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COMPARATIVE STUDY OF FIVE SCAB RESISTANT APPLE CULTIVARS

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Abstract

Vegetative and reproductive characteristics of five resistant apple cultivars budded on 'M9-T337' rootstock were compared in the intensive orchard, planted at the density of 2380 trees per hectare (3.5 × 1.2 m) in the period 2017-2023. Trees were formed as tall spindle, under an insecticidal net against hail. Trees were grown under drip irrigation and sod-mulch system was applied. The cultivars FUJIONpbr and ENTERPRISE demonstrate greater trunk-cross section area, higher trees and greater crown volume to the tested cultivars. The smallest trees were noted in Cultivar GEMINI*. The lowest yield per unit area was obtained on cultivar FUJIONpbr. There was no significant difference among other cultivars. Despite of generally good characteristics the cultivar GEMINI* has relatively small fruits.

Keywords: apple, vigor, productivity, fruit weight, yield

INTRODUCTION

In recent years, there has been an increase in consumer interest in organic fruits or those produced with the use of fewer pesticides. One of the ways to reduce the use of pesticides in apple production is the use of cultivars resistant to the main economically important apple diseases. There are a large number of scab resistant apple cultivars with different growth and productivity traits. The vast diversity of cultivars with different growth and productivity traits necessitates their study with both the common and newly selected rootstocks (Kviklys, 2002; Hernández et al., 2010; Stefanova et al., 2012; Licznar-Małańczuk & Sosna, 2013). It is known that the tree vigor, beginning with fruit bearing, tree productivity and quality of the fruits are some of the most important characteristics of each cultivar (Webster, 1993). The growth of certain cultivar depends on many as soil and climatic factors of the growing region, as well as altitude, which makes necessary the study of their adaptation in certain growing conditions (Fisher, 2001; Autio et al., 2005).

The aim of the study was to expand the knowledge about the behavior of newly introduced scab resistant apple cultivars grown in conditions of Central South Bulgaria.

MATERIALS AND METHODS

The orchard was planted in Plovdiv city region in the autumn of 2017 at the density of 2380 trees per hectare (3.5 × 1.2 m). The apple cultivars: GEMINI*, SIRIUS (S), MODÌ®CIVG198pbr, FUJIONpbr and ENTERPRISE were budded on 'M9-T337' rootstocks and the nursery trees were feathered (class 9+). No pruning was applied after planting. The experiment was set up in a randomized block design with four replications and four plants per plot in each variant. The trees were drip irrigated and sod-mulch system was applied between the rows. The soil in the rows was treated with herbicides. Trees were formed as tall spindle. During the period 2020 – 2023 the following parameters were evaluated

at the end of each vegetation: trunk diameter (at 15 cm above the graft union), tree height, crown volume, mean yield per hectare for the period, cumulative yield per hectare for the period, crop efficiency - total yield per cm^2 of trunk-cross section area (TCSA) for 2023 and total yield per m^3 of the crown volume for 2023. The data was statistically processed using a variance analysis and Tukey's test at 5% level of significance.

RESULTS AND DISCUSSION

The tree vigor of different cultivars is usually estimated according to the trunk diameter or trunk-cross section area (TCSA). Most researchers conclude that the cultivars with greater vigor favor the formation of trees with thicker stem (Kosina, 1988; James, 1997). The data from the current study confirmed these observations. At the end of the study, cultivars ENTERPRISE and FUJIONpbr had a larger TCSA in comparison to GEMINI*, SIRIUS (S) and MODÌ®CIVG198pbr (Table 1).

The trees characteristics such as: height, width, and volume of the crown of different cultivars are important to determine the optimal planting density. The significantly highest trees at the end of the studied period were those of cultivars ENTERPRISE and FUJIONpbr. The cultivar MODÌ®CIVG198pbr occupied moderate position. The lowest value of crown volume was recorded for cultivar GEMINI*. The highest values of this parameter were obtained for ENTERPRISE and FUJIONpbr cultivars. The yield per unit area can be considered as the most reliable parameter of the productive capacity of the cultivars. Concerning this parameter, there is a problem when trees do not cover the area provided to them in the trail and their number has to be calculated according to their crown sizes in order to achieve the optimum density (Pepelyankov & Tabakov, 1997; Sadowski et al., 2004).

Table 1. Vegetative characteristics of tested cultivars at the end of the studied period.

Cultivars	*Trunk-cross section area (cm^2)*	*Tree height (cm)*	*Crown volume (m^3)*
*GEMINI**	13.82	256.25	*2.02*
SIRIUS (S)	19.94	307.50	*4.42*
MODÌ®CIVG198pbr	23.35	330.00	*6.27*
FUJIONpbr	39.42	370.75	*9.91*
ENTERPRISE	41.91	381.75	*8.18*
LSD0.05	*5.83*	*20.10*	*1.17*

All cultivars included in this study have a productivity. During the studied period the highest total yield was obtained for the cultivars MODÌ®CIVG198pbr and GEMINI* (Figure 2). Certainly, one of the most important characteristics of the cultivars is their productivity and their ability to keep it for long time (Kviklys, 2002; Kosina, 2004; Vercammen, 2004). For many years, crop efficiency coefficient (CEC) was considered as one of the most important indicators of productivity (Autio & Anderson, 1998). At the end of the studied period, significantly high productivity per cm^2 of TCSA and per m^3 of the crown volume was obtained for cultivars GEMINI*, MODÌ®CIVG198pbr and SIRIUS (S) (Table 2).

Among the most important characteristics of each cultivar is also the fruit weight. Our results show that despite of generally good characteristics in terms of productivity the cultivar GEMINI* has significantly small fruits. All other tested cultivars have acceptable and better fruit weight (Table 3).

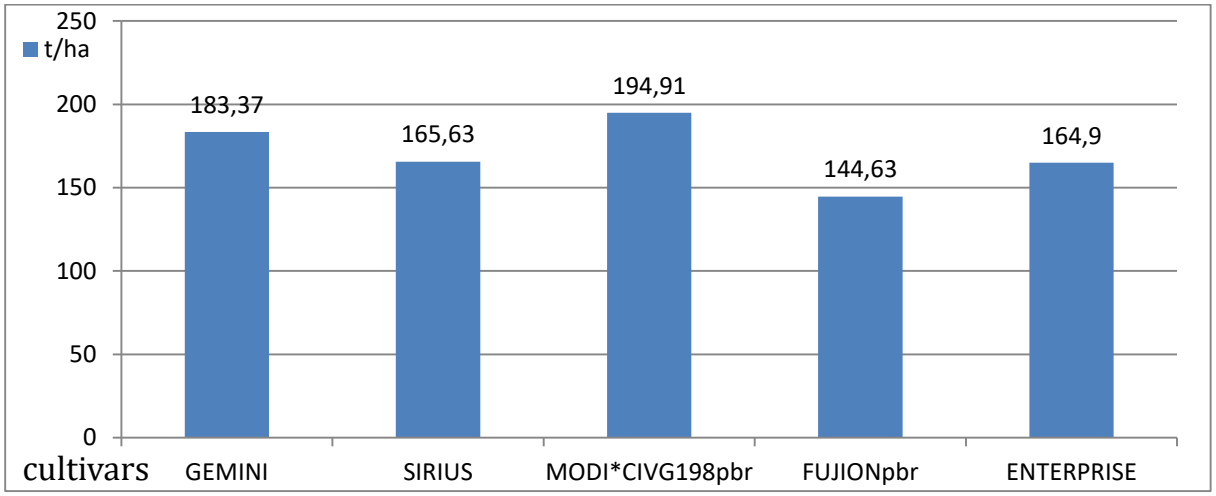

Figure 1. Cumulative yield (t/hectare) of apple cultivars for the period 2019-2023.

Table 2. Yield of tested cultivars at the end of the studied period

Cultivars	**Cumulative yield per cm^2 of TCSA for the last year of the study (kg)**	**Cumulative yield per m^3 of the crown volume for the last year of the study (kg)**	**Mean yield per hectare for the period 2019-2023 (t)**
GEMINI*	5.66	38.66	45.905
SIRIUS (S)	3.51	15.90	41.407
MODÌ®CIVG198pbr	3.76	15.96	48.665
FUJIONpbr	1,56	6.29	36.166
ENTERPRISE	1.68	8.63	41.224
$LSD_{0.05}$	0.56	4.16	8.961

Table 3. Fruit weight, (g)

Cultivars	**2020**	**2021**	**2022**	**2023**
GEMINI*	105.21	101.12	98.16	104.05
SIRIUS (S)	226.23	238.17	205.27	209.65
MODÌ®CIVG198pbr	196.28	201.43	191.14	197.34
FUJIONpbr	210.56	214.57	203.12	206.64
ENTERPRISE	209.23	209.43	199.66	208.73
$LSD_{0.05}$	14.56	15.16	17.97	15.42

CONCLUSION

All tested cultivars have demonstrated high productivity. The highest average yields per unit area were obtained for MODÌ®CIVG198pbr and GEMINI* cultivars. The GEMINI* cultivar has significantly smaller fruits (fruit weight) compared to the other tested cultivars. In terms of growth characteristics, the ENTERPRISE and FUJIONpbr cultivars showed a better growth, and the GEMINI* cultivar stands out with the weakest growth.

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