Legume Crops to Improve Soil Fertility for Enhanced Canola and Barley Production

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Researchers with Agriculture and Agri-Food Canada conducted a large multi-location study from 2009 to 2011 to determine if growing a pulse crop to supplement nitrogen requirements of canola is economical and could reduce the amount of inorganic nitrogen required to optimize yield. The study results showed that growing field pea or lentil as cash crops prior to hybrid canola can improve canola and subsequent barley yield, and can provide a viable alternative to fertilizer nitrogen. Finally, growing canola on canola resulted in the lowest hybrid canola yield in 2010 and should be avoided.

The unpredictability of fertilizer costs has resulted in increased interest in alternatives to fertilizer nitrogen. For example, the cost of a tonne of urea increased 31 per cent between 2006 and 2008. Farmers are interested in options that would reduce fertilizer input costs while maintaining soil nutrient levels for optimum crop production. Pulse crops, with their ability to fix nitrogen, have the potential to reduce the requirement for fertilizer N in subsequent crops.

Researchers with Agriculture and Agri-Food Canada conducted a large multi-location study from 2009 to 2011 across western Canada. The objectives were to investigate the effects of growing legumes in rotation on hybrid canola and barley productivity, and to find out if growing a pulse to supplement nitrogen requirements of canola could reduce the amount of fertilizer nitrogen required to optimize yield. The study also evaluated the economic effects and net revenues (NR) associated with the different practices.

Experiments were established at seven locations (Beaverlodge, Lacombe and Lethbridge, AB; Scott, Indian Head and Swift Current, SK; and Brandon, MB) in 2009. Crops grown were field pea, lentil, faba bean, canola and wheat for seed, and faba bean as a green manure. The legumes received no fertilizer nitrogen (N), while canola and wheat were fertilized according to the soil test recommendation. In 2010, hybrid canola was seeded and nitrogen was applied at 0, 30, 60, 90 and 120 kg per ha. All crops were direct seeded using zero tillage seeders with knife openers. In 2011, malting barley was seeded and nitrogen was again applied at 0, 30, 60, 90 and 120 kg per ha. All crops were direct seeded using zero tillage seeders with knife openers.

The study results showed that growing field pea or lentil as cash crops prior to hybrid canola can improve canola and subsequent barley yield without having a major negative impact on canola oil or malting barley protein concentration. Growing faba bean for seed
was less likely to result in an increased canola or barley yield response. On the other hand, growing faba bean as a green manure resulted in the highest canola and barley yields.

Table 1. Effect of different preceding crops sown in 2009 on canola yield in 2010, barley yield in 2011, and 3-year average annual net return (2009-2011). Means reflect data averaged over 5 nitrogen rates and 7 locations in western Canada.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Pea</td>
<td>45</td>
<td>84</td>
<td>115</td>
</tr>
<tr>
<td>Lentil</td>
<td>45</td>
<td>85</td>
<td>118</td>
</tr>
<tr>
<td>Faba bean</td>
<td>41</td>
<td>83</td>
<td>103</td>
</tr>
<tr>
<td>Faba bean (green manure)</td>
<td>52</td>
<td>91</td>
<td>31*</td>
</tr>
<tr>
<td>Canola</td>
<td>37</td>
<td>83</td>
<td>80</td>
</tr>
<tr>
<td>Wheat</td>
<td>41</td>
<td>80</td>
<td>68</td>
</tr>
</tbody>
</table>

*The low return with the green manure reflects the lack of revenue from a crop in 2009.

Overall, the results of the agronomic study (O'Donovan et al. 2014) showed that growing legumes as cash crops in rotation with canola and barley can provide a viable alternative to fertilizer nitrogen. A key finding was that growing pea or lentil for seed prior to canola can result in a 25% reduction in fertilizer N required to achieve a target yield, and an average 10% increase in hybrid canola yield compared to the more common wheat-canola rotation. Barley yield averaged over locations increased by 6 and 7%, when field pea and lentil were the preceding crops, respectively. Finally, growing canola on canola resulted in the lowest hybrid canola yield and should be avoided. On average, yield decreased 9% with canola on canola, relative to when wheat was the preceding crop.

Results from the economic study (Khakbazan et al. 2014) indicated that over the entire three-year crop sequence, the legume preceding crops (lentil or field pea) grown for seed provided the greatest net returns. Although the faba bean as a green manure improved the yield of the following crops considerably, the increased canola and barley yields were not able to compensate for the lost revenue in the green manure crop year, resulting in a very low net return when averaged over the three years of the study. The practice may be more feasible in organic production systems or as a replacement for fallow.

Scientific Publications

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