AGRI-FACTS
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# Pea-wheat Rotation in Southern Alberta

Using diverse crop rotations, which include three or four different crops, is generally the most desirable crop production practice. However, in the drier regions of southern Alberta, the pea-wheat rotation offers a number of significant advantages.

Wheat yields after pea are often higher than after wheat as a result of increased soil nitrogen (N) availability, higher amounts of stored soil water and reduced disease potential. With the pea-wheat rotation, the need for nitrogen fertilizer inputs for pea and wheat are greatly reduced and often eliminated.

From an economic and agronomic standpoint, the pea-wheat rotation can often be very profitable for southern Alberta dryland farmers.

*A pea-wheat rotation can offer advantages in drier regions*

## Background

In the Brown and Dark Brown soil zones of southern Alberta, crop production has historically focused on spring wheat. In the past 20 to 30 years, crops such as barley and canola have increased in areas where there is sufficient precipitation. However, summer-fallow and monoculture wheat systems remain a significant cropping practice for many producers.

### In the Brown soil zone:

- the average annual precipitation is approximately 350 mm (14 in) and growing season precipitation is about 150 mm (6 in)

### In the Dark Brown soil zone:

- the average annual precipitation is approximately 400 mm (16 in) and growing season precipitation is about 175 mm (7 in)

With relatively low precipitation, retaining soil moisture through summerfallowing has been an important agricultural practice in the semi-arid regions of the prairies. However in the long term, the practice of using summerfallow can lead to a decline in soil quality as a result of the following:

- decline of soil organic matter levels
- increased salinization
- increased wind and water erosion
- depleted soil nitrogen and other nutrient reserves

To reduce the negative effects on organic matter loss and erosion, producers have shifted from the use of conventional cultivation for weed control in fallow fields to the use of herbicides to control weed growth. This practice is referred as chem-fallow.

Producers have also adopted the use of commercial fertilizers to optimize wheat yield and quality, as soil nutrient reserves have declined. However, in the long term, the environmental sustainability of cropping systems that include summerfallow remains in question.

## Long-term crop rotation study – Bow Island

In 1992, a Long-Term Dryland Crop Rotation Study in the Brown Soil Zone study began at the Alberta Crop Diversification Centre South's Bow Island substation (approximately 10 km south of the town of Bow Island).

This long-term study compared rotations that are more typical for the region with those that include more crop diversity along with the influence of nutrient practices. The study focused on determining

the viability of existing and alternative crops and cropping systems under differing rates of inorganic fertilizers and manure.

The study was designed to determine the effects of different cropping practices on soil quality in the long term and to determine the economic performance of the various crop rotations that included several factors:

- reduced summerfallow use
- legumes in the rotation
- use of inorganic fertilizers
- use of manure/compost applications

One of the initial rotations was a wheat-legume plow-down rotation with the intention to replace fallow with a plow-down legume to reduce the need for nitrogen fertilizer. In 1996, the rotation was modified to have pea as the legume crop, but rather than terminate the crop at flowering, the crop was grown to maturity and harvested for grain. It was felt that this approach would be a more realistic agronomic and economic alternative.

The crop rotations in the study were continuous wheat, fallow-wheat, fallow-wheat-wheat, pea-wheat, fallow-flax-wheat and continuous grass, each with various nitrogen and phosphorus or manure treatments. An economic evaluation of all the rotations showed the pea-wheat rotation had the highest net annual income of the seven different crop rotations.

Figure 1 compares the yield of wheat in a continuous wheat rotation (without fertilizer and with nitrogen (N) and phosphate (P) fertilizer) to wheat yield grown on pea stubble without N fertilizer, from 1996 to 2007. The fertilized continuous wheat received 40 kg N/ha (36 lb N/ac) and 20 kg $P_2O_5$/ha (18 lb $P_2O_5$/ac). Wheat following pea received only 20 kg $P_2O_5$/ha (18 lb $P_2O_5$/ac) until 2003; since 2004, this treatment received 12 T/ha of composted manure once every four years.

From Figure 1, between 1996 and 2000, wheat yield after pea was similar to fertilized continuously cropped wheat. A severe drought in 2001 greatly reduced the continuously cropped wheat yields. Poor pea growth in 2001 resulted in reduced nitrogen fixation and depressed subsequent wheat yield the next year.

Pursuit residue from Odyssey herbicide application on pea from the previous year coupled with drought greatly restricted wheat yield in 2001; therefore, no yield data was collected. From 2003 to 2007, unfertilized wheat yield after pea out-yielded nitrogen and phosphate fertilized continuous wheat by an average of 36 per cent over 5 years.

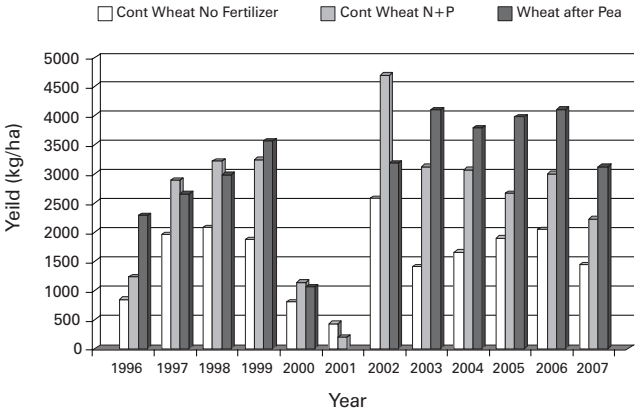


*Figure 1. Wheat yield in kg/ha from 1996 to 2007 when grown without fertilizer (continuous wheat – no fertilizer added), fertilized with N+P fertilizer (continuous wheat fertilized with N+P) and after pea fertilized with only P fertilizer until 2003; in 2004, received composted manure and no additional P fertilizer since 2003 (pea-wheat).*

# Advantages of the pea-wheat rotation

Having only pea and wheat crops in a rotation is not a true crop rotation. Ideally, having three or more crops in a rotation is best from a crop diversity standpoint and is preferred to help manage pest issues, particularly disease.

However, this short two-year rotation does offer a number of advantages in the drier regions of southern Alberta including:

- A pea crop will fix about 80 per cent of its nitrogen requirements. Generally, no additional N fertilizer is required with pea, however, pea seed must be inoculated with the proper rhizobium bacteria (Rhizobia leguminosarum) to ensure optimum N fixation.
- Residual nitrogen remains in the surface residue, roots and nodules of pea after harvest. As the pea residue degrades, N is released for subsequent crops. It is estimated that field pea contributes about 1.0 to 1.5 lb/ac of N for every bu/ac of pea grain produced. At the long-term crop rotation site at Bow Island, wheat was grown successfully without any additional commercial N fertilizer in the pea-wheat rotation (Figure 1).
- Pea is not very responsive to phosphate fertilizer and could be eliminated when soil test levels are greater than 30 kg P/ha.
- The need for phosphate fertilizer in the crop rotation can be eliminated if composted manure is applied at a sufficient rate once every four years.

- Using a pea-wheat rotation can help control some insect problems such as the wheat stem sawfly and foliar disease problems compared to when wheat is grown continuously.
- Using the pea-wheat rotation allows for the rotation of herbicide groups with different modes of action for weed control, reducing the potential for the development of herbicide-tolerant weeds.
- Pea is well adapted to no-till direct seeding. The elimination of tillage leads to conserved soil water, which results in increased grain yield and higher water use efficiency. Other benefits of no-till include the lower fluctuations in surface soil temperature, which favors increased nitrogen fixation.
- Generally, pea is shallower rooted and draws most its moisture from the top 60 cm of soil. When pea is seeded in early spring in southern Alberta, it is often harvested in early August. This practice leaves an extended period from early August to November to store precipitation for crop use the next year. As a result, there is often more stored soil moisture the following year after pea compared to after wheat for the next crop season.

## Concerns of the pea-wheat rotation

A major concern with the two-year pea-wheat rotation is the potential for increased disease pressure. To date, increased disease has not been an issue in the long-term dryland trials at Bow Island in southern Alberta.

Work conducted at Indian Head, Saskatchewan, in the Thin Black soil zone showed that in terms of plant establishment, plant numbers after 11 years without the use of seed treatments and by using no-till were similar among a wheat-wheat-pea, a wheat-pea and a continuous pea rotation, which suggested that root diseases may be less important than anticipated for field pea production on the Canadian prairies.

It is important to provide some break between successive pea crops to reduce potential disease pressure. In the drier regions of southern Alberta, a one-year break normally seems to be adequate.

## References


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**Prepared by**

Ross H. McKenzie Ph.D., P.Ag.
Agricultural Research Division
Alberta Agriculture and Rural Development
Lethbridge, Alberta T1J 4V6
Telephone: 403-381-5842

Rob Dunn P.Ag.
Agricultural Stewardship Division
Alberta Agriculture and Rural Development
Lethbridge, Alberta T1J 4V6
Telephone: 403-381-5904


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