FEATURES OF MINERAL NUTRITION ON THE CONTENT OF PLASTID PIGMENTS IN THE LEAVES OF MEDICINAL PLANTS (CYNARA SCOLYMUS L.)

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Abstract*. Based on the results of the studies, the authors note that in all variants of the experiments, regardless of the supply of soil with nitrogen, phosphorus and potassium, the maximum content of both chlorophylls and carotenoids falls on the phases of flowering and fruit formation, and the minimum during the periods of budding and ripening of artichoke seeds.*

It was also revealed that a decrease in the supply of soil with nitrogen, phosphorus and potassium, especially the exclusion of one of the main elements of mineral nutrition, leads to a significant decrease in the content of photosynthetic pigments in the leaves of the prickly artichoke (Cynara scolymus L.).

Thus, in the medicinal plant spiny artichoke (Cynara scolymus L.) in developmental phases, under different conditions, mineral nutrition has a significant effect on the content of plastid pigments. It was found that the exclusion of phosphorus from the nutrient mixture led to the strongest decrease in photosynthetic pigments in the leaves of the spiny artichoke. It has also been proven that the exclusion of not only phosphorus, but also one of the main elements of mineral nutrition leads to a decrease in plastid pigments.

Keywords*: medicinal plant, prickly artichoke, nitrogen, phosphorus, potassium, chlorophyll a, chlorophyll b, carotenoids.*

Introduction. The productivity of agricultural crops, including the medicinal plant artichoke prickly, is related to nutritional conditions.

It is known that the formation of the plastid apparatus and the content of photosynthetic pigments in it depend on nutritional conditions. Mineral nutrition is one of the main regulating factors of the external environment, with the help of which it is possible to achieve a certain maximum productivity of plants, especially medicinal ones.

The amount of green pigments is the most important factor determining the intensity of photosynthesis and the overall biological productivity of plants.

The conditions of mineral nutrition of plants contribute to an increase in the content of chlorophylls in plant leaves, an increase in the intensity of photosynthesis and plant productivity [1,2,3].

Nitrogen, especially together with phosphorus and potassium, has a positive effect on the formation and accumulation of green pigments in the leaves of plants, especially the prickly artichoke (Cynara scolymus L.) [4].

Many works have been devoted to the issues of accumulation of plastid pigments depending on the conditions of mineral nutrition.

Scientists have established that in the soils of old-irrigated typical gray soils, formed on powerful forest accumulations in Uzbekistan according to the Tashkent cycle, they have a thick humus horizon (40-50 cm) and an extended alluvial-carbonate horizon. However, the humus content in them is low (1.02-1.20%). In accordance with the low humus content, these soils are poor in nitrogen - 0.10-0.12%, the total potassium content is most often 1-1.5%, and phosphorus 0.12-0.23%. Nevertheless, soils need potassium and especially phosphorus fertilizers, since phosphorus in gray soils is presented in hard-to-digest forms. [5,6].

Accordingly, the issue of changes in the content of plastid pigments with a lack of phosphorus in the soil and with an increased supply of phosphorus against the background of nitrogen, potassium and the trace element cobalt has not been sufficiently studied. The biosynthesis of chlorophyll in plant leaves can change depending on the conditions of mineral nutrition. [1]. By studying the effects of various elements of mineral nutrition on the content of chlorophyll in plants, their influence was established both on the total content of chlorophylls a and b, and on their ratio.

It was shown in [5] that the content of plastid pigments, depending on the nutritional conditions of the cotton plant and the periods of its antagonistic development, undergoes quite a large quantitative change. Target. In this regard, the goal of our research was to find out the physiological response of prickly artichoke to insufficient and additional application of phosphorus to the soil at different levels and forms of nitrogen fertilizer.

Materials and methods. The object of the study was the prickly artichoke (Cynara scolymus L.), grown in the conditions of experimental plots of the Tashkent State Agrarian University (Table 1).

Table 1

EXPERIMENTAL SCHEME

No. of options	security phosphorus	forms nitrogen	annual rate			Fertilizers are applied in a container						
			г/ сосуд			when stuffing			Phase 2-3 true leaves	budding phase		flowering phase
			N	P	K	N	P	K	N	N	K	N
1	Low	NH_4NO_3	-	0	1,5	2,0	0	0,8	1,0	1,0	0,7	1,0
2	Low	$CO(NH_2)_2$	-	0	1,5	2,0	0	0,8	1,0	1,0	0,7	1,0
3	Average	NH_4NO_3	5	5	1,5	2,0	5	0,8	1,0	1,0	0,7	1,0
4	Average	$CO(NH_2)_2$	5	5	1,5	2,0	5	0,8	1,0	1,0	0,7	1,0
5	Average	NH_4Cl	5	5	1,5	2,0	5	0,8	1,0	1,0	0,7	1,0
6	Average	KNO_3	5	5	1,5	2,0	5	0,8	1,0	1,0	0,7	1,0
7	High	NH_4NO_3	10	10	3,0	4,0	10	1,5	2,0	2,0	1,5	2,0
8	High	$CO(NH_2)_2$	10	10	3,0	4,0	10	1,5	2,0	2,0	1,5	2,0

The experiments were carried out on Wagner vegetation vessels with a capacity of 30 kg of soil with sand in a ratio of 3:1 according to the method of the Uzbek Research Institute of Cotton Growing (Methodology of field and vegetation experiments with cotton under irrigated conditions). [7].

The soil moisture in the vessels throughout the entire growing season was maintained at 75% of its total moisture capacity. The experiment was repeated tenfold.

The content of plastid pigments in artichoke leaves was determined using the Wettstein method. [8]. 85% acetone was used as a pigment solvent.

Results and its discussion. The results of the analyzes showed that the conditions of mineral nutrition significantly affect the content of plastid pigments in the leaves of the spiny artichoke (Table 2). From the data in Table 2 it is clear that in the experimental variants, the total content of chlorophylls and their individual components in the ontogenesis of the spiny artichoke increases. So, for example, in the budding phase, the content of chlorophyll "a" in the control without the addition of phosphorus was 1.15 mg/g of raw material in the variant where 5 g of phosphorus was added and the same amount of nitrogen in various forms, the content of chlorophyll "a" fluctuates within 1.22-1.32 mg/g wet matter.

Increased nutrition with nitrogen, phosphorus and potassium (double norm) significantly increases pigment accumulation. At the same time, the content of chlorophylls in the leaves of the prickly artichoke, where cultivation was carried out with the presence of the trace element cobalt, increases by 41.7% compared to their content in the leaves of control plants.

With the onset of the flowering phase, the content of chlorophylls "a + b" increases in all experimental variants studied. At the same time, the highest (2.65 mg/g wet matter) content of chlorophylls was noted in plant 8 of option and the lowest (1.88 mg/g wet matter) amount of chlorophylls "a + b" in option 1, where the prickly artichoke plant is cultivated without adding phosphorus.

In subsequent stages of development of the prickly artichoke (Cynara scolymus L.). (i.e., in the phases of fruit formation and seed ripening), the content of plastid pigments begins to decrease, this is especially clearly visible in plants grown without the application of phosphorus fertilizers.

The increase in chlorophyll content in artichoke leaves grown under different nutritional conditions is mainly due to chlorophyll "a", while chlorophyll "b" changes less than chlorophyll "a".

Determination of the content of yellow pigments in the leaves of the medicinal plant spiny artichoke (Cynara scolymus L.) showed that the level of phosphorus nutrition significantly affects the content of these pigments.

The relatively low photosynthetic capacity of the prickly artichoke leaf is one of the main reasons for the lack of effect when applying high rates of nitrogen fertilizers to the prickly artichoke. For example, it has been shown that the action spectrum of nitrate reduction coincides with the absorption spectrum of chlorophyll. NO_3 assimilation also increases with increasing illumination.

All this indicates that recovery in light is associated with the absorption of light by chlorophylls and the photosynthetic functions of the leaves, although the mechanism of coupling of these two biological processes remains undeciphered. [9,10,11].

Table 2

The content of plastid pigments in the leaves of the prickly artichoke depending on the form and rate of nitrogen fertilizers and the supply of soil with phosphorus mg/g wet matter.

Experience Options		Chlorophylls				Total carotenoids
Provision of phosphorus mg/vessel	Form of nitrogen	a	б	a+б	budding phase % to control	flowering phase % to control
-	NH_4NO_3	1,15	0,60	1,75	100	0,65
-	$CO(NH_2)_2$	1,15	0,54	1,67	95,4	0,70
5	NH_4NO_3	1,22	0,70	1,92	109,7	0,75
5	$CO(NH_2)_2$	1,30	0,76	2,06	117,7	0,78
5	NH_4Cl	1,26	0,74	2,00	114,3	0,70
5	KNO_3	1,32	0,80	2,12	121,1	0,80
10	NH_4NO_3	1,45	0,86	2,31	131,4	0,85
10	$CO(NH_2)_2$	1,56	0,92	2,48	141,7	0,92
Bloom						
-	NH_4NO_3	1,20	0,68	1,88	100	0,75
-	$CO(NH_2)_2$	1,30	0,72	2,02	107,4	0,80
5	NH_4NO_3	1,45	0,90	2,35	125,0	0,95
5	$CO(NH_2)_2$	1,58	0,92	2,50	133,0	0,92
5	NH_4Cl	1,36	0,75	2,11	112,2	0,90
5	KNO_3	1,40	0,85	2,25	119,6	0,98
10	NH_4NO_3	1,60	0,90	2,50	133,0	1,10
10	$CO(NH_2)_2$	1,70	0,95	2,65	140,0	1,20
Fruit formation						
-	NH_4NO_3	1,17	0,60	1,77	100,0	0,72
-	$CO(NH_2)_2$	1,20	0,62	1,82	102,9	0,78
5	NH_4NO_3	1,25	0,72	1,97	111,3	0,92
5	$CO(NH_2)_2$	1,45	0,75	2,15	121,4	0,90
5	NH_4Cl	1,35	0,70	2,05	115,8	0,85
5	KNO_3	1,40	0,80	2,20	124,3	0,95
10	NH_4NO_3	1,50	0,80	2,35	132,7	0,98
10	$CO(NH_2)_2$	1,65	0,90	2,55	144,1	1,10
Seed ripening						
-	NH_4NO_3	0,65	0,45	1,19	100	0,70
-	$CO(NH_2)_2$	0,80	0,47	1,27	115,4	0,65
5	NH_4NO_3	1,12	0,65	1,77	160,0	0,85

5	$CO(NH_2)_2$	1,28	0,70	1,98	180,0	0,80
5	NH_4Cl	1,22	0,65	1,87	179,1	0,75
5	KNO_3	1,90	0,70	2,00	181,8	0,88
10	NH_4NO_3	1,32	0,75	2,07	188,1	0,90
10	$CO(NH_2)_2$	1,35	0,76	2,11	191,8	0,92

During the ontogenetic development of spiny artichoke cultivated under different nutritional conditions, the amount of carotenoids changes, their maximum content occurs in the phases of flowering and fruit formation, and the minimum in the phase of budding and seed ripening.

In the leaves of the medicinal plant prickly artichoke, cultivated in the absence of phosphorus (variant 1), a minimum content of the total amount of yellow pigments was noted in all phases of development compared to the experimental variants.

Medium and high phosphorus content with a combination of nitrogen and potassium, on the contrary, helps to increase the content of yellow pigments. Thus, the content of carotenoids in the budding phase in the control group experiencing phosphorus deficiency was 0.65 mg/g of raw material, in the variant where 5 and 10 g of phosphorus were added, respectively, 0.70-0.92 mg/g of raw material.

In the leaves of the prickly artichoke, which received a high dose of nitrogen, phosphorus, potassium and cobalt, a high content of carotenoids was noted in all phases of its development. Apparently, increased doses of fertilizers in the presence of cobalt contribute to a longer growing season and the process of pigment accumulation.

Conclusions. Thus, based on the data obtained, we can conclude that the growth of medicinal plants under different conditions of mineral nutrition has a significant impact on the content of plastid pigments. In our experiments, studies showed that the exclusion of phosphorus from the nutrient mixture led to the strongest decrease in photosynthetic pigments in the leaves of the prickly artichoke (Cynara scolymus L.). Accordingly, the exclusion of one of the main elements of mineral nutrition leads to a decrease in plastid pigments.

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