Canindex 1, a Superior Indicator Cultivar for Little Cherry Disease

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ABSTRACT

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In a search for a better indicator of little cherry (LC) disease, symptom development (early red foliage coloration) was evaluated on 2,000 bud-inoculated sweet cherry seedlings. One promising seedling was selected, freed of LC by thermotherapy, and cloned. Preliminary comparative tests in British Columbia have shown that LC-inoculated trees of this seedling developed earlier red leaf coloration than the standard indicator cultivars Deacon and Sam. The new indicator also facilitated clear distinction between healthy and LC-infected source trees because uninoculated control trees of the new indicator cultivar retained green foliage until just before leaf drop in late October, whereas healthy Sam control trees began to show red foliage in late September. The name Canindex 1 is proposed for the new indicator cultivar. To establish the usefulness of Canindex 1 as an LC indicator under other environmental conditions, tests in other geographic areas are recommended.

Little cherry (LC) is a poorly understood, graft-transmissible, viruslike disease of sweet cherries (*Prunus avium* L.) that occurs in several parts of the world (4). Patterns of field spread suggest that the LC agent is vectored by insects (*unpublished*), and the apple mealy bug (*Phenacoccus aceris* Sig.) has recently been implicated as a vector (6). Sporadic but locally devastating epidemics of LC have been documented in the Kootenay and Okanagan valleys of British Columbia in the 1940s and 1980s, respectively (3). The disease is generally recognized by two major symptoms: small, tasteless, and poorly colored fruits during the last 10 days before harvest and premature red leaf coloration displayed by some sweet cherry cultivars in the fall (2,5). Control efforts based on eradication of known infected trees combined with insecticidal sprays have been partially successful (3,6).

Success of the eradication program depends on early and accurate identification of LC-infected source trees. Field identification of LC-infected trees is complicated by such factors as zinc deficiency, winter injury, oversetting, and drought, which can induce similar fruit and leaf symptoms. Furthermore, partial amelioration of symptoms occurs in several cultivars about 3 yr after the initial infection. Even after 10 yr of annual field surveys, inspectors find it impossible to definitely decide the LC status of about 10% of the suspected field trees found each year (J. Yorston, *personal communication*).

Graft-indexing on sensitive sweet cherry cultivars has been used routinely to confirm the results of field observations and to decide the status of suspected field trees. Source trees are assumed to be LC-infected if bud or graft transmission induces early red leaf coloration on Sam or small fruits on Lambert (5). Of the two indicators, Sam has been used more frequently because the premature leaf coloration generally occurs within 1 yr after fall budding of LC-infected plant material on 1- or 2-yr-old trees, whereas reliable fruit symptoms can be obtained only on bearing 4- to 5-yr-old trees.

Although Sam has been used as an indicator in British Columbia for the last 15 yr, it has two major disadvantages. First, the diagnostic disease symptoms are expressed only in late fall of the year following bud transmission. During this incubation period, the suspected field tree has been a possible source of inoculum for a full growth season. Second, uninoculated Sam control trees also display bright red color in the fall, about 3–5 wk after inoculated trees. Visual observations have to be repeated and timed precisely to distinguish clearly between LC-induced and normal fall leaf coloration. This paper describes a new indicator cultivar that was developed to overcome these two flaws of the Sam indexing system.

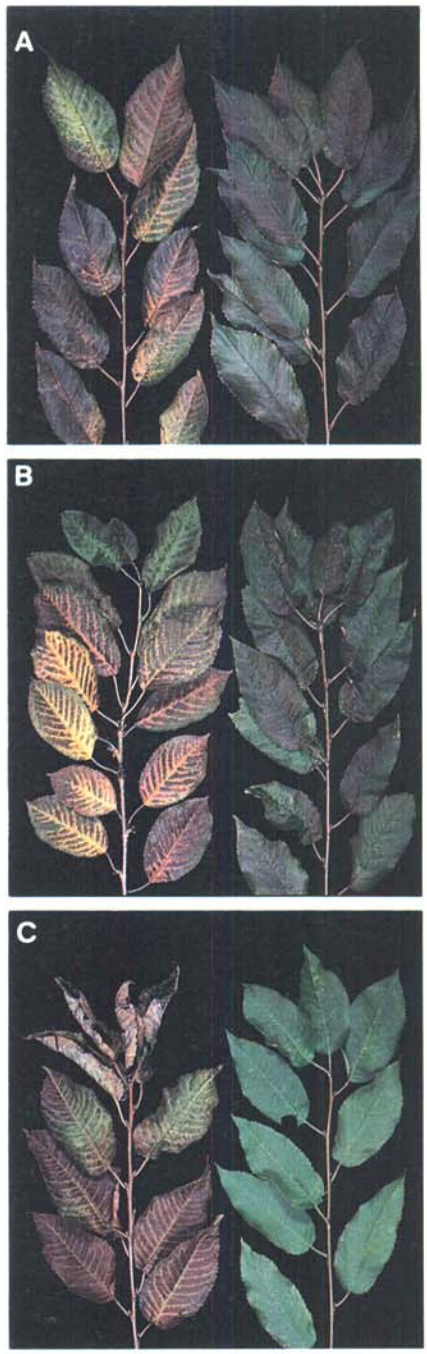

Fig. 1. (Left) Little cherry-infected and (right) healthy control branches of **(A)** Sam, **(B)** Deacon, and **(C)** Canindex 1 in early October 1983.

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MATERIALS AND METHODS

In 1962, a 2,000-tree orchard of self-rooted seedlings was established in the Creston Valley of British Columbia by C. Lapins, J. M. Wilks, and M. F. Welsh, Agriculture Canada Research Station, Summerland, BC. The seedlings had been obtained predominantly from crosses of Napoleon and several dark-fruited commercial sweet cherry cultivars, especially Van, Bing, and Lambert. In 1963, all seedlings were inoculated with buds from LC-infected trees that had become infected through natural means in Creston, BC. From 1964 until 1968, these seedlings were observed for early leaf coloration and one seedling was selected as a potential LC indicator.

Budwood from the potential indicator, named Canindex 1, was forwarded in 1969 to the Plant Quarantine Station at Sidney, BC, for thermotherapy. Budwood free of known viruses and viruslike agents was obtained from the Plant Quarantine Station in 1978 and multiplied on virus-free F12/1 rootstocks at Summerland. Groups of nine virus-free trees of Canindex 1 and Sam and a clone of Deacon were planted in nursery rows. The latter clone is a selection from Wenatchee, WA, where it is used as the standard LC indicator (L. Parish, *personal communication*). In August 1981, six trees in each group were inoculated with four buds from a local field source of LC that was free of other viruses and viruslike agents; three trees per group were left uninoculated and served as healthy controls. In 1982, leaf coloration data were taken in early and late July, and in 1983, detailed visual observations were made of date of first color appearance, leaf color intensity, and color distribution.

RESULTS AND DISCUSSION

During 1982, the first year of observation, all foliage on the three indicator cultivars remained green until mid-July. By 28 July, mild reddening (erythrite red to carmine red on the Royal Horticultural Society color index [1]) had appeared on 65% of the leaves of the inoculated Canindex 1 trees and on 20% of the Deacon foliage, whereas all Sam trees had remained green (Table 1). No further data were taken during 1982.

In 1983, the first coloration was observed on Canindex 1 on 8 June; both other cultivars were still green at this time. By 4 July, when the first color was detectable on about 25% of the leaves of infected Deacon and Sam trees, the intensity of leaf reddening and the percentage of affected leaves on Canindex 1 had increased to the point where they could be used as definite criteria for positive identification of LC infection. By the end of the growing season, 18 October, 90% of all leaves on the infected trees of the three cultivars showed a deep reddening.

Positive identification of infected indicator trees depends not only on the date and absolute degree of leaf coloration but also on the relative difference between infected and healthy trees. Virtually all leaves on the uninfected Deacon and Canindex 1 remained green until 1 wk before leaf drop, which permitted a clear differentiation between healthy and infected trees. By the time infected Sam trees showed good coloration (18 October), the healthy Sam trees had also begun to show normal red fall colors, to the point where it was difficult to distinguish with certainty between infected and healthy trees. Unrecorded observations and previous experience with Sam trees have shown, however, that there usually is a period of about 4 wk in late September/early October when the difference between healthy and infected material is sufficiently clear to allow identification of infected trees (4,5).

Differences in types of leaf coloring were less marked than differences in color intensity or date of first color appearance (Table 1); however, there was a marked clearing of the secondary veins in the inoculated but not in the healthy trees of all three cultivars. This was most pronounced in Sam and Deacon trees where all veins were yellow, giving the leaves an overall appearance of almost orange; in infected Canindex 1, the veins tended to be greenish instead of yellow (Fig. 1).

In all three cultivars, leaf color in infected trees was most intense on branches and shoots exposed to full sunlight and on leaves growing on current-season shoots rather than on older wood.

Further trials have been initiated to compare the reactions of the three LC indicators to other viruses and viruslike agents, to a wider range of LC isolates, and under screenhouse indexing conditions. Preliminary results have shown that symptoms induced by the common Prunus necrotic ringspot virus clearly differ from those induced by LC disease.

Although available data indicate that Canindex 1 is superior under British Columbia conditions to both Sam and Deacon, further tests in other locations are needed before a decision on its universal usefulness can be made. Limited amounts of healthy indexed budwood are available from the Quarantine Section of the Saanichton Research and Plant Quarantine Station, 8801 East Saanich Road, Sidney, BC.

Table 1. Red leaf coloration[a] and little cherry (LC) rating[b] of three sweet cherry cultivars in response to infection with little cherry agent

	Sam		Deacon		Canindex 1	
Date	**Infected**	**Healthy**	**Infected**	**Healthy**	**Infected**	**Healthy**
Color, 1982						
5 July	0	0	0	0	0	0
28 July	0	0	20% ery-carm	0	65% ery-carm	0
Color, 1983						
7 and 8 June	0	0	0	0	10% carm	0
4 July	24% ery-carm	0	25% ery-carm	0	75% ery-carm	0
2 September	30% ery-carm + garn spots	0	55% card	0	95% card	0
18 October	65% card-ox, 25% ox-garn, 10% 0	65% card, 25% ox, 10% 0	90% card-ox, 10% 0	7% garn, 93% 0	85% card-ox, 15% ox-garn	5% garn, 95% 0
LC rating, 1982						
5 July	0	0	0	0	0	0
28 July	0	0	6	0	19.5	0
LC rating, 1983						
7 and 8 June	0	0	0	0	4	0
4 July	7	0	8	0	23	0
2 September	9	0	33	0	57	0
18 October	68	59	63	7	73	5

[a] Average percentage of leaves showing color on all infected trees. Color rating is according to Royal Horticultural Society color index (RHSCI) (1), where card = cardinal red, RHSCI 822/1; carm = carmine red, RHSCI 21; ery = erythrite red, RHSCI 0027; garn = garnet brown, RHSCI 00918; oxbl = oxblood red, 00823/2; and 0 = normal lettuce-green leaf color, RHSCI 861.

[b] LC rating represents the product of the percentage of leaves affected divided by 10 and multiplied by numerical color rating as follows: ery = 2, carm = 4, card = 6, oxbl = 8, and garn = 10.

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