Nutrient Uptake and Partitioning in Winter Canola

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INTRODUCTION

Optimum nutrient management should be pursued in order to maximize canola yield. Nutrient uptake and removal values are critical for diagnosing plant nutrient programs. The main issue faced by the scientific community is that the lack of available public- or private-sector information about nutrient management for canola. In addition, less is known related to the crop nutrient dynamic, content and distribution within the plant (different fractions) as the growing season progresses for modern winter canola varieties.

OBJECTIVES

The objective of this project is to illustrate the changing plant nutrient uptake dynamics for modern varieties canola during the entire growing season. In addition, information for nutrient requirements/removals in canola for diverse nutrients will be obtained.

MATERIAL AND METHODS

Canola Management Practices
- Planted 09/20/13
- Ashland Bottoms, K-State Univ. (Manhattan, KS)
- OPV Variety
- Final stand 230,000 pl acre[1])

Measurements
- Biomass & Nutrient evolution
- Reflectance
- Color Infrared
- Thermal Infrared

RESULTS

Final grain yield was 37 bu acre^{-1} and biomass was 4500 lbs acre^{-1}, with a grain harvest index (HI, grain to whole-plant mass ratio) of 0.59 units. Close to 50% of the total biomass at maturity was reached at flowering time, with a critical period around flowering.

Vegetative biomass declined after flowering

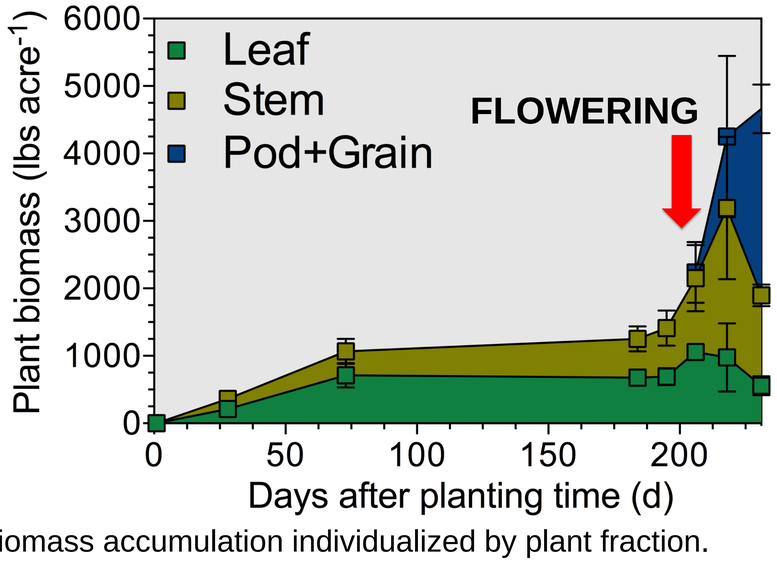

Figure 1. Plant biomass accumulation individualized by plant fraction.

RESULTS (continued)

Canola nutrient uptake and partitioning within the crop growing season is depicted in Figure 2. For all nutrients evaluated (N, P_2O_5, K_2O, S, Zn, and Mn), rapid uptake rate occurred 2-3 weeks before and after flowering (critical period for biomass accumulation). Nutrient accumulation follow a decreasing order from: K_2O (142 lbs acre^{-1}) > N (140 lbs acre^{-1}), P_2O_5 (48 lbs acre^{-1}) > S (21 lbs acre^{-1}) > Mn (0.20 lbs acre^{-1}) > Zn (0.12 lbs acre^{-1}).
Nutrient harvest index (grain to whole-plant nutrient content ratio at maturity) presented the following order, from the high to low nutrient HI: P_2O_5 > Zn > S > Mn > S > K_2O > N.

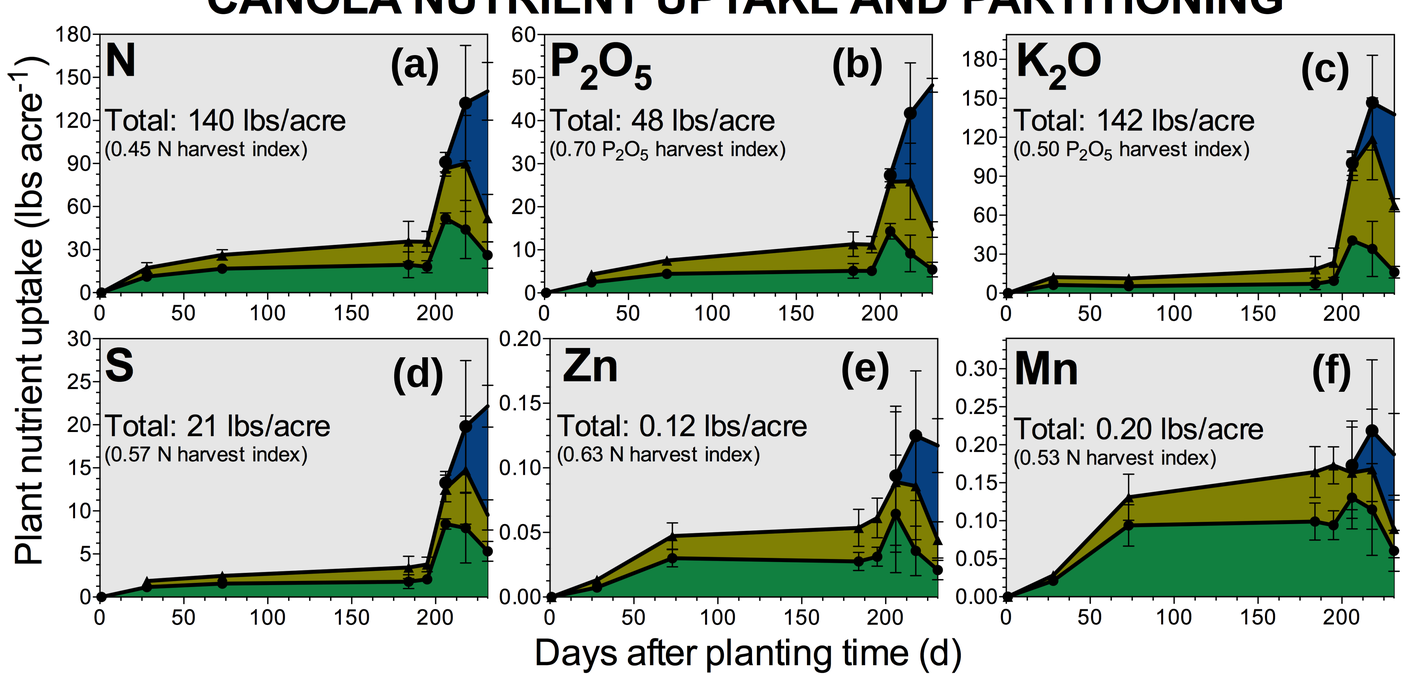

Figure 2. Plant nutrient uptake for: (a) N, (b) P_2O_5, (c) K_2O, (d) S, (e) Zn and (f) Mn.

Nutrient removal in the grain per unit of yield (grain nutrient content) is presented in Table 1.

Table 1. Summary of grain nutrient removal values from this research and scientific literature.

Reference	Nutrient removal (lbs acre^{-1})					
	N	P_2O_5,	K_2O	S	Zn	Mn
This study	1.7	0.91	1.92	0.32	0.002	0.003
IPNI[&]	1.5	0.76	0.38	0.24	-	-
Oklahoma***	2.5	-	-	0.12		
KSU*	1.7	0.77	0.44	0.33	-	-
Canada**	1.9	1.45	2.30	0.54	-	-

* http://www.agronomy.k-state.edu/documents/eupdates/eupdate072707.pdf
** Adapted Nutrient Uptake and Removal by Field Crops' Canadian Fertilizer Institute, 1998
*** http://npk.okstate.edu/petesheets/Full%20OilSeed.pdf
[&] https://www.ipni.net/ipniweb/app/calc.nsf/0/ED24A544615FF4A185257D7E001FA27C

CONCLUSIONS

- The critical period for plant growth and nutrient uptake was 2-3 weeks before and after flowering of winter canola (rapid growth and nutrient accumulation).
- Nutrient accumulation and partitioning presented similar dynamics with N and K representing the most critical nutrients in terms of quantities and with a N:K_2O ratio close to 1:1 at maturity; the P_2O_5:S ratio was close to 2:1, representing important nutrients for canola nutrition.
- N, P, and S removal were similar to values previously documented in the scientific literature.
- Still information is needed for properly calibrate and validate the nutrient removal coefficients for this crop. Following this rationale, more studies are investigated for these purposes.