Improving Nitrogen Use Efficiency for Winter Canola Using 4R Stewardship

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Background

Winter canola (WC) is a recently introduced to Washington. In low-intermediate rainfall areas with a dominant wheat-fallow cropping sequences, canola has potential as a valuable rotational crop. Rotational benefits for soil health include improving weed control, breaking disease and pest cycles, increasing water infiltration and increased wheat yields following a canola crop. Fertility research is needed to reach yield and quality potential for canola in this region. Current nitrogen recommendations for WC is 6-8 lbs N/100 lb seed yield, which is goal-based derived by growers.

Objectives

1. Evaluate sufficiency of current N recommendations.
2. Determine the best timing of N fertilizer for fields with different yield potential across different rainfall zones.
3. Evaluate how N application rate and timing affect canola yield and oil content.

Methods

Trial locations

In fall 2016, three trials were established in areas that represent different yield potentials, soil types, crop rotations, and climatic conditions. Two dryland trials were located near the towns of St. John and Hartline in Washington (WA) State and one irrigated trial located near Odessa, WA.

Washington State Rainfall and cropping zones. Labeled left to right

- 2016/17 Trial Locations- Odessa, Hartline, St. John
- 2017/18 Trial Locations – Troy, Colfax, Latah

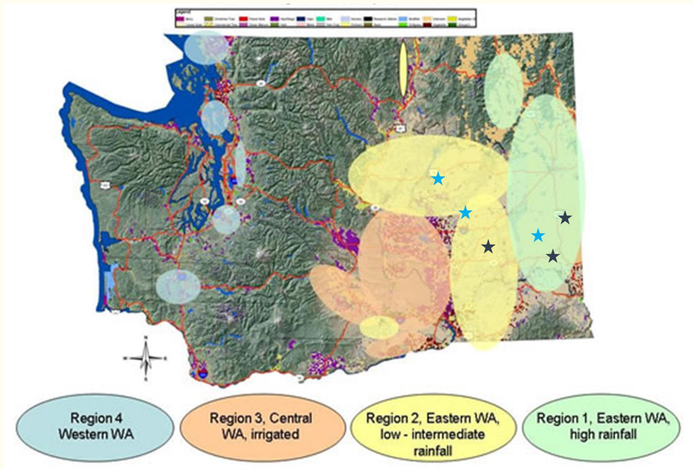

Table 1- Summary of soil analysis and site characteristics at each trial site

	pH (1:1)	OM (6in)	Mineral N ppm (4ft)	30yr Normal Rainfall (mm)	Yield Goal
Hartline	6.52	0.90	76.13	274.066	1800
Odessa	7.21	1.99	46.06	278.384	3800
St.John	5.14	3.22	118.45	439.42	2800

Experimental Design

- 4 replications of 3 rates x 3 timings, complete randomized design
- N fertilizer application stream jet urea ammonium nitrate solution in November for fall application, surface granular urea for spring
- Slow released sulfur applied uniform rate in fall
- For split application, 60% of fertilizer applied in fall, 40% in spring

Plant Analysis

- Plant tissue sampling at first fall/winter frost, spring rosette, stem elongation, flowering, and harvest used to determine N uptake during the growing season and yield response to N
- Nitrogen content analyzed using LECO dry combustion
- Seed Analysis preformed using near infrared reflectance (NIR)

Statistical Analysis

- Statistical analysis was carried out using SAS University Edition using ANOVA with Fisher's least significant difference testing

Table 2- Nitrogen fertilizer application rates by site.

	Nitrogen applied (lb/acre)		
Rate	Hartline	St. John	Odessa
Low (-0.5)	14	33	87
Recommended *	28	66	174
High (+0.5)	42	99	262

*Recommended N rate = yield goal/100 * 6 – (total preplant soil mineral N in the soil profile)

Preliminary Results

Table 3- Nitrogen fertilizer rate and timing effects on yield for each trial site

	Yield kg/ha		
Factor	**Hartline***	**Odessa**	**St. John**
Fall	N/A	2257.7	3411.6
Split	N/A	2772.5	3394.4
Spring	N/A	2091.5	3690.7
0	N/A	1551.5	3512.6
0.5	N/A	2225.8	3859.3
1	N/A	2212.7	3521.5
1.5	N/A	2284.2	3468.5

*Yield calculations inaccurate due to sampling error.

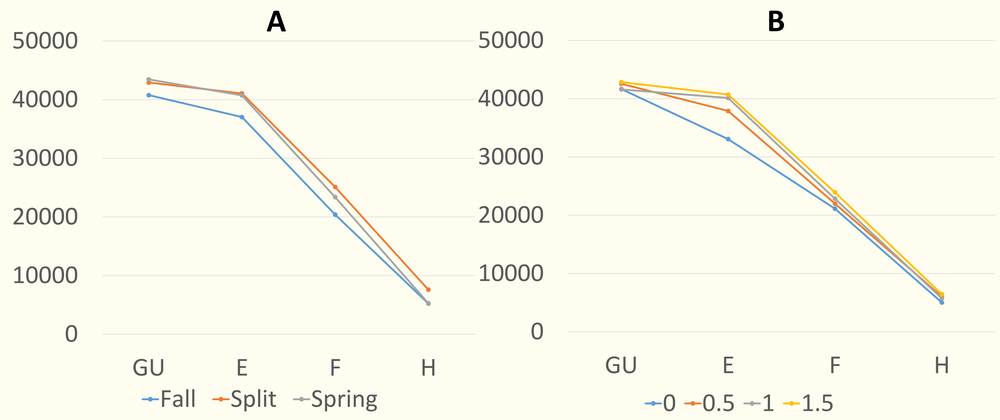

Figure 1- Tissue N content (mg kg^{-1}) at Greenup (GU), Elongation (E), Flowering, and Harvest (H) as affected by N application timing (A) and rate (B) in St. John, WA in 2016-17.

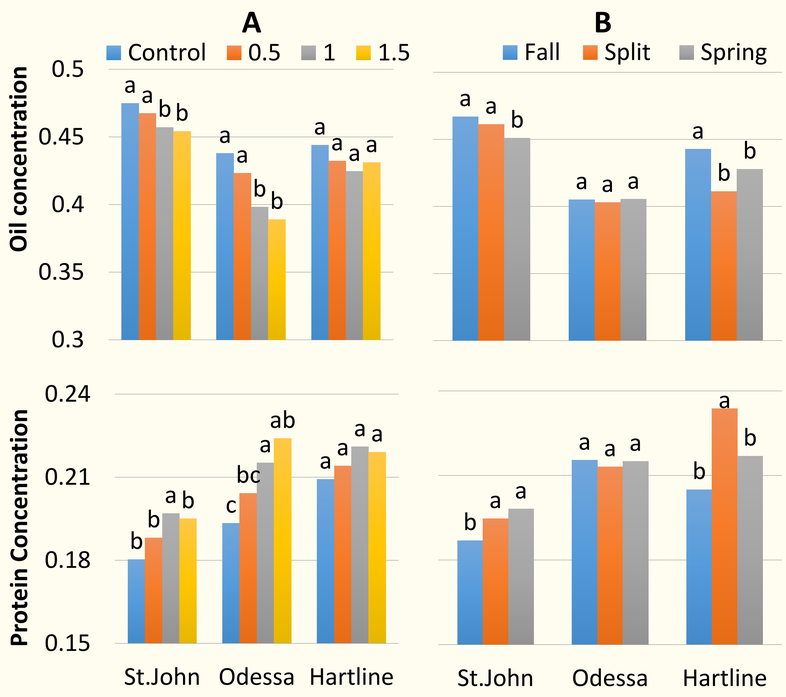

Figure 2- Seed oil and protein content response from rate (A) and timing (B) treatments. Different letters indicate significantly different values between treatments (P<0.1)

Discussion

- Lack of yield response to N may be due to high residual nitrogen at planting.
- Three trials have been established at Colfax, Latah, and Troy to conduct similar study in 2017-2018 crop season.

Conclusions

- No significant differences in yield or total above ground biomass among treatments.
- Above ground tissue N increased at all stages with increased with N rate.
- Split and spring N application resulted in greater above ground tissue N when compared with fall application.
- Seed oil and protein content were inversely related, with higher N rate contributing to higher protein content and lower oil content.

Acknowledgments

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