

An interdisciplinary tillage erosion experiment: establishing a new field in grassland with reconstructed ard plough of the Bronze Age – Iron Age

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Despite recognising the role of tillage erosion in landforms evolution, little research has documented its effects in prehistoric times. Herein, an interdisciplinary archaeological-geomorphological experiment with reconstructed tillage tools and management was conducted in order to measure tillage erosion when a new field in grasslands was established in the Bronze Age-Iron Age. Three wooden ards were reconstructed based on archaeological findings. They were tested in a cross-tillage experiment, consisting of a tillage pass perpendicular to the primary slope (6.5-9.7%), and a second tillage pass parallel to the primary slope of a convex-convex ridge with mowed grass (0.2 m high, vegetation cover >90%). The standard sole ard proved to be the most effective, with a mean tillage depth of ~0.12 m, a mean tillage speed of 3.8 km h⁻¹, and a mean distance between furrows of 0.20-0.25 m. Only 13% of the 264 tracers placed on 6 transects were displaced, and the mean tracers displacement parallel to the primary slope was 0.04 ± 0.17 m. Contour tillage perpendicular to primary slope created V or U shaped furrows with a mean depth of 0.1-0.12 m, a mean width of 0.05-0.1 m, and incision under the main root zone. Only soil in direct contact with the ard was displaced, with a mean translocation distance of 0.06 ± 0.2 m parallel and 0.06 ± 0.3 m perpendicular to the primary slope. During tillage parallel to slope, soil clods of ~0.20 x 0.25 x 0.10 m were created and slightly disturbed or turned over one another. The tracers moved within the furrows and with the soil clods. Loose soil, resembling a seedbed, was not covered by soil clods. Mean displacement during the second pass was 0.03 ± 0.19 m parallel and 0.00 ± 0.15 m perpendicular to primary slope. The displacement from cross-tillage with a wooden ard in permanent grasslands was lower than many previously measured values of traditional animal-powered metal ploughs in permanent fields. No relationship between mean soil displacement and slope gradient was found. Dense vegetation and root structure influenced ard soil-penetration, its movement within the soil, and the displacement of tracers packed between the roots. Cross-tillage with a wooden ard proved to be insufficient for seedbed preparation. The results suggest that grazing or fire management, followed by repeated tillage with ard or hoe in order to destroy soil clods were necessary to establish a new field in grasslands during the Bronze Age-Iron Age.