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Red Raspberry Clones Resistant to Root Rot[1]

BRUCE H. BARRITT, P. C. CRANDALL, AND P. R. BRISTOW[2]

Barritt, et al. (1) screened 41 clones of red raspberry for resistance to a root rot incited by *Phytophthora erythroseptica* (2) which is one cause of decline in red raspberry plantings in the Pacific Northwest. This report is an extension of that study and describes the level of resistance of 43 clones, 32 of which have not been studied previously.

In May, 1977, a planting of 99 clones was established in a field with a long history of this particular root rot at the Southwestern Washington Research Unit, Vancouver. Of the 99 clones evaluated, 56 were susceptible Washington State University (WSU) breeding lines and are not included in this summary.

Each hill was evaluated in September, 1979, for disease symptoms and plant growth characteristics. Data for four traits are reported:

1. Root rot rating on a 0-9 scale with 0 being no primocane wilting symptoms and 9 being death of all canes in the hill. Intermediate ratings were based on the proportion of primocanes showing wilting symptoms.
2. Percent infection is the precentage of hills with a root rot rating of 1 or more.
3. Cane number per hill was rated on a 0-9 scale with 9 being the greatest number of canes.
4. Cane height was rated on a 0-9 scale with 9 being the tallest.

The Sumner cultivar was found to have a moderate level of resistance to root rot (1) and, although adapted to the Pacific Northwest, it is not widely

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[2]Horticulturist, Western Washington Research and Extension Center, Puyallup, Horticulturist, Southwestern Washington Research Unit, Vancouver; and Assistant Plant Pathologist, Western Washington Research and Extension Center, Puyallup, 98665.

Table 1. Mean root rot injury ratings, percent of hills showing symptoms, and subjective ratings for cane number and height for 43 red raspberry clones.

Clone[1]	No. hills	Root rot rating[2,5]	Percent infection	Cane no. rating[3,5]	Cane height rating[4,5]
WSU 585	10	0 a	0	9.0 a	8.3 ab
Cherokee	12	0 a	0	9.0 a	8.8 ab
Sunrise	11	0.1 a	9	9.0 a	7.3 abc
MN 640	11	0.1 a	9	8.0 abc	6.5 abc
Durham*[6]	11	0.1 a	9	9.0 a	8.3 ab
Pathfinder	10	0.1 a	10	6.8 bcde	3.6 def
Latham*	10	0.1 a	10	8.9 ab	9.0 a
WSU 621	6	0.2 a	17	9.0 ab	8.8 ab
SWRU 7	12	0.3 a	17	9.0 a	7.5 ab
Newburgh*	10	0.4 a	30	8.7 ab	8.8 ab
WSU 586	12	0.4 a	17	8.6 ab	8.6 ab
WSU 622	7	0.4 a	29	9.0 ab	9.0 ab
Sumner*	11	0.5 a	27	9.0 a	8.4 ab
WSU 458*	12	0.5 a	50	9.0 a	8.3 ab
Augustred	8	1.1 ab	13	6.8 bcde	4.8 cde
Canby*	11	1.2 ab	55	7.3 abcd	8.3 ab
Willamette*	10	1.3 ab	60	6.2 cde	7.1 abc
Nootka	12	1.3 ab	83	8.6 ab	7.7 ab
Newman	10	1.5 abc	70	7.4 abcd	8.0 ab
Heritage	11	1.8 abcd	46	7.6 abc	7.8 ab
Meeker*	10	2.0 abcd	60	6.4 cde	7.7 ab
Puyallup*	12	2.4 abcd	58	5.1 ef	5.3 cd
WSU 460*	10	2.5 abcde	50	5.5 def	6.5 abc
Trailblazer	13	3.6 bcdef	54	3.9 fg	3.1 efg
M. Exploit	6	3.7 bcdefg	67	4.8 efg	6.5 abc
M. Promise	11	4.0 cdefg	91	2.9 gh	6.4 bc
Milton	12	4.2 defgh	75	4.9 ef	7.2 abc
M. Admiral	11	4.8 efghi	82	3.1 gh	5.1 cde
M. Enterprise	10	5.8 fghij	70	1.9 hi	3.2 defg
Zeva	10	6.3 ghijk	70	1.7 hi	2.0 fgh
SHRI 6820/35	10	6.5 hijk	90	0.8 i	1.9 fgh
M. Orion	11	6.7 ijk	82	1.7 hi	3.1 defg
Skeena	11	6.8 ijk	91	0.6 i	1.7 fgh
Pocahontas	11	6.9 ijk	91	1.6 hi	2.0 fgh
SHRI 705/32	10	7.3 ijk	90	1.1 hi	1.8 fgh
Gradina	11	7.8 jk	91	0.1 i	0.8 gh
M. Leo	11	7.9 jk	91	0.2 i	1.6 fgh
Krupna dvoroda	10	8.1 jk	90	0.3 i	0.6 h
Glen Esk*	10	8.1 jk	90	0.2 i	0.9 gh
SHRI 6820/54	11	8.2 jk	91	0.5 i	0.8 gh
SHRI 6820/64	10	9.0 k	100	0 i	0 h
M. Delight	10	9.0 k	100	0 i	0 h
Glen Isla	10	9.0 k	100	0 i	0 h

[1]WSU, MN, SWRU and SHRI refer to selections made at the Western Washington Research and Extension Center, the University of Minnesota, the Southwestern Washington Research Unit and the Scottish Horticultural Research Institute, respectively.
[2]0-9 rating scale, 0 = no symptoms, 9 = death of hill.
[3]0-9 rating scale, 0 = very few canes, 9 = many canes.
[4]0-9 rating scale, 0 = very short canes, 9 = very tall canes.
[5]Mean separation by Duncan's multiple range test, 5% level.
[6]* = Clones in common with previous study (1).

grown. It has many desirable traits and is considered the standard for root rot resistance that must be surpassed. In this study the following 12 clones were at least as resistant as Sumner: Cherokee, WSU 585, Durham, MN 640, Sunrise, Latham, Pathfinder, WSU 621, SWRU 7, Newburgh, WSU 586, and WSU 622 (Table 1). Each of these resistant clones had a root rot rating of less than 0.5 and a percent infection of 30% or less. All of them had many tall canes with ratings of 7 or greater, except for MN 640 and Pathfinder, two primocane fruiting clones, which bear fruit on the tips of their canes rather than producing extension growth.

The four measurement variables were correlated for all 99 clones as follows:

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Root rot rating vs. percent infection	0.835
Root rot rating vs. cane number rating	−0.947
Root rot rating vs. cane height rating	−0.936
Percent infection vs. cane number rating	−0.751
Percent infection vs. cane height rating	−0.708
Cane number rating vs. cane height rating	0.916

All correlation coefficients were significant at the 1% level. The very high correlation coefficients obtained for the associations of root rot rating and both cane number and cane height suggest that all three variables would be equally satisfactory as criteria for selecting resistant clones. However, cane height estimates for the shorter canes found on early ripening primocane fruiting clones such as Pathfinder, Augustred and MN 640 do not accurately estimate resistance.

Each resistant clone found in this study has one of three resistant clones, Latham, Newburgh or Taylor, or a combination of these in its ancestry. WSU 585, Sunrise, WSU 621, and SWRU 7 all have Latham as their female parent. WSU 622 has Newburgh as a parent, and Cherokee has both Newburgh and Taylor as grandparents. Durham has Taylor as a parent. The ancestry of Pathfinder includes Augustred which has Durham in its background, as well as wild *Rubus strigosis*. The only clone with a high level of resistance in this study which does not have known resistant ancestry is WSU 586, a Meeker selfed seedling. A possible explanation for its resistance is transgressive inheritance.

The ranking of clones common to this study and our earlier report (Barritt, et al., 1979) was in close agreement.

Most clones proved to be very susceptible to root rot, having either injury ratings of greater than 2, infection percentages of greater than 60, or cane number and height ratings of less than 7. The extremely susceptible group included the East Malling cultivars Delight, Leo, Orion, Enterprise, Admiral, Promise and Exploit and the Scottish Horticultural Research Institute (SHRI) clones Glen Isla, 6820/64, 6820/54, Glen Esk, 705/32, and 6820/35. It is unfortunate that the genes for resistance are not present in these clones, as United Kingdom breeders have incorporated high productivity, large fruit size and fruit firmness into their clones.

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