Deficit irrigation as a sustainable option for improving water productivity in Sub-Saharan Africa: the case of Ethiopia. A Critical Review

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Water scarcity is a major limiting factor for crop production by irrigation in sub-Saharan countries. Improved irrigation scheduling that can ensure the optimal use of the allocated water and enhance water productivity (WP) is required to address future water scarcity in the region. Maximizing WP by exposing the crop to a certain level of water stress using deficit irrigation (DI) is considered a promising strategy. To adopt DI strategies, a shred of comprehensive evidence concerning DI for different crops is required. This review aims to provide adequate information about the effect of DI on WP. We reviewed 90 research papers from Ethiopia and summarize the effect of DI on WP and yield. It is shown that DI considerably increased WP compared to full irrigation. Despite higher WP, reduced biomass yield was obtained in some of the studied DI practices compared to full irrigation. It was also found that yield reduction may be low compared to the benefits gained by diverting the saved water to irrigate extra arable land. From this review, we understood that growers must recognize specific soil management and crops before applying DI strategies. Maize revealed the highest (2.65 kg m\(^{-3}\)) and lowest (0.50 kg m\(^{-3}\)) WP when irrigated at only the initial stage compared with being fully irrigated in all growth stages, respectively. Also, onion showed a decreasing WP with increased irrigation water from 60% crop water requirement (ET\(_c\)) (1.84 kg m\(^{-3}\)) to 100% ET\(_c\) (1.34 kg m\(^{-3}\)). Increasing water deficit from 100 to 30% ET\(_c\) led to an increase of wheat WP by 72.2%. For tomato, the highest WP (7.02 kg m\(^{-3}\)) was found at 70% ET\(_c\) followed by 50% ET\(_c\) (6.98 kg m\(^{-3}\)) and 85% ET\(_c\) (6.92 kg m\(^{-3}\)), while the water application of 100% ET\(_c\) (or full irrigation) showed the least WP (6.79 kg m\(^{-3}\)). Teff showed the lowest WP (1.72 kg m\(^{-3}\)) under optimal irrigation, while it was highest (2.96 kg m\(^{-3}\)) under 75% ET\(_c\) throughout the growing season. The regression analysis (R\(^2\)) for WP increment and yield reduction versus saved water showed higher values, indicating that DI could be an option for WP increment and increasing overall yield by expanding irrigated area and applying the saved water in water-scarce regions. In conclusion, in areas where drought stress is the limiting factor for crop production, the application of DI is feasible.
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