# Camelina as a Replacement for Fallow in Wheat-Fallow Rotation

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## Introduction

Wheat (*Triticum aestivum* L.), an important crop & a key component of food security in the world, is usually cultivated under a wheat-fallow cropping system in dryer areas of the Northern Great Plains (NGP) due to limited rainfall. Although the fallow period is beneficial for conserving soil moisture, the overall profit is relatively low. Hence, there is a need to replace the fallow period of the cycle with another crop that will increase the farmers' economic return and minimize the negative impact on wheat production.

## Objective

To evaluate the impact on wheat productivity when the fallow period in winter wheat-fallow rotation is replaced with camelina.

## Materials and Methods

***Experiment:*** The study was set up as a randomized complete block design with five replications on an initial fallow field. Wheat-fallow (W-F) and wheat-camelina (W-C) rotations (treatments) with both phases of the rotations present in every year were established. A hard red winter wheat type "Yellowstone" & a spring-type camelina "Blaine Creek" were seeded at 67 kg ha$^{-1}$ and 5 kg ha$^{-1}$, respectively, on plots approximately 12 m X 52 m (Fig. 1). Nitrogen was applied at 40 kg ha$^{-1}$ for wheat, and 45 kg ha$^{-1}$ for camelina.

***Economics:*** Camelina diesel production cost, feed meal cost, and expected selling price were determined according to Foulke et al. (2013). The selling price of wheat grain was determined according to the USDA-ERS 2013 estimates. The fallow period was managed by a one-time herbicide application and tillage in the spring and was estimated at $34.7 ha$^{-1}$.

Fig. 1. Field plots at Wyarno, near Sheridan, WY showing both camelina and wheat in rotation.

Fig. 2. Soil moisture measurement using a neutron probe.

Fig. 3. Wheat showing differences in leaf pigment color between treatments.

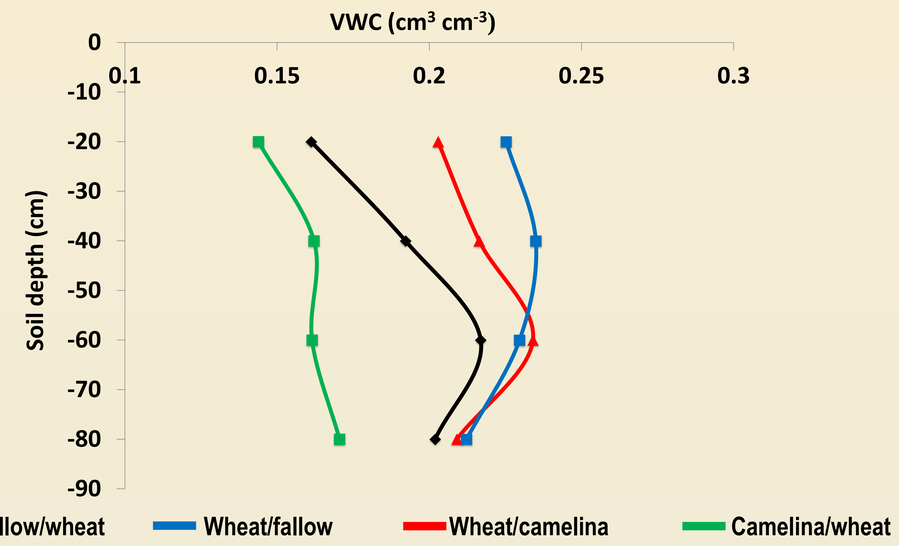


Fig. 4. Soil moisture content after harvest of the second phase of the rotation.

Table 1. The effects of fallow and camelina on wheat plant height, grain yield, harvest index, residue, WU and WUE.

| Rotation | Plant height (cm) | Grain yield (kg ha$^{-1}$) | Harvest index | Wheat residue (kg ha$^{-1}$) | WU (mm) | WUE (kg m$^{-3}$) |
|---|---|---|---|---|---|---|
| W-F | 98.35 | 3952 | 0.414 | 9523 | 391 | 0.980 |
| W-C | 87.98 | 3219 | 0.438 | 6913 | 365 | 0.888 |
| *P-value* | 0.001 | 0.007 | 0.013 | <0.0001 | 0.364 | 0.471 |

Table 2. Total seed yield, OM, and income of fallow-wheat and camelina-wheat rotations.

| Rotation | OM (%) | Total yield (kg ha$^{-1}$) | Gross income ha$^{-1}$ ($) | | Net income ha$^{-1}$ ($) | |
|---|---|---|---|---|---|---|
| | | | Sold* | Processed# | Sold* | Processed# |
| W-F | 2.47 | 3952 | 1021 | 1021 | 681 | 681 |
| W-C | 2.57 | 4276 | 1045 | 1239 | 661 | 757 |
| P-value | 0.101 | 0.117 | | | | |

*Sale of wheat grain (@ $0.105 kg$^{-1}$) and camelina seeds (@ $0.082 kg$^{-1}$)
#Sale of wheat grain and processing of camelina seeds valued at $0.816 L$^{-1}$ for biodiesel and $0.262 kg$^{-1}$ for feed meal
NB: Overhead cost was not included in the analysis

***Soil moisture:*** A neutron probe was calibrated for the specific conditions of the experimental site and used to record soil moisture content in 20 cm depth increments to 80 cm total soil depth (Fig. 2).

## Results

Moisture depletion of camelina occurred primarily within 20-40 cm soil depth, whereas wheat depleted soil moisture from deeper depths as well (Fig. 4). Average water storage efficiency for the fallow period was 33.7 % and 32.8 % when it was replaced with camelina. The Water use (WU) and the water use efficiency (WUE) for camelina were 221 mm and 0.373 kg m$^{-3}$, respectively. Replacing the fallow period with camelina resulted in 18.5 % grain yield loss, 27.4 % less wheat residue, and 10.5 % reduction in plant height (Table 1). Crop residue of camelina was 3986 kg ha$^{-1}$ and thus offsets the wheat residue reduction of the wheat crop following camelina.

The wheat harvest index increased with fallow replacement but the WU and WUE did not differ even though there were differences in the leaf pigment color (Fig. 3). Total yield and OM did not differ among the cropping systems (Table 2). In general, income gained from sales of camelina seeds was not sufficient to offset the yield reduction in wheat. However, processing camelina seeds for diesel and feed meal increased the net income of wheat-camelina rotation (Table 2).

## Conclusions

Based on our preliminary results, replacing the fallow period with camelina showed significant yield reduction in wheat. Current selling price of camelina seeds is not sufficient to offset the yield reduction in wheat.

## Acknowledgement

The project was supported by the USDA-NIFA Biomass Research Development Initiative Program and the Western Sustainable Agricultural Research and Education Program. We acknowledge ShREC farm crew for their contributions to this project.

## Reference

Foulke T., Geiger, M., and Hess B. 2013. Is biodiesel from camelina right for you? University of Wyoming Extension, B-1249, Ed. Miller, S.L.

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