‘NR7’ (Marketed as ‘Raspberry Shortcake®’ and ‘Ruby Beauty®’) Red Raspberry

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‘NR7’ is a new florican-fruiting red raspberry (*Rubus idaeus* L.) cultivar from The New Zealand Institute for Plant & Food Research Limited (PFR) and Northwest Plant Company (NWP) joint raspberry breeding program. It is owned by Pacific Berries LLC and marketed as ‘Raspberry Shortcake®’ in the United States and Canada and ‘Ruby Beauty®’ in the United Kingdom and Europe. In this article we describe the origin and selection process of this new cultivar, its characteristics, and use. It was derived from a family from controlled crosses between HR101 and ‘Willamette’. ‘NR7’ is a fully dwarf spineless plant that produces medium-to large-sized fruit in the early-midseason and is well suited to ornamental applications such as home gardens and containers. ‘NR7’ plants appear to have some tolerance to *Raspberry bushy dwarf virus* (RBDV) but are susceptible to mites.

Origin

The new cultivar of red raspberry, *R. idaeus* L., was created in the course of a planned breeding program carried out by PFR [formerly the Horticulture and Food Research Institute of New Zealand Limited (HortResearch)]. Activities contributing to the breeding process were carried out in two locations: Motueka, NZ, and Lynden, WA. ‘NR7’ was selected as a seedling within a family targeted to produce commercial machine harvest raspberry cultivars. The parents used to make the cross were the unpatented selection HR101 from the PFR New Zealand breeding program as the seed parent, and the unpatented cultivar ‘Willamette’ as the pollen parent (Fig. 1). HR101 (87-24WF9 × D188) was a selection from the Motueka-based PFR breeding program that

was spineless and had outstanding fruit firmness. The pedigree of HR101 includes Canadian cultivars ‘Haida’ and ‘Qualicum’ and the Scottish cultivar ‘Glen Prosen’ and breeding selection SCRI 7331/1REV (Fig. 1).

‘Willamette’ (‘Newburgh’ × ‘Lloyd George’) (Daubeney, 1989) was released from the Oregon State University—U.S. Department of Agriculture (USDA) breeding program in 1943 (Daubeney, 1989) and dominated raspberry production for processing in the Pacific North West until it was largely replaced by ‘Meeker’ in the early 1990s (Moore and Daubeney, 1993). ‘Willamette’ has dark colored fruit, good flavor and high acidity for jam making, and plants tolerate RBDV (Daubeney, 1989). Both of NR7’s parents had internode lengths typical of red raspberries in the range 50–150 mm.

The controlled cross performed to produce the population from which ‘NR7’ was selected was carried out in a greenhouse at

Fig. 1. Pedigree of ‘NR7’ (marketed as ‘Raspberry Shortcake®’ and ‘Ruby Beauty®’) red raspberry, including inbreeding coefficients.

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PFR Motueka, in 1997 and resulting seed was sent to Lynden, WA, in 1999. In total, 120 seedlings were raised and planted in the field in 1999. The original plant of the new cultivar was selected during the 2001 summer and initially given the breeders' code ZNH062. It was subsequently coded 'NR7' at the advanced selection stage.

Key characteristics of 'NR7' are:

- a) The ability to form medium- to large-sized fruit that are easy to pick, light red in color and ovate-round in shape (Fig. 2), and ripening early-midseason.
- b) A plant that has genetically controlled dwarf growth habit (Figs. 3 and 4).
- c) Completely spineless canes (Fig. 5).

When compared with the parent HR101 in the United States, the new cultivar has short canes (typically up to 700 mm) with very short internodes (typically 20 mm) and fruit are larger and softer. When compared with 'Willamette', the new cultivar has short spineless canes, with fruit that is larger and lighter colored (Fig. 2). While the parents from the family that gave rise to 'NR7' were HR101 [heterozygous for spines (Ss)] and 'Willamette' [homozygous dominant for spines (SS)], it is more likely 'NR7' arose from a HR101 $\times$ self or HR101 $\times$ op because NR7 is completely spineless (ss) that can only come about by both parents being either recessive (ss) or heterozygous (Ss) for spines.

The new cultivar was first asexually propagated in 2004, being reproduced by tissue culture. The resulting plants propagated true-to-type, demonstrating that the characteristics of the new cultivar are stable and are clonally transmitted without change through succeeding generations. The use of 'NR7' as a parent in the breeding program and subsequent assessment of its progeny has confirmed its dwarfing character is heritable and thus genetically controlled.

Performance and Description

Among other trials, 'NR7' was tested and evaluated as an advanced selection in 2014 and 2015 at Enfield Farms Inc., Lynden, WA. 'NR7' was included in a randomized complete block design trial along with three other genotypes; 'Meeker' (Moore and Daubeny, 1993), 'Wakefield' (Stephens et al., 2012), 'Cascade Harvest' (Moore et al., 2015). For these three, there were three replicates, each of six plants, and for 'NR7' there were three replicates, each of three plants and all were planted as ex-tissue culture plugs (spacing 0.7 m between plants, 3 m between rows) in May 2013. The lack of any other dwarf or ornamental raspberry cultivars available to the public meant that no comparable selections/cultivars in the trial were very similar to 'NR7', particularly in terms of internodes length and thus cane lengths. Percent bud-break during spring (recorded as the percentage of buds broken and percentage of flowers open) was recorded weekly for each plot.

Fig. 2. (A) 'NR7' (marketed as 'Raspberry Shortcake®' and 'Ruby Beauty®') red raspberry fruit on 1 cm grid. (B) 'NR7' fruit compared with 'Willamette' and 'Meeker'.

Fig. 3. 'NR7' (marketed as 'Raspberry Shortcake®' and 'Ruby Beauty®') red raspberry fruiting bush growing in a field.

'NR7' was hand harvested because canes were so short. For all other genotypes, each six-plant plot was machine harvested with an over-the-row XL 2007 harvester (Littau, Stayton, OR). All genotypes were harvested every 2–2.5 d between 25 June and 4 Aug. in

2014 and 22 June and 6 Aug. in 2015, and fruit weights per plot were recorded at each harvest date. For each plot, a loess smooth curve of cumulative yield vs. date was interpolated to derive the mid harvest date (date at which 50% of the final yield had been

Fig. 4. 'NR7' (marketed as 'Raspberry Shortcake®' and 'Ruby Beauty®') red raspberry mature primocanes. Ruler is in inches.

Fig. 5. 'NR7' (marketed as 'Raspberry Shortcake®' and 'Ruby Beauty®') red raspberry primocanes compared with 'Meeker', 'Cascade Harvest', and 'Wakefield'.

harvested) and harvest span (number of days over which the middle 95% of the crop was picked). In 2015, the total length and internode length (in the middle third) of all primocanes on each plant were measured following fruit harvest.

Firmness measurements (mean of 25 fruit per plot replicate $\times$ 3 harvest dates: early, mid, and late) were made using a Firmtech 2 firmness tester (Bioworks Inc., KS) and mean berry weight of each sample of 25 fruit recorded. The firmtech was set to measure the peak force during a 2-mm compression from the outside of each of the 25 fruit, which were placed collar down. Juice samples were extracted from 25 fruit per plot on each of the three harvest dates using a potato ricer to remove pulp and seeds, combined, and analyzed for total anthocyanin by high performance liquid chromatography [HPLC (Shimadzu, Portland, OR)] in a manner similar to that described by Connor et al. (2005). Total ellagitannin determined by HPLC was quantified using purified Sanguin H6 as a standard. Vitamin C was measured as part of the polyphenol HPLC method. It had a retention time shorter than any of the polyphenols and was quantified relative to an authentic standard at 247 nm.

Soluble solids content was recorded on juice samples using a digital pocket refractometer (PAL-1; Atago, Tokyo, Japan) and for total acidity measurements, 2 mL of berry juice in 40 mL of water was titrated with 0.1 M NaOH to pH 8.2 on an autotitrator (T70; Mettler Toledo, Zurich, Switzerland). Data were analyzed by analysis of variance using R 3.1.2 (R Core Development Team, 2015).

'NR7' plants exhibit a very strong dwarf growth habit (Fig. 3; Table 3). Dwarfism in 'NR7' appears to be genetically controlled: plants have been certified virus free and dwarfism is stable between propagation and breeding generations. The nature of the genetic dwarfism is not yet understood. Mature

Table 1. Mean time of budbreak, flowering, and fruit harvest measurements for the red raspberry replicated trial harvested in 2014 (1-year-old plants).

Genotype	% Budbreak 7 March	% Open flowers 2 June	50% Fruit harvest date	Harvest span (d) ²	Harvested yield ³ (kg/plant)	Berry wt (g)	Fruit firmness (N)
'NR7'	25 ^x	70 a	21 July a	30 c	0.6 b	4.7 a	0.27 b
'Meeker'	25 b	70 a	12 July a	38 b	3.3 a	3.5 b	0.23 b
'Cascade Harvest'	69 a	77 a	11 July a	52 a	2.2 a	5.2 a	0.26 b
'Wakefield'	47 ab	40 b	15 July a	55 a	3.6 a	3.7 b	0.39 a
SED ^w	9.7	7.2	9.0	7.5	0.37	0.23	1.541

^xNinety-five percent of fruit harvested by hand for 'NR7' and machine for rest.

^yHand harvest 'NR7', others are machine harvested Standard error of difference between means.

^zMeans within a column followed by the same letter are not significantly different ($P < 0.05$, Tukey's least significant difference).

^wSE of difference between means.

Table 2. Mean fruit chemistry measurements for the red raspberry replicated trial harvested in 2014 (1-year-old plants).

Genotype	Fruit soluble solids (% Brix)	Fruit acidity (%)	Fruit total anthocyanins (mg/100 g)	Fruit total ellagitannins (mg/100 g)	Fruit total vitamin C (mg/100 mL)
'NR7'	8.3 b ^z	2.1 a	47.9 b	38.9 b	20.6 a
'Meeker'	10.6 a	1.9 a	59.8 ab	80.9 ab	12.1 a
'Cascade Harvest'	10.8 a	1.2 b	31.2 b	54.8 ab	19.1 a
'Wakefield'	10.3 a	2.3 a	91.6 a	99.0 a	20.6 a
SED ^y	0.5	1.22	11.59	14.35	3.14

^zMeans within a column followed by the same letter are not significantly different ($P < 0.05$, Tukey's least significant difference).

^ySE of difference between means.

Table 3. Mean time of budbreak, flowering, cane length, and fruit harvest measurements for the red raspberry replicated trial harvested in 2015 (2-year-old plants).

Genotype	% Budbreak 9 March	% Flowering 28 May	Cane length (mm)	Internode length (mm)	50% Fruit harvest date	Harvest span (d) ^z	Harvested yield ^y (kg/plant)	Berry wt (g)	Fruit firmness (N)
'NR7'	13 b ^x	90 a	630 b	17 b	22 June b	32 a	0.8 b	3.9 ab	0.28 b
'Meeker'	9 b	32 b	2026 a	115 a	8 July a	32 a	3.8 a	3.2 bc	0.30 b
'Cascade Harvest'	78 a	90 a	1942 a	113 a	15 July a	50 a	3.9 a	4.2 a	0.27 b
'Wakefield'	47 ab	20 b	2007 a	121 a	11 July a	41 a	3.5 a	3.1 c	0.43 a
SED ^w	10.9	9.6	44.7	11.5	2.76	8.4	0.35	0.20	2.16

^xNinety-five percent of fruit harvested by hand for 'NR7' and machine for rest.

^yHand harvest for 'NR7', others are machine harvested.

^zMeans within a column followed by the same letter are not significantly different ($P < 0.05$, Tukey's least significant difference).

^wSE of difference between means.

Table 4. Mean fruit chemistry measurements for the red raspberry replicated trial harvested in 2015 (2-year-old plants).

Genotype	Fruit soluble solids (% Brix)	Fruit acidity (%)	Fruit total anthocyanins (mg/100 g)	Fruit total ellagitannins (mg/100 g)	Fruit total vitamin C (mg/100 mL)
'NR7'	8.7 b ^x	2.2 a	38.7 b	28.8 c	27.1 a
'Meeker'	10.5 a	1.8 a	55.6 b	56.1 b	15.5 b
'Cascade Harvest'	10.6 a	1.3 b	42.5 b	38.7 c	26.0 a
'Wakefield'	10.5 a	2.2 a	80.8 a	76.2 a	22.5 ab
SED ^y	0.36	0.14	7.92	10.35	2.4

^xMeans within a column followed by the same letter are not significantly different ($P < 0.05$, Tukey's least significant difference).

^ySE of difference between means.

plant height is commonly in the range 0.5–0.7 m (Fig. 4), compared with 1.9–2.4 m for common nondwarfing raspberry plants, although this may vary with the growing conditions. Internode length was typically very short and in the range 10–20 mm (Table 3; Fig. 5). Plants have high numbers of young shoots (typically 20–50 per plant) that spread by way of suckers. 'NR7' plants are spineless (Fig. 5) indicating it has the ss gene (Lewis, 1939). Canes are pubescent, indicating the presence of gene H (Jennings and Brydon, 1989).

In the field, 'NR7' plants broke bud and flowered at similar times to 'Meeker' (Tables 1 and 3) and later than 'Cascade Harvest'. Fruit ripening times were later (Table 1) than all cultivars in this study in the first season and earlier than all cultivars in the second season (Table 3). Particularly in containers or tubs it is expected that 'NR7' will flower and fruit early in the season. 'NR7' fruiting season is moderately short (30–32 d, Tables 1 and 3). Fruit of 'NR7' were normal sized (3.9–4.7 g) and in fact larger than some cultivars (e.g., 'Meeker' and 'Wakefield') but smaller than 'Cascade Harvest' (Tables 1 and 3; Fig. 2). Fruit were softer than that of 'Wakefield' and of similar firmness to 'Cascade Harvest' (Tables 1 and 3). 'NR7' fruit had low soluble solid content (8% to 9%), relative to the three standard cultivars, and moderate acidity (2.1% to 2.2%), similar to 'Wakefield' and much higher than 'Cascade Harvest' (Tables 2 and 4). Fruit also had relatively low levels of anthocyanins and ellagitannins and

moderate levels of vitamin C (Tables 2 and 4) compared with 'Meeker', 'Cascade Harvest', and 'Wakefield'.

Currently 'NR7' is propagated by both tissue culture and root cuttings methods. The resulting plants propagate true-to-type, demonstrating that the characteristics of the new cultivar are stable and can be transmitted without change through succeeding generations of multiplication.

Pest and Disease Reaction

Since the selection of this clone in 2001, numerous tests for RBDV have been carried out on 'NR7' in the United States using enzyme-linked immunosorbent assay. RBDV has never been detected in trial plots of 'NR7'. The parents of 'NR7' have never tested positive to RBDV and from this we suggest that 'NR7' is resistant to RBDV found in the United States. Resistance to aphids is unknown and 'NR7' is susceptible to mites.

Adaptability and Uses

'NR7' is not suited to commercial raspberry production because of its dwarfing nature and low yield but well suited to ornamental uses including home gardens and containerized gardens. Observations indicate that this cultivar is well suited to regions that offer a medium-high amount of winter chill; for example, 'NR7' performs well in USDA Plant Hardiness zones 8–10 (The United States National Arboretum,

2012) although this could be increased if containerized plants are protected.

Availability

'NR7' is the subject of a U.S. plant patent (grant no. PP 22,141) and is marketed in the United States and Canada as 'Raspberry Shortcake'® under the BrazelBerries® brand, and in Europe as 'Ruby Beauty'®. 'Raspberry Shortcake'® and BrazelBerries® are registered trademarks of Fall Creek Farm & Nursery, Inc., 'Ruby Beauty'® is a registered trademark of Hargreaves Plants Ltd. For more information about 'NR7', please contact NWP or PFR.

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