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Biodiversity and multifunctionality: insights from rice varietal mixtures in the highlands of Madagascar

Oral

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Abstract

The role of biodiversity on ecosystem functioning is increasingly discussed in a multifunctionality context. However, assessing multiple performances *in natura* is complex and applied perspectives remain scarce. Interestingly, the growing interest for varietal mixtures in agronomy represents a unique opportunity to challenge the role of intraspecific diversity for the regulation of multiple outcomes at the same time. This is the case for rice production in Madagascar. Especially, as the highlands region is increasingly impacted by climate change and by the socio-economic burden resulting from these environmental changes. Pests and pathogens are placing undue pressure on rice crops while disease resistance is also being affected by climate change.
The effect of varietal diversity on upland-rice multifunctionality, as well as yield components and resistance to *Pyricularia* were assessed and quantified during a two-year trial in the highlands of Madagascar. In the first year of the trial, binary mixtures of ten phenotypically contrasted varieties were established. Based on these first-year results, the four most contrasting varieties were selected to repeat the field trial the following season, this time with the inclusion of two levels of fertilization (high and low). First-year results showed that the crop susceptibility to blast disease was reduced by 6.5% in the mixed plots compared to plots with pure stand. Furthermore, varietal mixture generated a yield gain of 13% compared to pure crops in the first year and a yield gain of 17% in the second year under low fertilization. In the highly fertilized treatment, however, the gain was reduced to 4%. In order to identify the multifunctional variety combinations, a functional classification using a combinatorial model was used. Our results suggest that varietal association composed of different functional groups promotes the multifunctionality of cropping systems, when cultivated in suboptimal conditions for plant growth. Our findings represent a robust test of ecological theory, and the biodiversity-multifunctionality framework in particular, and pave the way of its applications in a crop diversification context. The identification of assembly rules for crop mixtures will be a critical next step.