



Water productivity of stacked and alternate-year rotations under conventional and ecological management.

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Dryland cropping system productivity in the North America northern Great Plains (NGP) likely can benefit from diversification of the traditional wheat-summer fallow system through improvements in crop sequence and level of management. A long-term study initiated in 2004 near Culbertson, Montana, U.S.A. compared the impact of rotation type (Stacked vs. Alternate-year) and management level (Conventional vs. Ecological) on canola, flax, and pea grown in rotation with durum. Ecological management included no-till, N fertilizer banded at planting, greater seeding rate, and taller stubble height. Conventional management included single pass tillage with sweeps in spring, fertilizer N broadcast just before planting, standard seeding rate, and standard stubble height. For years 2008-2010, a 13% increase in durum grain and pea seed yield in Ecological than Conventional management was not related to water use or water productivity of grain. Similarly, an 18% increase in pea seed yield in alternate-year rotations (e.g. durum-pea-durum-flax) than stacked rotations (e.g. durum-durum-flax-pea) was not related to water use or water productivity of seed. Water use, water productivity for grain, and water productivity for above ground biomass were similar for management level and rotation type within a given crop. Averaged across management level and rotation type, water use was 326, 351, 372, and 292 mm for canola, durum, flax, and pea. Likewise, water productivity for grain averaged 4.2, 6.5, 2.5, and 7.7 kg/ha/mm for canola, durum, flax, and pea. Water use and water productivity varied significantly among years, underscoring the need to development stable cropping systems that are less susceptible to the highly variable growing environment of the semi-arid NGP. Overall, Ecological management increased durum and pea yield, while Stacked rotations either decreased crop yield (pea) or offered no measurable advantage to Alternate-year rotations. Any differences in yield were not related to water use or water productivity.