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DIGGING INTO RESEARCH

Replace fallow with pulses to improve water- and N-use efficiency

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In a 3-year crop rotation, replacing summerfallow with a pulse crop increased total grain production by 35.5%, improved protein yield by 51%, and enhanced fertilizer-N use efficiency by 33%.

A 3-year crop sequence study was repeated five times (five cycles) from 2005 to 2011 at Swift Current, Saskatchewan. In the 3-yr crop rotation, spring wheat was grown in Year-1, followed in Year 2 by field pea, lentil, chickpea, spring wheat, barley, or summerfallow. In Year 3, durum wheat was planted on the different stubbles and summerfallow plots.

All crops were managed with normal agronomic practices. The crops were seeded with a no-till drill in one pass without pre-seed tillage. Summerfallow operations were three to four tillage operations with a cultivator and rodweeder.

Water profile after Year 2 harvest

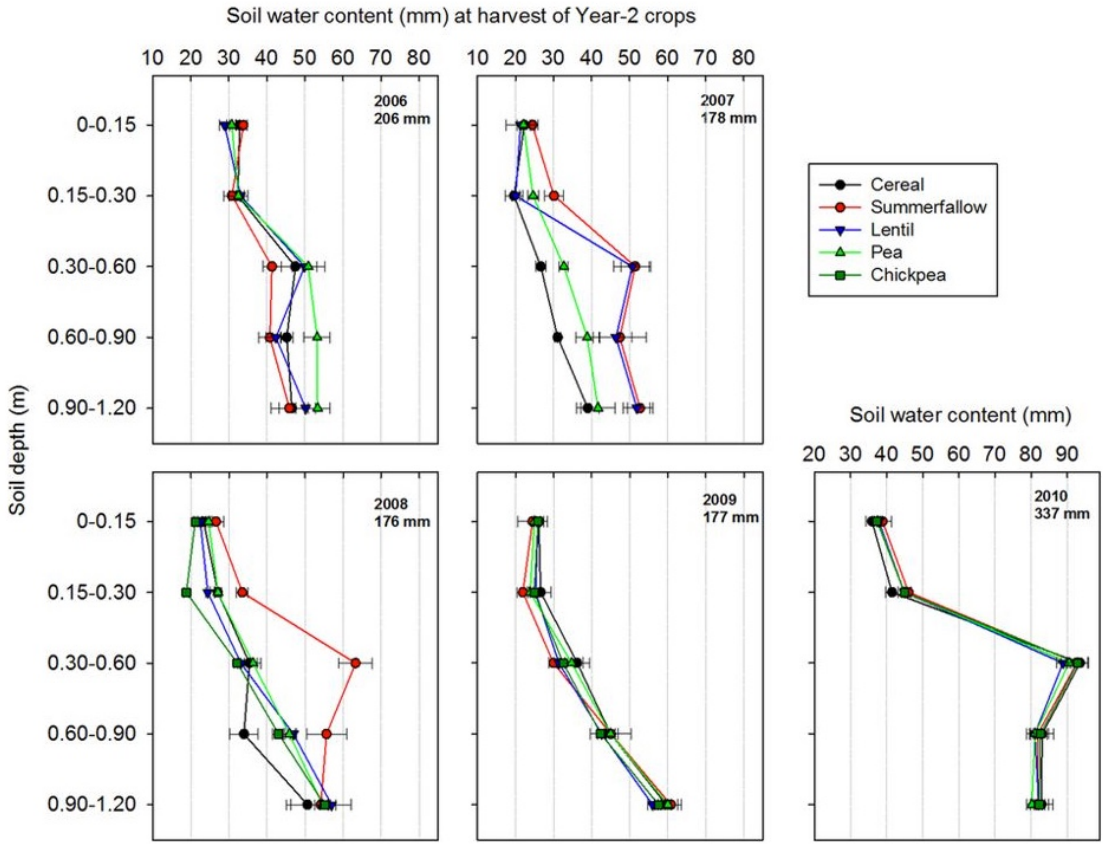
The Soil water content and soil N status were measured at three key stages each year:
(i) water and N remaining in the different soil layers at the harvest of Year-2 crops,

(ii) the additional soil water and N gained (or otherwise lost) over the postharvest (fall and winter) periods, and
(iii) the total soil water and soil N available at the planting of the Year-3 crop (durum wheat).

Moisture retention by the soil after harvest was fairly large across the five cycles at the 0 to 4 foot (1.2 metre) depth, but varied by cropping system and year.

In cycles-1 (2006), 4 (2009) and 5 (2010), soil moisture after harvest on pulse crop stubble was similar to moisture in summerfallow plots. However, in cycles-2 (2007) and -3 (2008), summerfallow plots had approximately 2 inches (53 mm) more soil moisture at the 0- to 4-foot depth than the cropped plots.

However, approximately 79% of growing season precipitation was not stored in the summerfallow plots and was essentially lost to evaporation.



The Year-2 crops were dry pea, lentil, chickpea, and a cereal (spring wheat or barley) that were no-till planted in the field of Year-1 wheat stubble in each of the five cycles (summerfallow was the control). The lines at each point are the standard errors of the means (n = 4).

Nitrogen balance

Soil N was measured prior to planting durum wheat. The pulse stubble had similar soil N values as summerfallow, and 87% higher than after cereals. The amount of N on summerfallow varied by each year, ranging from 45 to 150 lbs./ac (50 to 169 kg/ha). This variation means that relying on mineralized N on summerfallow fields can be risky, and could require supplemental N fertilizer in some years.

Grain yield

The research found that rain during the growing season was much more important for yield than residual soil moisture at seeding time.

In 2008, 2009, and 2011 with normal to above-normal precipitation, durum on pulse stubble produced similar yield as durum on summerfallow. For example, in 2011 durum yield on pea and lentil stubble and summerfallow was about 38 bushels per acre, while durum on chickpea stubble yielded 45 bushels per acre.

However, in the drier years of 2007 and 2010, summerfallow fields produced 36.5% higher durum yield than crops on pulse stubble. In 2007, durum on summerfallow yielded 26 bushels per acre compared to 21 bushels on pea and lentil stubble.

The missed year of grain production meant that the summerfallow crop rotation had less total grain produced in the three-year cycle. Replacing summerfallow with pulse crops increased total grain production by 35.5%, improved protein yield by 50.9%, and enhanced fertilizer-N use efficiency by 33.0%.

These production improvements with pulse systems were consistent in both dry and normal-to-wet conditions over the five cycles.

Summerfallow has been used as a risk management tool on the semi-arid Prairie as a way to conserve moisture in the soil and to take advantage of mineralized N from soil organic matter. This research shows that tilled summerfallow may no longer provide this risk management. Further research on chemfallow is required to determine if it would provide any more benefits than tilled summerfallow.

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Gan, Y. et al. Diversifying crop rotations with pulses enhances system productivity. Sci. Rep. 5, 14625; doi: 10.1038/srep14625 (2015). https://www.nature.com/articles/srep14625

