Season from the last of July to the middle of August. Our earliest white grape.

Goethe.— Vine strong but not entirely hardy, and gave but a light yield last season. Bunches varying in size, often large and fine; berry large, oval,

coloring to dull red when fully ripe, with a tough skin and much tough pulp; flavor a mild acid with a peculiar aroma.

Grein's Golden.—Vine of medium strength, nearly hardy. The crop of the present season good. The bunch is loose, uneven in size; the berry large, round, and when ripe, pale amber in color. The skin is tough, but the berry drops badly as soon as mature. The flavor is strongly acid, with considerable sweetness, not unlike sweetened vinegar. Season from the first to the middle of September.

Hartford Prolific.—The vines make a long, slender growth, and are quite hardy. With us, this variety has not given the abundant yield that might compensate, in a measure, for the inferior quality of the fruit. The bunches have been of uneven size and thinly set. Ripe about the 10th of August.

Frances B. Hayes.—In vine and leaf this variety closely resembles Eva. The bunch is of middle size, rather loose, and evenly filled; the berry of middle size, golden green, with white bloom; the skin rather thin and tender; the flesh juicy, melting, more sprightly and pleasant than the Eva. Season, last of August and first of September.

Herbert.—Vine coarse and rank, with much the habit of Agawam; bore this year a moderate crop of fruit. Bunch short, compact: berry very large, round, purplish black, with heavy bloom; skin thick and tough, the pulp large and tough; flavor brisk, sub-acid, pleasant. Season, the last of August and first of September.

Isabella.—In this variety the vines make a very rank growth, but a large part of the buds are winter-killed. But a few clusters have been obtained, and these of poorly matured fruit.

Ives.—The vines are rampant in growth, perfectly hardy, and fruit abundantly. The berry medium sized, compact bunches, black with a heavy lilac bloom, are quite attractive, and are often marketed when first colored, though yet immature and unfit for eating. When fully ripe, however, their strong musky flavor is against them. Their season of perfect maturity is with us about the same as that of the Concord.

Jefferson.—The vines of this variety seem to lack vigor, and half the buds failed last winter, but a few bunches of fruit being produced. The bunch is large, compact, shouldered; the berry large, oval, coppery-red with thin bloom; skin rather tough; flesh tender, juicy, pleasant. Season about the first of September.

Lady.—Vine hardy and fairly vigorous; yield of fruit only medium; bunch medium to large, oblong, with heavy shoulder; berry large, rich, golden, with a thick bloom, of very fine appearance; flesh meaty, not juicy, rich, sweet, but with a flavor resembling an over-ripe pear, which detracts from its quality. Ripened unevenly, from the middle of August to the first of September.

Lenoir.—Ninety per cent. of the buds on these vines winter-killed, but they have made an enormous growth during the summer; the foliage is

magnificent, the leaves being abundant and thick, glossy, dark green; a few bunches of fruit were produced; bunch very large, tapering, heavily shouldered; berry medium-sized, larger than *Cynthiana* or *Norton's*; round, black, with lilac bloom; skin tough; flesh juicy, brisk sub-acid; has a little tough pulp. Ripened the latter part of September. This is evidently too far north for the successful growth of this grape.

Lindley.— Vines of only moderate growth; sixty per cent. of the buds failed to start last spring; gave only alight yield of fruit; bunch and berry above medium size, dark red, with a heavy bloom; skin thick and tough; flesh with a good deal of tough pulp; flavor sweet and rich, but with a harshness if the skin is too closely pressed.

Marion.— Vine in habit much resembling *Clinton*, hardy and vigorous, but canes slender and much branched; produced a fair yield of fruit, which would be valued chiefly for jelly-making; bunch and berry of medium size; color black with lilac bloom; skin tough; flavor sharply acid, much resembling *Clinton*, but better. Colored in July, but not fully ripe till the first of September.

Martha.— Vines of vigorous, but slender growth, and did not prove quite hardy last winter; produced a medium crop of fruit; bunches uneven in size, some large and very fine; berry large, round, clear greenish yellow, with white bloom; flavor rich, sweet, with an aroma similar to *Eva* or *Hayes*. Season, the last of August.

Mason's Seedling.— Vines of only moderate vigor, but quite hardy; yield of fruit light; bunches of medium size, but berry large and fine; the best flavored of any of the *Concord* seedlings. Ripe the last of August.

Maxatawney.— Vines of rank growth, with dark leaves and purplish canes; has proved hardy, but the yield of fruit has been light; bunches long, rather slender, loose; berry of medium size, long, oval, pale yellow, slightly amber when fully ripe; flesh meaty, sweet, pleasant, seeds few. Season, 10th to last of August.

Mills.— The vines make a rank growth, but tender, killing nearly to the ground last winter; yield of fruit only a few bunches, which were medium to large, fairly compact, shouldered; berry of medium size, slightly oval, black, with lilac bloom; skin very thick and tough; when fully ripe the flesh is meaty, sweet, quite rich and pleasant, though hardly first-class. The berries adhere very firmly to the stem, and will bear more rough handling than any other grape in the list. Ripe the first of September.

Missouri Riesling.— Vines hardy and very strong; made a rampant growth and bore a heavy crop of fruit last season; bunch medium to large, compact, shouldered; berry medium to large, slightly oval, greenish yellow with a thin, pearly bloom; skin so thin as to crack and handle badly; flavor sweet, sub-acid, with the immature flavor peculiar to the class. Season from the middle to last of September.

Montefiore.— Growth of vine slender, but vigorous and hardy; produces

a good yield of fruit; bunch rather small, compact, with heavy shoulder; berry of medium size, slightly oval, black, with heavy lilac bloom; skin tough, flesh tender, juicy, sub-acid, not rich; the berries adhere firmly to the stem and do not crack. This has some of the qualities of a good market sort to follow the Concord.

Moore's Diamond.—Vine vigorous and thus far entirely hardy; the product this season was light; the bunches are large, long, compact, shouldered or doubly shouldered, and very handsome; berry medium to large, round, pale golden, with heavy bloom; skin so thin as to need very careful handling; flesh juicy, melting, leaving no pulp; flavor mild, sweet, lacking sprightliness, and rather disappointing.

Naomi.—Vines make a heavy growth of long, slender canes, so tender that half of the buds failed to start last spring, and the fruit set was only a few clusters; bunches too imperfect to show character; berry of medium size, clear greenish yellow with thin bloom. Ripe the last of August.

Niagara.—The vines make a strong but somewhat slender growth; many of the buds proved too tender for last winter; bore only a light crop; bunches large, compact, shouldered; berry large, oval, greenish yellow, with quite heavy bloom; skin tough, fruit does not crack or drop; flesh tender, juicy, pleasant; quality excellent. Ripe with Concord.

Norton's Virginia.—In vine and foliage we see nothing to distinguish this from the Cynthiana. The bunch and berry have been somewhat smaller and the yield considerably less.

Pearl.—Of this the vines have been quite hardy, and produce many long, slender canes, giving a fair yield of fruit. The bunches vary in size, and are rather long and loose; the berry medium, yellowish green with a pearly bloom; the skin thin; the flavor similar to that of Elvira or Missouri Riesling. Of medium quality as a table fruit, and ripening from the first to the middle of September.

Perkins.—The vines of this sort made a strong and hardy growth, but gave only a light crop of fruit. The bunches small and imperfect. The berry is oval, pale red, of strong, foxy flavor like that of Dracut Amber.

Pocklington.—Of this sort the vines are vigorous and hardy. They set a heavy crop of fruit last spring, but failed to mature it well. The bunches are large, rather long, very compact, heavily shouldered; the berry large to very large, often quite oblate; the color rich golden, with fine bloom when fully matured; flesh meaty and the flavor sweet. Ripened quite unevenly the last of September, and much fruit was cut by the frost in October.

Poughkeepsie Red.—The vines of this variety are of delicate growth, unhealthy and tender, and bore only a little fruit last season. Bunch small, compact, with short shoulder; berry about the size of Delaware, pale red, with thin bloom; skin tough; flesh meaty, sweet, rather insipid. Ripened the last of August, and some remained in good condition till the 24th of September.

Prentiss.— Fifty per cent. of the buds on these vines failed. Yield of fruit, only a few berries.

Rommel's Etta.— But few buds winter-killed on these vines, and the season's growth has been vigorous, the yield of fruit heavy. Bunch medium to large, compact, heavily shouldered; berry large, round, yellowish green, with a pearly bloom; skin thin but tough, flesh a little pulpy but juicy, sweet, and with less of the unripe flavor than any other white Riparia. Season from the middle to the last of September, some holding on into October, when most other grapes were gone. A fairly good table grape, and handles well.

Triumph.— Of this the vines make a good growth, but many buds failed last winter, and the crop of fruit was light. Bunch large, long, tapering, compact, heavily shouldered; berry large, round, pale green, with heavy bloom; skin rather thick and tough; flesh tender, rich, juicy, very fine flavored. Much the best white grape in the list, and nearly equal to Niagara as a handler. Follows Niagara in ripening.

Ulster Prolific.— The vines of this sort did not prove quite hardy, and while they have made a heavy growth during the summer, they bore only a light crop of fruit. Bunch of medium size, short and compact, shouldered; berry medium to large, dull mottled red; skin thick, tough; flesh with some tough pulp, sweet, but with some foxiness. Not a grape of first quality, "better than Delaware," as has been claimed for it. Ripened unevenly during September.

Venango, or Minor's Seedling.— A rank grower, and hardy. Gave but a light crop of the most unpalatable red fox grapes in the collection.

Vergennes.— The vines produce strong canes, but are quite tender and gave only a slight yield of fruit. Bunch and berry large, color dull red, with heavy bloom; skin thick, flesh tender, sweetish, but lacking in flavor. Season from the middle to the last of September.

Wilder.— Of this variety the vines gave a good crop of excellent fruit. The bunch and berry large and of fine appearance; the skin rather tough, the flesh with little pulp and with a fine, sweet, rich flavor. Season, the middle of August to the first of September.

Woodruff Red.— Of this hardy vigorous sort the vines gave last summer a heavy crop of attractive fruit. The bunch is large, heavy, compact, with a short shoulder; the berry very large, round, clear pale red; the flesh juicy, sweet, and with a slight musky flavor. The fruit of this variety attracted much attention and seemed to be as generally acceptable to the palate as it was agreeable to the eye. Season, late August and early September.

Worden's Seedling.— Of this sort the canes and foliage have all the characteristics of the Concord, and the fruit, of which there was a good yield, also closely resembles that of the Concord, with which it ripened; but the bunch is more oblong and compact, and not so heavily shouldered; the

berries are rather more thin-skinned and more liable to crack, and on this account the present variety is inferior as a shipper.

Wyoming Red.— The vines of this are of vigorous but slender growth, and quite hardy, producing this year a fair crop of fruit. The bunch is of middle size, compact, oblong, or sometimes shouldered; the berry of middle size, round, light red, with a heavy white bloom; the skin thin, tough; the flesh juicy, with some tough pulp; the flavor sub-acid and pleasant, with a slight foxiness. The fruit is of very attractive appearance, and sufficiently good to sell readily. Season a little earlier than the Concord.