Tropentag, September 10-12, 2025, hybrid conference

"Reconcile land system changes
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Enhancing smallholder food security through on-farm tomato-onion intercropping under agroecological practices in benin, west Africa

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Abstract

Agroecological practices offer promising alternatives for sustainable crop production among smallholder farmers in sub-Saharan Africa. This study assessed the combined effects of tomato-onion intercropping and agroecological nutrient management on crop growth, yield, and Land Equivalent Ratios (LER) in Southern Benin. On-farm experiments were conducted over two growing seasons (August 2022-January 2023 and May-September 2023) using a split-split-plot design with three replications. Five cropping systems were evaluated as main factor: sole tomato with biopesticide (0.52 % terpenoids, 5 mg/g diallyl disulfide, neem oil), sole tomato without biopesticide, sole onion, and two tomato-onion intercropping patterns (2:1 and 2:2 row arrangements). These were combined with five fertiliser treatments: no fertiliser input, 15 t/ha compost, 15 t/ha poultry manure, mixed poultry and cattle manure (7.5 t/ha + 7.5 t/ha), and synthetic fertiliser (200 kg/ha NPK+200 kg/ha Urea). Crops performed better in 2023 compared to 2022. Plant height was significantly affected by the source of fertilisers for both seasons ($p = 0.0007$). The highest plants were observed under organic fertilisers plots at 56 days after transplanting, reaching up to 75 cm for tomatoes and 45 cm for onions. Among cropping systems, sole tomato with biopesticide recorded the highest fresh fruit yields across seasons, while intercropping systems produced comparable tomato yields within each season. Onion yields remained stable across seasons under cropping systems (39.36 ± 10.16 g/plant). Compost and poultry manure were the most effective organic fertilisers for yield improvement, showing substantial increases over the control: up to 137.2 % and 160.6 % for tomato and 54.4 % and 52.1 % for onion in 2023. Intercropping is beneficial for efficient land use regardless of sources of fertilisers applied. The highest LER values of 1.97 under compost and 1.93 poultry manure application were recorded in 2023, suggesting the nearly double effect of intercropping per unit area compared to sole cropping. These findings underscore the potential of agroecological intensification-combining intercropping and organic fertilisation to enhance plant growth, crop yields, LER and reduce dependence on chemical inputs. Field-based results also highlight the practicality of scaling these innovations in similar agroecological zones. Further

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research is needed to assess the long-term agronomic and economic benefits to support their broader adoption.

Keywords: Agroecology, land productivity, organic fertiliser, tomato-onion intercropping, West Africa