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Agronomic and economic performance of fertiliser microdosing in the shea-maize agroforestry parklands of Benin

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Abstract

Maize (*Zea mays* L.) is widely cultivated and plays an important role in the food security and livelihoods in Africa. However, average maize yields have stagnated at 2 tons ha⁻¹ yr⁻¹, which is one third of the global average. This stagnation is primarily due to declining soil fertility, as nutrient losses through harvest are not replenished with fertiliser. In Benin, the government recommended blanket inorganic fertiliser rates of 76 kg N ha⁻¹, 13.1 kg P ha⁻¹, and 24.9 kg K ha⁻¹ to increase yields, but adoption rate is slow due the high cost and unavailability of inorganic fertiliser. As part of the solutions to mitigate this low adoption, the fertiliser microdosing has been developed to improve fertiliser use efficiency and increase yields. However, studies regarding its profitability, labour and time requirements are scarce. This study, conducted in the *Vitellaria paradoxa* parklands of the Sudano-Guinean zone, compared maize yields, profitability, and labour requirements across three fertiliser application strategies: (1) no fertiliser (control), (2) microdosing (MD) using NPK 15-15-15 at 17.8 kg N ha⁻¹, 3.1 kg P ha⁻¹, and 5.8 kg K ha⁻¹, and (3) the recommended rate (RR). Each treatment was tested across canopy area, 3 m away from canopy, 10 m away from canopy, and 20 m away from canopy, respectively zone A, B, C and D. Results showed no significant interaction between zone and fertiliser application strategies, but RR in Zone D produced 2.2 times significantly higher grain yield than the control in Zone A ($p = 0.01$). MD required 45 % significantly more time at sowing than control and RR ($p < 0.01$). MD and RR had total costs that were 1.15 and 1.55 times significantly higher than control, respectively, generating revenues that significantly exceeded control by 1.22 and 1.85 times ($p < 0.01$). Additionally, MD demonstrated 50 % higher fertiliser use efficiency ($p < 0.01$), whereas RR achieved 65 % significantly higher profits than MD. Therefore, fertiliser microdosing in shea parklands is less labor-demanding, increases maize yield, and enhances fertiliser use efficiency, making it a more efficient but less profitable option for resource-constrained smallholders farmers.

Keywords: Fertiliser application, labour requirements, Profitability, Soil fertility, sustainable agriculture, Tree crop interactions

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