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Suitability of winter canola (Brassica napus) for enhancing summer annual crop rotations in Iowa

Mary H. Wiedenhoeft
Iowa State University, mwiedenh@iastate.edu

Rafael A. Martinez-Feria
Iowa State University, r.martinez.feria@gmail.com

Thomas C. Kaspar
Iowa State University, tom.kaspar@ars.usda.gov

Keri L. Jacobs
Iowa State University, kljacobs@iastate.edu

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Suitability of winter canola (Brassica napus) for enhancing summer annual crop rotations in Iowa

Abstract
What are the prospects for winter canola as an alternative crop for Iowa farmers? This project examined the economics and costs/benefits of adding canola as a third crop or a cover crop in rotations.

Keywords
Agronomy, Economics, Cover crops double crops strip cropping, Economic and environmental impacts, Farmer profitability enterprise budgets, Soils and agronomy, Water quality quantity and management

Disciplines
Agricultural Economics | Agronomy and Crop Sciences | Water Resource Management
Suitability of winter canola (*Brassica napus*) for enhancing summer annual crop rotations in Iowa II: Economic analysis

**Abstract:**
What are the economics and costs/benefits of adding canola as a third crop or a cover crop in crop rotations in Iowa?

Results from the economic analyses suggest that the proposed alternatives are expected to produce substantially lower net returns when compared with the conventional corn-soybean system. Growing winter canola/red clover in rotation with corn silage and corn grain may have a greater economic advantage than if grown in rotation with short relative maturity soybeans and corn grain. To be a competitive alternative to the conventional corn and soybean cropping systems, high winter canola yields are needed.

**Background**
This project is part of a larger effort to explore an alternative for diversifying the conventional summer annual cropping systems in Iowa. Work has centered on potential uses of winter canola, and the suitability for enhancing existing summer annual rotations. In an earlier project (E2013-16), the PIs assessed the agronomic feasibility of introducing winter canola into summer annual rotations by studying the effect of seeding date on its ability to successfully overwinter and provide adequate winter cover benefits, and established reliable seeding dates for this crop throughout the state. The information gained from this previous stage informs this study of the economic feasibility of growing winter canola in Iowa.

The two main objectives for this stage of the project are to:

- Assess the economic feasibility of integrating winter canola as a third crop into Iowa cropping systems assuming functioning marketing and distribution channels for canola seed in Iowa, and
- Estimate the cost of establishing a winter canola cover crop.

**Approach and methods**
The researchers studied the economic profiles of two proposed alternative Iowa rotations that include winter canola. (See Table 1.) The objective was to determine the productivity and market scenarios under which these systems could compete financially with a corn-soybean rotation. They used information gained through reviewing literature and their own field experiments to determine reasonable estimates of costs and productivity potential of the studied systems. Whole farm net return analysis was conducted based on farm budget information published by Iowa State University Extension and elsewhere. The team compared the expected returns from these proposed systems to a conventional corn-soybean rotation with and without cover crops, throughout a number of commodity prices and yield scenarios.
Table 1. Details of the rotations studied in the analysis

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>Corn</td>
<td>Soybean</td>
<td>Corn</td>
</tr>
<tr>
<td>Alternative A</td>
<td>SRM* Soybean</td>
<td>Winter canola frost-seeded with red clover</td>
<td>Corn</td>
</tr>
<tr>
<td>Alternative B</td>
<td>Corn silage</td>
<td>Winter canola frost-seeded with red clover</td>
<td>Corn</td>
</tr>
</tbody>
</table>

* SRM = Short relative maturity

Results and discussion

Results from the economic analyses suggest that the proposed alternatives are expected to produce substantially lower net returns when compared with the conventional corn-soybean system. This holds across varied yields and market conditions. Growing winter canola/red clover in rotation with corn silage and corn grain (alternative B) may have a greater economic advantage than if grown in rotation with short relative maturity (SRM) soybeans and corn grain (alternative A). Nonetheless, to be a competitive alternative to the baseline rotation (the conventional system), or even against other NO₃ reduction practices, including planting a cereal rye or winter canola cover crop, these systems require relatively high winter canola yields, perhaps to levels in which they would be comparable to those of full maturity soybeans. It is uncertain, however, whether consistently achieving these yield levels is agronomically feasible in Iowa, or if this would require increased amounts of inputs, which could change the economic profile of these systems. Therefore, research is needed to determine the yield potential of winter canola established after corn silage or SRM soybeans in Iowa, and the optimum requirements of N fertilization and other inputs.

Another question is whether the inclusion of red clover in these canola-based systems would decrease N fertilizer use and/or affect the yield of the subsequent corn crop, which is not characterized in this analysis. In the Midwest, full season, overwintered red clover may contain as much as 78 kg ha⁻¹ of N at termination in May, while at least half of this N is estimated to be available to the following crop. Field research in Iowa showed that a corn-soybean rotation extended with a year of small grains interseeded with red clover required up to 80 percent less synthetic N fertilizer inputs than a conventional rotation, although this research did not calculate the amount of the N provided by manure applications and N fixed by the legume. Yet, inclusion of legume cover crops can offer agronomic rotation benefits to the succeeding corn crop in terms of increased yield, which are suspected to be due to factors beyond those related to the N supplied by legumes. Moreover, the benefit of rotating perennial legumes may increase over time, with changes in soil organic C and soil N mineralization potential, which could render these proposed systems more profitable in the long run. Further research is needed to quantify the short- and long-term agronomic benefits of the inclusion of red clover in these rotation systems.

Additional work is needed to address the challenges posed by the lack of infrastructure and marketing avenues for Iowa-grown canola. The state of Iowa has only one canola-processing facility, and it has the capacity to custom process up to 36,200 Mg year⁻¹ of food-grade, organic, and non-genetically modified oilseeds. However, other venues for marketing Iowa-grown canola are limited; the closest major canola seed processors are...
in North Dakota, Oklahoma and northern Minnesota. Substantial losses due to transportation costs would occur in order to reach these markets. Also, because global canola seed prices are set by trades performed in Canadian currency ($CAN), this means that expected net returns of these systems are influenced by the $CAN/$US exchange rate. A strong U.S. dollar could render Iowa-grown canola less competitive in the international markets, perhaps to a greater extent than it would affect other commodities. In this analysis, the value of adopting these diversified systems is calculated without regard to the cost of the negative environmental externalities that the strategies are aiming to ameliorate.

If the reduction in nutrient emissions achieved by adopting these strategies were compensated, the positive value of adoption could be attained at lower canola seed yields, making the alternatives more competitive. These incentives could be integrated as part of soil and water conservation plans or other environmental quality incentive programming. Assigning a monetary value to the reduction of these environmental externalities to determine the amount of the incentive is a complex task, and is not within the scope of this analysis.

Conclusions

Findings from this economic analysis suggest that in general these rotation alternatives produce relatively lower net returns than the conventional corn-soybean rotation. It was shown that Iowa-grown winter canola would need to generate relatively high oilseed yields (about 1.5 to 2 times the national yield average) to produce net returns similar to more traditional crop counterparts. Moreover, because the price of canola oilseed is tied to other commodities, a large deviation from current market conditions would be needed to make these systems competitive without high-yielding winter canola.

Based on these results and findings from previous research, winter canola can provide some environmental and economic enhancements to summer annual crop rotations in Iowa, but the specific situations in which canola can fit these rotations are limited. More research is needed to fully understand the productivity potential of winter canola, before touting these crops as feasible alternatives for Iowa producers.

Impact of results

The most important finding from this study is that the inclusion of winter canola into summer annual rotations may be feasible only if higher winter canola yields are achieved. Reaching these yield levels will demand investments in research and technology to ensure that these productivity levels can be met. Alternatively, financial incentives approximately equal to the cost of adoption could be put in place to improve the competitiveness of these alternatives.

A next step could be the establishment of long-term cropping system studies at various sites across the state to provide evidence of the true productivity potential of these systems under Iowa conditions, as well as their ability for effectively mitigating P and NO\textsubscript{3} losses. This would help determine if the strategies proposed here could potentially mitigate some of the impacts of agriculture on water quality, while maintaining economic feasibility of Iowa cropping systems. The results of this project increased the information available about the use of winter canola as both a grain crop and as a cover crop. This will be useful for designing strategies that increase the diversity and resilience of cropping systems in Iowa.
**Education and outreach**

*Peer-reviewed publications*


*Presentations*


*Research reports*


Researchers met with some Iowa farmers interested in the use of alternative crops to diversify their rotations. Cultivating these relationships may aid in establishing a network of producers who would be interested in on-farm research at later stages of the project. They also have reached out to farmers and farmer organizations to share results with this crop. In September 2014, together with personnel from the USDA-ARS, the researchers hosted staff from Practical Farmers of Iowa to visit the field plots and discuss potential alternatives for using canola as cover crop or third crop in rotations.

They also partnered with the Midwest Cover Crop Council and attended their April 2014 meeting in Warsaw, Indiana. During this meeting the graduate student interacted with other researchers involved in the evaluation and implementation of strategies to include cover crops into rotations. In addition, two undergraduate assistants developed their own side research projects: one on the effect of canola on splash erosion and another on the effect of red clover on corn yield. Their results were presented at on-campus research symposia and through research reports.

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