INFLUENCE OF STATIONARY MAGNETIC FIELD ON THE ABSORPTION SPECTRA OF THE PHOTOSYNTHETIC APPARATUS OF SOME ORNAMENTAL PERENNIAL SPECIES

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Abstract. The influence of stationary magnetic field with induction $B = 0.15\,T$ on the absorption spectra of the photosynthetic apparatus of the ornamental perennial species Caragana arborescens Lam., Robinia pseudoacacia L. and Laburnum anagyroides Med. has been investigated. It has been established that magnetic field treatment does not change the magnitude of the extinction, but affects the contribution of different plant pigments.

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1. Introduction

Numerous authors have established that the influence of the stationary magnetic field on the seeds fastens their growth, activates protein formation and root growth [8, 9]. Their investigations show that the influence of the magnetic field on the seeds increases the germination of non-standard seeds and improves their quality. The reason for these reactions can be found in some paramagnetic properties of chloroplasts [7], situated in plant cells and representing the photosynthetic apparatus of higher plants. Chloroplasts contain plant pigments (chlorophylls and carotinoids), their condition and structure being influenced by outer factors. Data are available about the influence of ionizing radiations, light intensity and spectral distribution, temperature, water deficit, but no data exist about the influence of the magnetic field [3]. The investigation of the influence of the stationary magnetic field on the absorption spectra of plant photosynthetic apparatus is an attempt to bridge this gap.
2. Materials and Methods

Leaves of the ornamental perennial species *Caragana arborescens* Lam., *Robinia pseudoacacia* L. and *Laburnum anagiroides* Med. have been treated by a stationary magnetic field with induction $B = 0.15$ T. These perennial species have been chosen because they are largely spread in Bulgaria and hence of their applicability in park design, phytopharmacy and some other industrial fields. Magnetic field indication values have been chosen according to the conclusion of Bonev [1] that a weak magnetic field has stronger effect on plant productivity.

The samples for the absorption spectra measurement have been prepared by grinding of 0.5 g fresh leaves with quartz sand in an agate mortar and then solving the obtained mixture in 20 ml 95\%-ethanol, after which the solution was filtered and diluted. The obtained extract was exposed to a stationary magnetic field with induction of $B = 0.15$ T for different time.

The absorption spectra $E = f(\lambda)$ of the samples have been recorded by a digital spectrocolorimeter "Specol 11".

The extinction $E$ was determined by the equation

$$E = \ln \frac{I_0}{I}$$

where $I_0$ and $I$ are the light intensity respectively before and after passing through the sample. The spectra have been recorded in the wavelength interval from 400 to 700 nm.

3. Results and Discussion

The absorption spectra of *Caragana arborescens*, *Robinia pseudoacacia* and *Laburnum anagiroides* before and after the treatment with a stationary magnetic field are presented in Figs 1, 2 and 3, respectively.

As it can be seen from the above figures, the control samples for the three studied species and as it is expected, manifest higher extinction values in the spectrum of the wave-lengths 420–460 nm and 620–660 nm, respectively, where the absorption maxima of the plant pigments chlorophyll and carotinoides are reported [6].

After an exposure to a stationary magnetic field structural changes occurred in the absorption spectra of all the studied samples in both absorption spectra of plant pigments. The plateau observed in the control samples in the short-wave area 420–460 nm turned into an obvious peak at 460 nm. Concerning the area 620–660 nm smaller changes were observed in the spectra at 660 nm, as well. Preserving the extinction value in the studied diapason of wavelengths could also be explained by the suggestion that under the conditions of the experiment
the treatment with a stationary magnetic field did not change the concentration of the plant pigments in the extract. The observed changes in the spectrum structure of the studied samples in the absorption peak areas could be due to the changes in the pigment ratio in the chloroplasts. It can be assumed that the magnetic field treatment reduces the effect of the carotinoide in the absorption at the expense of the chlorophyll b.

![Fig. 1. Influence of the stationary magnetic field on the absorption spectra of Caragana arborescens Lam.](image1)

![Fig. 2. Influence of the stationary magnetic field on the absorption spectra of Robinia pseudoacacia L.](image2)

The characteristics observed in the absorption spectra of the studied ornamental tree species could be explained with the paramagnetic properties of the chloroplasts established by Commoner [7]. It can be assumed that when submitting the extract to the magnetic field treatment the chloroplasts are oriented towards the field direction, which, analogous to the magnetic optic effect registered for the solid bodies, leads to the change of the absorption.

In a physical aspect photosynthesis is an energy conversion. According to Seliger [13] the pigment complex–chlorophyll or carotinoide absorbs energy as
light quanta, after which it transfers their energy to the electron and gradually that energy is spent for chemical reactions. The hypothesis about the magnetic properties of the chloroplasts could be an explanation of the stimulating effect exerted by the magnetic field on the initial stages of seed development [4]. Rendering an account that the paramagnetic substances increase their energy in a magnetic field, it can lead to the activating of the phytohormones.

Fig. 3. Influence of the stationary magnetic field on the absorption spectra of *Laburnum anagiroides* Med.

4. Conclusions

1. The effect of the stationary magnetic field causes changes in the absorption spectra of all the studied samples in both areas of plant pigment absorption, consequently it exerts an effect on the photosynthesizing apparatus of the studied ornamental tree species.
2. The effect of the stationary magnetic field decreases the role of the carotinoids and increases the contribution of chlorophyll $b$ in the absorption. After the magnetic field treatment in all the three studied species the differentiation of the short-wave absorption peak is obviously expressed, determined by the chlorophyll $b$.

References