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X-ray investigation of the needle cellular structure by polycapillary optics and lithium fluoride detectors

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The tree plantation conditions are the one of the most sensitive indicators of environmental state. The high levels of correlation relationships between morphological and physiological parameters of needle and toxicological loads were established [1]. It is known, that woody plants are highly sensitive to anthropogenic load, so they can serve as adequate indicators of the ecosystems condition [2-3]. There are several routes of chemical elements and compounds entry into the plants, the main of which are root absorption, gaseous exchange and exchange adsorption on the lamina surface. In the towns and suburbs among woody plants the major part are conifers, which show a high sensitivity to environmental changes. The analysis of the needle anatomical features demonstrated that for all investigated coniferous species under the technogenic stress conditions the resin channels area was decreased, and there were other changes in the cellular structure [4].

The standard algorithm of the needle anatomical structure investigation consists of the following steps: the needles are fixed using ethanol or glycerol, then the slices from the needle middle part are made by freezing microtome, after that the samples are analyzed by optical microscope, for example, by Axiostar plus light microscope (Karl Zeiss, Germany) [4]. However, this approach has some disadvantages. The main problem is that for the cell wall thickness measurements either the optical zoom is insufficient or the flares appear on image at high magnification.

A method based on the use of X-ray projections on the lithium fluoride detectors with the application of polycapillary optics is proposed in order to obtain more sharp images of the needle cross sections [5]. The radiation generated by the X-ray tube, passes through polycapillary half-lens forming a quasi-parallel beam. Then the partly absorbed in the sample radiation falls on the LiF detector and produces an X-ray image. After that, the image on the LiF crystal is analyzed by microscopic investigation.

It is expected, that such kind of data will be devoid of the standard method disadvantages and allow investigating the needle cellular structure more precisely, and that will increase the efficiency of the method of the environmental state estimation by condition of plants.

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