NATURAL ROOT GRAFTING IN CHERRY, AND SPREAD OF CHERRY TWISTED LEAF VIRUS[1]

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Abstract

Symptoms of the twisted leaf disease appeared in 4 uninoculated sweet cherry trees, closely interplanted with inoculated trees. This represented an exceptional rate of spread for twisted leaf virus. All trees were on mazzard seedling rootstocks. Exposure of the root systems disclosed numerous root grafts, providing union of xylem and phloem tissues,

Introduction

Natural root grafting of forest trees has received increasing attention during the past 12 years (1). Root grafting of fruit trees has been recorded (2) but has been much less intensively studied. Although movement of viruses from tree to tree through such unions is taken for granted by most Investigators of tree fruit virus diseases, there have been few published reports of the correlation of virus spread with the occurrence of root grafting,

Experimental transmission of phony peach virus by root grafting has been reported by Hutchins (5). McCrum (6) has experimentally transmitted apple mosaic and stem pitting viruses by grafting together in pairs the tap roots of dormant apple seedlings.

Natural root grafting has been reported by Hunter, Chamberlain and Atkinson (4) to be responsible for transmission of apple mosaic virus, and Hobart (3) has noted passage of necrotic ring spot, yellows, and prune dwarf viruses through intraspecific root grafts of *Prunus mahaleb*, *P. avium*, and *P. americana* seedlings, and also through interspecific root grafts among these.

There has been evidence of the spread of cherry twisted leaf virus through natural root grafts in experimental plots at Summerland.

History of the Test Trees

Twenty *Prunus avium* (mazzard) seedlings were planted in a nursery row in 1953, at spacings varying from 4 inches to 15 inches, In June, 1954, 16 of the trees were inoculated, by budding, with the virus of cherry twisted leaf. In November, 1955, 4 of the inoculated trees were killed by low temperatures, The surviving trees were numbered from 1 to 16. The gaps between

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Table 1. Occurrence of natural root grafting (self grafts and intraspecific grafts) in a row of cherry trees.

Tree Nos.	Spacing between trees (inches)	Number of grafts
1-1		0
1-2	6	6
2-2		1
2-3	15	0
3-3		2
3-4	28	0
4-4		0
4-5	24	0
5-5		0
5-6	12	3
6-6		0
6-7	8	1
7-7		0
7-8	15	0
8-8		0
8-9	15	0
9-9		1
* 9-10	4	2
10-10		0
10-11	10	0
11-11		0
11-12	12	0
12-12		1
* 12-13	4	3
13-13		0
13-14	12	0
14-14		0
* 14-15	12	1
15-15		0
15-16	12	1
16-16		0
10-13	26	1

*Unions between roots of inoculated and uninoculated trees.

them now ranged from 4 inches to 28 inches (Table 1). Twelve of the survivors were inoculated trees, and 4 trees, numbered 8, 10, 13 and 14, were uninoculated checks. All the 16 seedlings were budded to the variety Bing in September, 1955, and, where necessary, were re-budded to Bing in September, 1956.

Virus Spread

Twisted leaf symptoms were evident on most of the inoculated trees in 1956, and appeared on all inoculated trees in 1957. The uninoculated trees, 8, 10, 13 and 14, were symptomless in 1956. In 1957, tree 10 displayed severe twisted leaf symptoms, and tree 13 displayed mild twisted leaf symptoms, The other 2 uninoculated trees displayed no symptoms, In 1958, trees 10 and 13 displayed severe symptoms, and tree 8 had very mild twisted leaf symptoms. In 1959, trees 8, 10 and 13 displayed severe symptoms, and tree 14 displayed symptoms of moderate severity. Thus, within 5 years of the inoculation of neighbouring trees, all 4 of the uninoculated trees had become diseased as a result of natural spread.

Root Grafting

In June, 1961, a trench was dug parallel to the row of trees and water under high pressure was used to wash into this trench the soil surrounding the roots of the trees (Fig, 1). Careful examination revealed numerous root grafts, including self-grafting between roots of single trees, and intraspecific grafting among roots of neighbouring trees (Table 1).

Most of the observed grafts were among crowded roots, near their bases on the crown of the tree, but several were among relatively uncrowded roots at greater distances from the crowns. There were grafts between parallel roots (Fig. 2a) and between roots meeting at right angles (Fig. 2b) Grafting as a result of pressure was suggested by one graft of a small root within the fork of 2 larger roots (Fig, 2c). Several of the grafts were associated with galls (Fig. 2d).

Cross sectioning of root grafts demonstrated that unions of phloem and of xylem tissues had occurred (Fig. 3).

Roots of uninoculated trees 10, 13 and 14, had united with roots of inoculated trees by obvious root grafts, For tree 8 no such union was apparent.

Discussion

Natural root grafting among closely planted cherry trees has been demonstrated. The union of both xylem and phloem tissues in these root grafts indicates that a means of passage from tree to tree is provided for any virus that invades root tissues.

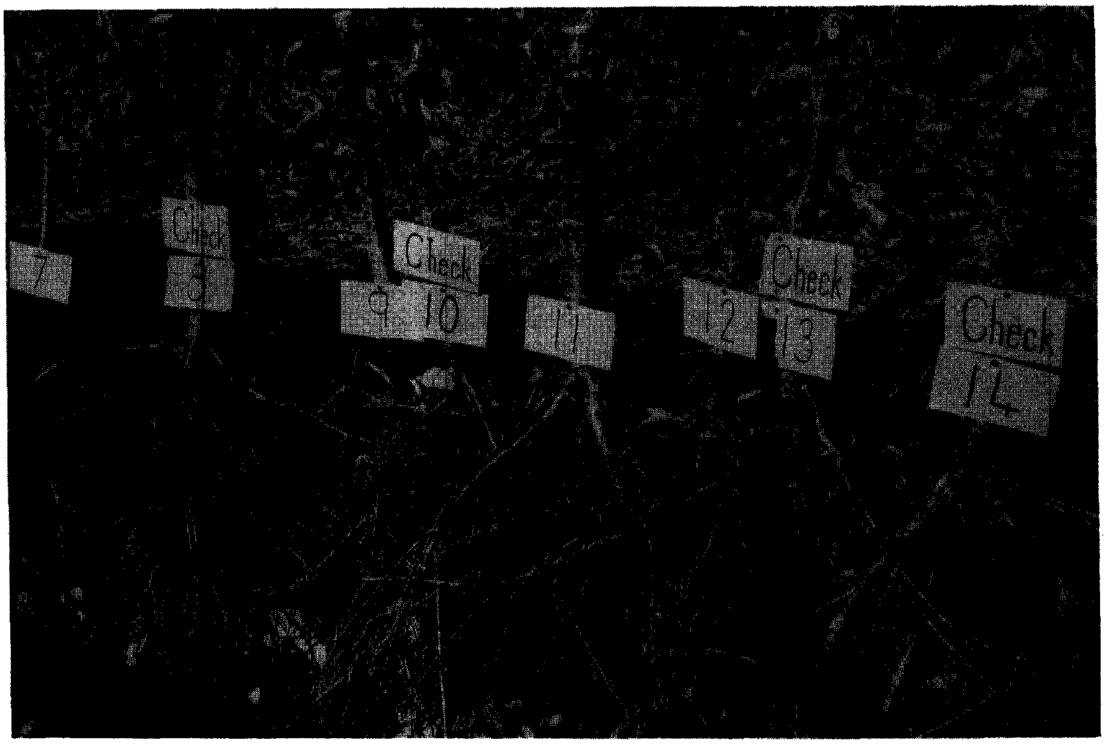


Figure 1. Cherry trees ~~in~~ situ following high-pressure washing of soil from roots.

The evidence supporting root transmission of the twisted leaf virus among these trees is strong. The experimental plantings among which they were growing have included many hundreds of cherry trees planted at various spacings. Among them have been trees inoculated with twisted leaf virus, inoculated with other viruses, and uninoculated trees. Natural spread of twisted leaf virus among them has been rare. Where it has occurred, it has been to trees adjacent to infected trees at spacings that would provide opportunity for natural root grafting. The recorded spread to all 4 of the uninoculated trees in the one row was an exceptional occurrence. The trees in this row were much more closely spaced than were any others in the orchard.

The method used to excavate the soil in the root zones did not allow examination of all possible sites of root grafting, Some root terminals were destroyed in digging the trench. The water pressure required to remove soil from the root systems was sufficient to damage weak graft unions and unions that had occurred among very small roots. Roots tended to break before their tips could be washed free. The absence of obvious root unions €or 1 of the 4 trees that became infected could be attributed to any of these factors.

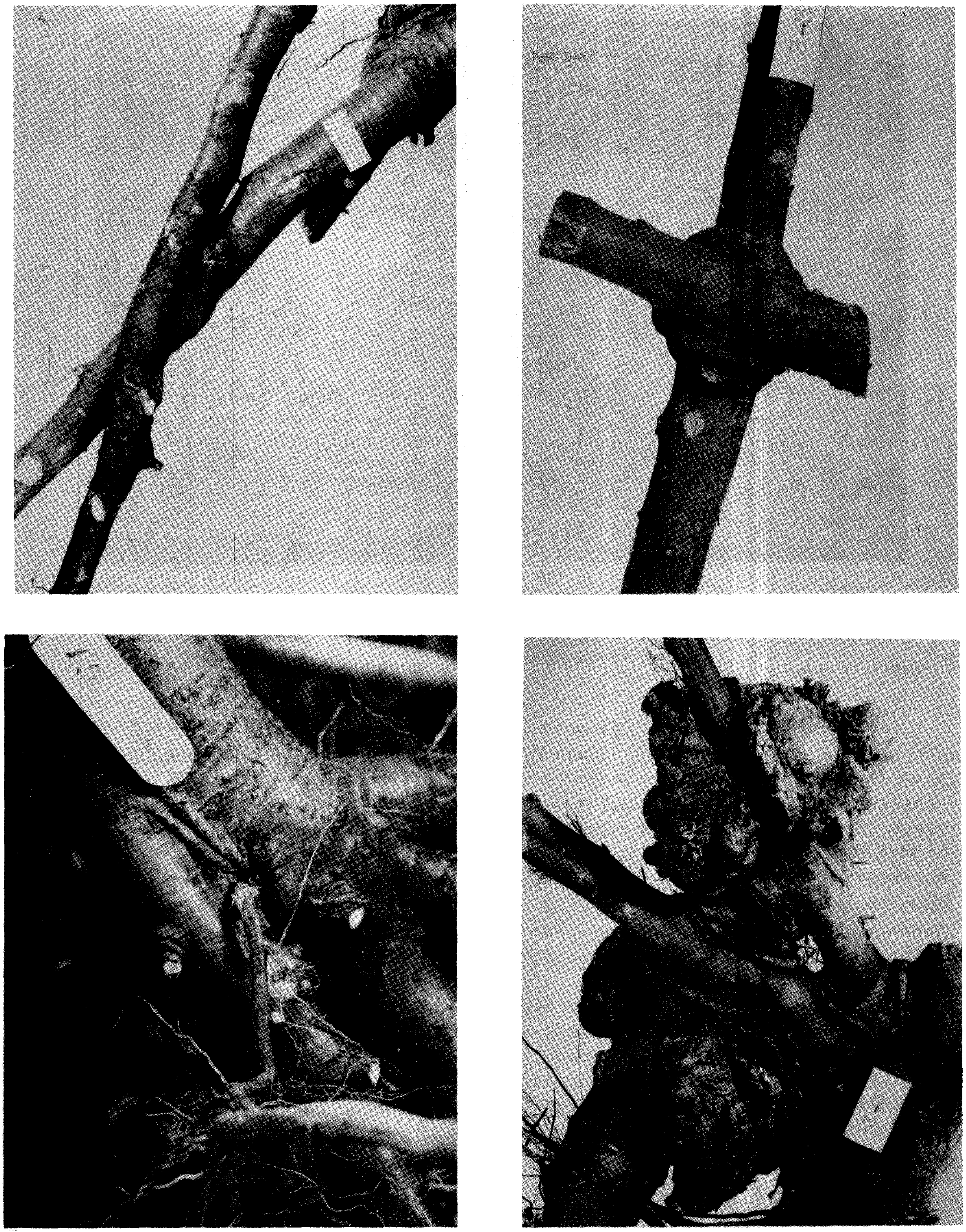
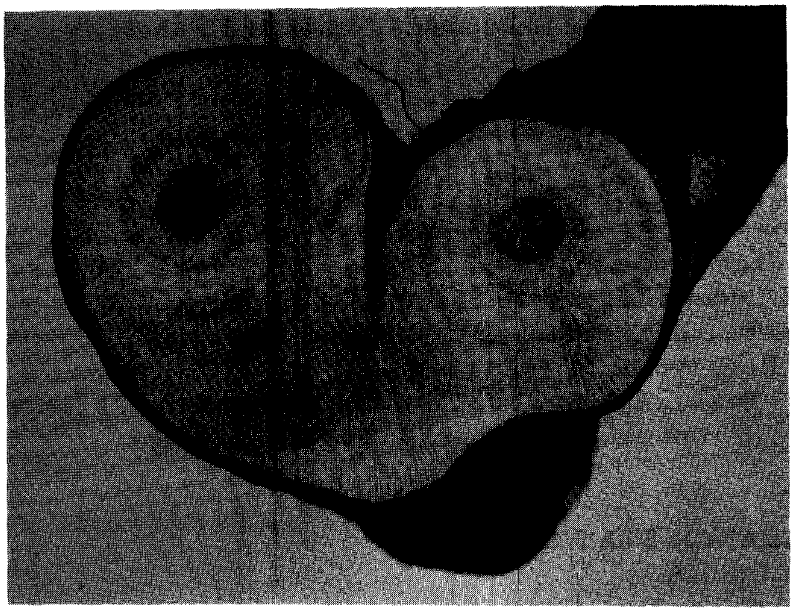
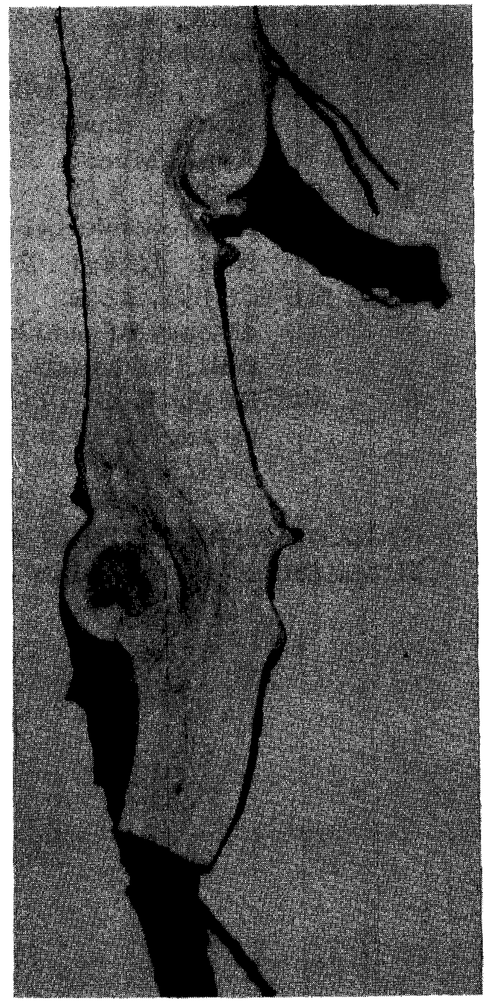


Figure 2. Natural grafting among mazzard cherry roots: (a) of parallel roots; (b) of roots meeting at right angles; (c) of a small root with larger roots between which it has been trapped; (d) associated with galls,





Fipure 3, Cross sections of natural grafts among mazzard cherry roots:
(a) between parallel roots;
(b) between roots meeting at right angles,

These data augment the experimental and observational evidence that is accumulating to substantiate the common assumption of tree fruit virus spread among neighbouring trees through root grafts.

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