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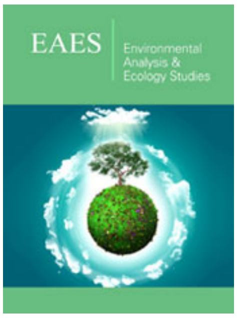
Review Article

The Response of Wood Species to Industrial Atmospheric Emissions

ISSN: 2578-0336



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Submission: May 28, 2021

Published: December 09, 2021

Volume 9 - Issue 4

How to cite this article: Rakhimov TU. The Response of Wood Species to Industrial Atmospheric Emissions. Environ Anal Eco stud. 9(4). EAES. 000716. 2021.
DOI: 10.31031/EAES.2021.09.000716

Abstract

Phytoindication can be carried out by the response of plants in the species most sensitive to pollutants, or by the accumulation of harmful substances in the body of plants. Therefore, among plants, bioindicators with a high sensitivity to pollutants and storage bioindicators are distinguished. The dendrochronological method makes it possible to study changes in climatic conditions on the planet and the effect of various ecological and anthropogenic factors on woody plants of the ecosystem. A reliable correlation has been established between the levels of air pollution by pollutants and a decrease in radial annual growth in tree species. The article discusses the assessment of environmental pollution using phytoindication. One of the signs of phytoindication in the industrial zone is the annual growth of wood of these trees. According to the data obtained, under the influence of industrial waste, first of all, there is a decrease in the annual growth of wood of existing trees.

Keywords: Phytoindication; Resistance; Wood; Bark; Annual growth; Dendrochnology; pollutants

Introduction

Changes in the ecological situation of the planet as a whole and many industrialized countries in the second half of the 20th century led to a revision of ecological concepts of nature protection, the search for new effective methods for assessing environmental pollution and the condition of biota at all levels of its organization, the development of new ecological standards for permissible anthropogenic loads on natural systems. Vegetation is the most important component of biogeocenosis, providing the vital activity of other biotic components. Changes in vegetation under the influence of various environmental factors influence to the biogeocenosis condition as a whole and, as a result, can be used as diagnostic signs. Phytoindication can be carried out by the response of plants in the species most sensitive to pollutants, or by the accumulation of harmful substances in the body of plants. Therefore, among plants, bioindicators with a high sensitivity to pollutants and storage bioindicators are distinguished. The classification of the principles and levels of phytoindication can be classified according to the generality of research methods phenological methods, morpho- and biometric, anatomical-cytological, physiological; biochemical, biophysical, floristic , genetical, biocenotic, ecosystem.

In this regard, phytoindication is singled out in the monitoring system - as one of the methods for assessing the quality of the environment.

Phytoindication methods are highly sensitive. They allow to:

i. To register air pollution 3-5 times lower than the sanitary and hygienic MPC (Maximum Permissible Concentration);

ii. Practically without physical and chemical analyzes of air samples or with their limited number to determine the levels of air pollution in large areas;

iii. To determine the level and danger of the impact of pollutants on ecosystems;

iv. To study the nature of anthropogenic digression of ecosystem components;

v. To identify the relative role of individual large sources of emissions and the environmental hazard of individual ingredients in the total pollution of the environment and their impact on ecosystems;

vi. To determine the permissible or critical loads of pollutants for biota, to develop environmental standards for anthropogenic impacts on ecosystems;

vii. To provide a scientific basis for forecasting the development of the ecological situation in the region and for the development of activities to improve the environmental condition.

The dendrochronological method allows it possible to study changes in climatic conditions on the planet and the effect of various ecological and anthropogenic factors on woody plants of an ecosystem. A reliable correlation has been established between the levels of air pollution by pollutants and a decrease in radial annual growth in tree species [1]. Some methodological rules have been developed to improve the reliability of the dendrochronological method for the bioindication of air pollution. It is also perspective because it allows to calculate the decrease in the growth of wood per year and, therefore, the economic damage from air pollution, and at the same time to assess the state of forest ecosystems [2]. In this regard, the purpose of our research was: a comprehensive assessment of the impact of industrial emissions from gas processing enterprises of the Kashkadarya region on the dendrological indicators of some tree species as the main link in the industrial ecosystem. Scientific substantiation and selection of criteria for the stability of tree species; scientific substantiation of phytoindication methods-identification of the most sensitive indicator tree species and selection of express methods for assessing industrial pollution.

We aimed to study the dynamics of changes in the nature of metabolic, photochemical disturbances in order to better understand the mechanism of photosynthesis disturbance. For this, we have chosen five landscaped trees (*Ulmus pumila L. - Siberian elm, Acer negundo L.* - Ash-leaved maple, Fraxinus syriaca Boiss. - Syrian ash, *Populus alba L. - White poplar, Morus alba L.* - White mulberry tree species of different stability that grow on the territory of the Mubarek gas processing plant (1st experience), Shurtanneftgaz UDP (2nd experience), Shurtan gas chemical complex (3rd experience) under the influence of $S0_2$ and a relatively clean sanitary zone of the city of Karshi (Control). Besides, we investigated the agro-climatic production characteristics of the study areas (Table 1). As can be seen from (Table 1), the pollution level of industrial zones is relatively high concerning the sanitary zone. To assess the pollution level of the industrial zone, we used some anatomical features of annual shoots of tree species (diameter of annual shoots, bark thickness, annual growth of wood) (Table 2).

Table 1: Brief description of the study areas (average annual data for 2016-2017).

Climate				
Parameters	Karshi City Control	MGPP 1st Experience	UPD Shurtannefte Gas 2nd Experience	Shurtan GCC 3rd Experience
Average annual air temperature, °C	14,3	14,9	15,7	15,7
Average temperature in July °C	27,0	28,3	29,1	29,1
Precipitation, mm	240	165	210	210
Vegetation period, days	298	283	301	301
Soil				
Soil type	Light gray soil	Takir	Light gray soil	Light gray soil
Soil salinity type	Weakly saline	Moderately saline	Moderately saline	Moderately saline
Humus, mg/kg	0,9-1,6	0,6-0,8	0,9-1,1	0,8-1,3
Air Pollution, Thousand Tons				
The total amount of substances emitted into the atmosphere, thousand ton	3,4	79,4	65,6	25,3
Maximum permissible emissions, thousand ton	2,9	58,1	54,7	23,9
Pollution level	Conditionally clean	Very strong	Strong	Strong
Brief description of the Production of Enterprises				
Cleaned natural gas, billion m3	-	25	25	4
Sulfur, thousand ton	-	271	100	-

Condensate thousand ton	-	11	9	2
Polyethylene granules, thousand ton	-	-		125

Table 2: Indicators of anatomical features of annual shoots of the studied tree species.

Study Areas	Investigated Features	Maple	Ash	Poplar	Mulberry	Elm
Sanitary Zone of Karshi City	Shoot diameter (mm)	10,3±0,53	8,1±0,42	11,4±0,38	18,1±0,9	13,3±0,91
	Bark thickness (mm)	1,4±0,02	1,1±0,03	1,4±0,05	1,3±0,03	1,5±0,04
	Annual wood growth (mm)	2,8±0,08	2,7±0,04	3,6±0,08	5,8±0,09	4,7±0,09
Mubarek Gas Processing Plant (MGPP)	Shoot diameter (mm)	8,1±0,67	7,6±0,43	9,8±0,47	16,5±0,90	11,4±0,73
	Bark thickness (mm)	1,2±0,03	0,9±0,04	1,0±0,09	1,4±0,04	1,2±0,04
	Annual wood growth (mm)	2,0±0,11	2,2±0,06	3,1±0,09	5,1±0,10	3,9±0,09
UDP Shurtanneftegaz	Shoot diameter (mm)	9,4±0,59	8,2±0,38	11±0,52	16,8±1,3	11±0,70
	Bark thickness (mm)	1,4±0,05	1,2±0,05	1,0±0,08	1,3±0,06	1,3±0,06
	Annual wood growth (mm)	2,2±0,14	2,5±0,04	3,4±0,09	5,1±0,12	4,2±0,09
Shurtan Gas Chemical Complex (SGCC)	Shoot diameter (mm)	10±0,52	7,8±0,41	11,1±0,47	16,7±1,0	10,1±0,82
	Bark thickness (mm)	1,4±0,06	1,1±0,05	1,4±0,08	1,3±0,05	1,5±0,06
	Annual wood growth (mm)	2,3±0,09	2,6±0,05	3,3±0,08	6±0,10	4,4±0,11

As can be seen from (Table 2), we traced the change in the anatomical features of the growth of annual wood in some tree species and obtained the following results. The highest growth of annual wood was observed in trees growing in the sanitary zone of the city of Karshi. It is noteworthy that in this area we have identified the minimum content of pollutants in the air (Table 1). Slightly lower growth of annual timber was observed in shurtan GCC. A similar relationship was typical for MGPP and Shurtanneftgaz but note that the difference between these three areas is statistically insignificant (Table 2). The smallest increase in wood and bark thickness was observed at MGPP and was 2.0±0.11 and 1.2±0.03 mm for maple, respectively, and the content of atmospheric emissions at these industrial facilities was the highest. It is noted that the difference between these two points is statistically insignificant. The difference in the length of the annual growth of wood of the studied species between all the other regions of the study is statistically significant. As can be seen from (Table 2), for mulberry, elm and ash, the difference in the growth of wood is insignificant, which indicates their resistance to industrial emissions.

Thus, considering the change in the diameter of the shoot, the annual growth of wood, in the studied species, we see a relatively clear inverse dependence of this parameter on the concentration of harmful substances in the air. According to literature data [3], it is known that SO_2 has an inhibitory effect on growth processes, given that one of the main emissions of the studied enterprises is SO_2, therefore, we observe a weakening of the apical and lateral growth of shoots of the studied breeds. These changes are manifested not only in a weakening of the annual growth of wood, but also in a decrease in the formation of latewood [4,5].

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