N Credit From August Seeded Pea Cover Crops

(Thames Valley Regional Partner Grant Project)

Purpose:

Field peas is a potential cover crop which could be easily seeded following wheat harvest to fix nitrogen, sequester residual soil nitrogen, contribute organic matter and have a living crop present during the extended non-crop season following winter wheat harvest. Prior to the start of studies in 2003, there was no information on the impact that pea cover crops would have on fertilizer N requirements or yield of corn planted the next year. Some of the objectives of these trials were to determine if pea cover crops could significantly reduce fertilizer N requirements and/or increase yield of corn planted the next year. If successful, establishment of pea cover crops following wheat, as either an exclusive cover crop or as a patch for spotty red clover stands, could add substantially to the economic value of including wheat in the rotation.

Methods:

This report summarizes the results of 36 on-farm pea cover crop evaluations that were conducted across the province from 2003 to 2008. Many of the trials also evaluated pea cover crop response to manure applied just prior to seeding. Only data from plots where manure was not applied are included in this analysis.

Within one month following wheat harvest (August) pea cover crops were seeded into wheat stubble fields using cooperating farmer's drills. Each trial consisted of a minimum of two replicates along with "no cover" controls which, on many sites, contained some volunteer wheat. Shallow tillage prior to pea seeding did occur at some sites based on cooperator's drill requirements or manure incorporation needs. Cooperators treated the fields as per their normal practice in the fall. Some elected to leave the site untouched, while others performed standard fall tillage operations.

The following spring corn was planted into the field area using cooperator's normal practices with the exception of fertilizer N application. Cooperators were asked not to apply nitrogen except for starter nitrogen at a rate not to exceed 30 lbs/ac. At side dress time in June, the previous pea and "no cover" strips were divided into plots so that a zero and full rate (150 lb-N/ac) of nitrogen could be applied as a side dress application.

Maximum Economic Rate of Nitrogen (MERN) was estimated based on the size of yield difference between the two N rate strips. Economic assumptions were based on corn price of $196/Mg ($5.00/bu), Nitrogen fertilizer price of $1.76/kg-N ($0.80/lb-N) and a pea cover crop seeding cost of $75.00/ha ($30.36/ac).

Results:

This article focuses on the benefits of pea cover crops, seeded following wheat harvest, to the next year's corn crop where manure is not applied.

<u>Pea Establishment and Growth</u>

Pea cover crop establishment was variable with some sites having spotty thin stands while other sites had excellent stands. The summer and fall of 2006 was unusually wet and, as a result, pea stands were especially spotty and thin on many sites in the fall of 2006. The results presented in Table 1 include the 2007 corn yield response following

the 2006 pea cover crops. Analyses were also conducted that eliminated the 2006/2007 data and the results are included in the text of the results section.

By the end of the growing season (November), pea cover crops produced, on average, 2100 lb/ac of above-ground biomass across all sites with above-ground biomass N content averaging 67 lb-N/ac. Pea cover crop yields averaged 2400 lb/ac with N contents of 75 lb-N/ac when the 2006/2007 sites were not included in the average. At about 10% of the sites, the N content of the above-ground biomass exceeded 100 lb-N/ac (maximum observed was 175 lb-N/ac) with biomass yields at these sites ranging between 3600 to 5600 lb/ac. At about 20% of sites, end-of-season pea biomass was less than 1000 lb/ac with N content that was less than 30 lb-N/ac

Corn Response

When fertilizer N was applied, on average, pea cover crops had no effect on corn yield (Table 1). The same corn yield response to pea cover crops was still observed when the 2007 data was not included. Therefore, on average, corn yields are not increased by seeding pea cover crops following wheat when sufficient fertilizer N is applied to ensure that N availability is not limiting.

Overall, pea cover crops increased corn yields by 6 bu/ac when N fertilizer was not applied (Table 1). When the 2007 corn yields were not included, the corn yield response when fertilizer N was not applied averaged 13 bu/ac. Clearly, successful establishment of pea cover crops did increase N availability to the next corn crop.

Across all 37 sites, pea cover crops reduced corn yield response to fertilizer N (delta yield) by 6 bu/ac and estimated Maximum Economic Rate of Nitrogen (MERN) by 14 lb-N/ac (Table 1). Not including the 2007 data effectively doubled the reductions in delta yield and MERN associated with pea cover crops. This study suggests that average pea N credits are about 25 lb-N/ac. Only at two of 36 (6%) sites were calculated credits in the 70 to 80 lb-N/ac range; N credits that were similar to those suggested for good red clover stands.

Establishment of pea cover crops reduced net profits for corn across all 36 sites by $33/ac. Even when 2007 data was not included, pea cover crops reduced net profit by $26/bu. Pea cover crops did not increase corn yields (Table 1), therefore, recovery of the $75/ha ($33/ac) seeding costs can only be obtained through savings in fertilizer N application. Assuming fertilizer N cost of $0.80/lb-N, a pea N credit of 40 lb-N/ac is necessary to cover the $33/ac seeding costs. Only at seven of 36 (20%) of sites were estimated credits in excess of 40 lb-N/ac, and only at two of 36 sites (6%) did the pea N credit exceed 50 lb-N/ac.

Summary:

The combination of not providing consistent and substantial increases in either corn yield or N credits suggest that it is unlikely that seeding a pea cover crop following wheat harvest will increase short-term profitability of wheat-corn rotation sequences. It should be acknowledged that there are other inherent benefits to cover crops including erosion control, weed suppression, soil health, etc., but these are difficult parameters to assign an economic value too.

Table 1: Pea cover crop impact on corn yield and estimated maximum economic rate of nitrogen (MERN). There was an average of 36 sites conducted across corn producing regions of Ontario from 2003-2008.

Peas	Yield (bu/ac)			MERN (lb-N/ac)
	No-N	Full-N	Response	
No	134	175	41	87
Yes	140	175	35	73
LSD 5%	5.6		ns	8.7

LSD refers to the least significant difference required between values to ensure that there is a less than 5% chance that the difference occurred randomly. An 'ns' indicates that differences between means are not significant at the 5% level.

Next Steps:

These results were disappointing relative to our expectation. This study suggests that further extension efforts with regard to pea cover crops should emphasize that:

1. At least for the short-term, pea cover crops probably will not increase corn yield potential;
2. The chance that pea cover crops seeded after wheat harvest will provide a N credit for corn that exceeds 40 lb-N/ac is 20% and in excess of 70 lb-N/ac is 5%;
3. Peas may be an appropriate cover crop for fields with low N availability because of their ability to fix their own N. However, spring cereal cover crops are probably a better choice for fields which are not N limited due to cheaper seeding costs and more consistent establishment when compared to peas;
4. There is a possibility that long-term use of pea cover crops may improve soil conditions resulting in increased corn yields and/or N availability over the long-term. At present, we do not have evidence supporting, or discounting, the benefits that long-term use of pea cover crops have on corn production.

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