Proposal # 9
North Central Region Canola Research
FY 2010 Proposal

Project Title:

The Minnesota Canola Production Centre & Canola Research

Variety and Systems Comparison Trial,
Nitrogen Application and Timing Trial,
Pre-harvest Desiccants and Straight Harvesting Trial
Date of Planting Trial

Principal Investigator:

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Amount Requested:

$33,076

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Grants Manager Date
Sponsored Projects Administration
University of Minnesota

Part 1: Variety and Systems Comparison Trial

Objectives:

To establish agronomic and economical criteria (such as yield, contribution margin, crop quality, lodging resistance, harvestability, and disease resistance) for choosing among canola (*Brassica napus L.*) varieties and their respective herbicide options.

Procedures:

This study will be located at the Canola Production Centre, which in 2009 will most likely be located near Roseau, MN. Varieties for the Variety and Systems Comparison Trial are submitted for testing by the canola seed industry. An invitation is sent to all the area seed dealers in March with final confirmations made by April 1. The seed is treated with the strongest commercially available seed treatment for each variety, perhaps either Helix Xtra or Prosper 400. Varieties are seeded with a 10-foot 9350 JD double-disk press drill at seed company recommended seeding rates. Plots are approximately 400 feet long by 30 feet wide. The trial is laid out in a modified RCB design with four replicates. The Roundup Ready varieties are grouped together to help avoid drift problems between the different systems. The other herbicide systems are also grouped together. All varieties receive the same tillage, fertilizer and post-emergent fungicide treatments. All the herbicide tolerant varieties are sprayed with their respective herbicides at the recommended rates for the weed spectrum in the field. Herbicide spraying is done with a 30 foot open boom sprayer on a calm day. If conditions are conducive for sclerotinia, all varieties are sprayed with a fungicide such as Ronilan at 20 to 50% bloom to reduce the risk of yield loss due to this disease. Each plot is swathed individually when seed color change in that plot reaches 30 to 40 % on the main stem and threshing is completed when suitable conditions exist. Swathing is done with an 18 foot Versatile 400 swather with side cutter bar and the plots are threshed with a commercial combine rented from a grower or local dealership. Yields are measured with a weigh wagon and 5 lb samples taken for dockage and quality testing.

Data collection during the season includes; canopy closure, beginning and end bloom dates, height, lodging, maturity date, swathing harvestability, and combining harvestability. After harvest, seed quality is measured by evaluating for damaged seed, green seed count, and oil and protein content. Contribution margins are calculated using the value of the crop at harvest minus variable costs (seed, fertilizer, herbicides, fungicides, insecticides, fuel, lube and machinery repair, check-off, and interest/opportunity costs).

All data, except the contribution margins, will be analyzed using SAS. The data will be compiled and published in a report that is made available to growers during winter meetings.

Justification:

Many canola growers prefer to see how varieties perform and compare in “field scale” plots rather than small plots. When appropriately designed, field scale plots take into account more field variability in the yield equation by including high ground and ditches. Small plots are typically located in an area of the field where the soil is uniform and well drained to reduce variability among treatments. The large plots allow each variety to be treated with its’ respective herbicide so that the varieties are treated like they would be in the grower’s field. Many growers select varieties based on not only yield and disease resistance, but also on ease of harvest.

Comparing harvestability of varieties is not possible in small plots because the equipment is not comparable to what a grower uses.

The Canola Production Centre provides a focal point for canola producers to come to a summer field day and look at the plots. They will hear from industry representatives as well as from University of Minnesota and North Dakota State University extension personnel about important current topics such as insect and disease concerns on canola and other crops.

Literature Review:

The Variety and Systems Comparison Trial has been conducted on the Canola Production Centres across Canada since 1997 and in Minnesota since 1999. Results have been published in each year's copy of the Canola Production Centre annual report. One exception occurred in 2006 when the trials at the Canola Production Centre failed due to lack of timely rainfall resulting in a variable and ultimately unacceptable plant stand. Other systems comparison work has been done in company strip trials which are also large plot. To our knowledge, no one else but the above mentioned has done the same kind of systems and variety comparison like we have conducted in the past and propose to conduct in 2010.

Current Work:

In 2009, the Variety and Systems Comparison Trial at the Minnesota Canola Production Centre near Roseau included eighteen varieties. Of these, sixteen varieties were Roundup Ready and two were Liberty Link. Included in the 2009 small plot trials were twenty-five varieties of Roundup Ready and Conventional varieties. Additional research included straight harvesting, no-till planting, evaluation of plant-health products, and additional screening of germplasm for shattering resistance.

Project Timetable:

Invitation to companies for variety testing will be sent out in March, 2010 with variety confirmation by April, 2010. These projects will consist of field trials during the 2010 growing season. A summer field day will held in late June or early July to show the research and offer other extension information to growers from industry people and University personnel. Results will be available via the internet web pages, presented at scientific and grower meetings, cited in area and regional extension newsletters, and published in an extension fact sheet and scientific journals when applicable.

Personnel:

Dr. Paul Porter (1%) & Rob Proulx (20%). (Rob teaches agriculture courses at the University of Minnesota – Crookston campus. Minnesota Canola Council - support will provided by organizing the summer field day, writing the land rental agreement, and providing the land rent to the grower.

Part 2: Nitrogen Application and Timing Trial

Objectives:

1. Evaluate canola response to multiple rates of nitrogen (N) applied pre-plant or at the 4- to 6-leaf stage of growth using field-scale equipment.

2. Evaluate the effectiveness of top dressing urea N (46-0-0) compared to Ammonium Nitrate (34-0-0).
3. Evaluate the effectiveness of ESN (controlled release) product when compared with conventional nitrogen.

Procedures:

This study will be located at the Canola Production Centre near Roseau, MN. The trial area will be sampled for nitrogen as well as phosphorous, potassium, and sulfur, and fertilized accordingly to its needs. All treatments will have approximately 50 lb/ac seed placed MAP (6-26-0). The canola variety Pioneer 45H21 will be seeded at a rate of 5 lb/ac. The field layout will consist of a randomized complete block (RCB) design with four replicates. Plots will be field scale (30 ft by 400 ft) and managed and harvested with field scale equipment.

Nitrogen treatments will consist of a set of pre-plant and top dress application rates of dry urea (46-0-0) and dry ammonium nitrate (34-0-0) fertilizer. ESN treatments will consist of a fall applied and spring applied treatment. All top dress applications will be applied at the 4- to 6-leaf stage or as close to that stage as possible. The no N check and pre-plant N application treatments will allow for meaningful treatment yield comparisons. Top dress applications will be applied prior to a rainfall event if possible. Urea requires approximately 0.30 inches of rain within 2 to 4 days after application for proper incorporation and the reduction of volatilization.

Rates of pre-plant (PPI) and post emergence N applications

Trt	PPI	4 to 6 leaf stage	N source	Targeted total N
	-Applied lbs N/ac -			lb/ac
1.	0	0	no additional N applied	45
2.	30	0	(46-0-0)	75
3.	60	0	(46-0-0)	105
4.	90	0	(46-0-0)	135
5.	0	30	(46-0-0)	75
6.	0	60	(46-0-0)	105
7.	0	90	(46-0-0)	135
8.	0	60	(34-0-0)	105
9.	30	0	(ESN) (Spring)	75
10.	60	0	(ESN) (Spring)	105
11.	90	0	(ESN) (Spring)	135

Canola growth stage data will be collected at canopy, begin bloom, end bloom and maturity. Plant height, lodging, sclerotinia infection ratings, seed yield, oil content, contribution margins, and weather data will also be collected. Abnormal growing conditions and pest occurrence will be monitored and managed if possible. The results will be statistically analyzed using SAS, and the data will be made available to the public and private sectors through a variety of oral and written presentations (SAS, 1999).

This study is a good example of what the Canola Production Centres were designed for: taking the best treatments from small plot research and putting them into large production scale plots that are more closely related to the grower's experiences.

Justification:

The cost and high use of Nitrogen (N) by canola has been a major limit in the production of canola in North America. Research has indicated that N accumulation in canola increases from about 20 lb/ac to 100 lb/ac in a 30 day period beginning twenty days after emergence, with the most N accumulation (about 110 lb/ac) occurring 55 days after emergence (Thomas, 2000). Rainfall during this period of rapid nitrogen accumulation could leach soil N beyond the canola-rooting zone. A top dress application of N, with a little or no N applied preplant and the remainder applied at 4- to 6- leaf stage, could be more efficiently utilized by the plants, which could result in less N needing to be applied. A split application of N would provide growers an additional month to evaluate their canola crop prior to purchasing and applying the additional N. ESN has been shown to prevent nitrogen loss during the growing season, optimizing nitrogen use by growing canola. This product may be able to decrease the total nitrogen applied to grow a canola crop when compared to traditional nitrogen sources.

Literature Review:

Canola requires high levels of N and usually shows increased yields with an N fertilizer application. The high N requirement of canola is one reason why canola acreage in Minnesota is being replaced with soybeans, which require very little to no additional N. If canola N levels could be managed to obtain more yield with the same or lower N input, then canola would be more economically competitive with soybean. Minnesota and North Dakota both recommend 130 lb/ac of available N to obtain a 2000 lb/ac yield (Rehm et al., 2001; and Franzen, 1999). Manitoba Agriculture recommends 150 lb/ac of available N to reach a 2000 lb/ac.

Studies on top dress applications of N fertilizer are limited. An Australian study on irrigated canola indicated that top dress applications were not effective (Taylor et al., 1991). Ty Dewitz, a canola grower from Tappen, North Dakota has been seeing a 15 to 20% yield increase by using top dress applications of N on both irrigated and dry-land canola (personal communications through Eric Eriksmoen). A 2001 study conducted at two locations in North Dakota showed a yield increase of up to a 30% when top dress applications of N were used (Bob Henson, personal communications). The trial was repeated in 2002 with an average yield increase of 9% across four site-years when all or part of the N was applied at the 3 to 5-leaf stage (Eric Eriksmoen, personal communications). In 2003 an extensive nitrogen application trial including 7 nitrogen levels PPI and 4 nitrogen levels top dress was conducted at 7 locations in North Dakota. Results from this trial showed no yield difference between applying fertilizer PPI and top dressing (John Lukach, personal communications). The results also indicated a range of 5 to 10 lb/ac of canola increase per pound of nitrogen applied, depending on location. In the last 4 years, 3 out of 10 site years (Langdon, Carrington and Valley City) showed yield increases of 300 to 500 lb/ac from top dressing nitrogen compared to PPI.

In 2003 a nitrogen trial was conducted at the Canola Production Centre near Roseau which looked at adding 30 and 60 lb/ac N at PPI and the 4 to 6 leaf stage as a top dress treatment. The field was flooded in 2002 and had high levels of residual nitrogen. Top dress treatments included three nitrogen sources; urea, ammonium nitrate and 28-0-0 liquid. The only significant yield increase obtained from top dressing occurred with urea at 30 lb/ac N. In 2004 the trial was repeated near Roseau looking at applications of 60 and 90 lb/ac PPI and topdress with no difference in yield between the two application timings.

In 2004 an extensive nitrogen application trial including 7 nitrogen levels PPI and 4 nitrogen levels top dress was conducted at 7 locations in North Dakota. Results from the Valley

City location showed significant yield increase of approximately 300 lb/ac from top dressing (John Lukach, personal communications). Langdon also showed yield increases from top dressing.

Studies on the timing of top dress applications are also limited. In 1999, the Canola Production Centres conducted a study at 5 sites with top dressing 10 lb N/ac and 10 lb S/ac at 7, 14, 21, and 7 plus 21 days after emergence (Canola Council of Canada, 1999). The total recommended rate of N fertilizer was applied prior to seeding. Increased yield from top dressing was observed at only one site. The 2001 North Dakota trials showed no yield difference with a split application at bolting compared to a 9% yield increase with the split application at the 3 to 5-leaf stage (Eric Eriksmoen, personal communications). A top dress application of N for winter canola seed production is recommended in Kansas with one third to one half applied in the fall and the remainder applied in late winter (Kansas State University, 1989).

Current Work:

A trial very similar to this proposed trial was conducted on the 2005 CPC near Grygla in a tile drained field, see attached data for 2005 results. Very wet weather from 20 to 50 days after planting provided optimum conditions to show significant differences between the PPI and top dress treatments. Top dressed treatments provided 12, 14 and 20% higher yield than the PPI treatments for the 30, 60 and 90 lb/ac N application rates respectively. Top dressing 30 lb/ac N provided a similar yield to 60 lb/ac N PPI. Top dressing 60 lb/ac N provided a better yield (131 lb/ac) than 90 lb/ac PPI.

This research was proposed for the 2006 Canola Production Centre. Preplant nitrogen applications were made and the trial was planted. Lack of rainfall at the site for over a month resulted in a very uneven stand. Because of that the trial was terminated prior to topdress application

In 2008, preliminary work was performed at the Canola Production Center comparing nitrogen timings and sources. The findings were not significantly different, but provided evidence that lower rates of nitrogen applied at the 4-leaf stage may yield as well as conventionally applied nitrogen.

In 2009, the ENS treatments showed significant promise in increasing yields.

The **Project Timetable** and **Personnel** have been described in Part 1 above.

Part 3: Pre-harvest Desiccants and Straight Harvesting Trial

Objectives:

The objective of this study is to evaluate the potential for pre-harvest desiccation and straight harvest in Minnesota canola production.

Procedures:

A field site near Roseau, MN will be planted with the P45H21 variety of canola. It will be seeded with a 10-foot 9350 JD double-disk press drill at seed company recommended seeding rates. Plots are 400 feet long by 30 feet wide. The trial is laid out in a modified RCB design with four replicates. Plots will be fertilized at recommended rates for 2,000 lbs/acre production.

Treatments consist of harvest method (straight or swathed), desiccating agent (Reglone) (application or non-application), and harvest date. Straight harvest treatments will be sprayed with the desiccating agent applied at early pod yellowing. There will also be non-sprayed straight harvest control treatments and a traditional swathed treatment. The first harvest date to occur at the optimum time with subsequent weekly harvests at 7, 14, and 21 days.

Reglone spraying will be done with a 30 foot open boom sprayer on a calm day. If conditions are conducive for sclerotinia, all varieties are sprayed with a fungicide such as Ronilan at 20 to 50% bloom to reduce the risk of yield loss due to this disease. Each conventionally harvested plot is swathed individually when seed color change in that plot reaches 30 to 40 % on the main stem and threshing is completed when suitable conditions exist. Swathing is done with an 18 foot Versatile 400 swather with side cutter bar and the plots are threshed with a commercial combine rented from a grower or local dealership. Yields are measured with a weigh wagon and 5 lb samples taken for dockage and quality testing.

Data collection during the season includes; Reglone application date, beginning and end bloom dates, height, lodging, maturity date, swathing date, and combining date. After harvest, seed quality is measured by evaluating for damaged seed, green seed count, and oil and protein content. Contribution margins are calculated using the value of the crop at harvest minus Reglone or swathing cost.

Justification:

In dry years, many canola crops are short and thin. Windrowing is recommended where yield potential exceeds 1 tonne/ha and crops are tall and thick enough to sit on 25-30cm of stubble. With light crops, where windrows may be blown about by strong winds, other options are desiccation and harvest or direct heading, depending on seed moisture levels.

Desiccation

Reglone® is registered for use as a pre-harvest desiccant in canola. Rates are 1.5 to 3.0 L/ha. Spray when 70% of the pods are yellow and the seeds are browny/bluish and pliable. Harvest 4 to 7 days after spraying.

In 2000, the Muresk Institute of Agriculture compared the effects of windrowing, desiccation and direct harvesting on the yield and quality of canola grown at Dowerin (WA). The highest yield of **0.91 tonnes/ha** was achieved by applying Reglone® (1.5 L/ha) at 56% seed colour change. Windrowing achieved a yield of **0.68 tonnes/ha**, whilst the direct harvest yield was **0.79 tonnes/ha**.

Timing is important. Windrowing or desiccating too early can significantly reduce seed yield and oil content compared with direct harvesting at maturity.

Project Timetable:

The canola will be evaluated for differences in yield and profit potential. Data will be collected throughout the summer and harvest will commence when the plots are mature. Results will be available via the internet web pages, presented at scientific and grower meetings, cited in area and regional extension newsletters, and published in an extension fact sheet and scientific journals when applicable.

Literature Review:

Currently all canola grown in Minnesota is swathed and harvest approximately 14-21 days after cutting takes place.

Part 4: Seeding Date and Production System (Herbicide Resistance/Variety) Influence on Canola Performance Trial

Objectives:

The study objective is to i.) evaluate seeding date effect on performance of glyphosate (Roundup Ready) and glufosinate (Liberty Link) herbicide resistant systems, with new hybrid canola varieties; ii.) compare net returns of the two herbicide resistant systems based on grain value and seed and herbicide costs; iii.) investigate seeding date influence under previously not reported no-till production and also conventional tillage. This research will be in conjunction with Dr. Burton Johnson at NDSU.

Procedures:

The field experiment will be a randomized complete-block design in a split plot arrangement with four replicates (Steele and Torrie, 1980). The study will be conducted at near Roseau in 2010, in conjunction with proposed plots at Carrington, Hettinger, Langdon, and Minot Research Extension Centers in North Dakota. The experiment is a RCBD with a split split-plot arrangement. Seeding date and herbicide resistance are the main and subplots, respectively, with variety nested as the sub subplot. The five seeding dates are spaced at approximately 8 to 10 day intervals with the first date when canola is normally planted. This corresponds to approximately 3, 13, and 24 May, and 2 and 11 June. Glyphosate and glufosinate herbicide resistant types will be evaluated with two varieties of each type. Standard agronomic practices will be applied for seeding rate, fertility, pest, and harvest management (Berglund et al., 2007). Plots will be approximately five feet wide with row spacing of 6 to 7 inches and a length of 20 to 25 feet. Herbicide systems will be bordered on either side by a plot of their respective herbicide resistance to prevent herbicide drift from the adjacent dissimilar treatment. This will increase the size and many management aspects of the study by 100%. This planting date study will spread out over a broad range most management aspects of the study from planting of the first date to harvest of the last planting date. Traits determined are stand rating, weed pressure, weed control, first flower and end flower, plant height and lodging, maturity, seed yield, test weight, seed weight, and oil content. Observations will also include pest incidence, seed shatter, and harvest concerns. Statistical analysis will be performed by SAS (1999) and consider seeding date, herbicide system, and variety fixed effects and location-year a random effect. Treatment means comparisons will be based on *F*-protected LSD comparisons at $P \leq 0.05$.

Rationale and Significance:

Published manuscripts and local research reports pertaining to canola response to seeding date in the region are limited and dated and consequently the topic was identified as a research priority in the RFP for the North Central Region Canola Research proposals for FY 2010. The study results will identify location, seeding date, herbicide resistant type, and variety interactions

useful for selecting varieties and herbicide resistance types for maximum production in different production regions. The study treatments will identify the variety and herbicide resistance type for optimum grain yield and economic yield (grain yield value minus seed and herbicide costs) at each location. This information is extremely helpful to producers, agricultural consultants, and university extension agronomists when making decisions/recommendations on which varieties perform best when seeded at different locations. The study results would also be helpful regarding discussion in adjustment of final canola planting dates for crop insurance.

The **Project Timetable** and **Personnel** have been described in Part 1 above.

Budget

Student salary and benefits - $6,814
Research Technician - $17,262
Domestic Travel - $2,000
Materials and Supplies - $1,000
Equipment Rental (Combine) - $3,000
NDAWN Weather Maintenance - $3,000
Total - $33,076