# Criteria For Determining Peach Variety Susceptibility to Cytospora Canker

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**ABSTRACT**

In evaluating some Harrow peach selections in the field for Cytospora (Valsa) canker resistance/susceptibility, natural infections were evaluated by 2 rating systems based on canker incidence over a 10-year period and on final tree condition, while cankers initiated by artificial inoculations were measured by linear extension and total area. None of the selections exhibited any *Cytospora* resistance under Colorado conditions. Correlations between inoculations and natural incidence were not significant. Caution is advised for relying solely on artifically induced cankers. Inoculation techniques are discussed. Further effort is needed to incorporate genetic resistance to Cytospora canker into new peach varieties.

**INTRODUCTION**

Cytospora or perennial canker of peaches (caused by the fungus *Cytospora leucostoma;* perfect stage = *Valsa leucostoma* or *Leucostoma persoonii*) is an important limiting factor in most northern climate peach production areas due to its association with winter injury. Nearly all peach varieties are susceptible to this fungus disease, possibly as a result of developing our varieties from a narrow genetic source (5). The ultimate control for Cytospora canker is genetic host resistance. Studies and comparisons have been reported from different fruit areas on peach tolerance or resistance to *Cytospora.* Varieties differ in their susceptibility, and these differences are further influenced by environmental factors, host physiology and pathogen virulnece. No real resistance has been identified in a commercially acceptable peach (2, 6, 9, 10, 11).

In determining peach tree susceptibility, researchers frequently utilize mycelial inoculum inserted under bark flaps or depend on natural canker incidence. In the latter case the number of active cankers per tree must be counted and recorded for at least 2 years. In Colorado we have generally used a crush-wound inoculation method, allowing *Cytospora* mycelium to penetrate through damaged external bark tissues rather than deeper implantation (9). Very few attempts are made using pycnidiospore inoculum because of the relative difficulty in producing spores, quantifying inoculum and providing optimum conditions for germination. However, one can artificially produce wounds on the tree and then allow natural inoculum (presumably spores) to infect these sites, although greater replication becomes necessary to insure a sufficient number of infections (7).

Evaluation of susceptibility ranges from rating visible symptoms of gummosis and bark necrosis to stripping away bark and measuring subsurface necrosis on the xylem (4, 9, 15). Subjective rating systems can be used to determine relative susceptibility using any number of intergrals from 0 to 10 or by employing more sophisticated weighted canker values (1, 6). Linear measurement of canker extension is used frequently. Determination of the total area discolored (necrosis) by fungal invasion can also be accomplished but takes more time and effort (14, 15). Due to the importance of peach Cytospora canker some standardized methodology for evaluating varieties is de-

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sirable and should be implemented by stone fruit researchers to better appraise trees for canker incidence and severity. This paper deals with our attempts to evaluate a number of Harrow peach varieties from the standpoint of canker susceptibility, using subjective ratings of natural incidence as well as measurements of inoculated limbs.

## MATERIALS AND METHODS

The Harrow variety/rootstock selections tested (see Table 1) were planted in April 1971 on the CSU Orchard Mesa Research Center, together with J. H. Hale in non-randomized complete blocks replicated 9 times in 4 rows of 27 trees each, planted 3.6 m × 4.9 m. All trees were examined once a year for canker incidence and general condition. Artificial inoculations were made upon tree limbs 3-4 cm in diameter in May 1977 (isolate 2114) and in June 1978 (isolate 2194) with virulent strains of *C. leucostma*. A 2 $cm^2$ area of the bark was wounded with a blunt tool and a 1 cm agar disc of mycelium was placed into the crush-wound. The site was wrapped with electrician's rubber tape, which breaks apart after several weeks exposure in the orchard. Gummosis was evident within 14 days after inoculation and canker development was measured after 1 year.

In the first set of inoculations, canker extension up and down the limb from the inoculation site was measured with a ruler after stripping off the bark to expose the farthest margins of the discolored area on the current season xylem. In the second set of inoculations, the total area of discoloration was exposed and the canker outline traced onto translucent paper. Canker area was determined by tracing the outline with a planimeter.

During the 10-year period each tree was rated annually for canker severity by visual symptoms such as gummosis and bark degeneration, taking into account the number, severity and location of natural canker incidence on each tree. A scale of 0-3 was used: 0 = none, 1 = light incidence, few cankers on small limbs, 2 = moderate, 1 or 2 cankers on main scaffolds or trunk, 3 = severe, numerous cankers on main structures. The accumulative ratings were finalized in 1980. Many of the trunk and limb cankers were the result of winter-injury infection sites (SW injury and crotch damage). In June 1980 a total tree condition rating was also made for each tree, considering winter injury, number and severity of cankers, and general tree vigor. These ratings were given a value of 1-10: 1 = excellent, 10 = dead or nearly dead.

## RESULTS AND DISCUSSION

A summary of evaluations of peach tree canker susceptibility is presented in Table 1, showing the average value of inoculation measurements and the rating systems. The 6th column is a subjective scoring of relative susceptibility based on the measurements and ratings. Peach selections that showed a very high incidence of Cytospora cankers under Colorado conditions include J. H. Hale, Canadian Harmony and H 719/R. Harbelle/R, H 593/R and H 2091/R were in the moderate or less severely susceptible group. All other selections were severely susceptible to natural infection. When inoculated, none of the selections exhibited any degree of immunity or resistance, i.e., they all produced gum at the inoculation site and necrotic lesions. The canker extension measurements from the 1977 inoculations showed no significant differences between the 12 selections, in spite of a spread of 22 mm differences. In the second set of inoculations differences in severity were apparent but the smallest average cankered area (H 593/R) was 72 $cm^2$, slightly over 11 sq. inches. This represents a substantial infection for 1 year.

Using the natural canker-severity ratings, Canadian Harmony/H ap-

**Table 1. Evaluation of Harrow peach variety susceptibility to Cytospora canker, using measurements of inoculated sites as well as canker incidence-severity and general tree-condition ratings.[1]**

| Variety/rootstock[2] | Canker[3] mm | Canker[4] cm[2] | Canker[5] rating | Tree[6] rating | Canker[7] suscept. |
|---|---|---|---|---|---|
| J. H. Hale/L | 63 a | 247 b | 2.1 abc | 7.3 c | +++ |
| Harbelle/H | 72 a | 139 ab | 2.0 abc | 3.9 ab | ++ |
| Harbelle/R | 53 a | 104 a | 1.5 abc | 3.9 ab | + |
| Can. Harmony/H | 60 a | 166 ab | 2.4 c | 4.4 abc | +++ |
| Can. Harmony/R | 59 a | 164 ab | 2.2 abc | 5.0 abc | +++ |
| H 593/H | 71 a | 157 ab | 1.8 abc | 3.2 ab | ++ |
| H 593/R | 58 a | 72 a | 1.4 ab | 2.7 a | + |
| H 416/R | 61 a | 86 a | 2.2 bc | 7.2 c | ++ |
| H 719/R | 52 a | 163 ab | 2.3 bc | 6.4 bc | +++ |
| Harbinger/R | 65 a | 109 a | 2.2 bc | 4.1 ab | ++ |
| H 2043/R | 58 a | 146 ab | 1.9 abc | 4.3 abc | ++ |
| H 2091/R | 50 a | 147 ab | 1.1 a | 4.0 ab | + |

[1]Values in the columns followed by the same letters are not significantly different---5% DMRT.
[2]H = Halford, L = Lovel, R = Rutgers Red Leaf.
[3]Canker extension measured in mm, average of 5 replications.
[4]Canker area measured as cm[2], average of 5 replications.
[5]Canker severity rating; 0—none, 3—very severe, average of 9 replications.
[6]Tree condition rating; 1—excellent, 10—dead, average of 9 replications.
[7]Susceptibility; + = moderate, ++ = severe, +++ = very severe.

pears to be the worst, with H 2091/R the best. In considering general tree condition, the tree-rating system suggests that of the 12 selections, H 593/R is the most desirable while the second best group included H 593/H, Harbelle (both rootstocks), H 2091/R and Harbinger/R. The greatset damage was observed in H 416/R and J. H. Hale.

No winter hardiness tests were made on these trees. Considerable cold injury occurred in this block during the first 2 winters. Thereafter low temperature injury consisted mainly of South-southwest scald-type injury and one winter with damage to foliar buds and 1-year-old wood (Dec. 1978). The naturally occurring cankers perhaps are a reflection of winter-injury susceptibility, especially of the tree scaffold system.

Correlation coefficients, both linear and parabolic, were determined on combinations of the rating systems and measurement techniques as variables. Table 2 presents the parabolic correlation coefficients. The only significant correlation was between the 2 rating systems, canker severity and tree condition. At a significance level of 13% there appears to be a relationship between the canker-extension and canker-area data, from the inoculation tests. The cankered area data seem to correspond closer to the natural canker incidence ratings (at 15% sign.) than do the canker extension measurements. There is no clear statistical relationship between naturally-occurring canker severity and the inoculation data.

The general conclusion of this study is that among the peach selections tested we still do not have genetic resistance to Cytospora peach canker, and that data obtained through artificial inoculations do not necessarily have a direct relationship with ratings based on natural canker incidence. Therefore, to depend solely on inoculation measurements without exposing peach trees to field conditions provides only a partial answer to varietal susceptibility and not enough of a

**Table 2. Correlation coefficients (parabolic) determined from the combination of rating systems and measurement techniques in comparing Cytospora canker severity in 12 peach selections.**

| Variables | Coefficient of correlation (r) | Level of significance |
|---|---|---|
| Canker Extension × Canker Rating | 0.11 | 0.38 |
| Canker Extension × Canker Area | 0.61 | 0.13 |
| Canker Extension × Tree Rating | 0.20 | 0.30 |
| Canker Area × Canker Rating | 0.59 | 0.15 |
| Canker Area × Tree Rating | 0.14 | 0.57 |
| Canker Rating × Tree Rating | 0.71 | 0.000001 |

basis for making grower recommendations. Both of the rating systems used seem to provide a suitable spread of values. The measurement of total canker area rather than only linear extension provides a better basis for determining differences in this study as well as in previous work (14, 15).

## Literature Cited


1. Bertrand, P. F. 1978. Evaluation of Cytospora canker severity in French prunes. Chap 20 *in* Methods for evaluating plant fungicides, nematocides, and bactericides. *Amer. Phytopath. Soc.* p. 59-61.
2. Gairola, C. and Dwight Powell. 1970. Cytospora peach canker in Illinois. *Pl. Dis. Reptr.* 54:832-835.
3. Jones, A. C. and N. S. Luepschen. 1971. Seasonal development of Cytospora canker on peach in Colorado. *Pl. Dis. Reptr.* 55:314-317.
4. Keil, H. L. 1976. Inoculation technique for evaluating Valsa canker resistance in stone fruits. *Fruit Var. Jour.* 30(1): 16.
5. Layne, R. E. C. 1975. New developments in peach varieties and rootstocks. *Compact Fruit Tree* 8:69-77.
6. Layne, R. E. C. 1976. Influence of peach seedling rootstocks on perennial canker of peach. *HortScience* 11:509-511.
7. Luepschen, N. S. 1978. Mertect 340-F as a wound protectant against Cytospora canker on peaches. *C.S.U. Expt. Sta. Prog. Rept.* 78-25, 2 pp.
8. Luepschen, N. S., J. E. Hetherington, F. J. Stahl and K. E. Mower. 1979. Cytospora canker of peach trees in Colorado: Survey of incidence, canker location and apparent infection courts. *Plant Dis. Reptr.* 63:685-687.
9. Luepschen, N. S., K. G. Rohrbach, A. C. Jones and L. E. Dickens. 1975. Susceptibility of peach cultivars to Cytospora canker under Colorado orchard condiitons. *HortScience* 10:76-77.
10. Palimiter, D. H. and K. D. Hickey. 1970. Relative resistance of 26 peach cultivars to bacterial spot and Valsa canker. *Pl. Dis. Reptr.* 54:395-399.
11. Ritter, C. M. and D. H. Petersen 1971. Peach varieties for the seventies. *Penn. Fruit Notes, Penn. State Univ. Ext. Ser. Leaflet,* 6 pp.
12. Rohrbach, K. G. and N. S. Luepschen. 1968. Environmental and nutritional factors affecting pycnidiospore germination of *Cytospora leucostoma. Phytopath* 58:1134-1138.
13. Rohrbach, K. G. and N. S. Luepschen. 1968. Seasonal changes in sugar alcohols and sugars in peach bark: a possible relationship to Cytospora canker susceptibility. *Proc. Am. Soc. Hort. Sci.* 93:135-140.
14. Smiley, E. T., N. S. Luepschen and L. Newby. 1979. Trichoderma as a biological control for Cytospora canker. *C.S.U. Expt. Sta. Prog. Rept.* 79-12, 2 pp.
15. Wysong, D. S. and L. E. Dickens. 1962. Variation in virulence of *Valsa leucostoma. Pl. Dis. Reptr.* 46:274-276.