

TREE DIVERSITY EFFECTS ON FOREST PRODUCTIVITY: DISENTANGLING THE EFFECTS OF TREE SPECIES ADDITION VS. SUBSTITUTION

maude toïgo¹, Bastien Castagneyrol², Hervé Jactel², Xavier Morin¹, and Céline Meredieu²

¹CEFE

²BIOGECO

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Abstract

1. Mixture effect on stand productivity is usually apprehended through a substitutive approach, whereby productivity in mixed stands is compared to productivity in monocultures, at equivalent stand density. This approach has proved that in many cases mixed stands perform better than monospecific forests, however, we do not yet have a solid theory about species behaviour in the mixture or even guidelines for combining species. The addition of a second tree species to an existing mono-specific stand has received much less consideration. Yet, this approach has the potential to separate the facilitation effect from the complementarity effect. 2. We compared the effect of tree species substitution vs. addition on the productivity of maritime pine and silver birch in a young tree diversity experiment implemented in 2008 in SW France. 3. Substituting pines with birches to create two-species mixtures resulted in an increase of tree productivity at stand level beyond what was expected from monocultures (i.e., overyielding). In contrast, creating mixture through the addition of birches to pine stands had no effect on the maritime pine stand productivity (transgressive mixture effect not significant). This absence of effect is produced by two distinct density-dependence responses at an individual level. 4. Our results allow clarifying the cases in which a mixed stand can be considered as an alternative to a monoculture of a productive species. In particular, the addition of a pioneer and soil low-demanding species during young developmental stages is a possibility to diversify the stand and potentially to increase ecosystem services without altering the productivity of the target species.

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