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Do long-term management practices impact tea soil properties and plant yield? insights from Sri Lanka

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Abstract

As the world's second-most-consumed beverage after water, tea is a perennial crop of major socio-economic importance in many countries. It is Sri Lanka's top agricultural export, bringing in a revenue of 1.3 billion USD annually. Here, young shoots are harvested regularly, making fertilisation vital for promoting growth and quality. Nevertheless, challenges regarding the high costs of fertilisers and their environmental risks persist. Further quantitative insights evaluating the long-term influence of different fertilisers on tea soil properties and subsequent aboveground plant yield are limited. Moreover, while organic production practices are considered an emerging solution for reducing nutrient losses, their effects on the tea soil-plant system remain underexplored.

To address these gaps, we assessed selected soil chemical properties and harvested tea flush yields in a long-term tea field trial (TRIORCON) in Sri Lanka. Each plot has received fertiliser inputs of either reclaimable tea (RT), neem oil cake (NOC), compost (COM), or a synthetic mixture of urea granules, rock phosphate and muriate of potash (MIN) since 2000. Despite differences in total carbon (C) added through fertilisation, topsoil C content did not differ significantly across treatments. Similar trends were observed for topsoil total phosphorus (P) and potassium (K), whereas total nitrogen (N) content may have been affected by varying inputs over time.

Annual tea flush yields were also analysed for the TRIORCON from 2007 to 2022. Yield differences were observed among the treatments: generally, COM yielded the highest, followed by RT and MIN, and finally NOC. Simplified soil surface budgets comparing fertiliser inputs with harvested tea outputs revealed positive nutrient balances. The N balances of the RT, NOC, COM, and MIN treatments were 224 ± 139, 142 ± 94, 272 ± 111, and 203 ± 50 kg N ha^{-1} yr^{-1}, respectively. High nutrient surpluses observed in the trial indicate inefficient fertiliser use for the tea plant and suggest potential nutrient losses. Ultimately, the findings offer a perspective on the nutrient use efficiency of the tea system and could contribute to more sustainable nutrient management in its cultivation.

Keywords: Long-term field experiment, nutrient balance, organic agriculture, Sri Lanka, tea

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