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Nutritional water productivity of selected leafy vegetables

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The major challenge affecting rural resource-poor households (RRPHs) in South Africa is deficiencies in micronutrients (iron and zinc) and vitamin A. Traditional leafy vegetables (TLVs) are dense in iron, zinc, and β-carotene concentrations. Therefore, they are deemed suitable to improve the dietary diversity of RRPHs. The main objective of this study was to assess the effect of irrigation regimes on nutritional water productivity (NWP) of selected leafy vegetables [*Amaranthus cruentus* (Amaranth) and *Cleome gynandra* (Spider flower), both TLVs, and Beta vulgaris (Swiss chard)]. Experiments were conducted under a rain shelter at the ARC-VOP, Pretoria, South Africa, during two consecutive seasons (2013/14 and 2014/15). Leafy vegetables were subjected to three irrigation regimes [well-watered (I30), moderate water stress (I50), and severe water stress (I80)]. Data collected [(aboveground biomass (AGB), aboveground edible biomass (AGEB), actual evapotranspiration, and nutrient concentrations (iron, zinc, and β-carotene)] were used to calculate NWP of leafy vegetables. Swiss chard exhibited a higher portion of AGEB compared to TLVs due to its larger harvest index (0.57-0.92). Selected TLVs displayed superiority in terms of nutrient richness compared to Swiss chard, under I50. Results indicated that TLVs could provide more than the daily-recommended nutrient intake (DRNI) for vitamin A to all age groups. For iron, Spider flower could supply more than the DRNI to infants between 1 and 3 years of age, whereas for zinc, it could supply approximately 11% to this age group. However, higher micronutrient and β-carotene concentrations did not translate to superior nutritional yield (NY). Swiss chard showed higher Fe-NY and Zn-NY, whereas TLVs were rich in β-carotene-NY. Similarly, Swiss chard demonstrated the highest Fe-NWP (1090 mg m^{-3}) and Zn-NWP (125 mg m^{-3}), whereas Amaranth was larger in β-carotene-NWP (1799 mg m^{-3}), under moderate water stress. These results show that there may be an opportunity to improve NWP under drought conditions. There is a need for future studies that will assess NWP for a wider range of leafy vegetables. These studies should be conducted in different locations and explore the effect of management factors (fertilizer, water stress, planting density, and planting date), and soil type on NWP of micronutrients and β-carotene.

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