WINTER CANOLA FERTILITY FOR THE EAST CENTRAL GREAT PLAINS

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ABSTRACT

The objective of this research is to develop Nitrogen recommendations for winter canola (*Brassica napus* L.) grown in the southern Great Plains. This work focuses on timing: fall, spring, or split; the possible benefits of sulfur application, and the effect of fall fertilizer N on winter survival. Studies were conducted at three sites in Kansas (one experiment field and two cooperator sites) and one research farm in Oklahoma. Applied N (urea and/or ammonium sulfate) were surface broadcast with rates ranging from 0 – 150 lbs/acre total applied N. Timing was all fall pre-plant, all spring top dress, or split. Canola (Wichita, DK 13-86, and Virginia) was seeded at 5 lb/acre in September 2006. Pre-plant soil samples were taken for profile N determination. Studies were monitored for qualitative growth differences and plant samples taken for N determination. Plots were mechanically harvested with yields adjusted to 9% grain moisture. For the 2006-2007 canola crop, winter survival was enhanced by applying at least one-third of the full N recommendation in the fall. Rates in excess of 30 lb/a N fall applied did not significantly decrease winter survival or yield. The amount of N needed for optimal yields in 2007 was accurately predicated by the current N recommendation formula.

INTRODUCTION

Interest in winter canola (*Brassica napus* L.) production has increased dramatically over the last five years in the southern Great Plains for several reasons. Canola is a broadleaf crop fitting well into dryland rotations with winter wheat, requiring no additional equipment, and is extremely beneficial in interrupting pest cycles. Bio-fuel interest and its status as a healthy food oil have also driven interest. Finally, compared to twenty years ago, canola varieties are available possessing good winter-hardiness, good yield potential, and traits such as Roundup tolerance. Most research regarding canola production recommendations has been conducted on spring canola in the northern U.S. and Canada with some work in the traditional Corn Belt on winter canola. Current recommendations for N are based on these areas and include warning producers to minimize fall N application (30 – 50 lb/acre total N) to prevent excessive fall growth and an increased risk of winterkill.

Kansas State University and Oklahoma State University are working cooperatively to determine Best Management Practices for winter canola in the southern Great Plains. One objective of this research is to develop N recommendations for the area that focus on the appropriate timing (fall, winter, split) and rate of N fertilizer to optimize winter canola yield and winter survival. The research in Kansas is funded by the USDA Risk Management Agency.

MATERIALS AND METHODS

Research was initiated during the 2006-2007 growing season. Two sets of studies were conducted: rate and timing studies were initiated on research farms (Hutchinson, KS and Perkins Oklahoma) and on-farm top dress rate studies (Sterling and Offerele, KS). Soil samples for standard soil analysis and profile N (0 to 24 in.) were obtained for all sites (Table 1). Fertilizer, except for N and S, were applied to recommended levels. All sites were drilled September 2006, except the Offerle, KS site where canola was surface applied with the N fertilizer and lightly harrowed followed by 0.5 inches of irrigation. No additional irrigation was applied for the remainder of the growing season. Treatments at the research farms included rate and timing variables while on-farm studies included spring applications only. For all sites, treatments were surface broadcast using urea and/or ammonium sulfate. Total N applications for these studies ranged from 0 to 150 lbs/acre N. There were a total of 21 treatments at the research farm sites and 10 treatments at the on-farm sites. Since N source had no significant effect on yield, data are combined across source.

Table 1. Site summary of properties and cultural operations.

Site	Perkins, OK	Hutchinson, KS	Sterling, KS	Offerle, KS
Property				
Soil type	Silt loam	Silt loam	Sandy loam	Sandy loam
Profile NO_3-N (preplant)	30.4 lb/acre	18.8 lb/acre	44.6 lb/acre[1]	94.6 lb/acre[2]
Previous crop	wheat	wheat	wheat	wheat
Tillage	Conventional	Conventional	No-till (7 yrs)	minimum
Variety	Wichita	DK 13-86 RR	Virginia	Wichita
Seeding rate	5 lb/acre	5 lb/acre	4.5 lb/acre	5 lb/acre

1 – 10.7 lb/acre residual N + 34 lb/acre fall N application.
2 – 44.6 lb/acre residual N + 50 lb/acre fall N application.

Measurements and observations included emergence, stand, fall growth, winter survival, whole plant nutrient analysis, bloom date, grain yield, test weight and N content, and oil content. Precipitation was measured on-site with temperatures recorded on-site at the research farms and using the nearest weather station for the on-farm sites. Plots at Perkins, OK were planted using a plot drill, using a ten foot no-till drill at Hutchinson, and using cooperator equipment at Sterling and Offerle KS. Plots were mechanically harvested using plot size harvesting equipment. Grain yield and test weight were determined a grain analysis computer. Grain samples were taken for oil analysis. Data were analyzed using SAS and the appropriate statistical analysis.

RESULTS AND DISCUSSION

Fall conditions were excellent at all sites for planting and the establishment of winter canola. Precipitation was above average as were temperatures with a killing frost not occurring at the Kansas sites until late November. These conditions resulted in excellent germination, emergence and fall growth. Emergence was greater than 80% at all sites. Visual ratings indicated significantly greater above ground growth for all treatments receiving fall N applications compared to the 0 lb N acre^{-1} check treatments. Fall soil profile nitrate levels (Tables 2 and 3) ranged from 11 lb N acre^{-1} at the Sterling site up to 45 lb N acre^{-1} at the Offerle site.

Winter conditions for the Kansas sites included several significant snow events and resulted in snow covering canola plots for over 30 days. Canola plants broke winter dormancy in mid-February with adequate soil moisture and above normal temperatures. Upon visual inspection, the only treatments resulting in stand loss were the 0 lb N acre^{-1} plots and stands were still greater than 60%. There was no stand loss by treatment at the on-farm sites. This resulted in development approximately 10 days ahead of normal development. Plants at all sites but Offerle had to be treated for army cutworm in March. The first week of April winter canola at the Sterling site had bolted and was beginning to bloom. Canola at the Hutchinson and Offerle sites had bolted was approximately seven days behind the Sterling site canola. From April 4 to April 7, a cold front resulted in temperatures below freezing each day. During this period the low at the Hutchinson research farm was 20°F and temperatures were below freezing for 40 hours continuously. Conditions at the Perkins site were not as severe but well below normal. These conditions resulted in sever damage to the flowering stalk at both Sterling and Hutchinson. Damage ratings seven days after the event were 90% damage at Sterling, 70% at Hutchinson, and 20% at Offerle. Damage was minimal at Perkins. N rates did not affect the level of damage but higher N rate treatments recovered visually more rapidly at the Hutchinson site. Winter wheat in the area was also significantly damaged.

In spite of the severe early April conditions and damage, the growing point of the plants was not killed. Cool, wet conditions through June allowed canola plants to recover, bloom, and mature. However, harvest was delayed by approximately 14 days and yields were significantly affected. Yields at the Perkins site were minimally affected by the freeze event. Yields were good at the Perkins site while the winter canola at the Hutchinson site was severely damaged (Table 2). At the Perkins site, soil N levels (profile plus fertilizer N) of 120 lb N acre^{-1} were necessary to optimize yields. Although large treatment variation resulted in no significant difference at the Hutchinson site the trend was for total available N was approximately the same. At the Sterling site, soil N levels of only 75 lb N acre^{-1} were necessary to optimize yields and the higher N rates appeared to decrease yield. This was likely caused by the more advanced growth stage at the higher N rates when the freeze occurred. At the Offerle site, a soil N level of 150 lb N acre^{-1} achieved optimal yields. At all sites, treatments included both urea and ammonium sulfate as N sources. Data are pooled due to a lack of interaction between some factors. These data are not presented as N source had no effect on any plant parameters. At the Offerle site, there was a trend for treatments receiving sulfur for slightly better yields but it was not significant.

Winter wheat in the freeze affected areas was more significantly affected than winter canola. Wheat yields at the on-farm Sterling site averaged 600 lbs grain acre^{-1} while the bulk canola at the study site (40 acre field) averaged almost 1500 lbs of grain.

Table 2. Winter canola grain yield at Perkins, OK and Hutchinson, KS for fall and spring applied N. 2007 Harvest

Application Timing		Grain Yield	
Fall N	Spring N	Perkins	Hutchinson
- -lb N acre^{-1}- -		- - - - -lb acre^{-1}- - - - -	
0	0	2060 a[1]	230 a
30	0	--	240 a
30	30	2090a	420 a
30	60	2470b	630 a
30	90	2540b	580 a
30	120	2450b	460 a
Soil NO_3-N[2]		34 lb N acre^{-1}	21 lb N acre^{-1}

1 – Means labeled with the same letter in a given column are not different at the 0.05 level of probability.
2 – Fall soil NO_3-N concentration obtained from a 0 to 24 inch composite soil sample.

Table 3. Grain yield for Sterling and Offerle, KS for spring applied N. 2007 Harvest.

Application Timing	Grain Yield	
Spring N	Sterling	Offerle
lb N acre^{-1}	- - -lb acre^{-1}- - -	
0	1490a[1]	1240a
30	1750b	1400ab
60	1740b	1650ab
90	1580ab	1740b
120	1560ab	1620ab
150	1520a	1770b
Soil NO_3-N[2]	11	45
Fall N Application [3]	34	50

1 – Means labeled with the same letter in a given column are not different at the 0.05 level of probability.
2 – Fall soil NO_3-N concentration obtained from a 0 to 24 inch composite soil sample.
3- Broadcast prior to planting.

With only one year of data and with the weather conditions, it is impossible to draw any conclusions but some trends are evident. Current recommendations in the region discourage winter canola planting if soil N levels are above 75 lb N acre^{-1} for concern that this will result in excessive fall growth, growing point elevation, and increased risk of winterkill. This was not the case at any of these sites and in fact, lower soil N levels decreased winter hardiness, delayed spring re-growth, and resulted in significantly lower yields. This would confirm limited work conducted in Missouri and Texas (Conley *et al*., 2004) that 50 lb N acre^{-1} significantly increased winter survival.

The current recommendation is for producers to take a pre-plant soil profile N test and use the following formula for determine total N needed:

Total N needed (lbs/A) = 0.05 X Yield Potential (lbs/A) – profile soil test N (lbs/A)

Using this formula accurately predicted Total soil N necessary for optimal yields at both Perkins and Sterling (Table 4) but underestimated soil N for the Offerle Site. Hutchinson data was not included due the extremely low and variable yields. The Offerle site discrepancy is likely due to the extremely deep sandy soils at the site and precipitation throughout the growing season that likely leeched available N below the root zone.

Table 4. Actual vs. predicted total N needed for optimal winter canola yields by site. 2007.

Site	Optimal yield	Total soil N[1]	Total soil N predicted
	lb grain $acre^{-1}$	----------lb soil N $acre^{-1}$----------	
Perkins	2470	124	124
Sterling	1750	75	88
Offerle	1740	155	87

1- Soil profile test Nitrate-N plus fertilizer N added.

SUMMARY

- This is the first year of a multi-year study.
- Some adjustments may be necessary for current total N recommendations but overall no major changes are planned yet.
- Applying at least one-third of the full N recommendation in the fall is critical to insure winter survival, particularly as you move north in the region.
- Higher fall N rates did not decrease winter survival or yield.
- Winter canola was able to recover from an early spring freeze much better than winter wheat.

REFERENCES

Conley, S.P., D. Bordovsky, C. Rife, and W.J. Wiebold. 2004. Winter canola survival and yield response to nitrogen and fall phosphorus. Online Crop Management,. Doi:10.1094/CM-2004-01-RS.