A NUTRIENT BALANCE APPROACH TO GROWING CANOLA IN EASTERN CANADA

AN ECODA FACT SHEET

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Nitrogen Use in Eastern Canadian Canola

The climatic conditions in eastern Canada present challenges to develop fertilizer guidelines for canola. Although N fertilizers are essential to increase canola yields by promoting vigorous growth and development, the N fertilizer use efficiency is highly variable under our moist temperate conditions. N fertilizer is vulnerable to loss during the growing season by volatilization, denitrification, surface runoff, and leaching such that N availability may limit canola growth and yields. Applying N fertilizer in excess of canola requirements increases production costs, induces lodging, reduces seed yield and quality, and increases N losses. Expansion of canola production in eastern Canada is highly dependent on the development of regional or site-specific guidelines for environmentally-sound N management that focuses on improving N fertilizer use efficiency.

The best way to improve N fertilizer use efficiency of canola is to adopt a nutrient balance approach, which considers the interactions among nutrients that occur in soils and plants.

Summary:

Western Canadian recommendations on fertilizer management for canola do not provide profitable results under eastern Canadian climate and soil conditions. This research used a nutrient balance approach in field trials across the region (NS, NB, QC, ON) to assess the individual and interactive effects of nitrogen, sulphur and boron with the overall goal of providing better regional guidelines for fertilizer application to canola. In general, under sufficient moisture both nitrogen and sulphur improved seed yields and the application of S improved the efficiency of nitrogen use, especially at higher yield levels. Boron fertilization mainly increased tissue B concentration but had minimal effect on seed yields. Our research illustrates the large variation in environment and soil conditions which result in corresponding large variation in canola yield response to fertilizer inputs. We conclude that N x S fertilizer recommendations for canola production need to be developed on a site-specific basis in eastern Canada. To assist in that calculation, this research identified critical tissue N, S, and B values which can be used in the future to validate fertilizer requirements for canola production in Eastern Canada.

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Research Objectives:

1) identify nutrient sufficiency levels by evaluating plant and soil levels of N, S and B in canola as affected by cultivar, environment, and management.
2) quantify any interactions which might improve nutrient use efficiency (NUE) and canola crop productivity.
3) develop improved guidelines for canola site-specific nutrient management.

IN FIELD STUDIES:

Field experiments were conducted for four years (2013-2016) to determine the response of canola (*Brassica napus*) to nitrogen (N), sulphur (S) and boron (B) fertilizers at locations across Eastern Canada. Urea (46-0-0) was the N source and ammonium sulphate (21-0-0 with 24% S) was the S source. Depending on the site, either Alpine Boron (10% B), Solubor (20.9% B) or Granubor (10% B) was the B source. The planting dates, planting rates, size of plots and herbicide treatment varied as per farm conditions.

Experiment 1 - Canola Nitrogen Fertility Experiment.

Experiment 1 tested the responses of two canola hybrids to preplant and sidedress N fertilizer at a total of 8 treatments (0, 50, 100, 150, 200, 50+50, 50+100 and 50+150 kg N ha^{-1}).

Results

1) Canola yields increased by both pre-plant and sidedress N application in 80% of trial sites.
2) Plots that received additional sidedress N (50+50, 50+100, 50+150 kg N ha^{-1}) frequently produced greater yields than the plots that received the same amounts of total N, but all applied at preplant.
3) The most economic rate of nitrogen (MERN) for eastern Canada is estimated, on average, at 188 kg N ha^{-1}. When N fertilizer is applied at the MERN value, the achievable yield was 3.27 t ha^{-1} for preplant and 3.40 t ha^{-1} for sidedress application. Although the overall MERN values did not differ much between N application methods, sidedressing could potentially increase crop yields on a site-specific basis.
4) Increasing N from 0 to 200 kg N ha^{-1}, either as preplant or sidedress increased seed protein concentration by an average of 3.7%, but decreased oil concentration by 3.1%.

Experiment 2 - Canola Sulphur Fertility Experiment.

Experiment 2 was conducted to determine the optimum rate of sulphur (S) required for growing canola in Eastern Canada. This study tested the responses of a canola hybrid to 4 levels of S (0, 10, 20, and 40 kg S ha^{-1}) at 3 levels of N fertilizer (0, 75 and 150 kg N ha^{-1}).

Results

1) The application of sulphur (S) increased seed yields at all trial sites and years. In most cases the highest yields were in plots that received 40 kg S ha^{-1}, while the 0 S plots always had the lowest yields. The effects of S application on yield seem to be site-specific. Therefore, examining soil S availability and S mineralization potential are required for site-specific S recommendations.
2) At most of the sites, the addition of S did not affect seed oil, protein, or Thousand Seed Weight (TSW).

3) The maximum economic rate of S is estimated, on average, at 29 kg ha^{-1}, but this varied largely among sites. For profitably canola production, it is recommended to apply 20-40 kg ha^{-1} of S fertilizer.

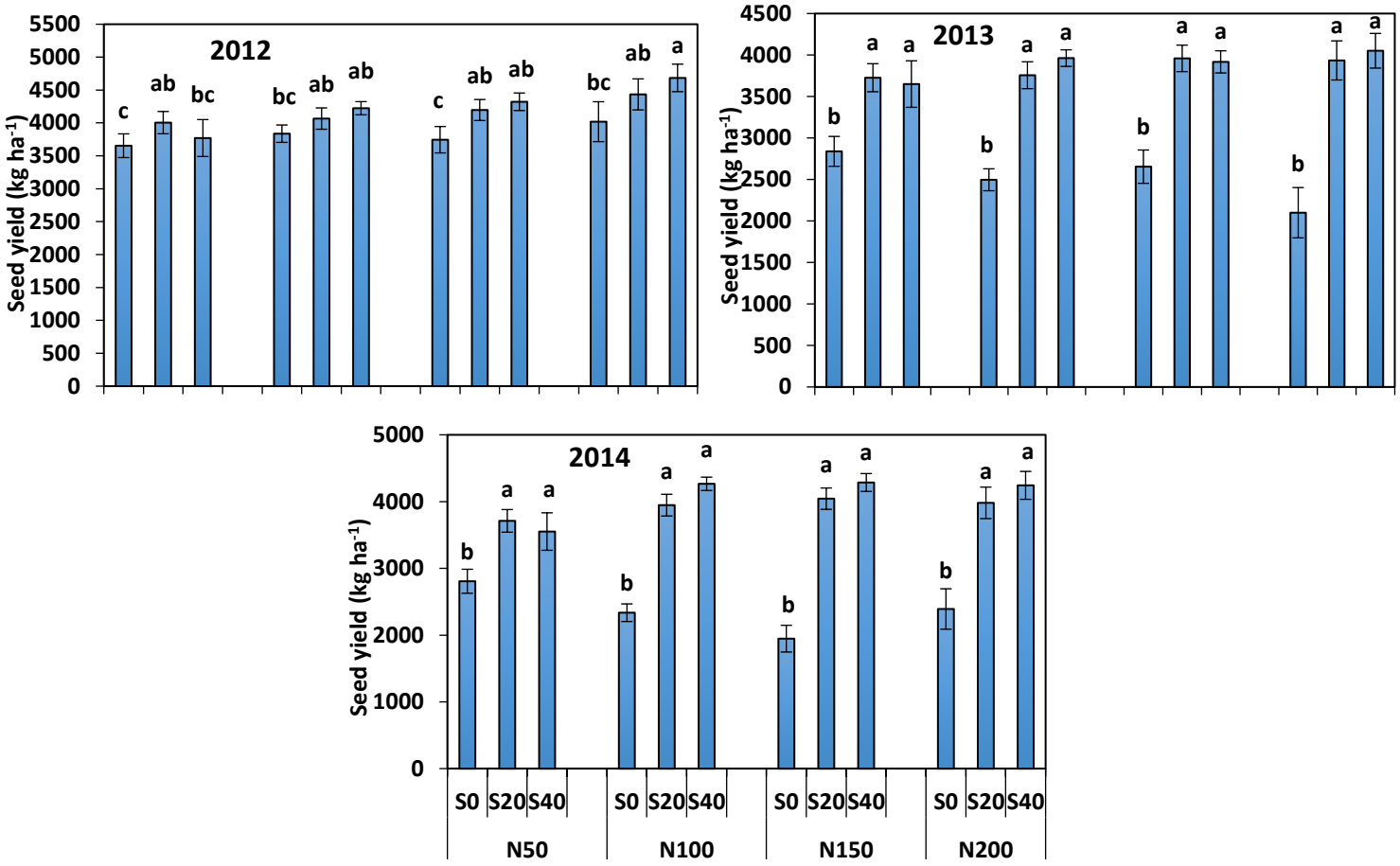

Fig. 1 Responses of canola seed yields to different levels (kg ha^{-1}) of N (50, 100, 150 and 200) and S (0, 20 and 40) at Normandin, Quebec, from 2012 to 2014. Error bars represent ± standard error; Bars with the same letters within a year are not significantly different at *P = 0.05* by the Student's T-test

Experiment 3 - Canola Boron Fertility Experiment.

Like Experiment 1, Experiment 3 focused on the responses of two canola hybrids nutrient application, this time to boron (B). The two hybrids were treated with 3 levels of B (0, soil applied at 2 kg B ha^{-1} and foliar applied B at 500 g ha^{-1} at the early flower stage).

Results

1) At all trial sites, B application as either preplant or foliar spray did not significantly affect yields. There was also no effect of B on seed oil or protein. This lack of difference in yields probably indicates that the test fields were sufficient in B.

On average, canola reached an optimum yield when plants contained 197 kg N ha^{-1}, 33 kg S ha^{-1} and 200 g B ha^{-1}, with a seed B content of 60 g B ha^{-1}. The critical N, S, and B values identified in this work should be useful to validate fertilizer requirements for canola production in eastern Canada.

TAKE AWAYS

- ✓ Canola responds positively in eastern Canada to both nitrogen and sulphur applications and there is a positive interaction between the two nutrients.
- ✓ In this experiment, there was no economic return from the application of boron.
- ✓ Specific rates of nitrogen and sulphur will need to be determined on a site basis.
- ✓ The critical levels of nutrients determined in this research opens the door for tissue testing approach to optimizing nutrient application.