Nitrogen and Sulfur Fertilization Effects on *Camelina Sativa* in West Central Kansas

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Summary

Camelina sativa is early maturing and possesses characteristics that make it a good fit as a rotation crop in dryland wheat cropping systems. Nitrogen (N) and sulfur (S) play very important roles in oilseed production, including camelina. This study was undertaken in 2013 and 2014 to determine N and S rates necessary for optimum camelina production in West Central Kansas. The experiment was set up as randomized complete blocks with four replications in a split-plot arrangement. Treatments were two S rates (0 and 18 lb/a) as the main plots, and N rates (0, 20, 40, and 80 lb/a) were the subplots. The results showed that plant stand, plant height, harvest index, biomass yield, and protein and oil content were unaffected by N and S application. Similarly, S application had no effect on seed yield. However, N rate had a significant ($P < 0.05$) effect on seed yield. Yield differences were realized for 2013 ($\simeq$450 lb/a) and 2014 ($\simeq$900 lb/a).

Introduction

Cultivation of *Camelina sativa* in Europe dates as far back as 1,000 BC. The crop has been referred to as "gold of pleasure," linseed dodder, and large-seeded false flax. Interest in camelina as a potential crop in the Great Plains had increased because of its lower requirements for inputs such as water, pesticide, and fertilizer compared with other crops. Another advantage is that it is early maturing, requiring only 85 to 100 days to mature. Camelina seed has high oil content with unique properties for both industrial and nutritional applications. The oil contains about 60% polyunsaturated fatty acids, mainly linolenic (18:2n-6), about 15% and 40% α-linolenic acid (18:3n-6), 30% monounsaturated, and 6% saturated fatty acids. Compared with other oilseed crops, camelina oil is very high in α-linolenic acid, an omega-3 fatty acid that is essential in human and animal nutrition. Because of its higher omega-3 fatty acid content, camelina oil has been promoted as a dietary supplement in human and animal nutrition. In addition to these applications, the oil has agricultural uses (seed coating, animal feed), industrial applications (biolubricants), and may be used as biofuel. Research has shown that camelina yield ranges from lows of 300 lb/a to highs of 1,800 lb/a, depending on biotic and abiotic factors influencing production in the growing locations.

Nitrogen plays an important role in plant physiological functions and is a component of chlorophyll, protein, and enzymes. Previous studies indicate that camelina has a lower N requirement than other oilseed crops such as sunflower and canola. Another nutrient of importance in oilseed production is sulfur, which is associated with protein and chlorophyll development and resistance to cold and water stress. Nitrogen and sulfur are strongly correlated with protein content in oilseed crops. Camelina responds to N and S with high yields and seed quality. This study was conducted to determine the N and S requirements for optimum yield of camelina grown in west central Kansas.

Procedures

The experiment was conducted at Kansas State University Western Kansas Agricultural Research Center in Hays, KS (38° 51' N/99° 20' W; elevation: 611 meters) on no-till ground after sorghum harvest in both 2013 and 2014. The experimental design was a randomized complete block with four replications in a split-plot arrangement. Individual plot sizes were 30 ft × 10 ft. Fertilizer treatments were 0, 20, 40, and 80 lb/a N and S rates of 0 and 18 lb/a. Sulfur was the main factor, and N was the subplot factor. Blaine Creek, a released spring camelina variety, was planted at 5 lb/a in April in both 2013 and 2014. Half-doses of the N fertilizer treatments were applied at the time of planting, and the remaining half-doses were applied after emergence. In the course of the season, data collected included plant stand, plant height, biomass yield, and seed yield (adjusted to 8% moisture). Oil and protein content were analyzed after seed harvest.

Results

Nitrogen and S application effects on plant stand and plant height at maturity were not statistically different ($P > 0.05$). Harvest index did not show any differences for N and S rates. Similarly, camelina protein and oil content were unaffected by N and S application. Averaged across N and S application rates, protein and oil content were 29.7% and 29.5%, respectively. Camelina seed yield was different between 2013 and 2014. Averaged across N and S rates, seed yield was 458 lb/a in 2013 and 910 lb/a in 2014 (Figure 1). The difference in yield between the two years may be due to the differences in the amounts and timing when rainfall was received. West central Kansas received cumulative rainfall of 15.76 in. and 14.79 in. in 2013 and 2014, respectively, from January through July. Although the total rainfall during this period was more for 2013, most of the rain in 2013 was received in July (i.e., 7.08 in.) compared with only 3.86 in. in July 2014. By July, the camelina crop had passed the flowering and seed formation stage. Rainfall in June (during flowering) was 2.73 in. and 9.45 in. for 2013 and 2014, respectively.

Sulfur application had no significant ($P > 0.05$) effect on seed yield. Averaged across N rates and year, seed yield was 698 and 669 when 0 and 20 lb/a were applied, respectively. In contrast, N application had a significant ($P = 0.009$) effect on seed yield. Increasing N application did increase seed yield, but not beyond 40 lb/a (Figure 2). Biomass yield was not significantly different across treatments. Average biomass yield was 1,200 lb/a.

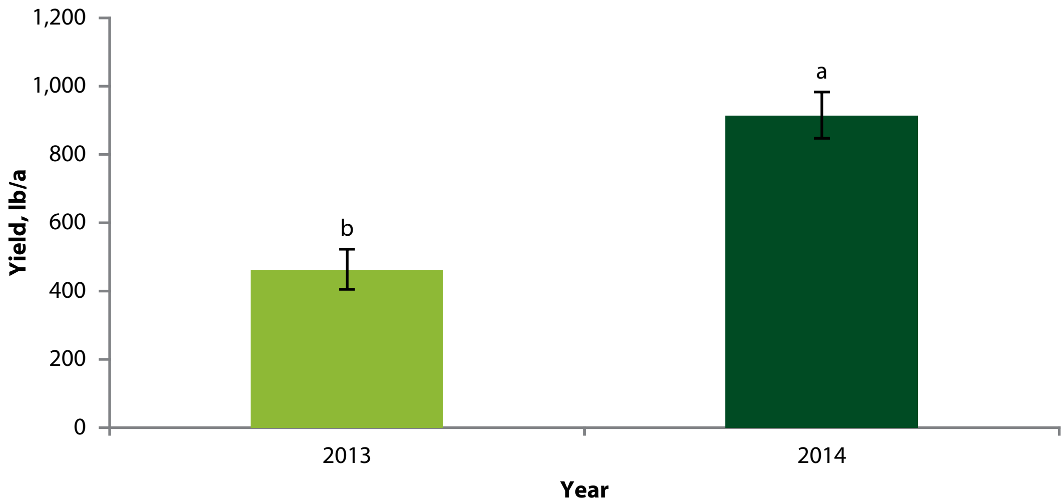

Figure 1. Average camelina yield in year 2013 and 2014, Western Kansas Agricultural Research Center–Hays.
Means followed by the same letter(s) are not significantly different at *P* >0.05.

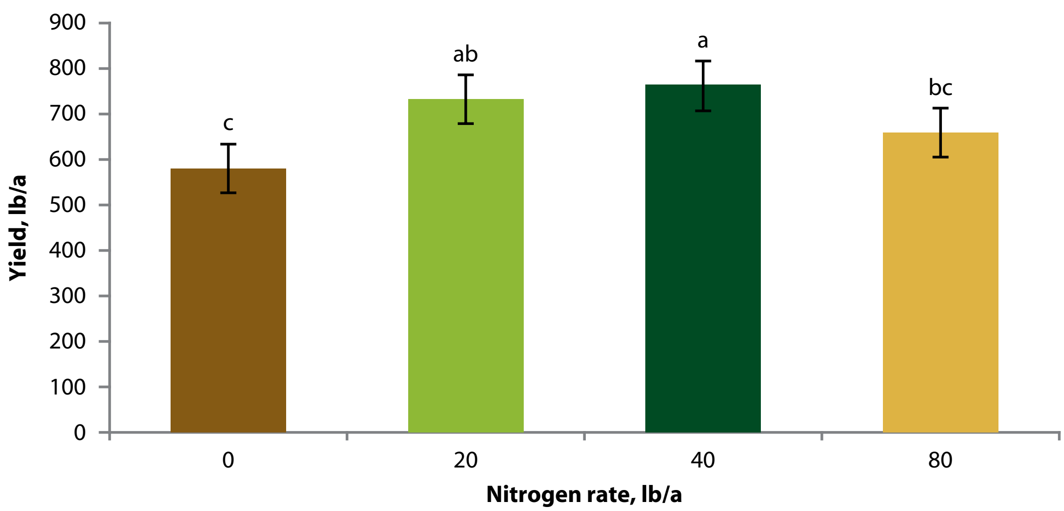

Figure 2. Effects of nitrogen treatment on camelina yield.
Means followed by the same letter(s) are not significantly different at *P* > 0.05.