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Stony Pit of Pear
In Oregon

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Stony Pit of Pear in Oregon

J. A. MILBRATH

Introduction

A special report of a survey of fruit and nut trees grown in Oregon in 1964 (*5*)[1] lists 22,185 acres planted to pears and 1,838,815 pear trees grown on that acreage. The fruit from these trees are ripened and processed, or stored and sold for fresh fruit during the winter months. This income from pears provides livelihood for many people.

The orchardists growing this crop have had many insect, disease, and production problems. Although many of these problems have been solved, stony pit disease still can cause severe losses. For example, when the Bosc variety is sorted and graded, the sort-outs keep the conveyer belt to the cull pile loaded. Most of these cull fruits express symptoms of stony pit. In 1954 the Medford Pear Growers provided funds to Oregon State University to start a study of this disease. This study has been continued since by the Oregon Agricultural Experiment Station.

History of Stony Pit

Kienholz (*7*) named and described stony pit of pears as a virus disease in 1939, and in a later publication (*8*) reported that the disease had been known in Oregon and Washington since 1919 and in California since 1925. Atkinson (*1*) reported stony pit in Australia in 1948 and stated that the disease had been widespread for at least 23 years. Thomas (*12*) made a brief report of some of his work in California in 1942; and in 1960 O'Reilly and Nyland (*10*) reported more of Thomas' work and some of their observations of the stony pit situation in California.

Stony pit is common in Bosc orchards in western Washington[2] and in British Columbia, Canada, (*3, 13*). Parker, Brase, and Schmidt

[1] Numbers in parentheses refer to Literature Cited, p. 23.
[2] Correspondence with E. L. Reeves.

(*11*) have reported stony pit present in the eastern part of New York, and Jones (*6*) reported stony pit in five counties of western New York. There are many reports from Europe of stony pit in various varieties of pears from different countries. Stony pit virus apparently is present in most areas where pears are grown.

Stony Pit Symptoms

No leaf symptoms

Leaves of pear trees with stony pit fruit often have mild mottling or a yellowing or pale green patterns along the veins, but trees without stony pit often show these same leaf patterns. The stony pit leaf symptoms Kienholz (*7, 8*) described for Forelle and other varieties probably were caused by latent viruses now commonly known to occur in most pear varieties. No distinct leaf effect was associated with stony pit virus on Forelle or any other pear variety in this study.

Bark and wood symptoms

Kienholz (*7*) described a "measled bark condition" on Bosc pear trees which was associated with stony pit. This angular checking and cracking was found on most Bosc trees severely diseased with stony pit (Figure 1). This rough bark condition has been called "bark edema" by Medford pear orchardists. A wood pitting (*9*) occurred on Bosc trees inoculated with sources which cause the rough bark condition.

Fruit symptoms

Kienholz (*7*) has given a very good description of the nature and development of stony pit fruit symptoms. Many pits are initiated 10 to 20 days after petal fall; these cause the deep pits and deformity of the fruit. Other pits develop near the surface of older fruits and cause scattered pits surrounded by stony cells, but these do not cause such severe fruit deformity as pits formed in early stages of fruit development.

One distinct type of virus, with many variations from mild to severe strains, was responsible for most stony pit found in Oregon pear orchards. The Bosc variety was affected in most orchards, the Anjou variety in several orchards, and the Comice in only a few trees in an occasional orchard. Only two Bartlett trees in two different orchards have been found or reported with stony pit; this proved to be a distinct type of stony pit. There were some Bosc trees that became unprofitable because of stony pit. These Bosc were cut off and topworked to the Bartlett variety; when such trees produced fruit, they were normal and free from injury from stony pit. Kienholz (*8*) reported that the stony pit virus could be recovered from such trees. Winter

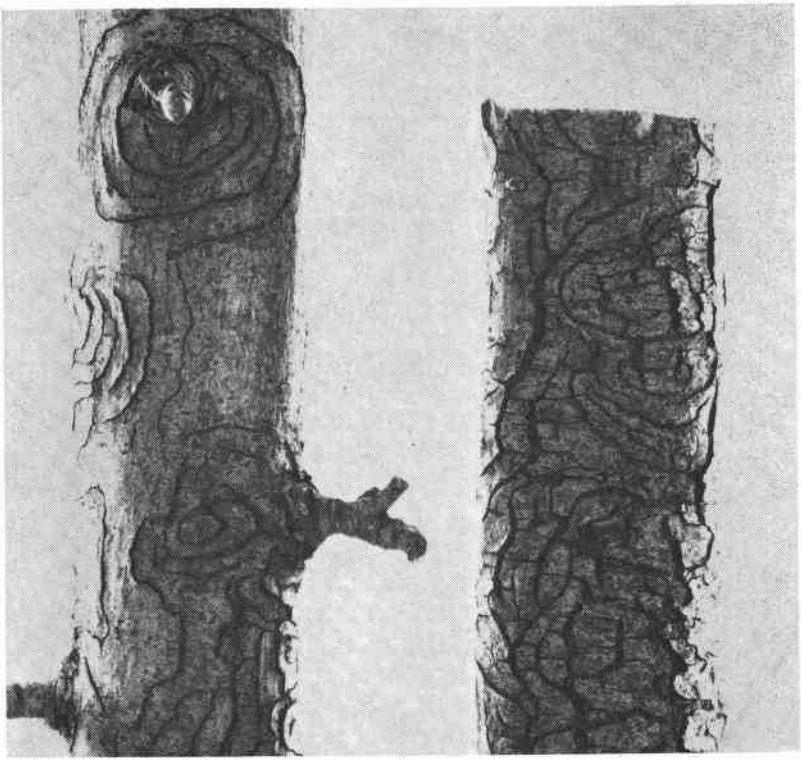

Figure 1. Young Bosc pear branches infected with severe stony pit virus. The branch on the left shows early ring development and the branch on the right has general cracking of the bark.

Nelis, Seckel, and Packham's Triumph pears also were infected with this common strain of stony pit virus. The extreme symptom variations commonly noted in Oregon orchards of Bosc and Anjous indicate mild-to-severe strains of virus or mixtures of these in the same tree (Figures 2 and 3). Kienholz also lists the following varieties as susceptible to the common strain of stony pit found in Oregon: Buerre Bedford, Buerre Clairgeau, Winter Cole, Durandeau, Laxton's Superb, Patrick Barry, Pitmaston Duchess, and Waite.

The Bartlett (Williams' Bon Chretein) strain has been found in only one Bartlett tree in the Hood River district and in one Bartlett tree and one Bosc tree in the Medford district in southern Oregon. This strain, which appears to be the dimple pit strain of stony pit as described by O'Reilly and Nyland (*10*), was a more severe type than the common type found in Oregon because of the pockets of black

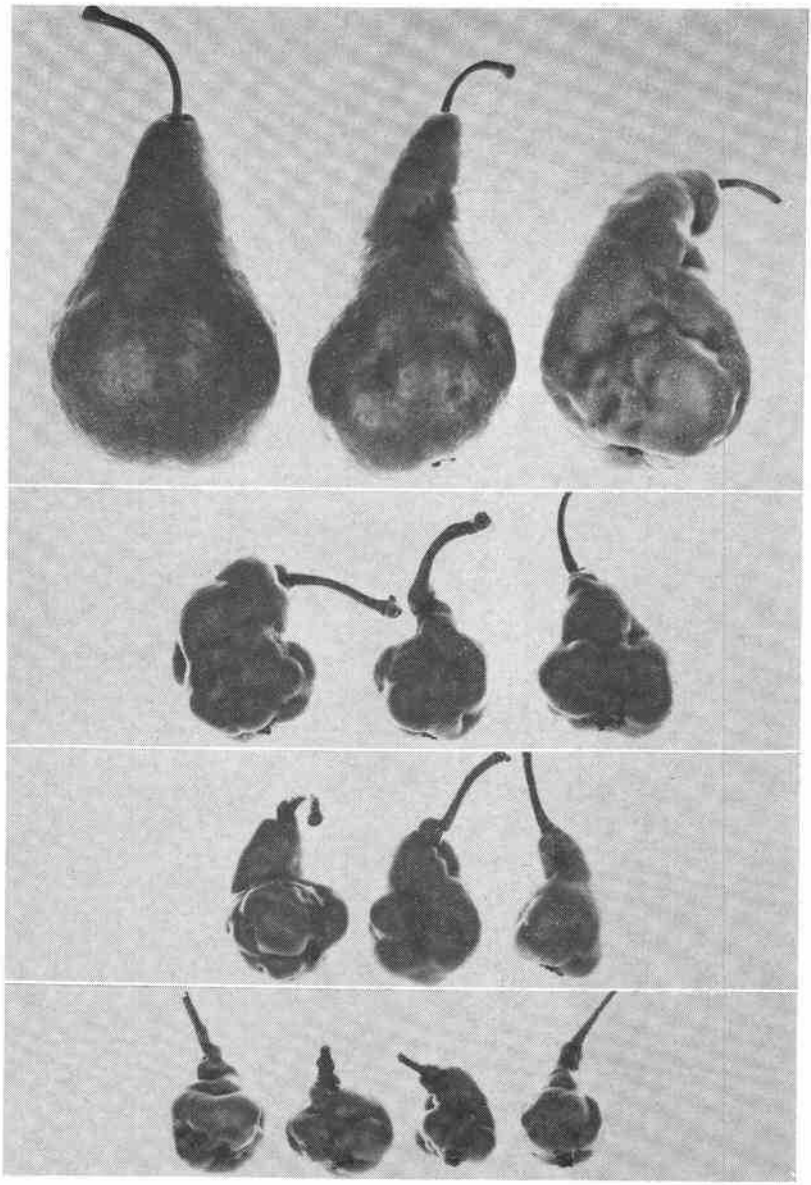

Figure 2. Bosc pear fruits, all from the same orchard tree. Some fruit were normal, with no or mild stony pitting or several stony pits. Other fruit were smaller than normal, with many stony pits.

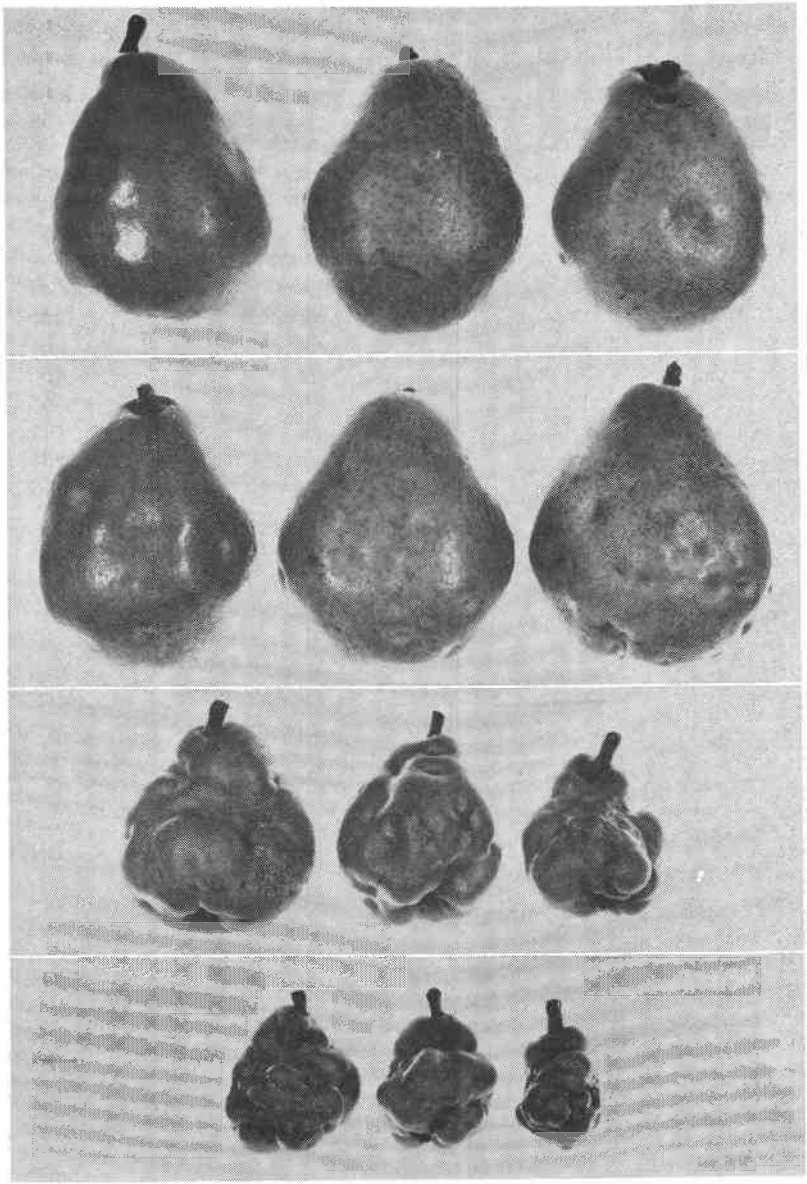

Figure 3. Anjou fruit, all from the same tree. Some branches bore nonpitted fruit, some branches had normal-sized fruit with one to several pits, and other branches bore smaller, distorted fruit with many stony pits.

tissue associated with stony cells (Figure 4). Fruits have been found with no external symptoms that could be detected by commercial grading. However, by cutting the fruit, internal pockets of black stony tissue could be found scattered through the otherwise normal fruit. Only this particular strain affected the Bartlett variety.

Only one Bosc tree with ring pit (Figure 5), as described and illustrated by O'Reilly and Nyland (*10*), has been observed in Oregon. This was one of the 325 trees in the Medford experimental block. This tree also produced symptoms of the regular strain of stony pit and some fruits with a black-russet sunken spot which may be a stage of the ring pit. No attempt has been made to separate these three symptoms or determine if they are caused by different viruses.

Medford Experimental Bosc Block

A block of Bosc pears at the Southern Oregon Experiment Station in Medford was planted by United States Department of Agriculture and Oregon Agricultural Experiment Station horticulturists for a study of fertilizer requirements of pears. This plot was planted in 1934 with pear seedlings of a controlled Old Home x Farmingdale cross and topworked to Old Home for a trunk. During the winter and spring of 1939, these trees were topworked to Bosc. At that time the virus situation in pears had not received much study. E. L. Reeves was asked to collect budwood for these trees in western Washington. Since he had not been given previous notice of requests for this budwood, he could not select the wood from trees known to be free of stony pit,[3] but he did not collect any scions from trees with rough bark. Therefore, the trees in this planting showed very few trees with the rough bark or severely stony pitted fruit, but most trees had mild stony pitted fruit.

When the Medford growers furnished funds to Oregon Agricultural Experiment Station plant pathologists in 1954 to start a study of stony pit control, permission was granted to use this plot for a study of stony pit behavior and spread. At harvest time there were ample fruits on the trees to make stony pit counts each year from 1954 to 1958 and in 1962. The fruit of each tree was counted and the percent of stony pit for each tree was recorded, often by different personnel. Any fruit showing any trace of pitting resembling stony pit was recorded. There were 252 trees in the planting and the trees produced 1 to 12 lugs per tree, or 500 to 7,000 fruits per tree. Although each fruit was examined, mistaken records could have been made for mild stony pit effects or other fruit injuries resembling stony pit, because several men were involved in taking records. All fruit had to be ex-

[3] Correspondence with E. L. Reeves.

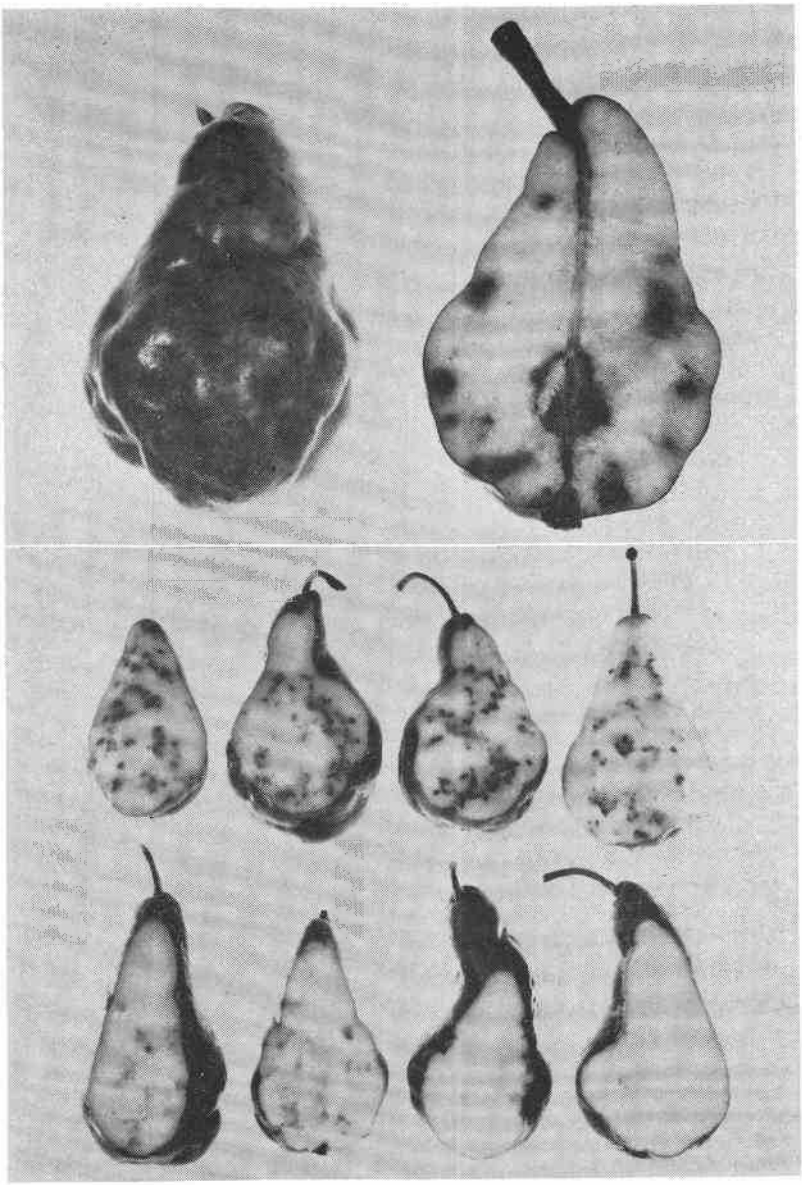

Figure 4. Top, the Bartlett or dimple strain of stony pit on Bartlett; center, Bosc fruit from tree inoculated with buds from affected Bartlett and peeled to show black internal pits; and bottom, Bosc fruit from tree with the common Oregon stony pit, peeled to show less and lighter-colored tissue associated with the pitting.

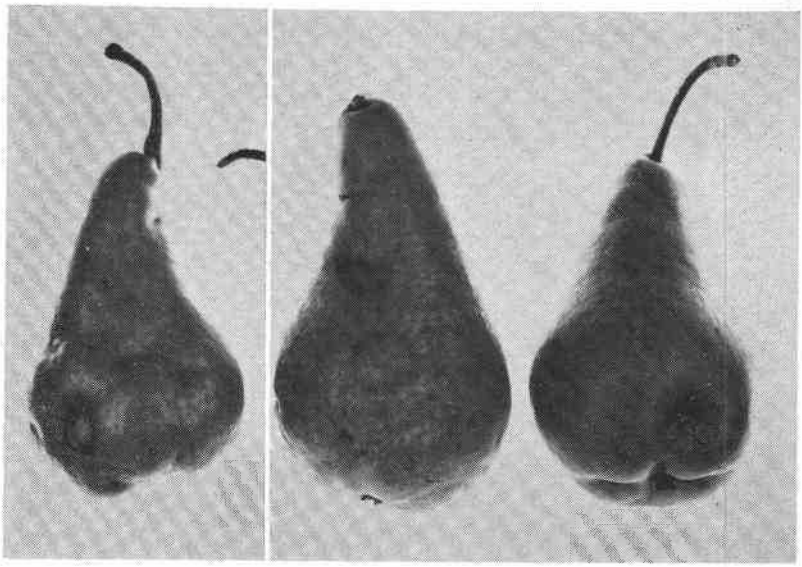

Figure 5. Ring pit from the one infected tree found in Oregon; this tree also was infected with the regular strain of stony pit.

amined and results recorded within 24 hours after the fruit was picked. Unfortunately, the time for counting and examining the fruit was limited. This might explain some of the erratic data from year to year on trees with a low percentage of stony pit.

Table 1 summarizes the data collected and shows the variation observed for each year. The percentage of infection variation for each year and any tendency toward increase or decrease of stony pit over the period of observation was recorded. No stony pit counts were made for the first 23 trees in row 1 in 1954, and counts for only 229 trees are given for that year. One sheet of data for 1962 was lost before permanent records were made, and none of the available data for that year were included in this table.

The data in Table 1 show trees in the plot which did not produce stony pitted fruit, others with only a trace, and those with increasing amounts. The variability of the data for different years could be due to seasonal variation in severity of stony pit and to opinions of different personnel making the records. More fruits were listed for stony pit in the 0.1 to 0.9 range in 1955 and 1956 than were listed for the same range of disease in 1954 and 1957—the most severe years for stony pit expression during the study. See Figure 6.

Table 1. The Number of Trees in Each Percentage Group for the Years 1954 to 1958 in the Bosc Block at the Southern Oregon Experiment Station

Percent stony pit	Number of trees in each percentage group for each year				
	1954	1955	1956	1957	1958
0.0	34	91	45	53	86
0.1- 0.9	86	110	141	82	104
1.0- 5.0	75	37	45	69	43
5.1-10.0	11	4	6	25	5
10.1-20	14	7	7	10	6
20.1-40	2	2	5	5	6
Over 40.0	6	1	3	8	2
Total trees	229	252	252	252	252

Five of the 252 trees in the plot did not produce any fruit with stony pit for the five-year period, 1954-1958. However, the yearly average yield of fruit for these five trees was only 1.52 lugs per tree, although the average yield for the entire plot was 6.23 lugs per tree. The eight trees with no stony pit for four of the five years yielded an average of 2.60 lugs. These data suggest that all trees with very low percentage or no stony pitted fruit were low yielders and poor growers because of mild symptomless strains of stony pit virus or some other virus that reduced the vigor and fruit production of these trees.

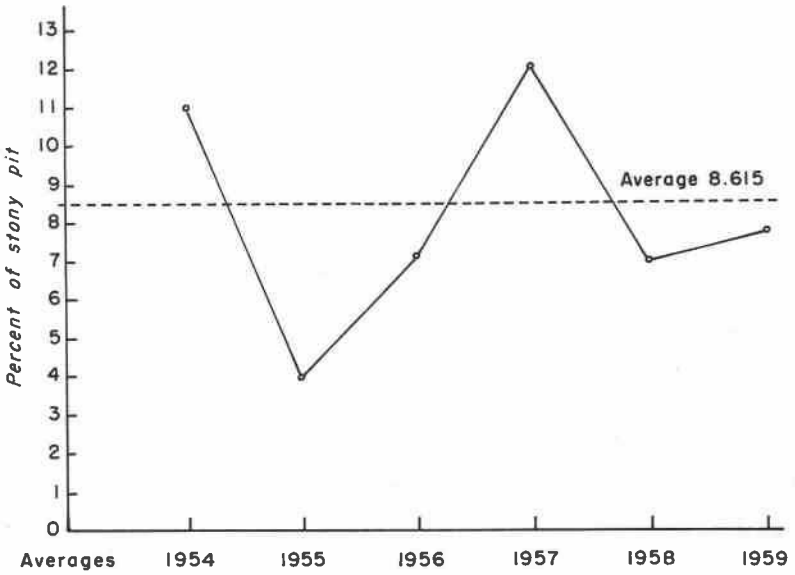

Figure 6. Yearly averages of percent of stony pit at the Southern Oregon Station.

One of the original plans for selecting the Medford plot was to study the natural spread of stony pit. There were some trees with obvious stony pit infection, but casual observations early in 1954 showed that there were many normal-appearing trees in the plot. When the fruit was harvested and examined, only 34 of the 229 trees appeared to be free of stony pit. However, only 5 of the 34 were consistently scored as producing fruit free from stony pit during the next four years. No evidence of natural spread of stony pit was obtained from this plot.

Seasonal Variation of Stony Pit

Pear growers often remark that a certain year was bad for stony pit. The data collected in different years on the same tree confirm this observation. Thirteen trees at the Southern Oregon Station Bosc plot were selected for study because they had a stony pit record range from 0.0% to the highest percent of stony pit for any tree in the plot, 95.2%. The percentage data were then recorded for the same trees for each year from 1954 to 1958 and for 1962 (Table 2).

Table 2. Yearly Variation of Stony Pit in Same Trees, 1954 to 1962

Tree No.	Percent of fruit with stony pit					
	1954	1955	1956	1957	1958	1962
G38	0.0	0.0	0.0	0.0	0.0	0.0
J46	0.0	0.0	0.2	0.0	0.0	0.3
J39	2.2	0.0	0.0	0.0	0.0	0.7
H35	2.5	0.5	1.2	3.8	2.2	1.5
I40	5.7	2.9	0.1	5.5	2.2	3.3
F41	6.8	1.6	2.7	9.5	0.4	5.8
E52	9.9	6.0	6.0	13.6	2.9	15.5
J50	12.0	2.5	3.5	17.5	3.2	1.0
E42	13.6	1.5	6.1	14.3	3.8	7.6
P48	26.8	12.1	26.4	16.9	6.4	19.2
F46	40.8	15.3	36.4	40.8	41.8	51.3
M43	42.8	29.1	42.8	36.2	31.5	33.4
O50	95.2	61.7	77.9	88.7	80.4	86.0

These data illustrate that 1954 and 1957 were years of high stony pit expression and that 1955 was a year of low stony pit expression.

In another study of trees from this plot, 73 trees were selected at random and the yearly variation for these trees for six years was determined. Figure 6 shows a graph of these averages.

A part of a grower's orchard of Bosc pears with a high infection of stony pit was picked in 1958, and the percentage of stony pit for

each tree was determined. The same trees were picked again in 1959, the fruit counted, and the percent of stony pit for each tree again was recorded. This block of Bosc consisted of 7 rows with many trees, but only the first 10 trees in each row were included in this study. Table 3 shows the data collected for three of the seven rows compared for the two years. The data for the other four rows showed similar variation and were not included in the table.

Table 3. Stony Pit Compared for 1958-59 on the First Ten Trees of Three Rows in a Commercial Planting

Tree No.	Percent of stony pit					
	Row A		Row B		Row C	
	1958	1959	1958	1959	1958	1959
1	1.2	0.0	47.6	17.2	3.0	1.6
2	31.4	3.1	34.9	11.4	2.9	2.5
3	8.4	2.2	68.3	12.6	25.8	3.2
4	1.5	2.0	31.3	5.7	46.0	8.6
5	9.4	12.5	63.6	4.4	15.7	4.1
6	3.2	4.3	57.0	3.8	21.8	4.7
7	0.5	1.1	64.5	18.1	21.8	1.8
8	6.0	8.5	41.9	6.5	26.2	4.2
9	6.0	5.6	42.9	2.3	4.2	5.5
10	2.6	2.8	39.5	7.7	33.9	9.7
Average	7.0	4.2	49.2	9.0	20.1	4.6

The seasonal variation between the two years was small on trees showing 0 to 10% stony pit, but the difference between the two years on trees showing 30% or more stony pit was large. For instance, Tree 5 in Row B varied from 63.6% stony pit in 1958 to only 4.4% for 1959. There were many trees with similar differences. Row averages also reflect the seasonal variation for stony pit expression.

Many Anjou orchards that had considerable stony pit were mapped[4] and studied. The same seasonal variation was noticed as for Bosc. Some years stony pit would be very obvious, while in other years the fruits on the same trees would appear normal with just an occasional fruit with a single mild stony pit dimple.

Strain Variation

Plant viruses change in their chemical make-up, and the symptoms they produce on plants can be quite different (*2*). In addition, the same plants may be infected with the same virus, but the environment may change symptom expression.

[4] With the help of Don Berry, Jackson County Extension Agent.

During the years that the stony pit virus has been present in pears, there have been major and minor changes. There are now three or four distinct major changes in the stony pit virus. Some of these changes have been great enough to allow formerly resistant varieties to be infected, and others cause a more severe symptom expression. Most of the stony pit in Oregon-grown pears was caused by closely related strains of the same virus that varied only in the degree of symptom severity produced. Bosc and Anjou pears were the usual hosts for the Oregon strain of stony pit. However, Winter Nelis, Packham's Triumph, Seckel, and occasionally Comice have been found to be affected with the same common strain of virus found in Oregon. The other types of stony pit which were described in the section on fruit symptoms were limited to a few trees in Oregon.

There can be an antagonistic relationship between two strains of the same virus in the same plant (*2*). The first strain to invade a plant multiplies and develops. Then when another strain tries to become established, it is repelled. However, when a tree is propagated by grafting, two strains of the same virus could be present. They could move at different speeds or directions, and different branches could become infected with each strain. They then may become antagonistic to invasion by the other strain and different branches or areas of a tree might be infected with a mild or severe strain of the same virus. This seemed to be the pattern in pear trees infected with mild and severe strains of stony pit. Such behavior was typical for the Bosc block of 252 trees at the Southern Oregon Experiment Station, and the same antagonistic behavior was seen in other Bosc and Anjou orchards. This would explain the seasonal behavior of severe stony pitted fruit one year and less stony pit the following years. When a virus-free tree was inoculated in the experimental plot, infection started with a few infected fruits the first year and there was a gradual increase over different parts of the tree each following year; this was normal development of a virus infection. However, none of the trees studied at the Station Bosc plot showed this type of virus spread. There was a high and low percentage on different trees, but most trees showed a lower percent of fruit in 1962 than in 1954 (Table 2).

The fluctuation in the percentage of stony pit for Tree No. O50 (see Table 2) was typical for the seasonal variation of stony pit for different years. This fluctuation was also typical for the amount of stony pit from the same orchard during different years. Some orchardists believed that a sudden increase of stony pit over the amount noticed the previous year was an indication that more trees were becoming infected. However, if the increase in stony pitted fruit was due to new infections, trees with a low percentage in 1954 would have shown a high percentage by 1962.

One of the commercial Bosc orchards mapped for stony pit in 1954 had been propagated by topworking rootstocks that had branched. Apparently, the Bosc scion wood used for this topworking had been taken from trees which were free from stony pit, trees with mild stony pit, and occasionally from a tree with severe stony pit. There were some trees in which severe stony pit occurred on only part of the tree and the rest of the tree produced unpitted saleable fruit. The portion of the tree which produced severe stony pitted fruit also had rough scaly bark (Figure 7). Some trees had branches with scaly bark starting at the graft line, all or nearly all their fruits had a severe

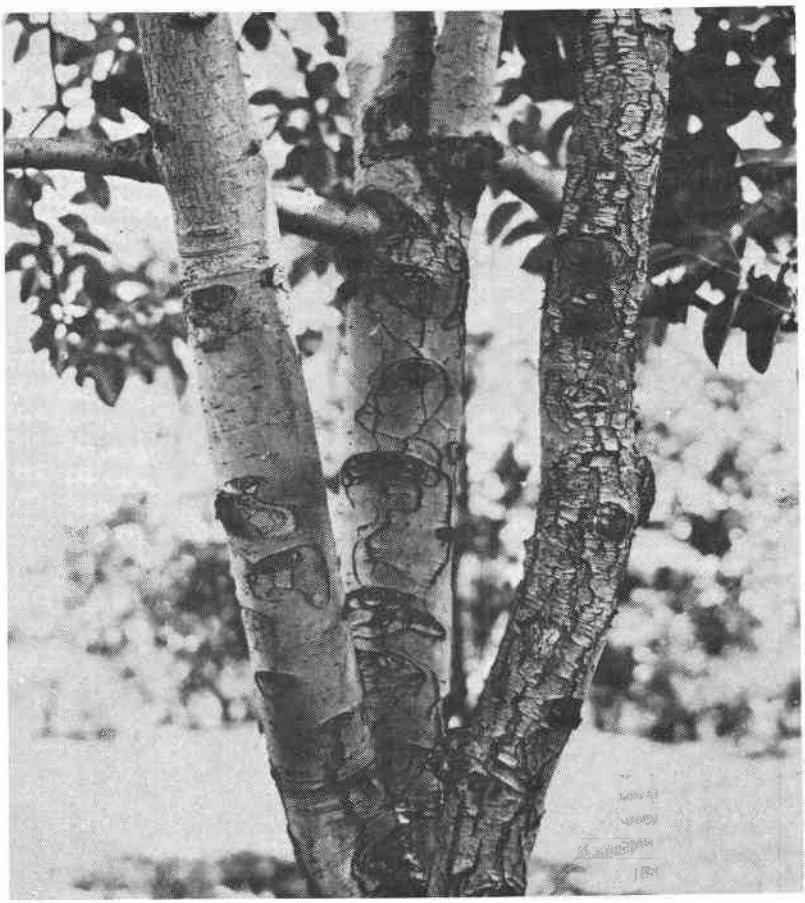

Figure 7. A three-scaffolded tree in which one pear variety was cut off and the tree re-grafted to the Bosc variety. The branch on the right has the severe rough bark caused by a severe strain of stony pit virus, and the other two branches have relatively smooth bark.

distorted type of stony pit, the terminal growth was shorter than normal, and the leaves were smaller than normal. In contrast, the bark on the other branches was smooth and the terminal growth and the leaf size appeared normal. Most of the fruit on these branches did not have stony pit symptoms, or at most only an occasional pit on a few normal-sized fruits. Figure 7 shows a three-branched tree that has one branch with rough scaly bark and two branches with smooth or normal Bosc bark.

Tree 19 in Row B of this orchard had three branches with rough bark and severe stony pit and one branch with smooth bark and only a trace of stony pitted fruit, even in years favorable for stony pit expression. This B-19 tree has been used for several experiments. Bud sticks were taken from the smooth branch, and trees were propagated by single buds on Bartlett seedlings. Comparable trees were propagated from the branches with rough bark. The buds were placed into Bartlett seedlings in the summer of 1957, and 9 to 11 trees budded from each branch were planted in randomized plots at Medford and at Corvallis. Fruit was harvested from both plots in 1964 and 1965. The fruit was counted and the number of fruits with stony pit was recorded. Data from both plots for both years are recorded in Table 4.

Table 4. Incidence of Stony Pit and Number of Fruits Produced From Trees Propagated from Two Branches of a Bosc Tree with Stony Pit

Plot location	Year	Source of buds	Trees with stony pit*	Number of fruit	Percent stony pit
Corvallis	1964	Mild	3/9	40	12.5
Corvallis	1964	Severe	0/9	0	.....
Corvallis	1965	Mild	8/9	193	29.5
Corvallis	1965	Severe	0/9	0	.....
Medford	1964	Mild	2/11	708	0.5
Medford	1964	Severe	5/7†	354	19.4
Medford	1965	Mild	1/11	1,508	0.1
Medford	1965	Severe	7/7	471	86.3

* Refers to ratio of number of stony pitted trees to total number of trees surveyed.
† Four trees from a severe stony pit branch died before 1964.

More fruit was produced by the trees at Medford than the trees at Corvallis. The trees propagated from the branches with severe stony pit did not produce any fruit at Corvallis. The trees propagated from the branch with mild stony pit produced 40 fruits in 1964 and 193 fruits in 1965, and 62 of these showed stony pit. At Medford much more fruit was produced by the trees propagated from the mild stony pit branch than from the branch with severe stony pit. Four of the eleven trees planted at Medford which were propagated from buds taken from the branch with severe stony pit symptoms died. The

11 trees propagated from the branch with mild stony pit symptoms produced 2,216 fruits, but the 7 trees propagated from the branch with severe stony pit produced only 825 fruits, and 671 of these showed severe stony pit.

An experiment was conducted in which the three branches of the B-19 tree with severe bark and fruit symptoms of stony pit were removed near the base of the main scaffold branches. Two of these branches were bark grafted with scions from the mild stony pit branch of the same tree, and one branch was grafted with scions from a virus-free tree. Six trees with severe stony pit in other orchards were topworked with scions from the mild B-19 in a similar manner. The grafts produced fruit in 1964 and 1965, but the protection in the mild B-19 branch was not complete. The new branches formed from the B-19 scions produced secondary branches with both severe and mild stony pit. A combination of grafting with very mild strains of stony pit, followed by removal of all branches that develop severe stony pit fruit, needs further investigation.

Inoculation Studies

Pear has been the only woody or herbaceous host reported for stony pit virus. Bud or scion grafting has been the only method reported for transmission of this virus from diseased to healthy trees. Therefore, pears which were mature and free from any stony pit history were used as the source of buds to propagate Bosc, Anjou, Bartlett, and Comice trees for an experimental plot in the Plant Pathology Farm at Corvallis. As different and unusual stony pit infected trees were observed in older orchards, budwood was collected (usually in late August) and buds were placed in the young experimental trees. As fruits developed, they were harvested (usually in late August) and examined for stony pit symptoms; variations in effects from different varieties or different trees were recorded. Some of the more significant results are reported here.

During the mapping of Anjou and Bosc orchards, trees were noted that had some branches with severely diseased fruits every year and other branches that bore normal-sized fruit with only an occasional pit even on years that favored stony pit expression. Bud sticks were taken from the terminal branches of an Anjou tree with severe stony pit on the fruit on one branch, and comparable bud sticks were taken from a branch that had normal fruit or fruit with only an occasional stony pit. Two Anjou trees in the experimental plot were inoculated as follows: One branch was inoculated with five buds from the branch with severe stony pit and another branch was inoculated with five buds from the branch with only an occasional fruit with stony

pit. Two other Anjou trees were inoculated only with five buds from the branch with severe stony pit. The trees were inoculated in 1960, but a good crop of fruit was not produced until 1964 and 1965. Table 5 shows the stony pit recorded for these four trees.

This experiment confirmed what was found on many field trees in the Anjou orchards and the Bosc plot at the Southern Oregon Station. Trees with a high percentage of stony pit each year could have been propagated from a bud or scion from a branch or tree with a predominance of a severe stony pit strain. Those that fluctuated from mild to severe and back to mild stony pit could have been infected with a more equal mixture of a mild and severe strain. Since there can be an antagonism between two strains of the same virus, this would explain why one branch would produce severe stony pit and this infection would remain in the same branch because other branches were infected with a mild strain, which prevented a spread of the severe strain. This may explain why the Bosc trees at the Southern Oregon Station showed many trees with a fluctuating percent of stony pit over a 10-year period rather than a steady increase each year. The trees were infected by using budsticks with mild and severe strains of the stony pit virus. Branches with a mild strain would express symptoms on more of the tree only in seasons favorable for stony pit symptoms.

In 1960 two Anjou trees were inoculated with 10 buds each from a branch of an Anjou tree with a record of severe stony pitted fruit every year since it was first observed in 1953. The inoculated trees produced their first crop in 1964. One tree produced 153 small green fruits (Figure 8) and the other tree only 59 fruits of similar size. Apparently the buds used to inoculate these two trees were infected primarily with a very severe strain of stony pit. There were some fruits on both trees (Figure 8) which showed both unpitted and severely pitted tissue on the same fruit, of which one could have been infected by the severe strain of stony pit virus and the other by the mild strain. This mild strain of virus could have come from the bud inoculations, or the severe strain of stony pit could have mutated to give rise to this mild strain. One of these two trees produced no fruit in 1965, and it had some dead branches and appeared to be dying. The other tree produced only eight fruits with severe stony pit symptoms, and this tree was also in the early stages of severe decline.

Table 5. Type of Symptoms on Inoculated Anjou Pear Trees

Kind of inoculation	Normal fruit	Fruit with mild stony pit	Fruit with severe stony pit
Five severe and five mild buds	174	319	196
Five severe buds	52	264	395

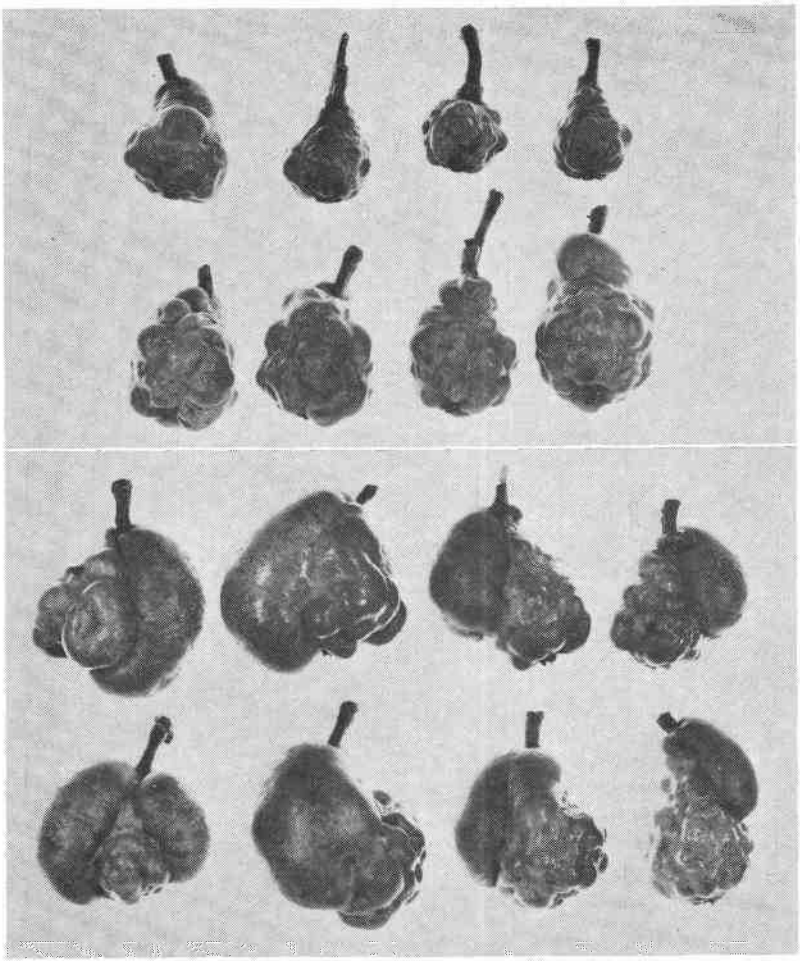

Figure 8. Actual size of fruits harvested from Anjou trees that were inoculated with buds from a branch of an Anjou tree with a record of severe stony pit since it was first observed in 1953.

Stony pit was seldom found in Comice orchards. When a Comice tree with stony pit was found in one orchard, buds were T-budded into two Bosc, one Bartlett and two Comice trees in 1959. In 1964 both Bosc trees showed stony pit of the common Oregon type. Neither the Bartlett nor the Comice showed any fruits with stony pit in 1964 or 1965. In 1965 the two Bosc trees produced 40 normal fruits, 38 fruits with mild stony pit symptoms, and 114 fruits with severe stony pit. Since this stony pit from Comice caused symptoms on Bosc typical

for the common strain found in Oregon Bosc and Anjou pears, it was considered to be the same virus. Since the stony pit disease was seldom found in Oregon-grown Comice, the Comice variety must be more resistant to the virus than Bosc or Anjou.

The Bartlett or dimple strain of stony pit from the one Bartlett and the one Bosc suspected of being infected with an unusual strain of stony pit were compared to the common strain of stony pit. Inoculations were made from the Bartlett tree at Medford to Bartlett, Max Red Bartlett, Bosc, Anjou, and Comice trees. Seventeen trees were also propagated from the same budwood from the Bartlett that was used for the inoculations. One of the Anjous and both of the Boscs developed stony pit. Seven of the 17 trees propagated from the same budwood produced severe stony pitted fruit in 1964 and 1965. At the same time two Anjou and two Bosc trees were inoculated with the Bosc tree which had symptoms different from the common stony pit usually found in the Medford area. Although the Bartlett trees and the Comice trees inoculated with the Bartlett stony pit or the Bosc with the abnormal stony pit produced abundant fruit in 1964 and 1965, none showed any stony pit symptoms. However, the two Bosc and the two Anjou trees which were inoculated at the same time with buds from budsticks from the same trees, produced abnormal fruit. These had sunken lines rather than pits (Figure 9) and black areas of tissue were scattered through the fruit. The fruit symptoms were of the dimple pit type illustrated and described by O'Reilly and Nyland (*10*).

These inoculation studies confirmed that there is one common type of stony pit virus in Oregon pears that exists as a strain which seldom causes symptoms of stony pit. Other strains are so severe that they express symptoms every year of fruit production. Most of the fruits of some trees have stony pit in some years, but other trees may show only a trace.

Natural Spread of Stony Pit

During these eight years of study there has been no evidence of spread of stony pit virus other than by man in his propagation procedures. A study of data in Table 4 and the records for the 252 trees at the Southern Oregon Station indicate that careless selection of grafting wood during the winter months from unmarked source trees has been the source of most or all of the stony pit infected trees in Oregon. The 1958 data in Table 4 indicate that the source of propagation for trees 1, 4, 6, 7, and 10 in row A was from the same branch of the same tree; trees 3, 5, 8, and 9 were from another source, and tree 2 from still another source. This could have been a regraft or a

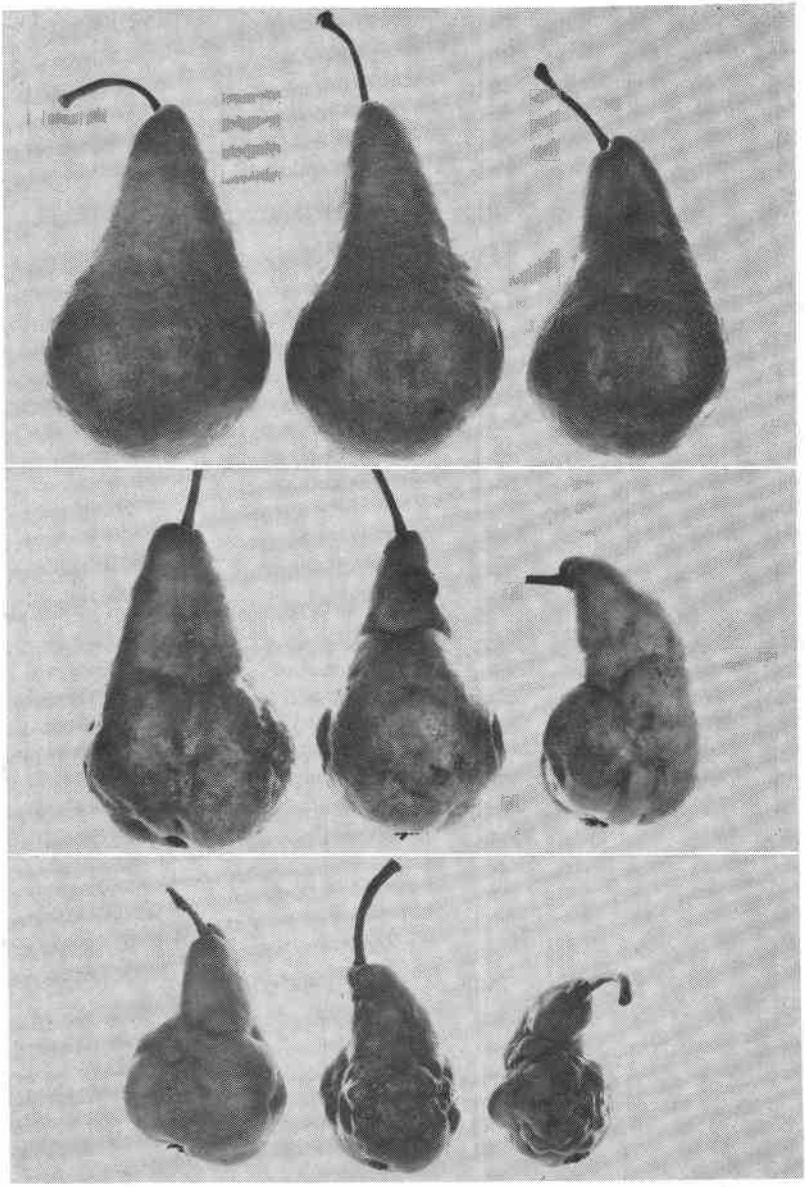

Figure 9. Bosc fruits from a tree inoculated with Bartlett or dimple strain of stony pit. The fruits show mild pitting or sunken lines with many pockets of internal black tissue.

propagation at a later date than the other trees. Two different sources could have been used in row B, one which produced 30 to 40% stony pit fruit and the other 40 to 70% stony pit. Row C could have been a mixture of three sources, one being 2 to 5% stony pit, another 20 to 30%, and the other nearly 50%.

During this study stony pit was observed and recorded for the first time on one or more trees in some commercial orchards. However, there were no previous records that provided sufficient proof that stony pit infection had been present for years and not observed.

Two hundred Bosc and 200 Anjou trees were propagated on Bartlett seedlings by a nursery in the Willamette Valley. The budwood was from a Bosc tree and an Anjou tree at the Mid-Columbia Experiment Station. Both trees had been observed for many years and stony pitted fruit had not been detected on either tree. The Bosc trees were planted in 1955 and the Anjous in 1956. This plot was adjacent to old Bosc and Anjou pear orchards which were infected with stony pit. Trees from the new planting produced considerable fruit, and culls from the plot were examined for stony pit in 1965;[5] however, no stony pitted fruit was observed.

An experimental plot of Bosc pears was planted at the Hanley Farm of the Southern Oregon Experiment Station near Medford. The trees were propagated from orchard Bosc trees which were infected with mild and severe strains of stony pit. Replications of 11 trees each were planted in a randomized plot, 20 by 20 feet apart. Twenty trees propagated from a stony pit free Bosc were randomized throughout the plot and an additional 30 trees were planted in adjacent rows. These trees produced considerable fruit by 1964 and 1965 and the fruits were harvested and examined for stony pit. Thirty trees with stony pitted fruit were scattered throughout the plot, but none of the stony pit free check trees had pitted fruit.

Conclusions and Recommendations

Most, if not all, of the stony pit virus now present in Oregon pear orchards has resulted from propagation from infected trees. This stony pit has occurred in nursery rows or when older trees were topworked with scions from infected trees.

Since mild strains of the stony pit virus do not cause stony pitted fruits some years, budwood should be taken only from trees with a known stony pit free history. Only certified stony pit free trees should be imported or purchased from any source.

Trees infected with severe stony pit should be removed and replaced with virus free roots and varieties. The annual production cost

[5] Don Berry, Jackson County Extension Agent.

of spraying, fertilizing, picking, hauling, grading, and storage must be considered. Virus free trees will produce more saleable fruit in a few years and soon repay the replanting loss.

Any tree infected with Bartlett or dimple strain of stony pit, or any type of stony pit different than the strain now usually found in Oregon pear trees, should be destroyed whenever found.

No evidence of spread of stony pit virus by insects or other virus vectors was noted in any experiment or observation during this study.

Since natural spread of stony pit was not detected, there should not be any sudden increase of stony pit. Stony pit has been more severe in some years than in others, but this resulted from changes in environmental conditions rather than increase in infection.

A tree can have some branches with a severe strain of stony pit and other branches with strains so mild that only an occasional fruit will show a mild stony pit. On Bosc, rough bark occurs on branches with the severe strains of stony pit and not on branches infected with a mild strain.

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