

## ASSESSMENT OF NEW APPLE HYBRIDS

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### Abstract

As a result of breeding activity at the Institute of Agriculture in Kyustendil are received a large number of apple hybrids. In the article are presented data for 5 promising hybrids. The study was carried out during the period 2012-2016. The trees are grafted on rootstock MM 106 and planted in the spring of 2007 at distances of 4.5 x 2.5 m. Ten years after planting the largest trunk cross-sectional area (TCSA) had the trees of hybrid № 2/30 ('Prima' x 'Sekai Ichi') and the smallest of hybrid № 2/28 ('Prima' x 'Florina'). The highest average yield per tree was obtained from hybrid № 1/3 ('Mollie's Delicious' – open pollinated) - 25.8 kg, followed by № 1/5 ('Malus robusta' x 'Liberty') - 24.9 kg. The fruit of № 1/5 were the largest - 230 g. The fruit of hybrid № 1/26 ('Melrose' x 'Kent') had the highest fruit flesh firmness - 9.05 kg/cm<sup>2</sup>, while those of hybrid № 2/28 and № 2/30 had the lowest firmness - 7.28 and 7.36 kg/cm<sup>2</sup>, respectively. The highest percentage of soluble solids (17,8%) and total sugar (8,7%) were contained in the fruit of hybrid № 1/3.

**Keywords:** TCSA, yield, fruit size, fruit firmness, chemical composition.

### Introduction

The cultivar as an essential element in the production of high quality fruits has been and will be subject to continuous improvement and renewal. The main method for breeding new cultivars is the controlled hybridization, resulting in what were created a lot of apple cultivars. The most important criteria for new cultivars are: better fruit quality, higher tree productivity, early and regular fruit-bearing, weaker growth of the trees, late flowering, resistance to biotic and abiotic stressors, a long storage period of fruit and others (Laurens, 1999, White, 2000, Lukic et al, 2005, Blagov et al., 2009, Dzhuvinov et al., 2014, Lukic and Maric, 2015). A purposeful selection work in the apple at the Institute of Agriculture - Kyustendil was started in 1945 and in different stages were selected and studied too many hybrids (Blagov, 2005, 2011). In 2010 were recognized as new the cultivars Besapara (Florina x Macfree), Marlena (Florina x Macfree), Gorana (Prima x Cooper 4), Martinika (Prima x Sekai Ichi) and Elegia (Prima x Cooper 4) and in 2015 the cultivar Siyana (Florina x Macfree). The most part of hybrids are under investigation yet. The purpose of this study was to determine the growth characteristics, productivity and fruit quality of five pre-selected apple hybrids.

### Material and methods

The study was carried out in the period 2012 – 2016 with five apple hybrids: № 1/3 ('Mollie's Delicious' – open pollinated), № 1/5 ('Malus robusta' x 'Liberty'), № 1/26 ('Melrose' x 'Kent'), № 2/28 ('Prima' x 'Florina') and № 2/30 ('Prima' x 'Sekai Ichi') selected at the Institute of Agriculture - Kyustendil. The hybrids were grafted on MM 106 rootstock and the trees planted in the spring of 2007 at distances of 4.50 x 2.50 m. Each hybrid was represented with five trees and each individual tree was treated as a repetition. Trees were trained as free-growing crowns. The soil is Chromic Luvisols, slightly sandy-loamy with a neutral reaction. The soil surface at the plantation was maintained in clean cultivation and irrigation was done by sprinkling. The trees were fertilised annually with 18 kg/da nitrogen in the form of ammonium nitrate. A routine management programme was applied. The yearly recorded parameters included: trunk cross-sectional area (TCSA, in cm<sup>2</sup>, 30 cm above the grafting zone), crown volume (m<sup>3</sup>), average and cumulative yield (kg/tree), yield efficiency (kg/cm<sup>2</sup> of TCSA), fruit weight (g), fruit size (mm) and chemical composition of the

fruit - soluble solids (% , determined by refractometer), total sugars (% , by Luff-Schoorl method) and titratable acids (% , titrimetrically with 0.1 N NaOH). Results were statistically evaluated by analysis of variance (ANOVA) and means were separated by Duncan’s multiple range test at  $p \leq 0.05\%$ .

### Results and discussion

During the 6<sup>th</sup>-10<sup>th</sup> year after planting, hybrid № 2/28 had the weakest growth rate of the trunk cross-sectional area (Figure 1). Although at the first year of the study the trees of hybrid № 1/26 had thinner trunks after the seventh year their increase was the most intensive. At the end of the studied period according to this indicator were identified three groups of trees with different growth. With weak growth were the trees of hybrid № 2/28. Moderate growth showed the trees of hybrids № 1/5, № 2/30 and № 1/3 and strong – hybrid № 1/26. Differences between the hybrids were statistically proven ( $p \leq 0.05$ ).

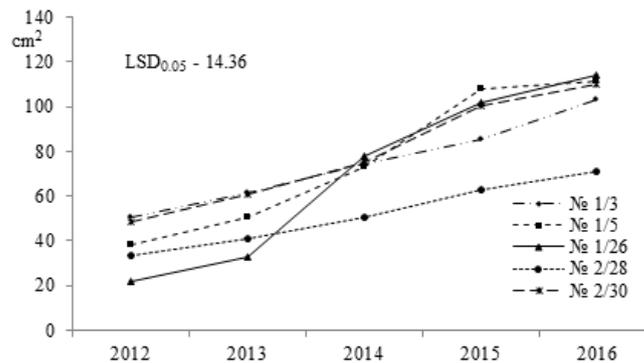


Figure 1. Dynamics of growth of the trunk cross-sectional area of apple hybrids

The trees of hybrid № 1/3 had the largest crown volume (7.2 m<sup>3</sup>), while those of № 2/28 - the lowest (4.0 m<sup>3</sup>), i.e. their volume was reduced by 55.6% (Figure 2). In the other hybrids the trees were with almost identical size - from 5.3 to 5.7 m<sup>3</sup>.

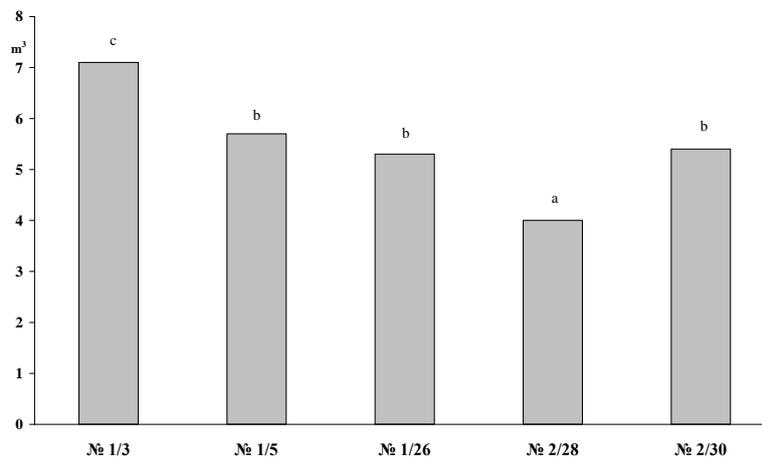


Figure 2. Trees crown volume of apple hybrids at the end of 10<sup>th</sup> growing year

Average yields per tree varied significantly over the years. The highest yields were registered in 2012 and 2016. In 2013 except hybrid № 1/3, and a certain extent of № 1/26, yields were significantly reduced as a result of damage from late spring frost. The highest 5-year cumulative yield per tree was obtained from hybrids № 1/3 (128.8 kg) and № 1/5 (124.3 kg). Good fertility had also the trees of hybrids № 1/26 (116.0 kg) and № 2/28 (100.9 kg). The lowest yield was obtained from hybrid № 2/30 - 96.6 kg. The differences between different genotypes were statistically proven (Figure 3).

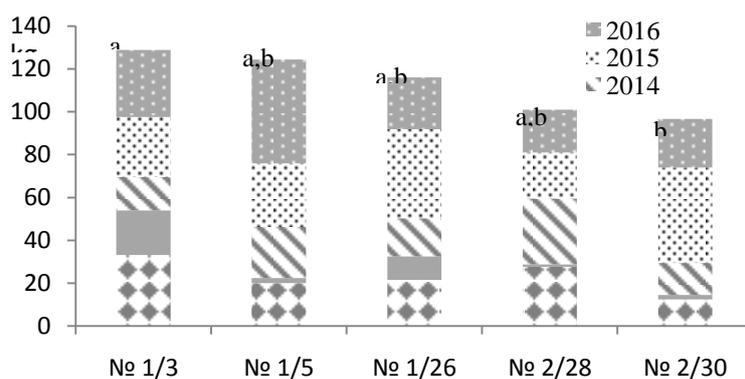


Figure 3. Average and cumulative yield of apple hybrids, kg/tree

The highest yield efficiency was calculated for hybrids No 2/28 (1.4 kg/cm<sup>2</sup> of TCSA) and No 1/3 (1.3 kg/cm<sup>2</sup>) and the lowest for No 2/30 - 0.8 kg/cm<sup>2</sup>. Hybrid No 1/5 had the highest fruit weight, average for the period, followed by No 1/26 and No 2/30, and the smallest were the fruit of No 1/3 (Table 1). The fruit mass was negatively affected by the yield, but to an insignificant extent degree, evidence of which is the low negative correlation coefficient and the percentage of determination (Figure. 4).

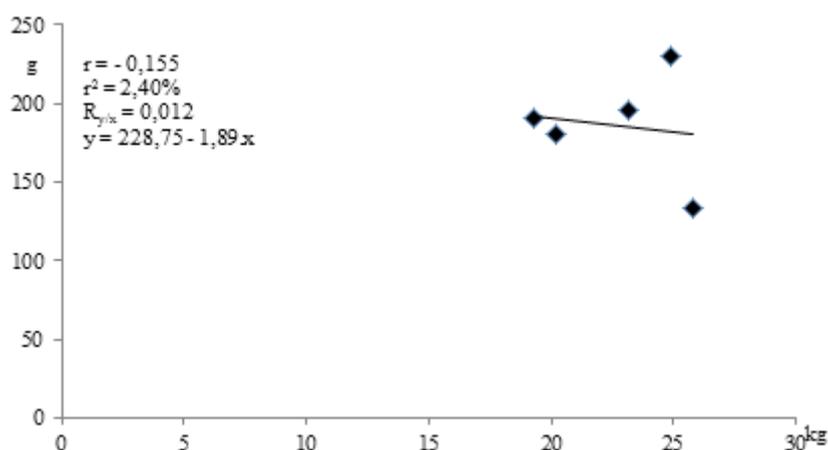


Figure 4. Relationship between the average yield per tree and fruit weight

The dimensions of the fruit largely corresponded to their weight. The studied hybrids had fruit with diameter over 65 mm, and cover the requirements for class 'Extra' quality according to Bulgarian standard. The measured fruit flesh firmness by hand penetrometer varied from 7.28 to 9.05 kg/cm<sup>2</sup> (Table 1).

Table 1. Biometrics data for fruit, average for 2012-2016

Hybrid	Fruit weight, g	Fruit height, mm	Fruit diameter, mm	Fruit flesh firmness, kg/cm <sup>2</sup>
No 1/3	133.6	58.6	67.3	8.68
No 1/5	230.0	61.6	82.5	8.11
No 1/26	195.1	68.5	74.8	9.05
No 2/28	180.7	60.8	70.7	7.28
No 2/30	190.0	66.7	78.9	7.36

Fruit of hybrid No 1/3 had the highest content of soluble solids and total sugars and at the same time the least titratable acids from where was calculated the highest sugar/acid index (Table. 2). The most

optimal ratio between sugars and acids was in fruit of hybrid № 1/5, which gives them a harmonious taste. The fruit of hybrid № 1/26 and № 2/28 had the highest acid content which gives them a sour taste.

Table 2. Chemical composition of the fruit, average for 2012-2016

Hybrid	Soluble solids, %	Total sugars, %	Titrateable acids, %	Sugar/Acids index
№ 1/3	17.8	8.7	0.2	43.5
№ 1/5	15.9	8.1	0.4	20.2
№ 1/26	15.9	8.2	0.9	9.1
№ 2/28	14.8	8.1	0.5	16.2
№ 2/30	14.1	7.6	0.2	38.0

### Conclusions

As a result of the study, hybrid № 1/5 proved to be the most promising among the tested apple hybrids. Although this hybrid indicated lower productivity in comparison with the other hybrids, at this stage its fruit were the largest, equal in shape and size. The ratio between sugars and acids was the most balanced, which gives them excellent flavor. The tree had moderate growth. The same hybrid can be used as a donor of these valuable qualities in future breeding programs in the apple.

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