

A STUDY OF HARVESTING, PACKING AND SHIPPING PROBLEMS WITH THE PEACH,
INCLUDING THE EFFECT OF CULTURAL TREATMENTS ON THE YIELD OF FRUIT.

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THE CROZET STATION PEACH ORCHARD

Approved

P L A N

OBJECT:

To determine the correct time and manner of harvesting, and to standardize if possible the manner of handling the peach after picking; also to compare the different packages for this fruit.

MATERIALS:

This station has at Crozet, Albemarle County, a peach orchard consisting of several varieties of trees, namely: Elberta, Carman, Hiley Belle, Early Crawford and Late Crawford, grown under three different cultural methods with seven different kinds of fertilizer treatments in each cultural plat; this gives sixty-three plats of six trees each, no two of which are alike. These trees have received uniform pruning and spraying.

On a nearby farm, the station owns the crop on nearly two-hundred White Heath trees, which have received five spray treatments with one check plat.

The Crozet Ice and Cold Storage Corporation offered a room in their plant, with the necessary refrigeration free of charge, for any purpose needed to carry out the plans of this work.

METHOD OF WORK:

1. Cultural treatments.

- A. With respect to total yields.
- B. With respect to time of ripening.
- C. With respect to size of fruit.

2. Harvesting.

- A. Observations were made to determine the value of harvesting the fruit at one or more pickings for each variety.
 - a. With respect to total yield.
 - b. With respect to grades of fruit.
 - c. With respect to cost of harvesting.
 - d. With respect to total money returned.
- B. Observations were made to determine the keeping qualities of the fruit harvested under varying weather conditions and at different times of the day.

3. Packing and Shipping.

- A. Observations were made to determine the effect of packing the fruit under different conditions.
 - a. On a table in the open.
 - b. On a table in a shed.
 - c. Pre-cooled and packed in a cold storage room.
 - B. Various methods of packing the fruit were used and the fruit examined to determine the shipping and keeping qualities in different styles of packages.
 - a. Georgia carriers with and without cushion covers.
 - b. Bushel and half-bushel baskets with and without cushion under cover.
 - c. Delaware baskets with and without cushion under cover.
 - d. Paper boxes in cartons. Cartons with fruit wrapped and unwrapped.
4. Study of different methods of storage and shipments.
- A. The fruit was shipped by freight, express and in iced cars.
 - B. Various lots of fruit were stored under refrigeration at Crozet and examined from time to time to observe their behavior.

A STUDY OF HARVESTING, PACKING AND SHIPPING PROBLEMS WITH THE PEACH,
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Perfect tillage, to conserve soil moisture, has proven to be of more value to peach production than has fertilizing the soil. This was illustrated, last season, in the Adam's Fund Orchard at Crozet. The experimental plant was divided into three equal parts, Series 1, 2 and 3. Each series had the same number of trees and each series was divided into eight plats of the same size and containing the same number of trees. The trees were planted 20' by 20' and received commercial pruning each year; the spray treatment was the same for all the trees. Fertilizers were sown broadcast June 25, 1914, as follows:

Series 1, 2 and 3.	Ounces per tree.
Plat 1. No fertilizer	
" 2. Nitrate of soda-----	8
" Dried blood -----	11
" 3. 16 percent acid phosphate -----	37
" 4. Muriate or sulphate of potash -----	8
" 5. Check. No fertilizer.	
" 6. Phosphorous and nitrogen (nitrate of soda and dried blood at above rate).	
" 7. Potash and nitrogen.	
" 8. Nitrogen, potash and phosphorous.	

There was no crop in 1914 on account of a severe winter freeze.

June 26, 1915, a heavier application was given at the following rate:

Nitrate of soda	15 oz. per tree.
Dried blood	22 " " "
16 percent acid phosphate	51 " " "
Muriate of potash	8 " " "

The tillage for 1914 and 1915 was the same:

Series 1 received perfect tillage during the growing season.

Series 2 received commercial or light tillage during the growing season.

Series 3 received no summer tillage; it being plowed in the winter and sown to grass in the spring.

The following table gives the weight of the fruit harvested from each plat in the three series:-

SERIES 1.									
Variety	Plat 1.	2.	3.	4.	5.	6.	7.	8.	Total.
Elberta	Young trees	388	399	468	455	435	524	499	3168
E. Crawford		209	172	246	240	279	360	146	
^{Hiley} Carman & Belle		416	502	369	466	594	665	349	
Totals		1013	1073	1081	1161	1308	1549	994	8179
SERIES 2.									
Elberta	234	329	228	183	242	265	366	319	2165
E. Crawford	91	127	94	89	29	55	91	98	
Carmen & Hiley Belle	184	301	216	143	220	195	242	246	
Totals	514	757	538	415	491	514	699	663	4591
SERIES 3.									
Elberta	160	197	185	168	120	200	262	261	1553
E. Crawford	147	133	129	157	75	119	133	74	
Carmen & Hiley Belle	156	215	201	81	96	90	190	149	
Totals	463	545	515	386	291	409	585	484	3678

The total yield of Series 1 was 220 percent greater than that of Series 3, and Series 2 was 124 percent greater than Series 3. In comparing the Elberta variety alone we find similar results. The high moisture series yielded 203 percent more fruit than the sod series and the commercial or lightly tilled series gave 139 percent more fruit than the sod or low moisture series.

The differences in yield, due to the application of fertilizers is very small and show that in this type of soil no fertilizers are needed, but that it is all important to increase fruit production by frequent and thorough tillage.

Intensive cultivation delays the ripening period a week or more. This may be beneficial if a large crop in a certain section will glut the markets and if by shipping a week or ten days later, a grower can miss a glutted market, he will be helped considerably. On the other hand, it may be a disadvantage to hold back a crop by intensive cultivation. The grower must decide for himself what plan to follow. The writer is of

the opinion that the advantages received from intensive cultivation far exceeds the disadvantages.

To show the effect of tillage on the size of the fruit, the following experiment was made:- Samples of twenty firm, well colored, edible peaches were taken from the Elberta trees in each of the plats of the three series and weighed and their weights recorded. The average weight of eight samples of twenty peaches from each series was:-

Series 1. 20 fruits weighed $85 \frac{5}{14}$ ounces;

Series 2 20 " " $71 \frac{5}{16}$ "

Series 3 20 " " $61 \frac{5}{8}$ "

There is a clear contrast in size of the peaches grown in the high moisture series over those grown in a commercially tilled series or sod series.

The trees in the high moisture series were much larger and stronger than those of either the commercially tilled or sod series; they had more bearing wood and hence more fruit.



The splendid condition of these four year old trees is the result of frequent cultivation.

The observations made to determine the value of harvesting the fruit at one or more pickings, for each variety, showed that the fruit did not ripen at the same time and that the ripening extended over a period of eight to ten days, with most varieties. No data was collected to show the effect on the total yield, but it was clearly seen that by cleaning the trees of their fruit at one operation, from one-third to one-half of the crop would be an absolute loss. By picking several times, the smaller and greener fruits are allowed to increase in size and color, thus increasing the yield of marketable fruit.

With respect to the grades of fruit, it was proven that fruits of higher color, larger size and of a more exact shipping condition were obtained only when two or more pickings were made.

Thinning the fruit played an important part in the grades harvested. Thinning increased the size of the fruit and reduced the spread of brown-rot.

EXPERIMENT 1: Trees 1 and 2 had the same cultural treatment.

Plat 1. Tree 1. Thinned.

1 bushel counted 255 peaches.

$\frac{1}{2}$ bushel No. 2's 124 " rating in size as follows:-

Fancy	No. 2's	Culls.
86	30	8

Plat 1. Tree 2. Unthinned.

$\frac{1}{2}$ bushel counted 144 peaches. A second half-bushel of 178 peaches was picked, taking the peaches as they came, which rated in size as follows:-

Fancy	No. 2's	Culls.
22	90	66

A comparison shows that the unthinned tree had eight times as many culls, three times as many No. 2's, and one-fourth as many fancy peaches as the thinned tree.

EXPERIMENT 2: Trees 1 and 2 in plat 1. Rea Orchard.

Thinned.

$\frac{1}{2}$ bu. counted 112 grading:-

Fancy	88
No. 2's	25
Culls	9

Unthinned.

$\frac{1}{2}$ bu. counted 172 grading:-

Fancy	8
No. 2's	66
Culls	98

The advisability of thinning a commercial orchard ~~is~~ depends upon the difference in price for large and medium sized fruit, the general prospect for peach production throughout the country, and how heavily the orchard is set in fruit. There is great danger of the branches breaking and splitting when heavily loaded with fruit.

A comparison of the cost of harvesting, by one and several pickings, was not made, because of the loss which would have resulted had one picking been resorted to, in green and unmarketable fruit. It is true that a saving is made in one picking; the labor bill being reduced one-half or more by cleaning the trees as the pickers go down the rows. Several pickings require much more time and care in selection of the fruit, with the result that when the fruit is poured on the packing table it is practically all salable; the product will reach the market in good condition, and the net profits from picking two or more times will far exceed those of one picking. Practically all the fruit picked in the Crozet orchard was of a number one grade. The prices received topped the market wherever shipped. High class fruit always commands a higher price than ordinary shipments.

The observations made to determine the keeping qualities of the fruit, harvested under varying weather conditions and at different times of the day, were not sufficient to advocate practicing as yet. It is true that in the afternoon the fruit is much hotter and to a certain extent, riper than in the morning. We know that warm fruit "goes to pieces" faster than cooler fruit. If a spell of rainy or misty days comes on at a time when the fruit is in the proper conditions for harvesting, it is permissible to pick and haul to the packing shed. The fruit can be poured upon the grading table to dry and then packed. Picking in the rain is allowable only when the orchard has been thoroughly sprayed.

The following experiments were not carried on long enough to show the effect of harvesting at different times of the day upon the size and weight of the fruit, but they may be taken for what they are worth; the results seem to show that morning pickings are best to get larger and heavier fruit.

Experiment 1.

Late Crawford. Tree 9, Plat 3, Series 3.

Harvested August 25th, 2 P.M. (Hot day).

75 fruits weighed 13 pounds 8 ounces or 216 ounces.

Average weight of one fruit 2.88+ ounces

At each test, the fruit was run over the grading machine twice with the same results.

Sizes:	2 inches	2 1/4 inches	2 1/2 inches	
No. of fruits:	4	41	30	-- 75 fruits.

Harvested August 26th, 8.30 A.M. Off same tree.

62 fruits weighed 11 pounds 8 1/2 ounces or 184 1/2 ounces.

Average weight of one fruit 2.96+ ounces.

Sizes:	2 inches	2 1/4 inches	2 1/2 inches	
No. of fruits:	3	27	32	-- 62 fruits.

Harvested August 26th, 3:30 PM. Off same tree.

89 fruits weighed 16 pounds 2 ounces or 268 ounces.

Average weight of one fruit 2.89+ ounces.

Sizes:	2 inches	2 1/4 inches	2 1/2 inches	
No. of fruits:	3	42	44	-- 89 fruits.

Experiment 2.

Hiley Belle twigs, with at least three fruits of the same apparent size per twig, were tagged. One fruit was removed from each tagged twig every time a count was made.

August 5th. 2:30 PM. 17 fruits weighed 42 1/2 ounces.

August 7th. 9:00 AM 17 " " 55 "

August 7th. 3:15 PM 17 " " 48 "

Experiment 3.

A random count was made taking 52 fruits at each test from the same tree.

August 6th 2:30 PM 52 fruits weighed 119 1/2 ounces.

August 7th 9:00 AM 52 " " 155 1/2 "

August 7th 3:15 PM 52 " " 149 "

These three experiments seem to confirm the belief that larger and heavier fruit is procured when picked in the morning.

Observations made to determine the effect of packing the fruit under different conditions showed that packing on a table in the open was detrimental to the condition of the fruit. Peaches are warmed by being exposed to the direct rays of the sun and soon go to pieces. The packers are more uncomfortable and work slower and with less care than if protected from the heat of the sun by a shed or canvas fly.



"Showing packing table in use in a Virginia peach orchard. Fruit ripens very rapidly on such a table and there is no protection from rain or sunlight. No work can be done except when the weather is clear. Note the rough woven basket in the hand of one of the pickers. It is almost impossible to pick peaches in a basket of this kind without bruising the fruit." Illustrating Prof. Starcher's paper, "Outlook for Peach Growing in Virginia."

A shed or a large tent fly is an important addition to the orchard equipment, for it is almost necessary that the fruit be packed under cover and protected from the sun until it can be hauled to the station or cooling plant. Fruit packed in a shed is in better condition for shipment than that packed in the open. The packages leave the shed in a much cleaner and more attractive condition than if hauled directly from the orchard.



The shed in the Crozet Experiment Station Orchard. It is cheap and serviceable.

Most of the crop at Crozet was packed and hauled to the cold storage plant. We found that precooling the peaches over night made them "stand up" better in shipment than shipping directly from the orchard. Storing in a refrigerated room for several days had no detrimental effect upon the quality of the fruit. A low temperature is not needed in cooling peaches; best results are obtained when the temperature stands between 35°F. and 45°F. We were able to keep Carmen and Hiley Belle peaches for six weeks in cold storage and when examined they were found to be sound and of good appearance, but the quality was poor and almost tasteless.

It is best to pack the fruit before putting it in cold storage, as it is unsatisfactory to work under storage conditions--limited space, poor light and cold.

Shipments of various packages of fruit were made to different sections of the country, in order to find out what kind of package would "stand up" best in shipment and which would present the most attractive appearance to the public eye. The styles of packages used were: The Georgia carrier, or six basket crate; the bushel hamper; the half-bushel Delaware; the bushel and half-bushel baskets, with and without center posts. The Georgia carriers were packed with and without cushions under covers and under racks; the hampers and baskets were shipped with and without cushions under covers.

Prof. Starcher discovered a way to fasten down the covers more securely than by using wire brads or clamps, in using eleven gauge wire. The end of the wire is bent back an inch, like a hook, and fastened under the first

slat of the crate or under the rim of the basket; the wire is stretched over the lid of the package and down far enough to cut off and hook under the slat or rim on the opposite side. The wire is tightened by kinking with a pair of pliers. This method of holding down the tops and preventing expressmen from extracting a peach or two, was found to be a complete success.

A crate of Hiley Belle peaches was shipped to Mr. G. W. Butterworth, a commission merchant of Philadelphia, from the Virginia Agricultural Experiment Station of Crozet, requesting him to answer the five questions which were:

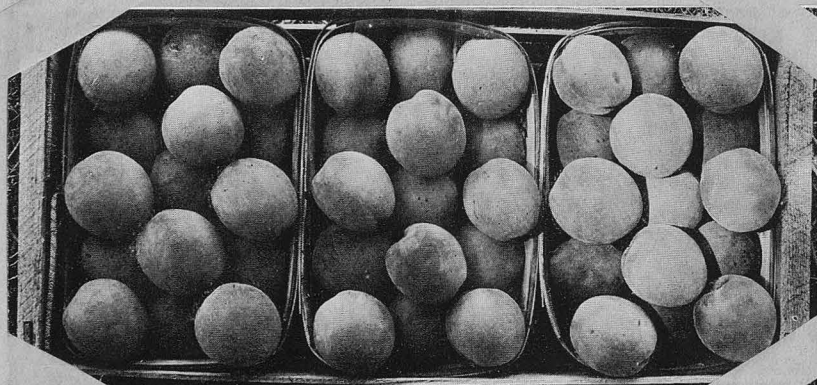
1. Were both wire fasteners (on top and bottom) still fastened? Answer: Yes.
2. Do you consider them satisfactory? Answer: Yes, in every respect.
3. In what condition did the fruit arrive? Answer: Perfect condition
4. Was the top layer as good as the bottom layer? Answer: Yes.
5. What do you think of using a cushion under the rack? Answer: The trade desires to see the second layer with as little trouble as possible. A cushion necessitates the removal of the entire first layer, the rack and the cushion, thus causing more trouble than the cushion is worth; the top cushion being necessary and sufficient.

Shipments were made to Philadelphia, Pa., Norfolk, Va., and Roanoke, Va. Prof. Starcher followed these shipments and reported on the condition of the fruit upon arrival. In every case it was shown that a full, firm pack was absolutely necessary; that a cushion on top was essential; that wires on top and bottom of carriers were needed; that bushel and half-bushel baskets, Delawares and hampers should have cushions under the covers and that the covers should be fastened with two wires; that center posts in bushel and half-bushel baskets were beneficial in preventing the fruit from being mashed; and that wrapping the peach was not worth while.

The cushion not only helps to hold the fruit in place, but prevents dirt and trash from settling on the fruit, and often adds twenty-five cents per crate on account of the neat appearance of the package. In bushel baskets and bushel hampers it is necessary to ship fruit which is not so ripe, because the weight of the fruit upon the bottom layers is so great as to cause considerable mashing, if the fruit is quite ripe.

The paper carton can not stand the rough handling of the expressman, the peaches rattle in the carton and soon bruise, and the commission man has a hard time to see the fruit. This style of package for peaches is new and needs further testing.

The results obtained by the Virginia Experiment Station have been that fancy and high quality fruit brings more money on the market when packed in Georgia carriers than when packed in any other package.



"Showing a three-layer two-one pack. Note that the peaches come above the top of the basket and package. When the lid is nailed on every peach will be held firmly in place and the lid will have a bulge of at least an inch." Illustrating Prof. Starcher's paper, "Outlook for peach growing in Virginia."

The Station made more money in private orders than selling in lots, either on consignment or to merchants under contract. The private orders were nearly all shipped in Georgia carriers with a cushion on top and one under the rack, which insured peaches free from bruise and in perfect condition.

We requested many of the buyers to report on the conditions of the fruit upon arrival. In every case, when the pack was tight and firm, and two cushions used, when top and bottom were wired, and when the fruit was just fully colored and firm under the pressure of the hand, the reports stated that the fruit arrived in perfect condition. Our honest pack made a demand for Experiment Station peaches; more orders came in than we anticipated.

Private orders were shipped by local and through express to towns and cities in Minnesota, Iowa, Wisconsin, Illinois, Virginia, Pennsylvania, New York and West Virginia; all of which were satisfactory to the buyers in every respect.

A crate of fancy Hiley Belle peaches was shipped to The National Apple Buyers Association at Chicago. The pack was a 2-1 and 2-2, of three layers each, with two cushions and wired on top and bottom. The judges and visitors at the show stated that our crate of Virginia peaches was the prettiest and most talked of display at the show.

Cold storage experiments were conducted to determine the effect of refrigeration on the keeping quality of the peach after being taken from cold storage. Example:-

July 31, 1915, a crate of Hiley Belle Peaches was put in storage at about 35°F.

August 5th. Box 1 was removed and stored in the packing shed, under fruit-stand conditions. The fruit was examined and reported firm and fresh.

" 7th. Box 1 still firm and in excellent condition.

" " " 2 taken out of storage in firm and perfect condition.

" 9th Box 1 fruit perfect, flavor excellent, condition sound.

" " " 2 fruit perfect, flavor excellent, quite firm.

" 12th " 1 fruit still in good condition, quite ripe, slightly shrivelled, but edible.

" " Box 2, two fruits very soft, rest excellent for eating.

" " " 3, taken out of storage this date, showing very little change since harvesting. The fruit was firm but gave slightly under the pressure of the hand, not due to ripening apparently, but possibly to evaporation.

" 16th Box 1, several sound but the rest were destroyed by Black Mold. Discarded.

" " Box 2, fourteen out of twenty fruits still sound.

" " " 3, all sound, firm and edible.

" 19th " 2, all decayed. Discarded.

" " " 3, all sound, soft and barely edible.

" 21st " 3, barely edible, soft and shrivelling.

" " " 4, taken out of storage in perfect condition.

" 24th " 3, all decayed. Discarded.

" " " 4, one decayed, rest sound and edible.

August 25th Box 4, four more decayed, rest sound and edible.
 " 30th " 4, total of one-half rotten. Discarded.
 " " " 5, out of storage six days; one rotten, rest firm and edible.
 Sept. 2nd " 5, five decayed, rest sound and edible.
 " " " 6, taken out of storage this date, in excellent condition.
 " 6th, " 6, all sound and edible.

We have shown that by means of cold storage, a fruit grower can hold his crop until able to find a suitable market for his product, and that it is possible to hold peaches under refrigerated conditions for a month. However, this practice of storing for a month is not recommended. It is often necessary for one to rush his crop to cold storage, should a delay in refrigerated cars be encountered, or should the market be temporarily glutted.

Pre-cooling the peach over night is a great benefit in improving its condition for shipment, whether by local or through express, refrigerated express or freight.

Competition is becoming of greater significance in every line of work. The orchardist must realize that if peach growing is to be his means of support, he must put better fruit on the market than the average grower; he must adopt efficiency methods; he must do more thinking and then follow out his thoughts with action.