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Cultural Factors Affecting Sour Cherry Production in Colorado

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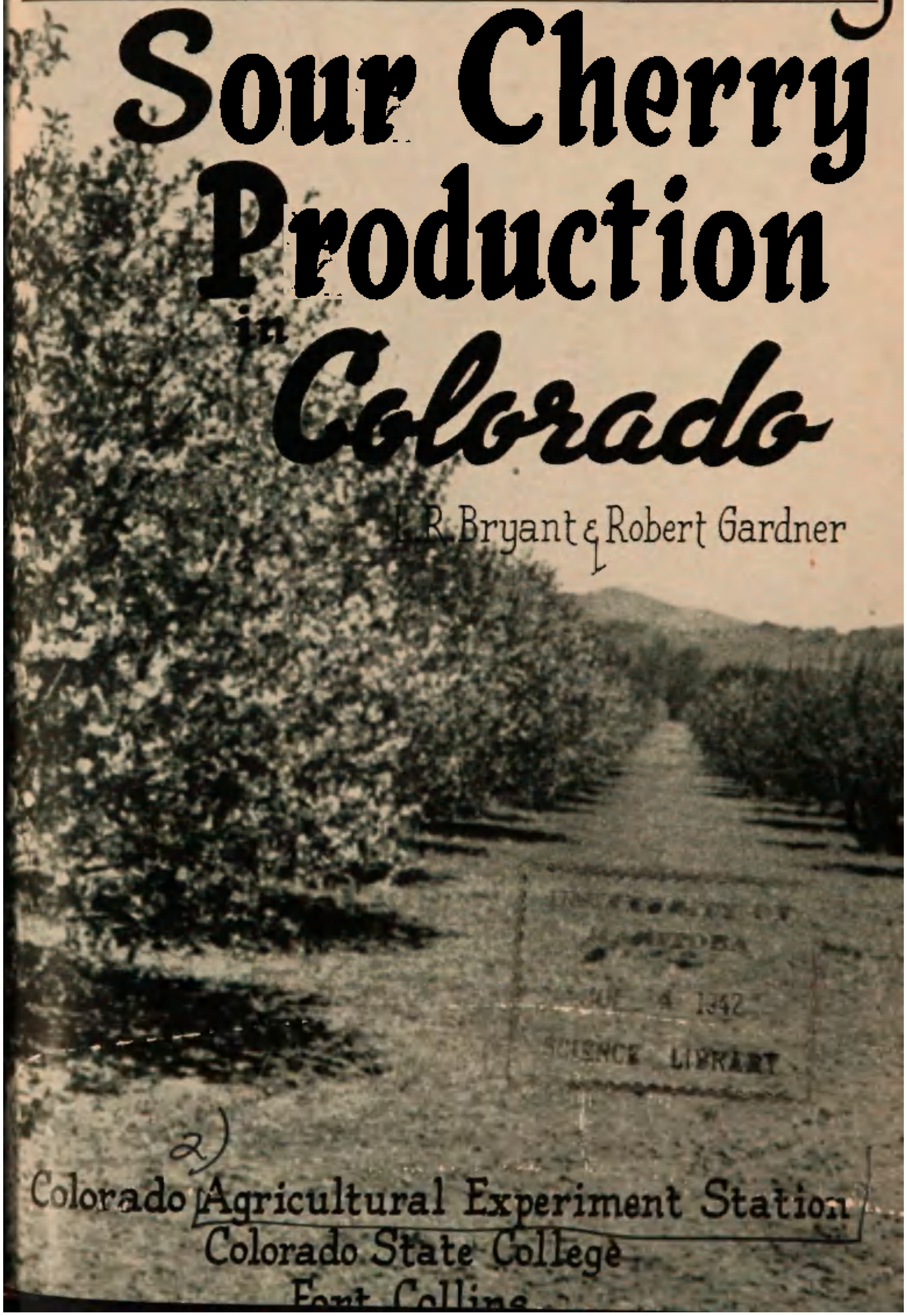

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Cultural Factors Affecting Sour Cherry Production in Colorado

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THE SOUR CHERRY is one of the fruits commonly grown in Colorado both as a commercial crop and for home use. Commercial production is limited mainly to the Montmorency variety since it is the sort preferred for both canning and freezing. Some English Morello and Early Richmond also are grown.

The 1935 census showed about 516,000 cherry trees growing in the State. A number of these were on poor sites or where there was insufficient water, and they were not able to survive the drought period which followed 1935. Poor management also contributed to mortality in and abandonment of orchards, and by 1940 the total number of trees had fallen to about 407,000.

A long-range experiment to determine management practices best suited to sour cherry production in Colorado was started by the Colorado Agricultural Experiment Station in 1935. This bulletin presents the results of 6 years of experimentation and observation on factors affecting production of Montmorency sour cherries in commercial areas in north-central Colorado.

Production Factors

Prices

Prices received for cherries in Colorado have fluctuated widely (table 1) and at times have dropped to a point so low that the grower has had difficulty in making a profit. The average grower seldom can make a profit growing sour cherries to

TABLE 1.—*Colorado cherry production and crop values.**

Year	Production in tons	Price per ton	Value of crop
1927	4,500	$140.00	$630,000.00
1928	1,650	140.00	231,000.00
1929	5,120	120.00	614,000.00
1930	3,570	90.00	321,000.00
1931	2,500	70.00	175,000.00
1932	3,820	52.00	199,000.00
1933	1,900	54.00	103,000.00
1934	5,230	45.00	235,000.00
1935	4,010	50.00	201,000.00
1936	700	80.00	56,000.00
1937	3,840	80.00	277,000.00
1938	5,280	45.80	242,000.00
1939**	3,770	50.00	188,000.00
1940**	4,090	50.00	204,000.00

* Data from Colorado Agricultural Statistics, 1939, F. K. Reed, Agricultural Statistician, Denver, Colo.

** The figures for 1939 and 1940 are for sour cherries only.

Figure 1.—An excellent cherry orchard site.

sell at $45 or $50 per ton or 2¼ to 2½ cents per pound. At such prices he must have heavy yields of good fruit to compensate for low prices.

Orchard Site

Selections of sites for sour cherry plantings in the State have not always been good. Some orchards have been planted in excellent locations (fig. 1.) but large numbers of trees in the commercial areas were planted for speculation with too little attention paid to the sites on which the trees were set. Too often planters have considered dry-land areas, where irrigation was impossible or water unavailable, as sites "good enough for sour cherries." Others have tried to use land which, although provided with some irrigation water, never had sufficient moisture in the soil to produce fruit of good quality over long periods of time. During the recent years of severe drought many trees on locations where water was always short have died.

Things other than availability of water supply are important in the selection of sour cherry orchard sites. For example, sour cherry trees do much better on light than on heavy soils. While it is true that the sour cherry is more tolerant of adverse soil conditions than are many other fruits, soil drainage should be good and the subsoil should be such as to permit root penetration to relatively deep levels. This means that shallow, very shaly, or poorly drained soils are not suitable for sour cherries. Soils which have sufficient natural fertility to grow fair grain or potato crops should be satisfactory for sour cherries if a definite program of soil management and fertility maintenance is followed.

There are a number of problems which must be considered if cherry production is to be profitable. The supply of organic matter in the soil is important since it affects both the physical condition of a soil and the availability of plant food. Under average orchard conditions in Colorado the soil organic content is low. By far the most of the sour cherry orchards have been clean-cultivated. This means that little or nothing has been returned to the soil in the way of nutrients or organic matter over the period of time the trees have been on the ground. Since continuous cultivation will decrease the amount of organic matter in the soil, it is essential that this material be replaced when lost. There are several ways in which this may be done, but the use of cover crops or manure is more common.

Cover Crops

Cover crops seem the more logical method for the grower who does not have sufficient manure or other litter available but has enough water to supply both the trees and cover crop. Cover crops have definite value wherever they can be fitted into an orchard soil management program but there is always a question as to the relative value of the different crops which can be used.

In an attempt to evaluate different types of cover crops, studies were initiated in two orchards to compare some of the more common cover crops with manure. The trees in these plantings ranged in age from 7 to about 18 years. All were of the Montmorency variety. The soil in orchards nos. 1 and 2 is a LaPorte loam. This is considered a moderately good fruit soil if it is fairly deep. It is rather low in organic matter. These trials were carried on for 4 years but failed to provide any data on the effects of the treatments used. This failure was due mainly to the fact that both these orchards were always somewhat short of soil moisture. At the time of seeding there was never enough available moisture to germinate the seed, let alone produce a satisfactory growth of cover-crop material. As a check on the moisture and fertility conditions of the orchards, soil samples were taken at frequent intervals and tested for percentage moisture and available nutrients.

Table 2 shows the available moisture to a depth of 3 feet at the time of these periodical samplings from 1935 to 1939. The permanent wilting point was ascertained by use of dwarf sunflowers grown on samples of soil in the greenhouses. The soil

TABLE 2.—*Available moisture in acre inches in upper 3 feet, 1935 to 1938, inclusive.*

Orchard No. 1

Depth in inches	1935 April 6	1935 June 7	1935 July 18	1935 Aug. 22	1935 Nov. 26	1936 April 6	1936 June 11	1936 Aug. 14	1936 Nov. 14	1937 April 6	1937 June 6	1937 July 26	1938 April 4	1938 June 8	1938 Aug. 9
0-6	.23	.54	.41	.00	.66	.41	.55	.47	.79	.91	.90	.22	.92	.74	.00
6-12	.50	.62	.36	.00	.48	.24	.37	.37	.52	.68	.60	.33	.66	.56	.93
12-24	.59	1.05	.69	.00	.00	.00	.49	.42	.00	.74	.78	.49	.53	1.10	.58
24-36	.07	.00	.51	.00	.00	.04	.19	.24	.00	.02	1.31	.01	.00	.31	1.05
Total	1.39	2.21	1.97	.00	1.14	.69	1.60	1.50	1.31	2.35	3.59	1.05	2.11	2.71	2.86

Orchard No. 2

Depth in inches	1935 April 6	1935 June 4	1935 July 17	1935 Aug. 21	1935 Nov. 29	1936 April 6	1936 June 11	1936 Aug. 14	1936 Nov. 14	1937 April 5	1937 June 6	1937 July 26	1938 April 4	1938 June 6	1938 Aug. 8
0-6	.00	.68	.11	.00	.54	.83	.69	.06	.72	.80	.63	.00	.80	.70	.28
6-12	.00	.70	.22	.00	.50	.70	.48	.00	.52	.71	.56	.00	.78	.71	.30
12-24	.00	1.31	.57	.00	.66	.82	.97	.05	.00	1.03	1.13	.14	1.63	1.39	.81
24-36	.01	1.01	.09	.00	.51	.53	.58	.06	.00	.00	.00	.45	.00	1.27	.71
Total	.01	3.70	.99	.00	2.21	2.88	2.72	.17	1.24	2.54	2.32	.59	3.21	4.07	2.10

Orchard No. 3

Depth in inches	1935 April 6	1935 June 3	1935 July 12	1935 Aug. 19	1936 April 6	1936 June 11	1936 Aug. 13	1937 April 21	1937 June 6	1937 Nov. 26	1938 April 4	1938 June 9	1938 Aug. 8	1939 July 17
0-6	.03	.75	.30	.03	.64	1.04	.35	.77	.57	.38	.86	.43	.19	.81
6-12	.00	.56	.23	.09	.27	.61	.06	.43	.21	.00	.47	.30	.00	.54
12-24	.00	.95	.65	.00	.76	.94	.20	.50	.56	.00	.27	.78	.29	1.11
24-36	.00	1.01	1.07	.54	.96	.89	.64	.50	.44	.00	.43	.69	.70	1.41
Total	.03	3.27	2.25	.66	2.63	3.48	1.25	2.20	1.78	.38	2.03	2.20	1.18	3.87

moisture in excess of the permanent wilting percentage is the amount usually considered as the available soil moisture; this is expressed in the table as acre inches. It is true that trees can, and probably often do, reduce the soil moisture below this point. However, when the available moisture falls below the permanent wilting percentage, it seems logical that the trees can make but little growth, although in this test they were able to maintain themselves. Study of the soil moisture data from these orchards will show that there was little if any moisture available in excess of that needed by the trees at any time and that the trees exhausted the entire available supply before the end of the season in nearly every year.

Further evidence of definite water shortage in orchard no. 1 has since developed. The cover-crop trials were discontinued in 1938 and trees in the drier part of this orchard have been abandoned because of damage from the lack of sufficient soil moisture.

Fertilizers

Another problem confronting the sour-cherry grower is the need or desirability of fertilizing his trees. If fertilizers are to be applied, what materials should be used? The use of commercial fertilizers has never become a definite part of the average cherry grower's soil management program in this State. Since high yields are essential for profit but have not been uniformly attained under the soil-management practices in common use, it seemed probable that the plant-food supply in some of the orchard soils must be low. Consequently a series of fertilizer trials was begun in 1935.

Although two orchards originally were included in these trials, data are reported on only one, orchard no. 3. The second orchard was extremely short of water in the summer of 1935, and so many of the trees suffered drought injury that the tests in this orchard had to be dropped.

Orchard no. 3 was on the Terry fine sandy loam soil type. This soil type is used quite extensively for fruit production in this area, and is of rather low natural fertility. This mature Montmorency orchard has received better than average care. Manure has been applied in limited amounts and cover crops have been sown in seasons when soil moisture seemed sufficient to permit satisfactory cover-crop growth. At least two irrigations have been applied each year, the time of application depending on the soil moisture and the availability of water. However, since water has been frequently difficult to obtain, this orchard has seldom had sufficient soil moisture throughout the entire year.

Soil treatments were used as follows: Nitrogen alone; phosphorus alone; potassium alone; nitrogen and phosphorus; phosphorus and potassium; nitrogen, phosphorus, and potassium, (or complete fertilizer); manure; and untreated or check. The nitrogen was obtained from ammonium sulphate applied at the rate of 2½ pounds per tree or 400 pounds per acre. Treble superphosphate was used at the same rate as a source of phosphorus. Muriate of potash used at the rate of 1 pound per tree, or 160 pounds per acre, provided the potassium. Manure was applied at the rate of 10 tons per acre annually. When two or more of the commercial fertilizers were combined, the rate of application for each fertilizer was the same as when the material was applied alone. None of these applications, except perhaps the manure, were heavy. All treatments were applied broadcast in the spring. The manure was applied at the earliest convenient date and the commercial fertilizers were spread 2 to 3 weeks before bloom. All orchard operations other than the fertilizer applications were the same as in the untreated part of the orchard.

Three trees per plot were used in these fertilizer trials. All treatments were replicated four times, and border trees surrounded all plot or record trees.

Yield data include records for the years 1935, 1937, 1938, 1939, and 1940. No yield data were available in 1936 because severely cold weather in February of that year killed practically all of the fruit buds. The data for the 5 crop years are given in table 3.

Examination of these data shows that the application of nitrogen annually tended to increase yields over those of the check or no-treatment plots. Naturally the differences have fluctuated from year to year. The greatest average increases were obtained from the plots where nitrogen was used alone, followed by the plots where annual applications of manures were made. Where a complete fertilizer, that is, one containing nitrogen, phosphorus and potassium, was used, yield trends continued upward to a significant degree. On the plots receiving both nitrogen and phosphorus the tendency was the same as for the plots receiving nitrogen, phosphorus, and potassium, although the complete fertilizer gave a higher average yield. Thus, where nitrogen was applied, whether in the form of a commercial fertilizer or as manure, yield increases followed. With the exception of the plots receiving both nitrogen and phosphorus these increases were of sufficient size to be significant over the period of these tests. In the case of treatment with both nitrogen and phosphorus, where the yields were barely below those needed to show significance, the condition of the trees in one of the repli-

TABLE 3.—*Yield on Montmorency cherry trees as influenced by fertilizer treatments. Plot and tree averages for 5 crop years in pounds.*

Treatment	1935	1937	1938	1939	1940	Plot average	Tree averages for 5 years
Nitrogen	278.4	171.5	174.0	117.1	185.0	185.2*	61.5
Manure	235.8	179.8	170.5	141.0	151.8	175.8*	58.6
Complete (N, P and K)	194.9	131.4	155.0	121.5	147.5	150.0**	50.0
Nitrogen and phosphorus	206.3	133.6	145.8	102.2	132.8	144.0	48.0
Phosphorus and potassium	210.8	137.9	124.4	80.4	120.4	134.8	44.9
Potassium	186.9	121.0	116.2	70.8	92.6	117.5	39.2
Phosphorus	198.3	84.5	104.5	80.5	88.1	112.2	37.3
Check, no treatment	173.3	109.1	96.2	74.1	88.3	108.2	36.1
Difference for significance (at 5-percent point)	109.8	102.5	98.9	61.8	57.0	40.06	

* Significance to 1-percent point.
** Significance to 5-percent point.

cations may explain some of the yield variations. Two of the trees in this replicate had suffered severe winter injury and sun-scald damage which had necessitated the removal of from one-half to three-fourths of the tops. In spite of these poor trees the yield tendencies were definitely upward.

None of the treatments other than the ones containing nitrogen either alone or in combination showed significant yield increases.

Fruit Size

One point of definite interest to commercial sour cherry growers is fruit size. If the fruit is to be accepted for processing by some canners, it is essential that it be of sufficient size to meet the requirements of the U. S. no. 1 grade. This means that the fruit must be at least five-eighths inch in diameter. Table 4 summarizes the size data for the 5 crop years. These data are based on the weight of 50-cherry samples selected at random from each plot in each treatment. To meet the U. S. no. 1 grade the weight of a 50-cherry sample must be 150 grams or more.

During the 5 crop years fruit size varied widely according to the fruit set and the moisture available. Much of the variation apparently depended on the crop the trees were maturing. In 1935, the heaviest crop year recorded as well as the one lowest in available moisture, none of the treatments produced fruit of sufficient size to meet the U. S. no. 1 grade requirements. In the other 4 years the size requirements were met, although in a number of cases the fruit size was barely over the grade minimum. There were no consistent size differences apparent between treatments over the 5-year period. This indicates that yield differences must have been the result of increased numbers of fruits setting and maturing. It also tends to confirm the view that moisture is very definitely a limiting factor in this area. The fact that soil moisture was very low in all the August samplings made immediately after harvest shows that moisture requirements often may not be met.

IRRIGATION.—Soil moisture should be maintained at a reasonable level at all times. However, if only limited amounts of water are available, irrigation is probably most essential shortly before the fruits reach maturity. Growers have found that water applied at this time will increase fruit size materially. The entire area should be soaked to a depth of at least 4 to 5 feet at this time if possible.

Another critical moisture period in sour cherry orchards is during the winter. Late irrigation applied as the trees go into a

TABLE 4.—*Summary of fruit size data based on the weight in grams of 50-cherry samples.*

Treatment	1935	1937	1938	1939	1940	Total	Five-year average
Nitrogen and phosphorus	137.1	167.4	152.4	160.4	160.6	779.9	155.8
Manure	148.2	176.1	165.4	174.9	182.4	847.0	169.4
Nitrogen	144.5	172.7	158.5	172.5	186.4	834.6	166.9
Phosphorus	146.1	184.0	154.6	163.5	156.0	804.2	160.8
Check, no treatment	136.5	186.4	161.8	175.1	151.0	809.9	162.2
Phosphorus and potassium	149.2	174.2	150.0	164.2	153.5	791.1	158.2
Potassium	136.2	169.9	154.6	160.1	156.3	773.5	154.7
Complete (N, P and K)	136.3	167.8	150.5	198.0	173.2	825.8	165.2
Difference for significance (at 5-percent point)	28.34	26.87	23.40	23.27	21.01		5.64

dormant condition, will supply the trees with needed winter moisture and frequently will decrease winter injury resulting from dessication.

Pruning

Another variable in sour-cherry production is pruning. In many orchards in Colorado little wood is removed each year, while in others the pruning is much more severe. Some pruning is necessary to maintain a sour-cherry tree in a satisfactory productive condition. Unpruned or very lightly pruned trees become thick and bushy with very little fruiting wood beyond a thin zone around the outside. However, when pruning is increased much in severity, yields drop in direct proportion to the severity of the pruning.

To test the effects of varying severity of pruning on sour cherries, a planting of Montmörency trees was set out in 1935. Pruning treatments used are as follows: No pruning; light pruning; medium pruning; and severe pruning. Light pruning consisted in the removal of all interfering branches and thinning out the centers of the trees sufficiently to maintain some fruit production on the interior branches of the trees. Medium pruning removed from 15 to 25 percent of the total annual growth. Heavy pruning removed from 30 to 50 percent of the annual growth.

Naturally these trees have produced only a few crops. Yield trends in general have followed those reported elsewhere (*1, 2*)[1], that is, severe pruning definitely decreased yields. Table 5 gives the average tree yields for 1940 and 1941.

These data indicate that the average yields per tree for the 2-year period given are not widely different for the trees receiving no pruning and the light and medium pruning. However, the severely pruned trees produced significantly smaller crops

TABLE 5.—*Yields of Montmorency sour cherry trees under different pruning treatments*, 1940 - 1941.

	Average yield per tree in pounds		
Type of pruning	1940	1941	2-year average
None	21.83	20.20	21.02
Light	17.11	18.30	17.71
Medium	13.56	19.40	16.48
Heavy	11.11	14.00	12.56
Difference for significance (at 5-percent point)	3.17	3.19	2.25

[1] Italic figures in parentheses refer to bibliography, page 19.

than did trees under any of the other pruning treatments. This was caused primarily by a reduction in the total number of fruit buds set due to the smaller number of branches carried by the heavily pruned trees (fig. 2).

In planning a pruning program there are other points than yield alone to be considered. Attention should be called to the condition of the interiors of the unpruned trees in this test. The tops have become thick and bushy. Already shading has caused some of the interior fruit spurs and branches to start to die back. The number of fruiting spurs on the interiors of the trees is decreasing and undoubtedly they all will die out in time. When this occurs, it is evident that the productive areas of these trees will be reduced, since they will then be confined to the outer parts of the trees. Yields then will decrease according to the loss of bearing area. This condition is present on the lightly pruned trees to some extent but is not found on those receiving medium pruning (fig. 3).

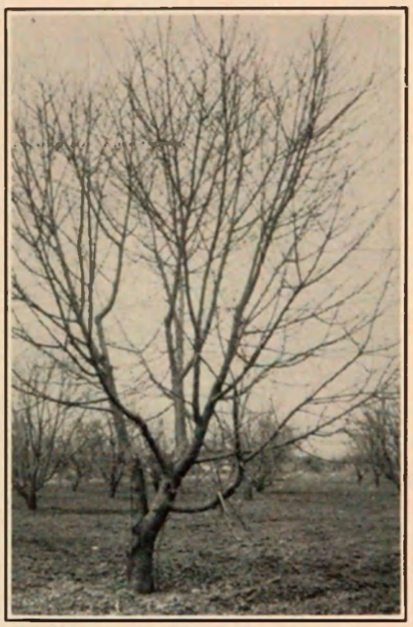

Figure 2.—A heavily pruned sour cherry tree showing the limited number of branches

Forcing of the bearing areas out and away from the center of the trees is objectionable from another point of view. It places much greater mechanical strain on the branches, and the danger of breakage is consequently increased. Harvesting is also made more difficult, since thick, bushy tops are much harder to pick. This is a consideration of definite importance when pickers are scarce.

While the available fruit size data are still incomplete, the tendency is for the unpruned and lightly pruned trees to produce smaller fruit.

On the basis of present knowledge, it seems best to use a moderately light type of pruning on sour-cherry trees in Colorado.

Rootstocks

For many years there has been some controversy over the relative merits of the mahaleb, *Prunus mahaleb*, and the mazzard, *P. avium*, L., as rootstocks for sour cherries. Test plantings at Fort Collins have shown that the mahaleb rootstock, which is the one commonly used, has certain advantages, especially for the Montmorency sour cherry. It has produced larger trees in a given period of time, and they have shown greater resistance to the alkaline soils of this area. They have shown distinctly better adaption to low temperatures and desiccation. It seems to be the more satisfactory rootstock for sour cherries wherever climatic and soil conditions are not the best.

Figure 3.—An unpruned cherry tree. Note the thick, bushy top growth. Fruit spurs in the center of the tree are dying out.

Harvesting

Cherries intended for processing (canning and freezing) are generally "pulled", leaving the stems still attached to the trees. Picked in this manner the fruit must be used within a short time after picking and it is not satisfactory for shipping or local marketing. For this type of outlet the fruit is "clipped" or picked with the stems still attached. When picking is done in this manner production costs will be increased over "pulling", but the fruit will hold up in good condition for a longer time.

There is no standard package for retail sales, all fruit being sold by the pound. Cannery stock is handled in factory lugs holding about 25 pounds.

Replacing Lost Trees

It is not practical to attempt replanting as trees die in old orchards. When stands become too thin it is better to remove the trees in blocks, build up the soil by the use of green manure crops, and then replant the area as a unit. Replanting should not be in the old tree positions if it can be avoided. Too often the results are unsatisfactory if this is done.

Summary and Discussion

There are several things to consider in evaluating any system of sour cherry orchard soil management. Some are within the control of the grower, while others are out of his hands. Two factors seem of the greatest importance: Namely, soil moisture and fertility level.

The data on soil moisture in these orchards (table 2) indicate that moisture deficiencies are rather common and that moisture must be considered a limiting factor in striving for higher yields. The amount of moisture needed for satisfactory fruit production naturally will vary widely from orchard to orchard and from soil type to soil type.

The depth at which adequate soil-moisture supplies exist also is of importance. The table shows that a moisture deficiency was common at the third foot in all the orchards studied. It is also evident that a definite shortage often occurred at shallower depths. The fact that trees have been abandoned in at least one of the test orchards, because of injury caused by moisture shortage, gives added emphasis to the need for greater consideration of the available soil moisture and irrigation-water supply. Records and observations in other orchards, both "dry-land" and irrigated, confirm this.

The value of a good orchard site cannot be overemphasized since it may mean the difference between success and failure. On established orchards there is little that can be done to rectify poor site selection except to discard plantings which definitely have shown that they will not produce at a profit. There is no justification for continuing to pay expenses on orchards which cannot be made to pay their way. Two factors difficult or impossible to change are depth of soil and water supply.

The sour cherry is grown on a wide variety of soils, although it usually does best on the sandy or gravelly loams. It is more tolerant of poor soil conditions than are most other fruits. For best results the soil should be well drained and fairly deep. Reasonable fertility is necessary. Even with the better and more fertile soils the use of fertilizers undoubtedly will become necessary in time.

The present fertilizer trials demonstrate the effect of nitrogenous fertilizers on trees which have been growing on the site for 15 to 20 or more years. Table 6 shows the returns from fertilizer application on the basis of average tree income for the 5-crop-year period under consideration. These returns are based on a price of 2¾ cents per pound of fruit, approximately the

TABLE 6.—*Income per tree following applications of commercial fertilizers. (Based on price of $2\frac{3}{4}$ cents per pound of fruit; labor costs not included.)*

Treatment	Average yield (5 years)	Gross income	Fertilizer cost*	Net income	Increase in income over check
Nitrogen	61.5 pounds	$1.69	$ .05	$1.64	$ .65
Manure	58.6 pounds	1.61	.14	1.47	.48
Complete (N, P, & K)	50.0 pounds	1.38	.13	1.25	.26
Nitrogen and phosphorus	48.0 pounds	1.32	.11	1.21	.22
Phosphorus and potassium	44.9 pounds	1.23	.08	1.15	.16
Potassium	39.2 pounds	1.08	.03	1.05	.06
Phosphorus	37.3 pounds	1.03	.06	.97	—.02
Check, no treatment	36.1 pounds	.99			

* Fertilizer costs are based on the following figures:

Ammonium sulphate	$40.00 per ton.
Treble superphosphate	47.50 per ton.
Muriate of potash	55.00 per ton.
Manure	2.26 per ton.

Manure costs are based on the value of the nitrogen, phosphorus and potassium contained in the manure and do not include the value of the organic matter added to the soil.

average return to Colorado sour-cherry growers for the 10-year period from 1931 to 1940. They substantiate the idea that nitrogen is deficient during at least part of the growing season, since the addition of 2½ pounds of a nitrogen bearing fertilizer per year gave increased returns of from 22 cents to 65 cents per tree per year exclusive of the labor costs of applying the fertilizer. The greatest returns were obtained from the application of nitrogen alone, increases with this material amounting to as much as 70 percent over the check plot yields during the 5-crop-year period.

Similar responses have been reported from other sources. Roberts and Potter (*3*) in Wisconsin obtained a definite increase in yield of sour cherries from trees receiving nitrogen either alone or in combination with phosphoric acid and potash, but no gain from the last two alone. Tukey (*4*) in New York reported that nitrogen fertilizers alone gave the greatest yield increases among the treatments receiving nitrogen. Nitrogen in combination with phosphorus was next, and the complete fertilizer last. None of the differences were large. Tukey called attention to the fact that the yield data indicated no return of significance from the phosphorus and potassium combined with the nitrogen.

Tree reactions indicate a shortage of nitrogen early in the growing season, and this was confirmed by a large number of soil tests. Increased fruit yields were apparently due to an increased number of fruits set and matured, the heavier sets undoubtedly being induced by a greater amount of available nitrogen at the time of bloom. No significant variations in fruit size were found over the period of these trials. As indicated before, this failure to increase fruit size following applications of nitrogenous fertilizers may have been due in part to a deficiency of soil moisture at the time the fruit was making rapid growth.

A word of caution on the use of fertilizers is necessary. While profitable returns followed the use of nitrogenous fertilizers in the orchard under this test and should be expected in other orchards known to be deficient in available plant food, there will be instances where applications of nitrogen are not warranted. To be on the safe side, the grower should make test applications of fertilizers on a limited number of trees before applying any fertilizer to his entire orchard. In this way he can obtain a knowledge of how his trees will react. There will be conditions where fertilizers will not give the desired results. Without ample moisture in the soil no response will follow the application of nitrogen fertilizer. Under extreme drought conditions the heavier sets which may be expected from nitrogen applications may even be harmful. On soils already containing a high level of nitrogen, wood and foliage growth might be increased to a point where fruit production and ripening may suffer. However, where yields are not already heavy and where terminal twig growth is short and foliage size small, profitable returns from the use of nitrogen may be expected under the proper soil moisture conditions.

It seems evident that the severity of pruning used will exert a considerable influence on the crops of fruit produced. There is no doubt that severe pruning is objectionable because of its effect in reducing yield. The other extreme also should be considered. The grower naturally is interested in long and profitable production from his trees. Pruning is one of the factors controlling it. Unpruned and too lightly pruned trees will not stay at the peak of their production long. When shading from the dense top growth stops fruit production on the interiors of the trees, yields can be expected to go down. Fruit size also will tend to decrease. Top breakage caused by the increased strains of fruit loads far from the union of main branches and trunk will increase.

Thus, again, a moderate course is the one to follow. Moderately light pruning, which will maintain a rather open tree with reasonably vigorous growth, can be expected to produce the desired results.

The question of which rootstock to use for sour cherries is relatively simple. Under most soil and climatic conditions found in the Colorado sour cherry producing areas, the mahaleb rootstock can be expected to give satisfactory trees. Its greater adaptability is definite enough to recommend it. While the mazzard rootstock may be suited to some areas, results with it have not been as uniformly satisfactory.

Recommendations

1. Do not attempt to keep unprofitable trees in production. If a tree cannot pay its way under the best possible orchard management methods, pull it out.

2. Use more care in the selection of sites for new plantings, especially as to available water supply and soil depth and type. Improper site selection may make profitable production impossible.

3. Maintain better nutritional conditions in the soil; it will pay. Try to build up the organic matter content in the soil to a more desirable level. Keep the nitrogen in the soil higher than is found in most sour-cherry plantings, especially early in the

season. If commercial fertilizers are to be used, run test plots before making a general orchard application. See if it will pay in your orchard. Remember each orchard is a problem in itself.

4. Use a moderate type of pruning to help maintain the trees in a vigorous fruiting condition.

5. Select the mahaleb rootstock for all locations where winters are severe or where soil conditions are not the best.

6. Do not forget that sour cherries are about 90 percent water and that fruits can not size up to best advantage on trees with an insufficient water supply.

7. Good orchard management requires that *all* factors be taken care of properly. Lack of care in any one place may mean poor returns.

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