Peach Stem Pitting: Transmission and Natural Spread

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ABSTRACT

Peach stem pitting was transmitted by buds or root chips from naturally infected peach trees into peach seedlings in both greenhouse and nursery experiments. Pitting and grooving of the lower trunk, resembling that in naturally infected trees, developed in the inoculated peach seedlings within 12 months after inoculation. Apricot seedlings on Elberta peach seedling rootstocks and inoculated with buds from naturally infected peach trees did not pit, but the peach rootstock developed typical symptoms. Natural spread of peach stem pitting was demonstrated by annual surveys in a densely planted peach seedling orchard. Typically, disease spread from an infected tree to adjacent healthy trees, and no random occurrence of newly infected trees in the orchard was observed. Attempts to transmit a virus mechanically from naturally infected peach trees to various herbaceous plants failed. The relation of peach stem pitting to pitting in other *Prunus* spp. is discussed. Phytopathology 60:1329-1334.

Additional key words: Prunus persica, virus disease, graft-transmission.

A stem-pitting disorder in peach of unknown etiology has been recently described (1, 7, 12). Wide geographical occurrence, and severe incidence of this disease in commercial peach orchards, threaten to become limiting factors for the peach industry in the eastern USA (3, 7, 12, 14, 15).

In general, peach trees affected by stem pitting are stunted, show brachytic terminal growth, and develop chlorosis and upward, lengthwise curling and drooping of the leaves. Thickened bark, pitting, and grooving in the woody cylinder of the lower trunk are diagnostic characteristics of this disease in orchard peach trees (Fig. 1-A, B). Young peach trees affected by stem pitting in the nursery or orchard may develop flattened, triangular areas in the lower trunk (Fig. 1-A, B) prior to development of pitting.

The pitting and grooving of the wood of peach trees affected by stem pitting resembles the symptoms of other virus disease of woody plants (4, 5). Recently, a disorder that strikingly resembles peach stem pitting was observed in several *Prunus* spp. other than peach (2, 9, 10, 13, 16). Several authors (1, 7, 12, 15) have suggested the possible viral nature of stem pitting in peach. Smith & Traylor (14) reported an association of stem pitting in yellow bud mosaic virus (PYBMV)-infected peach trees in California. Lott (8) reported that xylem aberration, a disease similar to peach stem pitting, is caused by a graft-transmissible agent. He transmitted the causal agent from apricot (*Prunus armeniaca*) to chokecherry (*Prunus virginiana* var. *demissa*). But there is no experimental evidence in the literature to indicate that peach stem pitting is caused by graft-transmissible virus(es), or that peach stem pitting and pitting in other *Prunus* spp. are caused by the same agent(s).

Our purpose was to determine the etiology of peach stem pitting and to determine possible patterns of natural spread of the disease in the field. A short account of this work was reported (11).

MATERIALS AND METHODS.—*Greenhouse transmission.*—*Prunus persica* (L.) Batsch. 'Elberta' and 'Sunhigh' seedlings and apricot (*Prunus armeniaca* L.) seedlings on Elberta peach seedling rootstocks were grown in steam-sterilized soil in 8-inch clay pots. Buds or root chips from stem pitted and symptomless peach trees from the field were used to inoculate 3 to 10 seedlings of each cultivar. The inoculum was inserted into T-cuts on the seedling trunks (1.0-1.5 cm diam) within 24 hr after collection. Controls consisted of unbudded seedlings and seedlings that received buds or root chips from healthy peach seedlings raised in steam-treated soil in the greenhouse. These plants were pruned when inoculated and every 2 months thereafter for the first 8 months. Inoculated seedlings were fertilized weekly with 20-20-20, soluble greenhouse fertilizer, and Nutra-min element concn (E. C. Geiger, Box 285, Route 63, Harleysville, Pa.) throughout the experimental period.

Nursery transmission.—Five-month-old Elberta peach seedlings were inoculated in the nursery row with buds from naturally infected peach trees in the field. Each seedling received four buds in T-cuts at the lower trunk. Controls were of the same type as in the greenhouse transmission tests.

RESULTS.—*Greenhouse transmission.*—The causal agent of peach stem pitting was transmitted to a substantial portion of the indicator plants (Table 1). Peach seedlings inoculated with buds or root chips from naturally infected peach trees developed thick bark, flattening, and triangular depressions (Fig. 1-C), and stem pitting and grooving in the woody cylinder at the lower trunk (Fig. 2-B, C, Fig. 3). Occasionally, the pitting in inoculated peach seedlings occurred in newly developed shoots 20-30 cm above the highest inoculation point (Fig. 2-C). The first symptoms in indicator plants resembling those in naturally infected trees were observed in some treatments 12 months after inoculation. Inoculum from 5 of 6 sources of naturally infected pitted peach trees induced stem pitting in the indicator plants (Table 1). However,

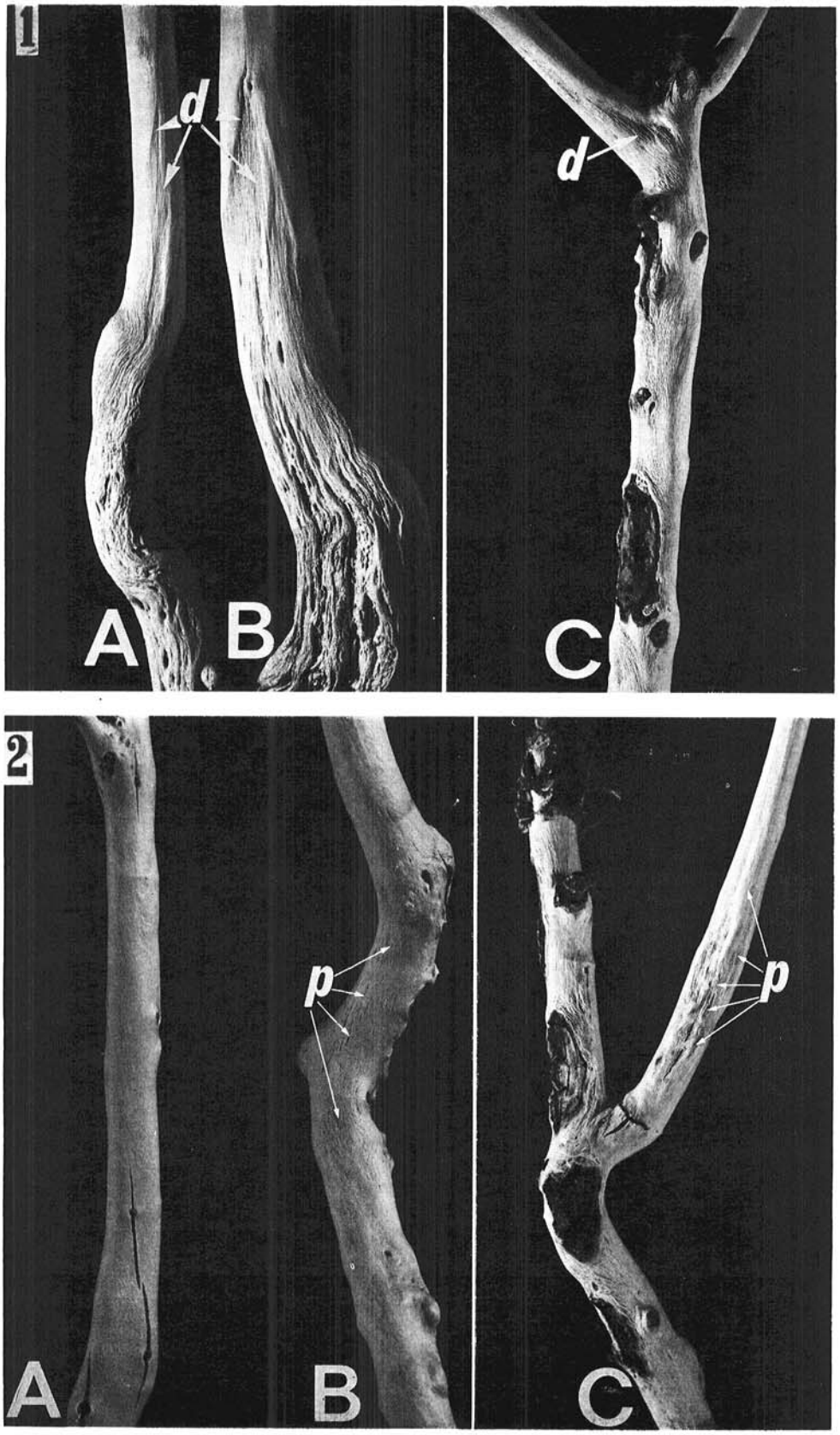

Fig. 1-2. **1)** Young peach trees affected by peach stem pitting showing flattening and triangular depression areas (d). **A)** Nursery tree. **B)** Two-year-old orchard tree. **C)** Experimentally inoculated Sunhigh peach seedling in the greenhouse. **2)** Sunhigh peach seedlings inoculated with root chips. **A)** From healthy peach tree. **B, C)** From naturally affected peach trees. Note pitting (p) in the trunk of B and in the newly developed shoot of **C.**

TABLE 1. Transmission of peach stem pitting in greenhouse tests

Source of inoculum (peach cultivar or seedling)	Type of inoculum	Indicators (seedlings)	Fraction[a] with stem pitting	
Seedling 65116, pitted[b]	Buds	Elberta	1/5	
Seedling 65116, pitted[b]	Buds	Apricot/Elberta		4/5[c]
Seedling 65117, nonpitted[b, d]	Buds	Elberta	0/3	
Seedling 65117, nonpitted[b, d]	Buds	Apricot/Elberta		1/3[c]
Blake, pitted[e]	Buds	Sunhigh		2/10
Blake, nonpitted[d, e]	Buds	Sunhigh	0/4	2/6
Sunhigh, pitted[f]	Buds	Sunhigh	1/5	2/5
Loring, pitted[e]	Root chips	Sunhigh	2/4	2/3
Seedling 65113, pitted[b]	Buds	Sunhigh		2/6
Seedling 65113, pitted[b]	Root chips	Sunhigh		4/6
Seedling 53625, pitted[b]	Buds	Sunhigh		0/6
Seedling 53625, pitted[b]	Root chips	Sunhigh		0/5
Seedling 60100, nonpitted[b]	Buds	Sunhigh		0/5
Seedling 60100, nonpitted[b]	Root chips	Sunhigh		0/5
Sunhigh seedling, nonpitted[g]	Buds	Sunhigh		0/5
Sunhigh seedling, nonpitted[g]	Buds	Apricot/Elberta		0/3
Sunhigh seedling, nonpitted	Root chips	Sunhigh		0/5
Control	Noninoculated	Sunhigh		0/5

[a] Number of plants with symptoms/number of plants inoculated.
[b] Inoculum from Plant Industry Station, Beltsville, Maryland, orchard tree.
[c] Pitting developed only in the Elberta rootstock.
[d] Nonpitted and apparently healthy when inoculum collected (August 1967). The tree showed pitting 1 year later.
[e] Inoculum from Ellicott City, Maryland, orchard tree.
[f] Inoculum from Arden, West Virginia, orchard tree.
[g] Grown in steam-sterilized soil in greenhouse.

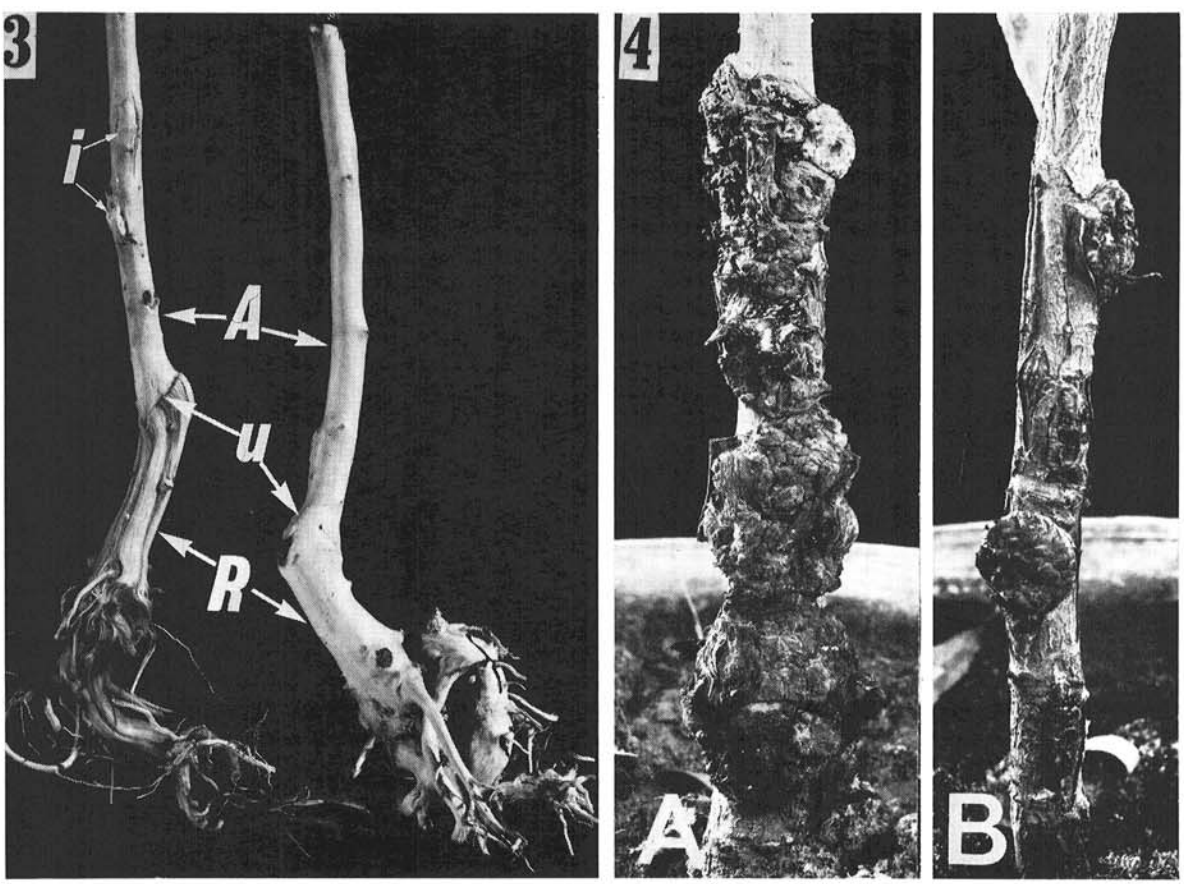

Fig. 3-4. **3)** Apricot seedlings on Elberta peach seedling rootstocks. (Left) Experimentally inoculated with buds (i) from naturally infected peach trees. Note pitting and grooving in the peach rootstock (R); distinct line at the union (u); and absence of pitting in the apricot scion (A). (Right) Control, inoculated with buds from healthy peach tree. **4) A, B)** Sunhigh peach seedlings with gall-like growths inoculated with root chips (A) and buds (B) from naturally infected peach trees.

two of three inoculum sources that were symptomless when the inoculum was collected also induced pitting in the indicator plants. Stem pitting was observed in these peach trees 1 year after the inoculum was collected. Apparently the causal agent may be present in peach trees before any macroscopic symptom of stem pitting is observed.

Apricot seedlings on Elberta peach rootstock, inoculated with buds from naturally affected peach trees, developed severe pitting and grooving in the Elberta rootstock, but no pitting developed in the apricot scion (Fig. 3). Thus, the causal agent apparently passed through the apricot scion without inducing pitting (Fig. 3). No pitting occurred in the controls (Fig. 2-A, Fig. 3). Leaf symptoms were observed occasionally in inoculated Sunhigh seedlings. Three of nine inoculum sources occasionally induced vein-clearing, mottling, chlorotic rings, and oak leaf patterns in inoculated Sunhigh seedlings. There was no correlation between these leaf symptoms and stem pitting, either in naturally infected peach trees or in the indicator plants.

In naturally infected peach trees, gall-like growths and enations are often associated with stem pitting (7, 12, 16). Inoculum from 4 sources induced gall-like growths and enations in indicator plants inoculated by root chips or buds (Fig. 4-A, B). Repeated attempts to isolate *Agrobacterium tumefaciens* from the gall-like growths on the indicator plants failed, and the tissue reacted negatively for crown-gall on young tomato plants (*Lycopersicon esculentum* Mill.) and *Datura* spp. plants. There appeared to be no correlation, however, between gall-like growths and stem pitting in inoculum-source trees or indicator plants. Five inoculum sources and the controls induced no gall-like growth in the indicator plants.

Nursery transmission.—Four of 5 Elberta peach seedlings inoculated with buds from naturally infected trees developed characteristic thick bark, grooving, and pitting at the lower trunk and in the roots (Fig. 5) within 11 months. No pitting occurred in the controls (Fig. 5).

Natural spread in the field.—Spread of the disease was determined by annual surveys in a densely planted (5 × 15 ft) peach seedling orchard. The orchard was replanted in 1965 with 594 peach hybrid seedlings. The orchard site previously was planted to Redhaven trees that were removed 1 year before replanting. Twenty-seven peach seedlings showed stem pitting in 1967, 52 in 1968, and 102 in 1969. In 1968, the spread typically was in the row from an infected to an adjacent tree 5 ft distant (Fig. 6). Sixty-eight per cent of newly infected seedlings were adjacent to diseased trees; 27% and 6% were 2 (10 ft) and 3 (15 ft) trees distant, respectively. In 1969, the spread was predominantly within the row, although it appears that in some instances the disease spread between the rows (Fig. 6).

Discussion.—Peach stem pitting is caused by graft-transmissible agent(s), possibly virus or viruses. Further studies are needed to determine whether peach stem pitting is caused by a new, undescribed virus(es), or by a strain(s) of known virus(es). Peach yellow bud mosaic virus is known to occur only in California (6). We observed no foliar symptoms resembling those of PYBMV (17) in naturally infected and indicator trees with stem pitting. In several attempts, we failed to transmit a virus mechanically from roots and leaves of naturally infected or indicator peach trees, affected by stem pitting, to herbaceous hosts of PYBMV (6). Thus, these studies failed to reveal any evidence indicating that common strains of PYBMV (6) are causal agents of peach stem pitting in the East.

Gall-like growth and enations, often associated with stem pitting in naturally infected peach trees, were reproduced in our transmission experiments. However, there was no correlation between the occurrence of gall-like growths and stem pitting in the indicator plants. Since the gall-like growths from the indicator plants reacted negatively for crown-gall, and since this symptom is similar to that of known virus diseases in other fruit tree species (18), the nature and potential value of this symptom in indexing for peach stem pitting should be investigated further.

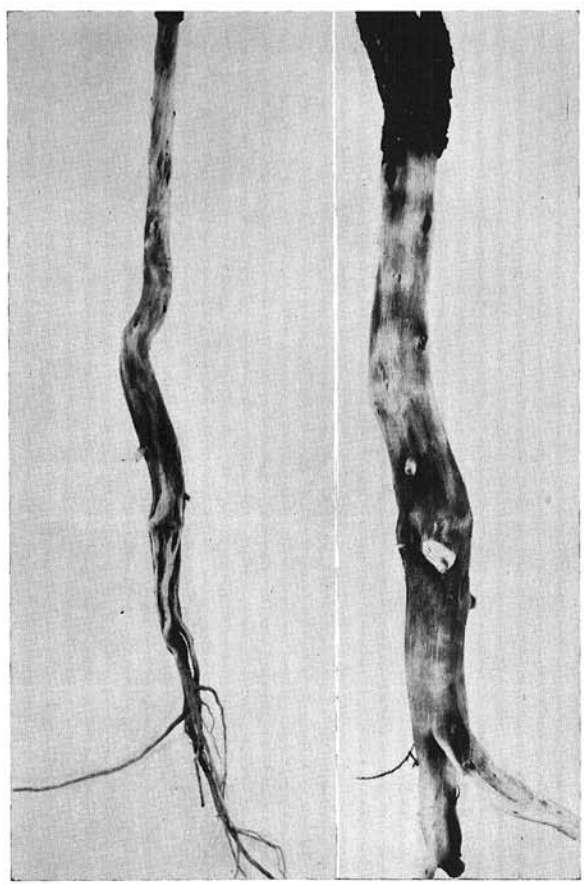

Fig. 5. Elberta peach seedlings inoculated in the nursery row with buds from naturally infected (left) and healthy (right) peach trees. Note grooving and pitting in the lower trunk of the seedling on the left.

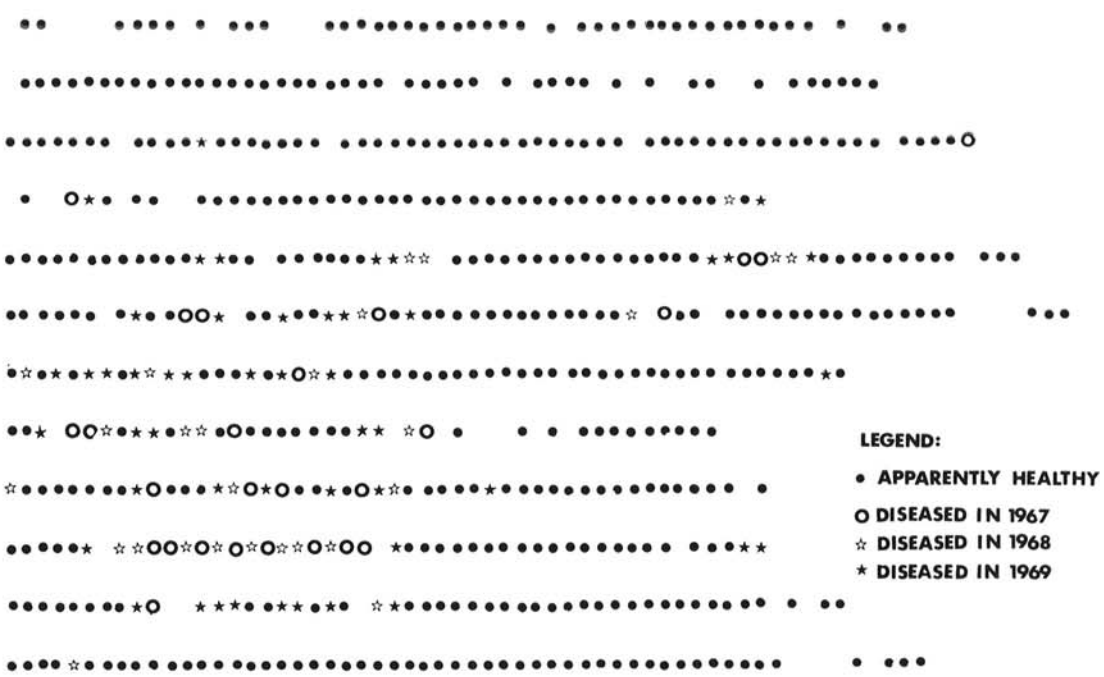

Fig. 6. Plan of seedling peach orchard showing natural spread of peach stem pitting.

Stem pitting in peach resembles that in other *Prunus* spp. (2, 9, 10, 13, 16). We do not know whether the stem pitting disease is caused by the same agent(s) in all *Prunus* spp. Lott (8) reported transmission of xylem aberration (a disease similar to peach stem pitting) to chokecherry, but no transmission to Italian Prune (*Prunus domestica*), Elberta peach, and Montmorency sour cherry (*Prunus cerasus*). Lott (8) considers xylem aberration to be different from twisted leaf and from ring pox of apricot, although occasionally he observed stem pitting in twisted leaf or apricot ring pox virus-infected trees. In our transmission tests, inoculation of apricot seedlings on Elberta peach rootstock resulted in severe pitting only in the peach rootstock, but no pitting in the apricot scion. Thus, stem pitting in apricot and peach may not be caused by the same agent(s).

Natural spread of peach stem pitting was demonstrated by annual surveys in the field. Newly infected trees are not randomly scattered in the orchard, but occur in clusters. The disease usually spreads from diseased to adjacent trees suggestive of underground spread and a soil-borne vector.

Since peach stem pitting spreads naturally in the field and is graft transmissible, control measures should include prompt removal of infected trees and use of propagation materials from healthy trees.

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