Crop Rotation and Cultural Practice Impact on Nitrogen Balance

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Nitrogen balance provides a measure of agroecosystem performance and environmental sustainability by taking into accounts of N inputs and outputs and N retention in the soil. The objective of this study was to evaluate N balance due to N inputs and outputs and soil N sequestration rate after 7 yr in response to five dryland crop rotations (two 4-yr stacked and two alternate-year rotations and one monocropping) and two cultural practices arranged in a split-plot design in the northern Great Plains, USA. Stacked rotations were durum (*Triticum turgidum* L.)-durum-canola (*Brassica napus* L.)-pea (*Pisum sativum* L.) (D-D-C-P) and durum-durum-flax (*Linum usitatissimum* L.)-pea (D-D-F-P). Alternate-year rotations were durum-canola-durum-pea (D-C-D-P) and durum-flax-durum-pea (D-F-D-P). Monocropping was continuous durum (CD). Cultural practices were traditional (conventional till, recommended seed rate, broadcast N fertilization, and reduced stubble height) and ecological (no-till, increased seed rate, banded N fertilization, and increased stubble height). Total annual N input due to N fertilization, pea N fixation, atmospheric N deposition, crop seed N, and nonsymbiotic N fixation was lower in CD than other crop rotations, regardless of cultural practices. Total N output due to crop grain N removal and N losses due to denitrification, volatilization, plant senescence, N leaching, gaseous N (NO$_x$) emissions, and surface runoff was lower in traditional CD and D-F-D-P than traditional D-C-D-P and ecological D-C-D-P, D-D-C-P, and D-F-D-P. Nitrogen sequestration rate at 0-125 cm from 2005 to 2011 averaged 50 kg N ha$^{-1}$yr$^{-1}$ for all treatments. Nitrogen balance was negative and lower with CD than other crop rotations, regardless of cultural practices. Because of reduced reliance on external N inputs and increased grain N removal, N flow, and N surplus, crop rotations with legumes, nonlegumes, and oilseed crops in the rotation had positive N balance and can be productive and environmentally sustainable compared with monocropping, regardless of cultural practices.