

Flat Peach SUBLOR and SUBLIM and Flat Nectarine PERLA Series

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Flat peach and flat nectarine (*Prunus persica* L. Batsch.) production in Spain started from local cultivars at marginal sites, mainly in the Ebro Valley and Murcia regions. At the end of the 1990s, the introduction of improved cultivars from France and Italy, with more red skin color coverage and better regular shape, fruit size, and styler cavity closure, together with superior handling and transport conditions led the Spanish peach sector to develop this fruit type on a commercial scale.

Currently, Spain is the largest European producer and exporter of flat peach and nectarine, offering a wide range of cultivars covering the producing period from May to September. In 2020, a total of 10,200 ha for flat peach and 481 ha for flat nectarine together produced 263,651 t (20% of the total peach production) (MAPAMA, 2022).

To guarantee adaptation to local growing conditions (Font i Forcada et al., 2021a), several national breeding programs started to develop new flat peach and flat nectarine cultivars. One of these breeding programs is the ASF-IRTA breeding program, which is located at Gimènells (Lleida) in the Ebro Valley (northeastern Spain), which is a major region of peach production in Spain (Batlle et al., 2012; Cantín et al., 2017). It was started in 2004, with the objective of developing new cultivars adapted to chilling between 1000 and 1500 chill units or between 42 and 75 chill portions and warm conditions similar to the Mediterranean area (32 °C mean daily summer temperature and 300–400 mm of annual rainfall). It aimed to produce high-quality fruits,

both at harvest and after cold storage, with the ultimate goal of satisfying consumers (Font i Forcada et al., 2021a, 2021b). As a result of this collaborative effort, the ASF-IRTA scion peach breeding program has already released the SUBLOR (one flat yellow-fleshed peach), SUBLIM (six flat white-fleshed peach), and PERLA (two flat white-fleshed nectarine) series. These nine new flat peach and nectarine cultivars produce highly attractive yellow-fleshed or white-fleshed fruits with high coverage of red skin, a balanced or acid flavor, sweet taste, and good flesh firmness. The harvesting calendar of these series will be progressively completed with new future releases.

Origin

Regarding SUBLOR flat peaches, ‘SUBLOR 2601’ was a seedling from 01.29E.17 NbPI × open pollination. For SUBLIM flat peaches, ‘SUBLIM 2801’ was a seedling from ASF 01.10.64.02 PbPI × ASF 02.10.66.02 Nb, ‘SUBLIM 3001’ was from PBP 01.29E.44 × open pollination, ‘SUBLIM 3002’ was from ASF 01.24.88.01 PbPI × ASF 02.10.66.02 Nb, ‘SUBLIM 3101’ was from PBP 01.29E.33 × open pollination, ‘SUBLIM 3201’ was from PBP 01.29E.44 × open pollination, and ‘SUBLIM 3801’ was from PBP 01.29E.44 × open pollination. For PERLA flat nectarine series, ‘PERLA 2501’ and ‘PERLA 3501’ were from 03.24.43 PbPI × ASF 02.10.66.02 Nb.

Description

Tree vigor, tree habit, and flower density were described according to the International Union for the Protection of New Varieties and Plants (UPOV, 2010) and the Community Plant Variety Office (CPVO, 2015).

SUBLOR flat peach (yellow-fleshed), with ‘SUBLOR 2601’ being the only one of this series, is moderately vigorous and has a spreading habit. Under the growing conditions of the Ebro Valley, it blooms during March and has medium flower density. It is considered an early cultivar, with its harvest time being during the third week of June (Supplemental Table S1).

SUBLIM flat peach series (white-fleshed) are moderately vigorous and have a spreading habit, except for ‘SUBLIM 3101’ and ‘SUBLIM 3201’, which have an upright to spreading habit. Under the growing conditions of the Ebro Valley, full bloom occurs during March, and harvesting dates are between the end of June and mid-September (16 June–15 Sept.) (Supplemental Table S1).

PERLA flat nectarine series (white-fleshed) is moderately vigorous and has an upright to spreading habit. Under local growing conditions, full bloom occurs during March, and harvesting dates are between the beginning of July and mid-September (9 July–16 Sept.) (Supplemental Table S1). Differently from other commercial cultivars, there is no need for flower thinning because adequate fruit thinning will effectively optimize fruit size.

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Fig. 1. Typical fruit appearance at the commercial ripening stage: 'SUBLOR 2601' (A); 'SUBLIM 2801' (B); 'SUBLIM 3001' (C); 'SUBLIM 3002' (D); 'SUBLIM 3101' (E); 'SUBLIM 3201' (F); 'SUBLIM 3801' (G); 'PERLA 2501' (H); and 'PERLA 3501' (I).

Performance

All nine cultivars were originally selected as seedlings grown at selection plots and then grafted (two or three replicates per selection) onto 'Cadaman' rootstock after selection (the fifth most used rootstock in the Ebro Valley) (Reig et al., 2013). The location and orchard management have been described by Font i Forcada et al. (2021a, 2021b). The data presented in Supplemental Table S1 summarize the average values for 6 years on full-sized trees.

Maturity time. SUBLIM 2801 and SUBLOR 2601 are early-season cultivars, whereas the rest of the cultivars are mid-season cultivars, except for 'SUBLIM 3801' and 'PERLA 3501', which are considered late-season cultivars (Supplemental Table S1).

Yield. Trees were harvested during one or two picks separated by 4 to 6 d. Then, all fruits were graded as reported by Font i Forcada et al. (2021a, 2021b). Under the growing conditions of the Ebro Valley, except for the midseason 'SUBLIM 3001', which had a small fruit size but great yield, the rest of the cultivars stood out for their high productivity and good fruit size, regardless of their harvesting season (Supplemental Table S1).

Fruit quality. Twelve fruits per cultivar were used for quality determinations. All cultivars were sweet, aromatic, firm, and melting (Supplemental Table S1). All the fruit evaluated had more than 80% red skin coverage, with a perfect styler cavity closure, except for 'PERLA 2501', which showed an unperfected styler cavity closure (Supplemental Table S1, Fig. 1), which never implied post-harvest problems caused by fungus infections. Skin lenticels are not visible on both PERLA cultivars (Fig. 1). It should be noted that hot climates such as that of the

Ebro Valley are conducive to the development of lenticels on fruit skin. In addition, this defect is related to wood aging. However, this issue does not seem to affect these new cultivars.

Postharvest performance. The sample size and methodology have been described by Font i Forcada et al. (2021a, 2021b). All cultivars showed good postharvest performance after 30 d at 0.5°C plus 2 d at 20°C.

Availability

The cultivars are protected by the Community Plant Varieties Office with the following registration numbers: 20191202 for 'SUBLOR 2601'; 20191135 for 'SUBLIM 2801'; 20191200 for 'SUBLIM 3001'; 20191215 for 'SUBLIM 3002'; 20191213 for 'SUBLIM 3101'; 20201225 for 'SUBLIM 3201'; 20191201 for 'SUBLIM 3801'; 20191214 for 'PERLA 2501'; and 20203072 for 'PERLA 3501'. Virus-free plants are available from nurseries authorized by the IRTA (Spain). The plant material was laboratory-tested to provide negative results for the following: *Agrobacterium tumefaciens* [reverse-transcriptase polymerase chain reaction (RT-PCR)]; Apple Chlorotic Leaf Spot Virus (ACLSV) [enzyme-linked immunosorbent assay (ELISA)]; *Candidatus* Phytoplasma prunorum (RT-PCR); Peach Latent Mosaic Viroid (PLMVd) (Molecular Hybridisation); Plum Pox Virus (PPV) (ELISA); *Prune Dwarf Virus* (PDV) (ELISA); *Prunus Necrotic Ring Spot Virus* (PNRSV) (ELISA); *Xanthomonas arboricola* pv. *pruni* (RT-PCR); and *Xylella fastidiosa* (RT-PCR).

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Supplemental Table S1. Agronomic and fruit quality characteristics of the SUBLOR and SUBLIM flat peach series, PERLA flat nectarine series, and reference commercial cultivars 'Platibelle' and 'Flatstar' trialed at IRTA, Gimenezells, Lleida, Spain.

Trait	SUBLOR 2601	SUBLIM 2801	SUBLIM 3001	SUBLIM 3002	SUBLIM 3101	SUBLIM 3201	SUBLIM 3801	PERLA 2501	PERLA 3501	PLATIBELLE ⁱ	FLATSTAR ⁱ
Tree vigor	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Tree habit	Spreading	Spreading	Spreading	Spreading	Upright to spreading	Upright to spreading	Spreading	Upright to spreading	Upright to spreading	Spreading	Spreading
Flowering period	6–18 Mar.	6–14 Mar.	8–15 Mar.	7–15 Mar.	9–16 Mar.	8–18 Mar.	9–19 Mar.	3–11 Mar.	7–10 Mar.	4–25 Mar.	4–25 Mar.
Flower density	Medium	Medium to sparse	Medium to dense	Medium to dense	Medium to dense	Medium	Medium to dense	Medium to dense	Medium to dense	Medium	Dense
Harvesting period	19 June–2 July	26 June–19 July	16–23 July	21 July–3 Aug.	16 July–2 Aug.	23 July–10 Aug.	12–15 Sept.	9–19 July	26 Aug.–16 Sept.	18 July–2 Aug.	9 Aug.–30 Aug.
Fruit development period (days) ⁱⁱ	99–115	119–123	130–135	130–144	138–144	131–152	181–191	127–132	177–193	124–139	150–172
Yield (kg/tree)	42.1	39.7	47.9	66.2	51.6	70.5	40.0	45.5	31.9	52.2	66.6
Dominant fruit size (mm)	70–75	75–80	70–75	80–85	75–80	75–80	80–85	70–75	75–80	75–80	75–80
Flesh color	Yellow	White	White	White	White	White	White	White	White	White	White
Flesh firmness (N)	41.2	50.0	51.9	44.1	45.1	46.1	54.7	56.8	59.8	47.0	46.1
Soluble solids (°Brix)	12.4	12.6	12.7	11.7	12.4	13.2	14.1	13.1	12.6	11.5	12.4
Acidity (g·L ⁻¹ malic acid)	4.6	5.6	4.5	4.3	4.4	6.3	4.1	4.7	5.1	3.4	4.2
Flesh texture	Melting	Melting	Melting	Melting	Melting	Melting	Melting	Melting	Melting	Melting	Melting
Flavor	Moderate	Intense	Intense	Moderate	Moderate	Intense	Intense	Intense	Intense	Intense	Intense
Red blush (%)	80–100	80–100	80–100	80–100	80–100	80–100	80–100	100	80–100	80–100	80–100
Stylar cavity closure	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Good	Excellent
Postharvest performance ⁱⁱⁱ	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Moderate

ⁱ Reference cultivar.

ⁱⁱ Days from full bloom to physiological ripening.

ⁱⁱⁱ Postharvest performance: good (<25% of total fruits showed mealiness and/or internal browning symptoms); moderate (25% to 50% of total fruits showed mealiness and/or internal browning symptoms); and poor (>50% of total fruits showed mealiness and/or internal browning symptoms).