Effect of Spring and Winter Rotation Crops on Subsequent Winter Wheat Productivity and Profitability in a Two-Year Crop Rotation in Northern Idaho

Jack Brown †, Eric Ireton, Jim B. Davis, and Ashley Job
University of Idaho, Moscow, Idaho
† Corresponding author: *jbrown@uidaho.edu*

Introduction

Cereal grains (mainly winter wheat, spring wheat and barley) occupy 80% of the dryland acreage in the Pacific Northwest (PNW), and there are few profitable alternative crop options to include in rotations. Alternative crops break disease cycles, help control weeds, and diversify production. The best alternative rotation crops with cereals are broadleaf species.

Canola has shown good adaptability to the PNW area and has the potential to be a profitable crop compared to wheat or barley. However, the effects of wheat-canola rotations need to be quantified to determine the impact, long-term sustainability, and profitability of this cropping system.

Material and Methods

Two multiple year field studies were grown to evaluate the effects of spring and winter rotation crops on the performance of subsequent winter wheat crops. The winter rotation study included winter canola, Austrian winter pea (AWP), winter wheat and fallow in the first year, while the spring rotation study included spring barley, canola, pea, and wheat in the first year. After year-1 harvest, soil samples were taken and analyzed for nutrient content and soil moisture. Water infiltration was determined two weeks after crop harvest. In fall following the year-1 crops, winter wheat was planted over both trial areas. At maturity, the wheat was harvested according to the previous year's crop.

Table 1. *Average yield of spring rotation crops, subsequent yield from growing winter wheat, and two-year gross return of growing each of the 4 crop rotations.*

Rotation Crop	Rotation Crop Year Yield	Winter Wheat Year Seed Yield	Two-Year Gross Return
	-kg ha^{-1}-	- kg ha^{-1} -	- $ ha^{-1} -
Spring wheat	4,598^{b}	4,779^{a}	1,799^{b}
Spring barley	5,070^{a}	4,173^{b}	1,576^{c}
Spring canola	2,259^{c}	4,442^{ab}	1,950^{a}
Spring pea	1,485^{d}	4,241^{ab}	1,228^{d}
Average	3,353	4,409	1,638

Based on commodity seed prices of $0.192 kg^{-1} for soft white wheat, $0.154 kg^{-1} for barley, $0.484 kg^{-1} for canola, and $0.286 kg^{-1} for pea.
Means assigned to different superscript letters are significantly different (P<0.05).

Results and Discussion

Spring Trial. Spring wheat and spring barley produced significantly higher seed yield compared to spring canola, and spring pea had the lowest spring crop yield (Table 1). Commodity crop prices at harvest resulted in the greatest spring crop gross returns from spring canola ($1,092 ha^{-1}), with lowest returns from pea. Winter wheat yield following spring wheat and spring canola were not significantly different, but was significantly higher than winter wheat following spring barley. The highest grower gross return over two years crop rotation was from spring canola-winter wheat, followed by spring wheat-winter wheat.

Winter Trial. Winter wheat yield was almost double than that obtained from winter canola in the winter rotation study (Table 2); however, commodity prices at harvest resulted in significantly higher gross returns from winter canola ($1,859 ha^{-1}) compared to winter wheat ($1,322 ha^{-1}). Winter wheat yield following AWP and winter canola was significantly higher than winter wheat following winter wheat or fallow. The highest two-year gross return from winter rotations was winter canola-winter wheat.

Canola proved to be an excellent rotation crop when planted before winter wheat. Rotation advantage of winter canola greater than spring canola. Including canola into cereal crop rotations improved water infiltration, most likely related to the different and more aggressive taproot system of canola crops.

Table 2. *Average yield of winter rotation crops, subsequent yield from growing winter wheat, and two-year gross return of growing each of the 4 crop rotations.*

Rotation Crop	Rotation Crop Year Yield	Winter Wheat Year Seed Yield	Two-Year Gross Return
	-kg ha^{-1}-	- kg ha^{-1} -	- $ ha^{-1} -
Winter wheat	6,888^{a}	5,587^{b}	2,397^{b}
Winter canola	3,846^{b}	6,731^{a}	3,153^{a}
AWP	868^{c}	7,068^{a}	1,589^{c}
Fallow	0^{c}	5,856^{b}	1,122^{c}
Average	3,867	6,327	2,066

Based on commodity seed prices of $0.192 kg^{-1} for soft white wheat, $0.484 kg^{-1} for canola, and $0.286 kg^{-1} for AWP.
Means assigned to different superscript letters are significantly different (P<0.05).