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Evaluation of Local and International Cacao Cultivars in Monoculture and Agroforestry Systems

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Abstract

Locally selected cultivars of cacao (*Theobroma cacao*) are supposedly better adapted to local environmental conditions compared with commercially selected cultivars. In this context, the objective of this study was to compare production and disease incidence of local cultivars with international cultivars and to test for interactions between cacao production systems and cultivars.

In the 1990s, the Bolivian cacao farmers' cooperative El Ceibo carried out a selection programme in the Bolivian Alto Beni region, by collecting germplasm from well-performing cacao trees, which originated from a governmental programme that distributed hybrid seeds to cacao farmers between the 1960s and 1980s.

From the El Ceibo program, four cultivars were selected and tested together with four commercial cultivars and four full-sib families encompassing five different production systems: two monocultures and two agroforestry systems under organic and conventional management, and one successional agroforestry system without external inputs. The long-term field trial was established in 2009 by the research institute FiBL and local partners in the Alto Beni region, Bolivia. Data on cacao yield and fungal disease incidence was recorded for each tree every 15 days between 2015 and 2019.

Across all years, the two monocultures were the most productive systems with an average production of 4.8 kg/tree (fresh beans with fruit pulp) under conventional and 4.3 kg/tree under organic management. Conventional and organic agroforestry systems obtained an average production of 2.7 kg/tree, while the successional agroforestry system had an average production of 2.1 kg/tree.

The local cultivars showed significantly higher yield in the five production systems across all years. The two best performing cultivars showed an average production of 6.6 and 6.4 kg/tree (fresh beans), respectively. The international cultivars had an average production of 3.6 kg/tree. The full-sib families performed very poorly with an average production of 1.3 kg/tree. There was a significant interaction between production systems and cultivars. Nevertheless, the rank between cultivars across production systems did not really change.

The incidence of fungal diseases was low in all systems and slightly lower in local cultivars compared with the international ones.

Our results highlight the relevance of selecting local genetic material.

Keywords: Agroforestry, breeding, cacao cultivars, fungal diseases, germplasm, Long-term system comparison, organic farming, *theobroma cacao*, yield