SECTION 2. EXPERIMENTAL BOTANY

DOI https://doi.org/10.30525/978-9934-26-521-1-2

ADAPTATION CHANGES OF *NICOTIANA TABACCUM* L. UNDER THE INFLUENCE OF HEAVY METALS

АДАПТАЦІЙНІ ЗМІНИ *NICOTIANA TABACCUM* L. ЗА ДІЇ ВАЖКИХ МЕТАЛІВ

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The pollution of the biosphere with heavy metals as a result of anthropogenic pressure has become global. The impact of heavy metals on plant adaptation is becoming increasingly important as the environment becomes more polluted. The supply of metals (Me^{2+}) to the environment is driven by human economic activity: the combustion of liquid and solid fuels, non-ferrous metallurgy, wastewater discharge, the removal of heavy metal ions from steel plants by water and air flows, and the high application of high doses of mineral fertilisers. Heavy metals are particularly toxic due to their high toxicity and transmission through food chains [4].

Some heavy metal ions, such as molybdenum, cadmium, iron, manganese, barium, and zinc, are classified as trace elements because they are present in micro quantities that are necessary for normal growth and development of a plant organism. At the same time, some chemical elements are cofactors of many enzymes that are part of cytochrome c oxidase, which is involved in the regulation of nitrogen metabolism, hormone biosynthesis, and plays an important role in the synthesis of proteins and nucleic acids. However, at a certain level, the accumulation of these metals in plant cells can have a negative impact. The toxic effect of heavy metal ions (HMI) is manifested in the activity of growth processes and at the cellular level, namely, in the disruption of photosynthesis, the state and content of pigments, and the biosynthesis of proteins and enzymes[3, 5].

Photosynthesis is a sensitive indicator of the plant's response to the effects of IPM. Photosynthesis is also one of the key biological processes in green plants. At the molecular and submolecular levels, a photochemical reaction of light quantum absorption takes place with the subsequent conversion of carbon dioxide and water into organic components. The reaction is carried out with the participation of pigments – mainly organisms such as higher plants, cyanobacteria, and microorganisms [1, 4].

Plant pigments are referred to as secondary metabolites and belong to a variety of chemical compounds. The influence of natural factors on the pigment-forming capacity of plants is currently being studied by many researchers, so there is a certain interest in investigating the effect of anthropogenic factors on them [1, 2].

Tobacco is the main non-food agronomic crop on the planet. Vegetative organs are used as raw materials in the manufacture of a wide range of consumer goods. For scientific purposes, tobacco is studied as a model object in various experiments. In both cases, the quantitative composition of plastid pigments is taken into account. Chlorophyll a differs from chlorophyll b in the type of residue group, namely, the former has a metal group in the molecule, while the latter has an aldehyde group. The ratio of chlorophylls a\b is 3:1. This indicator is disturbed when the nitrogen content in the leaves decreases. Also, the content of chlorophyll b increases in low light conditions due to its increased synthesis.

The content of chlorophylls a and b in the leaves of tobacco genotypes Samsun and Dubec of seed generations was analysed. The plants are the offspring of regenerants of cell lines resistant to lethal doses of cadmium cations, Cd^{2+} and barium cations, Ba^{2+}. The experiment showed that the quantitative composition of chlorophylls a and b in tissues under normal conditions dynamically fluctuates within the normal reaction range. No genotypic differences were observed, as well as differences between the cations with which the model systems were formed during cell selection.

It was found that, depending on the intensity of the light flux in the FAR region and the spectral composition of light, the total pigment content of in vitro plants can vary by 15-20 %, and the values of the Chla/car, Chlb/car ratios – by 1,5–2 times. The most stable values in in vitro plants were Chla/Chlb, regardless of the conditions (light) of their cultivation. The obtained data on the quantitative composition of the pigment complex were used as a criterion – a marker for assessing the compliance of the in vitro plant cultivation regime with their needs. In our experiments, we analysed plants obtained using an alternative biotechnology, namely cellular selection. For the sake of specificity, we conducted a preliminary comparative study of conventionally produced wild-type tobacco plants from germinated seeds with ex vitro regenerants obtained from cell cultures of the same wild type.

The lack of information on the state of carotenoids impoverishes the overall picture of the pigment status of new forms of tobacco plants, but is an incentive for further research in this area.

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