

THERE HAS BEEN mounting evidence that pear decline is caused by a graft-transmissible agent. Transmission of an agent inducing pathological conditions in pear phloem identical to those associated with the disease, and which were believed to lead to the decline and death of trees was reported last year. About the same time, Washington scientists reported transmission of a factor which caused abnormal reddening of pear foliage prior to winter dormancy, also a symptom of pear decline. Thus, graft-transmissible factors were found to cause certain symptoms of decline, but it was not known until now that they are capable of killing pear trees.

Transmission studies, using young Bartlett trees on *Pyrus serotina* roots, were started in the summer of 1961. Buds from diseased orchard trees were grafted to each of 103 two-year-old test trees growing in an unscreened nursery near Davis. An equal number of trees were grafted with buds from healthy trees as controls. Buds were grafted to the stem of the test trees several inches above the graft union. At the time of inoculation, all trees were apparently healthy and had normal phloem at the graft union—as indicated by microscopic examination of bark samples, using the Schneider test.

Trees died

Approximately one year later, six of the inoculated trees wilted and died (see table). Of these, four had phloem necrosis at the graft union typical of pear decline, and characterized by the presence of replacement phloem, as shown in photomicrographs. Two trees died before samples of phloem were removed. None of the control trees died in 1962. However, the following year (two years after inoculation), two additional trees in the inoculated group and one control tree died.

The incidence of quick decline among inoculated trees in the nursery was significantly higher (5% level) than among the controls. This suggested that the agent which caused the trees to die was introduced by the buds taken from diseased orchard trees. However, the incidence of disease was too low to be convincing.

The inoculated nursery trees were used as sources of inoculum for a second transmission experiment under conditions of rigid insect control. Ten buds were removed from each of three inoculated nursery trees in 1962. These were grafted to 30 similar test trees growing in a screenhouse covered with 32-mesh Lumite. As controls, 10 buds were removed from

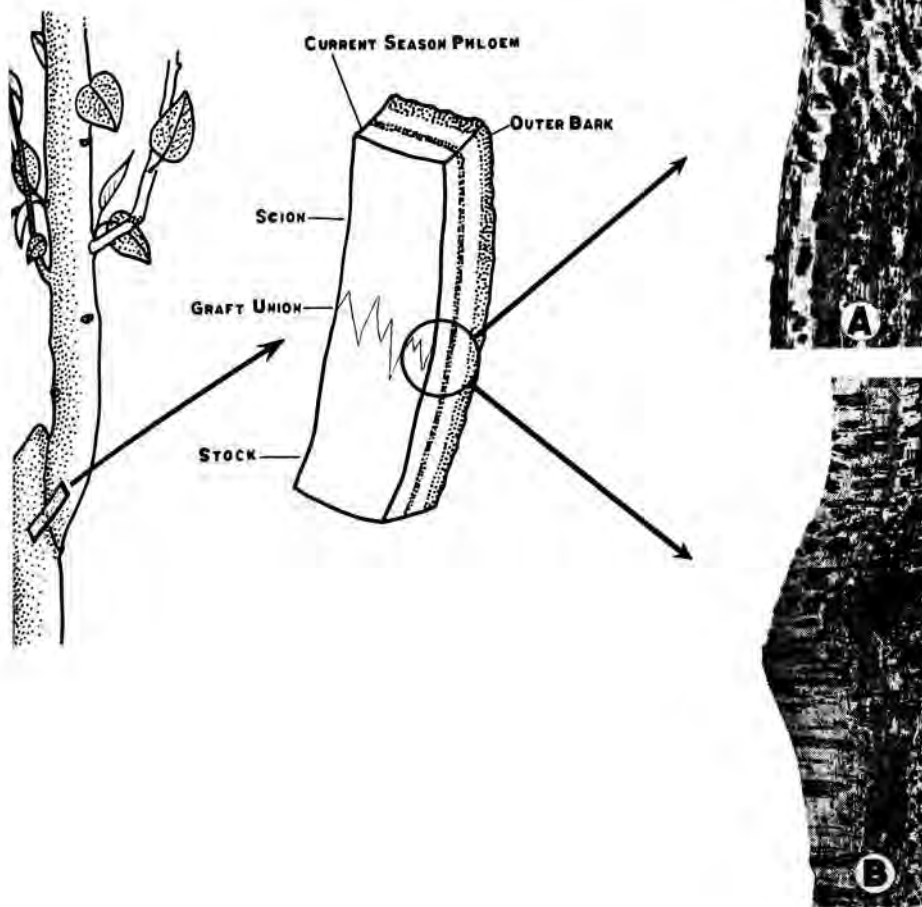
TRANSMISSION OF PEAR DECLINE BY GRAFTING

Graft transmission studies provide further evidence that quick decline pears is caused by a virus and that, under experimental conditions, it cause the disease in the absence of pear psylla.

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Two-year-old Bartlett pear trees on *P. serotina* roots used for the transmission experiment in screenhouse. (A) apparently healthy control; (B) inoculated tree in initial stage of wilting; (C) inoculated tree with typical symptoms of quick decline shown several weeks after the onset of wilting.



Photomicrographs of pear bark removed from the region of the graft union of young pear trees (Bartlett on *P. serotina* roots). (A) normal phloem; (B) necrotic phloem from a graft-inoculated tree showing the accumulation of replacement phloem at the graft union. The diagram to the left of the figure illustrates the part of the tree from which the bark sample was removed and the part of the sample shown in the micrographs (circle). Photomicrographs are shown at a magnification of 13X.

Furthermore, it seems that the transmitted factor multiplied in the test plants, because only a small amount of inoculum was used (one bud per test tree), and the causal factor apparently passed through the one series of test trees in the nursery to the second in the screenhouse. It is inconceivable that, under these conditions, any agent could survive in sufficient concentration to cause the disease, unless it multiplied in the test plants. Since no fungi or bacteria could be found to be consistently associated with the disease, it is concluded that the infectious factor was a virus.

Other recent University studies (see accompanying report) strongly indicate that, in nature, pear psylla (*Psylla pyricola*) transmits a virus which causes quick decline in pear trees. The results of our graft transmission studies provide further evidence that quick decline is caused by a virus and that, under experimental conditions, it can cause the disease in the absence of pear psylla. The disease developed in the screenhouse where frequent sampling failed to reveal this insect during the experiment.

The frequency with which the pear decline virus was transmitted by grafting was low in comparison to its transmission by pear psylla and to the degree with which most other plant viruses can be graft-transmitted. The reason is not clear, but it may be that the virus was rapidly inactivated in the detached buds used for inoculum. It may also have been unevenly distributed in the trees used as the source of inoculum, or inactivated by high summer temperatures or at the onset of symptoms. Any one or a combination of these conditions could account for the low frequency of transmission.

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each of three noninoculated trees in the nursery plot and were grafted to 30 additional test trees in the screenhouse.

During the following year (1963) 10 of the inoculated trees in the screenhouse wilted and died (see table and photos). Four of these had nonfunctional replacement phloem at the graft union. All of the control trees remained healthy in appearance and had normal phloem at the graft union as revealed by microscopic study. There was no apparent cause for the death of the trees except for the fact that they were grafted with buds from inoculated nursery trees. All of the trees which died in the screenhouse had been grafted with

buds from trees which developed symptoms of pear decline in the nursery plot. The difference, in this case, between the incidence of quick decline in the inoculated and control trees was highly significant.

Thus, in the two experiments, a total of 18 inoculated trees died compared with only one of the control trees. The one dead control tree had been growing under nonscreened conditions in the nursery plot for several years and may have been exposed to causal factors by natural spread. This provides strong evidence that the factor causing the quick decline was transmitted through the tissue grafts.

INCIDENCE OF QUICK DECLINE IN GRAFT-INOCULATED AND NONINOCULATED PEAR TREES (2 to 3-year-old Bartlett on *Pyrus serotina* roots)

Location	Treatment	Years after inoculation	Quick decline	
			No.	%
Nursery (nonscreened)	Inoculated	1	6/103	8*
		2	2/97	
		Total	8/103	
	Noninoculated	1	0/103	1
		2	1/103	
Total		1/103		
Screenhouse	Inoculated	1	10/30	33**
	Noninoculated	1	0/30	0

* Significance at 5% level

** Significance at 1% level