Adaptation of Oilseed Crops in Saskatchewan

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Introduction

Canola quality *Brassica juncea* L. (*juncea* canola), and hybrid, oilseed sunflowers (*Helianthus annus* L.) have potential for greatly increased production in western Canada. *Juncea* canola is a recently developed crop with seed quality similar to cultivars of *Brassica napus* L. and *Brassica rapa* L. with canola quality (Woods et al., 1991. and hybrid oilseed sunflowers have largely replaced open-pollinated oilseed sunflowers. (Beckie and Brandt, 1996). The economics of production, which includes the nitrogen (N) response of flax (*Linum ustitatissimum* L.) and *Brassica napus* (*napus* canola) in western Canada have been relatively well researched (Nuttall and Mahli, 1991; Mahli et al., 2007); However, much less is known about the N response of *juncea* canola and hybrid, oilseed sunflowers. If producers are to grow these two oilseed crops they need information on their adaptation and response to N. Currently there is very limited information comparing the economics of *juncea* canola, and hybrid oilseed sunflowers to established oilseed crops, canola and flax, in the soil-climatic zones of Saskatchewan using current production practices.

The introduction of *juncea* canola has created the potential to increase the production of oilseed crops in the drier areas of Saskatchewan. Due to its and resistance to shattering, it may have advantages over *napus* canola in wetter areas of Saskatchewan. Oilseed sunflowers are also adapted to drier areas of Saskatchewan, and varieties with early maturity and short stature may have potential in the moist areas of Saskatchewan.

Objectives

To compare the adaptation, N response curves and economic returns *juncea* canola and hybrid, oilseed sunflowers to flax and *napus* canola with in various soil-climatic zones of Saskatchewan.

Materials and Methods

Treatments

- 4 crops
  - *Brassica juncea* (*juncea* canola)
  - Sunflower (hybrid, oilseed)
  - *Brassica napus* (hybrid, *napus* canola)
  - Flax

- 8 nitrogen rates (kg ha^{-1})
  - 10
  - 30
  - 50
  - 70
  - 90
  - 110
  - 150
  - 200

- 5 Locations in Saskatchewan, Canada
  - Indian Head
  - Swift Current
  - Scott
  - Melfort
  - Redvers

- Years
  - 2004
  - 2005
  - 2006

Experimental design

  - three replicates
  - split plot with crop as the main effect

Agronomic Practices

- Seeding date
  - mid-May for both *Brassicas* and flax with sunflowers seeded approximately 10 days later

- all locations except Swift Current where the first seeding date was early-May and sunflowers were seeded 10 days later

- Target Plant Population (plants m^{-2})
  - 100 – *juncea* canola
  - 7.5 – Sunflower
  - 100 – *napus* canola
  - 400 – Flax

- Cultivars
  - *juncea* canola - Dahinda
  - Sunflower – 63M02 (hybrid)
  - *napus* canola – Invigor 5020 (hybrid)
  - Flax – CDC Bethune

- Cropping System
  - zero-till

- Fertility
  - nitrogen- determined by treatment
  - phosphorus – a minimum of 20 kg ha^{-1} with more being applied if suggested by soil test
  - potassium and Sulfur – followed soil test recommendations for each location in each year

Economics

- adjusted gross return
  = (Grain yield * grain price) – (amount of applied N *cost per unit of N)
- calculated at two grain prices $200 and $400 $tonne^{-1}$ and four N costs: 0.85, 1.00,1.15 and 1.30 $ kg^{-1}.

Statistical Analysis

- PROC MIXED procedure of SAS (Littell et al., 1996)
- A combined analysis was carried out using all locations and years except at Scott due to hail damage occurring in two years.
- Crop, N rate, and location were considered fixed effects.
- Replicate and year were considered random effects

Results

- Crop x N, location x crop, and location x N all affected grain yield.
- There was a curvilinear increase in grain yield of all four crops as the rate of applied N increased when averaged over locations and years.
    - As the N rate increased from 10 to 90 kg ha^{-1} grain yield response of *juncea* canola and sunflower was less than that of flax and Napus canola (Figure 1).
    - The grain yield of *juncea* canola and sunflower increased as N increased to 70 kg ha^{-1} but did not increase at higher N rates.
    - Flax grain yield did not respond to N rates above 90 kg ha^{-1}.
    - Grain yield of *napus* canola increased as the N rate increased to 200 kg ha^{-1}. A similar response was reported by Mahli et al. (2007).

- *Napus* canola and flax had similar grain yields at each location and never had a yield lower than sunflower or *juncea* canola at any location when yield was averaged over N rate and year (Figure 2).
    - The yield *of napus* canola and flax was greater than sunflower and *juncea* canola at Indian Head and Melfort when averaged over N rate and year.
    - *Napus* canola had a higher grain yield than *juncea* canola at Swift Current.
    - Flax had a higher grain yield than sunflower at Redvers.

- The adjusted gross return (gross return minus the cost of applied N) of *napus canola* and sunflower (Figure 3) and flax and *juncea* canola (Figure 4) are presented.
    - The adjusted gross return for sunflowers and *juncea canola* was similar from 10 to 70 kg N ha^{-1} when crop prices are low and N costs high. At N rates greater than 70 kg N ha^{-1} the adjusted gross return declined.
    - The adjusted gross return for sunflower indicated that there was no advantage to increasing N rate as the sunflower price increased and fertilizer cost decreased.

- A small increase in the adjusted gross return of *juncea* canola could be captured by increasing the N rate to 90 kg ha^{-1} as the crop price increased and fertilizer cost decreased.
- The adjusted gross return of flax did not increase above 50 kg N ha^{-1} when crop prices are low and N prices high.
- As the flax price increased, the adjusted gross return for flax was optimized at 90 kg ha^{-1}
- The adjusted gross return of *napus* canola was very similar across a wide range of N rates when crop prices are low.
- As the price of *napus* canola increased the adjusted gross return was maximized at 110 kg ha^{-1}.

Conclusions

- Current cultivars of j*uncea* and sunflower are less responsive to applied N than current cultivars of *napus* canola and flax.
- *Juncea* canola did not have an advantage over *napus* canola under the dry conditions that prevailed at Swift Current.
- The gain yield of sunflower was only similar to *napus* canola and flax at Swift Current, the driest location with the longest growing season.
- Shorter season sunflower hybrids are required to improve grain yield in Saskatchewan.
- The adjusted gross return indicates that producers using a wide range of N rates may have a similar adjusted gross return.
- A full economic analysis needs to be carried out on this data set

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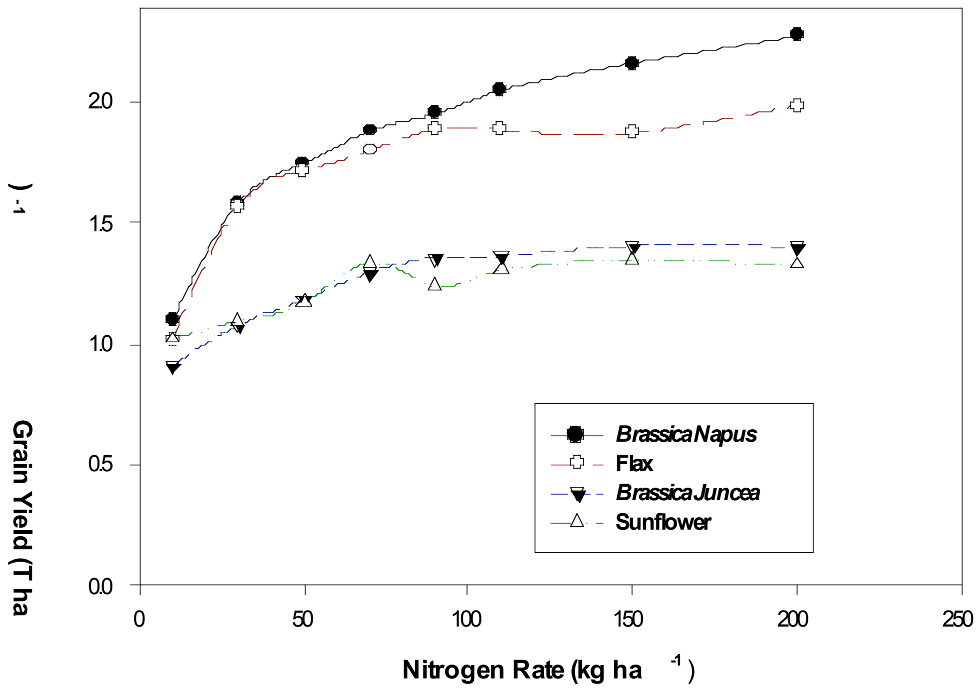

Figure 1. Crop grain yield response to changes in nitrogen rate averaged over years and locations.

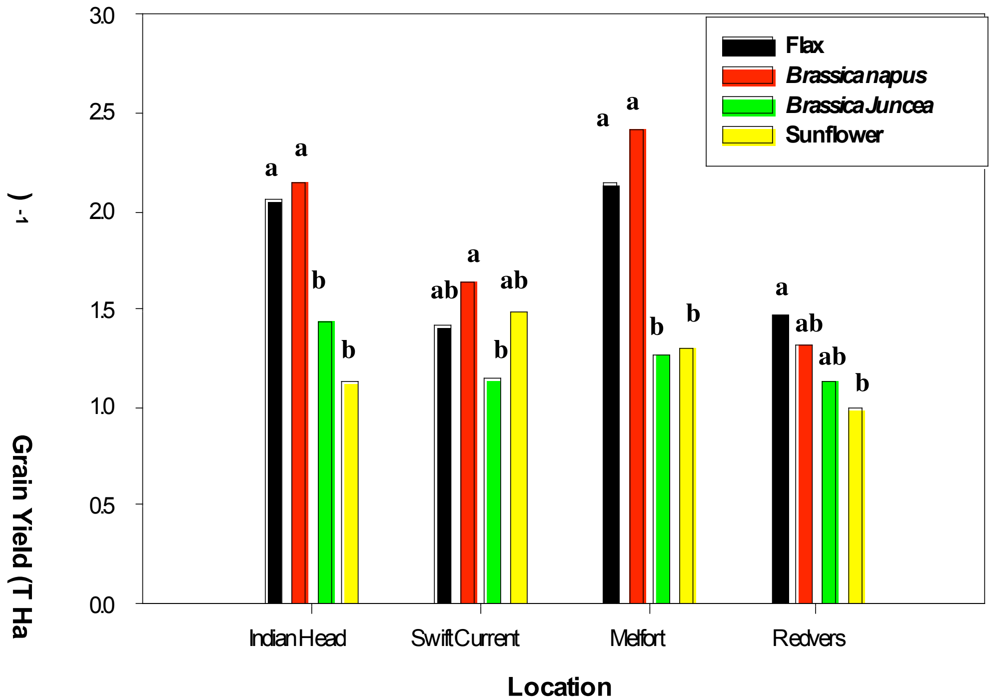

Figure 2. Crop grain yield at each location averaged over nitrogen rates and years.

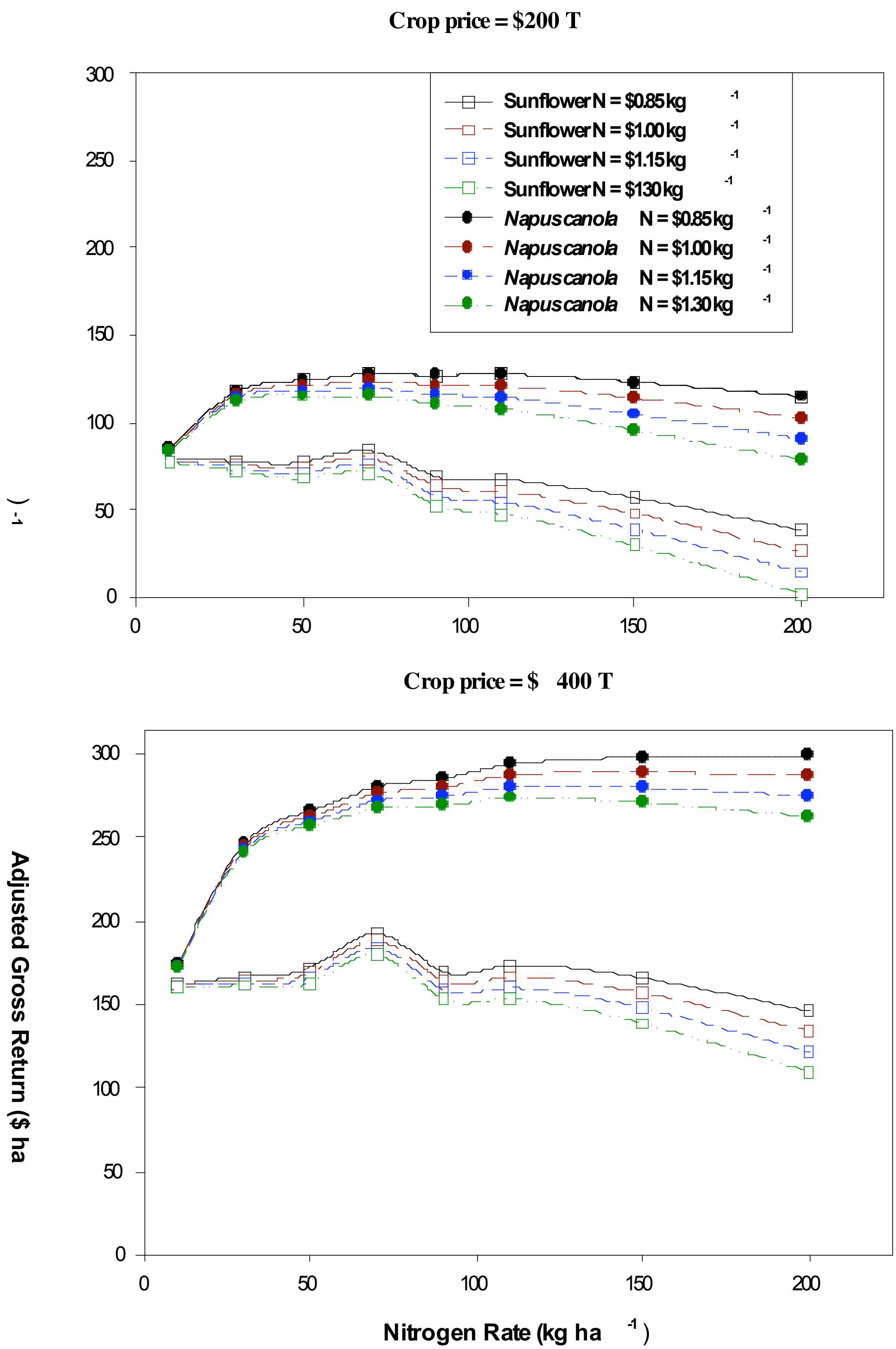

Figure 3. Adjusted gross return of *napus* canola and sunflower in response to changes in nitrogen rate averaged over years and locations.

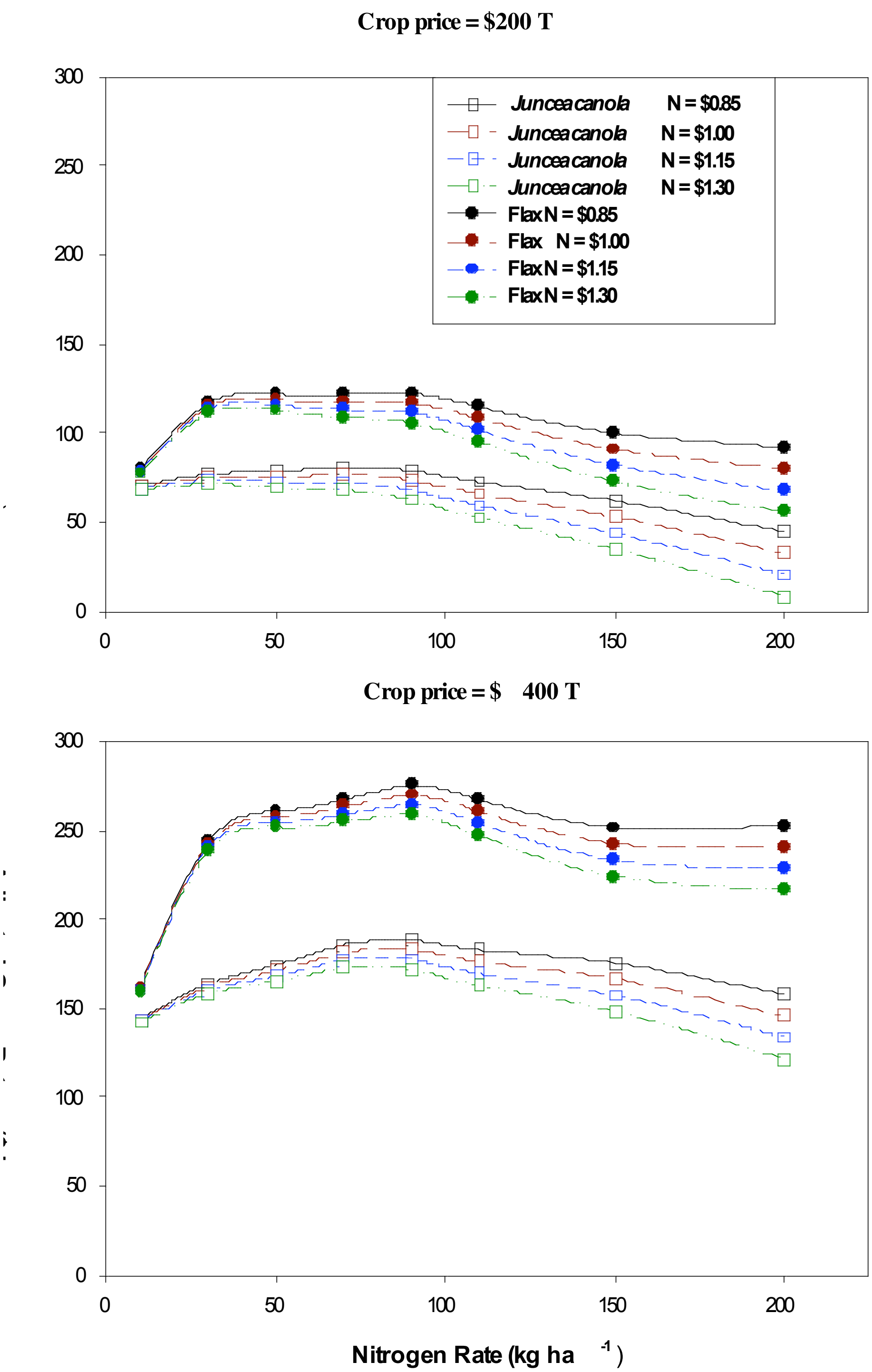

Figure 4. Adjusted gross return of *juncea* canola and flax in response to changes in nitrogen rate averaged over years and location