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CHANGES IN PRODUCTION PROCESSES GRAPES FOR DIFFERENT DENSITY OF VINES

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Abstract

The availability of water has a direct effect on photosynthesis. The density of vines determines the water supply for the plants. The results of the study of the dynamics of the parameters characterizing the photosynthetic activity of grapes, under the influence of different density of vines are presented in the article.

Studies were conducted on Riesling with a different planting density of the vines. Greater stability of the pigment apparatus was typical of plants grown in a lower density. In variants with a smaller supply area, increased efficiency of the photosynthetic process was accompanied by the accumulation of starch in the leaves.

The negative coefficient of the correlation between the content of starch and efficiency of primary processes of photosynthesis may indicate the absence of stress-induced blocking the outflow of plastic substances from the leaves in variants with a lower plant density.

Key words: grapes, planting density, photosynthesis, yield.

INTRODUCTION

Photosynthesis is the basis of the production process and is dependent on a large number of natural and anthropogenic environmental factors [1, 2, 3]. According to the theory of photosynthetic productivity formulated Nichiporovich, provision of essential resources - CO2, water and nutrients is one of the most important ways of intensification of the production process. Lack of water reduces the efficiency of the photosynthetic process, however, significant changes occur only at relatively high intensity exposure drought [4]. Increasing water deficit to stress values leads to a reduction of carbon dioxide assimilation, especially in unstable grape varieties [5, 6].

As a result, the differences between plants grapes in the normal manner and in conditions of varying intensity of drought manifest themselves in quality of the crop. Plants under the influence of the most intensive water deficit, are characterized by the minimum size of the fruit, a large value of the ratio of the peel and pulp, a weak accumulation of phenolic compounds and solids in berries [7].

Provision of grape plants with water has a significant impact on the process of photosynthesis and, as a consequence, the quantity and quality of the crop. This factor can be adjusted through the use of various agricultural activities, including science-based standards of placement plants on the site. The density of vines is one of the major determining factors in the water provision of plants. With denser planting of grapes water content is greatly reduced due to the increase of total water consumption. Reduced soil moisture 70-75% field capacity affects the intensity of shoot growth, quantity and quality of the harvest [8].

Finding solutions to the effective management of photosynthesis and productivity of grapes is an actual problem of modern viticulture. Ways of creating and maintaining the vines have the greatest impact on photosynthesis and productivity [9].

Influence of ways of creating and maintaining the productivity of bushes of grapes is more studied at present [6-9, 12-22]. Few scientific studies related to the management and improve the efficiency of photosynthesis, determining the level of realization of the potential productivity of grapes, is currently available.

The purpose of research is to study the dynamics of the changing parameters that characterize the photosynthetic productivity of grapes under the influence of varying density of bushes to support effective management of productive perennial plants.

Research carried out in agroecological conditions of the Black Sea area of viticulture, AZOSViV (Anapa) in the field stationary experiment on vineyards of variety Riesling with different density planting bushes: 1428 pcs. / Ha (3,5 × 2,0 m) and 4,000 pcs. / Ha (2,5 × 1,0 m).

Determination of quantitative and qualitative composition of pigments in the leaves of grapes produced by the spectral method [10] and the starch content - colorimetric method [11].

The climate is mild in Anapa, falls to 452 mm of rain. The total territory of hydration is not always sufficient to deficit-free growing season and fruiting vines. The frost-free period - up to 212 days. The amount of active temperature range of 3200–3800 °C. The hydrothermal coefficient is 0.8 - 1.1, increasing as we approach the foothills. Chance of minimum air temperatures below -18 °C - 11%; below -22 °C - 2%; below - 27 °C is close to zero [23].

Results. Growth processes and yield formation in the experimental plot were in abnormal weather conditions in 2014. The weather conditions are characterized by high insolation, a significant deviation from the mean annual air temperature standards; acute shortage of rainfall in some, the most important period of grapes ontogenesis. The sum of active air temperatures from May to October exceeded the average annual rate of 247 °C and amounted to 3318 °C. Rainfall for January - December was 612 mm as 10% more than the norm. In February - April, rainfall was 65% below the norm, and was 47 mm.

Reducing the amount of rainfall in this period was accompanied by a delay in the accumulation of water in the soil. The deficit of rainfall was observed also during the growth and ripening of berries in July - August. During this period it fell only 41 mm of rain in 1.9 times less than the norm. Abundant rainfall in June, September and October was higher than norm in 2.1; 1,9 and 3,2 times respectively. The rains were torrential character. In case of intensive atmospheric precipitation rain water was lost as surface runoff and did not participate in the replenishment of soil moisture.

Decrease of chlorophyll content of grapes leaves observed in these weather conditions during the period from June to August (Fig. 1).

The minimum value of this indicator documented in late July - early August, with the advent of sugar content in the grapes. The greatest stability of the pigment apparatus was typical of plants grown at low density of bushes. Increasing the pigment content in the leaves occurred in the second half of August. The highest chlorophyll content was observed in the leaves of grapes with a lower density of the bushes.

The coefficient of efficiency of the primary process is determined by the ratio of the light-harvesting complex pigments and pigments of photosystem I and II [24].

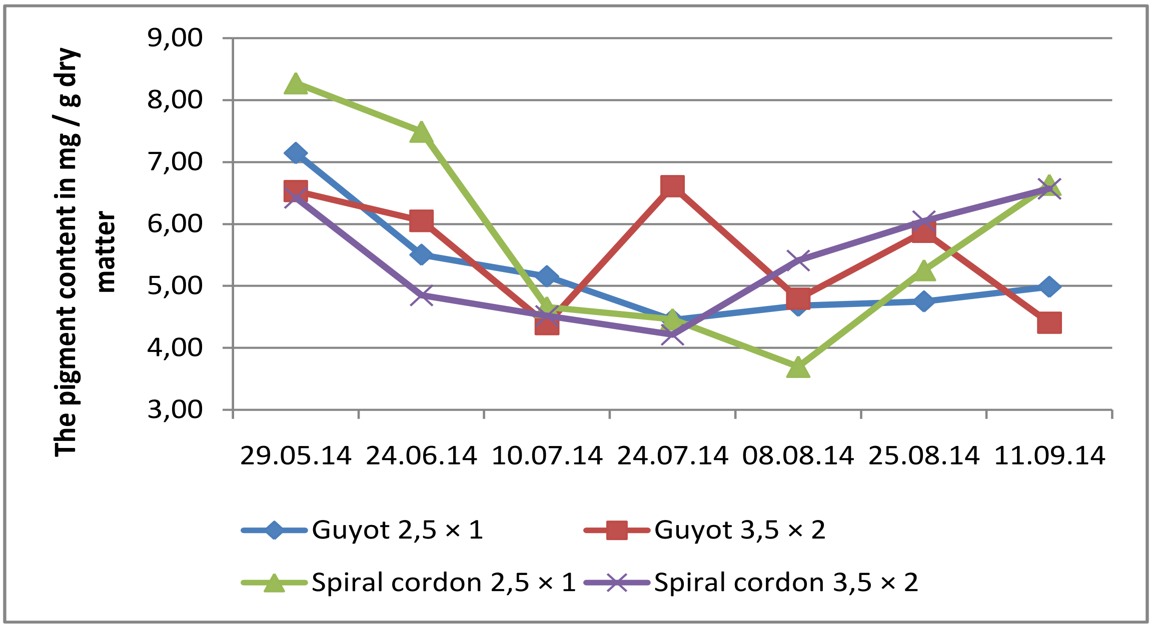

***Fig. 1.** The content of pigments in leaves of grapes*

The effectiveness of primary processes of photosynthesis significantly fluctuated during the growing season in all studied variants. In variants “Guyot 2,5 × 1” and “Guyot 3,5 × 2” the greatest values of this parameter were observed in the first week of August. In variants “Spiral cordon 2,5 × 1” and “Spiral cordon 3,5 × 2” highs efficiency of primary processes of photosynthesis occurs in 1 - 3 decades of July (Fig. 2).

Starch is the main product of photosynthesis. Starch accumulation in leaves was determined as an indicator of photosynthetic products (Fig. 3).

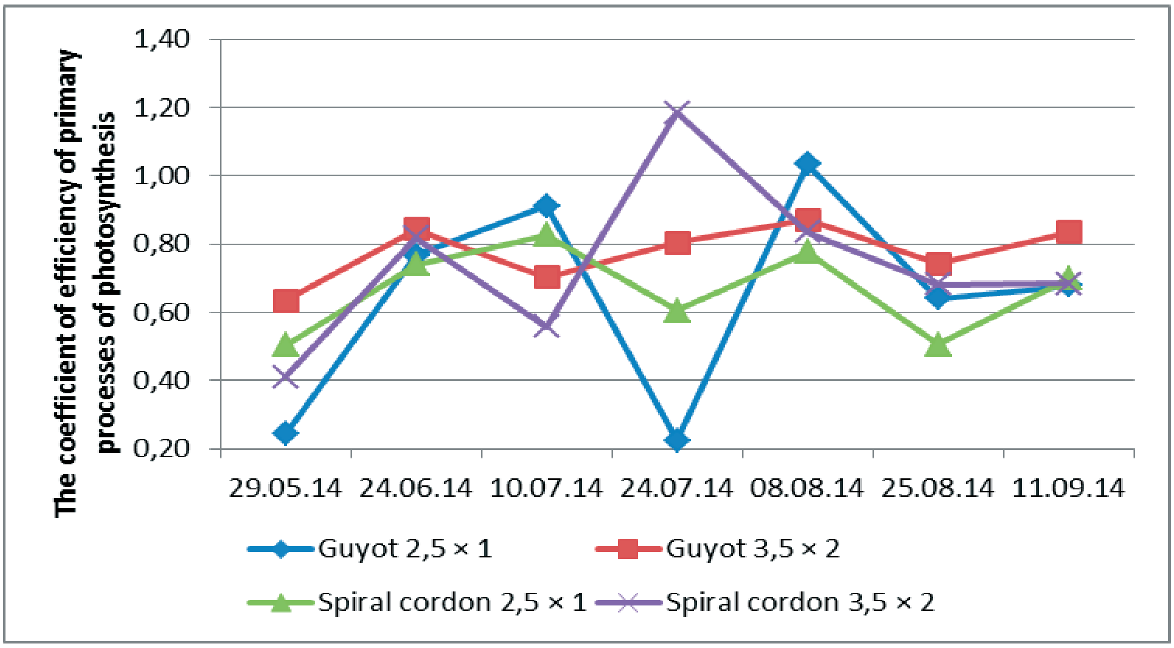

Fig. 2. *The effectiveness of primary processes of photosynthesis in grape*

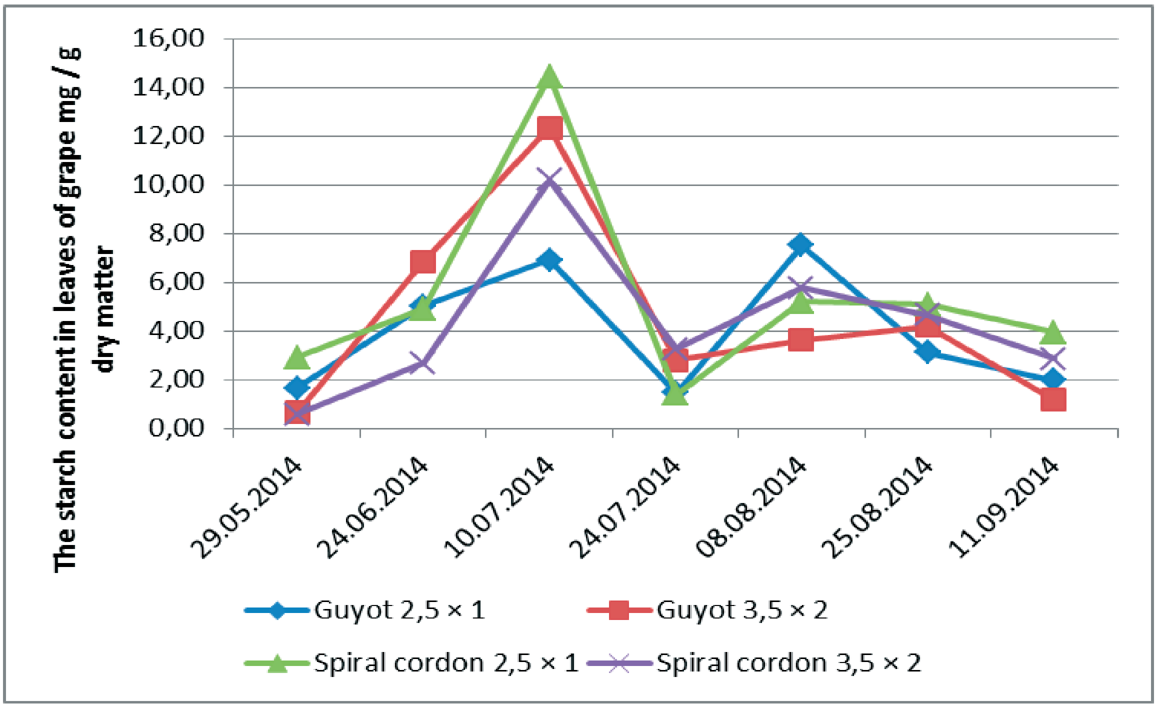

Fig. 3. *The content of starch in leaves of grapes*

The starch content in leaves reached a maximum in early July, and then decreased to a minimum in the third week of July. In the first decade of August starch accumulated in leaves again. From the third decade of August there was a decrease in leaf starch content. The dynamics of the starch content in the leaves corresponded to a change in the efficiency of primary photosynthetic processes in the third decade of July, since the beginning of the ripening of berries.

Dependence the starch accumulation from the effectiveness of the primary processes of photosynthesis during the growing season is shown in Figure 4.

In variants with a higher density of the bushes increase the efficiency of the photosynthetic process is accompanied by the accumulation of starch in the leaves, which may indicate a weakening of the outflow of plastic substances from the leaves under the influence of high temperature and lack of water during the growing season. Negative correlation coefficient between the starch content and the effectiveness of primary processes of photosynthesis may indicate a lack of stress caused blocking of the outflow of plastic substances from the leaves in variants with less density of the bushes.

Various schemes and planting density of vines on the experimental plot is not the same effect on the productivity of plantations. The number of green shoots on the vines was reduced from 26 to 14 pcs. / bush with increasing density of bushes. A similar trend was in the number of fruiting shoots. Coefficients of fruiting and fruitfulness increases with the density of planting bushes (Table 1).

The number of bunches on the bushes and grape yield were different and varied depending on the row spacing and the distance between the bushes. Vineyards with aisles width 3.0 m were the most productive in the conditions of 2014. Bushes differed from other variants with a large number of bunches per vine, and yield per unit area of plantations.

The distance between the bushes is also significantly affected the productivity of grapes. In the vineyards with row spacing of 3.5 and 3.0 m the highest number of bunches per vine and harvest was in variants with 1.5 m distance between the vines. In the vineyards with row spacing of 2.5 m the variant with the 2.0 m distance between the bushes was the most productive. Variant with 1 m distance between the bushes had the highest productivity per unit area (Table 2).

Thus, the vineyards planted by the scheme 3,5 × 1,0 m, are the most productive in high insolation and unsustainable natural soil moisture by atmospheric precipitation in the agro-ecological Black Sea area of viticulture. The grape yield was 13.1 t/ ha at a density planting bushes 2857 pcs./ha.

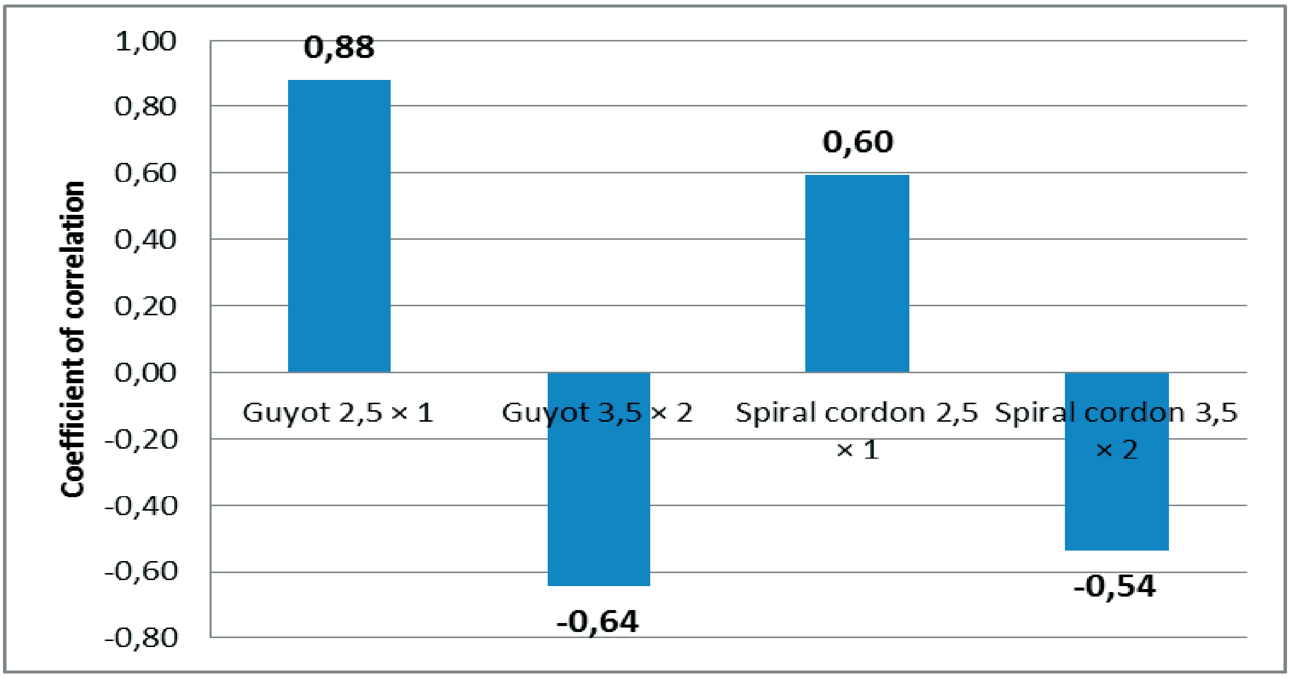

Fig. 4. *Dependence of starch accumulation from the effectiveness of primary processes of photosynthesis*

Table 1. Agrobiological characteristics of grapes

The scheme of planting bushes, m	The density of planting vines, pcs./ ha	The average number,pcs. / bush		Coefficient of fruiting	Coefficient of fruitfulness
		shoots	fruiting shoots		
3,5×2,0	1428	26	23	2,1	2,3
3,5×1,5	1905	24	21	2,1	2,3
3,5×1,0	2857	22	19	2,1	2,4
3,0×2,0	1667	20	17	2,1	2,5
3,0×1,5	2222	20	18	2,2	2,5
3,0×1,0	3333	19	17	2,2	2,5
2,5×2,0	2000	15	13	2,2	2,6
2,5×1,5	2667	17	16	2,5	2,7
2,5×1,0	4000	14	12	2,0	2,4

Table 2. The yield of grapes at different planting schemes

The scheme of planting bushes, m	The density of planting vines, pcs. / ha	The number of bunches, pcs. / Bush	Productivity	
			kg / bush	t / ha
3,5×2,0	1428	31,3	2,9	4,141
3,5×1,5	1905	49,8	5,8	11,049
3,5×1,0	2857	39,0	4,6	13,142
3,0×2,0	1667	42,3	4,8	8,002
3,0×1,5	2222	53,0	5,5	12,221
3,0×1,0	3333	48,8	3,8	12,665
2,5×2,0	2000	46,3	3,8	7,600
2,5×1,5	2667	33,0	2,4	6,401
2,5×1,0	4000	19,3	1,9	7,600

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