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Linking Land-Use and Product Quality: Do Micro-Environmental Growing Conditions Affect Cacao Bean Characteristics?

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Abstract

Global chocolate demand is increasing and also the demand on high quality cacao beans from geographical indication. Quality may concern commercial requirements and flavour, but also production conditions, i.e. ecological standards and certifications. The fermentation process is a very important factor for the structural development of cacao flavour, but little is known about the influence of micro-environmental conditions such as microclimate, light, and especially water availability during the ripening period of the cacao pods on bean quality. These conditions depend not only on the region but change over the harvesting period and differ within production systems. While cultivars are often selected by their agronomic performance, a selection according to their ability to cope with ecophysiological stressful conditions is also desirable.

Out of an experimental field trial in Alto Beni, Bolivia, cacao beans were sampled at the beginning and the end of the harvesting period from five production systems comprising full-sun and agroforestry systems under conventional and organic farming practices, and four cultivars. Micro-environmental conditions and soil moisture were measured. Beans were analysed according to their morphological traits including dry-bean-factor, 100-bean-weight, share of cotyledons, testa and radicle, fat content, and C/N ratio. Polyamines as a measure of systemic water stress response in the beans were estimated via HPLC-FLD.

Harvesting period prolonged over the dry season while water availability in the soil decreased. Cacao agroforestry systems provided a buffered microclimate for the understory cocoa in comparison to full-sun monocultures reducing transpiration. Finally, cultivars may have different strategies. Beans from different cultivars showed distinctions in their bean composition while polyamine content responded to the seasonal variation over the harvesting time in the production systems.

Enhancing knowledge about the ecophysiology of the cacao tree and responses to environmental conditions in the beans may help to support production systems that provide conditions in favour of the cacao performance and cultivation adapted to local and micro-environmental conditions. For small-scale farmers and cacao famers' cooperatives a stable cacao bean production over the season will improve their access and reliability on the chocolate market that asks for a constant supply and specific quality.

Keywords: Agroforestry, bean quality, soil moisture

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