FERTILIZER MANAGEMENT OF WINTER CANOLA IN ILLINOIS

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INTRODUCTION

Canola was grown in southern IL in the late 1980s and early 1990s, but varieties used back then were not appropriately adapted to the area. As a consequence crop failures were too common for wide-spread adoption. With better adapted varieties available, there is a need to evaluate canola management practices under southern IL climates. Well defined fertilizer recommendations are particularly important to maximize productivity while reducing undesirable, off-site fertilizer movement due to over-application or improper application timings. Our objectives were to: 1) determine the nitrogen (N) uptake response curve for several canola varieties in order to identify the time to apply N in the spring for optimum N utilization; 2) determine the optimum economic N rate for canola and assess the effects of variety selection; 3) evaluate the need for sulfur (S) fertilization with canola; and 4) determine P and K removal by canola varieties to amend tables in the IL Agronomy Handbook for maintenance fertilization.

MATERIALS AND METHODS

Six canola varieties (identified in Table 1) were planted after wheat at the University of Illinois Dixon Springs Ag. Center in Johnson county on September 15, 2010. The plot area was chisel tilled followed by disking and cultipacking to prepare a firm seedbed. Plots were drilled in 7.5" row spacings at a seeding rate of 8 seeds/sq foot. The canola seed was mixed with 10 lb/acre Tiger AccuSeed® (90% S) for bulking prior to drilling. The plot design was a split-plot with four replications, varieties as whole plots (strips) and N treatments as subplots. Plot size consisted of 5' x 20' with the whole area harvested for yield. The plot area received 30 lb/acre N at planting. Spring nitrogen rates of 0, 50, 100, 150 and 200 lb N/acre were applied to each variety on March 18. An additional 150 lb N/acre plot with a supplemental addition of 30 lb S/acre was included.

Each of the variety strips were extended 40' to allow for whole plant sampling approximately every ten days in the spring. These additional areas were fertilized with 150 lb/acre N in the spring. Beginning on March 1, a 3.75 sq. foot section of each strip was sampled for above-ground dry matter and nutrient composition.

Grain yields and moisture was determined at maturity. Grain samples were analyzed for N, P, K, and S composition. Crop removal was calculated based on grain yields and nutrient composition of the grain.

RESULTS AND DISCUSSION

There were huge differences in canola grain yields among the varieties used in this study (Table 1). Increasing N rates increased yields with a highly significant quadratic response with yields maximized at about the 150 lb/acre N rate (Table 1 and Figure 1). Although there appeared to be differences among the varieties, there was not a significant interaction with N rates. There also was no significant response to the additional 30 lb/acre S in the spring.

There were significant differences among the hybrids for each of the grain nutrient concentrations measured, but not always consistency (Table 1). For example, Hornet had the highest K concentration, but not the highest N, P or S concentration. Increasing N rates significantly increased grain N and S concentrations (Figure 2), but had no effect on P and K concentrations. It is interesting to point out how the N and S concentrations paralleled each other as N rates increased. The addition of 30 lb/acre S in the spring increased grain S, but had no effect on N, P or K. There was a significant variety x N rate interaction for grain S (Figure 3), but not for grain N, P or K. Some varieties maximized grain S concentrations at 150 lb/acre N or less, while others continued to increase the grain S up to 200 lb/acre N.

Variety selection did impact test weights, even though differences were relatively small (Table 2). N rate had no effect on test weights, nor were there any interactions between varieties and N rates. Variety and N rates both had a big influence on N removal (yield x N concentration) in the grain (Figure 4). The effect was less for S removal, but still highly significant. Because N rates had no significant effect on P and K concentrations, the significant response of P and K removal to increasing N rates is due to the effects of N rates on yield. Varietal differences in yield and nutrient concentrations both contributed to the significant effects on removal of each of the measured nutrients. There were no significant interactions between N rates and varieties for test weights or nutrient removal. S treatment also had no effect on test weight or nutrient removal, including S removal.

Since yield and nutrient concentrations were affected by both variety and N rates, nutrient removal in terms of lb nutrient/bu varied a lot. It was determined that the best measure of nutrient removal would be near optimum N rate for yield, in this case, around 150 lb/acre. At this N rate, N, P, K and S removal was 1.89-1.93, 0.33, 0.40-0.41 and 0.23-0.25 lb/bu, respectively, when averaged across varieties (Table3).

The final part of this study dealt with dry matter and nutrient accumulation over the spring period. Dry matter accumulation began in mid-March, about the same time that the N rates were applied (Figure 5). The accumulation was fairly linear until full bloom, at which time the accumulation rate was reduced as pod set and seed fill progressed. The accumulation then intensified again toward the end of grain fill (about the same time we ran out of plants to harvest). It is uncertain why this effect occurred. The N accumulation mirrored the dry matter until blooming, but then was flat throughout most of grain fill till the end, where it spiked upward (Figure 6). Potassium accumulation was very similar to the N. P and S accumulations were far less but had a somewhat similar pattern.

The nutrient concentrations varied over time as well (Figure 7). Concentrations were maximized before the onset of blooms, and decreased rapidly through grain fill as these nutrients were diluted out by continued dry matter production and accumulation with apparently reduced nutrient uptake.

CONCLUSIONS

This was the first year of this study with canola at Dixon Springs. Results should be interpreted with caution and the study will be repeated in future years and at more locations.

Table 1. Effects of variety and N rates on canola grain yields and nutrient composition, Dixon Springs, 2011.

Variety	**Yield**	**%N**	**%P**	**%K**	**%S**
	(bu/acre)	--------------------- *Concentration (%)*			---------------------
Hornet	46.8 a	3.49 b	0.66 b	0.89 a	0.44 b
PSTWC7	32.0 b	3.70 a	0.71 a	0.85 a	0.45 ab
PSTWC13	36.3 b	3.71 a	0.70 ab	0.84 a	0.46 a
PSTWC14	50.2 a	3.38 c	0.61 c	0.75 b	0.40 c
Safran	51.1 a	3.65 a	0.61 c	0.84 a	0.45 ab
Sitro	52.3 a	3.51 b	0.61 c	0.72 b	0.41 c
N Rate					
0	40.9	3.12	0.65	0.82	0.38
50	44.6	3.43	0.69	0.85	0.42
100	46.8	3.62	0.62	0.80	0.44
150	48.0	3.79	0.66	0.80	0.46
200	43.6	3.91	0.65	0.80	0.48
- Sulfur	48.0	3.79	0.66	0.80	0.46 b
+ Sulfur	46.5	3.87	0.67	0.82	0.49 a
Statistics:					
Variety	***	***	***	**	***
N Rate (NR)	***	***	*NS*	*NS*	***
lin	**	***	*NS*	*NS*	***
quad	***	***	*NS*	*NS*	***
Variety x NR	*NS*	*NS*	*NS*	*NS*	**
+/- Sulfur (S)	*NS*	*NS*	*NS*	*NS*	***
Variety x +/- S	*	*NS*	*NS*	*NS*	*NS*
LSD $_{Variety}$	*7.3*	*0.10*	*0.04*	*0.09*	*0.02*
CV	*11.8*	*3.3*	*15.9*	*10.6*	*3.7*

*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = non-significant. Means within a column followed by the same letter are not significantly different at the 5% level.

Table 2. Effects of variety and N rates on canola test weights and nutrient removal, Dixon Springs, 2011.

Variety	**Test Wt.**	**N**	**P**	**K**	**S**
	(lb/bu)	-------------------- *Removal (lb/acre)*	--------------------		
Hornet	50.3 b	82.1 a	15.7 a	20.8 a	10.3 a
PSTWC7	49.4 c	59.2 b	11.3 b	13.4 c	7.2 c
PSTWC13	49.7 c	67.2 b	12.7 b	15.1 bc	8.4 bc
PSTWC14	50.6 ab	85.4 a	15.5 a	18.8 ab	10.0 ab
Safran	51.0 a	93.8 a	15.9 a	22.0 a	11.5 a
Sitro	50.4 b	92.7 a	16.1 a	18.8 ab	10.7 a
N Rate					
0	50.2	63.7	13.2	16.7	7.7
50	50.4	76.6	15.3	18.8	9.2
100	50.0	84.8	14.6	19.0	10.2
150	50.5	90.5	15.7	19.1	11.0
200	50.1	84.7	13.9	17.2	10.3
- Sulfur	50.5	90.5	15.7	19.1	11.0
+ Sulfur	50.2	89.1	15.1	18.8	11.2
Statistics:					
Variety	***	***	**	***	***
N Rate (NR)	*NS*	***	*NS*	*	***
lin	*NS*	***	*NS*	*NS*	***
quad	*NS*	***	**	***	***
Variety x NR	*NS*	*NS*	*NS*	*NS*	*NS*
+/- Sulfur (S)	*NS*	*NS*	*NS*	*NS*	*NS*
Variety x +/- S	*NS*	*NS*	*NS*	*NS*	*
LSD $_{Variety}$	*0.51*	*13.2*	*2.8*	*4.1*	*1.8*
CV	*1.9*	*12.5*	*21.3*	*16.2*	*11.7*

*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = non-significant. Means within a column followed by the same letter are not significantly different at the 5% level.

Table 3. Nutrient removal (lb/bu) at the 150 lb/acre N rate, Dixon Springs, 2011.

Variety	N	P	K	S
	--------------------- Removal (lb/bu) ---------------------			
- Sulfur	1.89	0.33	0.40	0.23
+ Sulfur	1.93	0.33	0.41	0.25

Figure 1. Effects of variety and N rate on canola yield, Dixon Springs, 2011.

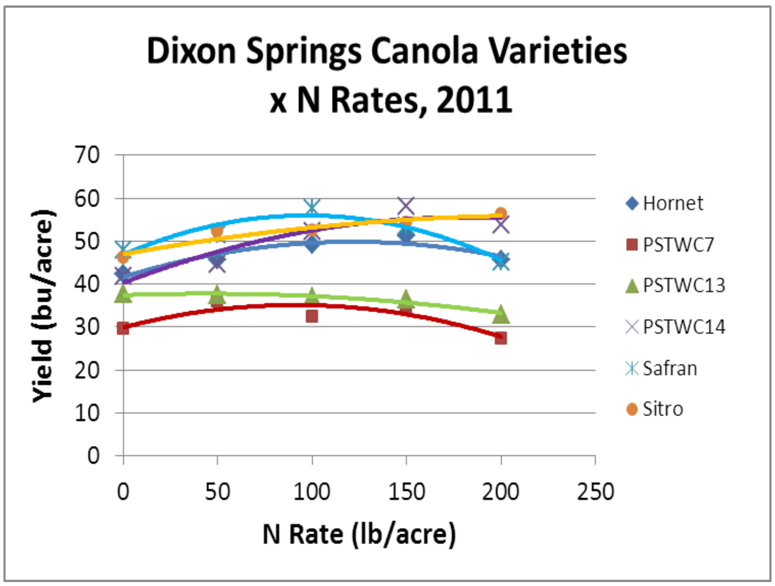

Figure 2. Effect of N rate on canola grain N and S concentrations, Dixon Springs, 2011.

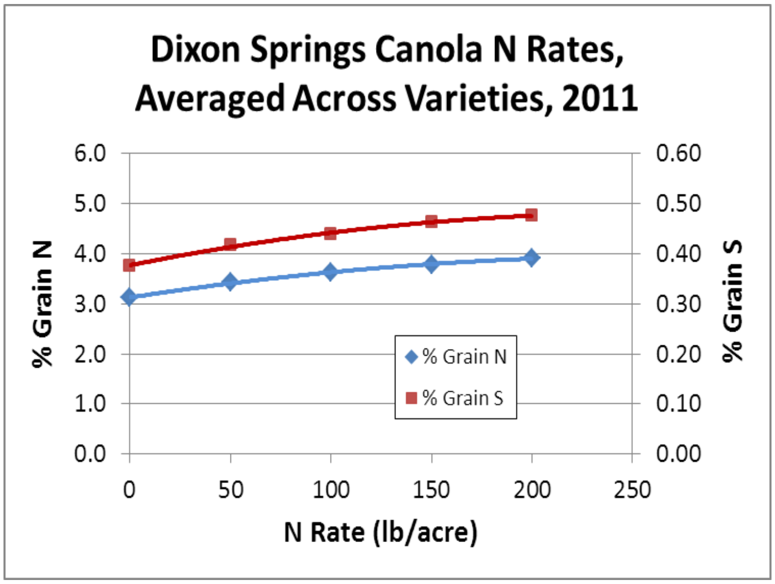

Figure 3. Effects of variety and N rate on canola grain S concentration, Dixon Springs, 2011.

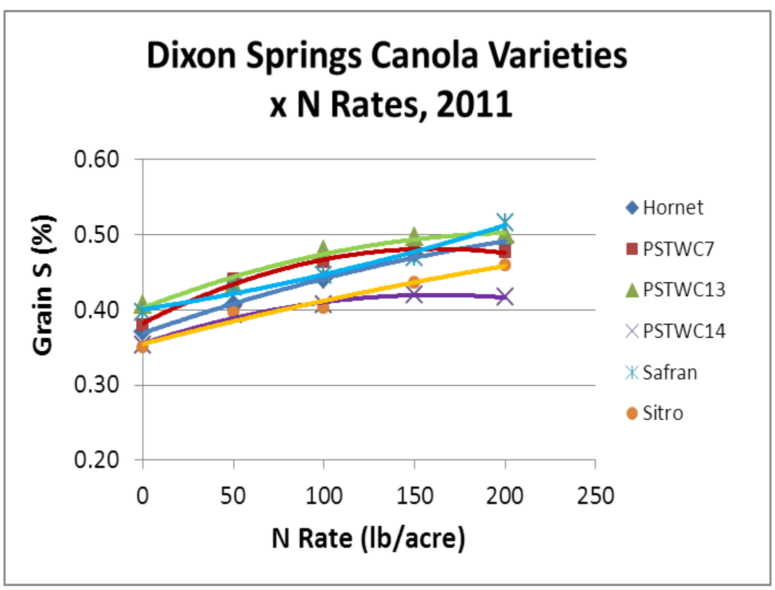

Figure 4. Effect of N rate on canola yield and N and S removal, Dixon Springs, 2011.

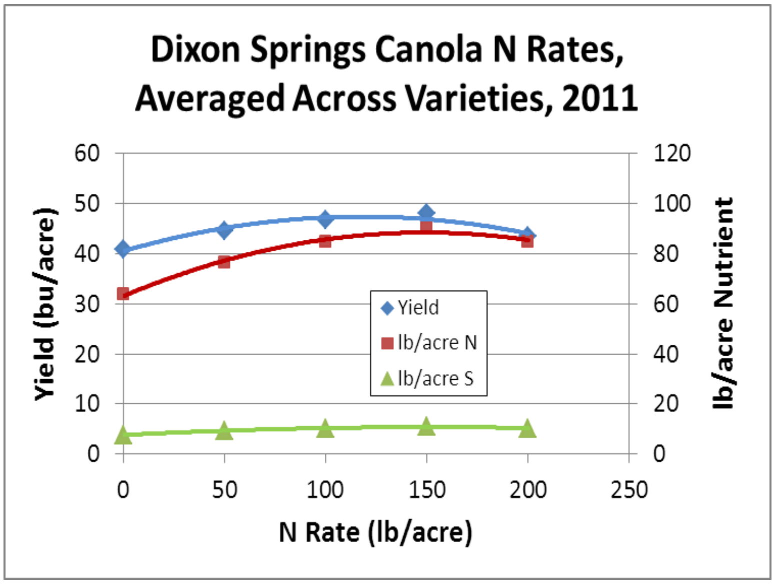

Figure 5. Effects of variety and sampling time on above-ground whole plant dry matter accumulation, Dixon Springs, 2011.

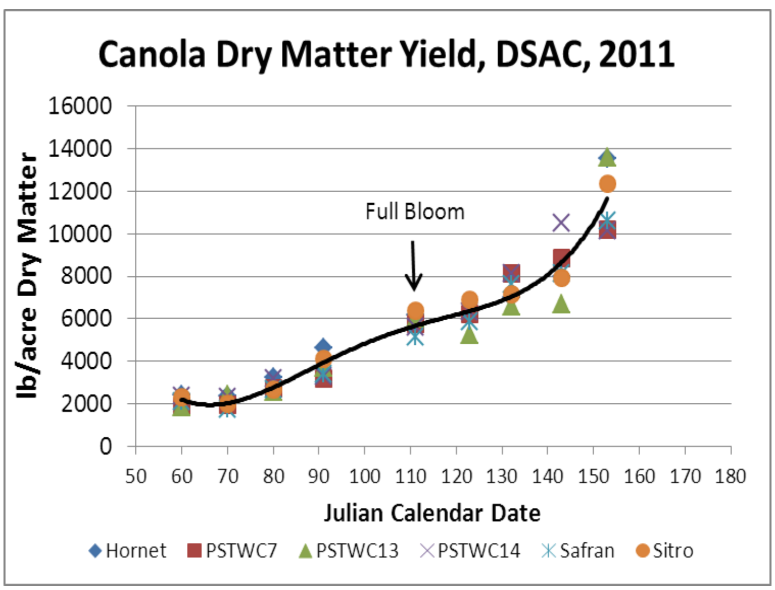

Figure 6. Effects of variety and sampling time on above-ground whole plant dry matter and nutrient accumulation, Dixon Springs, 2011.

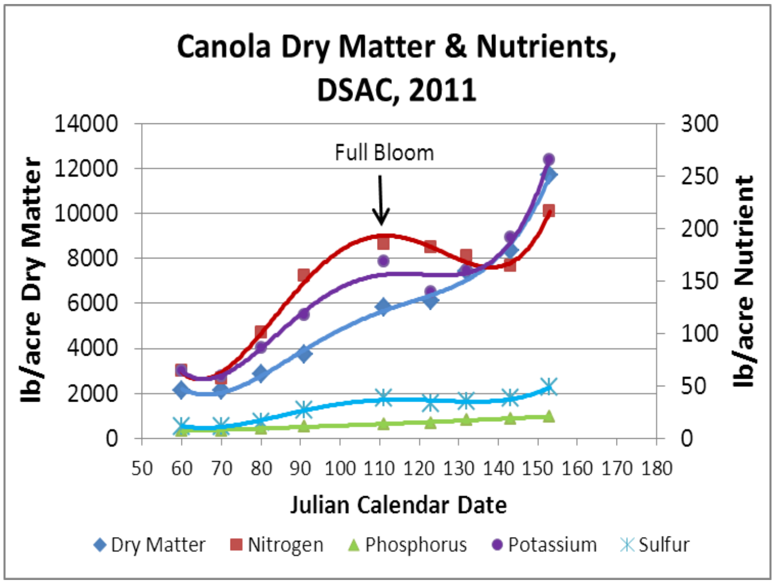

Figure 7. Effects of variety and sampling time on above-ground whole plant dry matter and nutrient concentration, Dixon Springs, 2011.