Temperature Sensitivity of Nitrogen Productivity

Sveta Ladanai⁎ & Göran I. Ågren

Department of Ecology and Environmental Research; Swedish University of Agricultural Sciences, SLU; Box 7072, SE-750 07, Uppsala, Sweden

Conclusions

•Nitrogen productivity is rather insensitive to temperature

•As a consequence, the effects of temperature change on tree growth and ecosystem carbon storage should mainly result from changes in nitrogen availability through changes in nitrogen mineralisation

Background

What factors or combination of factors are causing increased growth in European forests? In order to analyse effects of the predicted global warming on forest growth a mechanistic modelling approach has focused on the assessment on the growth response to temperature.

Theory

Environmental conditions control plant growth. However, the growth response is a complex function of several processes, but nutrients, and notably nitrogen, in the plant exert a strict control over growth (Ågren, 1983, 1985, 1998). We can therefore use an aggregate parameter of relationship between plant nutrition and plant growth: nitrogen productivity (dry matter production per unit of nitrogen in the plant).

Aim

• To analyse the temperature sensitivity of nitrogen productivity to improve the utility of a model of forest growth in response to a changing climate.

Method

The foliage is well suited as a test tissue. Data on dry matter, production, and nitrogen content in needles of Scots pine (*Pinus sylvestris*) from a wide range of climatic conditions were collected. Nitrogen productivities were calculated and plotted as a function of total needle biomass for two different temperature ranges (T>5 ºC, T<5 ºC). Linear functions were fitted to the data to evaluate the temperature effect.

Results

Figure 1 displays the nitrogen productivity as a function of total foliage biomass. The linear relationship confirm the unity and simplicity of quantitative relationship between plant growth and nutrient status.

This model was used to test the constancy of parameter against field data. A significant difference in intercept and slope point to distinction between the two lines for T < 5 ºC and T > 5 ºC (Fig.2). However, for practical applications it may be sufficient to use a nitrogen productivity that is independent of temperature.

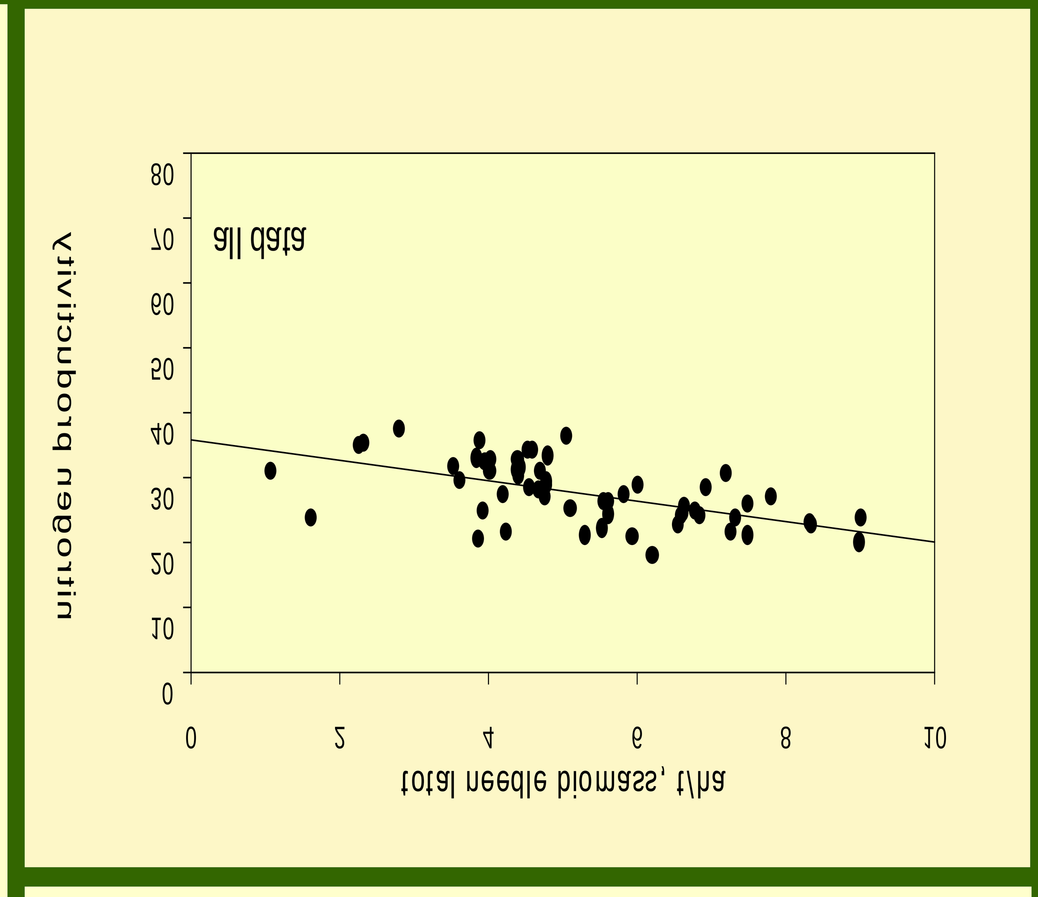

Fig.1.Relations between nitrogen productivity and total needle biomass for Scots pine stands, all data, regression: $y = 35.80 - 1.57x$, $r^2=0.33$, $n = 57$).

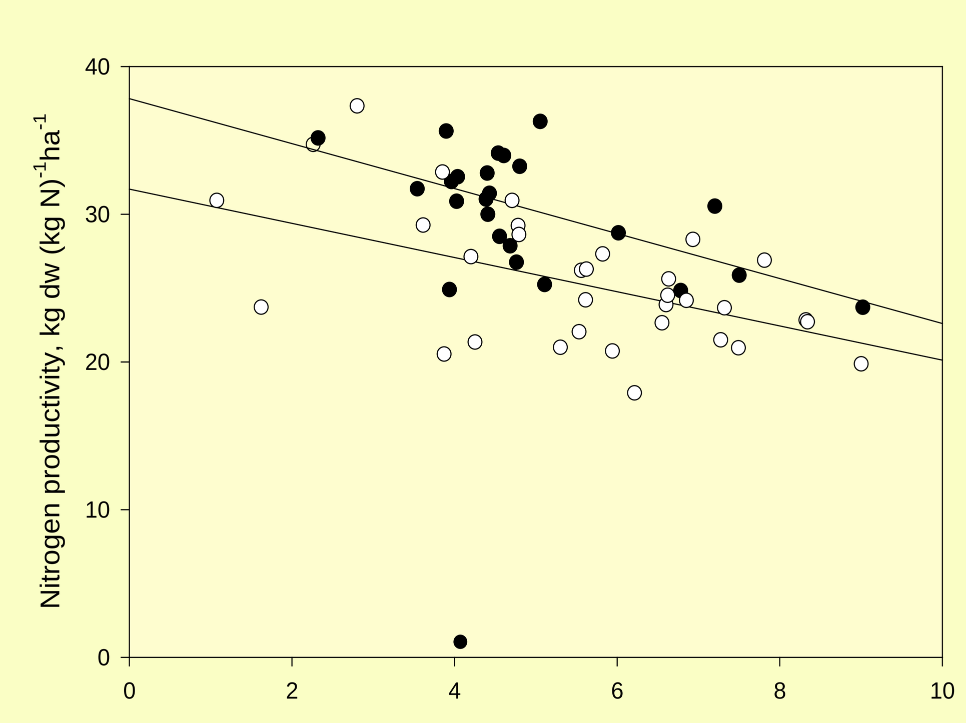

Fig.2.

Fig.2. Relations between nitrogen productivity and needle biomass for Scots pine stands. Regressions: (T < 5 ºC) $y = 37.82 - 1.52x$, $r^2 = 0.38$, $n = 24$, solid line and filled circles; (T > 5 ºC) $y = 31.70 - 1.16x$, $r^2 = 0.26$, $n = 33$, dotted line and open circles.

References

Ågren G.I. (1983) Nitrogen productivity of some conifers. Can.J.For.Res., 13, 494-500.

Ågren G.I. (1985) Theory for growth of plants derived from nitrogen productivity concept. Physiol.Plant. 64, 17-28.

Ågren G.I. and Bosatta E. (1998) Theoretical ecosystem ecology, Cambridge University Press

⁎ Sveta.Ladanai@eom.slu.se