Proposal # 8 – Burton Johnson $29,500

Seeding Date and Production System (Herbicide Resistance/Variety)
Influence on Canola Performance

Introduction

The short- and long-term goals of agronomic research are to enhance and preserve agricultural sustainability. This is an ever challenging endeavor with the addition of crops to not only provide for the basic human needs, but now also bio-energy in the form of bio-fuels to reduce reliance on crude oil imports. Past President Bush challenged, primarily the agricultural sector, to provide 35 billion gallons annually of renewable fuels by 2017, and to reduce U.S. gasoline consumption by 20% (The New York Times, 2007). Technological advances in genetics, pest and fertility management, equipment, infrastructure, and global marketing are critical to enable crop production to meet the additive demands of providing for the food, feed, and fiber for the worlds growing population and now also to supplement domestic fuel needs.

Definition and improvement in agronomic practices associated with successful crop production is constant and ongoing at the Research and Extension Centers (REC) across North Dakota and is a cornerstone of the North Dakota Agricultural Experiment Station's mission to preserve and enhance agricultural sustainability in the state and region. Maintaining pace with, and validation of new technological advancements requires testing at the Research Extension Centers to enhance success before new practices are adopted for production. This has been instrumental in the evolution of canola from a new crop to a principal crop in North Dakota in the past 20 to 25 years. North Dakota canola production quickly increased from 15,000 acres in 1991 to nearly 0.5 million acres in 1997, to 1.2 million acres in 2000, and 0.7 million acres in 2009 (Farm Service Agency, 2009). Production since 2000 has been near 1.0 million acres in five of the past nine years (NASS, 2010). During this period definition of production guidelines for successful canola production were defined and later modified to reflect changes in technology. Higher canola yield and oil content reflect genetic advances and implementation of improved agronomic practices.

Agronomic guidelines for canola seeding date recommendations are dated in time and genetics, and limited in number with only one scientific publication specific to North Dakota. Johnson et al. (1995) indicated greatest canola yield with open-pollinated varieties when seeded before 15 May at studies conducted at Carrington, Langdon, and Prosper, ND, during 1989 and 1990 with the highest yields obtained at the cooler, northern, Langdon location. Reduced yield at later planting dates was attributed to reproductive development occurring under greater heat and moisture stress that caused fewer pods per plant and lower harvest index. Seed oil content was not greatly affected by planting date at the tested environments, however, the environment by seeding date interaction indicated lower seed oil content from all seeding dates at the most heat- and moisture-stressed environments.

Canola seeding date studies, with hybrid Hyola 401, conducted at Carrington and Langdon, ND, from 1992 to 1996 indicated location-year interactions with seeding date with good yield at later May seeding dates in cool seasons, but in warm seasons yield decreased as seeding date was delayed from early to late May (Hanson et al., 1995). In 1998 at Carrington, Hettinger, and Williston late April seeding dates of Hyola 401, produced greater yield than most early and all mid May seeding dates (Eriksmoen et al., 1999). Mid-May seeding dates were higher yielding than early June seeding dates at Carrington. At Minot, 9 and 13 June seeding dates yielded 40% of the earliest 8 May seeding date. Hyola 401 seed yield for 15 and 30 May seeding dates was 27% of yields at 10 and 24 April, and 1 May seeding dates at Williston in 1998. Although these studies have a broad range in seeding dates they are limited by having only one or two varieties, only one hybrid, and no herbicide resistant types. These studies were all conducted with conventional tillage. Canola seeding date recommendations based on conventional tillage when applied to no-till production can result in severe frost damage to early seeding dates because of the cold soils associated with no-till systems.

I conducted a preliminary seeding date evaluation (3 dates spaced at 10 days, beginning 13 May) at Prosper, ND, in 2008 with a hybrid Liberty Link and Roundup Ready hybrid. The variety by seeding date interaction indicated greater yield decrease as seeding date was delayed for the Roundup Ready compared to the Liberty Link hybrid. Yield from the latest seeding date for the Liberty Link hybrid was equal to yield of the Roundup Ready hybrid at the first seeding date.

Some of the researchers that conducted these past canola seeding date studies are still agronomists at the RECs and would manage the proposed seeding date study with hybrid varieties of the new herbicide resistant types. Researchers at other RECs have experience with canola field studies and seeding date studies with other crops.

Collaborators for the study are Blaine Schatz at the Carrington REC, Bryan Hanson at the Langdon REC, Eric Eriksmoen at the Hettinger REC, and Mark Halvorson and Angela Sebelius at the Minot REC.

Objective

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.

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. Previous canola seeding date studies were also all conducted under conventional tillage. The proposed research will provide information for both conventional and no-till production on seeding date response of previously not reported newer hybrid canola varieties representing glyphosate and glufosinate herbicide resistant types at major canola production regions in North Dakota. 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 in North Dakota. Canola seeding date recommendations based on conventional tillage when applied to no-till production can result in severe frost damage to early seeding dates because of the cold soils associated with no-till systems. This can result in poor crop performance or reduced stands that require replanting and additional production costs. 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.

Approach

Sequence of events (Yearly and seasonally) and associated activities to reach objectives.

Year 1

Spring

i.) Select varieties for the study, obtain seed, and disperse seed to collaborators

ii.) Plant study at selected locations, begin recording field notes (stand establishment, flea beetle issues, and etc.)

Summer

i.) Apply herbicide treatments as necessary for weed control

ii.) Continue recording field notes (growth and development, flowering, pest management, maturity, plant height and lodging, harvest management

Fall

i.) Process harvested plot grain samples

ii.) Determine seed yield, test weight, seed weight, and oil content from processed plot grain samples

iii.) Enter all written data records into electronic Excel spreadsheets

Winter

i.) Individual locations will analyze their study data

ii.) Collaborators will provide the P.I. with their locations electronic data and a succinct report on the results

iii.) The P.I. will combine all locations data in a combined ANOVA and prepare a report on all the locations

Years 2 and 3 will follow the same seasonal activities as in Year 1

Year 3 – This year may not be necessary at all the study locations and will be dependent on the results obtained at each location in Years 1 and 2. At some locations factors beyond the researchers control may result in the study being abandoned due to the study being destroyed entirely (hail, flooding, drought, etc.) or the results may be considered confounded by factors (abiotic and/or biotic factors) causing uneven damage across the study area. This could extend the study to three growing seasons at some or all of the locations.

Materials and Methods

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 the Carrington, Hettinger, Langdon, and Minot Research Extension Centers during 2010, 2011, and possibly 2012. The Hettinger and Minot locations are no-till and the Carrington and Langdon locations are conventional till. 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 day intervals with the first date when canola is normally planted at that location. At most locations this would target 1, 8, 16, and 24 May, and 5 June. An optional late April seeding date will be at the discretion of the REC agronomist. 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 $P \leq 0.05$.

References

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Expected outcomes

Expected results from the agronomic field studies should indicate interactions between the independent variables location, seeding date, herbicide resistance type, and variety regarding agronomic and economic yield and other traits. Yield will likely decrease as seeding date is delayed, but the rate of decrease may be different among locations, herbicide resistance type, and varieties. Oil content may also differ among locations and also could be influenced by seeding date, herbicide resistance type, and variety. The interactions of location, seeding date, herbicide resistance type, and variety will be important to identify trends for agronomic and economic yield, oil content, and other traits. The western locations will provide information on previously not reported no-till production.

Uses for results or products

The results will guide seeding date, herbicide resistance type, and variety recommendations to improve canola performance and enhance sustainability.

Outreach/Extension Activities

The study would generate a lot of interest among growers and the canola industry regarding the two most common canola herbicide resistant production systems and could

be showcased at the Research Extension Center (REC) field days and/or for special canola tours (Minot and Langdon). A report or the study results could be posted at the RECs home page and also in the Northern Canola Growers Guide magazine. Dr. H. Kandel, Extension Agronomist at NDSU, will highlight and incorporate the study in his extension activities across North Dakota and northwestern Minnesota. An awareness of the study will be made with the local news media for sharing study information with the public. The study results will be presented at scientific meetings such as the American Society of Agronomy Annual Meeting. When the study is completed a scientific paper will be prepared and submitted to the Agronomy Journal and/or other agricultural journals for publication.

Budget Description

Funding for this study will support primarily materials and supplies, and salaries with a modest amount directed to travel and publication expenses. The travel dedicated funds apply to attending a scientific meeting such as the American Society of Agronomy or U.S. Canola Association and presenting results from the study. The publication dedicated funds would apply to publishing expenses of the study results in Agronomy Journal or another scientific journal. Expenses for materials and supplies include the agronomic inputs for growing canola (seed, fertilizer, pesticides, and fuel); items associated with conducting plot research (small sacks, tags, stakes, field books, flags, envelopes, markers, and etc.); maintenance of the plot equipment (fluids, filters, belts, hoses, batteries, and minor mechanical items (disks, springs, screens, sickles, and etc.); and transport of equipment, supplies, and workers to the research site. Salary expenses are associated with seasonal undergraduate or high school students for their help in management of the study. Their tasks would include assistance with packaging seed, planting, field notes, general study maintenance, harvest, processing harvested grain samples, recording data, and electronic filing.

Undergraduate student salary and fringe benefits - $14,000
Travel - $1,000
Materials and Supplies - $14,000
Publication Costs - $500
Total $29,500