

Increasing yield in maize in Minho (Portugal): the efficiency thresholds of different irrigation systems.

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Abstract

The Portuguese region of Minho is characterized by small parcels of agricultural land distributed in the so called "minifúndio" regime. Decisions in line with sustainable management are crucial in maintaining the economic viability of this small scale agricultural land. In terms of maize cultivation, irrigation and fertilization are the most important production factors accounting for 44% to 57% of the total production costs, respectively. In this study, a water balance equation and a simplified nitrogen balance equation were successfully used to increase yield in maize. The information provided by these equations allowed for changes in field management which resulted in a 36% reduction in nitrogen fertilizer added to the soil. In addition, both equations combined to minimize erosion through reducing surface water runoff and nutrient leaching. In terms of irrigation systems, the use of drip irrigation significantly increased the average water use efficiency: up to 66% reduction in water usage in relation to traditional irrigation (open channel flow/submersion) and up to 43% reduction in water usage in relation to aspersion irrigation methods. Furthermore, the irrigation system "drip tape without pumping" (tape flow assisted by gravity) led to a uniformity of irrigation of 87% and a reduction of the watered area down to 45% of the total field area. The present results suggest that in fields smaller than 0,75 hectares, the most cost efficient irrigation system is the "drip tape without pumping". In fields over 0,75 hectares but under 1.8 hectares, the system "aspersion irrigation with portable rain-gun" becomes the most cost efficient. From 1.8 hectares, the hose-reel machine shows an advantage over the "drip tape without pumping" but not over the "aspersion irrigation with portable rain-gun" which continues to be most efficient. From 3,5 hectares, the adoption of the "hose-reel machine" or "aspersion irrigation with the portable rain-gun" become equally adequate.