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STOROZHYK L. I., Candidate of Agricultural Sciences, Senior Researcher
Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine

CONTENT OF CHLOROPLASTS IN LEAVES OF SUGAR SORGHUM PLANTS AND THEIR ROLE IN THE PROCESS OF PHOTOSYNTHESIS

The dependence of formation of content of green pigments (a and b chlorophylls) on the growth of leaf area at plants of sugar sorghum on stages of organogenesis of culture is established. It is defined that the area of assimilation surface of crops and chlorophyll a and b content were the highest at plants of sugar sorghum which had reached a phase of shooting out panicle.

Keywords: *Sorghum, a and b chlorophylls, stages of organogenesis of culture, area and index of leaf area.*

Introduction. Researches of domestic and foreign scientists proved that photosynthetic productivity of plants depends on the assimilatory surface, the intensity of photosynthesis, the daily gain of vegetative mass, use factor of solar energy etc. Therefore, the larger the area of the leaf surface, the faster is the accumulation of organic matter by plants of crops that causes increase in productivity per unit of crop acre [1, 2].

The major photosynthesizing pigments of green plants are chlorophyll and carotinoids contents, status and activity of which define all complex of metabolisms of plant organisms. As the production process is provided by the photosynthetic activity of many structures that consistently change in ontogeny, it is important to be aware of their relative contribution in this process, and the presence of chlorophyll in the leaves and the ways of its preservation during long-term in the active state. [3]

Chlorophyll, which is the main component of the pigments of photo system of sweet sorghum plants, like other autotrophic plants, concentrated in chloroplasts - the

most important structures of the cells of green leaf. Critical role in photosynthesis plays a green pigment - chlorophyll. Currently, there are about 10 chlorophylls. They differ in chemical structure, color, spread among life. Chlorophyll formation takes place in two phases: the first phase - the dark, during which is being formed the precursor of chlorophyll - protohlorophyll, and the second - the light, during which it is being formed chlorophyll from protohlorophyll at light. It is necessary the presence of iron for the formation of chlorophyll. Wanting iron plants are characterized by pale stripes and faint green color of the leaves. Chlorophyll formation depends both on the temperature and on water supplying. The optimum temperature for the accumulation of chlorophyll is 26-300 C, and severe dehydration of seedlings leads to a complete cessation of chlorophyll formation [4, 5].

The functional role of plastid pigments in plants is not limited only to their participation in the assimilation of energy. Being in plastids, pigments focus in the integrated form all external conditions and their actions bag and baggage. The pigment complex carries out the major for the plant organism function - absorption of radiant energy of the sun which goes on formation of organic substance. In the productive crops plant leaves absorb 80-85% of photosynthetic active shafts with a wavelength of 380 - 710 nm (0,38-0,71 m). This part of the solar spectrum is known as photosynthetically active radiation (PAR). Rays are well absorbed by the green pigment of chloroplasts - chlorophyll and it is an energy basis of photosynthesis. The intensity of photosynthesis increases with increase of chlorophyll. However, photosynthesis consumes less than 1.5 - 3% of the absorbed energy of PAR [6].

By crops consideration as photosynthesizing systems yield of vegetative mass that is created for the vegetative period, or its gain for a certain period depends on the size of the average area of leaves, or leaf index, duration of the period and net productivity of photosynthesis.

In the initial stage of development of plants the assimilatory surface is insignificant and the considerable part of the PAR passes by leaves, not captured by them. Photosynthesis occurs and in other green parts of plants - stalks, awns, green fruits, etc., however the contribution of these bodies to the general photosynthesis is

usually insignificant. The greatest intensity is characteristic for almost created leaves. And this leaf surface has to be developed to the certain phase of plant development. With increase of the area of leaves absorption of energy of the sun by them increases also. When the index of leaf surface (the value that shows how many times the leaf area exceeds that area on which there are plants), is equal 4, the area of leaves makes - 40 thousand m ²/hectare, or 4 m ²/m ² make - 4 - 5, that is the area of leaves in crops makes 40-50tys m ²/hectare. For fodder plants in which leaves represent economic and valuable part of the crop the area of leaves can reach 60-85 thousand sq.m/hectare. At further increase of the leaf area absorption of PAR doesn't rise. In process of increase of age of leaves (ageing process) intensity of photosynthesis falls. At the rate of photosynthesis age affects the whole plant. In the majority of annual plants intensity of photosynthesis increases in the process of ontogeny and reaches maximum in the phase of budding, flowering. After flowering intensity of photosynthesis in leaves decreases [7].

In crops where the course of formation of the area of leaves optimum, PAR absorption can make on average during the growing season - 50-60% of the incident radiation. Vegetation absorbed PAR - power base for photosynthesis. However in the crop only the part of this energy accumulates. In coen with good indicators of the intensity of photosynthesis leaf index is equal 4-5 and reaches to 8-10 [8].

Therefore possibility of normal existence of plants, preserving the unity with environment conditions, ability of an organism to reconstruct all course proceeding in it physiological and biochemical processes according to change of these conditions it is closely connected with their pigment complex. In this context, the aim of our study was to determine the chlorophyll content in leaves of sugar sorghum according to the phases of growth and development and the dependence of this process on leaf area.

Technique of researches. Experimental work was carried out during the 2010-2013 on Veselopodilskiy and Ivaniv ESS.

The total acreage is 100 sq.m, registration acreage - 50 sq.m. Frequency of experience - quadruple.

Contents of a and b chlorophylls were determined by stages of organogenesis

by dimethyl sulfoxide extraction by spectrophotometer method [9-10, 12, 13] and were counted for 1 sq.m of leaf area for 1 g of raw matter.

Leaf index of crops was calculated as the product of area of green plants of a separate plant on quantity of plants which grow on 1 sq.m [11].

Results and discussion. According to the results of our research, the chlorophyll content in leaves of sugar sorghum plants gradually increased according to the phases of growth and development and reached the maximum in the phase of shooting out panicle, and in the phase of wax ripeness - intensively decreased (Table 1). Obviously, the maximum chlorophyll content in tissues is closely connected with the activities of middle layer leaves, which function during the conceiving and shooting out panicle by the plants of culture.

Table 1

Chlorophyll content in the leaves and leaf area index of sweet sorghum coens on stages of organogenesis, an average for 2010-2013

		Phases of growth and development of plants				
		bushing	booting	shooting	shooting out panicle	Wax ripeness
Hybrid Medovy						
Leaf area index, sq.м/sq.м		0,74	3,80	7,27	7,98	7,82
Chlorophyll content, mg/g of raw mass	*a*	0,61	1,01	2,65	5,92	0,61
	b	0,15	0,29	0,45	0,64	0,16
	a+*b*	0,76±0,06	1,3±0,13	3,1±0,10	6,56±0,16	0,77±0,25
Variety Sylosne 42						
Leaf area index, sq.м/sq.м		0,65	3,72	6,81	7,89	7,71
Chlorophyll content, mg/g of raw mass	*a*	0,49	0,82	2,44	4,73	0,53
	b	0,16	0,38	0,51	0,50	0,22
	a+*b*	0,65±0,16	1,2±0,23	2,95 ±0,21	5,23±0,10	0,75±0, 19

The chlorophyll absorbs solar energy and directs it on chemical reactions which can't proceed without the energy received from outside.

Analyzing the data in Table 1 it is lawful to claim that hybrid Medovy plants contain more a and b chlorophyll per unit of leaf area in comparison with the variety Sylosne 42.

Results of researches showed that the maintenance of a and b chlorophyll in the leaves of sugar sorghum plants and index of leaf area during their growth and development significantly differed: in variety Sylosne 42 the difference between phases of the lowest maintenance of a chlorophyll – bushing and the highest its indicator shooting out panicle made 5, 31 mg/g; chlorophyll b - 0, 43 mg/g of crude weight, in hybrid Medovy accordingly chlorophyll a - 4,27 mg/g, chlorophyll b - 0,49 mg/g of crude weight.

The area of assimilative surface of sweet sorghum less changes during the years of researches, in comparison with the total maintenance of a and b chlorophyll in the leaves of plants of culture (tab.1). The difference of values of the total content of a and b chlorophyll in the average for years of researches between the greatest and the smallest indicator made in variety Sylosne 42 - 4,58 mg/g, in hybrid Medovy - 5,8 mg/g of crude weight. This indicates that there is a significant difference, as in the mechanisms of photosynthesis of sugar sorghum, in system of redistribution and a translocation of plastic substances in plants.

The main indicators for coen define per unit of area – 1sq.м or 1ha. Besides, use such indicator, as an index of leaf area - the indicator of photosynthesizing biomass is equal to the area of the lighted leaves.

By our researches it is established that at the beginning of vegetation slow increase of the area of leaves was noted, but since the phase of shooting the growth rate of the leaf apparatus considerably increased in sorghum crops, their area doubled in 7-10 days. So, at the beginning of vegetation, in the phase of bushing the area of leaf surface was very low and made 157-176 sq.m/hectare, in the exit phase of booting - the area of leaf surface started growing and reached 4007-4623 sq.m/hectare.

After shooting out panicle growth of leaf apparatus of sugar sorghum continues, but the rate it's falling. In this phase, the area of leaves of crops reaches

69000 - 72000 sq.m/ha and leaf area index on average is 6,8-7,9 (Table 1.). In the phase of wax ripeness it reaches 8.0. The degree of leaf growth and dynamics of growth of leaf area changes during the growing season. A large number of leaves in crops of sugar sorghum in the phase of flowering and increase them in phenophase of wax ripeness testify about highly effective absorption of light by these plants that is connected with high ability of this culture to adapt to shading. Marked fact describes the culture of sorghum as a plant with very high efficience of coen.

Conclusions. In the phase of shooting out panicle sugar sorghum plants reached the highesr rates of index of leaf surface (7,9-8 sq.m/sq.m) and the maintenance of a and b chlorophyll (5,33 and 0,67).

Total quantity of a and b chlorophyll in the leaves of plants of sugar sorghum increased on stages of organogenesis from 0,65 mg/g in the phase of bushing and to 6,56 mg/g of crude weight in the phase of shooting out panicle.

The area of assimilative surface of crops and the maintenance of a and b chlorophyll were the highest at the plants of sweet sorghum which reached the phase of shooting out panicle then there was their considerable decrease.

Determination of power of development of the photosynthetic apparatus according to the maintenance of a and b chlorophyll can be used for the characteristic not only separate plants, but coen in general.

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Анотація

Сторжик Л.І.

Вміст хлоропластів у листках рослин сорго цукрового та їх роль в процесі фотосинтезу

Встановлено залежність формування вмісту зелених пігментів

(хлорофілів а і б) від наростання площі листкової поверхні в рослин сорго цукрового за етапами органогенезу культури.

Ключові слова: *сорго, хлорофіли а і б, етапи органогенезу культури, площа та індекс листкової поверхні.*

Аннотация

Сторжик Л.И.

Содержание хлоропластов в листьях растений сорго сахарного и их роль в процессе фотосинтеза

Установлена зависимость формирования содержания зеленых пигментов (хлорофиллов а и б) от нарастания площади листовой поверхности у растений сорго сахарного по этапам органогенеза культуры.

Ключевые слова: *сорго, хлорофиллы а и б, этапы органогенеза, культура, площадь и индекс листовой поверхности.*