Selecting Stone Fruit Trees Free From Virus Diseases

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Foreword

This bulletin summarizes the results of 10 years of investigation on methods of improving stone fruit nursery stock.

At the initiation of this project, Oregon stone fruit orchards were severely infested with virus diseases which were greatly reducing the annual production of marketable fruit. Most nursery stock planted was already infested with at least a mild type of virus disease, and many of the trees produced no marketable fruit even with the best of growing conditions.

Methods since have been developed which enable nurserymen to use budwood from regularly inspected registered trees or scion orchards which have been tested for virus and found to be the best stock available for future orchards. This enables growers to purchase Oregon-grown nursery stock with assurance that their future trees will produce more and higher quality fruit than in the past.

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RECENT COMPILATIONS (1)* indicate that there are between 40 and 50 distinct virus diseases in North America which occur on stone fruit trees. Nearly half of these are known to be present in Oregon stone fruit orchards. Fortunately, many of these are not the serious type of disease that causes destruction of the orchards or complete loss of the crop. Thousands of dollars are lost annually, however, by the reduction of yield and quality of fruit. In addition to this sustained loss, such diseases as western X disease of peach and western X little cherry and albino disease of cherry are actually destroying trees and orchards, and serve as a serious threat to the stone fruit industry.

This situation brought about the initiation of a research project to cope with the problem. One logical phase of this project was to start the virus control program in the nurseries where trees are propagated for planting new orchards and replacing dead or sick trees. When trees that are already diseased are planted in an orchard there is no opportunity to correct the situation, and serious losses may result for the life of the tree.

A survey of the trees being used by nurserymen as sources of propagation stock emphasized the seriousness of the problem. Very few nurserymen had heard of a virus disease and none of them was familiar enough with a virus condition to recognize that anything was wrong with the tree. Unfortunately, a tree carrying some of the more serious viruses often produced satisfactory 2-year-old whips. Very few nurserymen had an organized mother block for their scion wood, and were cutting buds or scions from any source available or convenient, without any regard to the desirability of the trees as a parent for orchard stock. This emphasized the need for some program which would provide nurserymen with disease-free sources of propagating stock.

When a virus control program was started in 1944, much of the research on the stone fruit virus complex was in the early stages of investigation. No virus-free stock was available and methods of indexing for virus were just beginning to be developed. The nurserymen could not be expected to stop propagating stone fruit trees until

* See literature cited page 27.

virus-free sources could be found, therefore the following four-point program was started:

- Selection and registration of trees that expressed no visual symptoms of the serious types of virus diseases.
- Selecting and indexing apparently virus-free trees for latent or masked viruses that expressed no apparent symptoms.
- Making a source of desirable indexed budwood available to all nurserymen for establishing mother scion orchards.
- Initiating a certification program as the need for such a program became apparent.

Tree Registration

Oregon Agricultural Experiment Station Circular of Information 335, *A Plan for Improving Oregon-Grown Fruit Tree Nursery Stock*, was prepared and issued in March 1944. This circular outlined the need for a program of selecting virus-free sources of budwood, suggested a method by which this might be accomplished, and outlined steps to be followed by the nurserymen, the State Department of Agriculture, and Oregon Agricultural Experiment Station. A blank was included for nurserymen to fill out and return, giving the number, variety, and location of stone fruit trees used for propagation. The State Department of Agriculture Nursery Inspection Service took an active part in helping nurserymen locate apparently virus-free trees to be considered for registration.

The requests by the nurserymen for tree registrations were assembled and the trees listed were inspected by plant pathologists familiar with stone fruit virus diseases. The inspections usually were made just before harvest in order to check foliage and fruit for virus symptoms as well as trueness to variety. Sweet and sour cherries have received the major attention, since the virus situation in these stocks in Oregon was much more serious than in other stone fruit varieties. The following virus or virus-like diseases usually could be detected by visual symptoms and infected stock could be eliminated: cherry mottle leaf, albino, little cherry, rusty mottle, pink fruit, rasp leaf, sour cherry yellows, twisted leaf, black canker, pinto leaf, crinkle, and deep suture. These diseases are all described in the stone fruit handbook (1) and no descriptions are included here.

Since most of the trees examined showed some evidence of virus infection, many of the trees registered as suitable for use showed faint mottles or a line pattern type of ring spot (Figure 1) which was assumed to be caused by the ring spot virus present in most cherry trees (5) (8). The nurserymen were encouraged to

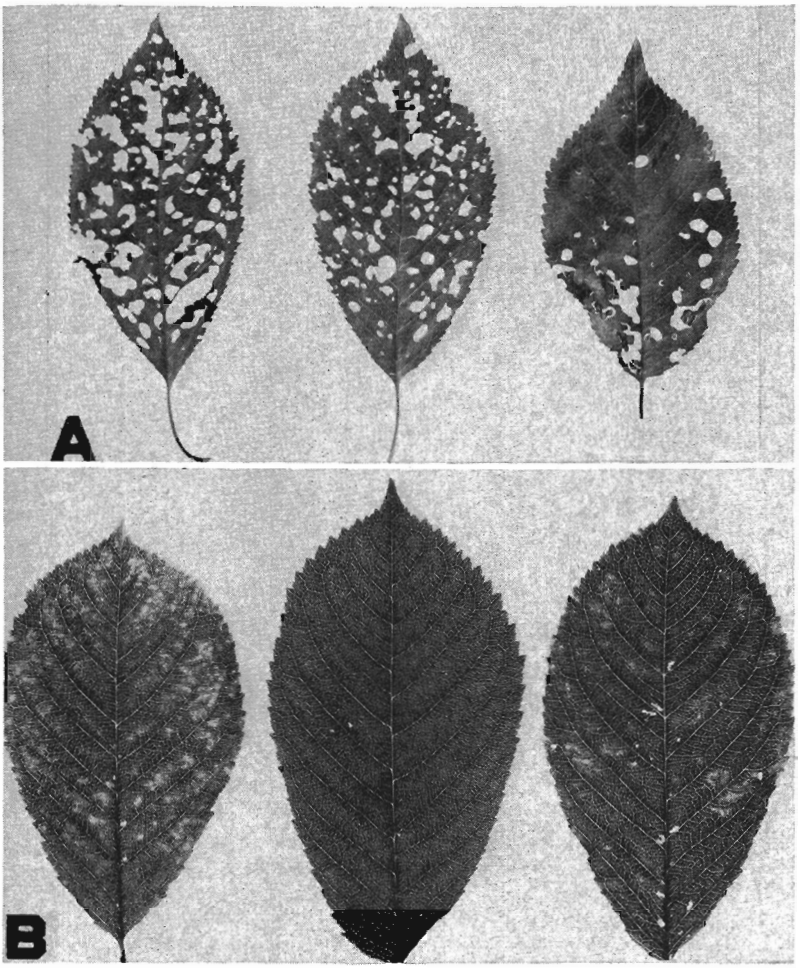

Figure 1. Leaves from sweet cherry showing evidence of virus infection, probably the more severe strains of ring spot virus. *A.* Leaves showing the lace leaf or tatter leaf condition. *B.* Center leaf shows no visible virus effect by transmitted light while the two outer leaves show a mild mottle.

keep searching for trees which did not show any evidence of virus infection.

If the tree selected by the nurserymen showed no visual indication of any of the serious virus-like diseases, the tree was given a registration number, and this number was painted on the trunk with

bright orange paint. The variety was represented by its first letter, such as B for Bing, A for Royal Ann (Napoleon), MD for May Duke, etc., and the trees were numbered in order of requests for registration. A number was used only once and became the code number by which the tree was recognized, for instance, A10, L89, B260, etc. All registered trees were listed in order in a permanent book giving the following information: registration number, variety, location, owner of tree, address of owner, nursery making the application, who made the inspection, and date of registration. This same information was placed on an official tree registration card and sent to the nursery making the application.

Any propagation wood taken from a tree was identified by tree code number and this number was placed at the first tree budded with that wood in the nursery row. Often the nurserymen would carry this number on their individual trees or bundles when they were sold. The tree was again inspected the following year and the nursery stock propagated from that tree was also examined. If either proved to be unsatisfactory on the second or subsequent inspections the number was removed from the tree and the registration card was recalled. The policy has been to encourage nurserymen always to watch for isolated trees in the vicinity of their nurseries that might prove to be better for propagation work than the ones already registered. This program has resulted in the registration of more than 500 different trees. Many of the first trees registered were soon cancelled because better performing trees were located. These registered trees served as the source of scion and budwood for Oregon nurserymen from 1944 to 1948—and some of the original trees are still being used.

Indexing for Virus-Free Trees

Many viruses exist in plants without showing any readily visible effect. This is true of several of the stone fruit viruses on some of their host plants. To determine the presence of such viruses some susceptible species or variety must be used which will exhibit definite symptoms when inoculated with these latent or hidden viruses. Such plants are called index hosts, and the process of testing for masked viruses has been called indexing for virus. In stone fruit indexing the primary virus concerned has been the ring spot virus, because it is a common contaminant in these plants and does not always exhibit visible symptoms. Peach, virus-free Montmorency, *Prunus tomentosa*, and the two varieties of flowering cherry Kwanzan and Shirofugen (*Prunus serrulata*) have been the common index host plants used for the ring spot virus.

During the process of tree registration several thousand trees were observed very carefully for indication of virus infection. All trees that did not show visible evidence of virus (Figure 1B, center leaf), then were tested for latent viruses by budding them onto an index host for ring spot. If abnormal symptoms developed on the healthy index plant a virus was known to be present and no further tests were made. If no reaction occurred the tree was tested further on several different host plants until the tree could be assumed to be free from all known viruses.

Peach as an index plant

Peach has been used extensively throughout North America as an index plant for the ring spot virus. Lovell seedlings, and many of the named varieties such as Hale, Elberta, Muir, etc., have been used. The ring spot virus is not a single entity but a complex of several different strains or combinations of strains. Many different reactions may occur on the index host, therefore, when different stone fruit varieties or different trees from different localities are tested. Some of the very mild strains of ring spot do not react on peach; others produce only a mild, fleeting ring spot and leaf drop early in the spring and thereafter the foliage and tree appears normal (Figure 2B). The more severe strains may produce a severe shock reaction with very conspicuous ring spots and necrotic spotting on the leaves. These leaves soon fall, the new leaves are normal, and the tree may show no further evidence of virus infection. Other strains of ring spot cause a very severe reaction on peach. Necrotic cankers may form around the point of bud insertion, the bark may split and remain rough, and the foliage may permanently be reduced to dark green rosettes of tufted leaves (Figure 2A).

The peach has not proved to be a satisfactory index host for ring spot virus because several strains do not produce sufficiently severe symptoms to make results infallible. Also one to three peach trees are needed for each tree to be indexed, therefore a large number of plants are necessary. The peach is difficult to use as an index plant for other stone fruit viruses because the ring spot contamination reaction often makes other virus reactions difficult to interpret.

Virus-free Montmorency as an index host

When most strains of the ring spot complex are inoculated into virus-free Montmorency and some of the other sour cherry varieties, a severe shock reaction occurs the first year after inoculation (7) (10) (12). Necrotic rings and necrotic areas appear on the leaves (Figure 3), and terminal growth is greatly retarded. Many of these

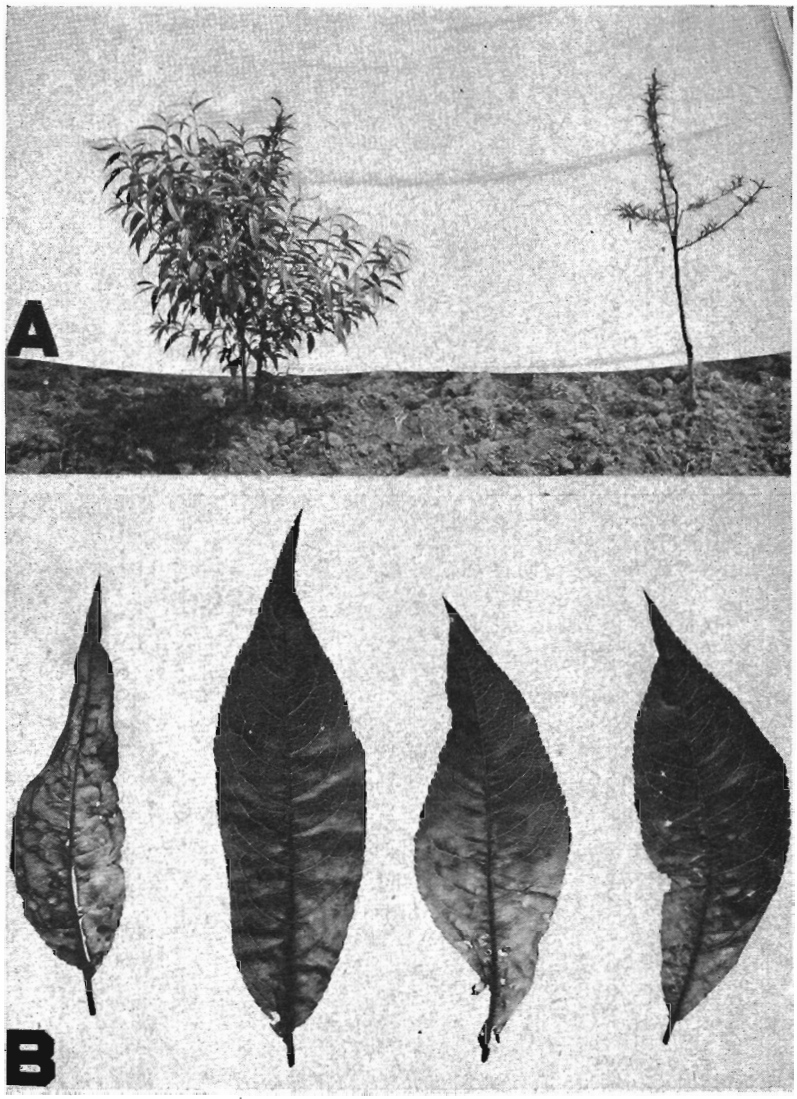

Figure 2. The reaction of ring spot virus on peach. *A*. Tree on right shows severe reaction resulting in a dwarfing, stunting, and rosetting of the foliage. *B*. Various stages of ring spot symptoms from mild chlorotic spots to necrotic burning.

leaves become chlorotic and fall from the tree. Such trees inoculated with most strains of ring spot begin to recover late in the growing season and by the following year produce normal appearing foliage and growth.

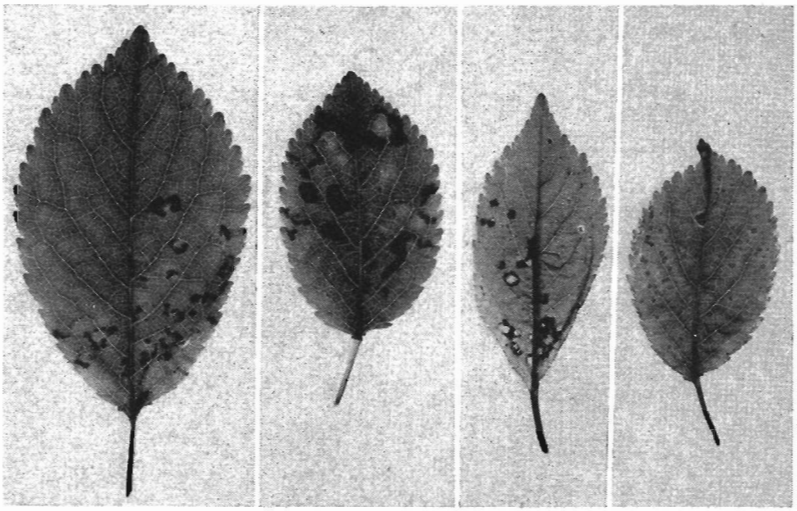

Figure 3. A series of Montmorency leaves showing various types of necrotic ring spots and necrotic areas resulting from first year invasion of ring spot virus.

Montmorency has not been used as a host index plant in Oregon work but has been used extensively in the North Central and Eastern states (11). Some of the very mild ring spot strains do not react on virus-free Montmorency.

Prunus tomentosa as an index plant

Prunus tomentosa has been reported (6) as an index host for ring spot virus. This plant has not been used in Oregon but from correspondence with other research workers it does not seem to have any advantages over the other hosts more commonly used.

Kwanzan flowering cherry as an index tree

The Kwanzan variety of flowering cherry (*Prunus serrulata*) has proved to be a reliable index plant for most of the ring spot complex of viruses (9). It has also been used to demonstrate strain differences in the ring spot complex (Figure 4). Some of the very mild strains have no effect on Kwanzan, and others produce only a faint foliage symptom. Intermediate strains cause a severe foliage reac-

tion, while the very severe strains may kill young Kwanzan trees down to the inserted bud or to the rootstock. Leaf symptoms vary from slight reduction in size, accompanied by an arching of the midrib and a cupping downward of the leaf tip, to extreme dwarfing in size, necrosis of the midribs and small leaves or even death to the unfolding buds. Internode elongation is often reduced, causing the leaves to be clustered together in rosettes.

When budded in late August or early September Kwanzan has reacted to all strains of ring spot virus except one mild strain which gives a necrotic reaction on Shirofugen. Readings have been made in the spring following fall inoculations, and no difficulty has been experienced in getting consistent readings. Some workers have reported failure with the Kwanzan reaction when winter budded in the greenhouse or spring budded out of doors. One or more Kwanzan trees are needed for each tree indexed and 2-year-old nursery whips are ideal size for use.

Figure 4. Ring spot virus reaction on Kwanzan flowering cherry. Branch on left normal, three branches on right showing various degrees of severity of reaction due to virus strain variation.

Shirofugen flowering cherry as an index tree

The Shirofugen variety of *Prunus serrulata* has proved to be a very valuable index tree for the ring spot virus complex (9). It reacts to all of the known strains of ring spot virus and it is hypersensitive to most strains so that a necrotic localized lesion occurs around each inserted bud. Many buds can be tested on each branch. Shirofugen trees to be used for indexing should be pruned severely during the spring to force long single branches. These branches may be used as soon as they are large enough to be budded, but more efficient use of the tree can be made if the budding is delayed until late summer or carried over for the next season's testing. Budding may be started in the spring as soon as the bark loosens, and may be continued until the bark sets in the fall. Buds placed in Shirofugen during the fore part of the season may be read before fall, but the later budding must be carried over until spring for accurate reading.

The buds to be indexed are inserted into the limb at 2- to 3-inch intervals in the same manner as for normal T-budding (Figure 5B). If dormant buds are not available corresponding strips of bark can be used. In keeping records the branches and the forks are given numbers and the coded buds are started at the base working out toward the terminals. Wired wooden labels or paper strips are used for each fork and the corresponding fork number should be cut into the bark. Records of branches and buds are made in notebooks and the reactions are listed at the end of the test period.

The following observations have been recorded following insertion of buds into Shirofugen. If no virus is present normal callus tissue develops around the bud, it breaks dormancy and grows into a normal branch (Figure 5C). If no virus is present but the bud fails to grow because of mechanical bud failures, the bud is pushed out as the wound heals over with normal callus tissue. When a virus of the ring spot complex is present, gum will soon begin to ooze out of the adjacent tissue (Figure 5A), the bud dies, no callus forms around the bud shield, and a necrosis slowly spreads out from the area of the bud insertion (Figure 5D). With favorable conditions readings can be made within 45 to 60 days after bud insertions, and readings must be made before the branch is completely girdled or before the necrosis spreads from one bud to another. The age of a branch is not a factor in accuracy, but on larger branches more distinct readings for each individual bud can be made before necrotic areas coalesce.

Only one strain of the ring spot virus complex has been segregated that does not react on Shirofugen in this localized manner. A bud carrying this strain will callus-in and grow very much in the same manner as a virus-free bud. There are some necrotic flecks

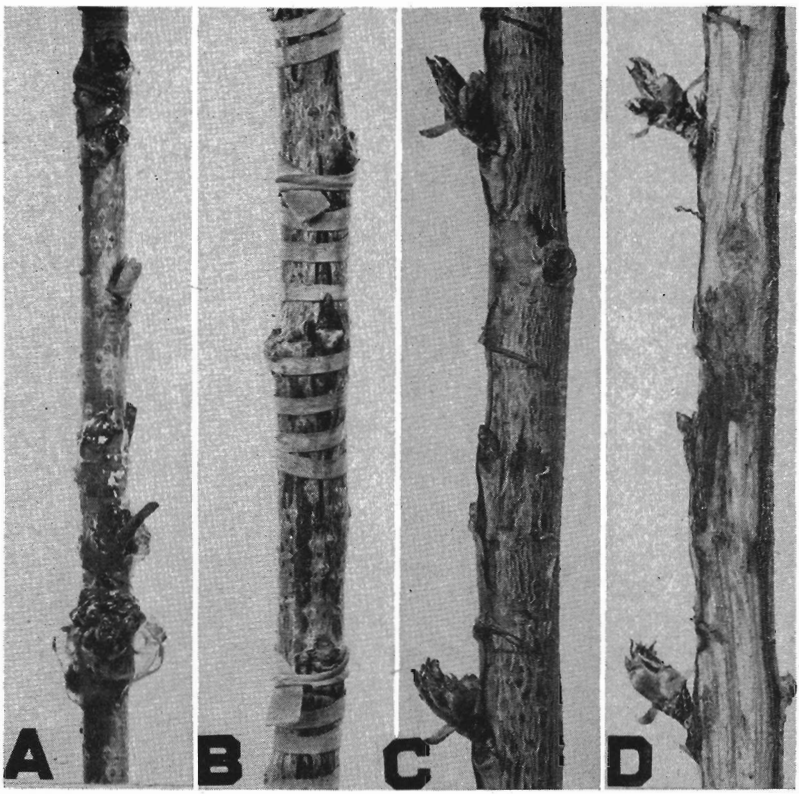

Figure 5. Ring spot virus reaction on Shirofugen flowering cherry. *A*. A strong reaction from fall budding with considerable gumming around bud. *B*. No reaction following fall budding indicating a virus-free tree. *C*. Virus-free buds near top and bottom starting to grow in spring while center bud with ring spot virus has died. *D*. Same branch as *C* with outer bark removed to show necrosis around center bud indicating ring spot virus invasion.

under the bud shield and the union between bud and stock is not as compatible as with virus-free buds. This strain of virus very rapidly becomes systemic and the entire Shirofugen tree responds to invasion much in the same manner as does Kwanzan to all strains (Figure 6). This particular strain of ring spot gives a typical reaction on Kwanzan.

If only the localized necrotic strains are tested on Shirofugen branches, the entire branch can be removed as soon as the readings are made and this will force new branches which again can be used for indexing.

Steps followed for indexing a tree

Trees selected for indexing showed uniform green leaves without any mottle breaks correlated with virus infection (center leaf, Figure 1B). Many trees showed an interveinal nutritional chlorosis that could be confused with a virus mottle. A bud stick was taken from opposite sides of a tree to be indexed and a bud from each

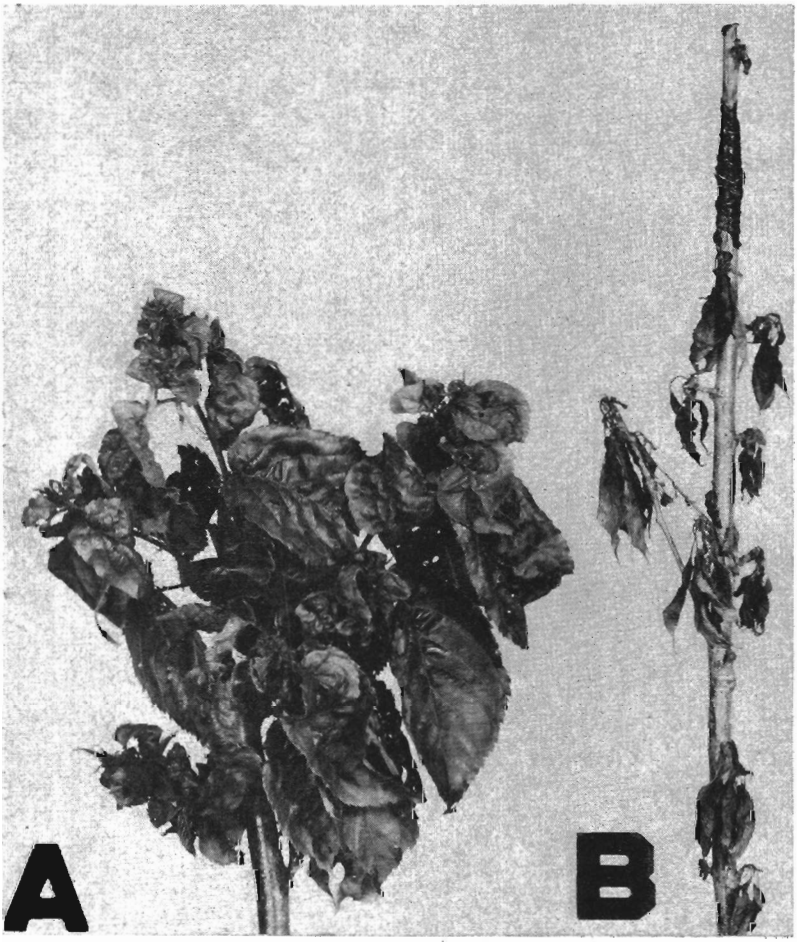

Figure 6. Unusual ring spot virus reactions on Shirofugen. *A*. Severe dwarfing and rosetting of leaves as a result of a strain of ring spot virus which becomes systemic without producing local necrosis about the bud. *B*. A severe spreading type of necrosis and sudden death on Shirofugen as a result of rapid invasion from a spring graft with other strains of ring spot virus.

stick placed in Shirofugen branches. If either bud reacted, no further tests were made, but if there was no reaction five more bud sticks were taken and a bud from each again tested on Shirofugen. If these buds did not react, the tree was then indexed on two or three Kwanzan trees. All trees which have not reacted on either of these two hosts have failed to react on Montmorency or peach and have been assumed to be free from the ring spot complex.

Further indexing, when deemed advisable, was made between cherry varieties, such as Lambert on normal Bing, or to other *Prunus* species such as peach to cherry, or sweet cherry to sour cherry, etc. No virus contamination has been found in trees shown to be free from the ring spot complex by indexing.

Virus-Free Scion Wood Orchards

Scion wood orchards can be established by planting 2-year-old nursery trees or by planting seedlings to be top-worked later. When nursery trees are used only those propagated from known virus-free stock should be planted. Recent work has demonstrated some of the ring spot viruses to be seed transmitted in both mazzard (4) and mahaleb (2) seed. This emphasizes the need for using indexed rootstocks or seedlings from indexed seed trees. In areas where bacterial gummosis is a factor there is considerable benefit from planting seedlings and topworking them on branched scaffolds with virus-free wood. Most seedlings are resistant to gummosis and the danger of loss of trees by trunk cankers is less by this method of propagation.

The mother block planting should be isolated as far as possible from any other stone fruit trees. No definite distance can be selected as a safe boundary which would protect the planting from outside infection. The most logical and practical plan would be to isolate as much as possible, inspect and index the block frequently, and remove all naturally infected trees as soon as they are found.

The spacing of the trees in the mother block does not require any special consideration other than convenience of operation and maintenance. A desirable plan and one that is frequently used is 10-foot rows with trees planted 5 feet apart in the row. As the trees become crowded alternate trees in the row can be removed to give a 10′ by 10′ planting. Good cultivation practices should be followed to keep the trees growing vigorously and the trees should be cut back each year to keep strong vegetative growth with few fruit buds.

Every tree should be reindexed for virus as soon as the planting becomes established, and before any scion wood is cut. Each tree should be examined at least once a year for visible virus symptoms

and should be reindexed whenever deemed advisable. The interval between indexing periods will be determined by the location and the possibility of virus spread in that area.

Results and Discussion

Registration of stone fruit trees in Oregon has about fulfilled its purpose, and certified virus-free scion orchards should replace this program as soon as possible. Tree registration has greatly improved the quality of the trees grown in nurseries and planted in orchards. Some nurseries will continue to use registered trees, but several mother blocks of virus-free trees have been established, and before many years all stone fruit trees grown in Oregon nurseries will come from regularly inspected and tested virus-free stocks.

There are several advantages to scion orchards and the use of virus-free propagation materials. Varieties are more easily segregated and maintained true-to-name. A local source of fresh budwood is available for each day's budding, and no time is lost in traveling from one orchard to another collecting miscellaneous lots of budwood. Carefully maintained scion orchards will give a high percentage of vegetative buds and few flower buds.

The value of the use of virus-free scion wood can readily be seen in comparative nursery rows. Virus-free trees give a more uniform stand of trees, a higher percentage of top grade trees, and a lower percentage of culls or grade outs. Table 1 gives a comparison of a group of 2-year-old nursery whips grown under identical conditions. The virus condition is the only variable.

Table 1. THE EFFECT OF VIRUS CONTENT OF DIFFERENT CHERRY SELECTIONS ON GROWTH OF YOUNG TREES IN NURSERY ROWS.[1]

Tree code	Virus reaction		Height of 2-year-old nursery trees			Average height
	Shiro-fugen	Kwan-zan	Over 5 feet	4 to 5 feet	Below 4 feet	
			Per cent	*Per cent*	*Per cent*	*Feet*
A7	+	+S[2]	4.8	53.3	41.9	3.8
A114	—	+M	31.6	46.9	21.5	4.4
A10	—	—	48.7	34.2	17.1	4.6
B386A	+	+S	0.2	33.1	66.7	3.3
B386B	—	—	42.8	36.6	21.6	4.5
B86	—	—	43.4	36.5	20.1	4.6
B260	—	—	48.4	34.8	16.8	4.6
L6	+	+S	1.3	28.5	70.2	3.3
L89	+	+M	45.1	27.7	27.2	4.3
R387	+	+S	0.0	20.0	80.0	3.4
R465	—	+M	14.0	55.5	30.5	4.2

[1]Based on approximately 200 trees per tree code.
[2]+S denotes a severe reaction on Kwanzan, +M a mild reaction.

The trees listed in the table were grown in the same block of nursery stock, and on the same grade of mazzard rootstock. Whenever possible comparisons were made on adjacent rows in order to minimize the effect of variation in growing conditions (Figure 7).

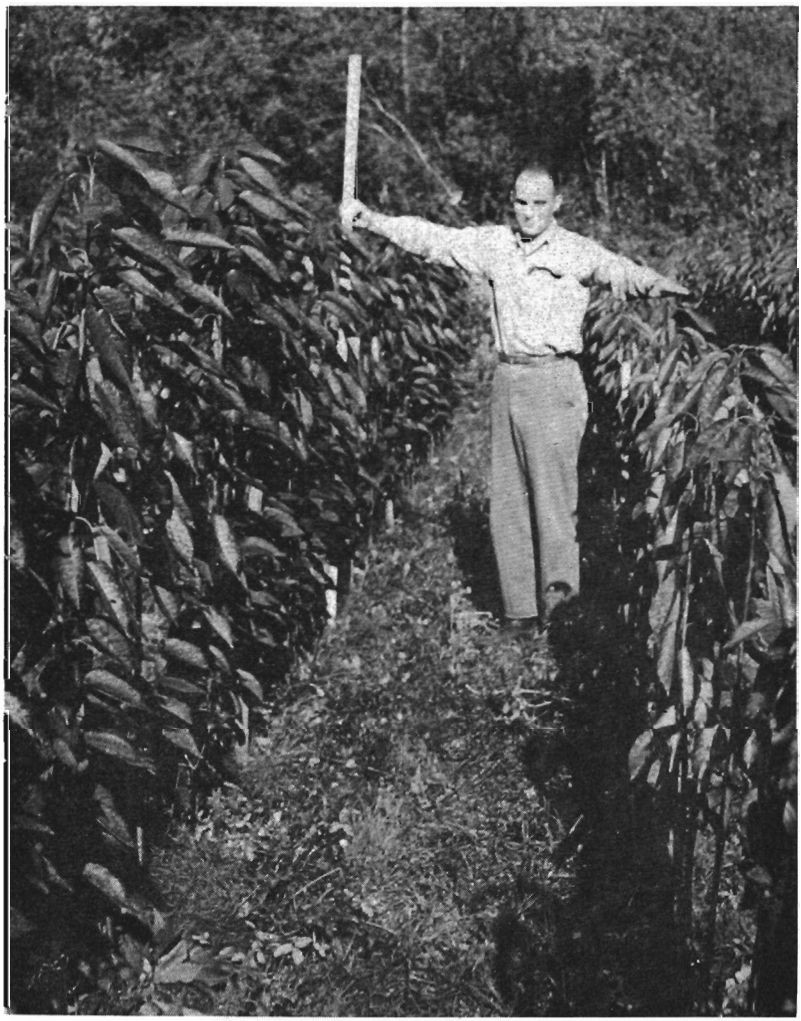

Figure 7. A comparison of the growth of virus-free Royal Ann (A10) on the left with ring spot virus infected Royal Ann (A7) on the right in adjacent nursery rows.

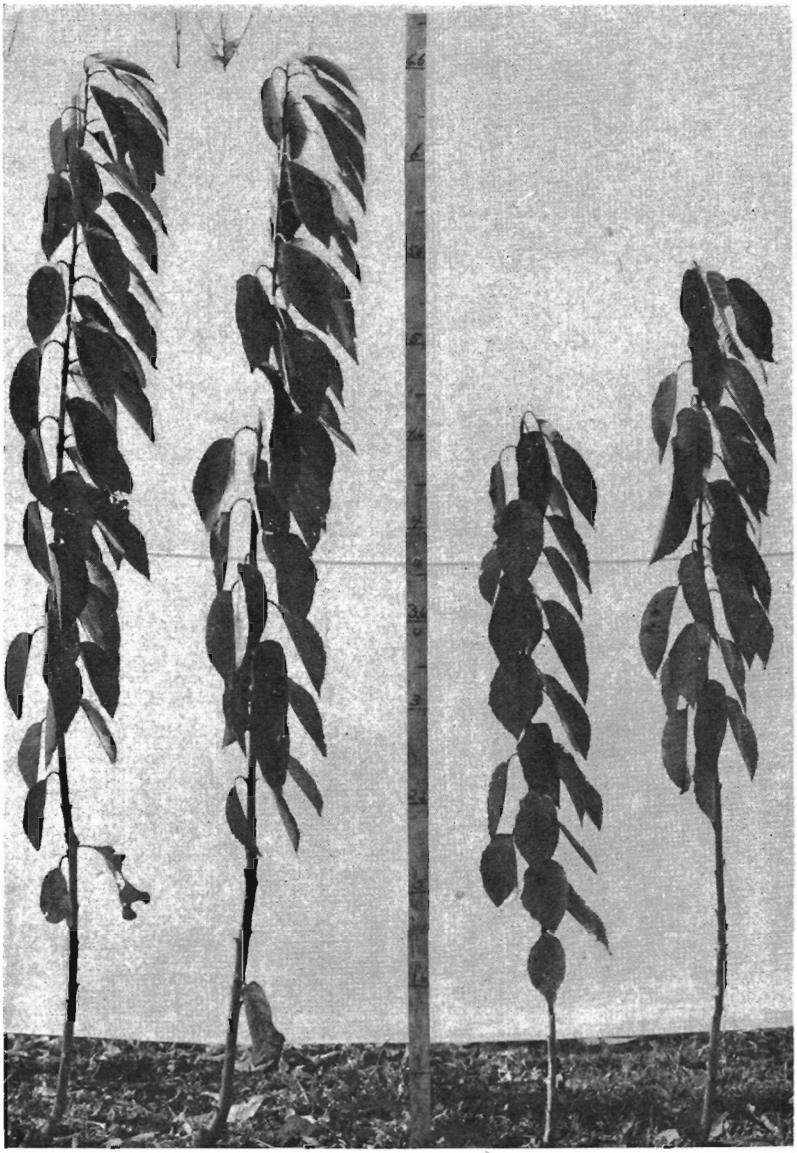

Figure 8. A comparison in height of virus-free Royal Ann (A10) on left with ring spot virus-infected Royal Ann (A11) on right.

Measurements were made at the end of the growing season, one year after budding. The height was measured from the point of bud insertion. When sufficient trees were available, 200 whips were measured for each tree code.

Trees that were negative for virus on both Shirofugen and Kwanzan grew best in the nursery row (Figure 8), and those that gave a mild reaction on Kwanzan, indicating a mild strain of virus, produced better trees than those with a severe strain of virus. This effect on growth has been noted many times when budwood has been used from trees both with and without virus. Montmorency sour cherry reacts in the same manner (Figure 9). In one instance a row

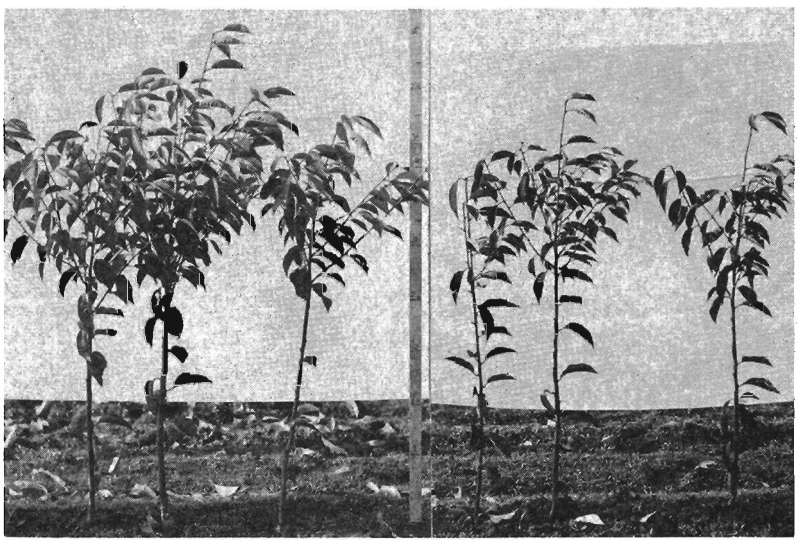

Figure 9. The growth of virus-free Montmorency compared with ring spot infected Montmorency in nursery row. Trees on the left are virus free and trees on right infected with ring spot virus.

of Montmorency from a virus tree had only a 50 per cent stand of buds and was 10 to 12 inches shorter than two adjacent rows from virus-free trees where the stand of buds ranged from 85 to 90 per cent. Most nurserymen who have had a chance to observe this behavior in their own nursery have immediately changed over to virus-free wood the following season.

Recommended Variety Selections

The indexing results and the nursery performance have demonstrated the desirability of propagating virus-free cherry trees. For those varieties where virus-free stock is not yet available, sources carrying the very mild strains are more desirable than those with severe strains of virus. These findings have been too recent to obtain comparable data on orchard performance, but preliminary observations indicate more vigorous and more rapid growth from the virus-free trees.

The varieties of sweet and sour cherry indexed on flowering cherry are given in Table 2. In addition to these varieties commonly grown in Oregon nearly 300 other varieties from other states and foreign countries have been assembled and indexed for virus diseases.

Many of the selections were infected with the ring spot virus and were discarded as sources for propagation, unless no virus-free source was available for that variety. Then those with the mild strains of virus were distributed for scion orchards. The following discussion lists the stone fruit trees by varieties or related groups with recommendations for the selection best suited for nursery propagation and orchard plantings.

Table 2. CHERRY VARIETIES FROM OREGON TESTED FOR RING SPOT VIRUS.

Variety	Number tested	Number with ring spot	Number without ring spot	Per cent infected
Bing	89	74	15	83.0
Black Giant	1	0	1	0.0
Black Republican	62	62	0	100.0
Black Tartarian	18	18	0	100.0
Centennial	6	6	0	100.0
Deacon	10	10	0	100.0
Early Richmond	30	30	0	100.0
English Morello	8	8	0	100.0
Hoskins	10	8	2	80.0
Lambert	53	53	0	100.0
Late Duke	10	0	10	0.0
May Duke	10	0	10	0.0
Montmorency	130	84	46	64.6
Napolean	122	121	1	99.1
Olivet	7	7	0	100.0
Schmidt's Bigarreau	2	0	2	0.0
Waterhouse	3	3	0	100.0
Windsor	1	0	1	0.0
Total	572	484	88	84.6

The Bing variety of sweet cherry

The following Bing selections have been distributed to Oregon nurserymen and are recommended for nursery propagation and orchard plantings: B260, B293, B294, B86, B62, and B525. None

of these selections has shown a virus reaction on any cross indexing test. B260, B292, B294, and B525 all have a common origin, having been purchased from the Carlton Nursery at Forest Grove, Oregon, in 1941 and planted in experimental plots at Corvallis. The original budwood for these trees apparently came from an orchard in the Yakima Valley, Washington. B86 was found in an old orchard near Eugene, Oregon, and B62 was found in a small home orchard near Fairview, Oregon.

Apparently the Bing variety was originally propagated on virus-free rootstock, but in the past years most of the trees have become infected with various strains of ring spot virus.

The Royal Ann or Napoleon variety of sweet cherry

The following selections of Royal Ann are recommended for propagation: A10, A114, A201, A202, A 203, A204, A318, A501. Of the 122 Royal Ann trees which were considered worthy of indexing for ring spot virus, only A10 has failed to give a ring spot reaction. All other selections listed above, and several other trees did not give a necrotic reaction on Shirofugen, but when retested on Kwanzan all produced a reaction. (See Figure 4.) A10 was found in a home yard in Forest Grove, Oregon. A114 originated from an old high-producing tree in the Wilmer Walton home yard near Eugene. Several trees were found in the Milton Nursery's scion orchard which have been registered under the numbers A201, A202, A203, A204, A521, A522, A523, and A524. A501 has been assigned to a group of trees from the Milton Nursery having the same index history as the original series. A318 was assigned to a tree in a yard near Canby, Oregon. Several other trees with similar index histories have been registered and may still be used by some nurserymen.

The Royal Ann variety has an unusual index history in that several trees have been found with mild strains of ring spot, but only A10 has indexed free from this virus. Perhaps A10 should be used as much as possible, but the other selections have given very good nursery row performance as shown by A114 in Table 1.

The Lambert variety of sweet cherry

Only four selections of Lambert, L89, L313, L314, and L315 have been recommended for use as scion stock. All of the 53 Lamberts tested for ring spot virus have reacted on Shirofugen but these four trees have given a very mild ring spot virus reaction on Kwanzan. This stock will have to be used until a virus-free source is available. Recently a Lambert has been obtained from Missouri which has been reported to be free from ring spot virus. This selection, which has been assigned the number L530, cannot be recom-

mended until it has been reindexed and the variety checked for trueness to type. The four selections of Lambert grow well in the nursery row and should be satisfactory as propagation sources unless stock is found which is superior. L89 originated in a home yard in Corvallis, Oregon, and L313, L314, and L315 are all in the same home yard in Fairview, Oregon.

The Black Republican variety of sweet cherry

The following selections of Black Republican trees are being used by various Oregon nurseries and are recommended for orchard plantings: R257, R316, R332, R468, R467, R466, R504. None of these selections give a typical reaction on Shirofugen, but they all react for a mild ring spot virus on Kwanzan. There is no preference in these selections, which probably have originated from a common source.

The Black Tartarian variety of sweet cherry

The following are the best Black Tartarians found during the indexing program: T261, T391, T349, T388, and T481. T261, T388, and T349 originated from a tree in Corvallis, Oregon, and T391 from a tree in a farm home near Hillsboro, Oregon. All four of these trees react on Shirofugen but give no reaction on Kwanzan, suggesting a mild strain of ring spot virus. T481 was found in an orchard near Sherwood, Oregon, and differs from the other selections in that it does not react on Shirofugen but gives a typical ring spot virus reaction on Kwanzan. All five of these selections grow very well in the nursery row.

Miscellaneous sweet and sour cherry varieties

In addition to these common varieties, nearly 300 other varieties have been collected by the Horticulture Department of the Oregon Agricultural Experiment Station. These are being indexed for virus and small amounts of scion wood will be available for propagation purposes. If any nurseryman or orchardist wishes to obtain a source of these varieties or any of the minor varieties of cherries he should consult the Oregon Agricultural Experiment Station before obtaining them from other sources. There is a constant danger of introducing new and serious diseases by using materials that have not been indexed for disease.

Sour cherry varieties

Montmorency is the most common variety of sour cherry grown in Oregon. The following selections are recommended for propagation and for orchard planting: M252, M322, M460, M461, M464,

and M505. All of these selections have indexed virus free on all cross-inoculation tests, and they have all originated from the Milton Nursery scion orchard at Milton, Oregon.

In addition to Montmorency some nurseries plant English Morello, Kentish, May Duke, Late Duke, Olivet, and Early Richmond. These varieties have not received much study, but Late Duke LD356 and LD516 and May Duke MD 82 have indexed free from virus. May Duke MD518 and MD519 have indexed with no reaction on Shirofugen but give a mild reaction on Kwanzan. Early Richmond ER517 indexed positive on Shirofugen but did not react on Kwanzan, indicating a mild strain of ring spot virus.

Peach varieties

Peach varieties have not been included in the tree registration plan. A study of the peach virus diseases of Oregon revealed that there was no serious problem in the areas where most of the peaches were being propagated. Surveys of nursery scion orchards and nursery plantings also indicated that there was no serious virus problem that required immediate attention.

Prune and plum varieties

Italian prune is the main variety of prune or plum grown in Oregon orchards. Several varieties of plums are grown by Oregon nurseries, but these are mostly for out-of-state shipments or for home orchards.

Research work on this group of stone fruits has been very preliminary in nature and very confusing. There are several virus or virus-like conditions in prunes that are bud-perpetuated and have been well distributed in orchards. Some of these abnormalities, such as prune leaf spot and a rusty-type mottle (Figure 10), are not transmissible from one tree to another and very little is known of their nature. The use of index host plants for such abnormalities is not feasible if they are not transmissible, and visual symptom expression is the only criterion for selecting superior stock.

The ring spot virus is present in prunes and plums and the few superior selections of Italian prune that have been studied grow more vigorously than other stocks carrying ring spot. A selection of Italian prune that was tested and studied in Washington State and listed as PrH1 has shown outstanding performance as a young tree. The foliage does not show any of the undesirable malformations and the tree has indexed free from ring spot virus. If this tree proves to be an Italian prune true to a desirable type it should be used for nursery propagation and orchard planting. Another selection of an Italian-type prune, which ripens 10 to 12 days earlier than the regular

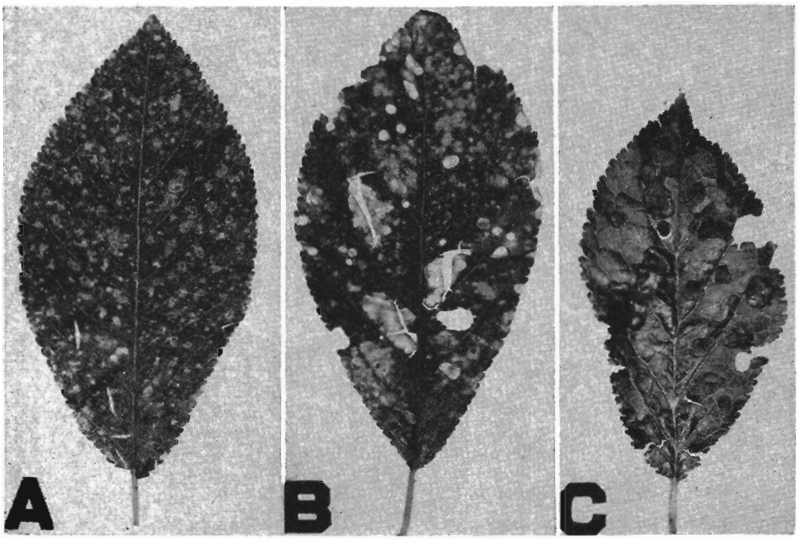

Figure 10. Virus-like abnormalities often noted on Italian prune. *A*. A rusty mottle type of foliage discoloration. *B*. Necrotic spotting and chlorotic mottle on same leaf. *C*. Necrotic spotting of prune leaf spot. These conditions are bud-perpetuated but have not been transmitted to normal trees.

Italian prune, was found in the experimental plots at Wenatchee, Washington. This is a vigorous, normal-appearing tree with good quality fruit. It has been propagated by some nurseries under the selection number E76.

More work is needed on the selection of undesirable types of all the plum and prune varieties.

Certification of Stone Fruit Trees

Nearly 15 years ago Oregon State College was asked by orchardists and Extension men to organize a plan for the certification of disease-free stone fruit nursery stock. This request was given careful consideration and was rejected, not because there was not a need for certification but because there had not been sufficient research on stone fruit viruses to make certification feasible. This situation has changed, and if there is sufficient interest in certification the following plan could be initiated.

Stone fruit trees, as they are being propagated now, fall into three distinct groups: (1) Indexed virus-free stock grown on seed-

lings from indexed virus-free seed trees; (2) indexed stock of known virus history grown on seedlings from any available source; (3) scion wood not indexed but from registered trees free from visible symptoms of serious viruses. This classification suggests a purple tag foundation grade, a blue tag certified grade, and a red tag commercial grade.

It would be ideal if all stock entered for certification could qualify for the purple tag or foundation grade. This is not feasible now because there are some varieties for which no virus-free trees have been found, and there are not sufficient virus-free seed trees to furnish the needed amounts for all rootstocks required by the industry. The certified blue tag, therefore, would be essential and certification would be based on the best stock available. There would not appear to be much reason for the commercial red tag, but such a certification could be made if demand was sufficient.

Certification would require regular inspection and indexing of mother scion orchards. Indexed seed sources would be essential. Nursery rows should be inspected and, if feasible, sampled and tested for ring spot on Shirofugen. Certification tags would have to be furnished for tagging the stock as it is sold.

Summary

▶ Recent compilations indicate that there are 40 to 50 distinct virus or virus-like diseases of stone fruit trees in North America and that nearly half of these are known to be in Oregon orchards.

▶ Some virus diseases are minor in nature and are difficult to detect—but do cause sustained yearly losses. Others are very serious in nature and destroy fruit quality and in some cases kill the tree.

▶ Control of viruses must start with nursery propagation, since once a tree is affected there is no known method of eliminating the disease without destroying the tree.

Topics Discussed

• Procedures for selecting virus-free trees as sources for nursery propagation.

• Methods developed for indexing stone fruit trees for latent viruses.

• The value of using indexed virus-free trees—from a nurseryman's viewpoint and an orchardist's viewpoint.

- The development, use, and advantages of virus-free mother block scion orchards.
- Desirable selections of sweet and sour cherries and their index history for virus.

Nurserymen and orchardists are advised to make frequent inquiries of representatives of Oregon State College as to the latest developments of selections best suited for their plantings.

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