Intercropping Legume and Non-legume Annual Crops for Agronomic and Economic Considerations

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Introduction

- Intercropping refers to growing more than one crop in the same field at the same time, usually a mix of non-legume and legume crops.
- Intercropping can have many benefits, such as: reduced input costs by lowering fertilizer and pesticide requirements; stability of crop production/economic returns due to diversity; convenience in harvesting/harvestability of crop, especially pea; and efficient use of resources (e.g., nutrients – N fixation from legumes, water, light).
- Also can lead to extra yield [called out-yielding (i.e., when yield produced by an intercrop is greater than yield produced by component crops grown in monoculture on same total land area)].

Objective

To determine the effects of intercropping annual non-legume (oilseeds or cereals) and legume (pea) crops on yield, produce quality, economic returns and nutrient uptake.

Materials and Methods

- Two field experiments were established in 2009 on a Gray Luvisol (Boralf) at Star City, Saskatchewan. Experiment 1 with canola-pea intercrop; and Experiment 2 with barley-pea intercrop

Treatments for Experiments 1 and 2:

1. Canola or Barley Sole Crop, 0 kg N ha^{-1}
2. Canola or Barley Sole Crop, 40 kg N ha^{-1}
3. Canola or Barley Sole Crop, 80 kg N ha^{-1}
4. Pea Sole Crop, 0 kg N ha^{-1}
5. Canola or Barley-Pea in Alternate Rows, 0 kg N ha^{-1}
6. Canola or Barley-Pea in Alternate Rows, 20 kg N ha^{-1} to only Canola
7. Canola or Barley-Pea in Alternate Rows, 40 kg N ha^{-1} to only Canola
8. Canola or Barley-Pea in Same Row, 0 kg N ha^{-1}
9. Canola or Barley-Pea in Same Row, 20 kg N ha^{-1}
10. Canola or Barley-Pea in Same Row, 40 kg N ha^{-1}

- All plots received blanket applications of P, K and S fertilizers and herbicides to control annual weeds.

- At maturity, the crop was harvested with a combine for seed yield. Plant samples were also harvested for biomass and straw yield. Seed and straw samples were analysed for total N concentration to calculate N uptake.

Summary

Canola + Pea

- In 2010, seed yield trends were generally similar to 2009, although seed yields were lower due to poor weather conditions. Seed yield of intercrop was higher than that of sole crops and LER values were greater than 1, suggesting the superiority of intercropping over sole cropping for land productivity.

Barley + Pea

- In 2010, seed yield of barley as a sole crop increased considerably with applied N. In intercropping, seed yield of barley also increased with N rate in both alternate rows and same row combinations, while seed yield of pea decreased with N rate. The LER values ranged from 1.30 to 1.85 in alternate rows, and from 1.43 to 2.04 when both crops seeded in same row, again suggesting intercropping more efficient than sole crops for land productivity.

Conclusions

- Compared to canola and pea as sole crops, seed yields improved with canola-pea intercropping and more so when these crops were grown in the same row.
- Application of N fertilizer decreased seed yield in both canola-pea intercrop systems, but more so when crops were seeded in the same row.
- Compared to barley and pea as sole crops, seed yields improved with barley-pea intercropping and more so when these crops were grown in the same row.
- In barley-pea intercropping, application of N fertilizer increased total seed yield when the crops were seeded in alternate rows.
- These findings are based on two-year data, and long-term and multi-site yield and nutrient uptake results are suggested for making valid conclusions under different soil-climatic conditions.

Acknowledgements

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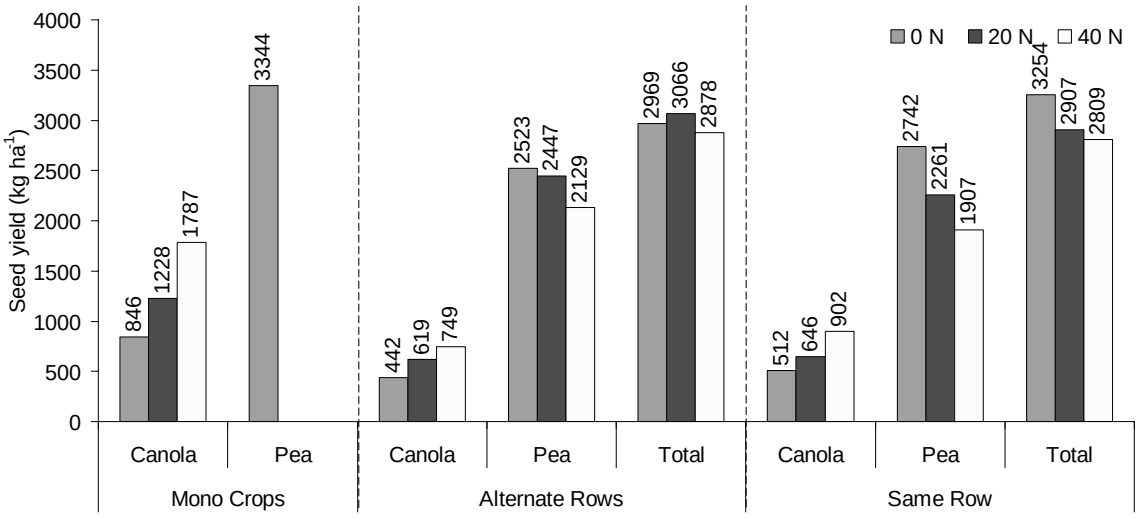

Figure 1. Seed yield of canola and pea grown as sole crops compared to various combinations of canola and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2009.

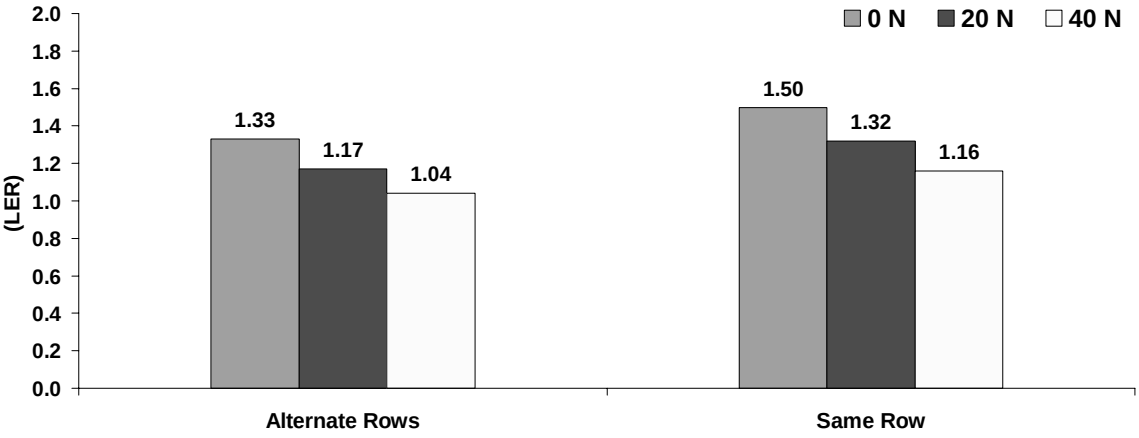

Figure 2. Land Equivalency Ratio (LER) for canola and pea grown as sole crops compared to various combinations of canola and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2009.

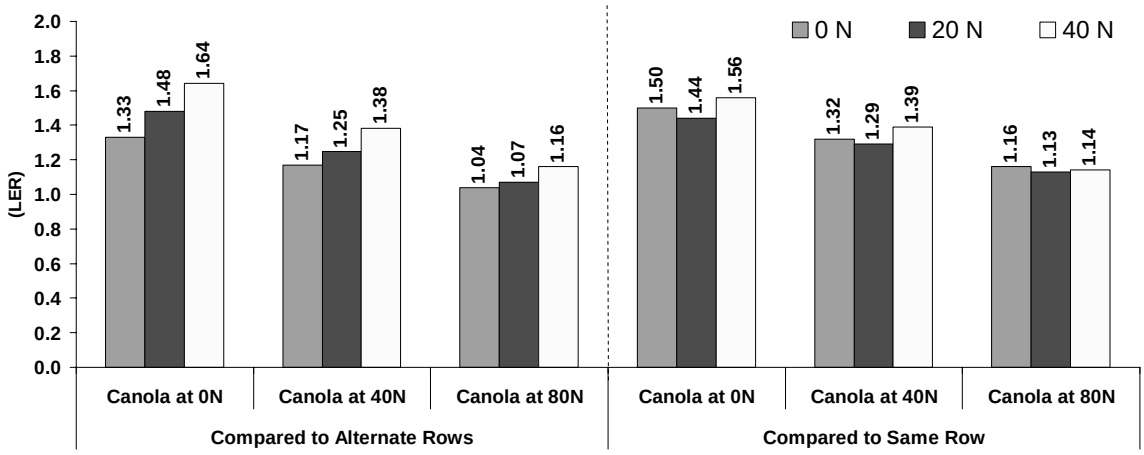

Figure 3. Land Equivalency Ratio (LER) for canola with or without applied N and pea without applied N grown as sole crops compared to various combinations of canola and pea intercrop treatments with or without applied N at Star City, Saskatchewan in 2009.

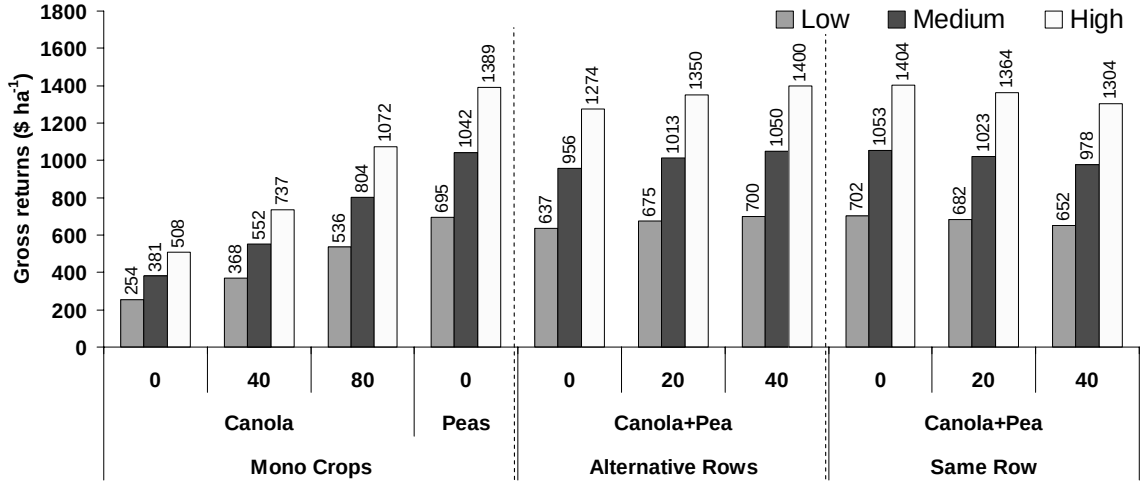

Figure 4. Gross economic returns for canola and pea grown as sole crops, and in various combinations as intercrop in alternate rows and in same row at low ($300 Mg^{-1} for canola and $200 ha^{-1} for pea), medium ($450 Mg^{-1} for canola and $300 ha^{-1} for pea) and high ($600 Mg^{-1} for canola and $400 ha^{-1} for pea) prices at Star City, Saskatchewan in 2009.

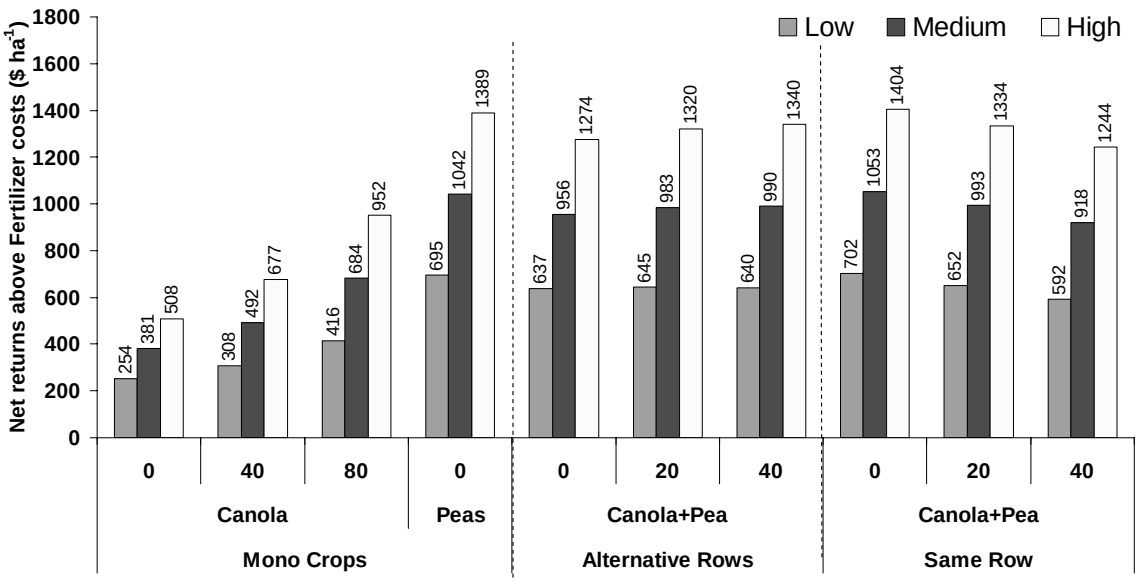

Figure 5. Net economic returns for canola and pea grown as sole crops, and in various combinations as intercrop in alternate rows and in same row at low ($300 Mg^{-1} for canola and $200 ha^{-1} for pea), medium ($450 Mg^{-1} for canola and $300 ha^{-1} for pea) and high ($600 Mg^{-1} for canola and $400 ha^{-1} for pea) prices at Star City, Saskatchewan in 2009.

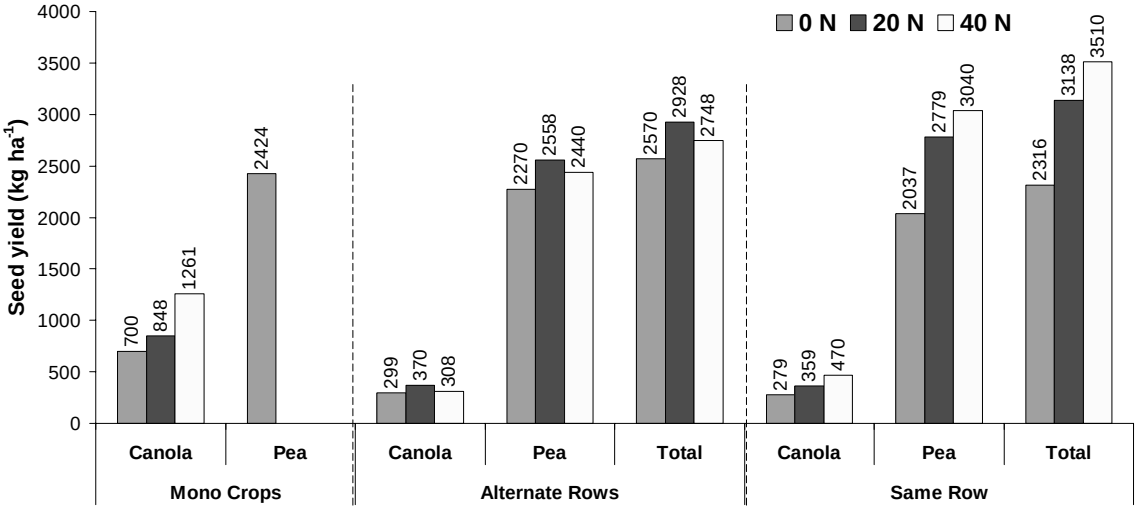

Figure 6. Seed yield of canola and pea grown as sole crops compared to various combinations of canola and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2010.

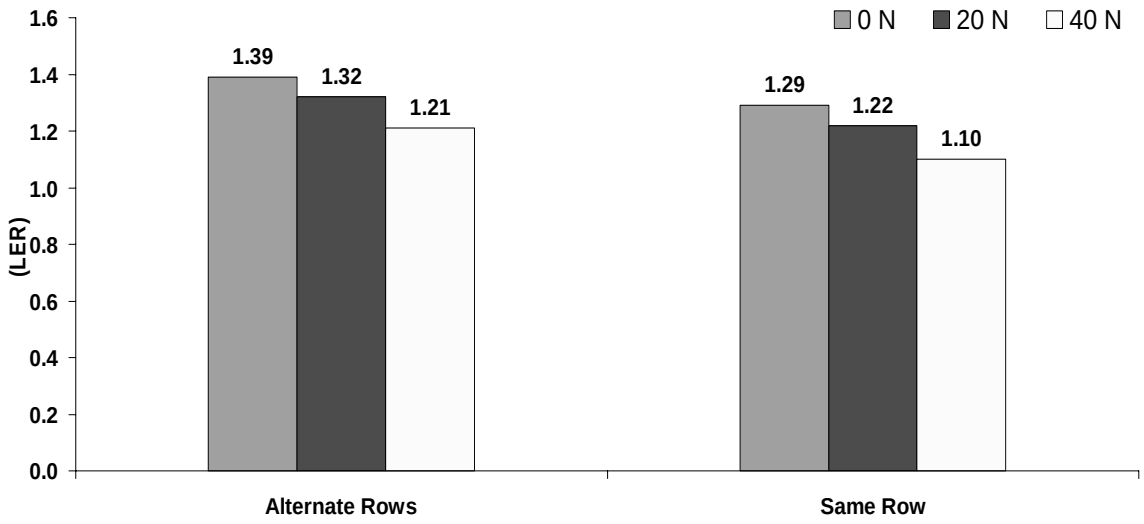

Figure 7. Land Equivalency Ratio (LER) for canola and pea grown as sole crops compared to various combinations of canola and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2010.

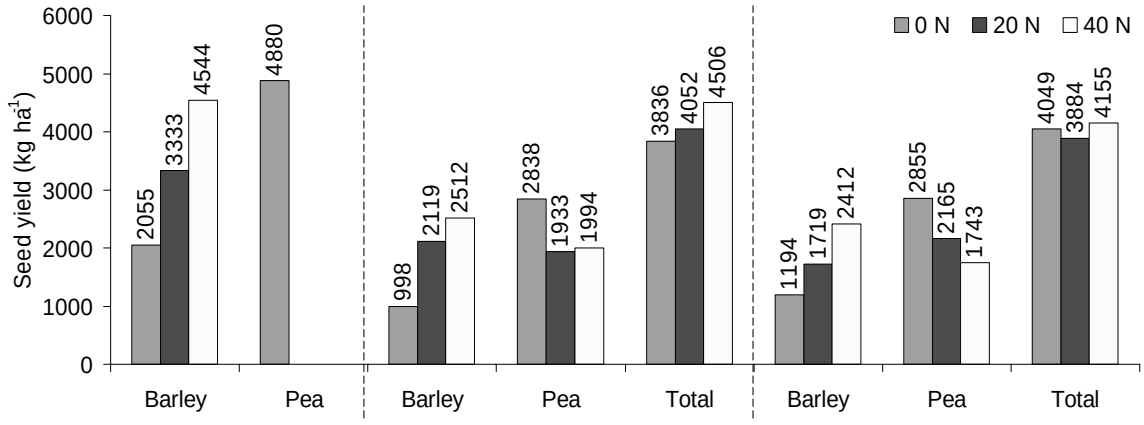

Figure 8. Seed yield of barley and pea grown as sole crops compared to various combinations of barley and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2009.

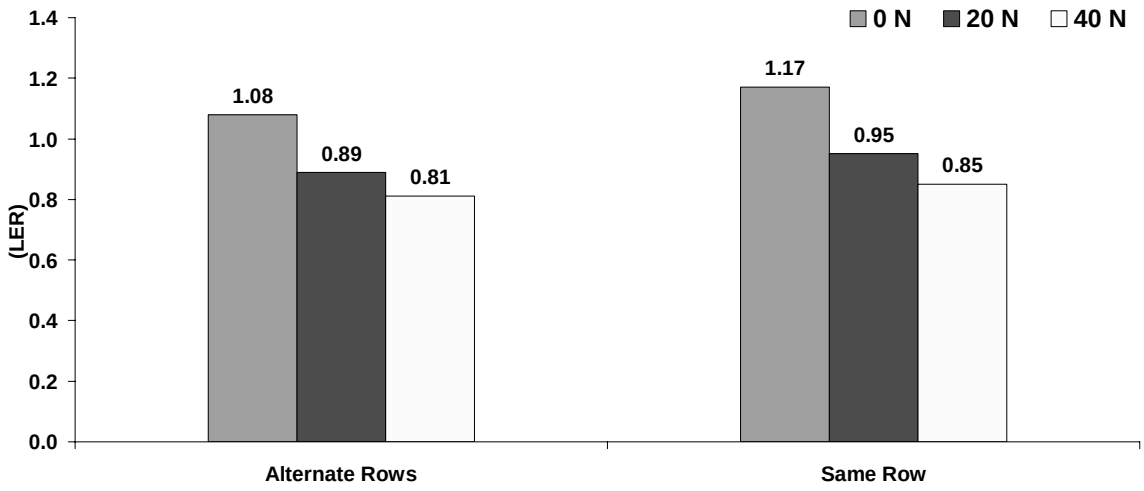

Figure 9. Land Equivalency Ratio (LER) for barley and pea grown as sole crops compared to various combinations of barley and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2009.

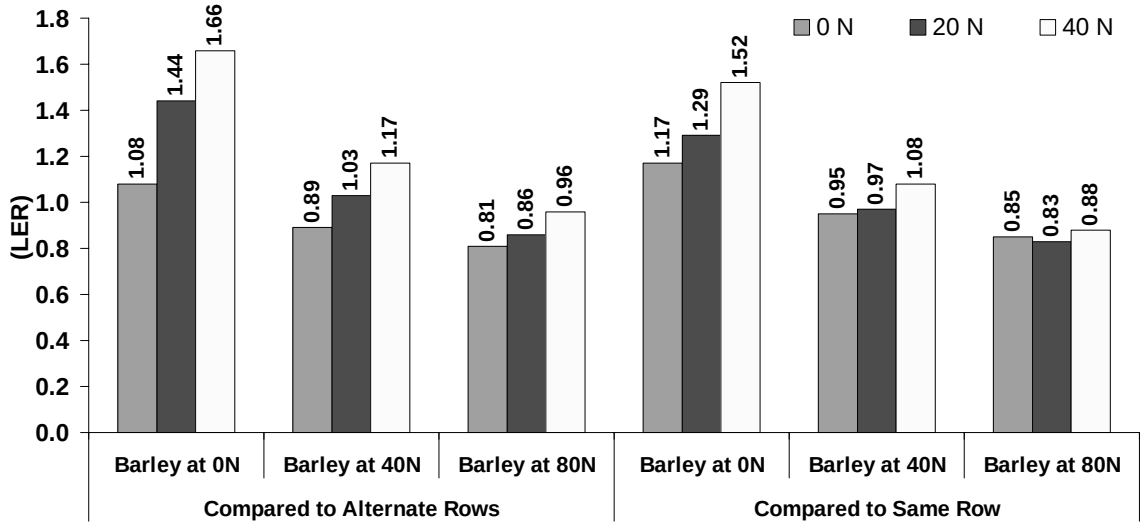

Figure 10. Land Equivalency Ratio (LER) for barley with or without applied N and pea without applied N grown as sole crops compared to various combinations of barley and pea intercrop treatments with or without applied N at Star City, Saskatchewan in 2009.

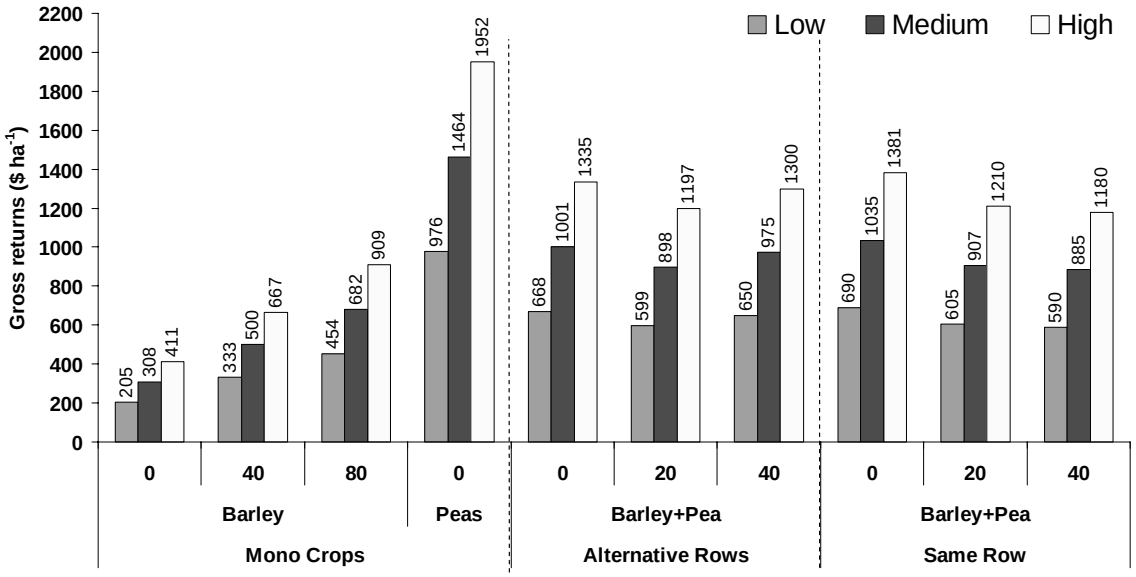

Figure 11. Gross economic returns for barley and pea grown as sole crops, and in various combinations as intercrop in alternate rows and in same row at low ($100 Mg^{-1} for barley and $200 ha^{-1} for pea), medium ($150 Mg^{-1} for barley and $300 ha^{-1} for pea) and high ($200 Mg^{-1} for barley and $400 ha^{-1} for pea) prices at Star City, Saskatchewan in 2009.

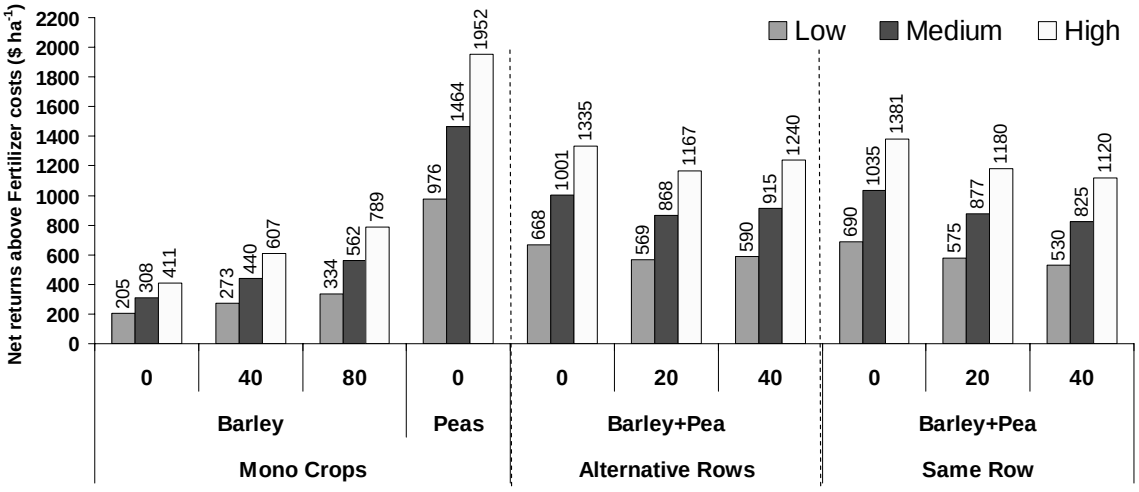

Figure 12. Net economic returns for barley and pea grown as sole crops, and in various combinations as intercrop in alternate rows and in same row at low ($100 Mg^{-1} for barley and $200 ha^{-1} for pea), medium ($150 Mg^{-1} for barley and $300 ha^{-1} for pea) and high ($200 Mg^{-1} for barley and $400 ha^{-1} for pea) prices at Star City, Saskatchewan in 2009.

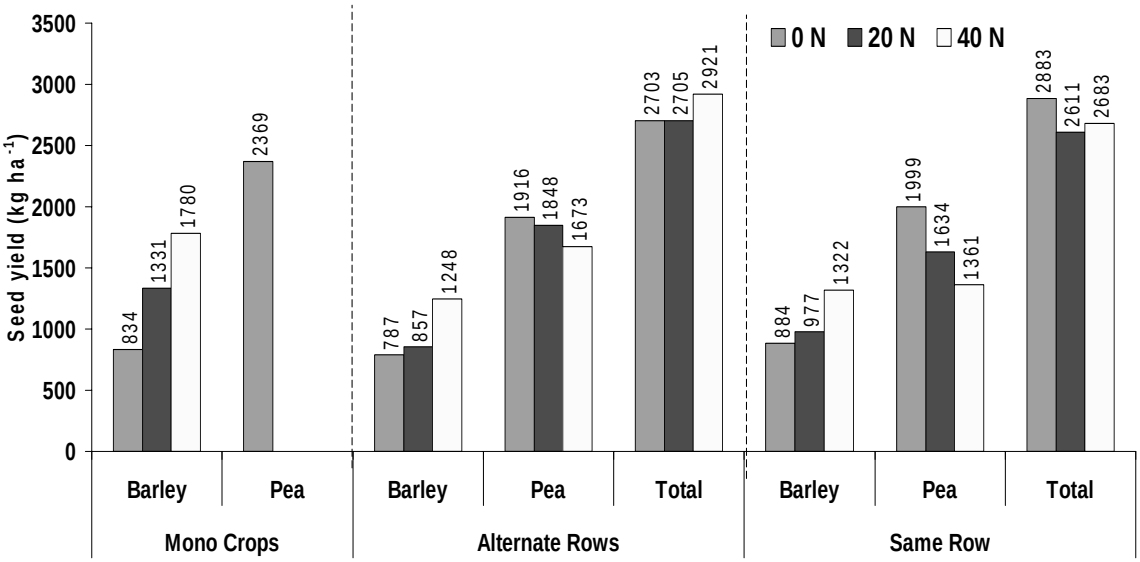

Figure 13. Seed yield of barley and pea grown as sole crops compared to various combinations of barley and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2010.

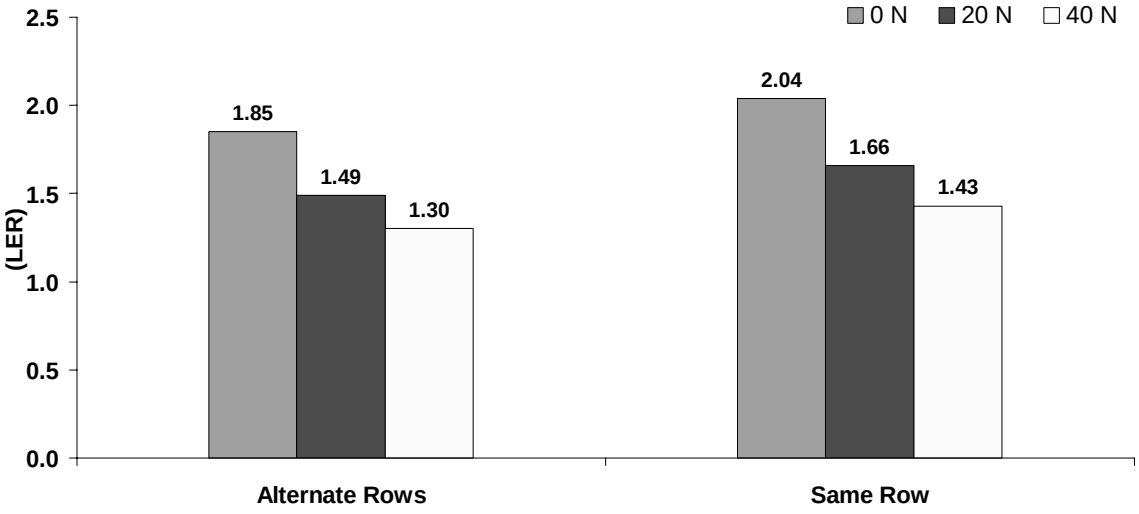

Figure 14. Land Equivalency Ratio (LER) for barley and pea grown as sole crops compared to various combinations of canola and pea intercrop treatments for similar N rates at Star City, Saskatchewan in 2010.