AN IMPACT OF CADMIUM UPON CONTENTS OF PHOTOSYNTHETIC PIGMENTS ×TRITICOSECALE

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The results of research that studied an impact of Cd upon contents of photosynthetic pigments of winter triticale ×*Triticosecale* are provided. It is shown that growing triticale within environemtn that contains 0,04 мМ Cd^{2+} leads to a decrease in numbers of chlorophyll *a, b* and carotenoids in average of 70% in 96 hours of exposition. Values of correlation between chlorophylls *a* and *b* (2,8-3,1), and also chlorophylls' part in light-accumulating complexes (55-58%) stay relatively stable duting the whole test.

Keywords: winter triticale, heavy metals, photosynthetic apparatus, chlorophyll, carotenoids, light-accumulating complex

Cadmium is one of the most toxic heavy metals. An increase in its contents in environment leads to a decrease in growth speed, alteration in intensity and direction of many metabolic processes in cells [2]. It is known that photosynthetic apparatus is one of the most vulnerable to the impact of heavy metals. Here a number and correlation of different pigment groups has a great significance for its work [3]. Therefore, the objective of this work was studying dynamics of contents of main groups of photosynthetic elements of winter triticale ×*Triticosecale* under its growing in an environment that contains Cd.

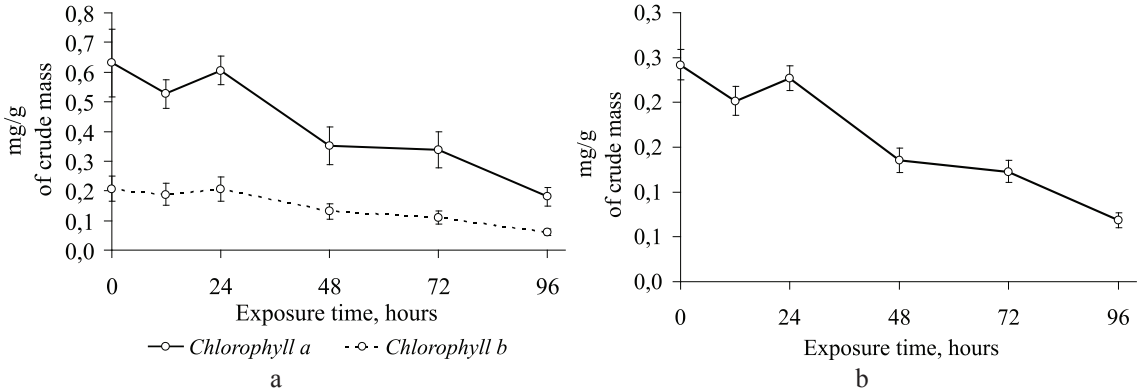
Methods and materials of the research

Sprouts of winter triticale of the kind «Don» (×*Triticosecale* Wittm. & A. Camus) served as objects of the research. Seeds were preliminary sterilized in 2,5% solution of $KMnO_4$, and after this grown in filter paper with presence of 1/10 environment of Knop with microelements of Hogland. Ten-days sprouts were transferred to vegetation vessels and grown in aerated water culture with full nutrition environment under 12-hour light period, air temperature of 23 ± 1/15 ± 1 °C (day/night), relative humidity of 55/75% (day/night) and lightness of 35 Vt/m^2. When a sprout reached the stage of bushing out, it was transferred to a nutrition solution that contained 0,04 mM $Cd(NO_3)_2$. Sprouts after 12, 24, 48, 72, and 96 hours of exposition Cd-containing environment were studied separately. A definition of contents of photosynthetic elements was carried out in ethanol extracts under 470, 649, and 665 nm with a spectrophotometer SF-26 (Russia), formulas of H.K. Lichtentaller и A.R. Welburn were used for calculations [5]. Chlorophylls' part in light-accumulating complexes (LAC) was calculated via method of H.K. Lichtentaller (1987) with allowance that almost all chlorophyll *b* is located in LAC, and correlation between chlorophylls *a* and *b* in this complex equals 1,2/1,0 [4].

Results of research and their discussion

The study has shown that growing triticale in presence of 0,04 mM Cd^{2+} led to a decrease in number of main photosynthetic pigments. During the first 12 hours of incubation under Cd-containing environment amounts of chlorophyll *a* and carotenoids decreased of 17%, and after that increased, reaching a control value (0,610 ± 0,048 mg/g of wet mass (for chlorophyll a) and 0,227 ± 0,028 mg/g of wet mass (for carotenoids)) by 24 hours (Figure). At the same time, amounts of chlorophyll b remained stable up to 24 hours.

During the next day (up to 48 hours), contents of chlorophyll *a, b* and carotenoids decreased of 42, 37, and 40% correspondingly. After this some stabilization in pigment levels for 72 hours was observed, it preceded further decrease in their numbers by the end of experiment. By 96 hours the part of chlorophyll *a, b* and carotenoids to the control equaled about 28% (Figure).



Dynamics of decrease in chlorophyll *a, b* (a) and carotenoids (b) in sprouts of triticale that was grown in Cd-containing environment

Nowadays it is well-known that molecules of pigments are not equal according to their functional characteristics: some of them are included into reaction centers of photosystems, others only take the light-accumulating function [1], therefore, a correlation between different photosynthetic pigments is crucial for maintaining a normal level of photosynthesis and related energetic processes. The research has shown that during the whole experiment a correlation between chlorophylls' forms (*a* and *b*) remained stable of 2,8-3,1 (Table).

A correlation in amounts of chlorophyll a to b, part of chlorophylls in light-accumulating complexes

Parameter	Exposition time, hours					
	0	12	24	48	72	96
a/*b*	3,1	2,8	3,0	2,8	3,0	3,0
Chlorophyll part in CCK, % ± σ	54 ± 8	58 ± 7	56 ± 6	57 ± 10	54 ± 8	55 ± 6

It is known that chlorophyll **a** is included into reaction centers and periphery antenna complexes of photosystem I (PS I) and photosystem II (PS II), while chlorophyll *b* is, mainly, a component of LAC of PS II [6].

A preservation of constant values in correlation between chlorophylls *a* and *b* testifies that, regardless of a decrease trend in photosynthetic pigments that is observed within plants that were grown in Cd-containing environment, a correlation between complexes of reaction centers of PS and LAC stays unaltered. Preservation of relatively constant value of chlorophyll part in LAC also proves for the lack of disbalance in work of photosynthetic apparatus (table).

Conclusion

The research has shown that while growing plants of triticale in environment that contains 0,04 mM Cd^{2+}, a decrease in quantitative contents of main photosynthetic pigment groups (chlorophylls and carotenoids). However, as their correlation stayed the same, we can conclude, that general decrease in pigment levels, obviously, reflected not only character of damage of photosynthesis apparatus under the impact of Cd, but its transfer into new physiological level of functioning that allows it to work relatively slably, but, probably, with lower efficiency.

References

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