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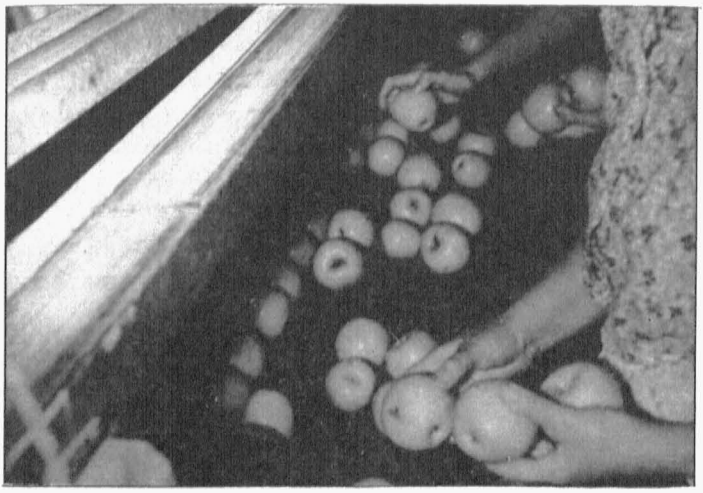
Factors Affecting Size and Color of Fruit

(With Reference to Apples and Peaches)

A. E. MURNEEK



Differences in size and color of fruit show up clearly in grading.

COLUMBIA, MISSOURI

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Fruit growers are becoming increasingly aware of the fact that the consumers' and therefore also the dealers' demand for fruit is considerably more exacting and discriminating now than it was formerly. Hence, appreciable differences exist at present in the price between a "good" and a "poor" product. There is no profit in growing low grade fruit, but invariably a loss.

It has been estimated, and on very good evidence, that 4 or 5 times as many bushels of "cull" apples, for example, have to be sold to obtain the same *gross* income as for 1 bushel of U. S. No. 1 apples. According to a federal authority, "cull apples are the growers' No. 1 enemy against successful apple production." The same thing may be said of peaches and most any other fruit.

If apple consumption is to be maintained or increased, the public must be supplied with fruit of good size, desirable appearance, and high eating quality. Specimens designated as "culls" are invariably short of one, more than one, or all of the above qualifications. They do not attract the consumer. Quality, like beauty, may be skin deep, but that is what many buyers seem to demand.

In most states where apples and peaches are grown commercially to any extent there have been established now official grades for these fruits, in order to distinguish clearly between good and poor produce. The Missouri Apple Labeling Law was put into effect in 1939, and is being enforced throughout the state. In compliance with this law, fruit not meeting any of the specified grades have to be marked "Culls" in well proportioned letters of at least 2½ inches in height. Moreover, talk is going around that eventually the sale on the fresh fruit market of cull apples and possibly other cull fruits may be prohibited in interstate trade. It would seem that slowly but surely culls are on the way out.

Considering this situation, it is highly desirable (a) to determine the various major factors that cause a fruit to become a cull, and (b) to ascertain to what extent orchard practices may be so directed as to reduce as much as possible the percentage of cull fruit in the crop.

The discussion presented here will be limited to apples and peaches—our chief tree fruits. Disease and insect control will be left out of consideration, since this subject has been fully treated in other publications and is fairly well understood by all commercial growers.

Causes of Cull Apples

Some years ago the Missouri Agricultural Experiment Station made a survey in representative counties of the southwestern and northwestern fruit growing sections of the state of the major causes responsible for defects of that portion of apples being designated in grading as culls.* The number of fruits examined during the two year period was close to 100,000. The results are presented in summary form in Figure 1.

It will be observed that lack of size and poor color were by far the two outstanding factors which caused apples to be thrown out as culls. In fact, it accounted for over one-third of all the defective fruit. While this was so in 1928 and 1929, which were years of ample rainfall and good weather for growth, it is quite certain that, because of recurring drought and other disturbances during the past few years, the same two causes have been at least just as, but most likely more, important since that time. An improvement in size and color in conjunction with better control of diseases and insect pests should go a long way in reduction of culls.

Nothing much can be done about the more or less direct effects of weather, causing a certain amount of injury to fruit, such as results from frost, hail, limb rub or sunscald. Though varying from year to year and place to place, on the whole, these factors account for a good proportion of the defective specimens, in our survey for about 15% of cull apples. It would seem that in fruit growing, as in the raising of a good many other crops, one has to take a chance with the weather.

A great deal of "mechanical injury" to fruit, which caused over 8% of the culls (Fig. 1), may be largely eliminated by exercising greater care in harvesting and packing of the fruit. The use of the right kind of containers, and more experienced and careful harvesting crews, should help to reduce this unnecessary loss to growers. The majority of apples thrown out of commercial grades because of mechanical injury were of No. 1 quality in all other respects. Some very fine fruits often are half ruined during the picking and packing operations.

*Mo. Agr. Exp. Sta. Bul. 343. Now out of print.

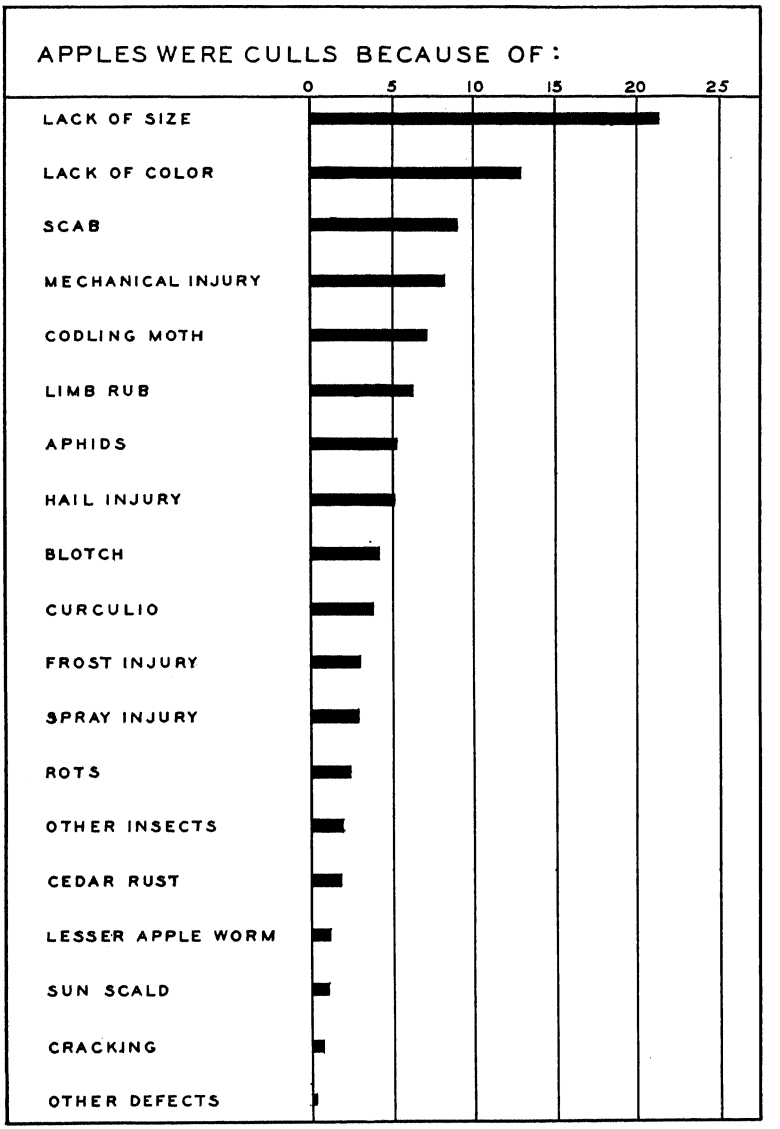

Fig. 1.—Average percentages of culls graded out due to various causes in 1928 and 1929 in the southwestern and northwestern apple growing districts of Missouri.

Size and Color as Variety Characteristics

There are distinct varietal differences in respect to size and color of fruits.* Everyone knows that normally the Jonathan apple, for example, is not as large as the Delicious, and Grimes and Winesap varieties are smaller than Golden Delicious and Stayman. The same is true of peach varieties. The Hale peach usually runs larger in size and the Champion smaller than Elberta.

If the trade demands large fruit, paying a premium for it, then it is a matter of wisdom to grow varieties that attain the desirable size. Naturally, this should be done only when such varieties are otherwise desirable and acceptable to the customers.

To change greatly the inherent average size of a variety, though possible, is usually not economical. Even under the most ideal growing conditions, the tree has to be exceptionally vigorous and the crop moderately small to accomplish this.

As regards size, so in respect to color there are hereditary varietal differences. Some apples, like Jonathan and King David, have considerably more red color than, say, Rome or York. The Red Bird and Halehaven peaches are generally more attractively blushed than the Salwey or Elberta. There are, of course, a number of apples and peaches that do not have a blush color, and therefore there are no specific "color requirements" for the higher grades of these fruits, the foundation color being either green or yellow.

The red color of fruit is enhanced greatly by exposure to bright sunlight. Generally, it is developed more extensively when the crop is grown in mountainous and continental parts of the country and in years of abundant sunny weather.

Experiments indicate that the invisible or ultraviolet light rays are most effective in coloring of apples and some other fruits. These rays are most prevalent at higher elevations and on very clear days. Red color is developed but little or is completely absent in localities where and in years when cloudy weather is prevalent during the growing season. Fruits in the interior of thick trees are usually off color because of shading.

Color development is subject also to the chemical composition of the fruit. The higher the sugar content the more color will an apple have. In summer varieties the sugar concentration reaches a maximum in summer, at which time color will also develop, while in winter varieties this will take place in autumn. The cool nights that are thought to be associated with coloring of winter apples probably have little to do with color development, excepting that during a period when the

*See also Mo. Agr. Exp. Sta. Bul. 371.

night temperature is low the sky is clear and the days are apt to be sunny. It is the bright sunlight and the increased sugar content of the fruit that result in extensive color production.

During the past few years, many so-called "red bud sports" of the apple have been discovered, propagated, and planted. They are "strains" within the same variety, differing from the parent plant only in that they develop more extensive and sometimes brighter red color. They will attain an attractive appearance earlier in the fall and hence may be picked before the parent variety is ready to be harvested.

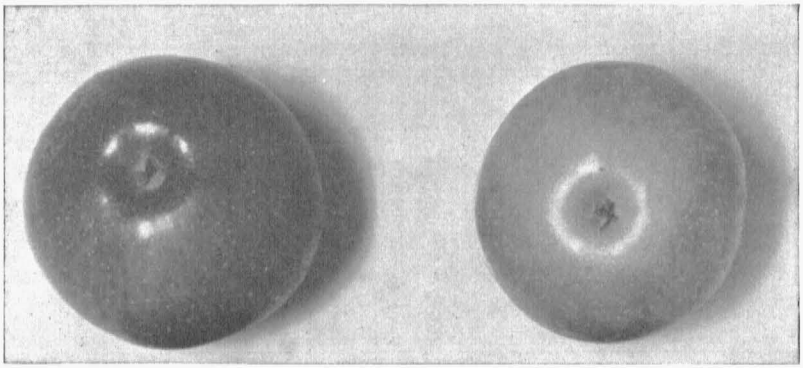

Fig. 2.—Selection of red bud sports provides a means of improving color of apples. Right—common Stayman apple; left—a red bud sport of Stayman. Both of the same stage of maturity.

Some of the more outstanding of such red bud sports of the apple, with the parent variety from which they originated, are: Delicious—Starking and Richared; Jonathan—Jonared and Blackjon; Rome—Red Rome and Gallia Beauty; Stayman—Stamared and Blaxtayman; Duchess—Red Duchess and Double Red Duchess; York—Yorking and Yorkared (Fig. 2). No red bud sports have been established for peaches. The color is not nearly as important a market requirement with this fruit as with apples.

To obtain red and blushed fruit of the highest possible color, growers are now planting extensively the red bud sports of certain varieties. But even these will attain the most attractive color under conditions of prolonged sunlight during the ripening period.

While apple and peach bud sports of increased size have been announced occasionally, to the writer's knowledge none have been placed on the market for commercial planting.

Effects of Weather

Being grown outdoors, fruit trees are exposed to all extremes of weather. The rainfall, sunlight and temperature are of the greatest influence on fruit size and color. When, because of prolonged drought, the soil moisture is so low that the trees are about to wilt or are wilting, though this may not be very conspicuous because of the stiffness of the leaves, fruit growth will be retarded.

Such conditions, for example, were experienced in the Central States during the growing periods of 1930, 1934 and 1936 (Table 1). When the rainfall is extremely low, then the depth of the soil and its water holding capacity are of great importance.

TABLE 1.—RAINFALL, IN INCHES, DURING THE GROWING PERIOD (MARCH TO AUGUST) AT COLUMBIA, MISSOURI, 1928-1940.

Year	Inches	Year	Inches
1928	27.12	1935	23.61
1929	31.15	1936	8.29
1930	11.24	1937	19.40
1931	23.53	1938	30.30
1932	20.98	1939	26.34
1933	18.35	1940	22.91
1934	14.71		

In districts where fruit is grown under irrigation, it has been observed repeatedly that during the last period of development of the fruit, which in peaches averages about 30 days and in winter apples longer, lack of soil moisture will affect unfavorably the final size and retard color production.

Drought reduces not only the supply of moisture but also that of sugar going to the fruit. With extreme water shortage, the leaves do not function properly. The small openings or pores on the under side of the leaves become closed and carbon dioxide from the air cannot enter the leaf, which is necessary for synthesis of carbohydrates (sugars).

In years of insufficient rainfall, irrigation would be highly desirable in some orchards for the proper growth of the trees and the fruit. When mature, apples and peaches contain about 85% water. Moreover, for proper functioning of the leaves, tremendous amounts of water are required continuously. For fully grown trees, this quantity has been estimated to be 10-15 tons per growing season.

Whether it would be practical and profitable to irrigate an orchard is for the grower to decide.

Frequently, drought is accompanied by bright sunlight and high temperature. When the heat is abnormally high, the color of apples and to some extent of other fruits may be "bleached" on the most exposed side, resulting in what is known as "sun scalding." In extreme cases conspicuous spots of yellowish red or bronzed yellow color may appear where the surface should have been bright red. Though the flesh below the skin usually is not injured thereby, the appearance of the fruit is undesirable.

Vigor of Tree and Size of Fruit

Only vigorous trees can yield good crops of large fruit regularly. The tree, more specifically the leaves, may be considered the equipment or machinery that produces the raw materials that go into the making of the fruit. If this equipment is reduced or devitalized, then crop production will be curtailed.

Young, vigorous trees usually produce fruit that is relatively large in size, while older, weakened trees form medium to small sized fruit. The foliage of a tree varies directly with the vigor or the amount of growth the tree is making. With most apple varieties, a terminal shoot growth of 6-12 inches is desirable. Good growth and annual production of quality fruit are associated.

If the crop is more than an average one for particular trees, as is often the case in Missouri in a year of good bloom, then the fruit may not reach a normal or desirable size. Certain orchard practices may then be put into operation, as will be discussed further on, that will help to make the fruit larger. Whether it is desirable or profitable to do this has to be left to the judgment of the grower.

Rich and deep soil, above all, is the most important requirement for the production of vigorous fruit trees. If it is not available, then vigor may be maintained only by especially good soil management, particularly ample soil fertilization. The natural soil deficiences have to be corrected by the grower. This is often done successfully, but always at considerable expense.

No fertilizer has been found to be as effective in maintenance of desirable growth and yield of fruit trees as one containing nitrogen in readily available form. Though many fruit growers believe that nitrogenous fertilizers are of benefit only for increasing the fruit set, they likewise stimulate vegetative development and increase the size of fruit (Fig. 3).* When twig growth is meager (less than 6 inches

*See also Mo. Agr. Exp. Sta. Bul. 363.

in the case of most apple varieties) and the foliage is sparse and of a pale green color, then application of nitrogen will lead to increased twig extension and the development of more and larger leaves with a healthy green color. Within certain limits, a luxuriant foliage is conducive to the proper growth of fruit.

Fig. 3.—Only vigorous trees with ample foliage can produce large fruit. Right—Elberta peach branch from a tree fertilized heavily with nitrogen; left—branch from not fertilized Elberta tree. Note relative size of leaves and fruit.

It should be understood, however, that a too liberal use of a nitrogenous fertilizer will have a tendency to delay the ripening of fruit, which in extreme cases may be 2 to 3 weeks. This may or may not be desirable from a marketing point of view. And because of the increased foliage as a result of fertilization, there may be more shading of the fruit and consequently less development of red color. It is evident, therefore, that while nitrogen is of great benefit for production of a fruit crop, it has to be used with judgment.

Leaves in Relation to Fruit Development

Leaves are the organs in which almost all the materials that make up the fruit, excepting water, are formed in the presence of light. Other things being normal, the larger the leaf area the more food materials will be received by the fruit, although a certain proportion may come from reserves in the tree. A fruit, like an apple or peach, contains, when fully developed, about 10-14% of sugar and other so-called carbohydrates, some nitrogen, and, in small amounts, a number of ingredients that, like nitrogen, come from the soil.

The volume or weight of fruit that can be produced per tree depends chiefly on the amount of foliage that is available for the developing fruit crop. It has been demonstrated repeatedly that a certain number of large leaves is required for the formation of an apple or peach of full size, color and quality. In order to obtain apples of commercially desirable size, 30-40 leaves are needed per fruit, depending on the variety (Fig. 4). When a tree is carrying a heavy crop, this number is often very much lower, and as a result the fruit is not able to reach full development. Counts made on heavily bearing King David and Jonathan trees at Columbia, Missouri, showed less than 20 leaves per fruit. These apples were conspicuously small when harvested.

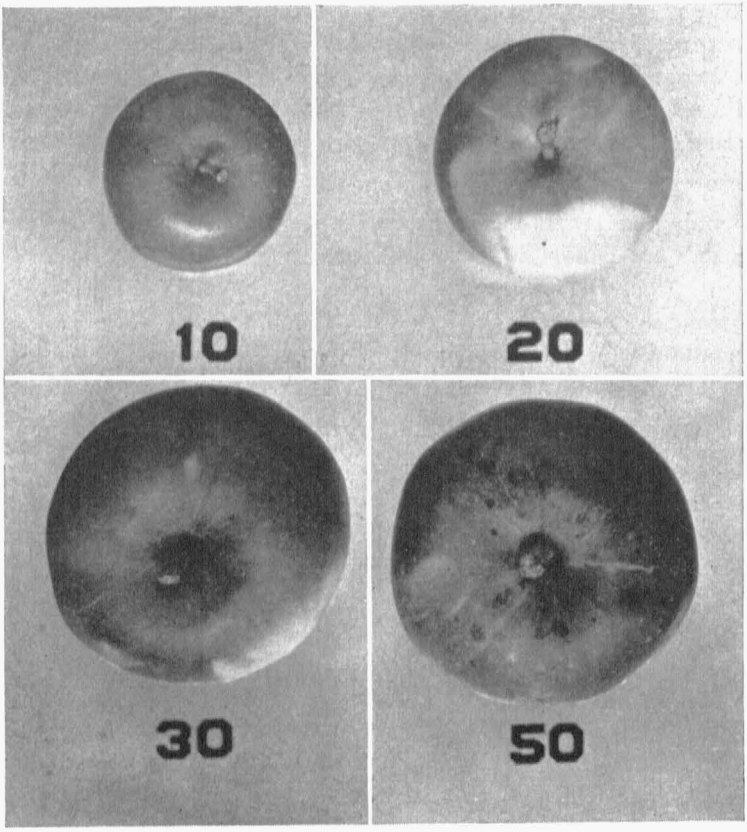

Fig. 4.—Relation of leaf number (10, 20, 30, and 50) to size of apples. About 30-40 or more leaves are required for the development of a large apple and for the support of the tree itself.

The fruit has the first call on the food resources of the tree, especially the carbohydrates formed in the leaves. If the leaf area exceeds the

requirements of the fruit crop, then the surplus of food substances will go to the vegetative parts of the tree. The increase in circumference of the trunk, limbs and spurs will be greater, and more flower buds will be formed for the next year. The reverse will be true when there is a reduced foliage in proportion to the amount of fruit that the tree carries, or when the leaves are severely injured or destroyed early in the season by insects or diseases.

The number of leaves that a tree may produce varies almost directly with the amount of shoot growth. If the tree is vigorous it will grow more and will have an ample foliage. The maintenance of good growth conditions, 10 or more inches of annual twig extension, by proper soil management or fertilization and pruning, will assure a good leaf area for the production of a satisfactory crop. By the time all the drops have occurred, and the final set has been established, the leaf area for that season has also been produced. The size of the fruit now can be increased only by adjusting through fruit thinning the number to the existing quantity of leaves present.

Influence of Pruning on Fruit Size and Color

Pruning of bearing trees is not to be judged by the amount of branches cut but by its effect on quantity and quality of fruit produced. The relation of pruning to size and color of fruit is largely an indirect one, through its effect on the tree. Pruning, however, can influence directly and considerably also the fruit crop by eliminating those branches on which, because of position or weakness undesirably small and off-colored fruits are borne, and by invigorating the remaining ones (Fig. 5).

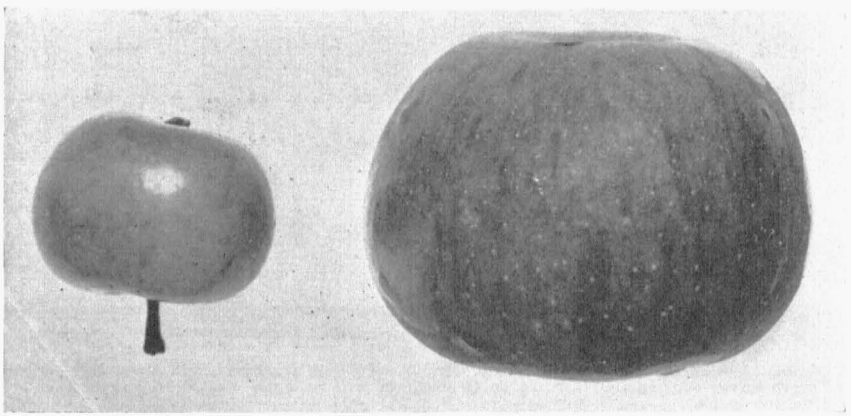

Fig. 5.—Extreme differences in size of Rome apples picked from weak inside (left) and strong outside (right) limbs. These two fruits were found in the same basket on the market (before the Missouri Apple Labeling Law was established). "Crab" apples ruin consumer demand.

The present discussion will be limited largely to the relation of pruning to the supply of moisture, nitrogen and carbohydrates—the materials that often limit fruit development. Mention will be made briefly of the effects of pruning on fruit color.

Pruning as a means of conserving moisture in the orchard is of considerable value in years when the rainfall is much below normal or when the subsoil moisture has been depleted, as it now possibly is in the western parts of the Central States because of recurrent droughts. Trees that have been pruned properly will have a reduced top in proportion to the root system. Therefore, what water is available will last longer. One should be aware of the fact that a tree uses a prodigious quantity of water during the growing season. When it is suffering from lack of moisture, vegetative growth will be reduced, the leaves will be small, and the fruit crop limited and of poor quality.

In regions of arid climate, deciduous trees are pruned more heavily than in Missouri. Now for the past few years we have had hot and dry weather during the summer months, that has been quite similar to that existing normally in some of our western states. It would be logical, therefore, that pruning be more severe, western as it were, during periods of drought. Precautions should be taken in all cases, however, so as not to expose the trunk and limbs on the west and southwest sides to such an extent that there be danger from sunscald injury.

Is pruning conducive to an increase in the carbohydrate or sugar supply, which goes into the making of every fruit? Fruits are eaten largely for their sugar content.

Pruning will increase the sugar supply only to a limited extent. By removing some of the branches, we not only decrease the fruit producing machinery, but also the amount of foliage that the tree will carry. And it is in the leaves, as we noted before, that the carbohydrates are produced.

A large proportion of the reserve food substances is stored during the fall and winter in the lower parts of limbs, the main stem, and roots of the tree. When the top is reduced by pruning, the remaining branches and in part the flowers and young fruits will have a larger share in the spring of what has been stored from the previous season. Moreover, when the tree is opened up by pruning more sunlight will reach the interior. Many of the leaves in the center of the tree will produce food more abundantly, which they would not when shaded.

Pruning will likewise conserve the nitrogen supply. In the spring nitrogen is very essential for the formation of flowers, fruit, leaves

and shoots. By pruning the tree, the remaining branches will obtain proportionally more of this soil nutrient for fruit setting and growth. Pruning, of course, does not supply nitrogen and is not a substitute for soil fertilization. It merely reduces the demand. Naturally this element can be furnished easily by a timely application of a nitrogenous fertilizer.

One should expect that the red or overlying color of apples and peaches will be improved to some extent by pruning. This would be particularly true of fruits that are located in the central part of the tree. If the tree is supplied with abundance of nitrogen then, because of the increased number and size of leaves, the fruit may be shaded and little benefit will be derived in the direction of increased color from pruning, especially heading back of branches. Shading has no effect on color of the yellow varieties.

One of the general objects of pruning bearing apple trees is either to eliminate or to modify all branches that because of shading or crowding are not producing fruit of desirable size and color (Fig. 6).

Fig. 6.—Jonathan apples harvested from the inside (left) and outside (right) branches of the same tree on the same day. Proper pruning will eliminate most of the small poorly colored fruit.

Such branches are located largely in the center of the tree, especially when it has not been trained and pruned properly. Overbearing may also cause the devitalization of many branches. By practicing the so-called "thin-wood" method of pruning, branches in the interior and the lower part of the tree may be removed, for mostly these shaded branches are the ones that produce the small and off-colored fruit, which more often than not go to the cull pile.

Increase of Size and Color by Fruit Thinning

While pruning, when properly executed, will affect fruit size only indirectly through conservation of moisture and increase in nitrogen and carbohydrate supply, fruit thinning will do it directly and conspicuously.

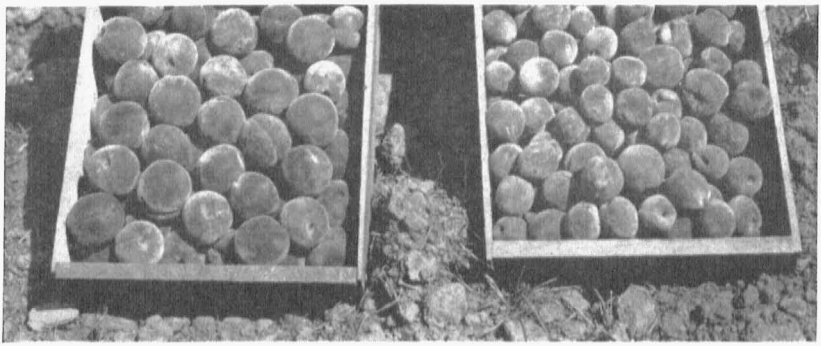

Fig. 7.—Peaches from thinned (left) and not thinned (right) trees of the same variety. The size and quality of peaches can be increased remarkably by fruit thinning.

With favorable conditions for fruit setting, many varieties of apples and most peaches are apt to overbear, in some years at least. The usual result will be fruit of small size and poor color (Fig. 7). By removing some of the fruit as soon as the natural drops are over, the remaining ones will increase in size in proportion to the amount of foliage present for their support. It was already noted that 30-40 leaves are needed to nourish a large apple. Any foliage in excess of this number will be of benefit for the tree itself in supplying necessary substances for increased fruit bud formation, growth in diameter of the woody parts, and in providing food reserves for the succeeding year.

Depending on variety, peaches require 20-40 leaves per fruit for best development of size, color and quality. With heavy yields, the average number of leaves per plant will be very much short of this requirement. Overloaded peach trees with poor leaf area produce inferior fruit. Said a fruit grower: "The main reason we thin peaches is to obtain fruit of uniform and acceptable size."

Not only the size but also the quality of the fruit is increased by thinning. Apples grown with a larger leaf area are higher in sugar

content than when grown with a reduced number of leaves. This difference may be as high as 30%, which will make an appreciable difference in flavor and should influence consumer demand.

Elberta peaches, when grown with 10-15 leaves per fruit, were abnormally small and low in sugar. With 30-40 leaves per peach, the size and flavor were superior.

When trees bear a heavy crop, the branches are weighted down. This results in shading of many fruits, especially those on the inside branches. Properly thinned branches will stay in a more upright position and will shade less those below. More light will reach the fruit with consequent increase in color.

Fruit thinning to improve color is of particular importance with the red varieties of apples and peaches. To obtain a good price for such fruit, it is necessary that they be well colored all over. This is secured only by proper and full exposure to light. Even the red bud sports of the apple will have a better color and finish and consequently a higher value when the fruit is thinned.

Varieties that characteristically produce small apples, such as King David, Grimes and Winesap, should be thinned more heavily than those that normally mature larger fruit. And as apple trees get older, the fruit becomes naturally smaller, requiring more thinning to obtain size. This to some extent is likewise true of peaches.

In thinning both apples and peaches, more fruit should be left on vigorous branches with large leaves and fewer on weak branches with small leaves.

The number of defective specimens will certainly be reduced by fruit thinning. Most of the young fruits that have been infected with scab and other diseases, or injured by insects, may thus be removed early in the season, and what is left will be better protected from further attack by various pests. When properly thinned, only infrequently two specimens will touch each other. This permits a more complete coverage with spray material. Moreover, the interior of the tree may be sprayed more efficiently when the branches are not drooping because of an overlord of fruit. In general, the closer the fruit is graded the more carefully it should be thinned.

Some New Orchard Practices in Relation to Size and Color

The following new practices, which should be considered still in the "experimental stage," are briefly mentioned as having a bearing on size and color development of apples and peaches. To what extent any of them may assume practical or commercial importance is difficult to predict at present.

Preharvest and Other Sprays.—The use of the recently developed preharvest spray, containing naphtalene acetic acid, which is applied for the purpose of preventing premature dropping of apples, will help to increase noticeably size and color. In fact, the object in the use of these sprays is to permit a delay in picking in order to obtain the highest amount of color on such varieties as Jonathan, Delicious, etc. As is well known, both the color and the size of most fruits will be increased by late picking. But the fruit will be also somewhat more mature, which may or may not be desirable, since these sprays do not prevent or retard ripening.

It is claimed that a special spray, sodium, potassium, or calcium thiocyanate, at concentrations of .05 to .2 per cent, when applied during August or September on winter varieties of apples, has increased the brightness and the amount of red color produced. Moreover, the foundation color is said to have turned yellow earlier, instead of remaining green. But since these "color sprays" injure the leaves to various extents and may also hasten the ripening of the fruit, they cannot yet be recommended.

Sun Coloring of Apples.—Many fruit growers perhaps have noted that when poorly colored red varieties of apples are exposed after picking to the sun, there is an additional development of red color. Recent tests in the eastern states have shown that when the fruit is kept for a week or ten days in a thin layer on straw mulch under trees a decided improvement in coloring is obtained on Jonathan and other varieties. But there is a great danger from sunscald, which may make the color worse (bronzed) in spots. By using a fairly heavy cheesecloth the fruit may be protected from scalding, but it will not be protected from ripening in the relatively high temperature that often prevails at harvest time.

Because of climatic conditions, this procedure is very questionable in the Central States. At best, it may be of possible value only when the fruit is intended for early consumption, for their storage quality most certainly will be reduced.

Effects of Branch Ringing.—The ringing of branches of mature vigorous trees at the time of full bloom of certain varieties of apples that are shy bearers may increase the set considerably. Provided the crop is not too large, it will result also in an improvement of size of the fruit, which, according to our experience, has been from 5 to 25%.*

Within reasonable limits, the fruit on the ringed branches not only will be larger, but will mature and color earlier. Branch ringing

*See also Mo. Agr. Exp. Sta. Bul. 416.

likewise speeds up coloring and maturing of peaches and other stone fruits (Fig. 8), but the increase in size is not as marked as in the case of apples. This may be due to the fact that peaches and other stone fruits, when they do, usually bear heavy crops, the size of the fruit then being limited by the amount of foliage present.

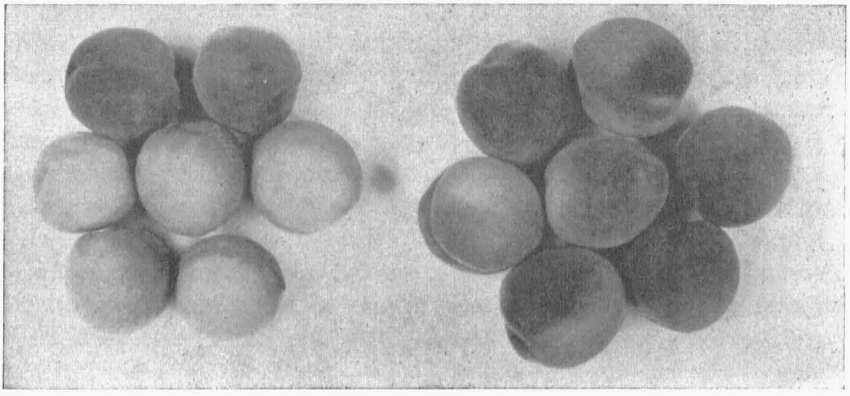

Fig. 8.—Ringing of branches of vigorous trees will increase the size and hasten maturity of most fruits if the crop is not too large. Peaches on the left from not ringed, and on the right from ringed limbs of the same tree.

Ringing of branches may or may not be a desirable practice, depending on whether there is or is not a satisfactory early trade for certain, especially summer, fruit. To be able to place on the market a variety even a few days in advance of the normal season is sometimes very remunerative, however, justifying a special practice and slight additional expense.

Summary

A survey conducted in representative apple growing regions of Missouri showed that about ⅓ of the cull apples are caused by lack of size and color. The various environmental factors entering into, and orchard practices having a bearing on growth and color development of apples and peaches, the two major tree fruits of the state, are discussed.

1. Size and color are variety characteristics. Though hereditary, the weather has a marked influence on their development. Increased color of certain varieties of apples is obtained by selection of "red bud sports."

2. The weather, specifically rainfall and temperature, has a marked effect on size and color development of apples and peaches. Excessive drought and high temperature are especially harmful for growth and coloring of apples.

3. Only vigorous trees can produce fruit of desirable size. Good soil, ample rainfall, pruning, and the use of fertilizers are some of the major factors in maintenance of tree vigor. Excessive fertilization with nitrogen sometimes results in a decrease of fruit color.

4. There is a direct relationship between good foliage and good fruit. To obtain apples and peaches of commercially desirable size and quality, a certain number of leaves are required for their proper development. The number of leaves that a tree carries varies directly with the amount of shoot growth.

5. Pruning helps to increase size and color of fruit by: (a) Conserving the moisture and nitrogen supply, if that be limiting; (b) increasing carbohydrate supply through development of larger leaves and their better exposure to light, and (c) improving color of fruit by reduction of shading.

6. Apples and peaches may be increased in size remarkably by fruit thinning. This practice should be based on adjustment of a desirable leaf-to-fruit ratio. For the full growth of an apple 30-40 leaves are required, and for a peach 20-40 leaves. Color and flavor of the fruit is also improved by thinning. Varieties or trees that characteristically bear small fruit should be thinned heavier; weak branches more than vigorous ones.

7. Certain new orchard practices that have a bearing on size and color development of apples and peaches are briefly discussed. These are: (a) "Preharvest" and "color" sprays; (b) sun coloring of apples; and (c) branch ringing. Because of their newness they are not recommended for general use.