Nitrogen Use Efficiency in Canola

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Canola is traditionally grown as the main break crop in cereal rotations. However, in recent years, rising costs of fossil fuels and their associated externalities such as carbon emissions have greatly increased interest in growing feedstock for biofuel, canola being just one of the many options. Although cultivated widely throughout the U.S., canola is a relatively new crop in Massachusetts and in 2009 was the first year its growth and yield performance as well as NUE were evaluated.

Nitrogen is generally the most limiting nutrient in canola production, and relatively high rates of N fertilizer are used to maximize yield. Studies have shown, though, that in comparison to the N supply, the N uptake is not high, resulting in low N use efficiency (NUE). This indicates an increased possibility of N leaching after harvesting. NUE is a complex trait which includes N uptake, N assimilation, and storage and remobilization of assimilates.

Improving NUE of canola can be achieved by increasing the seed yield for current N inputs or maintaining current seed yields using lower quantities of N. An improved NUE will also provide economic benefits for the grower as fertilizer and fuel costs continue to be an issue. Prices of fertilizer, for example, have risen so much that they now may make up 50% of the variable cost of the crop production.

In 2009 an experiment was initiated at the University of Massachusetts Crops Research and Education Center Farm, in South Deerfield, Massachusetts. The experimental site had no manure application history and received 300 lb/ac (0-25-25) on April 23, 2009. N fertilizer in the form of Calcium Ammonium Nitrate (CAN) was added to individual plots at rate equivalent to 0, 50, 100, or 150 lbs-N/acre following the P and K application. Weeds were controlled with a post-emergence application of Roundup at 4 leaf stage. Plots were planted on April 24, 2009, with two Roundup Ready canola cultivars; 906RR and 940RR (Croplan Genetics) at two seeding rates of 5.5 lb/ac (low density) and 8.0 lb/ac (high density). Experimental plots consisted of 7 rows 7 inches apart and 25 feet long. The experiment was replicated 4 times.

The goals of this research project were to i) gather information on growth, seed yield, and nitrogen uptake of canola in this geographical location ii) evaluate canola production under low N input system, iii) assess NUE components including nitrogen uptake efficiency and nitrogen utilization efficiency.

Table 1: Seed yield, Nitrogen Use Efficiency and NUE components for early and late cultivars.

Cultivar	Seed Yld. [1] g 3ft $^{-2}$	Plant N g 3ft $^{-2}$	Fert. Rec. [2] g 3ft $^{-2}$	$NU_{pt}E$ [3] (%)	NU_tE [4] (%)
Early (906RR)	80.5	1.2	21.2	49	70
Late (940RR)	66.6	0.9	15.1	35	80

[1] Results are averaged over all N treatments.

[2] Fertilizer recovery = (plant N in fertilized plots – plant N in unfertilized plots)/supplied N.

[3] Nitrogen uptake efficiency = total N in plant at harvest/supplied N.

[4] Nitrogen use efficiency = seed yield/total N in plant at harvest.

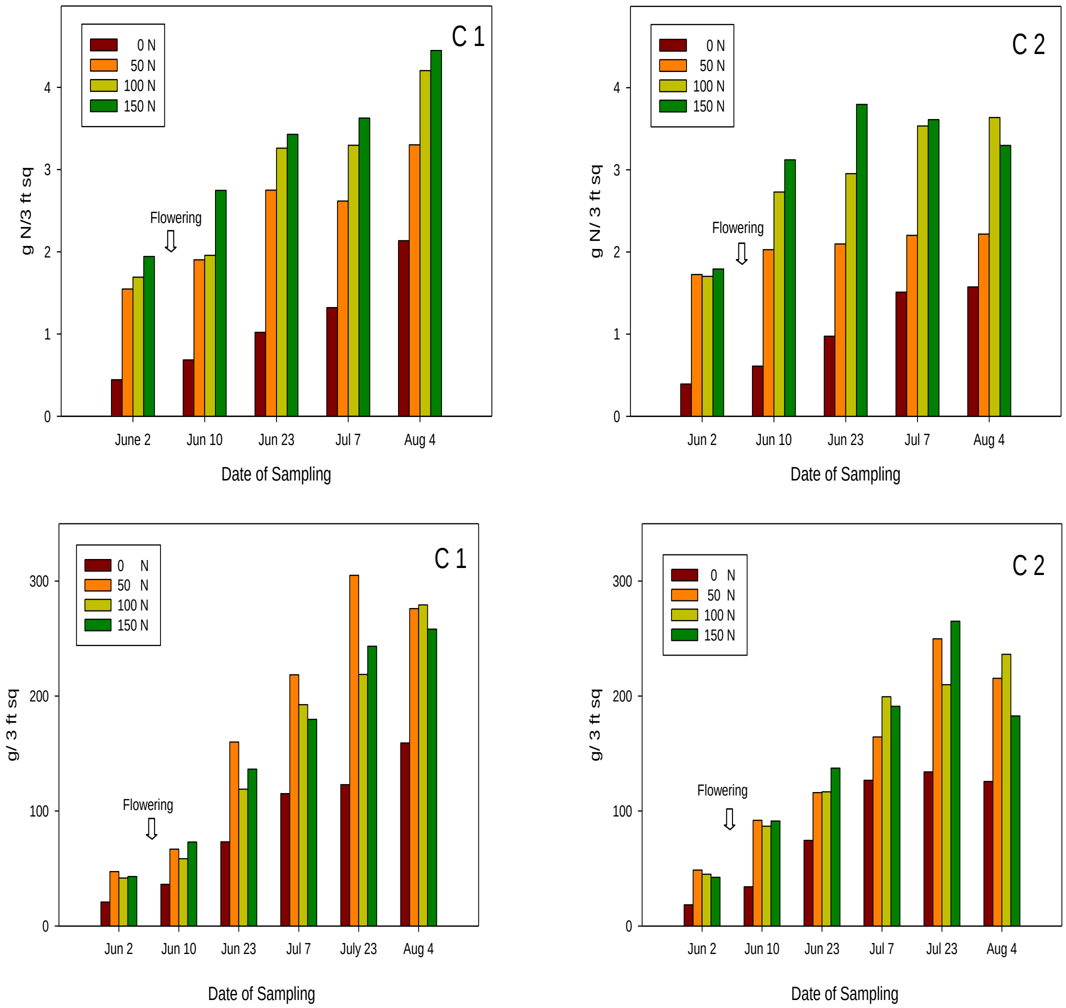

Figure 1: Dry matter and nitrogen uptake pattern for early (C_1) and late (C_2) canola cultivars.

Table 2: Effect of N rate application on seed yield, and fertilizer recovery of canola.

lb N/ac	Applied N $g\ 3ft^{-2}$	Plant N $g\ 3ft^{-2}$	Seed Yld[1] $g\ 3ft^{-2}$	Fert. Rec.[2] $g\ 3ft^{-2}$	$NU_{pt}E$[3] (%)	$NU_{t}E$[4] (%)
0	0.00	0.6	26.7	-	-	84
50	1.56	0.9	69.1	17.6	57	80
100	3.12	1.3	82.8	22.2	42	72
150	4.68	1.3	92.4	14.6	28	64

[1] Averaged two cultivars.
[2] Fertilizer recovery = (plant N in fertilized plots – plant N in unfertilized plots)/supplied N.
[3] Nitrogen uptake efficiency = total N in plant at harvest/supplied N.
[4] Nitrogen use efficiency = seed yield/total N in plant at harvest.