

# Comparing Water Use Efficiency and Precipitation Use Efficiency of Crops in the Semiarid Prairie

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Enhancing water use efficiency (WUE) in the semiarid prairie, is based on the notion that the available water is the most limiting factor influencing crop production. Although numerous studies have examined the effect of management on water use efficiency (WUE), most have concentrated on monoculture wheat, the major crop in the region, and even those dealing with other crops (e.g., pulses and oilseeds) have mostly been short-term in nature. Since precipitation is variable both in amount and timeliness of distribution, that such assessments are best conducted in long-term experiments. This paper uses data from a 21-yr study, conducted in the Brown soil zone at Swift Current, SK to determine the influence of crop type on water use efficiency (WUE). Four crop rotations were used in this comparison: fallow-wheat-wheat (F-W-W), F-flax-W (F-Flx-W), continuous wheat (Cont W) and wheat-lentil (W-Lent), all receiving N and P fertilizer based on soil test. About 11 mm more water is conserved in the 21-mo summer fallow period after wheat than after flax and most of this difference in water was located in the 0.3- to 0.9-m soil depth. But, by harvest flax left 14 mm more water in the profile than wheat (mostly in 0.6- to 1.2- m depth), because flax produces less biomass and has shorter roots. At harvest wheat dried the soil to near wilting point (154 mm) but flax and lentil left about 10 mm of available water in the profile. Over the 9-mo winter period about 50 mm of water was stored in the soil after either wheat or flax; however, wheat typically conserved more overwinter water than flax because of its taller stubble. Because lentil has much shorter stubble than wheat, it conserved about 7 mm less water over winter. Wheat grown following lentil left 10 mm less water in the soil than lentil grown following wheat with most of this difference located in the 0.6- to 1.2- m depth, suggesting a shallower lentil rooting depth. On average, wheat grown on stubble used about 275 mm of water; the water used was unaffected by crop in the rotation and was about 85% of that for wheat grown on fallow. Lentil used as much water as wheat even though its biomass was much less. Water use efficiency for wheat was higher when it followed flax than when it followed wheat. The WUE of flax was about 50% of that of wheat, and for lentil following wheat it was 64% of that of wheat following wheat. Water use efficiency for wheat grown on fallow averaged 8.11 kg ha<sup>-1</sup> mm<sup>-1</sup> and for wheat grown on stubble 6.9 kg ha<sup>-1</sup> mm<sup>-1</sup>. A more meaningful way of expressing the efficiency of water use is by the units of precipitation required per unit of produce for the complete cropping system (PUE). The PUE increased with cropping intensity on a yield basis (kg ha<sup>-1</sup> mm<sup>-1</sup>): Cont W (5.21) > W-Lent (4.39) > F-W-W (4.13) > F-Flx-W (2.95) (opposite response to WUE). Producers are more interested in dollars produced than yields. When PUE was calculated on a dollars produced basis (\$ ha<sup>-1</sup> mm<sup>-1</sup>): W-Lent (1.01) > Cont W (0.75) > F-W-W = F-Flx-W (0.64).