Partners in Progress
OILSEED

Oilseed Research at OSU 2015

Supported by the

Oklahoma Oilseed Commission

Oklahoma State University
Division of Agricultural Sciences
and Natural Resources
Oklahoma Agricultural Experiment Station
Oklahoma Cooperative Extension Service

In cooperation with the
U.S. Department of Agriculture -
Agricultural Research Service

P-1046

Partners in Progress OILSEED

Partners in Progress OILSEED

Oilseed Research at OSU 2015

Supported by the

Oklahoma Oilseed Commission

Oklahoma State University
Division of Agricultural Sciences and Natural Resources
Oklahoma Agricultural Experiment Station
Oklahoma Cooperative Extension Service

In cooperation with
U.S. Department of Agriculture - Agricultural Research Service

P-1046

Printed on recycled paper using soy-based ink.

This report of the Oklahoma Agricultural Experiment Station is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of $1,125.00 for 500 copies. 0116 RI.

Table of Contents

Foreword i

A Partnership 1

Tillage and Cropping Systems to Increase Dryland Crop Production
in Southwest Oklahoma 2

Documenting the Impact of Winter Canola on Nutrient Cycling
in a Winter Wheat Rotation 7

Development of a Sensor-based Nitrogen Rate Calculator for Winter Canola.....9

2014–2015 Winter Canola Demonstration Plots...12

Foreword

We have had a partnership with the Oklahoma Oilseed Commission and the oilseed producers of this state. There have been good times and bad times in terms of state budget restraints, shifts in oilseed production locations in the state and changes in the federal oilseed program. Together, we have survived and are looking forward to a brighter future.

Our *Oilseed Research at OSU 2015* report serves as a means to highlight significant accomplishments in research and Extension programs that have been supported in partnership with the OOC.

With all of the work accomplished, it is important to recognize much more research and Extension programming needs to be done to keep our oilseed producers competitive and in business. Therefore, our work must be focused to solve meaningful issue-based problems facing the oilseed producers in Oklahoma.

This report is one means of being accountable for the funds we have received and communicating the latest results of our programs to oilseed producers as rapidly as possible.

Keith Owens
Associate Vice President
Oklahoma Agricultural Experiment Station
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Oklahoma State University Division of Agricultural Sciences and Natural Resources Mission Statement

The mission of the Oklahoma State University Division of Agricultural Sciences and Natural Resources is to discover, develop, disseminate and preserve knowledge needed to enhance the productivity, profitability and sustainability of agriculture; conserve and improve natural resources; improve the health and well-being of all segments of our society; and to instill in its students the intellectual curiosity, discernment, knowledge and skills needed for their individual development and contribution to society.

A Partnership

Partners in Progress OILSEED

Looking Back

Dry planting conditions in the fall of 2014 were a problem for canola growers who were trying to get a stand established. The unfavorable situation actually prevented some planned acres from being planted. Lack of significant moisture continued to be a concern as the crop entered winter dormancy with dry conditions lasting through the early months of 2015. The canola-growing areas finally began receiving rain in May. The late-arriving rains greatly improved crop prospects but came too late to produce maximum yields.

Due to abnormally wet conditions during May and June, producers had to deal with harvesting delays, extending the season for most growers. Excessive rainfall and damage from a series of severe storms with high winds caused some crop loss.

With all of this adversity, Oklahoma growers reported widely varying canola yields ranging from 700 to 800 pounds per acre up to 2,000 pounds per acre. Where lower yields occurred, they were usually the result of some combination of the winter drought, harvesting delays and loss due to excessive rainfall.

Looking Forward

Since the first significant canola plantings in the region more than a decade ago, a goal of the industry has been to create a canola culture where each year, growers are deciding how much to plant rather than deciding to plant or not. While progress toward this goal has been made, well documented weather challenges have slowed industry expansion compared to what was anticipated.

Recently, prices paid to growers for their crop have been substantially lower than those received during earlier years. A glut of vegetable oils around the world is largely responsible for the down market. Doubtless, the lower prices growers received during the last two years have impacted acres that were subsequently planted. Producers are hopeful – even cautiously optimistic – that the weather will begin to work a little more in their favor. An improvement in prices paid to producers also is needed, but world oil supplies will have a huge impact on when that happens.

A Partnership

Through checkoff dollars collected on oilseed sales, growers support the oilseed research and Extension programs at Oklahoma State University, thus investing in their own prosperity. As state and federal government budgets shrink, grower support for research and outreach is even more critical. Historically, the OOC has contributed more than half of the checkoff funds collected each year to support research and Extension programs at OSU.

Unfortunately, low checkoff collections during the last two years have curtailed the commission's ability to fund research and Extension programs. The commission and growers are very appreciative of OSU's commitment to sustaining research and education efforts during this fiscally challenging period. The commission is committed to the future of the industry and will provide research and education funds as they become available.

The results of OSU's 2014-2015 research and education efforts on canola are contained in the following pages. This report reflects the productive relationship between Oklahoma oilseed growers and the university. Oklahoma's oilseed producers are proud to partner with OSUy and therefore to be "partners in progress."

Ron Sholar
Executive Director
Oklahoma Oilseed Commission

Tillage and Cropping Systems to Increase Dryland Crop Production in Southwest Oklahoma

Gary Strickland
Southwest Research and Extension Center and Jackson and Greer counties

Randy Boman, Josh Bushon and Josh Lofton
Department of Plant and Soil Sciences

2014 – 2015 progress made possible through OOC support

- **To determine and demonstrate the effects of tillage and crop rotation on the economic components of weed and yield management in cotton, canola and wheat systems in Southwest Oklahoma.**

Introduction

While the question of increasing dry-land crop production has been addressed in many studies, southwest Oklahoma producers continue to ask for input and study data that addresses dryland crop production scenarios that will improve economic returns above rising production input costs. To address these scenarios, investigations into 1) cropping and tillage systems, 2) soil organic matter, 3) pest management, 4) herbicide choices and associated residual impacts, and 5) economic analysis of these systems is necessary. A Tillage and Cropping Systems Study was established in Jackson County at the Southwest Research and Extension Center in fall 2002 and concluded in 2012. The study involved cotton, wheat and grain sorghum cropping systems imposed on two tillage treatments including no-tillage and conventional tillage. It is currently one of the longest-running no-till projects in Oklahoma. The results of this study demonstrated the overall study trend of increased returns above production inputs of no-till cropping systems over conventional-till cropping systems as shown in Figure 1.

However, canola was not included in this study as part of the cropping systems. Interest among producers in canola production on acres in Southwest Oklahoma remains an up-and-down prospect. The need for crop rotational data with proven crops in this area across both types of tillage systems is necessary to address continued crop production and economics questions related to canola production in the region. Therefore, as a logical extension of the above study, canola has been incorporated as part of this long-term project. One crop rotation (cotton and

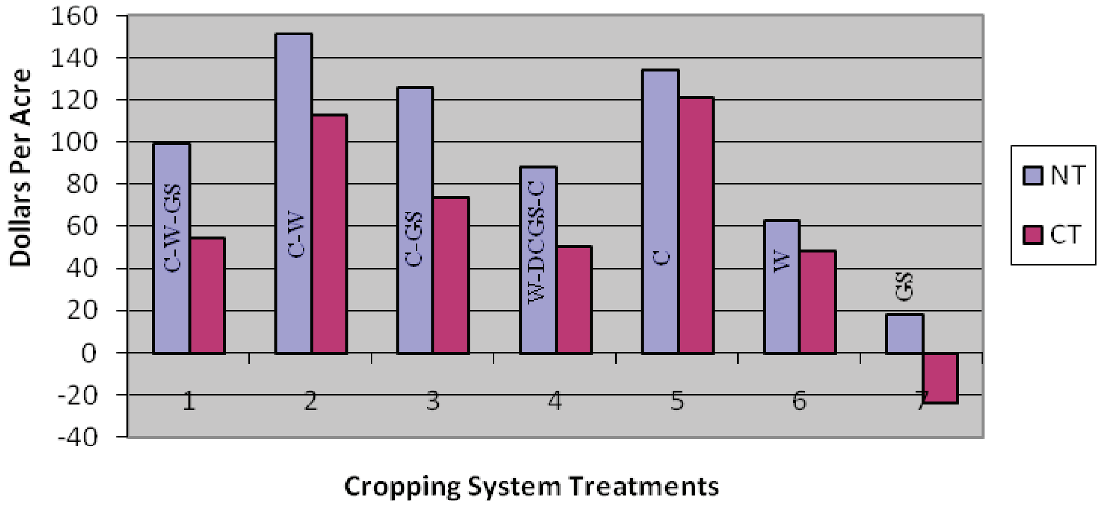

Figure 1. Cropping system by tillage adjusted. Average crop year system returns, 2003-2010 (monocrops minus 2007 crop year). C = Cotton; W = Wheat; GS = Grain Sorghum; NT = No-Till; CT = Conventional Till.

wheat) from the previous study that demonstrated significantly better overall crop performance and economic returns has been utilized in the extension of this long-term study for comparison purposes when introducing winter canola into crop rotation by tillage scenarios.

Study Objectives

The objectives of this study are as follows: to determine the effect of tillage and cropping management systems on weed species population dynamics; to determine and demonstrate the effects of tillage and crop rotation on the economic components of weed and yield management in cotton, canola and wheat systems in Southwest Oklahoma; and to estimate the effects of tillage and cropping systems on soil organic matter accumulation.

Approach and Statistical Procedures

The study site is located at the Southwest Research and Extension Center, utilizing the already existing long-term no-till study site. Two tillage systems (no-tillage and conventional tillage) and seven cropping systems: cotton-canola-wheat (C-Cn-W), cotton-wheat (C-W), canola-wheat (Cn-W), cotton-canola (C-Cn), cotton (C), canola (Cn) and wheat (W) were arranged in a randomized complete block utilizing a split plot design. Tillage systems serve as the main plots and cropping systems as the sub-plots. An ANOVA with F-test was used to analyze the data. When significance is noted, least significant difference was used to measure differences among means.

Cooperators

Cooperators includes above-mentioned principle investigators, plus associated project personnel, Shane Osborne, associate Extension specialist – SWREC; Jerry Goodson, Extension assistant, Department of Entomology and Plant Pathology; and Rocky Thacker, senior station superintendent – SWREC. Special appreciation also is expressed to the entire SWREC support personnel for their continued assistance with this project.

Preliminary Data Discussion

This is the beginning of a long-term study, therefore, data presented will be preliminary in nature. Discussion topics include soil organic matter, weed population and returns above agronomic production inputs up to the point of harvest. Agronomic inputs include tillage applications based on average prices given in the 2013-2014 Oklahoma Farm and Ranch Custom Rates Publication CR-205, fertilizer, herbicides, seed and crop insurance. Crop insurance was deemed necessary to include as part of initial agronomic inputs as the majority of producers purchase crop insurance to minimize financial impacts of crop failures and the resulting losses. Harvest, crop handling and storage all are handled on a very individual and diverse basis and are not estimated in the returns calculations for this report.

It also is important to note that the data discussed in this report comes at the end of a five-year severe drought period in Southwest Oklahoma. Agronomic responses were certainly impacted.

Soil Organic Matter

Soil organic matter is an important part of dryland agriculture production systems, especially in what is typically a more arid area and where stored soil moisture is critical to crop production. The benefits of SOM (i.e., increased water infiltration rate, water storage capacity, cation exchange capacity, anion exchange capacity, decreased soil losses from wind or water erosion, etc.) are all important from an agronomic perspective. In this study SOM is measured at seed placement depth (2 inches) and top soil depth (6 inches). In general, all no-till systems show higher SOM percentages (from 5 percent to 10 percent) than the conventional tillage systems. However, most of these differences are not statistically significant at this point in the study with the exception of the Cn-W system in its second crop year. This system showed significantly higher SOM values when compared to the Cn and W monocrop systems. This begins to reflect the importance of allowing time and potentially utilizing crop rotation systems when dealing with no-till systems in terms of building SOM and those associated benefits.

Weed Population Dynamics and Counts

Weed species across all cropping systems identified to date include grasses (primarily bromegrasses), kochia, common purslane, carpet weed, henbit, redstem filaree and marestail. Weed counts are taken at early crop postemergence and pre-harvest. Herbicide programs within each crop may include

- Canola - Roundup or Select
- Wheat - Roundup (Pre-plant or pre-emergence), Finesse (or other sulfonylureas) or PowerFlex
- Cotton - Trifluralin, Roundup or Dual Magnum (if needed).

Of course crop rotation restrictions must always be taken into consideration when making a herbicide choice.

While not always significant, the no-till cropping systems have higher weed species counts than conventional tillage systems, as would be expected. To date, herbicide programs have remained effective in controlling weed species during the growing season. Again, it is early in the study and differences between the monocrop and crop rotation systems within and across tillage systems is a strong possibility. In the previous study, significantly higher weed counts were noted with certain weed species (i.e., pigweeds and common groundsel) in both the grain sorghum and cotton monocrop systems within the NT system when compared to the other crop rotation systems. Table 1 reflects differences in the canola crop systems and grass control.

Crop Production and Economics

The 2013 crop year brought crop failures in both the canola and wheat cropping systems, regardless of tillage practice due to ongoing drought conditions and multiple late-season freezes. Crop insurance coverage payments utilizing county T yields and a 70 percent coverage policy were applied to production input costs and resulted in statistically significant greater dollar returns in the no-till canola and wheat systems when compared to conventional-till systems. Returns ranged from $88 for conventional till to $113 for no-till in the canola systems while the wheat ranged from $98 for conventional till to $123 for no-till. Without the insurance coverage payments, losses would have ranged from $77 for no-till to $102 for conventional till in the canola systems and $43 for no-till to $68 for conventional till in the wheat systems.

The cotton systems in 2014 (Table 2) did not show statistically significant differences between cropping systems either within or across tillage systems. However, a yield trend difference exists when considering the data as compared to the majority of the other crop systems yield and dollar returns. Again, while not significantly different, the conventional-tillage systems out

Table 1. Grass weed counts in canola cropping systems.

	2013		2014	
Treatments	EPE	PH	EPE	PH
3. Cn-W (NT)	12.3*	0	--	--
6. Cn (NT)	32.7	0	0	0.5
10. Cn-W (CT)	1.7	0	--	--
13. Cn (CT)	2.7	0	0	0
Mean	12.3	0	0	0.25
LSD (p=.05)	14.8	--	--	NS

* Plant counts were taken over a 1 square foot area, two readings per plot and then averaged.

Note: Interaction between tillage and cropping systems was not significant.

Table 2. 2014 Cotton tillage and cropping systems production economics.

	Yield			
Treatments	Lint (lbs./a)	Gin-Run Seed (lbs./a)	Production Expenses $/a	Returns above* Agronomic Inputs $/a
1. C-Cn-W (NT)	637	1,166	134.93	352.75
2. C-W (NT)	447	796	134.93	205.40
4. C-Cn (NT)	461	829	134.93	216.98
5. C (NT)	475	891	134.93	230.73
8. C-Cn-W (CT)	441	801	159.67	177.60
9. C-W (CT)	512	952	159.67	233.34
11. C-Cn (CT)	508	969	159.67	232.55
12. C (CT)	521	966	159.67	240.05
Mean	500	921	--	236.17
LSD (p=.05)	NS	NS	--	NS

Note: Interaction between tillage and cropping systems was not significant.

*Cotton returns include both lint and gin-run seed revenue.

yielded and had greater returns across all cropping systems with the exception of the C-Cn-W rotation. This is different from the other two crops in most tillage * cropping system responses where the NT cropping systems show an advantage. But, it should be noted this is the first cotton crop for this study and the beginning of the majority of the cotton crop systems and this may change with more time.

In 2014, the canola crop failed due to ongoing drought conditions at the time of establishment while the wheat crop was established (Table 3). Insurance coverage payments were applied to the canola systems and resulted in significantly greater returns in the no-till Cn than in the conventional till-Cn systems primarily due to the difference in input expense costs. The no-till wheat systems reflected higher return dollars than the conventional till system. However, these differences were not significantly greater than the conventional till systems. This probably is due to the high amount of variation around observation means associated with a combination of yield and production input expense differences.

Summary

In general, while not always significant, the no-till cropping systems continue to show an advantage in higher yields and greater returns with the exception of the 2014 cotton systems. This early suggested trend agrees with data from the previous study where no-till cropping systems also showed a consistent trend advantage (again while not always significant) in return dollars above agronomic production inputs. In terms of the inclusion of canola in cropping systems more time is needed to evaluate the impact and profitability of canola in these tillage by cropping system interactions for southwest Oklahoma.

Table 3. 2014 Canola and wheat tillage and cropping systems production economics.

	Canola			Wheat		
Treatments	Production Yield (lbs./a)	Agronomic Expenses $/a	Returns above† Inputs $/a	Production Yield (bu./a)	Agronomic Expenses $/a	Returns above Inputs $/a
3. Cn-W (NT)	--	--	--	25.3	93.97	87.69
6. Cn (NT)	0	130.92	25.88(a) *	--	--	--
7. W (NT)	--	--	--	34.3	93.97	151.69
10. Cn-W (CT)	--	--	--	29.1	131.23	77.13
13. Cn (CT)	0	180.81	-24.01(b)	--	--	--
14. W (CT)	--	--	--	27.8	131.23	68.38
Mean	0	--	0.94	29.1	--	96.22
LSD (p=.05)	--	--	--	NS	--	NS

* Means followed by differing letters significantly differ from each other at the .05 probability level.
† Canola returns are reflective of an insurance payment based on a comparable county T yield and a 70 percent coverage policy.
Note: Interaction between wheat tillage and cropping systems was not significant.

Documenting the Impact of Winter Canola on Nutrient Cycling in a Winter Wheat Rotation

Brian Arnall
Department of Plant and Soil Sciences

2014 – 2015 progress made possible through OOC support

- **Evaluate the impact winter canola has on nutrient cycling in a C-W rotation.**
- **Document the impact on winter wheat forage and grain production following winter canola.**

Project Purpose and Objectives

Many are observing an improved winter wheat crop when following winter canola. This increase has been attributed to increased soil quality and soil health, canola's potential as a biofumigant, improved soil bio-diversity, and improved nutrient cycling. Canola has the greatest accumulation of roots in the top 4 inches of soil per pound of yield of any major crop grown in Oklahoma (Cumbie et al.). Canola has twice the root mass of wheat per bushel produced. This increase in roots mass could have multiple impacts including improved soil tilth and improved nutrient cycling.

In Oklahoma's environment, with extremes of both temperature and moisture, the breakdown of above- and below-ground residual plant matter is difficult to predict. This study will attempt to document the organic matter cycle in both the wheat and canola systems. It is possible fertility management strategies of wheat following canola are different than that of continuous wheat. It would be a great impact if this project documents that wheat following canola has a greater yield potential at reduced input levels. At the same time, this project could show an increased wheat-yield potential requires an equal increase in fertilization.

Output

The first year of this project was to initiate a rotation consisting of the treatment structure outlined in Table 4. This trial was established at Lake Carl Blackwell in 2014 and had a successful harvest in summer 2015. After harvest, each plot was sampled and analyzed for soil nutrient levels. In fall 2015, the entire block was planted to wheat. Each plot from the previous year was split, where half received 90 pounds nitrogen per acre pre-plant and half received nothing.

Table 4. The treatment structure for the rotational study established in fall 2014.

Treatment	Crop	Preplant N
1	**canola**	**0**
2	**canola**	**30**
3	**canola**	**60**
4	**canola**	**90**
5	**wheat**	**0**
6	**wheat**	**30**
7	**wheat**	**60**
8	**wheat**	**90**

Table 5. The amended treatment structure for the second year of the rotational study established in fall 2015.

Treatment	Previous Crop	Previous Preplant N	Current Preplant N
1	**canola**	**0**	**90**
2	**canola**	**30**	**90**
3	**canola**	**60**	**90**
4	**canola**	**90**	**90**
5	**wheat**	**0**	**90**
6	**wheat**	**30**	**90**
7	**wheat**	**60**	**90**
8	**wheat**	**90**	**90**
9	**canola**	**0**	**0**
10	**canola**	**30**	**0**
11	**canola**	**60**	**0**
12	**canola**	**90**	**0**
13	**wheat**	**0**	**0**
14	**wheat**	**30**	**0**
15	**wheat**	**60**	0
16	**wheat**	**90**	**0**

These plots are being sensed with a GreenSeeker throughout the season and at maturity will be harvested. The grain yield and quality will be determined.

Yield was collected from the 2014-2015 crop year. The yields of the canola were lower than expected due to some stand issues. However, the crop was of significant level to continue the project.

Table 6. Grain yields collected from the first year of the rotational study.

Wheat		Canola	
lbs N	Bushels	lbs N	Bushels
0	47.4	0	26.7
30	50.7	30	24.1
60	55.1	60	31.2
90	54.8	90	22.0

Development of a Sensor-Based Nitrogen Rate Calculator for Winter Canola

Brian Arnall
Department of Plant and Soil Sciences

2014 – 2015 progress made possible through OOC support

- **Collect the necessary data to develop a sensor-based nitrogen rate calculator for winter canola.**
- **Have the needed data set to evaluate SBNRC nitrogen rate generated from SBNRC.**

Project Purpose and Objectives

As the acres under canola production increase and producers gain more experience with the crop, many want to improve their nitrogen management practices. The use of N-rich strips, optical sensors (GreenSeeker normalized difference vegetation index), and online SBNRCs has not only been proven through research but also it is supported as a Better Management Practice by the Natural Resource Conservation Service. In fact, the NRCS offers cost-share support for use of the technology through the Environmental Quality Incentive Program. OSU research and Extension personnel such as Bill Raun and Brian Arnall have been developing and promoting the use of N-rich strips and SBNRC in winter wheat since the late 9190s. By a conservative estimate, N-rich strips are applied in over 500,000 acres of winter wheat in Oklahoma each year resulting in an average increase in profit of $10 per acre per year. Over the past two years, Arnall has supported the use of N-rich strips and the GreenSeeker sensor in winter canola by adjusting the recommendation made by using the SBNRC created for Canadian-grown spring canola. This approach has been successful, however an emphasis must be placed on the creation of a regionally specific winter canola SBNRC for Oklahoma producers. Due to canola's higher market value, the return on using this technology could be even higher than the $10 per acre for winter wheat. Previous work, supported by the OOC, by Katlynn Weathers and the Precision Nutrient Management Project, has shown that split application of nitrogen is an adequate management strategy. This is extremely important as split application of nitrogen is a critical component of the SBNRC program. This project will create an algorithm specific for winter canola grown in Oklahoma and make the Oklahoma Winter Canola SBNRC available on the nue.okstate.edu website along with the other crop SBNRCs.

Output

The 2013–2104 crop year was a complete loss with zero of the three established locations being harvested. Therefore, in fall 2014, when the trials were established, the number of replications at each location was doubled from three to six to increase the number of observations. Two locations survived to harvest and produced quality data. Unfortunately one of the three locations was lost to drought and early season freezes. This project resulted in a completed master's thesis.

In 2015, all data was combined and showed a high correlation between final grain yield and normalized difference vegetative index. When the data was narrowed to only sensor readings taken after growing degree days reached 90, the relationship improved. Unlike previous algorithms developed, normalizing data with GDD or heat units did not improve upon the model. A low correlation was found between the response index at harvest and the response index of NDVI, which allowed the use of an adjusted response index value to be used in the nitrogen fertilization optimization algorithm. Utilization of the YP0 model and an adjusted response index along with percent grain nitrogen (3.76 percent) and a nitrogen use efficiency of 70 percent, the NFOA were developed. Using NFOA, top-dress N rates were calculated for both locations. The resulting recommendations were within 0 and 2 kilograms nitrogen ha^{-1} of the optimum N rate documented by the curve developed from the top-dress treatments. While much more work is needed this work documents that the use NDVI measurement and the N-Rich strip utilized in a yield prediction and RI model can be used to produce an accurate top-dress nitrogen rate.

The development of an NFOA will allow for accurate top-dress nitrogen rate recommendations to provide an alternative to applying all nitrogen pre-plant and ultimately reducing the risk of applying too much or too little nitrogen. Yield prediction is the most important component of the NFOA. Winter canola grain yield was highly correlated with NDVI within all YP0 models. However, when utilizing sensor readings collected after GDD reached 90 or more, the r^2 increased from 0.64 to 0.73. The r^2 slightly decreased when only using the last sensor readings, taken at the initiation of bolting, to 0.71. These two models produced the highest r^2 and are an indication that the best time to sense to get an accurate prediction of yield is after GDD reach 90 and prior to bolting. Unlike the algorithm developed for other grains, normalizing NDVI with the use of GDD and cumulative heat units did not improve the yield prediction. Utilizing heat units was an improvement over GDD, but still not as good as NDVI alone. It is also important to note that at least in this data set row space did not impact the correlation between NDVI and yield. A correlation between the response index at harvest and the response index of NDVI was not a 1:1 relationship so therefore to properly estimate the responsiveness to added nitrogen an adjusted RI equation was used. The yield model and an adjusted response index equation presented represent one year of data collection. The robustness of the models will have to be improved with additional data collected over a series of years and locations. It is important to continually update these algorithms to allow them to become accurate in multiple environments and account for changes in crop genetics. Canola NUE is not discussed often within literature, but the overall opinion is that it is highly dependent on variety and environments. Additional research would be needed to look into a more accurate NUE for winter canola. For this experiment, the NUE was set at 70 percent, which may need to be refined in the future. This research is a good start to producing an online SBNRC for use by producers. The data presented shows canola yield can be accurately predicted using NDVI and the GreenSeeker sensor. It also shows the ability to predict an accurate mid-season nitrogen rate for winter canola grown in Oklahoma. As previously discussed, the amount of N needed at the South Central Research Station near Chickasha and Lake Carl Blackwell Research Station were vastly different with no nitrogen needed at CHK to 89.6 kilograms nitrogen ha^{-1} needed at LCB. This demonstrates the importance of technologies such as the SBNRC in the pursuit of a cropping system which is both economical and environmentally sound.

Table 7. Treatment means showing t-grouping (LSD) for grain yield at the Lake Carl Blackwell Research Station (LCB) near Stillwater, and South Central Research Station (CHK) near Chickasha, 2014-2015.

	Yield kg/ha^{-1}	
Treatment	CHK	LCB
1	1,213	719 h[1]
2	1,201	802 gh
3	1,436	1,075 fg
4	1,286	992 ef
5	1,380	1,285 de
6	1,168	1,811 ab
7	1,597	2,010 a
8	1,130	1,218 ef
9	1,336	1,527 cd
10	1,072	1,707 bc
11	1,155	2,007 a
12	1,193	1,926 ab
SED	43.24	135.74

[1] Means with the same letter are not significantly different at 0.05 probability level.

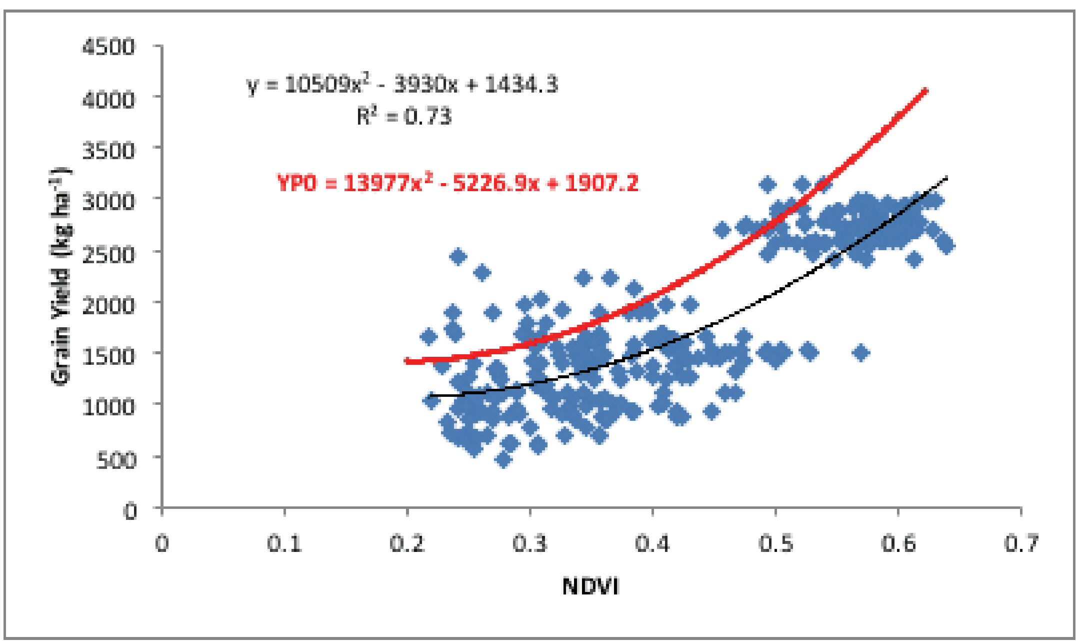

Figure 2. Polynomial relationship between final grain yield and NDVI using sensor readings taken after GDD reached or exceeded 90. Where YP = yield potential, mean + 1 standard deviation.

2014-2015 Winter Canola Demonstration Plots

Josh Bushong and Josh Lofton
Department of Plant and Soil Sciences

2014 – 2015 progress made possible through OOC support

- **Thirteen locations seeded across western Oklahoma.**
- **Thirteen field tours held in April with more than 300 attendees.**
- **Diammonium phosphate (18-46-0) applied in-furrow at seeding reduced canola stands, but not yields.**

Introduction

Canola producers in Oklahoma have experienced below-optimal growing conditions and a historic drought in recent years. This has caused a decrease in canola production acres. However, overall interest in the crop remains high. As canola is still a new crop for producers in the state of Oklahoma, the need for production education is at an all-time high in order to ensure optimum production for growers and to minimize production risks. Variety information and selection are two of the most critical decisions as it sets the yield potential of that production system. Additionally, variety selection provides growers one of the best tools for both insect and disease management. Therefore, growth and yield information regarding commercially and soon-to-be commercially available cultivars across a wide array of environments will help producers across the state identify cultivars that could be beneficial in their production system.

In addition to the information provided by these variety trials, the trials can also serve as a valuable educational tool for growers and managers in the state. The demonstration plots are an excellent way to interact with the local producers and to educate them about various aspects of canola production, as these will serve as locations for the spring field tours.

Methods and Materials

There were three demonstration plots that were carried through completion throughout the state for the 2014-2015 production season. These demonstration plots were centralized in the predominate canola-growing regions of Oklahoma and were situated in areas where interest in the crop was high. More locations were planted, but due to drought conditions and early freezes, other locations did not fully establish and were abandoned. Individual sites included Perry, Billings and Randlett. All locations had a minimum of three replications. All plot maintenance regarding IPM and fertility management were conducted in accordance to local practices and OSU Extension recommendations.

All cultivars used in the trial were glyphosate resistant. Individual cultivars used for this trial include Dekalb 41-

10, 44-10, 45-25, 46-15 and 47-15; Star Specialty Seeds 915W; HyClass 115W and 125W; Pioneer 46W94; and one experimental EXP 14-05.

The plots were all established on main roads for local growers to visit in their area and compare the different cultivars throughout the growing season. Signs were posted in early spring to showcase each cultivar during critical reproductive stages.

Harvest samples were analyzed using a near infrared machine to determine the oil quality. The NIR machine tests each sample for moisture content, protein, oil content, ash, chlorophyll, palmitate, oleate, stearate, linoleate, linolenate, eicosenoate and glucosolinolate, although only yields and total oil content will be presented.

Results and Discussion

The 2014-2015 canola production season in Oklahoma was average to good, but much improved over the previous two seasons. Throughout the season, much of the state's crop could be considered average to poor, mainly due to dry conditions and cold winter temperatures. A majority of these poor conditions were experienced at or around planting. These dry conditions significantly delayed planting for many parts of the state and required many growers to "dust in" the crop, i.e. plant into dry soil. Dry conditions continued through late fall and early winter. These conditions, paired with early season freezes and cool temperatures, resulted in some of the state experiencing stand loss or winterkill, similar to what was experienced during the 2013-2014 season. Dry conditions continued into early spring but plentiful moisture during the early to late-reproductive stages significantly improved the crop. These rains turned much of the crop around and yields ranged from average to good. Continued moisture through late maturity and harvest quickly turned from a benefit to a challenge, as harvest was delayed in many locations around the state.

As with previous years, the main highlight of these demonstration plots was showcasing them during the field tours conducted throughout April. Approximately 200 growers in attendance visited nine destinations during a four-day period, which paired OOC demonstration locations and Oklahoma official variety locations. Each program lasted approximately 90 minutes at each destination. Several production topics were emphasized during these meetings, which included fertility, no-till production, pest management, cultivar characteristics, harvesting options and marketing.

Yields were highly variable across trial locations. On average, highest yields across all cultivars evaluated were at the Perry location, followed by Billings and Randlett locations, respectively. While yields were generally higher, only one cultivar (Star 915W) was found to be significantly lower than the rest. The lack of yield difference due to cultivar can partially be explained by the high amount of variability associated with the trial (CV= 22.99). A similar lack of cultivar response can be noted at the Randlett location as well. As with the Perry location, the lack of a cultivar response can be denoted to the high degree of variability present (CV=23.37). This resulted in Billings having the only cultivar response during the 2014-2015 season. Cultivars DKW 44-10 and 45-25 recorded the highest yield throughout the trial. However, DKW 46-15 and HC 115W yielded similar but slightly lower. Due to the challenging conditions, as well as the lack of cultivar response at two of the three locations in 2014-2015, it must be stressed that growers should look at multiple years, as well as utilize both variety trials and demonstrations, to make informed cultivar selections.

In addition to yields, oil content was measured. These additional measurements also should be a critical decision tool when selecting cultivars, especially during high-stress environments. No differences in oil content were found at the Perry location. However, it is unclear as to why no differences were noted as variability in these cultivars can be expected and outside variability of the trial was low (CV=1.8). Oil content was found to be highest for HC 115W for both Billings and Randlett. This is a critical finding as not only was oil content high, but this cultivar was in the top yielding group at the Billings location. In addition, oil content for Star 915W, DKW 46-15 and EXP 14-05 were found to be similar to that found for HC 115W but slightly lower at the Billings location. Furthermore, Star 915W, DKS 46-15, 47-15, EXP 14-05 and P 46W94 were similar but slightly lower at the Randlett location. This demonstrates that not only do Oklahoma growers have access to high yielding varieties, but also numerous varieties that have the potential to achieve high oil content, with several that are able to achieve both high yields and oil.

Table 8. 2015 Oklahoma Oilseed Commission winter canola demonstrations.

	Perry				Billings				Randlett			
	Yield bu./a		Oil Content %		Yield bu./a		Oil Content %		Yield bu./a		Oil Content %	
Star 915W	33.0	b[1]	41.2	a	22.9	bcd	40.6	ab	21.6	a	39.1	ab
DKW 41-10	59.3	a	40.2	a	14.3	ef	37.0	d	15.0	a	37.2	bc
DKW 44-10	50.1	ab	40.2	a	30.8	a	40.0	bc	22.2	a	37.2	bc
DKW 45-25	42.4	ab	40.8	a	31.7	a	39.1	c	18.2	a	37.2	bc
DKW 46-15	51.4	ab	41.0	a	28.8	ab	40.6	ab	17.1	a	38.5	abc
DKW 47-15	48.1	ab	40.2	a	22.5	bcd	39.4	bc	18.1	a	38.5	abc
HC 115W	40.8	ab	41.1	a	25.4	abc	41.3	a	23.9	a	39.4	a
HC 125W	50.0	ab	41.1	a	20.4	cde	39.7	bc	17.7	a	36.7	c
EXP. 14-05	40.3	ab	40.7	a	15.8	def	40.2	abc	23.3	a	37.8	abc
P 46W94	45.7	ab	40.0	a	11.7	f	40.6	ab	20.7	a	39.6	a
Mean	46.1		40.6		22.4		39.8		19.8		38.1	
LSD (p=.05)	18.69		1.289		7.14		1.1023		7.93		1.8656	
CV	22.99		1.8		18.45		1.61		23.37		2.85	

[1] Letters within the same column indicate significant differences between the cultivars.

2014-2015 Reaction of the National Winter Canola Variety Trial to Blackleg and Winter Decline Sydrome

John Damicone and Tyler Pierson
Department of Entomology and Plant Pathology

Mike Stamm
Kansas State University

Wendal Vaughan, Jason Warren, Josh Bushong and Josh Lofton
Department of Plant and Soil Sciences

2014-2015 progress made possible through OOC support

- **In screening for field resistance to black leg, winter survival had the biggest impact on yield.**
- **Winter decline syndrome (swollen and hollowed lower stems with internal brown discoloration) made rating stem cankers from black leg difficult and black leg ratings were likely inflated.**
- **Popular round-up Ready varieties (DKW and HyClass) generally had good winter survival and intermediate levels of black leg while conventional KSU varieties and breeding lines were among the most resistant entries to black leg.**

Introduction

Blackleg, caused by the fungus *Leptosphaeria maculans,* has become a widespread disease of winter canola in Oklahoma. The fungus causes leaf spot on rosette-stage canola, grows without symptoms into the crown and eventually produces a canker at the stem base near the soil line during the ripening stage of crop development. The cankers disrupt normal stem function and may reduce yield by causing lodging and/or premature ripening. The disease is managed primarily by planting resistant varieties. This report details results of screening the varieties, hybrids and breeding lines in the National Winter Canola Variety Trial for resistance to blackleg.

Crop Management

The trial was located at the Cimarron Valley Research Station in Perkins in a field of Konawa fine sandy loam previously cropped to millet. The herbicide Treflan 4E at 1.5 pints per acre and granular fertilizer (46-0-0 pounds per acre N-P-K) were applied broadcast and incorporated into the soil prior to planting on Sept. 26, 2014. Entries were seeded at a rate of 5 pounds per acre with a grain drill. Plots consisted of six 23-foot-long rows spaced 8 inches apart. The experimental design was a randomized complete block with three replications separated by a 10-foot-wide fallow buffer. Plots were inoculated with the blackleg fungus by spreading canola stubble from an infested field along the center of each plot prior to emergence on Sept. 29, 2014. Plots were top-dressed with granular fertilizer (92-0-0 pounds per acre N-P-K) on Feb. 13, 2015. Insects were controlled with Warrior 1F at 3 fluid ounces per acre on April 2, 2015. Plots were swathed on June 2, 2015, and harvested with a small-plot combine on June 23. Yields were adjusted to 10 percent moisture.

Disease and Crop Assessment

Plots were evaluated for winter survival by estimating plot area with live plants just before regrowth in late winter. Blackleg was assessed on the stubble after swathing on June 2 – 3, 2014. Disease incidence, the percentage of plants with blackleg cankers, and severity, the level of internal stem decay from 0-5, were assessed by uprooting plants and examining basal cross sections of 12 stems per plot. The presence of winter decline syndrome, characterized by swollen, hollowed and internally discolored lower stems at the soil line, was noted for each stem. The cause of winter decline syndrome is unknown, but it has been associated with excessive fall growth and freeze damage.

Trial Conditions

Rainfall totals were nearly normal based on a 30-year average from October through May. However, rainfall was 4 inches below normal from October through April. Rainfall during the cropping period totaled 2.97 inches for October, 2.07 inches for November, 0.9 inches for December, 1.07 inches for January, 0.86 inch for February, 2.13 inches for March, 3.78 inches for April, and 7.63 inches for May. Average monthly temperatures were nearly normal except for November and February which were 5.5 F and 7.1 F below normal, respectively. The dry conditions in the fall and a hard freeze in early November limited blackleg development and the leaf spot phase of the disease did not develop in the fall. Blackleg cankers developed on basal areas of most stems near the soil line and reached severe levels compared to previous trials by harvest. Winter decline syndrome occurred frequently and contributed to plant lodging of some entries. The co-occurrence of blackleg and winter decline syndrome made rating internal crown decay from blackleg difficult and resulting blackleg severity ratings were likely overestimated.

Data Interpretation

In interpreting the result (Table 9), small differences in entries should not be overemphasized. Statistical analysis at the 95 percent confidence level was applied to the data. Where entry effects were statistically significant at 95 percent confidence (p=0.05), a LSD value is reported at the bottom of a column. Unless treatments differ by more than the LSD, little confidence can be placed in the superiority of one treatment over another. For variables (amount of disease, yield, etc.) where the entry effect was not statistically significant, an NS is reported at the bottom of the column, and differences by chance alone cannot be ruled out.

Results

The effect of entry was statistically significant for winter survival and incidence of winter decline syndrome, but not for blackleg incidence or severity (Table 9). The reference cultivars (DKW entries, HyClass entries, Wichita and Sumner) generally had good winter survival, low levels of winter decline syndrome, and intermediate levels of blackleg. Entries with the lowest blackleg severity included EXP 1301, KSUR21, and MH12AX37. Yields were generally higher than expected given the dry winter and frequent rains during May and June, which delayed plot combining.

Partners in Progress OILSEED

Table 9. Reaction of winter canola entries to blackleg and winter decline syndrome.

Entry	Winter survival (%)[z]	Winter decline syndrome (%)[y]	Blackleg Incidence (%)[x]	Blackleg Severity (0-5)[w]	Yield (lb/a)
NK Technic 115	66.7 b-h[v]	55.7 a-d	89.0	3.78	3,201 a-f
Einstein	76.7 ab	42.7 a-g	76.7	3.57	2,521 d-m
Croplan 15-19	65.0 b-i	39.0 a-i	72.3	3.53	2,797 c-l
Croplan 14-05	56.7 g-k	64.0 ab	75.0	3.50	3,020 a-i
Mercedes	73.3 a-d	47.3 a-g	77.7	3.50	3,042 a-i
DKW 46-15	68.3 a-g	39.0 a-i	75.0	3.47	3,002 a-j
SY Marten	63.3 c-i	55.7 a-d	69.7	3.44	2,104 h-n
Sitro	53.3 ijk	52.7 a-e	78.0	3.39	619 r
SY Fighter	70.0 a-f	58.3 abc	77.7	3.30	3,705 abc
Safran	65.0 b-i	44.7 a-g	69.7	3.28	3,100 a-h
Popular	73.3 a-d	36.0 b-i	67.7	3.26	3,499 a-d
KSR07363	68.3 a-g	27.7 d-i	71.3	3.19	2,624 c-l
Dimension	61.7 d-j	66.7 a	63.7	3.14	2,392 d-m
CHH2311	56.7 g-k	58.3 abc	63.7	3.12	2,444 d-m
DKW 47-15	46.7 k	36.0 b-i	61.0	3.11	653 r
HyClass 115W	75.0 abc	36.3 b-i	72.3	3.11	2,395 d-m
Edimax CL	68.3 a-g	46.7 a-g	69.0	3.09	1,956 k-p
HyClass 125W	76.7 ab	30.7 c-i	52.7	3.08	2,782 c-l
DK Severnyl	66.7 b-h	37.7 b-i	75.0	3.07	2,140 g-n
Chrome	50.0 mjk	58.3 abc	66.7	3.03	2,552 c-m
DK Sensei	70.0 a-f	11.3 i	64.3	3.03	3,709 abc
Claremore	61.7 d-j	36.0 b-i	69.3	3.02	2,793 c-l
Garou	50 jk	57.7 abc	73.0	3.00	854 qr
DKW 41-10	66.7 b-h	30.3 c-i	63.7	3.00	989 pqr
46W94	55.0 h-k	27.7 d-i	61.0	3.00	1,006 o-r
Star 915W	65.0 b-i	50.0 a-g	61.3	2.98	1,260 n-r
DK Imiron CL	71.7 a-e	30.3 c-i	69.3	2.97	3,040 a-i
Wichita	70.0 a-f	22.3 f-i	61.0	2.95	1,948 k-p
SY Harnas	63.3 c-i	45.3 a-g	63.0	2.94	2,374 e-n
DL 14001RR	53.3 ijk	58.0 abc	63.7	2.92	2,033 i-o
Raffiness	68.3 a-g	28.0 d-i	64.0	2.86	3,012 a-j
MH11M16	68.3 a-g	31.3 c-i	65.0	2.86	2,868 b-l
Inspiration	56.7 g-k	52.7 a-e	69.7	2.85	2,158 g-n
Croplan 15-20	66.7 b-h	28.0 d-i	66.7	2.79	2,792 c-l
PX117	76.7 ab	42.7 a-g	59.3	2.78	4,034 a
DKW 44-10	80.0 a	64.0 ab	55.3	2.78	2,797 c-l
DKW 45-25	68.3 a-g	28.7 d-i	68.3	2.78	2,766 c-l
Hekip	68.3 a-g	30.0 c-i	59.0	2.76	1,975 j-p
Hornet	63.3 c-i	40.7 a-h	55.3	2.75	1,889 l-q
MH11J41	73.3 a-d	50.0 a-f	61.0	2.73	3,843 ab
NK Petrol	55.0 h-k	50.3 a-f	55.7	2.69	3,048 a-i
DK Imistar CL	70.0 a-f	33.3 c-i	53.0	2.69	3,350 a-e
KS4549	65.0 b-i	13.7 h-i	50.0	2.64	2,971 b-k
VSX-4	60.0 e-j	58.3 abc	61.0	2.61	3,143 a-h
VSX-3	63.3 c-i	55.3 a-d	58.0	2.57	3,161 a-g
SY Saveo	61.7 d-j	53.0 a-e	66.7	2.53	2,986 b-k
Virginia	63.3 d-i	27.7 d-i	50.3	2.47	2,380 d-n
PX112	75.0 abc	27.7 d-i	52.7	2.47	3,606 abc
Sumner	58.3 f-k	19.3 g-i	50.3	2.42	1,580 m-r
Riley	58.3 f-k	33.0 c-i	53.3	2.34	2,299 f-n
KS5406	73.3 a-d	30.7 c-i	44.7	2.25	3,053 a-i
EXP1302	65.0 b-i	44.7 a-g	36.0	2.14	3,680 abc
EXP1301	66.7 b-h	25.0 e-i	36.0	1.97	2,501 d-m
KSUR21	70.0 a-f	39.0 a-i	53.0	1.81	2,934 b-k
MH12AX37	66.7 b-h	50.0 a-f	66.7	1.81	2,139 g-n
LSD[u]	<0.01	<0.01	NS	NS	<0.01

z Percentage of plot with live foliage on Feb. 11, 2015.
y Percentage of plants with winter decline syndrome.
x Percentage of plants with a blackleg severity rating of ≥3.
w Internal stem decay from blackleg on a 0 to 5 scale where 0 = no disease, 1 = 25 percent of the stem with decay, 2 = 50 percent of the stem with decay, 3 = 75 percent of the stem with decay, 4 = 100 percent of the stem with decay and 5 = dead plant.
v Values in a column followed by the same letter are not statistically different at P=0.05 according to t-tests produced by the Lines option of SAS Proc GLIMMIX.
u LSC at 95 percent probability. NS = treatment effect not statistically significant at 95 percent probability.

Partners in Progress OILSEED

2014-2015 Fungicide Performance Trials for Control of Canola Blackleg

John Damicone and Tyler Pierson
Department of Entomology Plant Pathology

Mike Stamm
Canola Breeder, Kansas State University

Wendal Vaughan, Jason Warren, Josh Bushong and Josh Lofton
Department of Plant and Soil Sciences

2014-2015 progress made possible through OOC support

- **The leaf spot phase of black leg appeared in the fall, but excessive fall growth followed by severe winterkill masked the effects of black leg.**
- **Fungicide (Priaxor) and/or growth regulator (Pentia) application in the fall did not reduce plant growth or increase winter survival.**
- **As previously observed, application of fungicides (Proline and Priaxor) in the fall resulted in moderate yield increases that were not statistically significant.**

Introduction

Blackleg, caused by the fungus *Leptosphaeria maculans,* has become a widespread disease in Oklahoma. The fungus causes leaf spot on rosette-stage canola, grows without symptoms into the crown and eventually produces a canker at the stem base near the soil line during the ripening stage of crop development. The cankers disrupt normal stem function and may reduce yield by causing lodging and/or premature ripening. The disease is managed by planting resistant varieties and applying fungicides to reduce plant infection. This report details the effectiveness of fungicide programs on control of blackleg and yield of winter canola.

Crop Management

Fungicide performance trials on winter canola were conducted at the Entomology and Plant Pathology Research Farm in Stillwater in a field of Easpur loam previously cropped to wheat. Granular fertilizer (37-0-0 pounds per acre) and the herbicide Treflan 4E at 1.5 pt/A were incorporated into the soil prior to planting the variety HyClass 115W at 5 pounds of seed per acre with a grain drill on Sept. 16, 2014. The herbicide Roundup Pro 4L at 1.5 pints per acre was applied post-emergence on Nov. 11, 2014, and on March 12, 2015 for additional weed control. Plots were top-dressed with additional granular fertilizer (70-0-0 pounds per acre) on Feb. 13, 2015.

Insects were controlled with Warrior 1F at 3 fluid ounces per acre on 2 Apr 2015. Plots consisted of eight 25-foot-long rows spaced 8 inches apart. The experimental design was a randomized complete block with four replications separated by a 10-foot-wide fallow buffer. Plots were inoculated with the blackleg fungus by spreading canola stubble from an infested field along the center of each plot after planting on Sept. 22, 2014. Fungicides were broadcast through flat-fan nozzles (Tee-Jet 8002vk) spaced 18 inches apart using a CO_2-pressurized wheelbarrow sprayer. The sprayer was calibrated to deliver 26 gallons per acre at 40 pounds per square inch. Plots were swathed into windrows on June 5, 2015, prior to harvest with a small-plot combine on June 12, 2015. Yields were adjusted to 10 percent moisture.

Disease and Crop Assessment

Plant growth was assessed by counting the number of leaves per plant on five plants per plot on Nov. 10, 2015. Incidence of leaf spot (0 to 3 scale) was assessed on Nov. 10, 2015 and winter survival, based onplot area with living plants, was assessed prior to spring regrowth on Feb. 11, 2015. The percentage of dead plants was estimated prior to swathing. Blackleg was assessed on the stubble after swathing on June 8, 2015. Disease incidence, the percentage of plants with severe (≥3) cankers, and severity, the level of internal stem decay, ranging from 0-5, were assessed on uprooted plants by examining basal cross sections of 12 stems per plot. The presence of winter decline syndrome, characterized by swollen, hollowed and internally discolored lower stems at the soil line, was noted for each stem. The cause of winter decline syndrome is unknown, but it has been associated with excessive fall growth and freeze damage.

Trial Conditions

Rainfall totals were nearly normal, based on a 30-year average, over the entire cropping period from October through May. However, rainfall was 6 inches below normal from October through April. Rainfall totaled 2.18 inches for October, 2.09 inches for November, 0.57 inch for December, 1.01 inches for January, 0.49 inch for February, 1.35 inches for March, 3.89 inches for April, and 9.2 inches for May. Average monthly temperatures were nearly normal except for November and February, which were 5.5 F and 7.1 F below normal, respectively. Despite the dry conditions in the fall, leaf spot was observed at low levels in early Nov. A hard freeze followed shortly thereafter and caused significant winterkill in plots. Blackleg cankers developed on basal areas of most stems near the soil line and reached severe levels compared to previous trials by harvest. Winter decline syndrome was frequently observed on sampled stems and resulted in significant plant lodging. The co-occurrence of blackleg and winter decline syndrome made rating internal crown decay from blackleg difficult and resulting blackleg severity ratings were likely overestimated.

Data Interpretation

In interpreting the results (tables 10 and 11), small differences in treatment values should not be overemphasized. Statistical analysis at the 95 percent confidence level was applied to the data. Where treatment effects were statistically significant at 95 percent confidence (p=0.05), a LSD value is reported at the bottom of a column. Unless treatments differ by more than the LSD, little confidence can be placed in the superiority of one treatment over another. For variables (amount of disease, yield, etc.) where the treatment effect

Table 10. Effects of fungicide and application timing on control of blackleg on HyClass 115W winter canola.

Treatment and rate/A (timing)[z]	Winter survival (%)[y]	Blackleg Leaf spot (0-3)[x]	Blackleg Incidence (%)	Blackleg Severity (0-5)[w]	Winter decline syndrome (%)[v]	Yield (lb/a)
Non-treated check	70.0 bcd	0.82 abc[u]	79.2	3.5	66.7	2,099 a-e
Proline 4F 5.7 fl. oz (1)	81.2 a	0.25 cde	77.2	3.5	66.5	2,637 a
Proline 4F 5.7 fl. oz (2)	68.7 bcd	0.17 ed	75.0	3.3	58.5	2,267 a-d
Proline 4F 5.7 fl. oz (3)	67.5 d	0.82 abc	79.0	3.6	58.2	1,945 cde
Proline 4F 5.7 fl. oz (1,2)	72.5 abc	0.07 e	74.7	3.2	66.7	2,550 ab
Proline 4F 5.7 fl. oz (1,3)	78.7 ab	0.00 e	79.2	3.5	73.0	2,507 abc
Proline 4F 5.7 fl. oz (2,3)	72.5 abc	0.57 a-e	74.7	3.3	67.2	2,237 a-e
Approach 2.08F 6 fl. oz (1)	71.2 abc	0.47 a-e	77.2	3.4	79.2	1,667 e
Approach 2.08F 6 fl. oz (2)	68.7 bcd	1.10 a	85.5	3.9	68.7	1,878 de
Approach 2.08F 6 fl. oz (3)	60.0 d	0.90 ab	85.5	3.5	81.0	1,742 de
Approach 2.08F 6 fl. oz (1,2)	70.0 bcd	0.32 b-e	64.5	2.9	66.7	1,690 de
Approach 2.08F 6 fl. oz (1,3)	75.0 abc	0.42 b-e	79.2	3.6	74.7	1,849 de
Approach 2.08F 6 fl. oz (2,3)	69.6 bcd	0.75 a-d	81.2	3.6	70.7	2,034 de
LSD (p=0.05)[t]	10.7	0.63	NS	NS	NS	588

[z] Applications were at 1=early rosette on 20 Oct 2014, 2=mid-rosette on Nov. 11, 2014, and 3=first bud on March 24, 2015.
[y] Percentage of plot with live foliage on Feb. 11, 2015.
[x] Incidence of leaf spot per plot from 0-3 where 0 = no leaf spot, 1 = 1-5 leaf spots, 2 = 5-10 leaf spots, 3 = $\geq$10 leaf spots.
[w] Internal stem decay from 0 to 5 where 0 = no disease, 1 = 25 percent of the stem with decay, 2 = 50 percent of the stem with decay, 3 = 75 percent of the stem with decay, 4 = 100 percent of the stem with decay and 5 = dead plant.
[v] Percentage of plants with winter decline syndrome.
[u] Values in a column followed by the same letter are not significantly different according to Fisher's LSD test.
[t] LSD at 95 percent probability. NS = treatment effect not statistically significant at 95 percent probability.

was not statistically significant, an NS is reported at the bottom of the column, and differences by chance alone cannot be ruled out.

Results

Evaluation of fungicides and application timing.

Fungicides registered for use on canola were applied at various timings in the fall and spring for protecting against the stem-canker phase of blackleg in the spring. Treatments were applied at one or two growth stages that included early rosette (2 to 4 leaves) and mid-rosette (6 to 8 leaves) in the fall and first bud in the spring.

Treatment effects were significant only for winter survival, leaf spot and yield. Proline applied once at early rosette had better winter survival compared to the untreated check, but the effect was not consistent as survival was not improved for the other Proline treatments that included the early rosette timing. Some, but not all, of the Proline treatments reduced leaf spot levels compared to the untreated check, but none of the Approach treatments reduced leaf spot levels. Yields did not significantly differ from the untreated check for any of the treatments. However, yield for Proline treatments that received an application at early rosette had significantly higher yields than respective Approach treatments.

Evaluation of fungicide and growth regulator application.

The experimental growth regulator Pentia and the registered fungicide

Table 11. Effects of growth regulator and fungicide application on control of blackleg on HyClass 115W winter canola.

Treatment and rate/A (timing)[z]	Leaves (no./plant)	Winter survival (%)[y]	Blackleg: Leaf spot (0-3)[x]	Blackleg: Incidence (%)	Blackleg: Severity (0-5)[w]	Winter decline syndrome (%)[v]	Dead plants (%)	Yield (lb/a)
Non-treated check	6.3	56.2	1.0	75.0 a-d[u]	3.4	75.0	25.0 a	1,626
Pentia 0.27F 16 fl. oz (1)	6.6	66.2	1.2	81.2 ab	3.6	75.2	10.0 b	1,957
Pentia 0.27F 16 fl. oz (1) Priaxor 4.17F 4 fl. oz (2)	6.5	71.2	1.0	87.5 a	3.7	75.0	10.0 b	2,278
Pentia 0.27F 16 fl. oz (2)	6.7	67.5	1.2	87.5 a	3.5	66.5	11.2 b	2,249
Pentia 0.27F 16 fl. oz (2) Priaxor 4.17F 4 fl. oz (2)	6.6	57.5	1.7	87.5 a	3.6	73.0	8.7 b	2,389
Priaxor 4.17F 4 fl. oz (2)	6.8	70.0	1.0	60.2 d	2.8	58.0	6.2 b	2,438
Priaxor 4.17F 4 fl. oz (3)	6.3	63.7	1.5	72.7 a-d	3.3	54.0	11.2 b	2,112
Priaxor 4.17F 4 fl. oz (4)	6.7	58.7	2.0	76.7 a-d	3.4	62.5	3.7 b	1,805
Priaxor 4.17F 4 fl. oz (2,3)	6.2	67.5	1.0	62.7 d	2.9	45.7	3.7 b	2,484
Priaxor 4.17F 4 fl. oz (2,4)	6.7	73.7	2.0	68.7 bcd	2.9	62.5	7.5 b	2,314
Priaxor 4.17F 4 fl. oz (3,4)	6.5	66.2	1.7	77.2	3.5	58.5	7.5 b	2,078
LSD (p=0.05)[u]	NS	NS	NS	16.6	NS	NS	9.8	NS

[z] Applications were at 1 = early rosette on Oct. 20, 2014, 2 = mid-rosette on Nov. 11, 2014, and 3 = late rosette on Jan. 9, 2015 and 4=first bud on March 24, 2015.
[y] Percentage of plot with live foliage on Feb. 11, 2015.
[x] Incidence of leaf spot per plot from 0-3 where 0 = no leaf spot, 1 = 1-5 leaf spots, 2 = 5-10 leaf spots and 3 = $\geq$10 leaf spots.
[w] Internal stem decay from 0 to 5 where 0 = no disease, 1 = 25 percent of the stem with decay, 2 = 50 percent of the stem with decay, 3 = 75 percent of the stem with decay, 4 = 100 percent of the stem with decay and 5 = dead plant.
[v] Percentage of plants with winter decline syndrome.
[u] Values in a column followed by the same letter are not significantly different according to Fisher's LSD test.
[t] LSD at 95 percent probability. NS = treatment effect not statistically significant at 95 percent probability.

Priaxor were applied at various timings from fall to spring and evaluated for effects on plant growth, winter survival and control of blackleg. Treatments were applied at one or two growth stages that included early rosette (2 to 4 leaves) and mid-rosette (6 to 8 leaves) in the fall, late-rosette in winter and first bud in the spring.

Treatment effects were statistically significant only for blackleg incidence and incidence of dead plants. Pentia had little effect on plant growth. There were numeric increases in winter survival for most treatments compared to the untreated check, but differences were not statistically significant. Priaxor applied once at mid-rosette and twice at mid- and late-rosette had the lowest blackleg incidence, severity and highest yield, although the treatment responses did not significantly differ from the untreated check. There was a nonsignificant trend for reduced incidence of winter decline syndrome for most treatments receiving Priaxor, but not for Pentia treatments. All treatments reduced the incidence of dead plants before harvest, which was apparently a response to the combined effects of blackleg and winter decline syndrome. All treatments numerically increased yield compared to the untreated check, but the treatment effect on yield was not statistically significant.

OKLAHOMA STATE UNIVERSITY

RESEARCH