

Abstract

Wet, poorly drained soils throughout the northern Cornbelt are often artificially drained to improve field conditions for timelier field operations, decrease crop damage resulting from excess water conditions, and improve crop yields. Drainage has also been identified as a contributing factor to water quality impairments in surface waters. Our objective was to quantify drain flow volume and nitrogen and phosphorus loss from a conventional free-drainage (FD) compared to a controlled drainage (CD) system in Southwest Minnesota. A field study was conducted from 2006-2009 on a tile-drained Millington loam soil (fine-loamy, mixed, calcareous, mesic Cumulic Haplaquoll). The field site consisted of two independently drained management zones, 15 and 22 ha. The project used a paired design approach to statistically evaluate treatment effects. During the calibration period (2006-2007) each zone was managed the same. The treatment phase of the experiment began in 2008 with one zone managed in FD mode and the other managed in CD mode. During the two year treatment period (2008-2009) drain flow volume was reduced on average 90%, 137 to 13 m³ d⁻¹. During the same time period NO₃N loads were reduced 93%, 74.80 to 5.0 g ha⁻¹, and TP loads were reduced 93%, 0.70 to 0.05 g ha⁻¹. Flow-weighted mean NO₃N concentrations were reduced 95%, 6.5 to 0.3 mg L⁻¹, and TP concentrations were reduced 95%, 80.8 to 3.8 µg L⁻¹. The use of CD showed environmental benefits compared to FD.