

‘Sava’ and ‘Krka’ Walnut Cultivars

Anita Solar¹

Biotechnical Faculty, Agronomy Department, Experimental Field for Nut Crops, Vinarska 14, 2000 Maribor, Slovenia

Robert Veberic and Franci Stampar

Biotechnical Faculty, Agronomy Department, Jamnikarjeva 101, 1000 Ljubljana, Slovenia

Additional index words. intermediate and lateral bearing, *Juglans regia*, late leafing, *Rhagoletis completa* Cresson, *Xanthomonas arboricola* pv. *juglandis*

‘Sava’ and ‘Krka’ are new walnut cultivars of Slovene origin. They were developed and evaluated at the Biotechnical Faculty Ljubljana, Slovenia, and were released in 2013. ‘Sava’ is a late-leafing cultivar, appropriate for orchard planting in continental climatic conditions. It has good and regular crop, owing to an intermediate fruiting pattern and good balance between vegetative growth and fruiting. As the homogamous cultivar, ‘Krka’ is suited for home gardens as a solitary tree that forms a densely branched canopy with a rather erect to spreading growth habit and lateral fruiting pattern. As a result of its good yielding capacity, it is also recommended for orchard planting in warmer areas.

Origin

‘Sava’ and ‘Krka’ were selected out of a Slovene domestic population of Persian walnut (*Juglans regia* L.). ‘Sava’ was tested as ‘Zdole-59’ and ‘Krka’ as ‘Erjavec’ (Solar and Stampar, 2006). Because the original trees grow in the vicinity of rivers Sava and Krka, the new cultivars were named after them. The selection was guided as a competition for collecting high-quality nuts in which owners of perspective trees were invited to send their walnut samples for evaluation. A total of 1215 genotypes were observed on-farm for their phenological and vegetative traits as well as for pomological traits of the nuts in a 3-year period, resulting in 24 preselected genotypes. They were clonally propagated and planted in ex situ collection Maribor together with ‘Franquette’ and Geisenheim sel. No. 139 (‘G-139’) as control cultivars. After 15 years of field and laboratory evaluations, which were conducted according to IPGRI (1994) and UPOV (1988), ‘Sava’ and ‘Krka’ were chosen as cultivars strongly fitted to selection goals, which were late leafing date, low susceptibility to walnut blight (*Xanthomonas arboricola* pv. *juglandis*) (WB), and walnut husk fly (*Rhagoletis completa* Cresson) (WHF), intermediate or lateral

fruiting habit, and high-quality, medium-sized nuts with a smooth shell, bright kernel, and high kernel percentage (Solar et al., 2002, 2003).

Description and Performance

‘Sava’. The time of leaf bud burst is late, 2 d before ‘Franquette’ and a week later than ‘G-139’ (Fig. 1). The first female and male flowers appeared 3 and 4 years after planting, respectively. Flowering is protandrous without any overlapping between pollen shedding and pistillate flowers’ receptivity. They can be efficiently pollenized by ‘Meylannaise’, ‘Ronde de Montignac’, and Slovene variety ‘Elit’. ‘Sava’ is an early-maturing variety, harvested in mid-September, 1 to 2 weeks before ‘Franquette’. Leaves fall at the beginning of November, similar to both control cultivars.

The tree is of strong vigor and high branching density (Table 1; Fig. 2). It has a spreading growth habit with strong shoots (Kelc et al., 2007, 2010), low susceptibility to WB and WHF, and good winter-hardiness. Owing to late leafing, it is not susceptible to

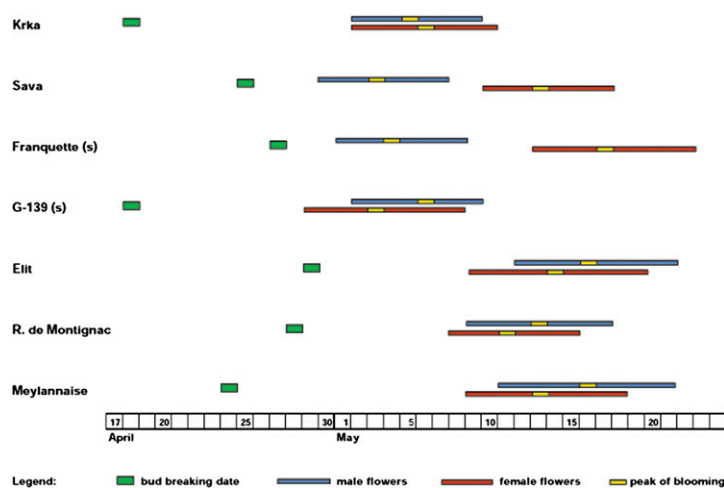


Fig. 1. Phenogram of Krka and Sava cvs. in comparison with standards ‘Franquette’ and ‘G-139’ and pollenizers ‘Elit’, ‘Ronde de Montignac’, and ‘Meylannaise’.

Table 1. Tree characteristics of Sava and Krka cultivars in comparison with standard cultivars Franquette and G-139 according to IPGRI (1994) and UPOV (1988).^z

| Trait | Sava | Krka | Franquette | G-139 |
|--|------|------|------------|-------|
| Vigor (3-5-7-9) ^y | 7 | 8 | 8 | 9 |
| Growth habit (1-2-3) ^x | 3 | 2 | 2 | 3 |
| Density of branches (1-3-5-7-9) ^w | 8 | 7 | 5 | 7 |
| Predominant location of fruit buds (1-2-3) ^v | 2 | 3 | 1 | 1 |
| Color of one-year-old shoot (1-2-3-4) ^u | 4 | 2 | 3 | 2 |
| Number of male catkins (3-5-7) ^t | 5 | 5 | 5 | 7 |
| Time of nut maturity (3-4-5-6-7) ^s | 3 | 3 | 6 | 4 |
| Time of leaf fall (3-5-7) ^r | 5 | 3 | 5 | 7 |
| Time of leaf bud burst (1-2-3-4-5-6-7-8-9) ^q | 6 | 4 | 8 | 4 |
| Time of male flowering ♂ (1-2-3-4-5-6-7-8-9) ^p | 7 | 6 | 7 | 3 |
| Time of female flowering ♀ (1-2-3-4-5-6-7-8-9) ^o | 6 | 6 | 7 | 3 |
| Time of ♂ flowering vs. ♀ flowering (1-2-3) ⁿ | 1 | 2 | 3 | 2 |
| Susceptibility to walnut blight (0-1-3-5-7-9) ^m | 1 | 5 | 3 | 3 |
| Susceptibility to walnut husk fly (0-1-3-5-7-9) ^l | 3 | 5 | 5 | 5 |

^zData are 10 years: 2001–12 mean.

^y3 = weak, 9 = very strong.

^x1 = upright, 3 = spreading.

^w1 = very sparse, 9 = very dense.

^v1 = at tip of 1-year-old shoot, 3 = all along the 1-year-old shoot.

^u1 = dark yellow, 4 = blackish.

^t3 = few, 7 = many.

^s3 = early, 7 = late.

^{q,p,o}1 = very early, 9 = very late.

ⁿ1 = protandry, 3 = protogyny.

^{m,l}0 = no sign of susceptibility, i.e., non-host response, 9 = very high susceptibility (strong host response).

Received for publication 11 Mar. 2014. Accepted for publication 30 May 2014.

¹To whom reprint requests should be addressed; e-mail anita.solar@bf.uni-lj.si.



Fig. 2. Tree of 'Sava' walnut at the end of the 14th vegetation period (8.1 m tall, 8.7 m in canopy diameter).

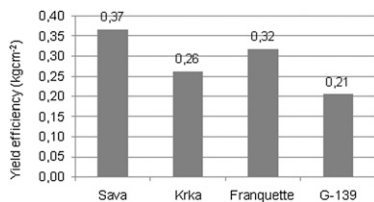


Fig. 3. Yield efficiency (cumulative yield per tree, presented as the 12-year average/cm² trunk cross-sectional area) calculated at the end of the 14th vegetation period.



Fig. 4. Nuts of 'Sava' walnut.

late spring frosts. It bears nuts on the tops of strong annual shoots that are inserted on 2-year-old or older parent shoots (intermediate fruiting behavior). Vegetative growth and fruiting are very well balanced. Yield is regular, about the same as in 'Franquette' and higher than in 'G-139', having better yield efficiency than both control cultivars (Fig. 3).

The nut is of medium to large size and a long trapezoid shape with a strong apical tip and a smooth shell (Fig. 4). The kernel is bright and can be easily removed from the shell. Kernel percent is medium, ranging between 38% and 49% (Table 2).

'Krka'. This is an early to medium leafing cultivar with the same date of leaf bud burst as 'G-139'. Flowers were first observed in the second year (females) and in the fifth year

Table 2. Nut and kernel traits of Sava and Krka cultivars in comparison with standard cultivars Franquette and G-139 according to UPOV (1988).^z

| Trait | Sava | Krka | Franquette | G-139 |
|---|------------|------------|------------|------------|
| Nut height (mm) | 37.2 ± 2.4 | 31.4 ± 1.9 | 41.1 ± 3.0 | 37.5 ± 1.9 |
| Nut width (mm) | 30.5 ± 1.8 | 29.1 ± 1.6 | 31.4 ± 1.9 | 32.1 ± 1.5 |
| Nut thickness (mm) | 31.6 ± 1.7 | 29.8 ± 1.5 | 31.1 ± 1.8 | 33.2 ± 1.7 |
| Roundness index | 0.84 ± 0.1 | 0.94 ± 0.0 | 0.77 ± 0.1 | 0.87 ± 0.0 |
| Nut weight (g) | 11.2 ± 1.2 | 8.0 ± 1.0 | 11.3 ± 1.2 | 11.8 ± 1.4 |
| Kernel weight (g) | 4.8 ± 0.9 | 4.0 ± 0.6 | 4.8 ± 0.7 | 5.1 ± 0.7 |
| Kernel percentage (%) | 42.9 ± 3.6 | 49.3 ± 2.8 | 42.7 ± 2.0 | 42.9 ± 1.8 |
| Shell thickness (mm) | 1.5 ± 0.2 | 1.0 ± 0.1 | 1.4 ± 0.2 | 1.4 ± 0.1 |
| Structure of shell surface (1–4 scale) ^y | 1.0 ± 0.3 | 1.5 ± 0.3 | 3.0 ± 0.4 | 1.0 ± 0.3 |
| Adherence of shell halves (1–9 scale) ^z | 7.0 ± 1.7 | 7.3 ± 0.6 | 7.4 ± 0.7 | 7.0 ± 1.2 |
| Ease of kernel removal (1–7 scale) ^q | 3.2 ± 0.4 | 2.1 ± 0.5 | 1.0 ± 0.5 | 1.9 ± 0.4 |
| Kernel color (1–7 scale) ^c | 2.2 ± 0.3 | 2.0 ± 0.6 | 1.9 ± 0.2 | 2.4 ± 0.3 |

^zData are 10 years: 2001–12 mean ± SD.

^y1 = slightly grooved; 4 = embossed.

^z1 = very weak; 9 = very strong.

^q1 = very easy; 7 = difficult.

^c1 = very light; 7 = dark.



Fig. 5. Tree of 'Krka' walnut at the end of the 14th vegetation period (9.6 m tall, 8.5 m in canopy diameter).



Fig. 6. Nuts of 'Krka' walnut.

(males) after planting. Flowering is highly homogamous. Pollen shedding completely coincides with pistillate bloom and assures self-pollination and yielding without other pollenizers (Fig. 1). The tree produces a lot of male inflorescences and could be used as a pollenizer for medium-flowering cultivars such as 'Chandler', 'Adams', and 'Ferjean'. 'Krka' harvest occurs in midseason, ≈1 week earlier than in 'Franquette'. Leaves fall in the last days of October, 2 to 3 d earlier compared with both control cultivars.

The tree is very vigorous and densely branched (Table 1; Fig. 5) with a semiupright to spreading growth habit, medium susceptibility to WB and WHF, good winter-hardiness, and medium susceptibility to late spring frosts. It has a lateral fruiting behavior and bears nuts on short but vital annual shoots that have from 50% up to 86% fruitful lateral buds. Vigorous growth and high yielding are in good balance. Yield is high and regular and exceeds both control cultivars. Considering yield efficiency, 'Krka' is similar to 'Franquette' and better than 'G-139' (Fig. 3).

The nut is small to medium, round-shaped with a weak apical tip (Fig. 6). The shell is smooth to slightly grooved and very thin with strong adherence of the halves. A bright kernel is easily removable; the kernel percent frequently exceeds 50% (Table 2).

Availability. 'Sava' and 'Krka' were released as public cultivars. Limited quantities of scion wood are available from the senior author.

Literature Cited

- IPGRI. 1994. Descriptors for walnut (*Juglans* spp.). International Plant Genetics Institute, Rome, Italy.
- Kelc, D., F. Stampar, and A. Solar. 2007. Fruiting behaviour of walnut trees influences the relationship between the morphometric traits of the parent wood and nut weight. *J. Hort. Sci. Biotechnol.* 82:439–445.
- Kelc, D., F. Stampar, and A. Solar. 2010. Architectural traits of fruiting shoots in *Juglans regia* (Juglandaceae) related to fruiting habit and environmental conditions. *Austral. J. Bot.* 58:141–148.
- Solar, A., A. Ivančič, and F. Stampar. Morphometric characteristics of fruit bearing shoots in Persian walnut (*Juglans regia* L.)—Potential selection criteria for breeding. *European Journal of Horticultural Sciences* 68:86–92.
- Solar, A., A. Ivančič, F. Stampar, and M. Hudina. 2002. Genetic resources for walnut (*Juglans regia* L.) improvement in Slovenia. Evaluation of the largest collection of local genotypes. *Genet. Resources Crop Evol.* 45:491–501.
- Solar, A. and F. Stampar. 2006. Evaluation of some perspective walnut genotypes in Slovenia. *Acta Hort.* 705:131–136.
- UPOV. 1988. Union internationale pour la protection des obtentions végétales. Draft guidelines for the conduct of tests for distinctness homogeneity and stability. Walnut (*Juglans regia* L.). UPOV, Geneva, Switzerland.