Soil Nitrogen Response to Manure Applications under Canola Production

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Introduction

After several years of researching the behavior of manure as a nitrogen fertilizer, the CREC has published several reports showing that manure works best as a nitrogen (N) fertilizer when used on a long-season crop such as corn. However, corn isn't the only crop grown in North Dakota. To determine how manure fits into a typical North Dakota rotation, a multi-year study was established in 2010 to evaluate the response of a canola and wheat rotation to several different applications of manure. This report showcases the response of the soil nitrogen to manure and urea fertilizer applications in the first year of the study when canola was grown.

Methods

A four-treatment study was established in the spring of 2010 to evaluate the impact of a one-year versus a two-year single application of manure on a canola and wheat rotation. The four treatments included; 1) no N or check, 2) urea applied to meet the canola N needs, 3) manure applied to meet the canola N needs, and 4) manure applied to meet the canola N needs in 2010 and the spring wheat N needs in 2011. In 2011, only treatments 2 and 3 will be reapplied to meet the N needs of spring wheat. The experimental design was a randomized complete block with three replications and plots were 15 ft by 30 ft in size. To determine the amount of N available in the soil over the study period, plant root simulator (PRS™) probes were inserted into the soil in each plot. Three pairs (i.e., three cation- and three anion-exchange) of PRS™-probes were spread throughout each plot and then combined for analysis. Another three pairs were placed individually in 6 in. by 26 in. root exclusion tubes to measure nutrient supply without root interference. A cumulative measure of nutrient supply throughout the growing season was measured by removing buried PRS™-probes every 14 days (starting 27 days after planting) and then re-inserting fresh PRS™-probes in the same soil slot for a total of four burials. The pulled probes were analyzed for nitrate-N and ammonium-N levels.

Results

According to data presented Tables 1 and 2, root interference lowered the total amount of nitrogen in the soil compared to root exclusion under all treatments and the soil nitrogen levels followed the same pattern with the urea treatment showing a significantly higher total amount of N in the soil than the manure or check treatments regardless of root interference or exclusion. On average, the manure treated plots had 71 percent and 60 percent less total soil N compared to the urea treatments for root interference and exclusion, respectively.

Table 1. Season-long soil nitrogen response to urea and manure with root interference.

Treatment	Total N	
	(µg/10 cm^2/56 days)	
Check	213.5	b
Urea + Sulfur	783.8	a
Manure for 1 yr	272.2	b
Manure for 2 yr	184.6	b

Numbers followed by the same letter are not significantly different at P = 0.05.

Table 2. Season-long soil nitrogen response to urea and manure with root exclusion.

Treatment	Total N ($\mu g/10\ cm^2/56$ days)	
Check	796.1	b
Urea + Sulfur	2243.4	a
Manure for 1 yr	938.3	b
Manure for 2 yr	821.5	b

Numbers followed by the same letter are not significantly different at P = 0.05.

Discussion

After conducting manure N mineralization trials over the last several years, the results of this study are not surprising. It is becoming fairly clear that manure N mineralization is a season-long and possibly a multi-year process. Therefore, this study was set up to be a two-year experiment with wheat as the rotation crop next year. Next year, similar measurements will be taken to assess the behavior of the manure N mineralization in the second year after an application.