

# ‘Smaragd’ Apple

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‘Smaragd’ is a columnar apple cultivar (*Malus × domestica* Borkh.) released in 2006, as a result of the breeding program at the Department of Fruit Growing, Viticulture, Horticulture, and Landscape Architecture, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia. The tree has columnar growth habit that, depending on the rootstock vigor, makes it an excellent commercial cultivar for use as a late-harvested dessert apple, as well as in amateur orchards or in potted growing conditions. The distinctive growth habit of ‘Smaragd’ cultivar enables extremely dense planting for commercial fruit production. In the climatic conditions of northern Serbia, ‘Smaragd’ fruits mature during the first week of October, 5 days before ‘Granny Smith’. ‘Smaragd’ is characterized by easily managed trees with green ground color without overcolor, while it combines the fruit appearance and internal characteristics of the commercially significant ‘Granny Smith’ with the columnar tree growth of ‘McIntosh Wijkic’.

## Origin

‘Smaragd’ originated from a cross between ‘Granny Smith’ and ‘McIntosh Wijkic’, created at Faculty of Agriculture, Novi Sad, in 1992, with the aim to create a columnar cultivar suitable for very intensive orchards and amateur gardens (Ognjanov et al., 2009). Hybridization included all activities on the part of plant breeders that could potentially result in segregating population of seedlings from which superior individuals were selected (Layne, 1983). Seeds were stratified in November, and sown in the vermiculite in early February, subsequently germinated and grown in greenhouse. The hybrid population of over 4000 seedlings was transplanted to the field in May with 1.2 × 0.2 m<sup>2</sup> spacing. Scab and mildew were controlled by spray treatments in the spring only. Early selection for columnar growth habit and field tolerance to fungal diseases was applied after 18 months of growth. Non-columnar trees were discarded. Superior seedlings were budded on M.26 rootstock and grown until the first fruit production. The seedling was selected in 1999 and grafted on MM.106 and M.26 clonal rootstocks. Only two selections, com-

binning desirable columnar tree habit with green ground color of fruit, were finally selected. Our results of columnar habit inheritance (Ognjanov, 2005) were in agreement with those of De Wit et al. (2004), Ikase and Dumbravs (2004), Tian et al. (2005), and Tobutt (1985, 1994).

The official trials by the Ministry of Agriculture of Serbia were organized on two locations. At least 15 trees, divided in three replications, were used as test plots. The experimental design was completely randomized, with ‘McIntosh Wijkic’ and ‘Granny Smith’ as standard cultivars. Officially elected Ministry Committee of experienced horticulturists and growers assessed the developmental characteristics of the new cultivar three times a year. DUS (Distinctness, Uniformity and Stability) and VCU (Value for Cultivation and Use) tests were conducted based on characterization and evaluation data during the three consecutive fruiting years—2004 to 2006—using UPOV (The International Union for the Protection of New Varieties of Plants) descriptor for apple.

The aim of the research was to provide information on the new apple cultivar ‘Smaragd’ and to conduct an evaluation in comparison with its parent cultivars regarding tree habit, productivity, fruit quality attributes, and disease tolerance.

## Description

The evaluation and the description presented in this article were carried out over three consecutive years (2008–2010; when the trees were 6- to 8-years old) in the officially approved experimental trial, located in Pančevo (long. 20°33’ E, lat. 44°42’, altitude 83 m). The soil of the experimental orchard at a depth of 0 to 60 cm was characterized as a chernozem of low organic matter content (1.98%), with a soil acidity of pH 6.3. Soil nutrient contents included phosphorus 27.6 mg·kg<sup>-1</sup>, potassium 31 mg·kg<sup>-1</sup>, calcium 4.6%, and nitrogen 1.59%. Climate conditions were continental, mid-European in character. According to the data from the nearest meteorological station (12 km), the average year-round temperature was 11.3 °C with 643.8 mm of rainfall per year. Furthermore, the latest set of 30-year average climate records indicate that the absolute temperature in Pančevo ranges between –29.5 and +40.5 °C.

*Tree and leaf.* ‘Smaragd’ is characterized by erect, dense, and compact columnar branchless cordon of low vigor that can extend up to

1.6 m in height and 30 cm in width when grafted on MM.106 after 8 years of growth (Fig. 1). Dormant 1-year-old shoots are thick with very short internode length. The foliage is dense and evenly distributed along the cordon. The leaves are large, leathery, thick, dark green, and extend outward from the shoot. Leaf blade length/width ratio is medium with serrate margin incisions. Trees may be planted in close proximity, requiring a distance of only 40 cm in the row. When grafted on M.26, ‘Smaragd’ has dwarfing columnar tree form, suitable for cultivation as a potted tree. After 1 year in the nursery, ‘Smaragd’ began to bear fruit in the first year after planting, with axillary buds forming fruit-producing spurs in successive years. However, limited growth of side branches was observed, mostly in instances when the terminal bud was damaged. This is a medium annual cropping cultivar with no tendency toward biennial bearing.

*Inflorescence.* ‘Smaragd’ has a late onset of flowering, 3 d before Granny Smith, and 5 d later than ‘Waltz’. The flowers tend to be small, with medium pink petals at the full balloon stage, changing to white with a tinge of pink once fully opened. Recommended pollinating varieties for ‘Smaragd’ are columnar apple varieties ‘Zeleni dragulj’, ‘Kraljica čardaša’, ‘Charlotte’, ‘Obelisk’, and ‘Maypole’. Flowers of ‘Smaragd’ produce viable pollen. Using full diallel design, ‘Smaragd’ was proved to be suitable for pollinating ‘Granny Smith’, ‘Golden Delicious’, ‘Jonagold’, ‘Idared’, and all above-mentioned columnar apple varieties.

*Fruits.* The fruit characteristics presented in this article are the mean values of five fruits per tree, harvested from 15 trees (three replications × five trees) of each cultivar. ‘Smaragd’ has a late ripening season, 5 d earlier than ‘Granny Smith’ (Table 1). Fruit is larger in size than ‘Granny Smith’ variety, measuring 75 mm in diameter, weighing 175 g, with flat globose and symmetric vertical cross-section (Fig. 2).

Stem cavity is wide and regular, with medium stalk length (20.6 mm on average). The calyx cavity is wide and shallow, with a tendency for the calyx tube to be closed. Skin color is 100% uniform green, with no overcolor, with the presence of small, usually inconspicuous, lenticels. The skin is fine, smooth, covered by a light waxy layer, with no russetting.

The fine, crisp, juicy, white flesh has fine-grained texture and a taste superior to ‘Granny Smith’. It is mildly acidic with pleasant flavor and a fragrant aroma. Maturity indices, such as firmness and starch iodine index, were used to categorize ‘Smaragd’ into very late maturity group. The starch index was 6.2, evaluated using the starch iodine test. Fruit is ready to harvest with the least susceptibility to scald when all areas within the core line are white, a quarter of the cortex is white and the remainder is blue. At harvest time, the flesh firmness value was 8.64 kg·cm<sup>-2</sup> (measured using a FT 327 penetrometer with a 11-mm probe; Winopal Forshchungsbedarf GmbH,

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Fig. 1. 'Smaragd' is a weak vigor columnar tree with distinct green fruits.

Table 1. Fruit characteristics of 'Granny Smith', 'McIntosh Wijkik', and 'Smaragd' apple cultivars grafted on M.26 rootstock—mean values over a period of 3 years (from 6th until the 8th year of the tree age).

Character	Granny Smith	Smaragd	McIntosh Wijkik
Harvest maturity	4.10	2.10	2.09
Tree habit	Spreading b	Upright a	Upright a
Fruit weight (g)	173.6 b	176.3 b	163.9 a
Fruit height (mm)	67.5 b	67.8 b	61.8 a
Fruit width (mm)	74.1 a	74.3 a	80.0 b
Fruit attractiveness	Good b	Extremely good c	Intermediate a
Ground color	Green b	Green b	Cream white a
Overcolor (%)	15 b	0 a	70 c
Sunburns (%)	11 b	0 a	25 c
Flesh color	White a	White a	White a
Mildew susceptibility	High a	Low b	High a
Scab susceptibility	High a	Low b	High a
Firmness (kg·cm <sup>-2</sup> )	9.16 c	8.64 b	7.43 a
Flavor	Acid a	Acid a	Sweet/acid b
Total soluble solids (%)	11.5 a	11.6 a	12.6 b
Titrate acidity (% of malic acid)	1.03 b	1.03 b	0.88 a

Means for particular trait followed by different letters are significantly different according to Duncan's multiple range test ( $P < 0.05$ ).



Fig. 2. Fruits of 'Smaragd' apple.

Ahnsbeck, Germany), total soluble solids content (0%–32%, measured with hand-held refractometer) was 11.6%, and titrate acidity was 1.03 (percentage of malic acid, titration with 0.1 N NaOH to pH 8.1). Although most of the 'Smaragd' fruits were exposed to the sun, no sunburn occurred, whereas under the same conditions, 'Granny Smith' developed undesirable yellowish to pinkish blush on the skin surface and sunburn damage on 30% and 11% fruits, respectively. Storage quality is good, with the fruit retaining green color, firmness, texture, juiciness, and flavor for at least 4 months in standard cold storage at +2 °C, 90% to 95% RH. Susceptibility to physiological disorders during storage is comparable to that of 'Granny Smith', mainly being prone to superficial scald. However, without preharvest calcium sprays, 'Smaragd' is less susceptible to bitter pit than 'Granny Smith'.

Principal component analysis provided differentiation between 'McIntosh Wijkik',

'Granny Smith', and 'Smaragd' with respect to fruit weight, height and width, fruit attractiveness, susceptibility to sunburn, mildew and scab, tree habit, and percentage of fruit overcolor.

**Productivity.** 'Smaragd's distinctive growth habit enables extremely dense planting for commercial fruit production. The new cultivar can be grown in single rows with 40-cm distance between the trees and 1.2 m between rows, thus enabling planting densities of up to 12,000 unstaked trees per hectare. It complies with technological solutions reported by Schwarz (2009). With 6.9 kg/tree annual yield from 6th to 8th season without biennial bearing, 'Smaragd' allows a yield increase up to 85 trees per hectare. The trees of the new cultivar are easy to manage and require little pruning. Most of the time, 'Smaragd' sets one or two fruits per cluster. Thinning is required only occasionally but overbearing must not be allowed in the first 4 years as it could hinder the vegetative growth. Nevertheless, fruit setting rate is always lower than in 'McIntosh Wijkik'. Preharvest fruit drop is low, regardless of summer thinning, water availability, or seasonal temperature variations.

**Pest and disease susceptibility.** 'Smaragd' has shown moderate field resistance to apple scab and powdery mildew caused by *Venturia inaequalis* (Cke) Wint. and *Podosphaera leucotricha* (Ell.&Everh.) Salm. A few spray treatments in the spring—one before and after the bloom—are recommended. Hypersensitive reaction to scab and mildew without sporulation are usual leaf reactions to natural infection from the end of May until the harvest, but they are never observed on the fruit. If the fruits are individually arranged by thinning, the *Cydia pomonella* L. damage is rare. Aphid susceptibility is low due to its low vigor and thick, leathery leaves.

### Availability

Limited quantities of budwood are available for testing and commercial propagation from the Department of Fruit Growing, Viticulture, Horticulture and Landscape Architecture, Faculty of Agriculture, Novi Sad, Serbia. 'Smaragd' is not a patented cultivar. Budwood source trees are virus-tested negative. Virus-free material will be available in 2 years time from the Naktuinbouw Test Center Horst, Holland.

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