

A preliminary study on some features of two new resistant apple cultivars in a multi-row planting system

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Summary: The aim of this work was to report preliminary results on some features of two new resistant apple cultivars (cvs. 'Galiwa' and 'Story Inored') in multi-row system in the early bearing years of the orchard. Trees were planted in spring of 2015 in double row design (3.5 m+1.4 m x 1.0 m) with planting density of 5357 tree/ha. According to our results cv. 'Story Inored' presented more vigorous growth, than cv. 'Galiwa'. Trees of cv. 'Story Inored' reached 2.7 m in the third year, but cv. 'Galiwa' could reach only 1.95 meter. Due to late spring frost 100% yield loss was observed in the second year. In 2017 cv. 'Galiwa' produced 5.3 kg/tree (25 fruit/tree), while cv. 'Story Inored' presented 7.7 kg/tree (50 fruit/tree). Average yield was 28.4 t/ha for cv. 'Galiwa', as 'Story Inored' reached 41.3 t/ha in the third year. Cultivar 'Galiwa' reached the required fruit size (79.1 mm), but its coloration was weaker (43% fruit surface color). Cultivar 'Story Inored' can be described with smaller fruit size (69 mm) and higher percentage of surface color (93%).

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Key words: resistant apple cultivars, multi-row planting system, yield, fruit size, fruit surface color

Introduction

Cultivar choice has a decisive effect on the profitability of the production. Only cultivars are recommended to produce which can satisfy the needs of the consumers in a long term (Porpáczy et al., 1964; Tomcsányi, 1973). In environmentally friendly fruit production systems it is advisable to apply resistant, tolerant or less sensitive cultivars in order to achieve better protection against the plant pathogens (Holb, 2000; Holb et al., 2006). These cultivars ensure the possibility to reduce the used pesticides, which results in lower production costs and lower pollution (Fischer & Fischer, 1996, 2004; Earles et al., 1999; Holb, 2008, 2009). Nowadays besides the resistant ability, the colour of the apple skin is an other determining factor regarding the values of the cultivars. Apple fruits with red skin are more preferred among the consumers, at the same time inside a cultivar fruits with better coloration have higher demand (Saure, 1990; Guerra, 2007; Csuhon et al., 2015; Csuhon & Gonda, 2016).

An intensive apple orchard should bear the first yields early, ensure high yields and adequate quality yearly in an economically justified way (Wertheim et al., 2001). More studies proved that yield can increase with the growing tree intensity (Robinson et al., 1991; Meland & Hovland, 1997; Lepsis & Blanke, 2001), although regarding the optimal tree density there are different opinions. According to Mika et al. (1997) the optimum planting density is about 2000 to 3000 in an intensive plantation, but this may vary based on the cultivar and the growing conditions. In Northern Europe systems on

M.9 with densities between 3000 and 6000 can be named optimal for quality production (Wertheim et al., 2001). In Hungary slender spindle (1200-3300 trees/ha) and super spindle (3600-4167 trees/ha) canopies were adopted with a single row planting system (Gonda, 1995; Soltész et al., 2000).

In this study we aimed to evaluate some features of two resistant apple cultivars (cv. 'Galiwa', 'Story Inored') in an intensive orchard with a multi-row training system.

Materials and methods

Experimental site

The experimental orchard is located in Nyírbátor, 55 km far from Debrecen in Northeast Hungary, at a major apple growing region of Hungary.

Main climate and soil parameters of the experimental site are: i) mean temperature of the year: 10-11 °C, ii) sunshine hours: 1900-2050 hours/year, iii) average precipitation: 500-550 mm, iv) pH: 6.5-6.9, v) humus content: low (1%), the type of the soil is light sandy, and vi) the „Arany” number of heaviness: 27-29.

Trees were planted in spring of 2015 on M.9 rootstock with multi-row training system. Plant-to-plant distance was 1 m. Double rows are located 1.4 m far from each other, as the space between two double rows is 3.5 m (3.5 m+1.4 m x 1 m), which means 5357 tree/ha. Trees were trained to slender spindle

canopy and fixed to wired trellis system. Orchard is equipped with dropping irrigation system and managed according to the integrated production principles. To determine the optimal crop load chemical fruit thinning was necessary to perform in 2017.

The weather was more wet in 2016 and 2017, rainfall reached 720 and 636 mm, respectively. The experimental orchard suffered from total yield loss due to the spring frost in 2016. At 23 April -3.3 °C was measured, which caused 100% fruit damage in both apple cultivars.

Cultivar features

'Galiwa': a scab resistant cultivar originated from Switzerland. Fruits are characterized by larger size and higher sugar content than its male parent ('Gala'). Shape is lightly conical, surface color is orange-red. Fruits are firm and juicy with intense aroma. It ripens after the most common Gala clones, in September. Ripening is staggered, harvest period is long. Trees bear first yields early, but they are vulnerable to alternate bearing.

'Story Inored': a scab resistant cultivar originated from France. Fruits are sweet with high firmness and low acidity. Shape is elongated. Skin is blushed and very attractive, intensive red. Susceptibility to alternate bearing is low. Harvest time is in October. Storage potential is outstanding. It is recommended for organic production.

Measured parameters

Vegetative and generative parameters were measured in the first three years of the orchard. Five trees were selected and assessed for each measurements.

For vegetative parameters, the thickness of the trunk, as the complex index of the vegetative accomplishment is expressed in cm² values (trunk cross sectional area) was assessed. In addition, the height of the trees (cm) is related with the size of the cropping surface was also measured.

For generative parameters, yield at harvest as fruit number per tree and fruit kg per tree was measured. Fruit diameter and height were also measured. Fruit surface color was determined with visual estimation as percentage. Intensity (darkness) of the fruit surface color was evaluated with similar method on a scale ranging from 1 to 5. To determine the quality parameters 20 fruits were picked from each tree (100 fruits/cultivars).

Results and discussion

The trunk cross sectional area was considered as the complex indicator of the vegetative growth. Cultivar 'Story Inored' presented more vigorous growth, than cv. 'Galiwa' (Figure 1). In the year of planting (2015) trunk thickness showed only slight difference (4.7-6.1 cm²) between the cultivars, but two years later the difference between the cultivars increased significantly (9.1-15.7 cm²).

Stronger vigor of cv. 'Story Inored' is manifested also in plant height (Figure 2). Cultivars had the same tree height (164-168 cm) in autumn of 2015, but their development was diverse later. Trees of cv. 'Story Inored' reached 2.7 m in the third year, but cv. 'Galiwa' could not reach 2 m (1.95 m). This phenomenon determines obviously lower yields in the first years of the plantation compared to later years.

In 2016, late spring frost caused 100% fruit damage in the orchard, therefore no data for yield was available. In 2017, the

ripening time of cv. 'Galiwa' was at 7 September, as cv. 'Story Inored' was picked at 10 October (Table 1). In 2017, cv. 'Galiwa' produced 5.3 kg/tree (25 fruit/tree), while cv. 'Story Inored' presented 7.7 kg/tree (50 fruit/tree). Mean fruit yield was 28.4 t/ha for cv. 'Galiwa', while 'Story Inored' reached 41.3 t/ha in the third year.

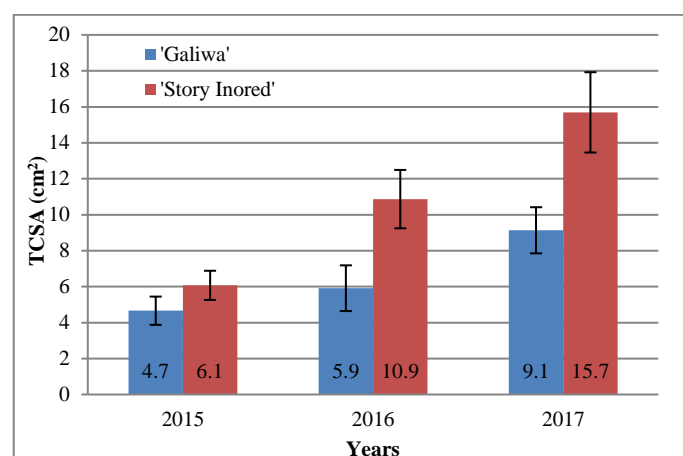


Figure 1. Trunk cross sectional area (TCSA) of the examined cultivars (Nyírbátor, 2015-2017)

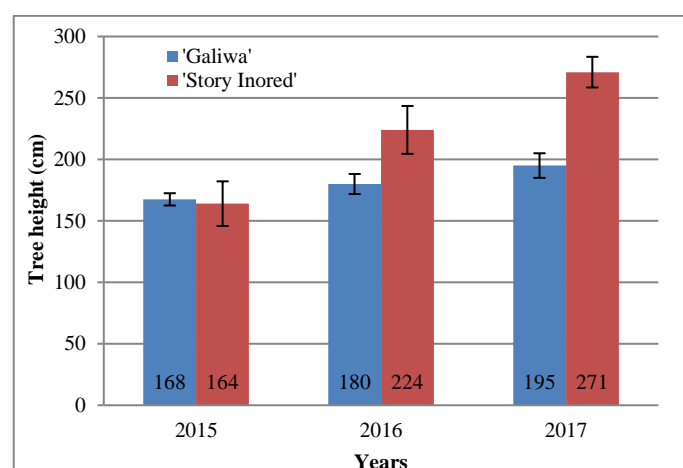


Figure 2. Tree height of the examined cultivars (Nyírbátor, 2015-2017)

Table 1. Ripening time and harvested fruit amount of the examined cultivars (Nyírbátor, 2016-2017)

	'Galiwa'		'Story Inored'	
	2016	2017	2016	2017
Ripening time	–	07/09	–	10/10
Total yield (kg/tree)	–	5.3±0.4	–	7.7±1.5
Fruit number (number/tree)	–	25±3	–	50±14
Average yield (t/ha)	–	28.4	–	41.3

Cultivar 'Galiwa' reached the optimal fruit size (79.1 mm) and weight (220 g) in 2017 (Table 2). Fruit surface color was 43%, while fruit color intensity (darkness of the red color) reached value of 4.6 (Figure 3). Cultivar 'Story Inored' can be described with smaller fruit size and weight (Figure 4). Diameter was 66.9 mm per fruit, while fruit weight reached 165 g per fruit. Fruits showed 93% surface color and excellent color intensity (5.0).

Table 2. Fruit quality of the examined cultivars (Nyírbátor, 2016-2017)

	'Galiwa'		'Story Inored'	
	2016	2017	2016	2017
Fruit diameter (mm)	–	79.1±1.1	–	69.0±0.6
Fruit weight (g)	–	220±14	–	165±4
Fruit surface colour (%)	–	49±4	–	93±2
Fruit color intensity (1-5)	–	4.6±0.31	–	5.0±0.0



Figure 3. Large orange-red fruits of cv. 'Galiwa'



Figure 4. Dark red fruits of cv. 'Story Inored'

Conclusions

Based on our preliminary data, cv. 'Story Inored' showed a stronger vigor, than cv. 'Galiwa', which resulted in higher yield in the third year. Fruits of cv. 'Galiwa' produced an optimal fruit size, but the color could not reach 50% cover. Cultivar 'Story Inored' showed excellent fruit coloration and medium fruit size. Effects of the planting system on the yield and fruit quality needs further evaluation in the later years.

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