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THE PHYTOTOXIC EFFECTS OF LEAD, CADMIUM AND SODIUM CHLORIDE ON THE MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF ORNAMENTAL HERBACEOUS PLANTS

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ABSTRACT

In this chapter, we present the review of literature and our own data on the effects of lead (Pb) and cadmium (Cd) (as components of motor vehicle emission ingredients) and NaCl (anti-icer agent used on highways) on the morphological and physiological characteristics of lawn grass and ornamental plants, commonly grown on the roadsides and middle lines of city highways. Mechanisms of plant growth inhibition are analyzed. Mitotic activity of root cells of *Festuca rubra* L. under the impact of Pb and Cd was demonstrated to be inhibited. The cell mitotic activity under the condition of combined effect of Pb and Cd was decreased more than by separate action of each element, indicating the synergy of these factors. The greatest suppression of mitotic activity was established under the combined impact of Pb and Cd and salinity. Increase of prophase/metaphase index and decrease of anaphase and telophase cells were established. Peroxide oxidation parameters are increasing in the following sequence: NaCl>Cd=Pb<Cd+Pb<Cd+Pb+NaCl. The degree of cell division inhibition correlates well with peroxide oxidation levels. The intensity of cell division in root cells was decreased under combined action of the pollutants. However, duration of the mitotic cycle was increased. Speed of cell division in cells which had transitioned to elongation growth is inhibited by Pb and Cd, while those metals had almost no effect on cell elongation. Combined effect of Pb and Cd on the intensity of cell division in roots, speed of cell division, duration of mitotic cycle, and speed of transition of the cells to elongation growth was analyzed and demonstrated to be greater than action of each metal alone. Both NaCl and the heavy metals inhibited all phases of cell growth. However, salinity inhibited cell division and the duration of cell elongation in almost equal manner, while the effect of Pb and Cd had much more effect on cell division than on cell elongation. Single and combined effect of Pb, Cd and NaCl on leaf growth and development, assimilation area and leaf-area index of *Lolium perene* L., and stomatographycal parameters were analyzed. Number of stomata per unit of leaf area was increased by Pb and Cd, but decreased by NaCl. Combined action of the metals and NaCl increased the number of stomata even greater than only the action of the metals. Complex effect of the pollutants on the width and length of stomatal pores was established. In the plants exposed to both heavy metals and salinity stomata were less open compared to the control plants, and this negatively affected plant photosynthesis and water metabolism. Negative effect of Pb, Cd and NaCl on chlorophyll content was investigated. Pollutants increased the content of chlorophyll *a* greater than the amount of chlorophyll *b*, so Chl*a*/Chl*b* ratio decreased. Prolonged action of pollutants decreased content of carotenoids in plant leaves. Productivity of photosyntesis was more inhibited under the combined effect of Cd and NaCl than under the action of each pollutant alone. Transpiration rate and the amount of free and bound water was also analyzed and demonstrated to be significantly affected under the combined exposition to Pb, Cd and NaCl.

Keywords: lead, cadmium, salinity, ornamental plants, pollution

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