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Soil-based site conditions affect productivity of silver birch regeneration more than the plant species richness

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INTRODUCTION & AIM

Silver birch (*Betula pendula* Roth.) is a pioneer species that very often colonises former arable lands or is used to afforest them.
Recognition of the properties of the post-agricultural land intended for afforestation that are important from the point of view of productivity of regenerating species is crucial for its management.

This study investigates what, plant richness or soil conditions, affects the productivity of naturally regenerated silver birch more.

METHODS

We analysed 31 plots in central Poland with birch regeneration aged from 2 to 19. At each plot, we determined the features of stands, vegetation cover, and soil.
Relevés were elaborated according to the Braun-Blannquet procedure and Ecological Indicator Values were calculated according to Zarzycki et al.

To describe soil characteristics, we sampled its upper 50 cm layer and determined texture, reaction, total carbon, total nitrogen, and base cation content. These features served to calculate the soil fertility index (ITGL).
Tree height measurements were applied to determine the site index (i.e., height at the base age of 25 years) for the analysed stands with the following formula:

$$SI = H_L \frac{25^{1,41} \cdot (T^{1,41} \cdot R + 16640,57)}{T^{1,41} \cdot (25^{1,41} \cdot R + 16640,57)}$$

$$R = H_L + 21,77 + \left((H_L + 21,77)^2 + \frac{2 \cdot 16640,57 \cdot H_L}{T^{1,41}} \right)^{0,5}$$

T – age [yrs], H_L – height [m]

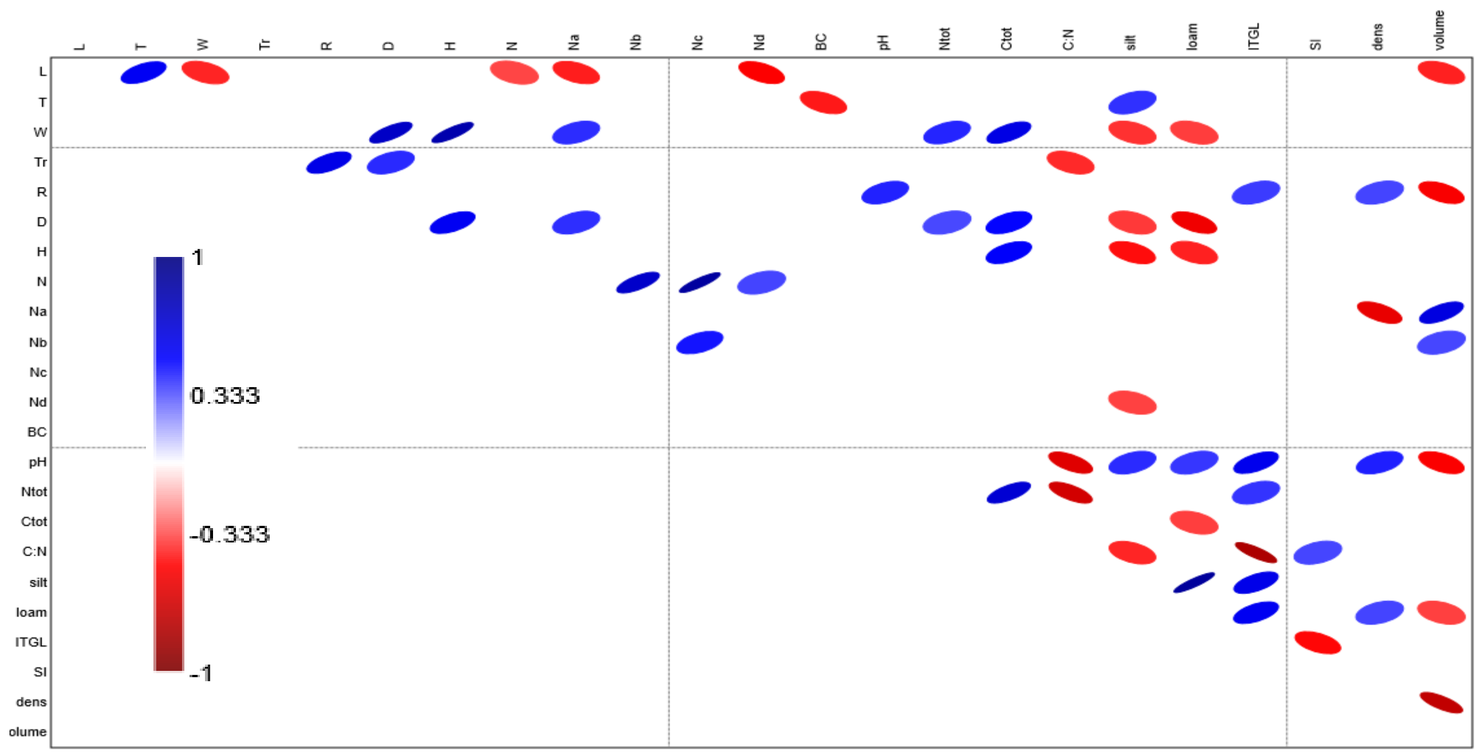
The analysed stands were also characterised with density and volume.

RESULTS

The site index ranged from 13.5 to 50. 0 m and depended significantly on the **C:N ratio** ($r = 0.36$, $p = 0.045$) and **soil fertility index** ($r = -0.49$, $p = 0.005$).
That suggests that over-fertility of the site results in lower potential productivity of the stand.

The stand density varied form 2926 to 1555556 trees/ha and was driven by both soil properties and vegetation cover features. The highest impact can be attributed to **acidity EIV, pH** and **loam content** ($r = 0.36$, $p = 0.044$; $r = 0.44$, $p = 0.013$ and $r = 0.36$, $p = 0.044$, respectively) as well as to the **number of trees in canopy layer** ($r = -0.52$, $p = 0.003$).

The volume of the naturally regenerated silver birch ranged from 0.6 to 270.7 m^3/ha. This parameter was significantly correlated with **light** and **acidity EIVs** ($r = -0.44$, $p = 0.014$ and $r = -0.52$, $p = 0.003$, respectively), **pH** and **loam content** ($r = -0.52$, $p = 0.003$ and $r = -0.37$, $p = 0.038$, respectively) as well as the **number of trees** and **ingrowths** in the respected stand layers ($r = 0.62$, $p < 0.001$ and $r = 0.36$, $p = 0.046$, respectively).



Correlation among vegetation cover features, soil properties and silver birch productivity (SI, dens and volume)

CONCLUSION

At the early stage of silver birch regeneration on the post-agricultural lands, soil conditions play more important role in the stand development than the vegetation cover, and has the negative effect on birch productivity.

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