‘Chemainus’ Red Raspberry

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‘Chemainus’ (Fig. 1) is a new floricanefruiting red raspberry (*Rubus idaeus* L.) cultivar from the breeding program at the Pacific Agri-Food Research Center (PARC) of Agriculture and Agri-Food Canada (AAFC), Agassiz, B.C. ‘Chemainus’ produces a high yield of large, firm fruit suited to machine harvesting. It is adapted to both processing and fresh markets. It is resistant to the common biotype of the North American raspberry aphid, *Amphorophora agathonica* Hottes, a vector of the raspberry mosaic virus (RMV) complex. It is recommended as a potential replacement for ‘Meeker’ because it has higher yields of larger fruit, is slower to show symptoms of RBDV, machine harvests well, produces high-quality fruit suited for IQF, and may convey some resistance to raspberry root rot. ‘Chemainus’ is the name of a popular tourist town on Vancouver Island. The choice of the name follows the tradition of naming PARC berry cultivars with B.C. First Nations names. The name translates as “bitten breast,” which describes the shape of the bay on which the town is situated.

Origin

‘Chemainus’, tested as BC 89–33–84, was selected by H.A. Daubeney from a 1989 cross of BC 82–5–84 x ‘Tulameen’ (Fig. 2). BC 82–

5–84 was selected from a cross of ‘Algonquin’ and ‘Chilliwack’. ‘Algonquin’ is relatively cold hardy and is homozygous for gene Ag1, which confers resistance to the common biotype of *A. agathonica*, the aphid vector of RMV (Daubeney and Anderson, 1993). ‘Chilliwack’ was selected from a cross between BC 64–10–198 and ‘Skeena’. BC 64–10–198 was selected from a cross of ‘Sumner’ and ‘Carnival’; ‘Sumner’ has moderate resistance to raspberry root rot and may be a source of root rot resistance in ‘Chemainus’. The other parent, ‘Tulameen’, was released from the PARC program in 1989 and was chosen as a parent because of its large fruit size and high fruit quality (Daubeney and Anderson, 1991).

Performance and Description

Performance data for ‘Chemainus’ and several other Pacific Northwest (PNW) cultivars, including ‘Meeker’, which is widely planted for processing, and ‘Tulameen’, which is currently the world’s leading fresh market cultivar (Kempler and Daubeney, 2006), were obtained from replicated plantings established in 1996, 1999, and 2000 at PARC’s Substation in Abbotsford, B.C. (Tables 1 and 2). The plantings were evaluated for 3 years each. Each planting

was arranged in a randomized complete-block design with a cultivar represented in three replicate plots of three plants each with 0.9 m between plants and 3 m between rows. Yield, fruit weight, fruit firmness, dates of harvest, and postharvest fruit rot (caused primarily by *Botrytis cinerea* Pers. ex. Fr.) were measured each season from 1999 to 2004. Soluble solids concentration (SSC), firmness, titratable acidity, and postharvest fruit rot tests were determined according to Barritt et al. (1980) and Daubeney and Pepin (1974). Fruits were harvested from nine to 14 times a season depending on the duration of a cultivar’s harvest period and environmental conditions. The average fruit weight for the season was calculated from the weight of a randomly selected 50-fruit sample from each plot at each harvest and adjusted for the yield of each harvest. The fruit-ripening season was characterized by the dates at which 5%, 50%, and 95% total harvest fruit weight were reached (Table 2). Fruit firmness was measured as the force required to close the opening of the fruit with a push-pull spring gauge (Hunter Spring Mechanical Force Gauge Series L; Ametek, Hatfield, Pa.) and was calculated on a randomly selected subsample of 10 fruit three to five times each harvest season. Fruit samples were frozen; a thawed subsample was used to determine pH and titratable acidity (as a percentage of citric acid). ‘Chemainus’ was also evaluated at Mt. Vernon and Puyallup, Wash., Aurora, Ore., and in grower fields in British Columbia, Wash., and Ore.

Yield was the only variable in which there was a significant interaction of cultivar x planting year x harvest year ($P = 0.001$), and hence data are presented for each planting year (Table 1). For the other variables, means of all harvest years are presented for each cultivar (Tables 2 and 3). ‘Chemainus’ yielded significantly more than ‘Meeker’ in five of nine planting x harvest year combinations, but yields were not significantly different in the other four combinations

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Fig. 1. Fruit of ‘Chemainus’.

Fig. 2. Pedigree of 'Chemainus'.

(Table 1). 'Chemainus' produced significantly lower yield than 'Qualicum' in five planting $\times$ harvest year combinations, significantly higher in one, and was not significantly different in three (Table 1). This indicates that 'Chemainus' yielded more than the industry standard, 'Meeker', but less than

'Qualicum', which is recognized as a high-yielding cultivar (Daubeney and Kempler, 1995). The average fruit weight of 'Chemainus' was significantly greater than that of 'Meeker' and less than that of 'Cowichan', 'Malahat', 'Qualicum', and 'Tulameen', which are recognized for their large fruit sizes (Kempler and Daubeney, 2000, Kempler et al., 2005). The harvest season of 'Chemainus' was between 1 and 3 d earlier than 'Meeker', 'Qualicum', 'Cowichan', and 'Tulameen' and was 3 to 5 d later than that of 'Malahat' (Table 2).

'Chemainus' has excellent fruit appearance. It resembles 'Tulameen' but is smaller; the fruit is long and conical with fine drupelets (Fig. 1). Fruit color is medium to dark red, and the fruit is shiny. Soluble solids concentration of 'Chemainus' was not significantly different from that of the tested

cultivars (Table 3). 'Chemainus' fruit was the firmest of the cultivars tested but only significantly firmer than fruit of 'Meeker' and 'Cowichan' (Table 3). Percent postharvest fruit rot of 'Chemainus' was similar to that of 'Malahat', which is recognized for its good postharvest fruit quality (Kempler and Daubeney, 2000) but lower than that of the other cultivars included in this trial. The pH of 'Chemainus' fruit was very similar to that of other cultivars. The titratable acidity of 'Chemainus' fruit was the highest of all the tested cultivars, but only significantly different from that of 'Cowichan', 'Malahat', and 'Meeker'. This suggests that 'Chemainus' fruit is suited to processing.

In unreplicated machine harvest trials planted in 2002 in Lynden, Wash., 'Chemainus' was rated the highest fruit quality (unpublished data). It was also the highest in suitability for machine harvesting, unlike 'Qualicum' and 'Tulameen', which have comparable fruit yield but are not suitable for mechanical harvest (Kempler and Daubeney, 2006). In a trial planted in 2000 at the Oregon State University-North Willamette Research and Extension Center in Aurora, Ore., 'Chemainus' produced low yield with a harvest season that was similar to that of 'Meeker' (unpublished data). The relatively poor performance of 'Chemainus' in Aurora could be a result of the higher daytime temperatures during the harvest season at that location.

'Chemainus' flowers are self-fertile, and the percentage of drupelets set under field conditions appears to be similar to that of 'Qualicum', 'Malahat', and 'Meeker', each of which is recognized for its high percentage of set (Kempler and Daubeney, 2000).

'Chemainus' plants are highly vigorous with an upright habit. Cane diameter is greater (11 mm) than that of 'Qualicum', 'Tulameen', or 'Meeker' (10, 8, and 9 mm, respectively, data not shown). After tipping to 1.5 m, the average number of nodes per floricanes is 27, compared with 'Cowichan', 'Tulameen', 'Qualicum', and 'Meeker', which have 23, 25, 26, and 27 nodes, respectively. Over 1 year, it was measured that 'Chemainus' produced 104 g of dry matter per primocane compared with 'Tulameen', 'Meeker', and 'Qualicum', which produced 97, 89, and 49 g, respectively. 'Chemainus' produced 22 primocanes per hill compare with 'Meeker', 'Tulameen', and 'Qualicum', which produced 14, 11, and 10, respectively. The cultivar is very quick to establish and produces a large crop after the first planting year.

Bud break on 'Chemainus' canes is even along the length of the cane and begins sooner than budbreak on 'Meeker'. 'Chemainus' could, therefore, be susceptible to early spring freezing events. Flowering begins at the same time as for 'Qualicum' and 'Tulameen' but later than for 'Malahat' and 'Meeker' (data not presented).

'Chemainus' floricanes are thick and strong. They are light brown in color with a silvery-glossy wax overlay with cracking in

Table 1. Yield (kg/hill) and fruit weight of 'Chemainus' and other Pacific Northwest raspberry cultivars in three plantings, Abbotsford, B.C.

Cultivar	Planting year									Fruit wt ^z (g)
	1996			1999			2000			
	Harvest year									
	1999	2000	2001	2001	2002	2003	2002	2003	2004	
Chemainus	4.4	4.5	3.8	6.0	3.7	4.2	3.2	4.1	3.4	3.7b ^y
Cowichan	3.9	4.3	4.0	3.7	3.3	4.1	3.4	3.4	4.3	4.2a
Malahat	5.0	3.7	4.0	5.0	2.9	3.8	3.9	4.2	3.7	4.2a
Meeker	4.1	3.7	3.1	4.2	3.1	4.2	2.6	4.0	3.7	3.0c
Qualicum	4.4	4.4	4.6	7.2	4.2	5.4	4.5	3.2	3.1	4.3a
Tulameen	4.1	4.3	3.4	6.6	4.5	-	3.9	4.1	4.1	4.4a
LSD ^x	0.4									

^zFruit weight is an overall mean for all planting and harvest years based on means of 50 fruit subsamples from each harvest.

^yMean separation within the column by Student-Newman-Keuls multiple range test, $P = 0.05$.

^xMean separation within columns with least significant difference (LSD), $P = 0.05$.

Table 2. Yield and harvest season for 'Chemainus' and other Pacific Northwest red raspberry cultivars^{xy}

Cultivar	Harvest season ^z			Harvest duration (d)
	Start (5%)	Midpoint (50%)	End (95%)	
Chemainus	6 July b ^x	19 July a	7 Aug. b	33 a
Cowichan	4 July c	16 July b	3 Aug. cd	30 b
Malahat	1 July d	13 July c	3 Aug. cd	33 a
Meeker	7 July a	21 July a	4 Aug. c	29 b
Qualicum	6 July b	20 July a	2 Aug. d	29 b
Tulameen	7 July a	20 July a	10 Aug. a	35 a

^zHarvest season = the date by which 5%, 50%, and 95% of the total fruit weight was harvested.

^ySeason data were taken in 1996 to 2004 from three plants plots of each cultivar in each of three replications. The plants were maintained in stool beds.

^xMean separation within columns by Student-Newman-Keuls range test, $P = 0.05$.

Table 3. Fruit traits of 'Chemainus' and other Pacific Northwest red raspberry cultivars.

Cultivar	Soluble solids ^x (%)	Firmness ^y (N)	Botrytis-incited fruit rot after 48 h ^w (%)	pH ^v	Titratable acidity ^v (% citric acid)
Chemainus	10.4 ab ^z	2.60 a	19.0 d	2.89 b	1.24 a
Cowichan	10.2 b	1.99 b	26.5 c	2.97 a	1.00 b
Malahat	10.9 ab	2.14 ab	20.9 d	2.93 ab	0.97 b
Meeker	10.7 ab	1.57 c	30.7 b	2.86 b	0.95 b
Qualicum	11.1 a	2.27 ab	26.0 c	2.87 b	1.14 ab
Tulameen	11.2 a	2.19 ab	34.9 a	2.82 b	1.20 a

^zMean separations within columns by Student-Newman-Keuls multiple range test, $P = 0.05$.

^yFirmness (given in Newtons) is measured as the force required to close the opening of the fruit. It was obtained for 10 fruit from each of two to four harvests each year from 1999 and 2004.

^wMeans of 10 fruit from each of two to four harvests each year from 1999 and 2004.

^vMeans from two to three tests each year from 1996 to 2004. In every test, each cultivar was represented by 12 fruit replicated four times.

^xMeans of 10 fruit from each year from 1996 to 2004.

the bottom portion. Spines are dense on the lower 30 cm of the canes but relatively sparse up the canes, which is similar to those on 'Tulameen'. Spines are large and dark in color with pigmentation extending to the base of the spine. Spines are straight and angled toward the base of the cane.

Primocane leaves are pinnately compound with three or five leaflets. Emerging leaves are green with bronzing around the edges. Leaves have two straight stipules. Basal lateral leaflets have short (2 mm or less) petiolules, but distal lateral leaflets are sessile. Petioles of primocane leaves have spines similar to those on the canes but smaller.

In large-scale growers' trials in British Columbia and Washington State, 'Chemainus' has shown itself to be well suited for mechanical harvesting, producing large crops of high-quality, firm fruit. The firmness, color, and attractive appearance of 'Chemainus' fruit make it highly desirable for individual quick freezing (IQF). Fruit color is acceptable for processing and is comparable to that of 'Meeker', the main processing cultivar grown in the Pacific Northwest.

'Chemainus' has been characterized by sequence repeat SSR markers analysis for three markers, the patterns obtained were group 9, 3, and 4 for the first second and the third markers, respectively (Graham et al., 2002). The markers produce a unique cultivar identification pattern for 'Chemainus'.

Disease and Pest Reaction

'Chemainus' was selected in greenhouse screening trails for the gene Ag₁, which confers resistance to the common biotype of *Amphorophora agathonica* Hottes, the North American aphid vector of the RMV complex. Aphid colonization has been noted on plants of the cultivar in trials at the PARC Agassiz substation in Abbotsford, B.C. We assume that this is a resistance-breaking biotype of the aphid, which has been found on other cultivars with the Ag₁ gene (Kempler and Daubeny, 2000). 'Chemainus' has been indexed yearly (1992–2003) for RMV using the double-stranded RNA technique (Kurppa and Martin, 1986) and for RBDV using the enzyme-linked immunoassay technique (ELISA). It tested positive for raspberry

bushy dwarf virus (RBDV) for the first time in 1999. Although susceptible to RBDV, 'Chemainus' does not express symptoms of yellow leaves and experiences a long delay before expression of crumbly fruit symptoms.

'Chemainus' may exhibit some degree of field resistance to root rot incited by *Phytophthora fragariae* var. *rubi* Wilcox & Duncan. In field trials at the WSU Research and Extension Center at Puyallup, under extreme root rot pressure, it died after 4 years, and at the Mt. Vernon Research Station, Wash., it exhibited a slower rate of decline than 'Meeker' (unpublished data). In growers' plantings in British Columbia and Wash., it appears that 'Chemainus' survives better under root rot pressure than 'Malahat', 'Meeker', and 'Willamette', which are the most widely planted cultivars in the Pacific Northwest (unpublished data).

In the Pacific Northwest, 'Chemainus' has been moderately susceptible to spur blight [*Didymella applanata* (Niessl) Sacc.], to cane *Botrytis* (*B. cinerea*), and to Anthracnose (*Elsinoe veneta* Burk.), a similar reaction to its parent 'Tulameen'.

Because of its early budbreak, 'Chemainus' shows some bud damage after sudden drops in temperature during mild winters. When winters are cold, it shows good winter hardness with little or no damage relative to other Pacific Northwest cultivars (unpublished data).

Uses

'Chemainus' is a multipurpose cultivar suited for processing and fresh market uses in the Pacific Northwest. It is high yielding, is suited for machine harvesting, and produces high-quality fruit that is firm, attractive, and highly desirable for individually quick-freezing processing. It is suggested that the cultivar be considered as a replacement for 'Meeker', currently the most widely planted red raspberry cultivar in the Pacific Northwest (P. Moore, 2005, personal communication). It takes longer for 'Chemainus' to become RBDV-infected and for 'Chemainus' plants to develop crumbly fruit. 'Meeker' is susceptible to RBDV, with fields becoming 100% infected within 5 to 6 years (Martin, 1998). Infected 'Meeker' plants show poor fruit set and a reduced yield (Daubeny et al.,

1978). In addition, 'Chemainus' may have more resistance or tolerance than 'Meeker' to *Phytophthora fragariae* var. *rubi*, the main causal organism of raspberry root rot in the Pacific Northwest.

Availability

Certified 'Chemainus' plants are being propagated under royalty agreements with propagators in the Pacific Northwest. For licensing information, contact the Okanagan Plant Improvement Company (PICO), P.O. Box 6000, Summerland, BC, V0H 1Z0, Canada, e-mail: PICO@agr.gc.ca

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