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Short Communication

Pollen Viability of White Birch (*Betula Pendula Roth.*) in Polluted Areas of Siberia

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Abstract

Pollen viability of white birch in Krasnoyarsk vicinity are studied. Birch forests are grassy type of V–VIII age classes in Krasnoyarsk forest-steppe both in buffer zone of Krasnoyarsk city industrial emissions and in background conditions. Pollen germination and pollen tube length varied considerably depend on growth conditions (directions and distance from city). Pollen germination weakly correlated to dust contamination of foliage as well as lead and aluminum foliage content. Birch pollen may be used as bioindicator of air pollutions.

Keywords: Betula pendula roth; Pollen viability; Krasnoyarsk vicinity

Introduction

The detrimental effect of air pollution on vegetative as well as reproductive organs of plants is a well-known and broadly documented phenomenon. All stages of reproductive cycle have been shown to be sensitive to air pollutants [1]. Air pollution greatly affects the male generative organs of many sort of plants at the gametophyte level and most of all, pollutants influence on pollen viability [2]. Evidence shows that both susceptible and resistant species pollen is vulnerable to pollutants impact. In general, pollen production and viability is decreased under their high concentration and prolonged influence [3]. It is believed that pollen of plants may be used as bioindicator of air pollutions [4].

In Siberia, birch forests *Betula pendula* Roth. occupy vast tracts of floodplains and mountain slopes often mixed with aspen, pine and larch, and are characterized by significant species diversity and productivity. Productivity and reproductive activity of the species are the main indicators of resistance of plantings to influence of adverse environmental factors, including air pollutions. At the same time in urban birch plantation the decrease of the pollen quality was noted [5].

The purpose of this study is to analyses pollen viability of *Betula pendula* Roth. in Krasnoyarsk vicinity. The climat is strongly continental with annual precipitation is about 485mm. Air pollution of region is estimated as very high, pollution index is 85.01 (https://www.numbeo.com/pollution/in/Krasnoyarsk). Pollen was collected from 10-15 sample trees per plots situated at different directions and distance from Krasnoyarsk 1, 2, 4-North-East suburb of the Krasnoyarsk city and 3 at distance of 30km to north-east from Krasnoyarsk, polluted area 5 at distance of 40km to the north from Krasnoyarsk, control plots 6 North-West suburb, 7- south-west suburb, 8-at distance of 15km to north-west from city, control plots. On each plot, the pollen cones were collected and the pollen was analyzed for viability (starch content, in vitro percentage germination and tube length, in μm) and sizes (two perpendicular diameters of grain body, and length and height of air sacs, μm). More than ten thousands of pollen grains were tested using Micromed-2 microscope. Up to 100 pollen grains were analyzed per sample tree. STATISTICA 7.0 was used to calculate descriptive statistics including the standard deviations and the confidence levels of the differences.

The viability of pollen grains varied considerably between plots (Figure 1). At control plots, from 53.6 to 95.1% of pollen grains gave a positive reaction on starch content. At the same time on the northeastern and southwestern suburb of the city, the starch content as well as pollen tube length sharply decreased. In Krasnoyarsk vicinity pollen germination was varied from 11.6 to 19.7% and increased up to 21.3-24.6% in control plots.

Pollen tube length is most sensitive pollen parameters. At polluted plots it three times and more shorter than in control. It is shown Hak, Russel, 19 that pollen is no viable in case pollen tubes *in vitro* are less then pollen body diameter. Birch pollen body diameter was varied from 17.7 to 20.8μm. The researches were shown that pollen tubes of trees growing on Krasnoyarsk suburb from three to forth times less than trees growing at south-west suburb and north-west direction (Figure 2).

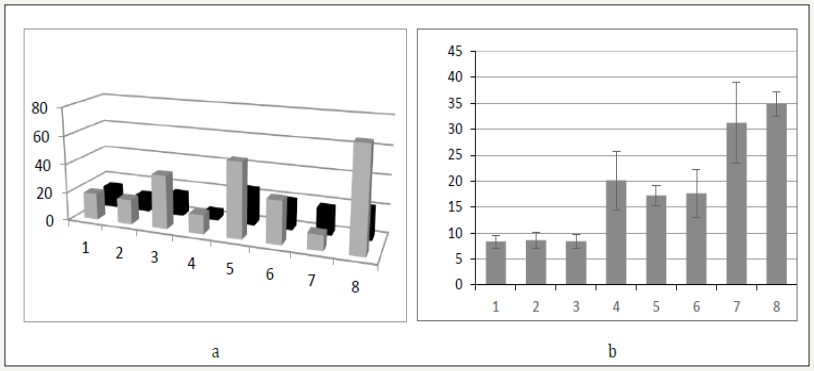

Figure 1: Pollen viability of birch:
(a) Grey bars-the starch content, black bars-pollen germination, %;
(b) Pollen tube length, μm, bars-average meaning ±Δ); 1,2…8-Plot number.
The researches were shown that pollen germination was weakly correlated to dust contamination (r=0.3) as well as lead (r=0.6) and aluminum (r=0.2) content (Figure 2).

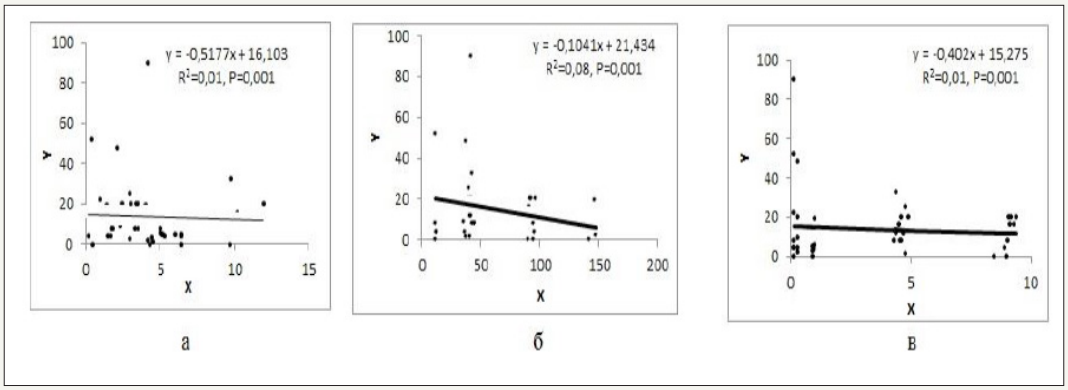

Figure 2: Regression between dust contamination
(a) as well as lead
(b) and aluminum
(c) content, P=0,001. Axe Y-Pollen germination, %.

Thus, decrease of birch pollen germination is considered to be a response of this species to pollution. Pollen tubes are most sensitive to stress conditions. Germination was weakly correlated to dust contamination as well as lead and aluminum content.

Acknowledgement

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