

THE INFLUENCE OF THE PLANT DENSITY TO THE PHOTOSYNTHETIC ACTIVITY OF THE POTATO SORTS

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Abstract. The influence of the plant density to the photosynthesis process was studied during the ontogenesis in the sorts Sevinj and Amiri-600 of the potato. So the plant density influence significantly to the leaf surface size, chlorophyll content and photosynthesis potential. The leaf surface area, the increase of the photosynthesis potential and in the amount of the chlorophyll in the leaf were researched during the growth and development of the plant. It was determined that the photosynthetic indicators are higher during the flowering period.

Keywords: potato, plant density, leaf size (area), chlorophyll, photosynthetic potential.

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1. Introduction

The leaves play an important role in the vital activity of the plants, by the playing the source role of the assimilates in the growth and development of the plants. That's why, the study of the processes taking place in the leaf is great importance in the optimization of the vital activity of the autotrophic plants and at the same time of the potato plant (Gaplayev, 2014; Gaplayev & Nadezhkin, 2014; Eyvazov *et al.*, 2016).

The plants densities, the application of the organic and mineral fertilizers to the soil, the application of the siderates and the other agro-technical measures influence strongly of the photosynthetic ability of the plant (Yusifov, 2004; Eyvazov *et al.*, 2017).

The purpose of the research was to determine the influence of the plant density to the photosynthetic activity of the plant during the ontogenesis of the potato sorts, to clarify the change regularities of the photosynthetic indicators during the growth and development stages of the plant, at the same time, to determine the optimal plant density for increase the productivity of the potato plant.

2. Materials and methods

The researches were carried out in the fields of the experimental farm of the Scientific-Research Vegetable Institute located in the Absheron peninsula in 2016-2018.

The size of the experimental areas was 42 m² and was carried out in 3 repetitions.

The local origin sorts Sevinj and Amiri-600 were taken as experiment objects. The material of the research was the leaves of the plants at different development stages of the sorts. The scheme of the experiments: 1) 60000 plants per 1 ha; 2) 48000 plants per 1 ha; 3) 40000 plants per 1 ha. In the different vegetation phases the leaf surface area of the

plants was measured by the LI-3000 portative apparatus, the amount of the chlorophyll in the leaf by the SPAD-502 Plus Chlorophyll Meter device.

The photosynthetic indicator (PI) consists of the product of the average value of the total leaf surface areas (1000 m² ha) at the different stages of the vegetation to the calculation period (in terms of time) (Tv, day) during the vegetation period and is calculated by the following formula:

$$(PP) PI = Lsr (Lcp) Tv$$

3. Results and discussions

The optimal sparseness of the plants allows to their normal nutrition, lighting, ventilation, intensive physiological and biochemical processes in the planting areas and also causes to the increase of the productivity. As we can see from the Table 1, the leaf surface area is very small in the first days of the vegetation season, and this indicator increases during the growth and development processes of the plant. In all the variants, the indicator reaches a maximum during the flowering phase. At the end of the vegetation, the value of the noted indicator decreases.

The sort Amiri-600 was the exception in the 3rd variant, so 2 maximums were recorded in this variant - one was observed during the budding (22.5 thousand m² / ha) and the other during the flowering (19.9 thousand m² / ha) phases. The size of the leaf surface decreases sharply after these phases.

Table 1. The influence of the plant density to the size of the leaf surface, the amount of the chlorophyll in the leaves and the photosynthetic potential in the different sorts of the potatoes (the average for the years 2016-2018)

Vegetation phases	Sort names					
	Sevinj			Amiri-600		
	1	2	3	1	2	3
The leaf surface area, 1000 m² / ha						
The formation of 6-7 main leaves	10.4	7.9	9.4	13.0	9.2	6.0
Budding	20.2	15.1	19.4	23.9	21.3	22.5
The beginning of the flowering (<25%)	22.1	28.8	19.1	25.8	23.9	11.5
Mass flowering (>75%)	32.5	21.4	17.5	39.6	22.8	19.9
The technical maturation of the tubers	18.1	20.2	12.1	19.5	18.3	9.1
The amount of the chlorophyll in the leaves, mg / 100 gr						
The formation of 6-7 main leaves	243.5	345.1	470.6	24.6	226.4	197.3
Budding	246.6	412.7	271.9	336.4	342.0	419.6
The beginning of the flowering (<25%)	163.9	348.7	274.2	287.3	204.6	100.7
Mass flowering (>75%)	355.9	328.5	286.7	343.8	229.1	279.5
The technical maturation of the tubers	150.3	193.9	136.4	218.4	101.1	113.5
Photosynthetic potential, 1000 m² x day / ha						
The formation of 6-7 main leaves	346.4	268.9	328.1	354.0	302.7	201.4
Budding	285.6	215.3	262.8	312.2	294.8	321.4
The beginning of the flowering (<25%)	199.5	334.1	231.1	330.9	254.5	117.1
Mass flowering (>75%)	572.5	332.8	217.3	623.4	358.4	315.4
The technical maturation of the tubers	218.6	254.3	182.4	296.7	308.4	151.4

The amount of the chlorophyll in the leaves plays an important role in the photosynthetic evaluation of the plant, because the photosynthesis process takes place in this organ. The amount of the chlorophyll in the leaves of all the researched sorts varies during the budding and flowering phases, and reaches the maximum limit twice.

A slight exception is noted only in the 3rd variant of the sort Sevinj, so in this variant the first maximum limit was observed at the beginning of the vegetation.

A common similarity in the change of the amount of the chlorophyll in the leaves was a sharp decrease of this pigment at the end of the vegetation in all the variants of both sorts.

The results given in the Table 1 show that the photosynthetic indicators are relatively high in all the variants of both sorts, except the 3rd variant of the sort Amiri-600, when the seedlings have 6-7 main leaves (268.9-354.0 thousand $m^2 \times day / ha$), and during the budding period, this decrease extends during the mass flowering period.

In the mass flowering phase, in all the variants (except the 3rd variant of the sort Sevinj) the photosynthetic potential of both sorts reaches a maximum. In this case, a relatively high PP is noted in the first variant of both sorts (in the sort Sevinj-572.5; in the sort Amiri-600-623.4 thousand $m^2 \times day / ha$).

In the 3rd variant of the sort Sevinj, a relatively high indicator of the PP is noted in the phase of the formation of 6-7 real leaves (328.1 thousand $m^2 \times day / ha$), in the phase of the growth and development of the plant this indicator decreases until the end of the vegetation. The regularity observed at the end of the vegetation in the area of the leaf surface and in the amount of the chlorophyll in the leaf is repeated also during the change of the value of the PP, and also the value of these indicators decreases sharply.

During the experiments, it was determined that the relatively high productivity of the sort Sevinj (365.1 cents / ha) is noted when the plant density is 49000 plants per hectare, and in the sort Amiri-600 (377.2 cents / ha) when 40000 plants per hectare.

Table 2. The influence of the plant density to the potato productivity
(the average for the years 2016-2018, s/ha)

The scheme of the experiments	Potato sorts	
	Sevinj	Amiri-600
1. 60000 plants per 1 ha	207.3	255.6
2. 48000 plants per 1 ha	365.1	294.9
3. 40000 plants per 1 ha	256.2	377.2

So, it was determined that the plant density in the planting areas is one of the main factors influencing the size of its leaf surface area, the amount of the chlorophyll in the leaf and the PP, and at the same time, determining the productivity. When 48000 plants are planted per hectare in the sort Sevinj, the nutrition and development of the plant are normal, at the same time, the productivity is high.

4. Conclusions

- The plant density in the planting areas influences significantly the leaf surface area of the plant, the amount of the chlorophyll in the leaf and the value of the PP. In the potato sorts the value of the photosynthetic indicators increases (rises) during the growth and development of the plant. The relatively increase the size

of the leaf areas, the amount of the chlorophyll and the PP in the leaf is mainly observed during the flowering period.

- The relatively high productivity is noted when 48000 plants are planted per hectare for Sevinj sort and 40000 plants per hectare for Amiri-600 sort. In these variants, the plant feeds and grows normally.

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