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Comparison of growth response to thinning in oak forests managed as coppice with standards and high forest

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The BIOME-BGC model integrates the main physical, biological and physiological processes based on current understanding of ecophysiology to assess forest ecosystem dynamics. This study evaluates the application of the model to assess the thinning effects on coppiced oak forests in Austria. We analyze the growth response, i.e. growth efficiency (GE), nitrogen use efficiency (NUE), water use efficiency (WUE) and radiation use efficiency (RUE) of oak forests to thinning. The results of coppice with standards and high forests simulations are analysed for differences in simulated growth response after thinning. The forest field data of the year 2006 and the respective model runs are used to evaluate model application. Strong positive relationship (r2 = 0.90) with unbiased results and statistically insignificant differences between predicted and observed volume allows the use of the model as a diagnostic tool to assess management effects. Results indicate that the coppice with standards exhibits a significantly higher yield by 2.97% (i.e. 10 cubic meters per hectare in one rotation), a higher harvest (49.9%) but a lower growing stock (19.69%) than the high forests. The higher growing stock and the lower extraction in the high forests confirm that the high forest sequestrates significantly more carbon than the coppice with standards. Results show that thinning leads to an increase in the GE, the NUE and the WUE, and to a decrease in the RUE. Although the coppice with standards forest ecosystem exhibits higher values in all studied growth parameters, only the difference in the NUE was statistically significant. This verifies that the difference in the yield between the coppice with standards and the high forests is mainly governed by the NUE difference in stands after thinning. The coppice with standards system produces an equal amount of net primary production while consuming significantly less nitrogen (16%) compared to the high forest system. In the coppice with standards thinning plays a greater role on optimal distribution of nitrogen and increases the nitrogen use efficiency per unit leaf area of the remaining stand. Within one complete rotation the coppice with standards looses less nitrogen through leaching (23%) and volatilisation (19%) than the high forest system. Coppice with standards allows a higher amount of biomass extraction and exhibits a higher production after thinning.

Key words: Thinning, growth response, BIOME-BGC, coppice with standards, high forests