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"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

Yield and drought resistance of maize within *Gliricidia sepium* and pigeonpea intercropping systems

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Abstract

Crop diversification through intercropping can enhance agroecosystem resilience to low and sporadic precipitations typical in semiarid areas. We tested whether intercropping maize with *Gliciridia sepium* and/or pigeonpea improves productivity and drought resistance of maize. A split-split-plot experiment was adopted to test the effects of intercropping (maize monoculture, sole pigeonpea, maize-Gliricidia, maize-pigeonpea and maize-pigeonpea-Gliricidia), fertilisers (with and without) and rainfall (ambient and drought). Drought was induced using above-canopy rainout shelters which intercepted 50 % of the ambient rainfall.

Drought reduced gravimetric soil moisture in 2019 by 12.5 % without creating artificial growing conditions under shelters. Intercropping with *G. sepium* (2.9 t ha^{-1}) and/or pigeonpea (2.5 t ha^{-1}) in 2020 did not significantly affect grain yield compared to maize monoculture (2.8 t ha^{-1}), suggesting that farmers can diversify their fields without compromising crop yields. The cropping systems by fertiliser effects on rainwater use efficiency by maize was significantly higher in 2020 and the effect was the highest when both *G. sepium* and pigeonpea were intercropped. Maize grain yield changes due to induced drought (resistance) was affected by the interactions of fertiliser and cropping systems in 2019 ($p < 0{,}05$), but no significant effects were noted in 2020. In both seasons, maize yield change was the highest (low drought resistance) in cropping system with fertiliser, suggesting that fertilisation reduced maize drought resistance. Also, nonsignificant effects on drought resistance in 2020 would reflect improved moisture conditions under the rainout shelters as precipitation in sheltered conditions (554 mm) was within the optimum range for semiarid zone. Pigeonpea yield change due to drought was not significantly affected by cropping seasons and fertiliser in both seasons. Intercropping improved resource use efficiency to increase maize yields and the appropriate selection of a drought resistant component, like pigeonpea, enhanced maize drought resistance across cropping seasons. In addition to the positive impact on drought resistance and resource efficiency, *G. sepium* provides a sustainable (regrowing) source of fuelwood. If the suggest intercropping systems are used in areas with high household dependency on fuelwood from off-farm sites, on-farm fuelwood from *G. sepium* can potentially offset this demand making the household fuelwood self-sufficient.

Keywords: Agroforestry, drought resistance, intercropping, semi-arid Tanzania

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