'Ligolina' Apple

Edward Żurawicz¹, Dorota Kruczyńska, Mariusz Lewandowski,
and Krzysztof Rutkowski

Research Institute of Horticulture, Konstytucji 3 Maja 1/3, 96-100 Skierniewice,
Poland

Additional index words. *Malus* × *domestica*, apple cultivar, apple breeding, fruit breeding, diseases resistance

'Ligolina' is a new apple cultivar released from the apple breeding program conducted at the Research Institute of Pomology and Floriculture (presently Research Institute of Horticulture) in Skierniewice, Poland (lat. 51°91'N, long. 20°10'E). 'Ligolina' is a good quality dessert apple cultivar with high storage potential. Its fruit is very attractive and has very good flavor. Trees are low susceptible to winter frosts, apple scab [*Venturia inaequalis* (Cke.) Wint.], apple powdery mildew [*Podosphaera leucotricha* (Ellis at Everh.) Salm], and moderately susceptible to fire blight [*Erwinia amylovora* (Burr.) Winsl]. Harvest maturity is the third decade of September or the first decade of October.

Poland, for many years, has been the top world producer and exporter of apples with an annual production ranging in the past 3 years from 2.5 to over 3.0 million metric tons (FAOSTAT, 2013; GUS, 2013). Export of processed and fresh apples in the same period has increased from 0.8 to 1.2 million metric tons. The apple breeding program started at the Research Institute of Pomology and Floriculture in 1951 when the Institute was funded. Its aim is to release cultivars producing high-quality apples, well suited to the Polish agroclimatic conditions and resistant to the most important diseases and pests. Several dessert apple cultivars such as Fantazja, Alwa, Redkroft, and Ligol, and also three *V_f* scab-resistant cultivars—Free Redstar, Melfree, and Gold Milenium (earlier tested under the name 'Early Freegold') have been released (Przybyła et al., 2009; Rejman, 1994; Żurawicz et al., 2004, 2013). Of this group of cultivars, recently Alwa and Ligol are cultivated commercially, and the scab-resistant cultivars mentioned above are just being introduced into commercial production of apples in Poland.

Origin

'Ligolina' was selected among seedlings originated from a cross made between 'Linda' and 'Golden Delicious' (Fig. 1). Crossing of parental forms was made in early 1960s. The seedling, from which 'Ligolina' was originated, was selected in

1972 and in Poland was registered in 2005. Breeders of the cultivar are S. Zagaja, A. Przybyła, and J. Krzewiński (Przybyła et al., 2009). Both parental forms originate from North America; however, their pedigrees are not known and they differ widely in terms of many agronomical traits. The seed parent 'Linda' was selected by Canada Department Agricultural Station in Ottawa, Ontario, in 1914, as an open pollinated seedling of 'Langford Beauty' (Brooks and Olmo, 1972). In Poland, 'Linda' was commercially grown from early 1950s till late 1960s and recently is recommended for home gardens only. It is a fall cultivar (harvest maturity is in the first half of September), its fruit is medium large to large, very regular in shape, the skin is thick, green yellowish, covered with intensive blurred deep crimson blush, very juicy, and tasty. The trees are vigorous, winter hardy, and moderately susceptible to apple scab and apple brown rot disease [*Monilinia fructigena* (Aderh. et Ruhl.)]. The cultivar is very precocious but has tendency to alternate bearing (Rejman, 1994). 'Golden Delicious'—the pollen parent—is a popular and very attractive yellow-pinkish apple of unknown pedigree. It was discovered as the chance seedling in 1890 in West Virginia, by A.H. Mullins (Baughner and Blizzard, 1987; Bultitude, 1983; Percival and Proctor, 1993). It is still one of the most commonly grown apples in

the world. In Poland, 'Golden Delicious' is recommended for commercial cultivation since 1976. It's very valuable trait is abundant, and late blooming is what usually allows to avoid big flower losses caused by the late spring frosts, and affecting the reduction of yield. Unfortunately, in Polish agroclimatic conditions this cultivar is more demanding to the environment than 'Linda', it requires more fertile soils and warm stands. Its disadvantages are also susceptibility to apple scab, apple mildew, and fire blight as well as insufficient winterhardiness (Rejman, 1994).

'Ligolina' has been tested in Central Poland under the clone number XIX-133-D1 at two sites: since 2000 at Dąbrowice (lat. 51°91'N, long. 20°10'E) and since 2004 at Nowy Dwór (lat. 51°87'N, long. 20°24'E) for organic production.

Description

Flowering and fruit. In central Poland, flowering of 'Ligolina' starts about 2–4 d before 'Golden Delicious', depending on the site and weather conditions. Flowers usually do not suffer from the late spring frosts when at blooming temperature is not lower than –1.5 °C. Flower buds are pink; corolla diameter is 45–47 mm; petals' arrangement is medium, petal size is 21 × 16 mm; color is white with pale pink shadow. According to COBORU (2006), descriptor for *Malus* flower density of 'Ligolina' is 7 (Table 1).

Fruit. Fruit of 'Ligolina' is medium to large (160–210 g); height is medium, diameter 72–78 mm, ratio height/diameter is medium, shape is cylindrical, background color is pale green, skin is smooth, without russeting (sometimes the small russeting area appears around stem cavity), shiny, medium thickness, in 60% to 80% covered with bright red, flushed blush (Fig. 2). Medium in size and average numerous lenticels are spread all over the fruit skin. Petiole is long (22–25 mm)

Fig. 1. Pedigree of 'Ligolina'.

Table 1. Time of flowering and harvest of 'Ligolina' at Nowy Dwór Year of planting: Spring 2004; rootstock: M.9.

Yr	Blooming				Harvest date
	Beginning	Full	End	Intensity ^z (1–9)	
2011	1 May	8 May	14 May	5	28 Sept.
2012	1 May	5 May	9 May	8	17 Sept.
2013	13 May	15 May	20 May	5	8 Oct.
2014	25 Apr.	28 Apr.	1 May	5	26 Sept.

^zRanking scale: 1–9, where 1 = absent, 9 = very abundant.

Received for publication 2 Apr. 2015. Accepted for publication 19 June 2015.

¹Corresponding author. E-mail: edward.zurawicz@inhort.pl.

and medium thick. Stem cavity is moderately deep and not very wide. The calyx is medium, closed with long and raised sepals. Calyx cavity is moderately wide, average deep or shallow, slightly ribbed. The flesh is creamy, medium grained, crunchy, juicy with a slight aroma, firm flesh (60–80 N), sweet-sourish, very tasty, values of total soluble solid content and titratable acidity (TA) vary, according to the years, respectively from 11 to 16 Brix and from 0.4% to 0.7% as malic acid. Fruit firmness was measured by penetrometer type EPT-1R (Kelowna, BC Canada) equipped with 11.1 mm M-T probe. The results were expressed in N. Total soluble solids content (TSS) and TA were measured within 24 h after fruit harvest in freshly prepared juice. TSS

Fig. 2. Fruit of 'Ligolina'.

was determined using a digital refractometer ATAGO 101 (Japan) and expressed in percent (%). TA was determined using automatic titrator DL 50 Graphix (Mettler Toledo, Swiss, Switzerland) by titration of juice with 0.1 N NaOH to the endpoint pH = 8.1. The results were expressed as a percentage of malic acid (%). The eating quality of fruit is judged to be very good. All these traits make 'Ligolina' very attractive and distinct from other cultivars.

Harvest time and storability. 'Ligolina' is a winter cultivar. Its harvest maturity is the third decade of September or the first decade of October, the same as 'Jonagold' and about 10 d earlier compared with 'Golden Delicious'. In general, fruit mature homogeneously within the tree, so that only two pickings are recommended. The fruit of 'Ligolina' is not susceptible to preharvest drop and the storage ability is very good. The results of preliminary study show that at normal atmosphere at 1 °C fruit can be stored at least 5 months and at control atmosphere (2% of oxygen and 2% of carbon dioxide) at least 7 months. The fruit firmness after storage was still in the range of 50–55 N. Fruit is not susceptible to the storage disease and physiological disorders (Bryk et al., 2013). During storage at proper conditions the skin shriveling was not observed, but sometimes appeared grassiness caused by natural wax. The good flesh firmness is noticed for a long time, also during shelf life.

Tree. Trees of 'Ligolina' on dwarf (M.9 and P 67) and semidwarf rootstocks (M.26 and P 14) grow moderately vigorously with a low branching amount and have a spindle-shaped crown (Fig. 3). Fruits are formed abundantly, mainly on spurs, which at the ripening time are hanging from the tree causing the whipping shape of the canopy.

Fig. 3. Trees of 'Ligolina'.

'Ligolina' is a very precocious cultivar and the fruit cropping is generally high. Unfortunately, it has a tendency toward biennial bearing. The proper pruning and complementary mechanical or chemical thinning are recommended to get a large number of good-sized fruits each year (by using chemical preparations such as ammonium thiosulfate at a dose of 15 kg/ha (thinning of flowers at the beginning of blooming or at the full, or at the end of flowering) or Regalis at a dose of 1 kg/ha (spraying trees at the end of May, in the year of abundant fruiting). One-year-old shot is thin with internodes of medium length, hairy on the upper part, bark is cherry-brown, shiny, and lenticels very small, oval, and beige. Leaves are medium in size (84 × 45 mm), the leaf blade is slightly folded along the main vein, incision of margin is serrate, and tip of the leaf blade is sharp. Results of our trials show that 'M.9' and 'P 16' dwarf rootstocks can be recommended for 'Ligolina' (Kruczyńska, 2008).

Frost, pest, and disease susceptibility. The trees of 'Ligolina' possess sufficient level of winterhardiness (Czynczyk et al., 2004). Till now in Polish conditions were not observed any frost damages on trees even if the winter temperatures dropped below –30 °C. Trees are not very susceptible to apple scab, medium susceptible to apple powdery mildew (Bryk and Kruczyńska, 2011), and susceptible to fire blight (Sobiczewski et al., 2004, 2008).

Availability

'Ligolina' is admitted to the Polish National List of Fruit Plant Varieties by the Polish Research Center for Cultivar Testing [in Polish: Centralny Ośrodek Badania Odmian Roślin Uprawnych (COBORU)] and is protected on the European Union territory by Plant Breeder's Right, which was granted by the President of Community Plant Variety Office in Angers, France with effect from the date of the decision (Decision of 23th January 2012, N° UE 31389), for a period expiring on 31 Dec. 2042 at the latest. The exclusive license for propagating and selling the certified plant material of this cultivar was obtained by the Center for the Elite Nursery Stock [in Polish: Ośrodek Elitarnego Materiału Szkółkarskiego (OEMS)] in Prusy, 96-130 Głuchów, Poland. The first bud sticks were sold in 2013. Nurserymen who are interested in propagation of 'Ligolina' trees as well as fruit growers who would like to cultivate the cultivars have to be in contact with OEMS; e-mail: oems_prusy@poczta.onet.pl.

Literature Cited

- Baughner, T.A. and S. Blizzard. 1987. 'Golden Delicious'—famous West Virginian known around the world. *Fruit Var. J.* 41(4):130–132.
- Brooks, R.M. and H.P. Olmo. 1972. *Apple*, p. 55. In: Register of new fruit and nut varieties. 2nd ed. Berkeley, University of California Press, Los Angeles, London.

- Bryk, H. and D.E. Kruczyńska. 2011. Possibilities in growing and protection of apple trees against diseases in organic orchards. (Możliwości uprawy i ochrony jabłoni przed chorobami w sadach ekologicznych). J. Res. Applications Agr. Eng. 56(3):40–44.
- Bryk, H., D.E. Kruczyńska, and K.P. Rutkowski. 2013. Jakość i zdolność przechowalnicza jabłek kilku odmian z sadu ekologicznego. J. Res. Applications Agr. Eng. 58(3):59–65.
- Bultitude, J. 1983. Apples a guide to the identification of international varieties. ISBN 0-295-96041-8:177.
- COBORU. 2006. Metodyka badania wartości gospodarczej odmian (WGO), odrębności, wyrównania i trwałości (OWT) roślin uprawnych. Wydanie II, Słupia Wielka.
- Czynczyk, A., G. Hodun, M. Hodun, and D. Kruczyńska. 2004. Susceptibility of one-year-old shoots of scab-resistant apple cultivars to low temperatures in laboratory tests during four winters (1999/2000 – 2002/2003). Acta Hort. Ann. 16(1):61–72.
- FAOSTAT. 2013. Food and Agriculture Organization of the United Nations. <<http://faostat.fao.org>>.
- GUS. 2013. Central Statistical Office. <http://www.stat.gov.pl/gus/index_ENG_HTML.htm>.
- Kruczyńska, D. 2008. Jabłonie nowe odmiany, p. 214. Hortpress, Warszawa.
- Percival, D.C. and J.T.A. Proctor. 1993. 'Golden Delicious' progeny: 21st century apples. Fruit Var. J. 48(1):56–62.
- Przybyła, A.A., M. Kantorowicz-Bąk, and K. Tomala. 2009. New Polish winter cultivars of apple. Acta Hort. 814:193–195.
- Rejman, A. 1994. Jabłonie, p. 19–130. In: A. Rejman (ed.). Pomologia—odmianoznawstwo roślin sadowniczych. PWRiL, Warszawa, Poland.
- Sobiczewski, P., E. Żurawicz, S. Breczyński, and M. Lewandowski. 2004. Terminal shoot susceptibility of new Polish apple cultigens to fire blight. Folia Hort. Ann. 149–157.
- Sobiczewski, P., E. Żurawicz, S. Breczyński, A. Mikiciński, and M. Lewandowski. 2008. The importance of the type of *Erwinia amylovora* inoculum in screening of apple genotypes susceptibility to fire blight. J. Fruit Ornam. Plant Res. 16:305–313.
- Żurawicz, E., M. Lewandowski, A. Broniarek-Niemiec, and K. Rutkowski. 2004. Preliminary results on production value of new scab resistant apple cultivars bred at the Research Institute of Pomology and Floriculture (RIPF), Skierniewice, Poland. Acta Hort. 663:879–992.
- Żurawicz, E., M. Lewandowski, K. Pruski, and K.P. Rutkowski. 2013. Productivity of selected Polish scab resistant apple cultivars grown on different rootstocks. Acta Hort. 976:141–146.