Some Physiological Indicators of Domestic and Foreign Soybean Varieties under Different Water Regimes

Matniyazova H.Kh[1], Nabiyev S. M[2], Abzalov M.F[3], Kholiqova M.A[4], Yuldashev O'.H[5]

Institute of Genetics and Experimental Biology of Plants of the Academy of Sciences of the Republic of Uzbekistan

Abstract: ***The article presents the results of an analysis of physiological indicators of the total content of chlorophyll "a" and chlorophyll "b" on the leaves of plants during mass podding in domestic and foreign soybean varieties grown under different conditions of water availability. Under conditions of water deficiency, in some varieties, there is an increase in chlorophyll "a", chlorophyll "b" and an increase in the total amount of chlorophyll, and in some varieties, on the contrary, it decreases. This indicates that the content of plastid pigments in the leaves of plants varies depending on the biological characteristics of the varieties and water supply conditions.***

Keywords: soybean, variety, water regime, simulated drought, nature, total chlorophyll, chlorophyll "a", chlorophyll "b", adaptation

1. Introduction

In recent years, the accelerated development of food and feed for livestock requires an increase in soybean production. Soy contains valuable and irreplaceable proteins, which in nutritional value are not inferior to animal protein. It contains unique biologically active substances, lecithin, choline, vitamins A, B and E, macro- and microelements and other valuable nutrients. Soy contains no lactose and cholesterol. It is worth noting that in terms of calorie content and composition, basic nutrition and biologically active substances, this product is alternatively balanced [4].

The main products from soy are soy flour and soybean oil. Soy flour is used in the manufacture of confectionery products, fillers, and in the production of meat, milk and cheese substitutes. Oil is used in the food industry, in the production of mayonnaise and margarine. Many scientists and producers believe that "soy is food, feed and the future". With the help of soy, the problem of the production of complete vegetable protein is almost completely solved[4].

Due to the limited water reserves in Uzbekistan and the recent water shortage in the region in recent years, the identification and introduction of drought-resistant soybean varieties in Uzbekistan is one of the key areas of agriculture. Because water scarcity affects crop yields and their quality. To prevent this,new water-saving technologies should be introduced [6].

Most of the irrigation water for irrigation of crops in irrigated fields, i.e. 65-70% is absorbed by plants, and the remaining 30-35% are physically evaporated and absorbed into the deep layers of the soil [1]. Photosynthetic organisms are subjected to various abiotic stresses during their life. The effects of excessive lighting, drought, low temperatures, high concentrations of salt and herbicides are the most common types of stress and reduce the productivity and vitality of plants [3], [5].

According to the research of V.V. Polevoy [16], various stresses (adverse factors) cause nonspecific chain reactions in the plant cell. The permeability of membranes for different ions increases in the initial stage of this chain reaction. Calcium ions pass into the cytoplasm from various components. The increased content of calcium ions in the cytoplasm leads to many calcium-dependent processes and increased activity of enzymes, especially enhancing the stability of plant enzymes (the state of the cytoskeleton and the assembly of microfilaments, synthesis of stress proteins, ATPase, protective amino acids, enzymes for the synthesis of toxic substances from insects and microorganisms, various hydrolases, peroxidases and etc.).

According to E.V. Mashkin [12], especially the control of homeostasis of oxidation and reduction of plastids and mitochondria is one of the classifications that determine the resistance of plants to the effects of extreme environmental factors. Increased resistance due to cytoplasm organelles is associated with their copying, which reduces breeding pressure and increases the heterogeneity of populations of cytoplasm organelles. Stress can lead to the effective selection of organelles and the formation of tissues, organs and organisms with altered reaction rates. Under the influence of extreme environmental factors, plastids and mitochondria gain the advantage of tissues adapted to high concentrations of free radicals.

According to the experiments of A.M. Lysogorenko, A.S. Kazakova, N.E. Samofalova [11], in the dry conditions of the year, the seeds were partially hardened in the mother plant, and under water stress, their yield increased by 11% compared to the seeds of the optimal year, and in case of high water deficiency, the seed germination of these varieties increased by 24%.

The most difficult part of evaluating genotype – environment interactions is the need for large-scale multidisciplinary field experiments, including many varieties and genotypes.

According to I.N. Kudryashov, L.A. Bespalova, A.V. Vasiliev [9], the certification of varieties based on the mutual influence of genotype-environment makes it possible to regulate the use of varieties in their production in accordance with their agroecological addresses (classifications).

Resistance to drought - the ability of plants, cells and tissues to adapt to dehydration. The resistance of plants to drought decreases sharply with the advent of fruiting organs. During the process of adaptation to drought, the balance of phytohormones changes and the metabolism of amino acids is disrupted [16]. As you know, a plant contains about 95% of organic matter in dry matter, which is formed during photosynthesis. Most of the organic matter in plants is used to produce reproductive parts. As a rule, plant productivity depends primarily on the net productivity of photosynthesis, leaf surface, the duration of assimilation, the amount of organic matter used for respiration, and also on external and internal factors [8].
Scientists in their studies found that with water deficiency, chlorophyll “a” and “b” and changes in the total chlorophyll of plants in barley [2] and cotton [13,14] compared with optimal water conditions.

2. Research Method and Conditions

Our experiments were carried out under a lysimetric condition at the Datura experimental base of the Institute of Genetics and Experimental Plant Biology of the Academy of Sciences of the Republic of Uzbekistan. The objects of study are the foreign varieties Selekta-302, Selekta-301, Selekta-201, Amigo, Sparta, Vilana, Nana, Eureka-357, Chara, Arleta, Duar and local Genetic-1, Sochilmas, Orzu, Tumaris, Ustoz, Baraka.

The experiment was conducted on different backgrounds with different water regimes. Against a 1-background (experiment), a three-time watering was carried out according to a 1:1:1 scheme, i.e. against an experimental background, watering was carried out once during the setting of the bud, once during flowering and once the time of release of the pods and a simulated drought was formed - an artificial water shortage. On the control (2-background) during the growing season of plants was carried out five times irrigation according to the scheme 1:2:2.

Physiological analyzes were determined simultaneously for all genotypes under laboratory conditions, when the moisture content in the soil was 70-72% in the optimal water regime relative to the ChDNS and 48-50% in the simulated drought. Physiological parameters of total chlorophyll [10.15], chlorophyll “a” [10.15], chlorophyll “b” [10.15] on the leaves of the plant were extracted from 3 leaf tissues at the point of soybean growth on a 96% ethanol spectrophotometer (Agilent Cary 60 UV-Vis. Germany) and was determined by the following equation

$$\mathbf{Ch\text{-}a=13.36A_{664} – 5.19\ A_{649}}$$
$$\mathbf{Ch\text{-}b=27.43A_{649} – 8.12\ A_{664}}$$
$$\boldsymbol{F}\ \mathbf{[mg/g]} = \boldsymbol{(V * C) / P}$$

Here: the chlorophyll content in the leaves of the plant F [mg / g]; B is the volume of liquid [ml]; C is the concentration of chlorophyll [mg / l]; P - leaf weight, [g].

Other agricultural activities were carried out uniformly in both backgrounds. Landing was carried out in the first decade of May according to the scheme 60x20x1 in the prepared lysimeter. Seeds were sown on the ground to a depth of 4-5 cm, and varieties studied on both backgrounds were randomized and sown in 3 replicates, 2 rows in each revolution and 25 nests in each row.

Statistical analysis of the studied cotton varieties based on experiments in conditions of water shortage and optimal water supply was performed using EXCEL 2010 software on a Pentium 4 computer. Water deficit in soybean varieties, that is, the level of sensitivity based on the characteristics of the simulated drought, the adaptability coefficient is estimated using the following formula by S.A. Ebarhart, W.A. Russell [7]

$$Cad\% = (\frac{x_1}{x_2} * 100) - 100\%$$

where x_1 is the indicator of water shortage, and x_2 is the indicator of optimal water supply.

3. Results and discussions

Photosynthesis is one of the main processes in the body of a plant, and its dynamic state is determined by internal and external factors. Any change in environmental conditions, first of all, will affect the intensity and direction of photosynthesis processes. This will ultimately lead to changes in the growth and development and productivity of the plant. The growth and productivity of plants in different climatic and soil conditions depends on the adaptation of different physiological processes, especially photosynthesis. In the process of photosynthesis, pigments are light acceptors, the physicochemical properties of which determine the primary reactions of photosynthesis, that is, the efficiency of the photosynthetic apparatus in green plants is determined by the position and amount of pigments in chloroplasts [10, 17].

An analysis of the results of our experiments shows that in case of water deficiency, the content of chlorophyll in soybean varieties has a different level of sensitivity and varies depending on the genotype.

With optimal water availability, the highest chlorophyll “a” was recorded in foreign varieties of Arlet and Vilan (3.35±0.01 mg / g and 3.28±0.02 mg / g, respectively), with the lowest rate. was found in the local variety Tumaris (2.00±0.01 mg / g) (table 1). High levels of chlorophyll “a” in simulated drought conditions were found in the local varieties Sochilmas, Tomaris and the foreign variety Selecta 301 (3.27±0.01 mg / g, 3.27±0.01 mg / g and 3.27±0, respectively). (01 mg / g), and the lowest indicator was in the variety Orzu (1.62±0.02 mg / g). When the coefficient of adaptation was determined by the content of chlorophyll “a”, it was found that in some cases of water deficiency, in some varieties there is an increase or decrease in some of them. This indicates that the amount of chlorophyll “a” in the leaves of plants depends, along with the presence of water, on the genotypic composition.

With optimal water availability, high chlorophyll “b” values were found in foreign Selecta-201 varieties (1.84±0.03 mg / g), and the lowest in local Tomaris varieties (0.86±0.04 mg /

g)) Under simulated drought conditions, high levels of chlorophyll "b" were recorded in the local variety Ustoz (1.94±0.02 mg / g). The lowest sensitivity to water deficiency in the content of chlorophyll "b" is in the foreign variety Arleta, with an adaptability coefficient (K_{adapt}%) of -8.13, with the highest sensitivity recorded in the local variety Tumaris with a coefficient of +72.09, with a water deficiency of Arleta variety, the chlorophyll "b" indicator decreased, while on the Tumaris variety, on the contrary, sharply increased.

In conditions of optimal water availability, the highest total chlorophyll in soybean varieties was recorded in the foreign Arleta variety (4.95 ± 0.01 mg / g), with the lowest indicator in the local Tomaris variety (2.76 ± 0, 01 mg / g).) In case of water deficiency, the highest levels of total chlorophyll were found in local Sochilmas and foreign varieties of Vilan (4.99 ± 0.06 mg / g and 4.94 ± 0.02 mg / g, respectively). The lowest values of total chlorophyll were in the local variety Orzu and amounted to 2.23 ± 0.01 mg / g.

With a water deficit, from the point of view of the total chlorophyll content, various changes are observed in soybean varieties, which means that in some varieties the total chlorophyll levels increased, and in some varieties they decreased under conditions of water deficiency. The smallest susceptibility to water deficiency was observed in foreign varieties of Select-301 with a fitness coefficient of -0.45, with the highest sensitivity in local varieties of Sochilmas and foreign varieties of Nena (48.96 mg / g and 48.70 mg / g, respectively).), i.e. the total chlorophyll content increased sharply in case of water shortage in these varieties.

4. Conclusion

Thus, the research of the amount of chlorophyll "a", chlorophyll "b" and total chlorophyll by physiological criteria in local and foreign soybean varieties under different water conditions showed that the content of plastid pigments in soybean leaves varies depending on the biological characteristics and conditions of water availability. A sufficient amount of plastid pigments to a certain extent reflects the intensity of photosynthetic processes in the plant, ensuring their growth, development speed and yield. The high amount of chlorophyll "a" in soybean leaves compared to chlorophyll "b" indicates that soy is a photophilousplant.

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Table 1: Chlorophyll content in different water regimes during the mass roaming in local and foreign soybean varieties. mg/g

№	varieties	Chlorophyll (a),mg/g			Chlorophyll (b),mg/g			Chlorophyll (a+b),mg/g		
		OF	SD	Cad%	OF	SD	Cad%	OF	SD	Cad%
1	Selekta-302,	2,69 ±0,02	2,89±0,02	+7,43	1,05±0,01	1,17±0,02	+11,43	3,79±0,01	4,07±0,04	+7,39
2	Selekta-201	3,12±0,01	3,18±0,02	+1,92	1,84±0,03	1,53±0,01	-16,85	4,51±0,09	3,81±0,02	-15,53
3	Ustoz	3,17±0,02	3,22±0,01	+1,57	1,38±0,03	1,94±0,02	+40,58	4,28±0,02	4,67±0,01	+9,11
4	Amigo	2,26±0,02	2,96±0,03	+30,97	0,78±0,07	1,21±0,03	+55,12	3,28±0,02	4,22±0,01	+28,66
5	Selekta-301	3,04±0,04	3,27±0,01	+7,57	1,33±0,04	1,68±0,01	+26,32	4,44±0,06	4,42±0,01	-0,45
6	Arleta	3,35±0,01	3,15±0,01	-5,97	1,60±0,03	1,47±0,02	-8,13	4,95±0,01	4,63±0,02	-6,46
7	Sparta	3,02±0,01	3,22±0,04	+6,62	1,14±0,01	1,47±0,02	+28,95	4,22±0,01	4,71±0,02	+11,61
8	Duar	2,90±0,05	2,21±0,01	-23,79	1,13±0,01	0,84±0,04	-25,66	4,07±0,01	3,10±0,03	-23,83
9	Vilana	3,28±0,02	3,24±0,03	-1,22	1,63±0,01	1,69±0,01	+3,68	4,28±0,02	4,94±0,02	+15,42
10	Chara	3,01±0,02	2,88±0,02	-4,32	1,18±0,05	1,29±0,01	+9,32	4,28±0,02	4,12±0,01	-3,74
11	Nena	2,48±0,01	3,13±0,02	+26,21	1,00±0,03	1,45±0,01	+45,00	3,08±0,03	4,58±0,02	+48,70
12	Eureka-357	3,09±0,01	2,85±0,05	-7,77	1,29±0,02	1,18±0,02	-8,53	4,39±0,02	4,05±0,01	-7,74
13	Baraka	2,39±0,02	3,11±0,03	+30,13	1,02±0,02	1,48±0,01	+45,10	3,54±0,01	4,61±0,01	+30,23
14	Sochilmas	2,49±0,02	3,27±0,01	+31,33	1,04±0,03	1,70±0,03	+63,46	3,35±0,05	4,99±0,06	+48,96
15	Genetic-1	3,16±0,02	2,03±0,01	-35,76	1,40±0,06	0,74±0,01	-47,14	4,58±0,01	2,78±0,01	-39,30
16	Orzu	2,63±0,01	1,62±0,02	-38,40	0,96±0,01	0,61±0,02	-36,46	3,35±0,02	2,23±0,01	-33,43
17	Tumaris	2,00±0,01	3,27±0,01	+64,00	0,86±0,04	1,48±0,02	+72,09	2,76±0,01	4,07±0,01	+47,46

Note: OF - Optimum water regime, SD - simulated drought