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Hidden diversity in a perceived uniform crop: Linking farmer perception and phenotypic variation in amaranth

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Abstract

Urban farmers in Niger cultivate amaranth (*Amaranthus* spp.) primarily as a leafy vegetable and commonly use seed colour (black versus white) as a practical proxy to distinguish and maintain local seed lots. However, the extent to which this farmer-defined category reflects underlying biological diversity remains poorly understood. This study investigates a widely cultivated black-seeded landrace known locally as *Tchapata* (Zarma) or *Aleyyahou* (Hausa) in Niamey, by combining field-based phenotyping with structured farmer interviews.

A field experiment conducted on 180 plants revealed substantial intra-population variation in key vegetative traits. Plant height ranged from 5.0 to 32.5 cm (CV = 39.4 %), while leaf number also showed considerable dispersion (CV = 27.2 %). Robust Principal Component Analysis captured 93.5% of total variance along a single axis, indicating a continuous gradient of vegetative vigour rather than discrete morphotypes. Clustering analyses further revealed a dominant phenotypic core with peripheral variation but no extreme outliers, consistent with a cohesive yet internally differentiated population.

Farmer interviews (n = 40) revealed a striking paradox. While 80 % of respondents described their fields as phenotypically uniform, 77.5 % reported actively selecting seeds based on plant height, growth rate and leaf abundance, precisely the traits exhibiting the highest variability in the experiment. Seed sourcing was highly convergent, with most farmers renewing their stock each cropping cycle from the same local markets (83 %), a pattern that helps explain population cohesion but may also limit the introduction of new diversity. The black-seeded type was consistently valued for rapid growth, resilience and strong market demand.

These results show that a visually uniform, farmer-named landrace can function as a reservoir of structured and functional diversity maintained through informal seed systems and active farmer selection. The alignment between farmer selection criteria and measured phenotypic variation highlights clear entry points for participatory selection and decentralised crop improvement. More broadly, this study underscores the need to recognise farmer-defined categories as dynamic management units rather than fixed varieties, with important implications for agrobiodiversity conservation and the design of resilient urban food systems in West Africa.

Keywords: Agrobiodiversity, farmer knowledge, informal seed systems, intra-population variation, neglected and underutilised species, urban agriculture

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