Activity 19
Winter Canola Rates/Dates Trial
Annual Report – March 31, 2016

Overall Objective

The objectives of this activity are to:

1. Test varieties/genotypes at sites across eastern Canada and identify combination of varieties and optimum fertilization for specific locations.
2. Assess the suitability of winter-seeded spring-type canola for eastern Ontario.
3. Investigate winter survivor and the yield potential of winter canola.
4. Evaluate the ability of microbe-to-plant signals to help winter canola survive winter stresses.

Audience

The audience is crop producers, specifically those who grow or who have an interest in growing canola.

Highlights

Canola, a cool season crop is likely able to survive our harsh weather and grow early right after snow melt in the spring, thus use the sunlight and soil moisture resources for extended growth period (maximizing resources use efficiency), it could also avoid the heat and drought stress during flowering. As a result, winter canola is expected to yield more than spring canola. There is however, no information available for growing winter canola in eastern Canada. Therefore, a field experiment with 4 winter canola varieties at three planting dates and three seeding rates was conducted in a split-plot design with five replications, at Ottawa, ON, Montreal, QC, Saint-Mathieu-de-Beloeil, QC, Canning, NS, and Charlottetown, PE.

- The results showed that winter canola generally had lower germination rate and lower stand counts after emergence, compared with those of spring canola at the same seeding rate, indicating a higher seeding rate may be needed. However, winter canola has a longer growing season than spring canola.
- While the early and mid-planting crops grew well in early November before winter, the late planting crop appeared to be small and may have not accumulated sufficient non-structural carbohydrates for wintering. All three plantings of winter canola in PEI, Saint-Mathieu-de-Beloeil, QC and Canning, NS did not survive the winters of both years. In Ottawa, only 2 plantings survived both years: the early planting and the normal planting. In Montreal 2013, all plantings survived but in 2014 only 2 plantings: the early planting and the normal planting (Aug,27 and Sep 13).
- In Ottawa, both years, the winter canola yields were not better than spring canola yields in the same area. The normal September planting yields were better than the yields of the first plantings, but not as good as the average spring canola yields in the same location, which averaged around 3100 kg ha-1 in 2014 and 3400 kg ha-1 in 2015 at the Ottawa site.
- In Montreal, the spring canola yield was higher than winter canola. The early and normal planting with baldur (3463 & 3485 kg ha $^{-}$1) variety yields was better than other variety with early and normal seeding but the spring canola average yield was 4207 kg ha^{-1}.

Outcomes

Introduction

Successful canola production is largely dependent on genotype (hybrids or open pollinated cultivars). The production and release of canola hybrids is faster than cultivar development through the traditional breeding processes, and generally the adaptability of each hybrid is limited to specific edaphic and climatic conditions. On the other hand, there is limited studies on site-specific best management practices that enhance crop performance of a hybrid by modifying crop growth conditions. In the past few years, combinations of seeding rates, seeding dates and fertility levels have been tested for one hybrid in one soil type of each test site. Soil characteristics and cropping systems are known factors to influence the performance of canola hybrids (Clayton et al., 2004). To narrow the yield gap between a genotype's yield potential achievable with recommended practices and actual yields using producers' practices in eastern Canada, it is necessary to define site and hybrid specific agronomic practices.

In western Canada, a field test showed that seeding canola very early in the spring or before fall freeze up has several advantages:

1. Spreads out farming operations;
2. May minimize the impact of devastating diseases, insects, frosts or periods of extreme heat; and
3. Advances maturity and harvest (Clayton et al., 2004).

At northern European locations, where the climate is more similar to eastern Canada, Rathke et al. (2005), working in central Germany, found that when grown in rotation with barley and peas and at 4 N rates the highest yields (4.9 t ha^{-1}) occurred at 240 kg ha^{-1} mineral N fertilization when the effects of the previous crop were small. Butkute et al. (2006), under Lithuanian conditions, found that crude protein generally increased with increasing N fertilizer application, but that oil levels were not strongly affected by nitrogen rates and mid-August seeding generally resulted in best yields. Laaniste et al. (2010) conducted field research in Estonia and found that lower plant densities produced good yields, and the optimal sowing date was mid-August, and achieved best yields of 1748 kg ha^{-1}. In addition, in cooler conditions in central Turkey, Öztürk (2010) found that ammonium sulfate and urea gave higher seed yield than ammonium nitrate and that ammonium sulfate at 150 kg N ha^{-1} resulted in the best yields.

It has also been shown that microbe-to-plant signal compounds can be applied to crops to improve growth and development (Prithiviraj et al., 2003; Lee et al., 2009; Mabood et al., 2006) and, particularly, to allow them to better deal with stresses encountered during crop development (Wang et al., 2012; Smith, 2010; Smith, 2009; Subramanian et al., 2010; Subramanian et al., 2009; Subramanian et al., 2011). However, the effect these compounds might have on winter survival of canola has not been evaluated. Given that winter conditions present the crop with a suite of stresses (low temperature, ice encasement, snow molds, smothering) these compounds could be very useful in this context.

Winter canola can significantly out-yield spring canola. It has other advantages, such as improved distribution of the workload over the cropping season, better competition with spring germinating weeds, reduced herbicide costs compared to spring crops, and reduced risk of herbicide resistance. Information on the performance of winter type canola varieties is also required, especially where spring canola production is restricted by hot and dry weather conditions during flowering. Therefore, we also plan to initiate a winter canola variety test.

Objectives

The main goal of this activity is to determine if winter canola could be grown successfully in eastern Canada. Specifically, we want to:

a. Test varieties/genotypes at sites across eastern Canada;
b. Identify combinations of varieties and optimum seeding date and rate for specific locations;
c. Investigate winter survivorship and the yield potential of winter canola; and
d. Evaluate the ability of microbe-to-plant signals to help winter canola survive winter stresses.

Approach/methodology

The winter canola experiments, which involved the combinations of 3 seeding dates (early (Aug. 27), mid (Sep.13) and late (sep.26)) and 3 rates (2.5, 5.0, and 7.5 kg ha^{-1}) with 3 varieties (Bonanza, Sitro and Sensation) and another 1 variety (Baldur) with 5.0 kg ha^{-1} of seeding rate with the same 3 seeding dates. Trials were conducted at the Lods Agronomy Research Centre (Macdonald Campus, McGill University, Sainte-Anne-de-Bellevue, Canada) in 2014 & 2015 (seeded in 2014 and harvested in 2015). Soil preparation was conducted using conventional tillage.

Fertilizer was broadcast onto the experimental site at the rate of 50 kg of N as urea (46-0-0), 20 kg ha^{-1} sulphur, as ammonium sulphate (21-0-0 with 24% S), boron as Granubor (10% boron) at 2 kg ha^{-1} 20 kg P (0-46-0) and 40 kg K (0-0-60) were broadcast on all plots prior to seeding. The 50 kg of N as urea (46-0-0) applied after the winter (May 13, 2015).

The experiments were organized following a randomized completely block design with four blocks for each experiment and the plot size was 5 x 2.6 m. this experiments were conducted at Ottawa, ON, Montreal, QC, Saint-Mathieu-de-Beloeil, QC, Canning, NS, and Charlottetown, PE.

Data collection

Data was collected and recorded, according to established protocol, on the following variables for canola: plant emergence (number of seedlings per m); stand count after winter yield components (10 plants per plot); branches per plant; pods per plant; seeds per pod; and seed yield (at 10% moisture). All the canola plots were regularly observed for the presence of insects and diseases.

Statistical analyses

Data were subjected to statistical analyses based on the model (negative binomial or log normal) by low BIC using the SAS PROC GLIMMIX (9.3) to detect differences among the treatments. Means were compared using the LSD test ($P < 0.05$ and $P < 0.1$).

Results and discussion

- All three plantings of winter canola in PEI, Saint-Mathieu-de-Beloeil, QC and Canning, NS did not survive the winters of either year.
- In Ottawa, only 2 plantings survived both years: the early planting and the normal planting. In Montreal 2013, all planting survived but 2014 only 2 plantings: the early planting and the normal planting (Aug,27 and Sep 13).
- In Ottawa, both years, the winter canola yields were not better than spring canola yields in the same area. The normal Sept planting yields were better than the yields of the first plantings, but not as good as the average spring canola yields in the same location, which averaged around 3100 kg ha-1 in 2014 and 3400 kg ha-1 in 2015 at the Ottawa site.
- In Montreal site, the results are as follows:

Table 1. Effect of seeding date & rates with different varieties on seed emergence in canola

Emergence count (no m^{-2})		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	39^{bc}	68^{abc}	113^{abc}
Sitro	Early (Aug. 27)	60^{bc}	104^{abc}	169^{a}
Sensation	Early (Aug. 27)	64^{bc}	90^{abc}	143^{ab}
Baldur	Early (Aug. 27)	-	126^{ab}	-
Bonanza	Mid (Sep.13)	43^{c}	60^{bc}	74^{abc}
Sitro	Mid (Sep.13)	38^{c}	64^{bc}	100^{abc}
Sensation	Mid (Sep.13)	39^{c}	76^{abc}	79^{abc}
Baldur	Mid (Sep.13)	-	57^{bc}	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

The results showed that, there were significant differences in emergence (No of plants m^{-1}) due to treatments.

The highest emergence occurred in Sitro planted in Early (Aug. 27) at the rate of 7.5 kg ha^{-1} (169). The lowest emergence was observed in all varieties planted in mid (Sep. 13) planting at the rate of 2.5 kg ha^{-1} (Table 1).

Table 2. Effect of seeding date & rates with different varieties on stand count after the winter in canola

Stand count after winter (no m^{-2})		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	23	32	34
Sitro	Early (Aug. 27)	22	29	42
Sensation	Early (Aug. 27)	30	41	58
Baldur	Early (Aug. 27)	-	69	-
Bonanza	Mid (Sep.13)	20	35	33
Sitro	Mid (Sep.13)	17	31	52
Sensation	Mid (Sep.13)	30	41	60
Baldur	Mid (Sep.13)	-	50	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

Table 3. Effect of seeding date & rates with different varieties on No of plants m^{-2} at harvest in canola

Stand count at maturity (no m^{-2})		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	23	32	34
Sitro	Early (Aug. 27)	22	29	42
Sensation	Early (Aug. 27)	30	41	58
Baldur	Early (Aug. 27)	-	70	-
Bonanza	Mid (Sep.13)	17	23	34
Sitro	Mid (Sep.13)	22	33	55
Sensation	Mid (Sep.13)	22	55	43
Baldur	Mid (Sep.13)	-	39	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

Table 4. Effect of seeding date & rates with different varieties on No of branches plant^{-1} in canola

No of branches		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	7	6	5
Sitro	Early (Aug. 27)	7	5	6
Sensation	Early (Aug. 27)	7	5	5
Baldur	Early (Aug. 27)	-	5	-
Bonanza	Mid (Sep.13)	7	5	6
Sitro	Mid (Sep.13)	12	8	7
Sensation	Mid (Sep.13)	4	5	4
Baldur	Mid (Sep.13)		6	
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

Table 5. Effect of seeding date & rates with different varieties on No of pods plant^{-1} in canola

No of pods plant		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	165	115	127
Sitro	Early (Aug. 27)	187	97	105
Sensation	Early (Aug. 27)	169	90	102
Baldur	Early (Aug. 27)		81	
Bonanza	Mid (Sep.13)	136	105	148
Sitro	Mid (Sep.13)	289	136	145
Sensation	Mid (Sep.13)	63	106	62
Baldur	Mid (Sep.13)	-	80	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

Table 6. Effect of seeding date & rates with different varieties on No of seeds pods^{-1} in canola

No of seeds pod^{-1}		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	20	19	19
Sitro	Early (Aug. 27)	21	20	22
Sensation	Early (Aug. 27)	21	20	20
Baldur	Early (Aug. 27)		19	
Bonanza	Mid (Sep.13)	16	20	17
Sitro	Mid (Sep.13)	17	18	18
Sensation	Mid (Sep.13)	21	20	21
Baldur	Mid (Sep.13)	-	22	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

There were no significant differences in winter survival, stand count at maturity, no of branches, pods and no of seed pod^{-1} due to seeding date, rate and varieties (Table 2 to 6).

Table 7. Effect of seeding Rate & rates with different varieties on Yield kg ha^{-1} in canola

Yield kg ha $^{-1}$		Seeding rates		
Variety	Seeding date	2.5 kg ha^{-1}	5 kg ha^{-1}	7.5 kg ha^{-1}
Bonanza	Early (Aug. 27)	2313	2330	2624
Sitro	Early (Aug. 27)	2490	2299	1913
Sensation	Early (Aug. 27)	2709	2402	2495
Baldur	Early (Aug. 27)	-	3463	-
Bonanza	Mid (Sep.13)	1671	1698	2755
Sitro	Mid (Sep.13)	2078	2374	2602
Sensation	Mid (Sep.13)	729	2351	1571
Baldur	Mid (Sep.13)	-	3485	-
Bonanza	Late (sep.26)	-	-	-
Sitro	Late (sep.26)	-	-	-
Sensation	Late (sep.26)	-	-	-
Baldur	Late (sep.26)	-	-	-

There was no significant difference in yield due to seeding date, rate and varieties, but the highest yield was obtained in baldur planted in early and mid dates at the rate of 5 kg ha^{-1} (3463 and 3485 respectively).

Overall, the spring canola yield was better than winter canola at both sites (Ottawa and Montreal).

The locations, varieties, seeding date and rate influenced the winter canola yield. However, it does not appear that current winter canola types are well suited to production in much of eastern Canada.