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'Galaxy' Thornless Semierect Blackberry

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'Galaxy' is a thornless, semierect high-quality blackberry (*Rubus* subg. *Rubus* Watson) that has firm, large, dark fruit suited for the fresh market and that ripen in the early season for this type of blackberry. 'Galaxy' was released by the U.S. Department of Agriculture–Agricultural Research Service (USDA-ARS) breeding program in Corvallis, OR, in cooperation with Oregon State University's Agricultural Experiment Station. This cultivar is unique in that we believe it and 'Eclipse' (Finn et al., 2020) are the first cultivars to combine germplasm from the eastern and western North American blackberry germplasm pools. 'Galaxy' is introduced as a high-quality blackberry that has medium-large berries that ripen in the early, semierect blackberry season when it is firmer or earlier than current standards. 'Galaxy' and 'Eclipse have many characteristics in common, including high-quality fruit in the early semierect season and vigorous, productive plants. 'Galaxy' fruit tend to be slightly larger and slightly more irregularly shaped than those of 'Eclipse'. 'Galaxy' should be adapted to areas where other semierect blackberries can be grown successfully. A U.S. Plant Patent (USPP 30,062) was granted (Finn, 2019).

Origin

'Galaxy', tested as ORUS 2711-1, was selected in Corvallis, OR, in 2003 from a cross made in 2000 of ORUS 1393-2-1 ('Illini Hardy' × 'Chester Thornless') and 'Triple Crown'. The pedigree of 'Galaxy' is the same as 'Eclipse', but the cross was made 1 year earlier (Finn et al., 2020). As with 'Eclipse', the ploidy of 'Galaxy' has not been determined, but is presumed to be tetraploid because it crossed readily with, and produced fertile offspring with, other tetraploid parents, whereas crosses with trailing blackberries at the hexaploid or higher ploidy levels produced fewer seeds than typical and no viable seedlings in the field. Similar to other erect and semierect thornless cultivars, 'Galaxy' has the 'Merton Thornless' source of thornlessness (botanically "spineless" but commonly referred to as "thornless" in industry and research communities) (Crane, 1943; Jennings, 1986). Firm, medium-large fruit that have excellent fruit quality ripen early in the semierect blackberry season, and have excellent flavor that distinguishes 'Galaxy' from most other semierect cultivars.

'Galaxy' was evaluated most extensively in trials at Oregon State University's North Willamette Research and Extension Center (OSU-NWREC; Aurora, OR), USDA-ARS (Corvallis, OR), and Enfield Farms Inc. (Lynden, WA). In the Oregon trial plantings, standard cultural practices for semierect blackberry production were used, including annual pre- and postemergent herbicide applications, spring nitrogen fertilization (78 $kg \cdot ha^{-1}$ N), postharvest removal of floricanes, topping of primocanes at 1 m to encourage branching, training of primocanes to a two-wire trellis, and application of 2.5 to 5.0 cm of irrigation per week during the growing season, depending on rainfall. Delayed dormant applications of liquid lime sulfur and copper hydroxide were made to control leaf and cane spot (*Septoria rubi* Westend), purple blotch [*Sphaerulina westendorpii* (Westendorp) Verkley, Quaedvlieg & Crous (formerly *Septoria rubi* Westend)], rust [*Kuehneola uredinis* (Link) Arth.], and anthracnose [*Elsinoe veneta* (Burkholder) Jenk.] as a standard practice without any knowledge of the susceptibility of the selections in the trial to these diseases. The cooperating Washington grower is primarily a red raspberry (*Rubus idaeus* L.) grower, and although plants were spaced and trained similarly to those in the Oregon trials, they were irrigated and received nitrogen fertilizer rates that were standard for red raspberry but greater than typical for blackberry. At OSU-NWREC, 'Galaxy' was planted in a replicated trial in 2005, along with other selections and 'Navaho', which was a reference cultivar at the time (Finn and Strik, 2014; Moore and Clark, 1989). The experimental design was a randomized complete block with three replications (Moore and Clark, 1989), and each experimental unit consisted of three plants. Each replication was harvested once a week to determine harvest season, yield, and average fruit weight (based on a randomly selected subsample from each harvest) (Finn et al., 2005, 2014). A weighted mean fruit mass was calculated that adjusts the average mean fruit mass based on the proportion of the total yield harvested on each picking date. These data, collected from 2007 to 2009, were analyzed as a split plot in time with a fixed-effect model, with cultivar as the main plot and year as the subplot, with mean separation by least significant difference (LSD) (SAS PROC GLM; SAS Institute, Cary, NC). LSD values are presented only when there were significant differences for the trait. Of the multiple genotypes harvested from this replicated trial, only the data from 'Galaxy' and the named cultivars were included in the analysis (Table 1). The cultivar × year interaction was significant for yield but not for fruit weight, and the means for yield in each year are presented and compared.

Fruit evaluations were made during the harvest seasons using a 1- to 9-point scale

Table 1. Berry weight average and yield in 2007–09 for ‘Galaxy’ and ‘Navaho’ blackberries at Oregon State University’s North Willamette Research and Extension Center (Aurora, OR); planted in a replicated trial (three plots of three plants each) in 2005.

Cultivar	Berry wt (g) 2007–09	Yield (kg/plant) 2007	2008	2009	Avg 2007–09
Galaxy	8.1 a[z]	8.27 a	6.78 a	8.07 a	7.71 a
Navaho	5.7 b	9.54 a	4.37 b	5.30 b	6.40 a

[z]Means within a column followed by the same lowercase letter are not significantly different at $P > 0.05$ by the least significant difference test.

Table 2. Subjectively evaluated fruiting traits in 2012–18 for ‘Chester Thornless’, ‘Eclipse’, ‘Galaxy’, ‘Navaho’, ‘Ouachita’, and ‘Triple Crown’ blackberries at Oregon State University’s North Willamette Research and Extension Center (Aurora, OR).[z]

Cultivar	Drupelet fertility	Firmness	Skin toughness	Shape	Color	Glossiness	Heat/ultraviolet damage	Texture	Flavor
Chester Thornless	6.1 b[y]	7.9 ab	7.7 a	5.7 b	9.0 a	7.7 b	4.8 b	5.3 b	5.3 c
Eclipse	6.7 a	8.4 a	8.2 a	6.8 a	9.0 a	8.8 ab	7.0 a	6.0 a	7.3 a
Galaxy	6.8 a	7.6 b	7.3 a	6.3 a	8.8 b	8.0 ab	7.5 a	6.1 a	6.8 ab
Navaho	5.5 c	7.8 b	8.5 a	5.1 c	9.0 a	9.0 a	7.0 a	4.7 c	6.7 b
Ouachita	5.4 c	7.8 b	8.0 a	5.1 c	8.7 b	9.0 a	5.0 b	4.9 c	5.6 c
Triple Crown	6.7 a	6.1 c	5.5 b	6.1 a	8.8 b	7.8 b	6.8 a	5.4 b	7.2 a

[z]A 1- to 9-point scale was used, where 9 = the best expression of each trait and 1 = the worst for all traits.
[y]Means within a column followed by the same lowercase letter are not significantly different at $P > 0.05$ by the least significant difference test.

(9 = the best expression of each trait). The subjective fruit ratings included drupelet fertility (rating of drupelet set), firmness (as evaluated by hand in the field using six to eight fruit), color (ideal is a solid, dark black), shape (with a uniform, long conic berry being ideal), texture (as rated when chewed while tasting berries in the field), separation (how easily the ripe fruit were separated from the plant), and flavor (rated by tasting fruit in the field) (Table 2). Fruit were rated in 2015–17 for glossiness (ideal is glossy), skin toughness (while holding fruit, thumb was rubbed across the fruit surface and, ideally, the skin surface did not break and “bleed”), and tolerance of heat/ultraviolet light damage (when fruit were fully ripe the incidence of bleached or sunburned fruit was scored, where 9 = no evidence of injury). The number of fruit per lateral was determined based on counting the fruit on five typical fruiting laterals in each plot once during the season in 2015–17.

In 2016, fruit were harvested from single observation plots of ‘Eclipse’, ‘Galaxy’, and ‘Chester Thornless’ for a simple fresh market storage evaluation. Fruit were handpicked into three 125-g vented, plastic clamshell containers (unknown manufacturer). Samples were refrigerated (1 to 2 °C) and evaluated weekly for marketability.

Percent soluble solids, pH, total anthocyanin content, anthocyanin profile, and titratable acidity were determined from harvested fruit as described and presented in Finn et al. (2020). In separate trials, fruit also were evaluated informally as a thawed, individually quick frozen product by growers, processors, and researchers.

In 2008 and 2009, ‘Galaxy’ was planted along with a number of other genotypes in plots at Enfield Farms Inc. to assess cold hardiness. Although observations were made on these plants from 2008 to 2011, the winters were relatively mild (minimum temperature range, –12.2 to –10.0 °C in Dec. 2008, Dec. 2009, Nov. 2010, and Jan. 2011). In addition, single plots of multiple plants were planted at Berry Haven Farms (Abbotsford, BC), North Carolina State University (Raleigh, NC), the University of Arkansas (Clarksville, AR), Nourse Farms (Whatley, MA), and Willems Family Farm (Kingsburg, CA) to assess adaptation to these diverse climates.

Fig. 1. Typical fruiting laterals with ripe fruit of ‘Galaxy’.

The fruit ripening season in Oregon was characterized by the dates on which 5%, 50%, and 95% of the total fruit were harvested. Plant ratings were conducted once each year during the fruiting season for primocane and floricane vigor, flowering, or fruiting lateral length (1 = very short, 5 = very long) and strength (1 = weak, droopy; 5 = stiff, sturdy), and damage resulting from winter injury (9 = no injury, 1 = dead) (Table 2).

Description and Performance

‘Galaxy’ was moderate yielding, with yields greater than those for ‘Navaho’ in most years (Table 1). In unreplicated trials in 2002–15, ‘Galaxy’ yields were

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Mention of trade names or commercial products in this manuscript is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.
In loving memory of Dr. Chad E. Finn.
C.E.F. is deceased.
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Fig. 2. Flat of hand-harvested fruit of ‘Galaxy’ (**left**) vs. ‘Triple Crown’ (**right**).

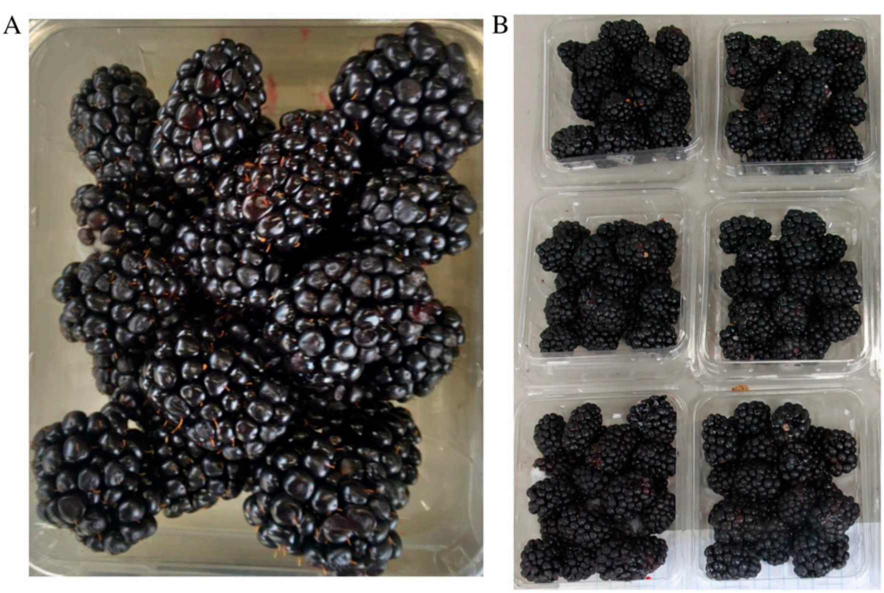

Fig. 3. Hand-harvested ‘Galaxy’ fruit (**A**) after 7 d of storage in a clamshell and (**B**) after 14 d of storage in a clamshell compared with ‘Eclipse’ (right column of three clamshells).

comparable to ‘Eclipse’ in most years (data not shown).

There were statistically significant differences between cultivar fruit-weight means, but no significant year or cultivar × year interaction effects. ‘Galaxy’ fruit were consistently about 50% heavier than ‘Navaho’ fruit (Table 1). ‘Galaxy’ fruit were more attractive and uniform than those of ‘Navaho’, ‘Ouachita’, and ‘Triple Crown’, resulting part from greater drupelet fertility (Table 2; Figs. 1–3). In the field, ‘Galaxy’ fruit were rated firmer than ‘Triple Crown’, softer than ‘Eclipse’, and similar to the other cultivars in the trial. The fruit’s skin toughness for the cultivars in the trial were similar except for ‘Triple Crown’, which had a very tender skin (Table 2). Although there were statistical differences in fruit color for the genotypes in the trial, they were not meaningful because all the genotypes had excellent dark color (Table 2). ‘Galaxy’ fruit were comparable to the other genotypes in the trial for fruit glossiness. When chewed, ‘Galaxy’ and ‘Eclipse’ fruit were perceived to be much less “crunchy” or “seedy” than those of ‘Navaho’ and ‘Ouachita’ (Table 2). ‘Galaxy’ fruit flavor was rated better than that for ‘Chester Thornless’ and ‘Ouachita’, and comparable to the other genotypes evaluated (Table 2). ‘Galaxy’, ‘Eclipse’, ‘Navaho’, and ‘Triple Crown’ had tolerable levels of heat/ultraviolet damage, and less than for ‘Ouachita’ and ‘Chester Thornless’ (Table 2). Although this could be the result of genotypic differences, we suspect that it was a result, in part, of ‘Galaxy’s earlier ripening season and thus fewer incidents of high temperature. In California’s Central Valley, ‘Galaxy’ fruit held up to sun and heat (up to 43 °C) with minimal fruit damage and was still liked by customers (J. Willems, personal communication).

Although ‘Galaxy’ fresh fruit was not tested in formal storage trials as a fresh fruit, in our informal trials it was rated comparable to ‘Chester Thornless’ and ‘Eclipse’ for quality after 7, 14, and 21 d of storage (Fig. 3). A commercial fresh market shipper rated ‘Galaxy’ fruit quality as comparable to ‘Chester Thornless’, better than ‘Von’ and ‘Eclipse’, and much better than ‘Triple Crown’ after 7 d of storage in clamshells in their commercial storage conditions (HBF International LLC, Sheridan, OR; personal communication).

In multiple years of evaluation, ‘Galaxy’ had percent soluble solids comparable to most cultivars, but was much higher than for ‘Black Diamond’, ‘Columbia Giant’, and ‘Čačanska Bestrna’, but not as high as ‘Navaho’ and ‘Triple Crown’ (Finn et al., 2020). The pH of ‘Galaxy’ fruit puree was similar to that of other blackberry cultivars. It was higher than that for ‘Columbia Giant’, ‘Columbia Star’, and ‘Marion’, and lower than that for ‘Osage’ and ‘Tupy’. ‘Galaxy’ fruit had a titratable acidity that was higher than for ‘Von’ and ‘Columbia Sunrise’, but was lower than most of the trailing blackberries including ‘Columbia Giant’, ‘Columbia Star’, ‘Hall’s Beauty’, and ‘Marion’. This combination of high soluble solids, moderate pH, and low titratable acidity makes ‘Galaxy’ desirable for fresh consumption because the fruit are perceived as being sweet.

The major anthocyanin was in fruit of ‘Galaxy’ and the other blackberry cultivars evaluated was cyanidin-3-glucoside (Finn et al., 2020). The total anthocyanin concentration for ‘Galaxy’ and ‘Eclipse’ was much less than for the trailing blackberries ‘Marion’, ‘Columbia Star’, and ‘Columbia Giant’, but similar to that for ‘Black Diamond’. The proportions of the various anthocyanins were different for ‘Galaxy’ and ‘Eclipse’; they had much lower proportions of cyanidin-3-rutinoside than the trailing blackberries. ‘Eclipse’, ‘Galaxy’, and ‘Marion’ were the only cultivars with measurable levels of cyanidin-3-dioxylaylglucoside. ‘Black Diamond’, ‘Columbia Giant’, and ‘Columbia Star’ had no detectable levels of this compound (Finn et al., 2020).

The trailing cultivars ‘Marion’ and ‘Black Diamond’ reached 50% ripe fruit 21 to 23 d ahead of ‘Galaxy’ (Table 3). ‘Galaxy’ and

Table 3. Ripening season estimated as the date at which yield passed the given percentage of total yield in 2007–09 for the semierect 'Čačanska Bestrna', 'Eclipse', and 'Galaxy'; the trailing 'Black Diamond' and 'Marion'; and the erect, floricane-fruiting 'Navaho' and primocane-fruiting 'Prime-Ark®45' at Oregon State University's North Willamette Research and Extension Center (Aurora, OR).

	Harvest season (percent total yield)		
Cultivar	5%	50%	95%
Marion	3 July	13 July	24 July
Black Diamond	1 July	15 July	29 July
Galaxy	22 July	5 Aug.	28 Aug.
Eclipse	20 July	7 Aug.	31 Aug.
Navaho	27 July	14 Aug.	14 Sept.
Čačanska Bestrna	3 Aug.	19 Aug.	12 Sept.
Prime-Ark® 45	13 Sept.	29 Sept.	13 Oct.

Table 4. Subjectively evaluated plant traits and the number of fruit per lateral in 2002–18 for 'Chester Thornless', 'Eclipse', 'Galaxy', 'Navaho', 'Ouachita', and 'Triple Crown' blackberries at Oregon State University's North Willamette Research and Extension Center (Aurora, OR).[z]

Cultivar	Floricane vigor	Primocane vigor	Lateral length	Lateral strength	No. of fruit/lateral
Chester Thornless	8.3 ab[y]	8.7 a	5.0 a	1.9 c	18.8 a
Eclipse	8.0 bc	8.4 a	4.0 b	2.9 a	10.8 b
Galaxy	7.6 cd	8.1 b	3.9 b	3.1 a	7.0 b
Navaho	7.2 de	7.7 c	3.9 b	3.0 a	7.5 b
Ouachita	7.0 e	7.5 c	3.1 d	2.2 c	7.0 b
Triple Crown	8.7 a	8.8 a	4.9 a	2.8 ab	10.0 b

[z]A 1- to 9-point scale was used for vigor scores, where 9 = the most vigorous and 1 = dead; a 1- to 5-scale for lateral scores, where 1 = short and weak and 5 = long and strong. Flowering date was an estimate of when 10% of the flowers were opened, and the number of fruit per lateral were counted.
[y]Means within a column followed by the same lowercase letter are not significantly different at $P > 0.05$ by the least significant difference test.

Fig. 4. Entire fruiting plant of 'Galaxy'.

'Eclipse' 5%, 50%, and 95% harvest dates were within 3 d of one another. 'Galaxy' began ripening before 'Navaho' and reached its 50% harvest date more than a week ahead of 'Navaho'. 'Navaho', unlike 'Galaxy', has a propensity to fruit heavily late in the season on basal buds that flower late, and this is seen with 'Navaho's 95% harvest date 21 d later than that for 'Galaxy'. 'Galaxy' was typically about 14 d earlier than 'Čačanska Bestrna' for the different harvest dates and much earlier than the primocane crop of 'Prime-Ark® 45'.

Although there were differences in floricane and primocane vigor among the cultivars evaluated, all those evaluated would be considered vigorous (Table 4, Fig. 4). 'Galaxy' had fruiting laterals that were comparable in length and strength to those of 'Navaho', and shorter, stronger, and less droopy than those of 'Chester Thornless' and 'Triple Crown' (Table 4). All the cultivars were similar in the number of fruit per lateral except 'Chester Thornless', which had more than twice as many fruit per lateral as some of the other cultivars (Table 4). All the cultivars showed excellent winter cold tolerance wherever they were trialed in the Pacific Northwest. Although 'Galaxy's overall adaptation has not been well tested, it has proved to be winter hardy in Arkansas, North Carolina, and British Columbia in typical winters (J.R. Clark, G. Fernandez, C. Lewis, D. Mutz, personal communication), but not in Massachusetts (P. Rizzo, personal communication).

'Galaxy' is similar to 'Eclipse' in that no significant incidence of foliar or cane diseases occurred in the Pacific Northwest with a minimal spray program. In Arkansas, 'Galaxy' was susceptible to anthracnose (*Elsinoë necator* Ellis & Everhart) as a young plant (J.R. Clark, personal communication). In a North Carolina trial, 'Galaxy' was not damaged by fusarium wilt (*Fusarium oxysporum* f sp. *mori* Pastrana and Gordon), whereas adjacent 'Eclipse' plants were. As with all semierect or erect blackberry genotypes growing in the western United States, 'Galaxy' is susceptible to redberry mite (*Acalitus essigi* Hassan) and spotted winged drosophila (*Drosophila suzukii* Matsumura).

'Galaxy' is a thornless, semierect blackberry that produces large yields of very firm and excellent-flavored fruit that should be well suited to fresh market production in the early season for a semierect blackberry. 'Galaxy' is higher yielding and has larger, better flavored, and/or firmer fruit than current cultivars ripening in this season. Although 'Galaxy' is expected to be adapted to areas where other semierect blackberries (e.g., 'Chester Thornless', 'Triple Crown') can be grown successfully, it should be tested on a moderate scale in colder regions before being widely planted.

The parentage of 'Galaxy' was confirmed using a fingerprinting set of eight simple sequence repeat (SSR) markers (Table 5) developed at the USDA-ARS National Clonal Germplasm Repository to genotype our blackberry collection (Zurn et al., 2018). All the alleles amplified in 'Galaxy' were found in either parent: ORUS 1393-1 or 'Triple Crown'. Five alleles at four loci (RH_MEa007aG06, Ro942, RH_ME0013dA06, and RH_MEa0015cE06) were shared uniquely with the ORUS 1393-1 parent, and four alleles at three (RH_MEa007aG06, Ro942, and RH_ME0013dA06) of the eight SSR loci could only be inherited from the other parent, 'Triple Crown' (Table 5).

'Galaxy' nuclear stock has tested negative for *Arabis mosaic virus*, *Cherry leaf roll virus*, *Cherry rasp leaf virus*, *Prunus necrotic ringspot virus*, *Raspberry bushy dwarf virus*, *Raspberry ringspot virus*, *Strawberry necrotic shock virus*, *Tobacco ringspot virus*, *Tomato black ring virus*, and *Xylella* by enzyme-linked immunosorbent assay. It also tested negative for *Apple mosaic virus*, *Blackberry chlorotic ringspot virus*, *Beet pseudo yellows virus*, *Blackberry virus Y*, *Blackberry yellow vein associated virus*, *Black raspberry necrosis virus*, *Raspberry latent virus*, *Raspberry leaf mottle virus*, Rubus *yellow net virus*, *Strawberry latent ringspot virus*, and *Tomato ringspot virus* in reverse transcription–polymerase chain reaction (PCR) assays, and for phytoplasmas and *Xylella* in PCR assays. It also was negative in bioassays when it was grafted onto *R. occidentalis* 'Munger'.

When this germplasm contributes to the development of a new cultivar, hybrid, or germplasm, it is requested that appropriate recognition be given to the source.

Availability

'Galaxy' is protected by U.S. Plant Patent 30,062 (Finn, 2019). Further information or a list of nurseries propagating 'Galaxy' is available on written request to Mary Peterson. Nurseries interested in a license for 'Galaxy' should contact the Office for Commercialization and Corporate Development at OSU. The USDA-ARS and OSU do not sell plants. In addition, genetic material of this release has been deposited in the National Plant Germplasm System as CRUB 2805 (PI 682651), where it will be available for research purposes, including development and commercialization of new cultivars.

Table 5. Genetic profiles of the parents (ORUS 1393-1 and 'Triple Crown') and the offspring ('Galaxy') at each of the eight simple sequence repeat (SSR) markers in the blackberry fingerprinting set (Zurn et al., 2018). Allele composition for all three genotypes is listed for each SSR. The light-gray highlighted alleles indicate alleles shared only with ORUS 1393-1; the dark-gray highlighted allele were inherited from the other parent, 'Triple Crown'.

Genotype	RH_MEa007aG06					Ro942					RH_MEa0008cF01					RH_ME0013dA06				
ORUS 1393-1		123	131	134	146	128	131		140		138	147	150		206	219		224	230	
Galaxy	111	123		134	146	128	131	138		142	138	147	150			219	221	224	230	233
Triple Crown	111		131		146	128		138		142	138	147	150	159		219	221		230	233

Genotype	RH_MEa0006bG05					ERubLRSQ_07-4_D05					RH_MEa0015cE06					RH_MEa011dG03a				
ORUS 1393-1	265	273	277	285	288		241			244	237	247	252	254	336	339		348	351	354
Galaxy				285						244	237		252							354
Triple Crown				285						244		247	252				345			354

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