Fertilizing Canola and Mustard

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Canola is an important crop in North Dakota. It is grown for its oil content for both food and fuel purposes. Nitrogen (N), phosphorus (P) and potassium (K) requirements of canola and mustard are similar to those of small grains. Sulfur (S) requirements for canola are higher than most crops. Soil test results direct fertilizer rates for N, P, K and S. Soil cores should be taken from 0 to 24 inches deep and divided into 0- to 6-inch and 6- to 24-inch samples. P and K should be analyzed on the 0- to 6-inch sample, while N and S should be tested on each depth.

Nitrogen

Previous N recommendations were borrowed from Canadian sources. Recent N calibration studies conducted through the NDSU Langdon, North Central, Williston, Carrington and Hettinger Research Extension Centers, and additional sites at Valley City and Wishek, have provided ample data to support the new recommendations.

The data, which are well represented by the charts in Figure 1, show that the optimum N rate is similar for a lower producing variety compared with a more productive, N-efficient variety. Therefore, producers do not need to adjust rates for relative productivity. The data also showed that at sites that supported yields above 3,000 pounds/acre (lb/A), the researchers did not need to correspondingly increase N rates. The higher organic matter and climatic conditions at these more productive sites provided the additional N from the soil without N rates higher than 150 lb/A. Growers in cooler, moister areas of the state should consider a maximum 150 lb/A N cap recommendation rate, while growers in the drier, warmer areas of the state should use the 120 lb/A N rates cap (Figure 2). Overapplication of N to canola led to drastic profit reduction at all of the sites.

Nitrogen recommendations are based on the following formula:

NR = (YP x 0.065) - STN - PCC

where **NR** = supplemental nitrogen recommended
YP = Yield potential in lb/A
STN = soil nitrate-N 0- to 24-inch depth
PCC = previous crop credit

Nitrogen recommendations at select yield potentials are shown in Table 1. Nitrogen may be fall applied on most North Dakota soils, except on sandy loam or coarser textures, or where flooding is expected in the spring. We recommend ammonium sources of N, including anhydrous ammonia and urea, for fall application. Guidelines for fall N application may be found in the “North Dakota Fertilizer Handbook” (NDSU EB-65, 2003). Spring application may be made pre-plant or at planting. Canola is very sensitive to fertilizer salts. We recommend no more than 5 lb/A of N with the seed in 12-inch row spacing for medium-textured soils, but the rate can be increased proportionally with narrow row spacing or increase in seed spread (Table 2).

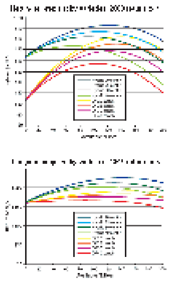

Figure 1. Return to N at Hettinger and Langdon. Return to N was calculated using a canola price of 10 cent/pound and the yields of the N rate study at each site in 2003. Higher canola prices only slightly shift the curves to the right. Available N is soil test nitrate to 2 feet in depth, plus any previous crop credit and supplemental N. OP is an open-pollinated variety and Hybrid is a hybrid variety. (22KB)

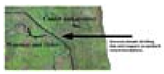

Figure 2. General climate map of North Dakota with respect to canola production. In any given year, the line separating cooler, moister areas from warmer, drier areas may move east or west considerably. (Image courtesy of NASA, Angela King compiler, Hobart King at Geology.com, publisher) (13KB)

Table 1. N, P and K recommendations for canola and mustard.

		Olsen-P, ppm					Soil Test K, ppm				
Yield Potential	Soil N + Supplemental N	VL 0-3	L 4-7	M 8-11	H 12-15	VH 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 160
lb/A	lb/A 2 ft.	- - - - - - lb P2O5/A - - - - - -					- - - - - - - lb K2O/A - - - - - - -				
1,500	100	49	36	23	9	0	70	50	30	10	0
1,850	120*	60	44	28	12	0	86	62	37	12	0
2,300	150**	75	55	35	15	0	95	77	46	15	0
3,000	150	80	60	35	15	0	140	100	60	20	0

* indicates cap for warmer and drier areas in the state.
** indicates cap for cooler, moister areas in the state.

Table 2. Maximum rates of seed-placed N + K2O for canola and mustard.

	Disc or Knife (1-inch spread) Row Spacing			Spoon or Hoe (2-inch Spread) Row Spacing			Sweep (4- to 5-inch Spread) Row Spacing		
Soil Texture	6 in.	9 in.	12 in.	6 in.	9 in.	12 in.	6 in.	9 in.	12 in.
	- - - - - - - - - - - - - - - lbs N + K2O / A - - - - - - - - - - - - - - -								
Light	5	0	0	20	15	10	30	20	15
Medium	10	5	5	25	20	15	35	25	20
Heavy	15	10	5	35	25	20	45	30	25

Phosphorus (P) and Potassium (K)

P and K recommendations are shown in Table 1. Canola and mustard are good scavengers of P, and a row-starter fertilizer rate of 20 to 30 lb P2O5/A is sufficient for most soil test levels unless you plan additional build-up P rates. On light soils, where no nitrogen is recommended, 11-52-0 (MAP) would be a better seed-placed choice of phosphate since its nitrogen component is not as likely to injure seed as 18-46-0 (DAP). K, if needed, may be added to row starter if final N + K2O is 10 lb/A or lower, using a double disc opener with 12-inch row spacing (Table 2). Broadcast P and K are acceptable. However, we recommend a small amount of P as a row starter in addition to any broadcast.

Sulfur

Canola has special requirements for sulfur, while mustard does not. A 2,000 lb/A canola crop contains about 12 lb S/A in the straw and 15 lb S/A in the seed. A 40 bushel/acre (bu/A) wheat crop, on the other hand, contains only 5 lb/A S in the seed and 7 lb/A in the straw. The consequences of low soil S levels are very serious in canola production. Low sulfur can make the difference between having a crop and not having a crop, as shown in Table 3. Responses to sulfur have been demonstrated in North Dakota (Table 4). A composite soil test for sulfur may not represent sulfur fertility variation across the field. The current S soil test tends to overestimate available sulfate-S and field variability is huge, as shown in Figure 3. Therefore, at medium to low sulfur soil test levels, we recommend 20 to 30 lb/A of S. At high soil sulfur levels, we recommend 10 to 15 lb/A.

Table 3. Canola response to sulfur, Manitoba. (adapted from Canadian canola recommendations, 1994)

Fertilizer Applied	Yield, lb/A
Check (residual fertility)	900
NPK	250
PK + 20 lb S/A	1,250
NPK + 20 lb S/A	1,800

Table 4. Canola response to sulfur, Garrison, N.D. McKay, 1995.

Treatment	Yield, lb/A
N only	1,192
N + 20 lb/A 12-0-0-26S (ATS)	1,432
N + 20 lb/A elemental S	1,240
N + 40 lb/A elemental S	1,431
N + 20 lb/A blend of 21-0-0-24S and elemental S	1,361

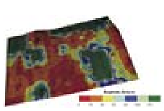

Figure 3. Sulfate-S soil levels, from a square, 40-acre area sampled in a 110-foot grid, Valley City, N.D, 1995. Levels vary from 4 lb/A 2 feet to 580 lb/A 2 feet. (20KB)

Canola takes up sulfate-S. The form of sulfur fertilizer may be ammonium sulfate (21-0-0-24S) or another available sulfate fertilizer, such as ammonium thiosulfate, potassium thiosulfate and other sources. We do not recommend elemental sulfur because it breaks down slowly to sulfate-S. An example of the effectiveness of ammonium sulfate compared with elemental sulfur is shown in Table 5. For this reason, supported by additional research in both North Dakota and Canada, we do not recommend elemental sulfur alone or in a blend unless the blend contains sufficient available sulfate to make a crop on its own. Gypsum (calcium sulfate) generally is not recommended because it has relatively low solubility compared with ammonium sulfate, and because most gypsum commercially available is in forms that are not as easy to handle and spread as ammonium sulfate or elemental sulfur. If gypsum pellets were available with acceptable spreading qualities and rates were increased somewhat to compensate for lower solubility, gypsum application would be acceptable.

Table 5. Response of canola to ammonium sulfate and degradable elemental sulfur on three soil types, on conventional till and no-till. Rocklake, N.D. (Halley and Deibert, 1996).

			Yield, lb/acre		
			Soil Types		
Rate lb S/acre	Sources	Tillage	Buse	Barnes	Svea
0		CT	400	1,020	1,180
20	AS	CT	1,810	1,980	1,860
40	AS	CT	1,890	1,670	1,980
40	ES	CT	1,260	1,290	1,470
0		NT	30	240	1,450
20	AS	NT	1,650	1,680	2,100
40	AS	NT	1,810	1,870	1,810
40	ES	NT	620	1,060	1,630

LSD 5% within tillage treatments 155 lb/acre.
Sources: AS= ammonium sulfate (21-0-0-24S); CT= conventional tillage
Tillage: ES= degradable elemental sulfur (0-0-90S); NT= no-till

A variety of sulfur deficiency symptoms are shown in Figures 4-6. Deficiencies often are seen on higher landscapes (hilltops and slopes) where soils are coarser or eroded and organic matter levels are lower. Early season symptoms are yellowing between the leaf veins, cupped leaves and stunting. Later in the season, leaves are cupped, slender and purple, especially at the edges and on the bracts. Flowering is delayed and flowers may be pale yellow or white when they emerge. Deficient areas may have a bronze appearance from a distance. Seed often does not set and pods will be barren or poorly developed. Producers must seriously consider sulfur nutrition in a canola fertility program.

Figure 4. Canola early season S-deficiency symptoms. Cupping, stunting and interveinal yellowing. (23KB)

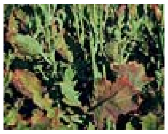

Figure 5. Later season S-deficiency symptoms in canola. Cupping, purpling along leaf margins and bracts, narrow leaf structure. (26KB)

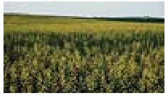

Figure 6. Typical landscape relationship of S deficiency. Photo taken from hilltop, showing sparse, uneven growth at the summit and the eroded hillside on the next hill. (32KB)

Providing adequate sulfur before or at planting is best. However, if deficiencies are identified early in the season before significant flowering, yield responses still are possible by applying a rescue treatment of ammonium thiosulfate (12-0-0-26S) or ammonium sulfate (Table 6). The earlier a treatment is made, the greater the yield response. Leaves absorb little sulfur. A rescue treatment needs rainfall to move the soluble sulfate to the roots. A top-dressed treatment also may be the best alternative to sulfur application on dormant seeded canola. Fall application places available sulfur at risk for spring leaching. In a dry spring, this may not be a problem, but in wet springs, leaching can place the sulfur below the rooting zone. Top-dressing when canola is small reduces the risk of spring losses. Dry sulfate materials do not volatilize and remain available, providing rainfall incorporates the application. Top-dressing with liquids should wait until after the fifth leaf emerges and leaves become sufficiently waxy to minimize leaf burn potential.

Table 6. Response of S-deficient canola to a foliar rescue at bolting. Sulfur from ammonium

thiosulfate (12-0-0-26S). Lukach, 1995. Rocklake, N.D.

Treatment	Yield, lb/A
Deficient 0 lb S/A	290
Deficient 10 lb S/A	613
Deficient 20 lb S/A	870
Adjacent area, not deficient	919

Following the canola harvest, cut canola stems may continue to bud and regrow into small plants if they are deficient in sulfur. Plants that received adequate sulfur during the growing season will not branch and regrow in this way, but will be dead stubble following harvest. The unfortunate producer may use this delayed senescence resulting from sulfur deficiency to advantage as a map of deficient areas in future years. Do not confuse this type of regrowth with volunteer seed sprouting following harvest.

Micronutrients

Although some published reports indicate micronutrient deficiencies are possible, canola and mustard have not been shown to exhibit any micronutrient deficiency, including zinc, boron or copper, in North Dakota.

References

Halley, S. and E.J. Deibert. 1996. Canola response to sulfur fertilizer applications under different tillage and landscape position. 1996 Annual Report to USDA-CSREES Special Programs, Northern Region Canola and North Dakota Oilseed Council. North Dakota State University Fargo, N.D.

For more information on this and other topics, see: www.ag.ndsu.edu

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