HortScience 54(9):1641–1643. 2019. https://doi.org/10.21273/HORTSCI14024-19

# ‘Red Rhapsody’ Strawberry

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*Additional index words. Fragaria ×ananassa*, fruit breeding, subtropical

Queensland’s winter strawberry (*Fragaria ×ananassa* Duch.) industry would benefit by having an early ripening, more profitable cultivar to replace current cultivars. ‘Strawberry Festival’ (Chandler et al., 2000) and, more recently, ‘Florida Radiance’ (Chandler et al., 2009) were introduced to Queensland and rapidly became major early-season cultivars with fruit and plant attributes desirable to growers. ‘Florida Radiance’ is marketed in Australia as ‘Florida Fortuna’. The average fruit size of ‘Strawberry Festival’ is less than ‘Florida Radiance’, but the latter is more difficult to establish in the field. Numerous plant losses sometimes occur, especially when demand for early supply of runners results in premature digging and lower quality runners.

The commercial desirability of strawberry cultivars for producers, distributors, retailers, and consumers depends on many traits. Supply volumes influence market prices and profitability to the producer. Producer profitability is a key need for a stable production system. Herrington et al., (2012) analyzed the production and marketing system in Queensland in relation to the effect of changes in plant traits on the notional profitability of production. When this information was combined with genetic parameters, they found (Herrington et al., 2014) the key drivers of greater profitability compared with the current profitability in subtropical Southeast Queensland were having a greater proportion of yield early in the season and having a larger fruit size. In the development of ‘Red Rhapsody’ (Fig. 1), we focused on selecting for these traits while maintaining levels of other traits at or above commercially acceptable threshold levels.

‘Red Rhapsody’ strawberry has produced high early-season (May–August) yields of firm, attractive fruit at the Department of Agriculture and Fisheries (DAF) Research Facility in Nambour and in several commercial fields in the Caboolture district in Southeast Queensland. It is recommended for trial in areas with mild winter climates and where the market requires robust, well-flavored fruit, but can accept fruit that are slightly darker red than cultivars such as ‘Florida Radiance’.

The name ‘Red Rhapsody’ was chosen, first, because of its consumer appeal as identified in a survey of consumers (Herrington, unpublished data). In addition, the name was chosen to emphasize the balance of plant traits with levels that were harmonized to enhance the profitability of producers while addressing the requirements of other market cycle segments.

## Origin

‘Red Rhapsody’ originated from a 2009 cross between DAF breeding line ‘2005-063’ and ‘Suncoast Delight’ (Herrington and Price, 2010). ‘2005-063’, an unreleased breeding line selected in 2005, was used as a female parent because of its high yield potential, day neutrality under subtropical temperatures, large fruit size, and medium-red fruit color. ‘Suncoast Delight’ is a selection made at Bundaberg, Queensland, from a cross produced in Florida, and was the product of a collaborative breeding effort between the University of Florida and DAF. ‘Suncoast Delight’ was used as the male parent because of its early and continuous production; smooth, regular, conic fruit shape; and dark fruit color. ‘Red Rhapsody’ was first selected as a desirable genotype based on earliness of fruit, large fruit size, good flavor, high resistance to bruising, attractive fruit appearance, an open but compact plant habit, erect trusses, and readily detachable fruit that are displayed outside the leaf canopy. First selection was at Maroochy Research Facility, Nambour, Queensland, during the 2010 season (May–September) and was identified as ‘Selection 2010-114’ before being released as ‘Red Rhapsody’. ‘Red Rhapsody’ is a sister line of ‘2010-119’, which is one of the parents of ‘Florida Beauty’ (Whitaker et al., 2017).

## Description

‘Red Rhapsody’ has medium vigor with a compact but spreading plant habit and a sparse to medium density of foliage with a terminal leaflet that is concave in cross-section. Stipule anthocyanin coloration is absent or very weak. Color of the upper side of the leaf is medium green (137A; Royal Horticultural Society, 1995), with blistering and glossiness absent or weak. The terminal leaflet is much longer than broad (mean length/width ratio = 1.10) and has an acute shape of the leaf base. Incisions of leaf margins are crenate. The compact plant habit and medium-long, stiff pedicels produce the inflorescence at the same level as the foliage, resulting in many exposed flowers. Fruit are well displayed beyond the leaf canopy. This exposure makes the fruit easy to harvest, but also increases the fruit’s exposure to raindrop impact.

‘Red Rhapsody’ produces fruit that are larger than ‘Strawberry Festival’, ‘Suncoast Delight’, and ‘Florida Radiance’ (Table 1). Fruit are mostly conical in shape and much longer than they are wide (mean length/width ratio = 1.29). They are glossy, with a blackish red external color (53A; Royal Horticultural Society, 1995) and a medium-red internal flesh color (43A; Royal Horticultural Society, 1995). The calyx is slightly larger than the fruit diameter. Fruit of ‘Red Rhapsody’ are firm to very firm, yet juicy, with a soluble solids (measured in degrees Brix):titratable acidity ratio similar to ‘Florida Radiance’, ‘Strawberry Festival’, and ‘Suncoast Delight’ (Table 2). Together these attributes confer a good overall consumer acceptability on ‘Red Rhapsody’.

## Performance

‘Red Rhapsody’ was included in replicated cultivar selection trials at Maroochy Research Facility, Nambour, from 2012 through 2018, with two or three replications of six plant plots in each trial. Ripe fruit were harvested, graded, counted, and weighed weekly from May through August. The proportion of fruit (counts) not damaged was assessed following various rain events during this 7-year period. Titratable acidity (measured as percent citric acid equivalent) and soluble solids (measured in degrees Brix)

Fig. 1. Fruit and plant of ‘Red Rhapsody’ strawberry.

Received for publication 7 Mar. 2019. Accepted for publication 24 May 2019.
Funding support was provided by Hort Innovation, using the Hort Innovation Strawberry Industry research and development levy, co-investment from the Queensland Government through its Department of Agriculture and Fisheries, and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.
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Table 1. Monthly and total season fruit yield (g/plant) and fruit size (g/fruit) of 'Red Rhapsody' and comparators based on eight field trials from 2012 through 2018.[z]

| Genotype | Yield | | | | | Fruit size |
|---|---|---|---|---|---|---|
| | May | June | July | August | Total | May–August |
| Festival | 44 b[y] | 58 b | 122 b | 230 b | 467 b | 16.9 b |
| Florida Radiance | 50 b | 67 b | 185 a | 317 a | 652 a | 18.7 b |
| Suncoast Delight | 68 a | 106 a | 195 a | 342 a | 688 a | 18.1 b |
| Red Rhapsody | 69 a | 103 a | 222 a | 289 a | 715 a | 22.4 a |

[z]Values were obtained using best linear unbiased prediction from eight field trials over 7 years. Mixed statistical models were used to analyze the unbalanced clonal trial data to estimate genetic parameters and predict clonal values, using ASReml-W software (Gilmour et al., 2006).
[y]Within columns, all comparisons are with 'Red Rhapsody'. Values followed by a letter other than a are significantly different ($P \leq 0.05$) from 'Red Rhapsody'.

Table 2. Quality traits (resistance to bruising, resistance to rain damage, titratable acidity (TA), soluble solids concentration (SSC), and external color) of 'Red Rhapsody' and comparators.

| Genotype | Resistance to bruising[z] | Resistance to rain damage[y] | TA[x] | SSC | Ratio SSC/TA | External color[w] |
|---|---|---|---|---|---|---|
| Festival | 73 a[v] | 0.57 a | 0.85 a | 9.5 a | 11.3 a | 6.5 a |
| Florida Radiance | 72 a | 0.58 a | 0.76 a | 9.1 a | 12.1 a | 5.9 b |
| Suncoast Delight | 74 a | 0.46 b | 0.77 a | 8.7 a | 10.6 a | 7.0 a |
| Red Rhapsody | 73 a | 0.55 a | 0.80 a | 8.5 a | 10.4 a | 6.5 a |

[z]Bruising resistance is the score of fruit firmness determined using an Agrosta®100 Field Digital Firmness Tester. A score of 0 = very soft; 100 = very firm.
[y]Resistance to rain damage is proportion (count) of fruit not damaged following a rain event.
[x]TA is the percentage of citric acid equivalents with a pH endpoint of 8.1.
[w]External color: 1 = white (or very, very pale pink), 5 = orange–red, 9 = very dark (black) red.
[v]Within columns, all comparisons are with 'Red Rhapsody'. Values followed by a letter other than a are significantly different ($P \leq 0.05$) from 'Red Rhapsody'.

Table 3. Resistance of 'Red Rhapsody' and comparators to fusarium wilt, colletotrichum crown rot, and charcoal rot diseases.

| Genotype | Resistance to | | |
|---|---|---|---|
| | Fusarium wilt[z] | Colletotrichum crown rot[y] | Charcoal rot[y] |
| Red Rhapsody | 0 a | 0.70 a | 0.12 b |
| Festival | 0 a | 0.75 a | 0.35 a |
| Florida Radiance | NA | 0.39 b | 0.25 b |
| Suncoast Delight | 0 a | 0.70 a | 0.10 b |
| Camarosa | NA | 1.00 a | 0.68 a |
| Albion | NA | 0.96 a | 1.0 a |
| Redlands Crimson | 4.4 b | 0.52 a | NA |

[z]Resistance as disease severity. Severity of foliar symptoms was evaluated on a 0-to-10 disease visual index scale where 0 = plant healthy and 10 = plant dead. Within columns, all comparisons are with 'Red Rhapsody'. Values followed by a letter other than a are significantly different ($P \leq 0.05$) from 'Red Rhapsody' (Paynter et al., 2018).
[y]Resistance as hazard ratio. Within columns, genotype hazard ratios greater than one suggest a greater rate of death (lower survival) than the comparator. 'Camarosa' is the comparator for colletotrichum crown rot (Neal et al., 2018) and 'Albion' is the comparator for Charcoal rot (Gomez et al., 2019). Within columns, values followed by a letter other than a are significantly different ($P \leq 0.05$) from the respective comparator.
NA = data not available because the cultivar was not included in the trial.

were assessed in the 2018 season only. Three fruit were collected on each of three times during the harvest season from each plot in two randomized trials, each with two or three replicates. Fruit firmness was assessed in each of years 2016–18, at least twice each season, from each plot of two trials, each with two or three replicates using an Agrosta®100 Field Digital Firmness Tester (Agrosta SARL, Compainville, France), where 0 = very soft and 100 = very firm. Linear mixed models were used to analyze the unbalanced clonal trial data to estimate genetic parameters and predict clonal value as a best linear unbiased prediction using ASReml-W (version 4.1.1051) (Gilmour et al., 2006) combined across the eight yield experiments over the 7 years.

Consistent with traits that were identified as highly influencing profitability (Herrington et al., 2012, 2014)—namely, early production and larger fruit size—'Red Rhapsody' had yields in May, June, July, and August that were greater than 'Strawberry Festival', and in May and June they were greater than 'Florida Radiance', but in all months they were similar to 'Suncoast Delight'. Total yield of 'Red Rhapsody' was similar to 'Florida Radiance' and 'Suncoast Delight', and greater than total yield of 'Strawberry Festival' (Table 1). In addition, 'Red Rhapsody' produced fruit that were larger (22.4 g) than 'Strawberry Festival' (16.9 g), 'Suncoast Delight' (18.1 g), and 'Florida Radiance' (18.7 g) (Table 1).

The darker fruit of 'Red Rhapsody'—compared, for example, to that of 'Florida Radiance' (Table 2)—has been well accepted by consumers. The level of retail sales when the dark-fruited 'Red Rhapsody' was on supermarket shelves remained as high as when the lighter color 'Florida Radiance' fruit had been offered previously (R. Broadley, personal communication).

Resistance to fusarium wilt (incited by *Fusarium oxysporum* Schlecht ex. Fr. f. sp. *fragariae,* Winks and Williams) was evaluated in glasshouse pot trials (Paynter et al., 2018). Disease resistance scores were based on a 0- to 10-scale of visual foliar symptoms, where 0 = plant healthy and 10 = plant dead, with a mean disease severity score for each treatment calculated across replicates. Data were analyzed using analysis of variance in GenStat (2008). Differences among means were based on the estimated means using Fisher's protected least significant difference test ($P < 0.05$).

Resistance in glasshouse trials to colletotrichum crown rot (incited by *Colletotrichum gloeosporioides* Penz.) and to charcoal rot [incited by *Macrophomina phaseolina* (Tassi) Goid.] were evaluated using survival analysis based on the Cox proportional hazards model (Cox, 1972), incorporating hazards and associated hazard ratios (Gomez et al., 2019; Neal et al., 2017, 2018). The concepts of hazard and hazard ratio are based on Cox (1972) and Southey et al. (2003), and are described by Duerden (2014). In summary, the statistically calculated hazard gives the rate at which mortality events happen for a genotype. The hazard may change over time, but the model assumes the hazard for one genotype is a constant proportion of the hazard in the other genotypes (Cox, 1972). The proportion of one genotype's hazard to another genotype's hazard is the hazard ratio (Duerden, 2014). If one genotype is nominated as a standard, and ratios calculated using that standard, then one can compare resistances on this basis. Genotypes having a ratio of greater than one are more susceptible than the standard; those with a ratio of less than one are more resistant. Data were analyzed using a discrete time survival analysis based on Cox's proportional hazards model (Southey et al., 2003) using ASReml-R (Butler et al., 2009). Hazard ratios were predicted for each genotype relative to the hazard of 'Camarosa' or 'Albion'. Genotype hazard ratios greater than one suggest a greater rate of death (lower survival) than 'Camarosa' for colletotrichum crown rot and a greater rate of death than 'Albion' for charcoal rot.

'Red Rhapsody' has resistance to fusarium wilt at a similar level to 'Strawberry Festival' (Table 3). Resistance to colletotrichum crown rot, although similar to 'Camarosa', is not as high as that of 'Florida Radiance' (Table 3). In contrast, resistance of 'Red Rhapsody' to charcoal rot is greater than 'Albion', 'Festival', and 'Camarosa' (Table 3). During rain events, fruit of 'Red Rhapsody', 'Festival', and 'Florida Radiance' are damaged to the same extent, but less than those of 'Suncoast Delight' (Table 2).

Although the relative susceptibility to Anthracnose fruit rot (*Colletotrichum* *acutatum* Simmonds), botrytis fruit rot (*Botrytis cinerea* Pers. ex Fr.), powdery mildew [*Sphaerotheca macularis* (Wallr. ex Fr.) Jacz. f. sp. *fragariae*], and two-spotted spider mite (*Tetranychus urticae* Koch) has not been determined, serious epidemics of these diseases and infestations of this pest have not been observed when appropriate control measures—such as clean planting material, standard fungicide applications, and predatory mite releases—have been used.

'Red Rhapsody' provides producers with a profitable subtropical cultivar with high yields of large, firm, attractive, well-flavored fruit from late autumn through early spring. 'Red Rhapsody' now comprises 49% of the total subtropical plantings in Southeast Queensland (R. Broadley, 2019, personal communication). 'Red Rhapsody' is worthy of trial in winter producing areas, especially where high early yield and darker color, consumer-acceptable, bruise-resistant berries are desired.

## Availability

'Red Rhapsody' has been officially registered by DAF and Hort Innovation Australia Limited with Australian Plant Breeders Rights (application no. 2013/312). Internationally, requests for plants and licenses for 'Red Rhapsody' can be made through Business Manager, Horticulture and Forestry Science Group, Department of Agriculture and Fisheries, GPO Box 267, Brisbane, QLD 4001 Australia, www.daf.qld.gov.au or e-mail callweb@daf.qld.gov.au directing to the Business Manager Horticulture and Forestry Sciences or the strawberry breeding team.

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