DEPENDENCIES BETWEEN VEGETATIVE AND REPRODUCTIVE PERFORMANCES IN 'SHOPSKA ALENA' RASPBERRY CULTIVAR

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Abstract

The scientific experiment was conducted during the period of 2018-2020 in a collection plantation of the Research Institute of Mountain Stockbreeding and Agriculture in Troyan. The object of the study is the 'Shopska Alena' raspberry cultivar. The plantation was created in the autumn of 2016. Correlation analyzes were made between the vegetative indicators: number, height and thickness of the shoots with the yield. The highest values for height (1.38 m) and thickness (8.41 mm) of the shoots were recorded in the second year of the experiment, and the highest yield was obtained in the third year - 1.69 kg/1m². A high correlation dependence between the height and thickness of the shoots was recorded through all three years and between the height and thickness with the yield in the second and third year.

Key words: cultivars, fruits, raspberries, reproductive indicators, vegetative indicators.

INTRODUCTION

In the last twenty years, Europe has occupied the largest share in rasperry production (72.5%), followed by America (25.4%) and Asia (1.9%).
World production has grown by 21.9% in the last 5 years. According to FAO, the main European raspberry producers are: the Russian Federation (153 827 t), Serbia (93644 t) and Poland (85616 t). (https://www.fao.org/faostat/en/?#data/QCL/visualize).
Raspberry takes the first place among the small-sized fruit species in Bulgaria. Under the new economic conditions, there is an increase in occupied production areas in Bulgaria (except 2020 and 2021), due to the appropriate agroecological conditions for its cultivation, increased prices for producers and the rapid return of the insurance funds invested.
In recent decades, the demand for small-sized fruit, including raspberries, has increased many times because of their optimal yields, healthy ingredients and the ability to obtain attractive food with rich biochemism and high market value (Ivanova et al., 2012).
The cultivar structure in Bulgaria is made up of Bulgarian and introduced raspberry cultivars. Most of them are high-yielding, large-fruited, resistant to abiotic and biotic stress factors, with a good opportunity for mechanized harvesting and transportation (Boycheva, 1999; Boycheva, 2001; Georgiev et al., 2012; Domozetova et al., 2014; Bozhanska et al., 2019; Serbezova et al., 2019).
Profitability of raspberry fruit production is determined by the correct choice of cultivar, suitable agroclimatic conditions of the habitat (temperature, wind, precipitation, pests) and modern cultivation technology (Woznicki et al., 2016; Contreras et al., 2019).
The aim of the present research is to study the correlational dependences between the vegetative and reproductive indicators of 'Shopska Alena' raspberry cultivar, grown under the agro-climatic conditions of the Troyan region.

MATERIALS AND METHODS

The scientific experiment was conducted in a collection plantation of the Research Institute of Mountain Stockbreeding and Agriculture in Troyan. The planting scheme is 3.00/0.50 m, as the experiment was laid out in three replications, each one linear meter of the intra-row area of the plantation.
The plantation is located on a north-eastern slope, at an altitude of 460 m.
The soil on which the plantation was made is a gray forest, typical of the Troyan region.
Its mechanical composition is heavy sandy-

clay, moderately eroded with a low content of humus (Atanasova, 2021).

The raspberry cultivar 'Shopska Alena' was created in 1954 by crossing [(*Prussia x England*) x *Newburgh*] and was recognized by the State Cultivar Comission in 1970 (Popov and Hristov, 1970). The shrubs are fast-growing, forming a large number of medium thick shoots. The cultivar tolerates temporary heat and droughts well during the harvesting period. Fruits are average-sized to large-sized with a spherical shape. It begins to ripen towards the end of June, the beginning of July. It is characterized by great fruitfullness. The cultivar has great potential for yield and high fruit quality (Hristov et al., 1988; Boycheva et al., 1994; Serbezova, 2019).

The following biological and economic indicators were monitored:

- average number of shoots per linear meter;
- average height of shoots (m);
- average thickness of shoots (mm), measured at 10 cm from the soil surface;
- average fruit weight (g);
- average yield $1/m^2$ (kg).

The methodology for studying plant resources in fruit plants was used to report the indicators (Nedev et al., 1979). The data were processed by correlation analysis, the software product MS Excel - 2010 was used.

RESULTS AND DISCUSSIONS

The results regarding the vegetative indicator average number of shoots report that there is no significant variation in the values during the three-year period, which were in the range of 12.33-13.33 number (Table 1). The average for the period was 12.66 number, which shows that the cultivar has good shoot formation. The average plant height was greater in the first (1.35 m) and second year (1.38 m). The average shoot height of 1.24 m was recorded for the period. The average thickness of the shoots was significantly higher in the second year (8.41 mm), as the lowest was recorded in the third year (6.64 mm). The average thickness for the period was 7.48 mm, which necessitated the use of a supporting structure for growing the plants. According to Jenning (1980), "thicker shoots are more favourable to fruiting branches".

Table 1. Vegetative and reproductive indicators in 'Shopska Alena' cultivar for the period of 2018-2020

Average number of shoots $1/m^2$	Average height of shoots (m)	Average shoots thickness (mm)	Yield (kg/1 m^2)	Average fruit weight (g)
2018				
12.33	1.35	7.40	0.51	3.26
2019				
12.33	1.38	8.41	0.90	2.23
2020				
13.33	0.98	6.64	1.69	2.50
Average for the period 2018-2020				
12.66	1.24	7.48	1.03	2.66

The lowest average yield was obtained in the first experimental year (0.51 kg/1 m^2), whereas the highest value was registered in the third year (1.69 kg/1 m^2). The average yield for the period was 1.03 kg/1 m^2. The largest fruits were gathered in the first experimental year (3.26 g). The average fruit weight for the period was 2.66 g, which defines it as medium-large. The fruit weight is correlated with the height and diameter of the fruit, the size of the receptacle, the number of fruiting bodies and the seed weight, as it increases during the ripening process and decreases during pre-ripening (Serbezova, 2019). According to Kichina (1990) no definite correlation was found between the size and shape of the raspberry fruits.

A very high correlation dependence was reported in 2018, from the correlation analyzes, between height and shoot thickness indicators (0.93) (Table 2). It was high for number of plants and height (0.86) and high but with a negative sign between shoot thickness and yield (-0.88). A significant correlation was reported between number of plants with plant thickness (0.60) and negative for shoot height and yield (-0.64).

Table 2. Correlation dependences between vegetative and reproductive indicators in 'Shopska Alena' in 2018

	Number of shoots	Height	Thickness	Yield
Number of shoots	1			
Height	0.86	1		
Thickness	0.60	0.93	1	
Yield	-0.15	-0.64	-0.88	1

In the following year 2019, the correlation analyzes showed a very high correlation between shoot height and yield (0.98) and between plant thickness and yield (0.92) and a high correlation between height and plant thickness (0.82) (Table 3).

Table 3. Correlational dependences between vegetative and reproductive indicators in 'Shopska Alena' raspberry variety in 2019

	Number of shoots	Height	Thickness	Yield
Number of shoots	1			
Height	0.09	1		
Thickness	-0.50	0.82	1	
Yield	-0.10	0.98	0.92	1

A significant but negative correlation was reported between shoot number and thickness (-0.50). The obtained results regarding the correlation dependencies differ to a significant extent compared to the previous year.

In the third experimental year, very high correlation dependences were registered between the indicators number and height of shoots (0.99), number and thickness of the plants (1.00) and height with the thickness of the shoots (0.99) (Table 4). High correlations were reported between plant thickness with yield (0.87), number of shoots with yield (0.88) and plant height with yield (0.81). Based on the correlation dependences between the indicators, a repetitiveness in the three years of high to very high correlation of the height with the thickness of the shoots can be reported.

Table 4. Correlational dependences between vegetative and reproductive indicators in 'Shopska Alena' raspberry cultivars in 2020

	Number of shoots	Height	Thickness	Yield
Number of shoots	1			
Height	0.99	1		
Thickness	1.00	0.99	1	
Yield	0.88	0.81	0.87	1

CONCLUSIONS

The present study analyzed the interconnections between the vegetative and reproductive indicators of the Bulgarian raspberry cultivar 'Shopska Alena', grown under the soil and climatic conditions of the Troyan region.

During the three-year period, the 'Shopska Alena' cultivar had good shoot formation, medium-thick shoots, which necessitated growing them on a support structure. A high to very high correlation dependence between shoot height and thickness was reported over the three-year period. Repetitiveness of results from high to very high correlation was recorded for number with plant height, shoot height and thickness with yield.

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