The optimization of replanting trees based on basal area increment models and competition thresholds of saplings in northeastern China

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Abstract:【Objective】The mixed-broadleaved Korean pine forests have been transformed into various types of secondary forests due to excessive timber extraction. In contrast to virgin forests, these secondary forests, are distinguished by inadequate natural regeneration of preferred tree species, and worse production. Consequently, New methods based on forest management theories should be developed to accelerate the restoration of secondary forests. The main aims of the manuscript were to identify the impacts of competition on sapling growth and establish an optimal replanting method that can promote the growth of saplings. 【Method】Three nonlinear mixed-effects models (total model, layers model and species model) were developed in this study to compare the competition effect on sapling growth. And the replanting optimization model based on simulations was developed with competition acting as the limiting factor and maximal sapling growth serving as the objective function. 【Result】The effect of intraspecific competition on sapling growth was greater than that of interspecific competition. The competition for the growth of saplings mainly came from the regeneration layer, followed by the lower layer, and finally the upper layer. Korean pine saplings were optimal replanted based on simulations for the following rules: for the total model, 39, 270, and 6 saplings, respectively; for the layers model, 28, 238, and 5 saplings, respectively; and for the species model, 30, 160, and 1 sapling, respectively. As compared to saplings that were randomly replanted, the mean growth of the optimally replanted saplings was considerably higher. 【Conclusion】Our study highlighted the importance of competition in sapling growth modeling and provided a useful approach for replanting saplings based on the competition thresholds in mixed forests.

Key words: Replanting optimization; Competition threshold; Sapling growth model; Simulation method.