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Investigations on the Harvesting
and Handling of Bosc Pears
from the Rogue River
Valley

By

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CORVALLIS, OREGON

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SUMMARY

PART I

(1) That time of picking affects the dessert and storage quality of Bosc pears is evident from these studies.

(2) The pressure test is the best known means of determining time of picking for these pears.

(3) The period during which Bosc pears of first-class quality can be harvested from any one orchard appears to vary from 10 to 15 days.

(4) It is clear from these studies that temperature after harvest has material bearing on the storage life and dessert quality of Bosc pears.

(5) For long keeping, immediate storage at temperatures of 30° to 32° F. is essential.

(6) Storage at 40° and 50° F. materially shortens the storage life and does not improve the dessert quality.

(7) While Bosc pears may be kept at 30° and 32° F. for a considerable period, they do not develop quality unless removed from storage while still firm and allowed to ripen at temperatures between 60° and 70° F.

(8) Pears harvested at the proper time and stored immediately at 30° and 32° F. reach prime condition in from 8 to 12 days when removed to a temperature of 66° F.

(9) Relative humidities varying between 76 and 80 percent are sufficient to prevent excessive wilting provided the fruit is properly wrapped in paper.

(10) The practice of subjecting Bosc pears to a "delay" of several days prior to storage at low temperatures usually does not improve the dessert quality and may materially shorten the storage life.

(11) Storage at the shipping point appears to be feasible and practical in the handling of Bosc pears from the Rogue River Valley.

PART II

(1) Investigations have been conducted to determine the best storage conditions for Bosc pears, in order to prolong the marketing season and at the same time secure highest possible dessert quality.

(2) The longest possible storage season results from holding the fruit from time of picking at a temperature as near 30° to 32° F. as can be maintained.

(3) Bosc pears at this temperature, or while being held even at 40° F., will not ripen with satisfactory dessert quality unless almost full ripe when stored. To secure high dessert quality, fruit should be removed from cold storage while firm and in good condition, and ripened at temperatures above 50° F. Sixty-five to 70° F. results in very best quality.

(4) Bosc pears carried in the top layers of non-precooled refrigerator cars have a possible storage season averaging at least one month less than that of similar fruit loaded in the bottom layers in the car.

(5) Fruit picked in the proper stage of maturity, and shipped immediately in the top layers of the car, then stored at 32° F., upon eastern arrival usually held in satisfactory commercial condition until about Thanksgiving, some lots holding slightly longer than this. Similar fruit shipped in the bottom of the car held in satisfactory commercial condition until Christmas and in some cases longer.

(6) Delaying placing the fruit under refrigeration following picking markedly decreased the possible storage season of late picked Bosc pears, although the storage season of early picked fruit was not greatly shortened by a moderate delay.

(7) Holding fruit in storage at 40° F. did not result in a higher quality product than did storing at 32° F. and greatly reduced the possible storage season.

Investigations on the Harvesting and Handling of Bosc Pears from the Rogue River Valley

INTRODUCTION

The best method of handling Bosc pears to prolong the storage season has been a problem confronting the pear industry for some time. When well grown and well ripened, this variety is one of the finest of fruits. When improperly handled, however, Bosc pears are frequently of most unsatisfactory quality.

The general experience in the fruit trade has been that this variety when placed on the market shortly after harvest, develops very fine quality. If held in cold storage for a considerable period, however, so that cold weather is prevailing when the fruit is removed from storage, the pears remain hard and have little flavor. Under such conditions they usually develop break-down, scald, or discoloration at the core, without reaching satisfactory eating condition. Consequently the idea prevails in the trade that Bosc is a "warm weather pear" and that it ought not to be held in storage after the weather becomes cool in the fall.

A considerable amount of investigational work on the storage of Bosc pears has been reported. Lewis, Magness, and Cate¹ found that Bosc pears would not ripen properly and with good quality under refrigeration. Even the fruit held at approximately 50° F. was of poor to fair quality when ripe, although similar fruit ripened at 70° F. was very good to excellent. Fruit held continuously at 36° or 32° F. was worthless. They state: "It is certain that the cold storage of large quantities of Bosc pears is not to be advised until some better way of handling the stored product can be devised." Murneek,² continuing the investigations, found that if Bosc pears were held at fairly high temperatures for a considerable period after picking, they could then be placed in cold storage and held until fully ripe with fairly good quality. He suggested a "delay" of 10 to 15 days at the prevailing temperatures before placing the fruit under refrigeration.

This method of handling Bosc pears, however, has seemed questionable to the fruit trade and has not come into general use. Consequently, the Fruit Growers' League of the Rogue River Valley appointed a committee early in 1925 to make such arrangements as were necessary for more experimental work on this problem and, as a result, a joint project was arranged between the Bureau of Plant Industry of the United States Department of Agriculture and the Oregon Experiment Station. To carry on the work at Medford the Fruit Growers' League and the Medford Precooling and Cold Storage Company constructed at their own expense three storage rooms in which temperatures and humidity could be controlled. Other funds for the project were furnished by the Oregon Experiment Station and the Bureau of Plant Industry.

¹The committee from the Fruit Growers' League consists of Messrs. Leonard Carpenter, Paul Sherer, and F. C. Kenly.

Part I of this report is confined to the tests carried on during the seasons of 1925 and 1926 by the representatives of the Oregon experiment stations at Medford and at Corvallis. This phase of the problem is confined largely to (1) a study of the effects of time of picking on the dessert and storage quality of Bosc pears and (2) the storage of Bosc pears prior to eastern shipment.

Part II gives the results obtained by the representatives of the Bureau of Plant Industry. This part of the work deals (1) with the transportation of Bosc pears and (2) the storage and ripening of these pears at Eastern points.

Preliminary reports dealing with the work of the first season were published in the Proceedings of the Oregon State Horticultural Society for 1925.

PART I. HARVESTING AND STORAGE AT SHIPPING POINT

By

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Storage facilities. The facilities at hand for the work in Oregon made possible a wide range of storage temperatures which afforded an excellent opportunity for a study of the effects of temperature on the quality and storage life of Bosc pears. For the tests in 1925 the rooms in the plant of the Medford Precooling and Cold Storage Company were maintained at constant temperatures of 32°, 40° and 50° F. Storage facilities at Corvallis afforded a ripening room with a constant temperature of 66° F., while an earth cellar at the experiment station at Talent provided a fluctuating temperature ranging from 40° to 70° F. In 1926 the rooms were maintained at temperatures of 32° and 66° F.

The previous work on the storage of Bosc pears showed clearly that this variety wilts badly in storage unless kept at fairly high humidities. Consequently humidities varying between 76 and 80 percent were maintained in all the rooms during the entire storage period.

Fruit used. The fruit used in these experiments was taken from five different orchards representing as nearly as possible the chief soil types of the Rogue River Valley, as follows:

Klamath, the heavy or "sticky" soil.

Belmont, the red or "foothill" soils.

Upton, agate gravelly sandy loam.

Station Lowland, silty clay loam.

Station Upland, heavy but somewhat lighter than "sticky."

In all cases, the fruit was taken from orchards of full bearing age and from trees bearing average crops. All the orchards are under irrigation although the Klamath and Belmont orchards received only small amounts of water in 1926.

Terminology. In describing the quality and condition of the various lots of fruit mentioned in this report, certain terms are employed which may require explanation. The term "prime condition" as used here re-

fers merely to that stage of maturity when the fruit is ready for eating. The term is not used to describe quality. The term "very good" is used to designate the maximum quality for the variety and is applied only to the lots that developed full Bosc quality. The term "good" is used to describe fruit that is marketable but somewhat less desirable than that which is "very good." "Fair" refers to fruit that is generally unsuited for dessert uses, but which may be of some value for culinary purposes, while "poor" implies that the fruit is practically unmarketable.

EXPERIMENTAL

Time-of-picking tests. Casual observation, as well as experimental evidence, has shown that the degree of maturity attained by the fruit when picked exerts a pronounced influence upon the quality and storage life of pears. With the hope of gaining some definite information on this factor as it applies to Bosc pears grown in the Rogue River Valley, rather comprehensive time-of-picking tests were conducted during the seasons of 1925 and 1926.

The tests in 1925 were conducted as follows: Beginning with August 25, eight separate pickings were made at intervals of 5 days. Part of the fruit from each picking was ripened at 66° F., part of it was ripened in the Station cellar, part of it was kept at 40° F. for 30 days and then ripened at 66° F. and in the Station cellar. A separate test was conducted for each of the five orchards already described.

Pressure-test determinations were made at the time of picking with both the Oregon and the U. S. pressure testers, the Oregon tester being equipped with a plunger 7/16 of an inch in diameter while the U. S. tester was equipped with a plunger 5/16 of an inch in diameter. In case the fruit was pared the peel was removed with a paring knife from the portions where the plunger was applied.

Similar tests were carried on during 1926 with fruit from the Klamath, Belmont, and Upton orchards. Beginning with August 7, eight separate pickings were made at intervals of five days. The fruit from these pickings was all ripened at a temperature of 66° F. Pressure tests were made as in 1925.

The data obtained in the various time of picking tests are presented in tables I to IX inclusive.

Storage tests. For the various storage tests in 1925, four separate pickings from the Klamath orchard were made at intervals of 7 days, the first picking occurring on August 29. Part of the fruit from each picking was immediately stored at 32°, 40° and 50° F. Part of it was subjected to a "delay" of 7 days in the Station cellar, and was then stored at 32°, 40°, and 50° F., while the remaining portion was subjected to a "delay" of 14 days, after which it was stored at 32°, 40°, and 50° F.

Removal dates were so arranged that fruit from each lot was removed after storage periods of 30, 60, and 90 days. In case the fruit was still green upon removal, part of it was ripened in the Station cellar, while the remainder was allowed to reach prime condition in the ripening room at Corvallis at a temperature of 66° F.

For the storage tests in 1926, three separate pickings were made from the Klamath, Belmont, and Upton orchards at intervals of five days. Part of the fruit from each picking was stored immediately at

32° F.; part of it was subjected to a "delay" of 7 days at 66° F. followed by storage at 32° F. Removal dates were arranged so that fruit from each picking remained in storage for periods of 30, 60, 90, 120, and 150 days. Upon removal, this fruit was ripened at a temperature of 66° F.

Tables XI to XXII inclusive give the data obtained in the various storage tests.

DISCUSSION OF RESULTS

Time of picking affects the quality. That time of picking affects the quality of Bosc pears is very evident from the results of these tests. When picked prematurely, the fruit is inclined to wilt in storage and lacks in character and sweetness. When picked too late, it is usually dry in texture and more or less insipid in character.

When compared to that of other varieties, the desirable picking season of Bosc is rather short. In the case of the Klamath and Belmont orchards in 1925, full Bosc quality was obtained only with the fruit harvested between August 30 and September 9, while in the case of the Upton orchard, full quality was obtained only with the fruit picked between August 25 and September 4. The tests in 1926 gave similar results. With the fruit from the Klamath and Belmont orchards, full quality developed only in the lots picked between August 11 and August 26.

It appears, therefore, that the period during which Bosc pears of first-class quality can be harvested from any one orchard varies generally from 10 to 15 days.

Time of picking affects the storage life. Time of picking also affects, in a marked degree, the storage life of Bosc pears. A study of the data presented in the accompanying tables makes this point clear. When harvested prematurely, the fruit was inclined to scald in cold storage, and to break down rapidly after reaching prime condition, there being a manifest tendency for the pears to break down at the stem end. When picked beyond the optimum picking time, the fruit ripened quickly and was inclined to develop core break-down.

The effect of time of picking on the storage life of Bosc pears is well illustrated by the tests from the Klamath orchard in 1925. The fruit picked on August 25, for example, required 14 days to reach prime condition at 66° F., that picked on September 4 required 17 days to reach prime condition at 66° F., while that picked on September 29 was ready for consumption in 9 days at this temperature.

Fortunately, what proves to be the best picking time so far as dessert quality is concerned, also proves to be the most desirable picking time for maximum storage quality.

The pressure test. The pressure test again proved to be a fairly reliable index of time of picking in pears. It is clear from this work, however, that this test is of little value unless it is used with reasonable care. It is by no means "fool proof," and should only be applied by some one who has made a study of the factors involved.

When the Oregon tester is used, the most desirable picking range for Bosc on unpared specimens appears to be between 28 and 24 pounds. On pared fruit the desirable range is probably between 26 and 22 pounds. The results with the U. S. tester show the desirable range with this instrument to be between 18 and 16 pounds on unpared, and between 16 and 14 pounds on pared specimens.

Orchards vary as to time of picking. As shown by the data presented, the fruit in the various Bosc orchards of the Rogue River Valley does not reach the proper picking stage at the same time. The fruit from the Upton orchard, for example, was generally ready for harvest about one week sooner than that from either the Klamath or Belmont orchards. It appears that the orchards situated in the lower portions of the Valley on the lighter soils are more advanced than are those on the "sticky" and "free" soils at the higher elevations. The age of the trees, cultural treatment, and amount of crop may also affect the time of ripening in some cases.³

Maturity varies with the seasons. Calendar dates alone, apparently, are not reliable for setting picking dates from season to season. Bosc pears in 1926, for example, were ready for harvest twelve or fifteen days earlier than they were in 1925. There is considerable evidence to show that maturity is more or less associated with the earliness of the blooming period⁴ and the character of the growing season. Generally, it can be assumed that early springs lead to early maturity.

Increase in size. From the time of the first picking to that of the last, Bosc pears undergo a marked increase in size. This increase is noticeable not only during the early part of the harvest period, but is usually still in progress at the time of the last picking. Evidently the fruit continues to gain in size and weight for some time after the optimum picking time has been reached. If the seasons of 1925 and 1926 are typical of the average, it is quite clear that when full dessert and keeping quality are desired, Bosc pears cannot be left on the trees until all growth has ceased.

Bosc pears adhere to the tree. As compared to other varieties, Bosc pears cling to the trees well during the harvest period. Windfalls during this period are generally confined to wormy, seedless, or otherwise imperfect specimens. Toward the end of the season, some of the sound specimens may fall to the ground, but barring excessive winds, the sound fruit adheres to the tree for some time beyond the best picking stage.

Temperature affects the storage life. It is very clear from these results that temperature after picking has material bearing on the storage life of Bosc pears. It was found, for example, that Bosc pears kept constantly at 66° F. ripened very rapidly and became ready for consumption in a comparatively short time. For the season of 1925 the average length of time for all lots to reach prime condition at this temperature was 12 days. At 50° F. the pears ripened at a fairly rapid rate, but required about twice as long to reach maturity, the average length of time being 26 days. When held at 40° F. the pears held up somewhat longer than they did at 50° F. Most of the lots in the 40° F. room were in good condition at the end of 30 days. Following this, however, the fruit in this room began breaking down and none of it survived the second month. At 32° F., most of the lots kept well and pears still firm and in good condition came out of the 32° F. room after storage periods of 30, 60, and 90 days. The results for 1926 show that the lots harvested at the proper time and stored immediately were in good condition and developed fairly good quality after 120 days of storage at 32° F.

Bosc pears must be ripened at high temperatures. It is clear from the results of these tests that Bosc pears require fairly high ripening temperatures. While they may be held at low temperatures for a considerable time, they do not develop quality unless they are removed from storage and allowed to ripen at temperatures between 60° and 70° F.

Of the many pears held in storage during the season of 1925, practically none ripened if held constantly at 32° and 40° F. At these temperatures, the pears remained firm and green for varying periods and then invariably broke down at the core and scalded on the outside without ripening. Fruit from the same lots, however, developed very fine quality when removed from cold storage and allowed to ripen at 66° F.

When held constantly at 50° and 60° F., all the pears ripened, but the quality obtained in the 66° F. room was far superior to that obtained at 50° F. The fruit ripened in the Station cellar developed good quality, while the outside temperatures were fairly high. Later in the season, however, after the temperature of the cellar had dropped below 50° F., the fruit did not ripen properly.

The fact that Bosc pears require high ripening temperatures undoubtedly accounts for many of the past failures with this variety when held in cold storage.

Time required to ripen. Bosc pears reach prime condition in a comparatively short time after removal from cold storage. Pears harvested at the proper time and stored immediately at 32° F. for periods of 30 to 120 days, have generally ripened in 8 to 12 days upon removal to a temperature of 66° F. Apparently the time required for the fruit to reach eating condition at the higher temperatures is not materially influenced by the length of time it was held in cold storage. Pears removed at the end of four or five months usually require about as long to ripen as those removed at the end of 30 days.

Storage humidity must be fairly high. Bosc pears wilt badly in storage unless kept at fairly high humidities. This is especially true of the early picked fruit. In the present investigations, relative humidities varying between 76 and 80 percent proved to be sufficiently high to prevent wilting, provided the fruit was properly wrapped in paper. Fruit stored loose showed considerable wilting even at these humidities.

Immediate vs. delayed storage. The practice of subjecting Bosc pears to a "delay" of several days prior to storage at low temperatures is not generally in accord with the results of these investigations. In the cases of early harvesting, the fruit subjected to a delay of 7 days at the prevailing temperatures probably developed a little better quality, and delay in this case did not seem materially to affect the storage life. With all the fruit harvested at mid-season or later, however, no improvement in quality was noticed as a result of this practice, and, in most cases, the storage life was materially shortened. In 1926 a delay of 7 days at a temperature of 66° F., was responsible for a reduction of at least two months in the storage life of the fruit. A delay of 14 days proved too long for even the early-picked fruit, the pears in many instances being nearly ripe at the end of the delay period.

Quality depends somewhat upon the inherent nature of the fruit. Some Bosc pears apparently are inherently deficient in the characteristics that make up quality and remain inferior no matter what the treatment

at harvest time or in storage has been. Specimens that are naturally coarse in form and texture seldom develop full Bosc quality. Those that are highly russeted are usually spicier and sweeter at maturity than are the specimens possessing little or no russet. Large, over-grown fruits are frequently short lived in storage, and go down quickly after reaching prime condition.

Soil type affects quality. The type of soil upon which the fruit has been grown appears to influence the quality of Bosc pears. This certainly was true so far as the orchards under observation in these tests were concerned. The pears grown on the heavier types of soil undoubtedly developed better dessert quality than did those grown on the lighter soils.

Core break-down. The present investigations have shown again that core break-down is closely associated with time of picking. In general, the trouble was more pronounced in the fruit harvested late in the season. The results in this case, however, were less clear cut than those obtained in former seasons with fruit from other districts.⁴ Core break-down in the Bosc pears from the Rogue River Valley apparently is not a serious factor provided the fruit is picked at the right time and stored and ripened under proper conditions.

Determining prime condition. Bosc pears are usually in prime condition before they become thoroughly soft, and because of this many people are not able to determine when they are at their best. When in prime condition, these pears are generally soft at the stem end but are comparatively firm at the calyx end. The bronze or yellow color is not an indicator of eating maturity in Bosc, for this color usually comes on before the pears are thoroughly ripe. The appearance of brown areas or discoloration on the surface invariably indicates that the fruit is past prime condition.

PRACTICAL APPLICATION

The pressure test is the best known indicator of time of picking in Bosc pears. Either the Oregon or U. S. tester may be used. For maximum dessert and storage quality the fruit should be harvested within the following ranges of pressure:

Type of tester	Size of plunger	Unpared	Pared
		<i>lbs.</i>	<i>lbs.</i>
Oregon	<i>inches</i> 7/16	28 to 24	26 to 22
U. S.	5/16	18 to 16	16 to 14

Usually from ten to fifteen days are required for the fruit to pass through these ranges. This, in most cases, should afford ample time to harvest the crop.

Since Bosc pears undergo a marked increase in size during the harvest period, it is unwise to harvest the entire crop as soon as the pressure tester registers at the upper limits of the desirable picking range. Rather, harvesting should be so distributed that the last of the fruit will be picked about the time the tester registers at the lower limits of the desirable range.

In selecting samples for the pressure test only normal average specimens should be used. Fruits that are blemished, wormy, or over-colored

should be eliminated. The test, so far as possible, should be made only on turgid specimens. Wilted specimens do not give a fair test. Those from the larger branches on the inside of the tree are usually more turgid than those from the outer portions. The test should be made as soon after picking as possible. From ten to twelve specimens are necessary to give a fairly representative test.

When long keeping is desired the fruit should be placed under refrigeration as soon after picking as possible. This is especially true of the fruit picked late in the season. A delay of a few days may cause a material shortening of the storage life. In case the fruit, for some reason or other, cannot be placed under refrigeration immediately after picking, it is better to allow it to hang on the trees for a few days longer. At the prevailing temperatures, Bosc pears ripen much faster after picking than they do while attached to the tree.

For long keeping the fruit should be held at 30° to 32° F. Holding it at higher temperatures materially shortens the storage life and does not improve the dessert quality.

Bosc pears usually wilt badly if kept at the prevailing humidities. Relative humidities between 76 and 80 percent will usually prevent wilting provided the fruit has been harvested at the proper time and has been properly wrapped in paper.

To secure high quality, Bosc pears must be removed from cold storage while still firm, and ripened at temperatures between 60° and 70° F. They will not ripen properly if kept constantly at 30° to 32° F.

The combination of cold storage and high ripening temperatures makes possible a comparatively long marketing season for Bosc pears. With proper handling, pears of excellent quality can be available at any time from the middle of September to the middle of January.

Storage at the shipping point apparently offers a practical and efficient method of handling Bosc pears. The length of time the fruit can be held at the shipping point, however, depends upon several factors such as season, time of picking, time of storage, and temperature of the storage rooms. It appears, however, that in cases where the product has been properly handled, shipping point storage can be extended at least until the Christmas holidays. The color changes occurring in the fruit itself are of some value in determining the length of the storage period. As long as the fruit retains its green color, it is generally safe in cold storage. When the fruit begins to turn yellow, however, it is usually nearing the end of its storage life, even though it may still be very firm in texture.

TABLE I. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCO PEARS

Klamath orchard, 1925. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of prime condition	No. of days to reach prime condition	Dessert quality
		Unpared	Pared			
1	8/25	28.4	24.6	9/8	14	Fairly good
2	8/30	26.4	24.3	9/14	15	Very good
3	9/4	25.3	23.2	9/21	17	Very good
4	9/9	24.0	22.5	9/22	13	Very good
5	9/14	22.4	21.2	9/25	11	Good
6	9/19	21.8	20.4	9/30	11	Fair
7	9/24	21.2	19.4	10/3	9	Fair
8	9/29	20.0	18.8	10/8	9	Fair

TABLE II. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Belmont orchard, 1925. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of prime condition	No. of days to reach prime condition	Dessert quality
		Unpared	Pared			
1	8/25	28.0	24.1	9/8	14	Fairly good
2	8/30	25.7	23.6	9/13	14	Very good
3	9/4	25.0	23.5	9/21	17	Very good
4	9/9	23.6	21.8	9/22	13	Very good
5	9/14	22.2	19.9	9/24	10	Very good
6	9/19	20.9	18.9	9/30	10	Fair
7	9/24	21.3	18.9	10/3	9	Fair
8	9/29	19.5	17.0	10/7	8	Fair

TABLE III. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Upton orchard, 1925. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of prime condition	No. of days to reach prime condition	Dessert quality
		Unpared	Pared			
1	8/25	27.6	24.3	9/9	15	Very good
2	8/30	26.3	23.4	9/15	16	Very good
3	9/4	24.7	22.7	9/22	18	Very good
4	9/9	23.7	21.6	9/22	13	Good
5	9/14	21.7	20.2	9/25	11	Fair
6	9/19	20.8	18.3	10/29	10	Fair
7	9/24	19.2	17.3	10/2	8	Fair
8	9/29	19.3	17.9	10/6	8	Fair

TABLE IV. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Stored 30 days at 40° F. Ripened at 66° F.

Lot No.	Date of picking and storing	Pressure test (Oregon tester)		Date of removal from 40° F.	Condition upon removal from 40° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared					
1	8/25	28.4	24.6	9/25	Firm, yellow	9/30	5	Good
2	8/30	26.3	23.4	9/30	Firm, yellow	10/6	6	Very good
3	9/4	25.3	23.2	10/4	Firm, yellow	10/11	7	Very good
4	9/9	24.0	22.5	10/9	Firm, yellow	10/17	8	Very good
5	9/14	22.4	21.2	10/14	Firm, greenish yellow	10/20	6	Good
6	9/19	21.8	20.4	10/19	Firm, yellow	10/26	7	Fair
7	9/24	21.2	19.4	10/26	Firm, yellow	11/2	6	Fair
8	9/29	20.0	18.8	10/29	Firm, yellow	11/4	5	Fair

TABLE V. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Belmont orchard, 1925. Stored 30 days at 40° F. Ripened at 66° F.

Lot No.	Date of picking and storing	Pressure test (Oregon tester)		Date of removal from 40° F.	Condition upon removal from 40° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared					
1	8/25	28.0	24.1	9/25	Firm, yellow	10/1	6	Good
2	8/30	25.7	23.6	9/30	Firm, yellow	10/6	6	Very good
3	9/4	25.0	23.5	10/4	Firm, yellow	10/11	7	Very good
4	9/9	23.6	21.8	10/9	Firm, greenish yellow	10/16	7	Very good
5	9/14	22.2	19.9	10/14	Firm, greenish yellow	10/20	7	Fairly good
6	9/19	20.9	18.9	10/19	Firm, yellow	10/25	6	Fairly good
7	9/24	21.3	18.9	10/26	Firm, yellow	11/2	6	Fair
8	9/29	19.5	17.0	10/29	Firm, yellow	11/4	5	Fair

TABLE VI. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Upton orchard, 1925. Stored 30 days at 40° F. Ripened at 66° F.

Lot No.	Date of picking and storing	Pressure test (Oregon tester)		Date of removal from 40° F.	Condition upon removal from 40° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared					
1	8/25	27.6	24.3	9/25	Firm, yellow	10/1	6	Good
2	8/30	26.3	23.4	9/30	Firm, yellow	10/7	7	Good
3	9/4	24.7	22.7	10/4	Firm, yellow	10/12	8	Good
4	9/9	23.7	21.6	10/9	Firm, yellow	10/16	7	Fairly good
5	9/14	21.7	20.2	10/14	Firm, greenish yellow	10/20	7	Fair
6	9/19	20.8	18.3	10/19	Firm, greenish yellow	10/25	6	Fair
7	9/24	19.2	17.3	10/26	Firm, yellow	11/1	5	Fair
8	9/29	19.3	17.9	10/29	Firm, yellow	11/3	4	Fair

TABLE VII. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1926. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of prime condition	No. of days to reach prime condition	Dessert quality
		Oregon tester		U. S. tester				
		Unpared	Pared	Unpared	Pared			
1	8/7	29.4	28.1	18.9	16.8	8/22	15	Good
2	8/11	28.4	27.3	18.6	16.2	8/28	17	Very good
3	8/16	26.9	25.3	17.9	14.8	9/3	18	Very good
4	8/21	24.7	23.6	17.6	14.6	9/6	16	Very good
5	8/26	24.1	22.7	17.9	14.5	9/9	14	Very good
6	8/31	24.5	22.7	17.4	14.4	9/14	14	Good
7	9/5	22.6	20.9	13.7	12.3	9/20	13	Fairly good
8	9/10	22.2	20.3	13.5	12.1	9/23	10	Fair

TABLE VIII. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Belmont orchard, 1926. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of prime condition	No. of days to reach prime condition	Dessert quality
		Oregon tester		U. S. tester				
		Unpared	Pared	Unpared	Pared			
1	8/11	31.3	28.5	21.1	18.0	8/28	17	Good
2	8/16	28.2	26.5	19.8	16.5	9/2	17	Very good
3	8/21	25.8	24.9	17.6	15.2	9/6	16	Very good
4	8/26	25.0	22.6	17.8	15.3	9/11	16	Very good
5	8/31	24.3	22.7	16.8	14.4	9/14	14	Very good
6	9/5	24.7	22.6	16.7	13.1	9/19	14	Good
7	9/10	22.5	20.8	16.0	13.8	9/21	11	Fairly good

TABLE IX. THE EFFECT OF TIME OF PICKING ON THE QUALITY OF BOSCH PEARS

Upton orchard, 1926. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of prime condition	No. of days to reach prime condition	Dessert quality
		Oregon tester		U. S. tester				
		Unpared	Pared	Unpared	Pared			
1	8/11	26.0	24.2	15.7	13.6	8/24	13	Good
2	8/16	24.2	21.8	16.0	13.8	8/30	14	Good
3	8/21	23.7	21.3	15.9	13.2	9/3	13	Good
4	8/26	22.7	20.2	16.9	13.6	9/7	12	Fairly good
5	8/31	23.2	21.4	15.8	13.2	9/13	13	Fair
6	9/5	23.6	21.6	13.4	12.4	9/18	13	Fair
7	9/10	21.5	18.5	13.3	11.6	9/24	14	Poor
8	9/16	21.0	18.0	13.3	11.7	9/27	11	Poor

TABLE X. THE EFFECT OF TEMPERATURE ON THE STORAGE LIFE OF BOSCH PEARS

Klamath orchard, 1925. Immediate storage.

Lot No.	Date of picking	Pressure test (Oregon tester)		Storage temperature (°F)	Date of prime condition	Length of storage life (days)
		Unpared	Pared			
1	9/5	26.2	24.1	66	9/21	17
2	9/5	26.2	24.1	50	9/30	25
3	9/5	26.2	24.1	40	10/11	36
4	9/5	26.2	24.1	32	12/12	98

TABLE XI. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Immediate storage at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 32° F.	No. of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	9/30	30	Firm, green	10/10	10	Good
				10/29	60	Firm, green	11/7	9	Good
				11/28	90	Firm, green	12/9	11	Fairly good
2	9/5	26.2	24.1	10/5	30	Firm, green	10/15	14	Very good
				11/4	60	Firm, green	11/14	10	Very good
				12/4	90	Firm, green	12/12	8	Fairly good
3	9/12	23.5	21.5	10/12	30	Firm, green	10/23	11	Good
				11/11	60	Firm, green	11/21	12	Good
				12/11	90	Firm, green	12/26	15	Fair
4	9/19	21.8	20.4	10/19	30	Firm, green	10/29	10	Fair
				11/18	60	Firm, green	11/30	12	Fair
				12/18	90	Firm, green	12/28	10	Fair

TABLE XII. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Delayed one week. Stored at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 32° F.	No. of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	10/5	30	Firm, green	10/11	6	Good
				11/4	60	Firm, green	11/13	9	Good
				12/4	90	Firm, yellow	12/14	10	Fairly good
2	9/5	26.2	24.1	10/12	30	Firm, green	10/21	9	Very good
				11/11	60	Firm, green	11/20	9	Very good
				12/11	90	Firm, yellow	12/24	13	Fairly good
3	9/12	23.5	21.5	10/19	30	Firm, green	10/29	10	Very good
				11/18	60	Firm, yellow	11/28	10	Very good
				12/18	90	Firm, yellow	12/27	9	Fairly good
4	9/19	21.8	20.4	10/26	30	Firm, yellow	10/30	4	Fair
				11/29	60	Soft, yellow	10/31	2	Fair
				12/29	90	Soft, yellow	10/31	2	Fair

TABLE XIII. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Delayed two weeks. Stored at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 32° F.	No. of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	10/14	30	Firm, yellow	10/20	6	Good
				11/11	60	Firm, yellow	12/18	7	Good
				12/11	90	Firm, yellow	12/16	5	Fairly good
2	9/5	26.2	24.1	10/19	30	Firm, yellow	10/29	10	Very good
				11/18	60	Firm, yellow	11/28	10	Very good
				12/18	90	Firm, yellow	12/28	10	Fairly good
3	9/12	23.5	21.5	10/26	30	Almost ripe	10/29	3	Good
				11/25	60	Broken down	10/29	...	Fair
				12/25	90	Broken down	10/29	...	Fair
4	9/19	21.8	20.4	11/3	30	Broken down	10/26	...	Fair
				12/3	60	Broken down	10/26	...	Fair
				1/2	90	Broken down	10/26	...	Fair

TABLE XIV. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Immediate storage at 40° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 40° F.	No. of days at 40° F.	Condition upon removal from 40° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	9/30	30	Firm, yellow	10/6	6	Good
				10/29	60	Broken down	.....	.....	Fair
				10/5	30	Firm, yellow	10/11	6	Very good
2	9/5	26.2	24.1	11/3	60	Breaking down	.....	.....	Fair
				10/12	30	Firm, yellow	10/23	11	Very good
				11/11	60	Broken down	.....	.....	Fair
3	9/12	23.5	21.5	10/19	30	Firm, yellow	10/29	10	Fair
				11/18	60	Broken down	.....	.....	Fair
				11/18	60	Broken down	.....	.....	Fair

TABLE XV. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Delayed one week. Stored at 40° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 40° F.	No. of days at 40° F.	Condition upon removal from 40° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	10/4	30	Firm, yellow	10/10	6	Good
				11/3	60	Soft, yellow	.....	.....	Fair
2	9/5	26.2	24.1	10/11	30	Firm, yellow	10/17	6	Very good
				11/11	60	Breaking down	.....	.....	Poor
3	9/12	23.5	21.5	10/19	30	Firm, yellow	10/25	6	Very good
				11/18	60	Broken down	.....	.....	Poor
4	9/19	21.8	20.4	10/26	30	Firm, yellow	10/29	3	Fair
				11/26	60	Broken down	.....	.....	Poor

TABLE XVI. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Delayed two weeks. Stored at 40° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 40° F.	No. of days at 40° F.	Condition upon removal from 49° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Unpared	Pared						
1	8/29	27.2	24.8	10/12	30	Firm, yellow	10/17	5	Good
				11/12	60	Broken down				.....	.....	Fair
2	9/5	26.2	24.1	10/19	30	Firm, yellow	10/27	8	Very good
				11/18	60	Broken down				.....	.....	Fair
3	9/12	23.5	21.5	10/24	30	Soft, yellow	10/27	3	Very good
				11/25	60	Broken down				.....	.....	Fair
4	9/19	21.8	20.4	11/3	30	Breaking down	10/19	.....	Very good
				12/2	60	Broken down				.....	.....	Poor

TABLE XVII. THE EFFECT OF TIME OF PICKING AND STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Immediate storage at 50° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of prime condition	No. of days to reach prime condition	Dessert quality
		Unpared	Pared			
1	8/29	27.2	24.8	9/21	22	Good
2	9/5	26.2	24.1	9/30	25	Good
3	9/12	23.5	21.5	10/9	27	Good
4	9/19	21.8	20.4	10/15	26	Fair

TABLE XVIII. THE EFFECT OF STORAGE AT 32° F. ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1925. Immediate storage at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test (Oregon tester)		Date of removal from 32° F.	No. of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 32° F.	Dessert quality
		Unpared	Pared						
1	9/5	26.2	24.1	(check)	0	Firm, green	9/20	15	Very good
2	9/5	26.2	24.1	9/6	1	Firm, green	9/20	14	Very good
3	9/5	26.2	24.1	9/10	5	Firm, green	9/23	13	Very good
4	9/5	26.2	24.1	9/15	10	Firm, green	9/26	11	Very good
5	9/5	26.2	24.1	9/20	15	Firm, green	10/1	11	Very good
6	9/5	26.2	24.1	9/25	20	Firm, green	10/6	11	Very good
7	9/5	26.2	24.1	9/30	25	Firm, green	10/12	12	Very good
8	9/5	26.2	24.1	10/5	30	Firm, green	10/17	12	Very good
9	9/5	26.2	24.1	11/4	60	Firm, green	11/14	10	Very good
10	9/5	26.2	24.1	12/4	90	Firm, green	12/12	8	Very good

TABLE XIX. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Klamath orchard, 1926. Immediate storage at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of removal from 32° F.	Number of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Oregon tester		U. S. tester							
		Unpared	Pared	Unpared	Pared						
1	8/16	26.9	25.3	17.9	14.8	9/16	30	Firm, green	9/26	10	Very good
						10/16	60	Firm, green	10/25	9	Very good
						11/16	90	Firm, green	11/26	10	Very good
						12/16	120	Firm, green	12/26	10	Good
						1/16	150	Firm, yellow slight scald	1/25	9	Fair
2	8/21	24.7	23.6	17.6	14.6	9/21	30	Firm, green	10/2	11	Very good
						10/21	60	Firm, green	10/30	9	Very good
						11/21	90	Firm, green	11/29	8	Very good
						12/21	120	Firm, green	12/30	9	Fairly good
						1/21	150	Firm, yellow	1/30	9	Fair
3	8/26	24.1	22.7	17.9	14.5	9/26	30	Firm, green	10/7	12	Very good
						10/26	60	Firm, green	11/6	11	Very good
						11/26	90	Firm, green	12/7	12	Very good
						12/26	120	Firm, yellow	1/5	10	Good
						1/26	150	Firm, yellow slight scald	2/4	9	Fair

TABLE XX. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSCH PEARS

Belmont orchard, 1926. Immediate storage at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of removal from 32° F.	Number of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Oregon tester		U. S. tester							
		Unpared	Pared	Unpared	Pared						
1	8/16	28.2	26.5	19.8	16.5	9/16	30	Firm, green	9/26	10	Very good
						10/16	60	Firm, green	10/26	10	Very good
						11/16	90	Firm, green	11/24	8	Very good
						12/16	120	Firm, green	12/25	9	Good
						1/16	150	Firm, yellow slight scald	1/25	9	Fair
2	8/21	25.8	24.9	17.6	15.2	9/21	30	Firm, green	10/1	7	Very good
						10/21	60	Firm, green	10/28	10	Very good
						11/21	90	Firm, green	11/29	8	Very good
						12/21	120	Firm, green	12/31	10	Good
						1/21	150	Firm, yellow	1/30	9	Fair
3	8/26	25.0	22.6	17.8	15.3	9/26	30	Firm, green	10/8	12	Very good
						10/26	60	Firm, green	11/7	11	Very good
						11/26	90	Firm, green	12/8	12	Very good
						12/26	120	Firm, green	1/8	12	Good
						1/26	150	Firm, yellow	2/6	10	Fair

TABLE XXI. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSC PEARS

Upton orchard, 1926. Immediate storage at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of removal from 32° F.	Number of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Oregon tester		U. S. tester							
		Unpared	Pared	Unpared	Pared						
1	8/11	26.0	24.2	15.7	13.6	9/11	30	Firm, green	9/20	9	Good
						10/11	60	Firm, green	10/19	8	Good
						11/11	90	Firm, green	11/21	10	Good
						12/11	120	Firm, green	12/20	9	Fair
						1/11	150	Firm, yellow	1/20	9	Poor
2	8/16	24.2	21.8	16.0	13.8	9/16	30	Firm, green	9/27	11	Good
						10/16	60	Firm, green	10/25	9	Good
						11/16	90	Firm, green	11/26	10	Good
						12/16	120	Firm, green	12/25	9	Fairly good
						1/16	150	Firm, yellow	1/25	9	Fair
3	8/21	23.7	21.3	15.9	13.2	9/21	30	Firm, green	10/1	10	Good
						10/21	60	Firm, green	10/29	8	Good
						11/21	90	Firm, green	11/30	9	Good
						12/21	120	Firm, green	12/30	9	Fair
						1/21	150	Firm, yellow	1/30	9	Fair

TABLE XXII. THE EFFECT OF TIME OF PICKING AND TIME IN STORAGE ON THE QUALITY OF BOSC PEARS

Klamath orchard, 1926. Delayed one week at 66° F. Stored at 32° F. Ripened at 66° F.

Lot No.	Date of picking	Pressure test				Date of removal from 32° F.	Number of days at 32° F.	Condition upon removal from 32° F.	Date of prime condition	No. of days to reach prime condition at 66° F.	Dessert quality
		Oregon tester		U. S. tester							
		Unpared	Pared	Unpared	Pared						
1	8/16	26.9	25.3	17.9	14.8	9/16	23	Firm, yellow	9/24	8	Very good
						10/16	53	Firm, yellow	10/20	4	Very good
						11/16	83	Soft, yellow	11/18	2	Fair
						12/16	113	Badly scalded	.....	.....	Poor
						1/16	143	Badly scalded	.....	.....	Poor
2	8/21	24.7	23.6	17.6	14.6	9/21	23	Firm, yellow	9/27	6	Very good
						10/21	53	Firm, yellow	10/25	4	Fair
						11/21	83	Soft, yellow	11/21	0	Fair
						12/21	113	Badly scalded	.....	.....	Poor
						1/21	143	Badly scalded	.....	.....	Poor
3	8/26	24.1	22.7	17.9	14.5	9/26	23	Firm, yellow	10/2	8	Very good
						10/26	53	Soft, yellow	10/27	1	Good
						11/26	83	Soft, yellow	.....	.....	Fair
						12/26	113	Badly scalded	.....	.....	Poor
						1/26	143	Badly scalded	Poor

PART II. TRANSPORTATION AND STORAGE FOLLOWING EASTERN SHIPMENT

by

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Methods of procedure. Work in cooperation with the Oregon Agricultural Experiment Station was started on fruit from the Rogue River Valley, Oregon, during the season of 1925. Representatives of the Oregon Experiment Station carried on investigations at Medford to determine the proper time for picking the fruit and the best methods of storage at the shipping point. The results of this work are reported in detail in Part I of this bulletin.

In addition to the fruit held in storage at Medford, certain lots of pears were picked, packed, and loaded into commercial car lots of fruit and then forwarded to New York City. Three boxes of fruit of each lot were loaded in the bottom of the car near the bunker—the coldest position in the car, and three similar boxes were loaded in the top of the car at the brace—a position nearly as warm as any in the car. In one box in each position was packed a recording thermometer which gave a record of the temperature at which the fruit was carried while in transit. This fruit was picked, packed, and loaded the same day.

When the cars containing these experimental shipments were unloaded in New York City, the test boxes were shipped at once by express to Washington, the time in transit being overnight. Upon arrival in Washington, the fruit was at once placed under the storage temperature at which it was to be held.

In addition to the lots of fruit picked and shipped immediately, a similar quantity and lot of fruit was picked, held at the packing house for seven days under prevailing temperatures and then loaded, half in the top and half in the bottom of commercially loaded refrigerator cars. This fruit was also forwarded via New York City to Washington. These experiments were designed to show definitely whether or not a delay prior to loading in the cars is commercially feasible or desirable.

Upon arrival in Washington part of each shipment from each position in the car was placed in storage at 70° F. for immediate ripening. Part was placed in storage at 40° F. and part at 32° F.

Three pickings were made and forwarded by the representatives at the Oregon Experiment Station, these being at weekly intervals, the first on August 29, the second on September 5, and the third on September 12. Pressure tests, with both the tester developed by the Oregon Experiment Station using a plunger point 7/16 of an inch in diameter and the tester using the 5/16 inch plunger point developed by the United States Department of Agriculture, were made at the time of picking. Pressure tests made on the pared fruit with the United States Department of Agriculture tester showed the first picking to test 16.1 pounds. This fruit was loaded into a refrigerator car and shipped under ordinary refrigeration. As shown by the thermograph records, the temperatures in the boxes loaded on the bottom of the car at the bunker averaged 39° F. The temperature at the top of the load was not obtained due to the failure of the thermograph to record properly, but would probably aver-

age about 50° F. considering the temperature obtained on the bottom. The car was unloaded after sixteen days. The detailed record for this fruit while in transit and while in storage in Washington is given in Table XXIII and is shown graphically in Fig. 1.

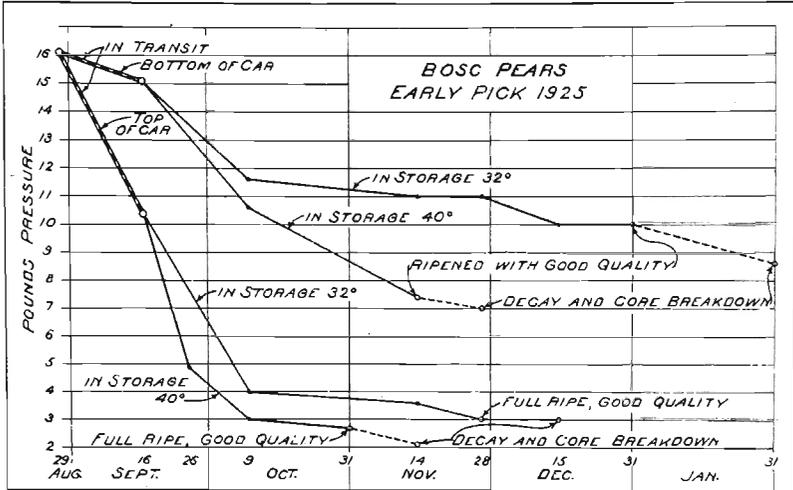


Fig. 1. Softening of early picked Bosc pears in transit and in storage, 1925.

Behavior of early picked Bosc pears. Upon arrival at Washington fruit from the top of the car tested 10.4 pounds, while that from the bottom tested 15.1 pounds. Samples of the fruit from the top of the car when placed in 70° F. storage reached a full ripe condition in four days, while that from the bottom of the car was full ripe in five days. The quality of the fruit ripened at 70° was very good.

In 40° F. storage, fruit from the top of the car reached the end of good commercial condition the last of October, while that from the bottom of the car remained in good commercial condition until the middle of November. Thus the storage limit at 40° F. was 1½ months with fruit from the top of the car, and 2 months with fruit from the bottom of the car. After that period so much decay, scald, and discoloration at the core, or core break-down, developed that the fruit had little commercial value.

Fruit from the top of the car placed in storage at 32° F. remained in satisfactory commercial condition until the end of November. Fruit from the bottom of the car under similar storage conditions was in good condition at the end of December, but was showing scald and decay by the end of January. Thus the fruit which was carried in the top of the car reached the end of its commercial storage condition a full month earlier than did the fruit carried in the bottom of the car.

The fruit from the bottom of the car, whether held at 40° or at 32° F., did not ripen with satisfactory quality while in storage at these temperatures. At monthly intervals, however, fruit was removed, both from 40° and from 32°, and was ripened at a temperature of 70° F. The num-

ber of days required for this fruit to ripen and the quality of the ripened fruit after removal from 32° F. storage are given in Table XXIII. Fruit of this lot ripened immediately was of very good quality. After two months storage at 32° F. fruit carried both in the top and in the bottom of the car ripened with good quality and at the end of December fruit carried in the bottom of the car still ripened with good quality.

TABLE XXIII. BEHAVIOR OF EARLY PICKED BOSC PEARS IN TRANSIT AND STORAGE

Date picked and shipped, 8/29/25. Pressure test, 16.1. Unloaded New York, 9/15/25.
Arrival Washington, D. C., 9/16/25. Temperatures in transit—top of load, average 48°; bottom of load, average 39°.

Date	Pressure test				Ripening at 70° F. after removal from 32° storage			
	In 40° storage		In 32° storage		From top of car		From bottom of car	
	From top of car	From bot tom of car	From top of car	From bot tom of car	No. days to full ripe	Quality	No. days to full ripe	Quality
9/16/25	10.4	15.1	10.4	15.1	4	Very good	5	Very good
9/26/25	4.9	13.2	.....	.....	.....	.....	.....	.....
10/ 9/25	3.0	10.6	4.0	11.6	3	Very good	5	Good to very good
10/31/25	2.7	8.6	.....	.....	.....	.....	.....	.....
11/14/25	Gone— decay and core break-down	7.4	3.6	11.0	3	Good	5	Good
11/28/25	.....	Gone— decay and core break-down	3.0	11.0	1	Fair to good	5	Fair to good
12/15/25	.....	.....	Gone— decay and core break-down	10.0	.....	.....	5	Fair to good
12/31/25	.....	.....	.....	10.0	.....	.....	4	Good
1/30/26	.....	.....	.....	8.6	.....	.....	5	Fair to good
				Gone— scald and decay				Scald

It is interesting to note that after the first three weeks in storage the fruit at 32° F. showed little further softening. It is also interesting to note that there was practically no decrease in the time required for this fruit to ripen when removed from 32° storage and held at 70° F. Approximately a five-day interval was required in January, which was the same interval required when the fruit was received on September 16. It would appear that the Bosc pear showed little ripening activity while in storage at 32° F. The end of the storage season was determined by the development of scald, decay, and core break-down. Up until the time these forms of deterioration set in, the fruit, when removed to 70° F., ripened with good quality.

Behavior of mid-season picked Bosc pears. The second or mid-season experimental picking was made on September 5, 1925, from the same orchard from which the first picking was obtained. The pressure test at the time of picking was 14.1 pounds. This fruit was loaded into a commercial car, which was shipped under salt-ice refrigeration. Eighteen days

elapsed between the date of shipping and the unloading of the car, during which period the average temperature in the top of the load was 45° F. and at the bottom of the load was 34° F. This fruit was loaded into the car during cool weather, which partly accounts for the very favorable temperatures secured.

Upon arrival in Washington there was little apparent difference in pressure test between fruit from the top and fruit from the bottom of the car, that in the top testing 13.9 pounds and that from the bottom testing 14.7 pounds. The rate of softening of this fruit under different storage conditions is recorded in Table XXIV and is shown graphically in Fig. 2.

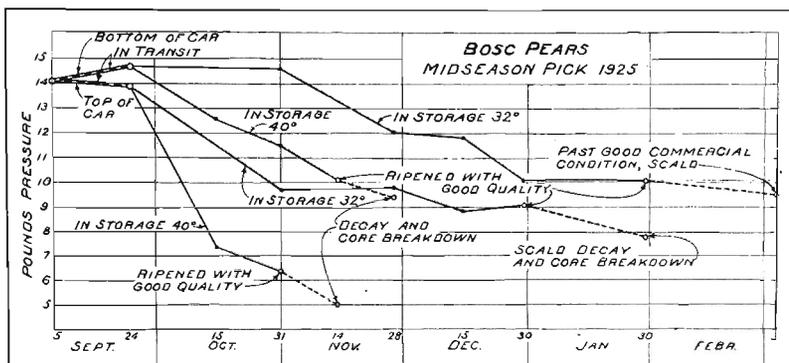


Fig. 2. Softening of mid-season picked Bosc pears in transit and in storage, 1925.

When placed in storage at once at 70° F. fruit from the top of the car was full ripe in five days, while that from the bottom of the car required six days to ripen. All fruit was of very good quality.

When placed in storage at 40° F. the fruit from the top of the car was past good commercial condition by the middle of November, and that from the bottom of the car was gone commercially by the end of November.

In 32° F. storage, fruit from the top of the car remained in good commercial condition until the end of December, while that from the bottom of the car was in good condition at the end of January. All of this fruit, when removed to 70° F. before the development of scald, decay, or core break-down, ripened with good to very good quality. This lot of pears was of the best quality, both from the dessert and storage standpoint, of any received during the 1925 season.

Behavior of late picked Bosc pears. This lot of fruit was picked and shipped September 12, one week later than the mid-season fruit. The pressure test at time of picking was 13.2 pounds. The fruit was in the car fifteen days before unloading, at an average temperature of 49° F. at the top of the car and 33° F. at the bottom. This car was under salt-ice refrigeration.

Upon arrival in Washington the fruit tested 11.7 pounds at the top of the car and 13 pounds at the bottom of the car. At 70° F. the fruit from the top of the car was full ripe in 3 days, while that from the bot-

tom of the car was full ripe in 5 days. The quality was good, although distinctly poorer than the mid-season picked fruit.

TABLE XXIV. BEHAVIOR OF MID-SEASON PICKED BOSC PEARS IN TRANSIT AND STORAGE

Date picked and shipped, 9/5/25. Pressure test, 14.1 lbs. Unloaded New York, 9/23/25. Arrived Washington, D. C., 9/24/25. Temperatures in transit—top of load, average 45° F; bottom of load, average 34° F.

Date	Pressure test				Ripening at 70° F. after removal from 32° storage.			
	In 40° storage		In 32° storage		From top of car		From bottom of car	
	From top of car	From bot tom of car	From top of car	From bot tom of car	No. days to full ripe	Quality	No. days to full ripe	Quality
9/24/25	13.9	14.7	13.9	14.7	5	Very good	6	Good
10/15/25	7.4	12.6	.....	.....	.....	.....	.....	.....
10/31/25	6.4	11.5	9.7	14.6	4	Good	5	Good
11/14/25	Slight decay and core break-down	10.1	.....	.....	.....	.....	.....	.....
11/28/25	Bad decay and core break-down	Decay and core break-down	9.8	12.0	3	Good to very good	5	Good to very good
12/15/25	.....	.....	8.8	11.8	3	Very good	5	Good to very good
12/30/25	.....	.....	9.1	10.1	2	Very good	4	Good
1/30/26	.....	.....	Scald and decay; core break-down	10.1	.....	.....	4	Very good
3/ 3/26	.....	.....	.....	Slight scald	.....	.....	.....	Bad surface decay and scald after 2 days

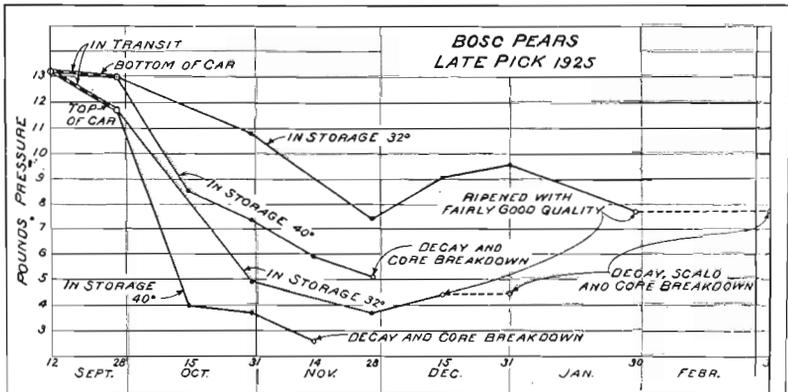


Fig. 3. Softening of late season picked Bosc pears in transit and in storage, 1925.

At 40° F. fruit from the top of the car reached the end of good commercial condition by the middle of November, while from the bottom of the car the fruit was breaking down before the end of November. At

32° F., fruit from the top of the car reached the end of good condition by the middle of December, while from the bottom of the car it remained in good condition until February, being good commercial fruit on January 30. Throughout the storage period this fruit, when removed to 70° F. for ripening, ripened with fair to good quality, being distinctly poorer than the fruit from the first two pickings from the same orchard.

TABLE XXV. BEHAVIOR OF LATE PICKED BOSCH PEARS IN TRANSIT AND STORAGE

Date picked and shipped, 9/12/25. Pressure test, 13.2 lbs. Unloaded New York, 9/27/25. Arrived Washington, D. C., 9/28/25. Temperatures in transit—top of load, average 49° F.; bottom of load, average 33° F.

Date	Pressure test				Ripening at 70° F. after removal from 32°			
	In 40° storage		In 32° storage		From top of car		From bottom of car	
	From top of car	From bottom of car	From top of car	From bottom of car	No days to full ripe	Quality	No days to full ripe	Quality
9/28/25	11.7	13.0	11.7	13.0	3	Good	5	Good
10/15/25	4.0	8.5	.....	.....	.....	.....	.....	.....
10/31/25	3.7	7.3	4.9	9.1	3	Fair to good	4	Fair to good
11/14/25	Past good condition	5.9	2.6	.....	.....	.....	.....	.....
11/28/25	.....	Slight decay and core break-down	3.7	7.4	2	Fair to good	4	Fair to good
12/15/25	.....	.....	4.4	9.1	1	Fair to good	4	Fair to good
12/31/25	.....	.....	Scald and core break-down	9.7	.....	.....	4	.....
1/30/26	.....	.....	.....	7.7	.....	.....	4	Fair to good
3/ 3/26	.....	.....	.....	Gone—core break-down, scald and decay	.....	.....	4	Fair to good

EFFECT OF DELAY IN SHIPMENT ON STORAGE AND DESSERT QUALITY BOSCH PEARS

As stated above, half of each experimental lot was held at the packing house for one week before being shipped. Thus the first picking of Bosch delayed was forwarded with the mid-season immediate shipment, while the mid-season pick delayed was forwarded with the late season pick immediate.

A summary of the length of time the fruit from delayed and immediate shipment held up in storage at 32° is given in Table XXVI. In the case of the early picked Bosch pears there was practically no difference in the possible storage life due to a delay in shipment of one week. With the mid-season pick, fruit that was delayed prior to shipment and then loaded in the top of the car ripened a full month earlier than did that shipped immediately. With the late picked Bosch pears the delayed

fruit in the top was past commercial condition two weeks earlier than that shipped immediately, while the immediately shipped fruit from the bottom of the car remained in good condition for six weeks longer than did delayed shipped fruit from the same position.

TABLE XXVI. SUMMARY OF END OF STORAGE PERIOD
Bosc pears from immediately and delayed shipped fruit in storage at 32° F.

Picking	Time of shipment	Position in car	Date past commercial condition
Early season 8/29/25	Immediate	Top	Dec. 15
Early season 8/29/25	Delayed	Top	Dec. 15
Early season 8/29/25	Immediate	Bottom	Jan. 30
Early season 8/29/25	Delayed	Bottom	Jan. 30
Mid-season 9/5/25	Immediate	Top	Dec. 30
Mid-season 9/5/25	Delayed	Top	Nov. 28
Mid-season 9/5/25	Immediate	Bottom	Mar. 3
Mid-season 9/5/25	Delayed	Bottom	Feb. 15
Late season 9/12/25	Immediate	Top	Dec. 15
Late season 9/12/25	Delayed	Top	Nov. 28
Late season 9/12/25	Immediate	Bottom	Feb. 15
Late season 9/12/25	Delayed	Bottom	Dec. 31

Thus it is apparent that delay in placing the fruit under refrigeration will probably reduce the possible storage period, particularly with mid-season or late picked fruit. There was little significant difference with the early picked fruit, but with the mid-season and late picked fruit delay in placing the fruit under refrigeration seriously reduced the possible storage life.

Effect of delayed shipping on quality. Delaying the shipment of the pears appeared to improve the dessert quality of fruit taken directly from the refrigeration temperature and consumed. None of the fruit, however, was particularly satisfactory under these conditions. Highest quality was secured in all cases in fruit placed under refrigeration as soon as possible after picking, and held at a temperature of approximately 32° F. until ready for ripening; then removed to a temperature of 65° to 70° F. until full eating ripe. Very good quality was secured by this method of handling, even with fruit held until January.

INVESTIGATIONS IN 1926

Work along the same general line was again carried on during the season of 1926. Due to unsettled conditions in the industry, however, it was impossible to carry through a complete series of tests such as were made in 1925. A mid-season picking of fruit and a late season picking were made, shipped east, and stored. The results closely approximated those of 1925. A detailed record of the behavior of the mid-season picked fruit is given in Table XXVII and Fig. 4. This fruit was picked August 24, at which time it tested 15.5 pounds.

Because of conditions in the shipping industry a five-day delay elapsed between the date of picking and the date of loading this lot of fruit. The car was unloaded after thirteen days. At the time of arrival in Washington the fruit loaded in the top layers in the car was firm eating ripe, testing only 5.5 pounds, while that from the bottom of the car had showed little softening during the time of transit.

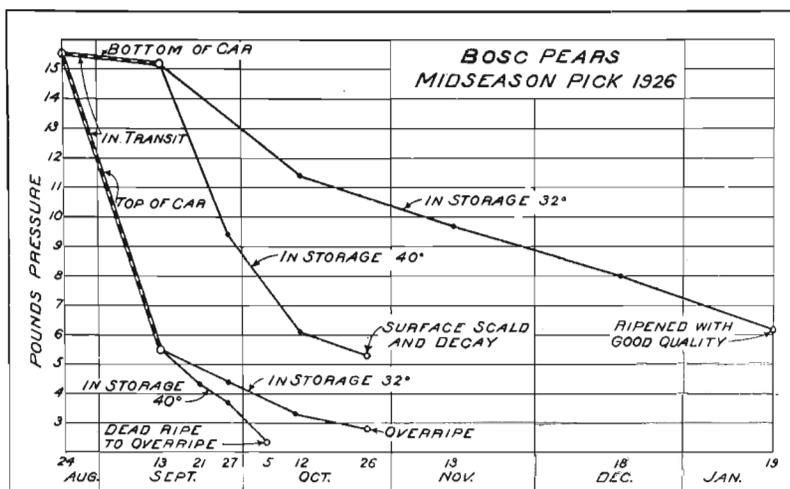


Fig. 4. Softening of mid-season picked Bosc pears in transit and in storage, 1926.

TABLE XXVII. BEHAVIOR OF MID-SEASON PICKED BOSCH PEARS IN TRANSIT AND STORAGE, 1926

Date picked, 8/24/26. Date shipped, 8/29/26. Pressure test, 15.5. Unloaded New York City, 9/11/26. Arrived Washington, D. C., 9/13/26. Temperatures in transit not secured.

Date	Pressure test				Ripening at 70° F. after removal from 32°			
	In 40° storage		In 32° storage		From top of car		From bottom of car	
	From top of car	From bottom of car	From top of car	From bottom of car	No. days to full ripe	Quality	No. days to full ripe	Quality
9/13/26	5.5	15.2	5.5	15.2	2	Very good	6	Very good
9/21/26	4.3	.....	.....	.....	.....	.....	.....	.....
9/27/26	3.7	9.4	4.4	.....	1	Very good	.....	.....
10/ 5/26	2.3	.....	.....	.....	.....	.....	.....	.....
10/12/26	Dead ripe to over-ripe	6.1	3.3	11.4	0	Good	7	Good
10/26/26	.....	5.3	2.8	.....	0	Good	.....	.....
11/13/26	.....	Gone—surface scald and decay	Overripe	9.7	.....	.....	7	Very good
12/18/26	.....	.....	.....	8.0	.....	.....	5	Good
1/19/27	.....	.....	.....	6.2	.....	.....	6	Good

The fruit from the top of the car in storage at 32° F. was full eating ripe in a month and was overripe and past commercial condition within two months, or before the middle of November. Fruit from the bottom of the car was still in good condition on January 19, ripening with good quality after six days at 70° F.

Fruit at 40° F. behaved much as during the previous season. The fruit from the top of the car was overripe within a month. That from the bottom of the car failed to ripen with good quality while in storage at 40° F. It was past commercial condition with surface scald and decay within two months.

GENERAL DISCUSSION

The results of the two seasons' investigations have been entirely consistent and indicate clearly the methods of handling which will result in the highest possible quality in Bosc pears together with the maximum length of storage season.

Apparently Bosc pears from the Rogue River Valley should be picked when testing from 14 to 16 pounds upon the flesh with the peel removed and using a plunger tip 5/16 of an inch in diameter. This range of firmness at date of picking has given fruit which combined highest dessert quality with the best storage quality during each season.

If long storage holding is desired the fruit should be placed under refrigeration at once. This is particularly true during the latter part of the picking season or with riper fruit. A few days delay in the time of placing the fruit under refrigeration shortens the possible storage season of late picked fruit much more than of fruit picked early.

For long storage holding the temperature at which the fruit is held should be as near 30° to 32° F. as possible. Holding the fruit at 40° F. or any higher temperature which will appreciably retard the ripening process, shortens the possible storage season without improving the dessert quality of the fruit. The fruit should be held at a temperature as near 30° to 32° F. as can be maintained until it is desired for use or for the retail trade.

In order to secure high quality the fruit should then be removed from cold storage and be held at temperatures of 65° to 70° F. If outside temperatures are moderately high, running above 50° F. cold storage fruit will ripen with fairly good quality in the open air. If outside temperatures are below 50° F. for very much of the day it is desirable that the fruit be placed in a heated room and maintained at from 65° to 70° F. for ripening.

There was a marked difference in the possible storage season of the fruit shipped in the top as compared to that shipped in the bottom of the refrigerator cars. Average temperatures in the top fruit layers of cars loaded with hot pears will usually be around 50° F. for a 12- to 14-day trip, while the average temperature in the bottom layer will be not over 40° F. A period of two weeks at these two temperatures apparently is sufficient to make a difference of a full month in the time the fruit will remain in good commercial condition in storage at 32° F. In some cases, particularly with the mid-season pick for 1926, where there was a delay prior to shipment, there was a difference of more than two months in the possible storage period of fruit from the top and from the bottom of the same car.

Under commercial handling conditions, car-loads of fruit are usually handled as a unit, that from the top and from the bottom of the car being mixed in storage. Under these conditions the possible storage life of the car lot is determined by the condition of the boxes carried in the top of the car, since it is necessary to move the whole shipment

when a considerable percentage of the pears in certain boxes mixed through the lot begin to break down. If Bosc pears intended for fairly long holding are shipped without precooling it would seem desirable to store the fruit from the bottom layers separate from that from the top layers of the car. Otherwise the possible storage period is likely to prove rather short.

The difference in temperature between the top and bottom layers in cars will vary with several factors, including the temperature of the fruit when loaded and the prevailing outdoor temperatures in transit. The warmer the fruit when loaded and the higher the outdoor temperatures the greater the average difference between the top and bottom temperature in the car. Precooling of the fruit prior to loading not only reduces the temperature of the fruit as a whole but greatly reduces the difference between the top and bottom of the load. Fruit thoroughly cooled until the centers of the boxes are well below 40° F. when loaded should carry to destination with an average top layer temperature not higher than 44° to 45° F. Bosc pears handled under these conditions if cooled promptly after picking and if placed in storage at 32° F. upon arrival on the eastern markets will generally hold until December in fairly good condition. In this investigation, particularly well grown and carefully handled fruit picked in the right stage of maturity sometimes held until mid-winter and then was ripened with very good quality.

Ripening of the fruit. The results of this investigation bear out the commercial reputation of the Bosc pear and previous investigational work to the effect that this fruit will not ripen with good quality while under refrigeration, particularly at 30° to 40° F. unless almost full ripe when placed in cold storage. In order to secure satisfactory quality in fruit held in cold storage the fruit should be removed from cold storage while still in a firm, sound condition and be placed in a temperature above 60° F. for ripening. A temperature of 65° to 70° F. has been found to give the very best quality.

The results obtained with placing practically ripe fruit in cold storage are interesting. Fruit of the mid-season pick in 1926 and shipped in the top of the car was firm eating ripe by the time the fruit reached Washington. This fruit remained in marketable condition for a month and a half in storage at 32° F. and was of good quality throughout that period. Late picked Bosc in 1925 also were firm ripe upon arrival in Washington but held three weeks with good quality at 32° F. These results indicate that fruit when ripe can be held under cold conditions and retain a good dessert quality for a reasonable length of time. Fruit which has been removed from cold storage in the winter season and ripened at 65° to 70° F. can be marketed at prevailing temperatures and still retain good quality.

To summarize, the Bosc pear is one of a number of fruits which attain their highest quality when ripened at moderately high temperatures. These pears can be held in cold storage for a relatively long period, however, the best holding temperature being 30° to 32° F. The nearer the temperature can be held to this point during the handling and storage season the longer the possible storage season will be. The fruit should be removed from storage while still in a firm, sound condition and ripened under relatively warm temperature conditions, 65° to 70° F. having proved most desirable. If these temperatures are not available

outdoors when the fruit is removed from storage the fruit should be placed in a room held at this temperature until firm eating ripe. It can then be exposed to prevailing temperatures for retail marketing.

Bosc pears from other districts. Investigations, rather limited in scope, have been carried on with Bosc pears from other producing sections, having very different climatic conditions. This included fruit from the Santa Clara Valley, California, the Wenatchee Valley, Washington, and the Hudson Valley, New York. Results so far as best storage and handling conditions are concerned, have been similar to those here reported for fruit from the Rogue River Valley of Oregon. The firmness of the fruit when in best picking condition has, however, varied considerably in the different districts, so that the pressure test range of 16 to 14 pounds recommended for Rogue River Valley fruit may not be applicable to this variety from other sections.

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