Economics of Preceding Crops and Nitrogen Application Rates for Canola and Barley Production in Western Canada

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Abstract

The objective of this study was to evaluate the economic effects of a range of legume and non-legume preceding crops and N rates on costs and net revenue (NR) of canola (*Brassica napus* L.), barley (*Hordeum vulgare* L.) and canola-barley rotation under various environmental conditions. Legumes such as field pea (*Pisum sativum* L.) and lentil (*Lens culinaris* Medik.) as preceding crop generated higher net revenues for the following crops canola and barley than when wheat (*Triticum aestivum* L.) and canola were the preceding crops. Although faba bean (*Vicia faba* L.) grown as a green manure produced the highest annual net revenues for the following crops canola and barley, this contribution was not enough to compensate for the loss of income during the green manure production year. Therefore, growing faba bean as a green manure was not economical. Response of net revenue to N rates was mainly linear or quadratic, and N was optimal at 60 to 90 kg ha^{-1} at most sites. The results indicate that growing legumes for seed prior to canola can increase net revenues of canola and subsequent barley.

Introduction

The high cost of fertilizer in western Canada has generated interest in alternative sources of nitrogen (N). Roots of legume, by fixing symbiotic N_2, may increase soil residual and mineralizable N, thus reducing the need for fertilizer N in subsequent crops. The objective of this study was to evaluate the combined economic effects of a range of preceding crops and multiple N fertilizer rates on costs and net revenue (NR) of the subsequent crop canola (C), barley (B), canola-barley (C-B) and preceding crop-canola-barley (P-C-B) under various agroecosystems environmental conditions.

Materials and Methods

Field experiments were conducted in 2009 through 2011 at Beaverlodge (lat. 119.48 W, long. 55.28 N), Lacombe (lat. 113.78 W, long. 52.58 N) and Lethbridge (lat. 112.88 W, long. 49.78 N) located in Alberta, Indian Head (lat. 103.78 W, long. 50.58 N), Scott (lat. 528.21 W, long. 108. 51 N) and Swift Current (lat. 107.78 W, long. 50.38 N) in Saskatchewan, and Brandon (lat. 99.98 W, long. 50.08 N) in Manitoba. These locations covered a wide range of soil types and spanned a distance of 1600 km from east to west agroecosystems to provide a wide range of soils to fully evaluate the nutrient management systems being studied. Preceding crops grown in 2009 included field pea (CDC Golden) grown for seed, lentil (CDC Imperial) grown for seed, faba bean (Snowbird) grown for seed, faba bean (Snowbird) grown as a green manure, imidazolinone-resistant canola (45H73) grown for seed, wheat (CDC Imagine) grown for seed, followed by canola sown in 2010 and barley sown in 2011. Applied fertilizer rates were 0, 30, 60, 90 and 120 kg ha^{-1} of N fertilizer (46-0-0).

The NR was estimated as the income remaining after paying for all cash costs, ownership costs on machinery and buildings, and labour. Statistical analysis was conducted using PROC Mixed of SAS software. The analysis was done by site and by preceding crop types. Polynomial analysis to the quadratic level was performed for response of NR to applied N rates at a given preceding crop type for all locations.

Results

The NR of C, B, C-B or P-C-B rotation was significantly influenced by preceding crops. When preceding crop was used as green manure (GM), the average annual NRs of C, B and C-B were highest but this positive contribution was not enough to compensate for the loss of income during the GM production year. When three years of production including preceding crop year were considered, legume crops such as lentils or peas grown for seed as preceding crops provided better returns than preceding wheat or canola. The effects of preceding crops on NR diminished over time. On average, the optimal economic N rate was achieved at 60 to 90 kg ha^{-1} in quadratic form, while the response of NR to N application in linear form depends on potential available soil N. Overall, the combination of legumes grown for seed as preceding crops and N fertilizer rate of 60 to 90 kg ha^{-1} is recommended to optimize NR.

Conclusions

When the preceding crop was faba bean GM, the average annual NRs of C, B and C-B were the highest. However, this positive contribution was not enough to compensate for the loss of income during the GM production year. Thus the NR of P-C-B was lowest for the GM. Annual NRs of C, B, C-B and P-C-B were usually higher when the preceding crop was lentils or peas grown for seed compared with wheat or canola. Over the three-year crop rotation, pea and lentil grown for seed as preceding crops performed generally better than wheat and canola as preceding crops. Growing faba bean as a GM was not economical due to loss of crop revenue in the faba bean GM year. Response of NR to N was mainly linear or quadratic, and N was optimal at 60 to 90 kg ha^{-1} at most sites.

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