Oilseed Root Characteristics: Implications for Water and Nutrient Management

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Introduction

Canola and camelina have distinctly different root systems compared to the cereal crops grown in the PNW. Some of these differences should be considered when designing soil and fertilizer management schemes for maximizing water and nutrient use efficiencies. Differences in the root morphology arise immediately at germination and extend through the rest of the plant life cycle.

Figure 1. Germinating canola seedling.

Objective

Characterize oilseed root morphology

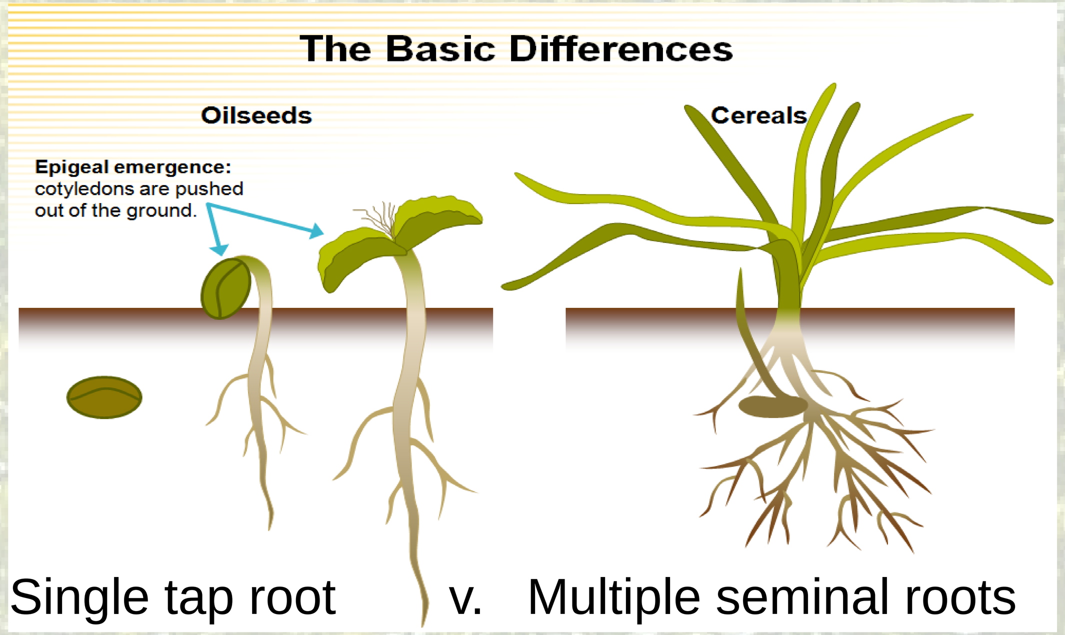
a. Determine root hair dimensions of canola and camelina.

b. Characterize apical root meristem sensitivity of canola and other species to N fertilizer banding.

c. Assess depth of canola root activity in extracting water and nitrogen from the soil profile.

Approaches

Root morphology and activity analysis was accomplished with in-soil digital scanning, root excavation and monolith construction, and pre-plant vs. post-harvest soil water and nitrate analysis of extraction depths.



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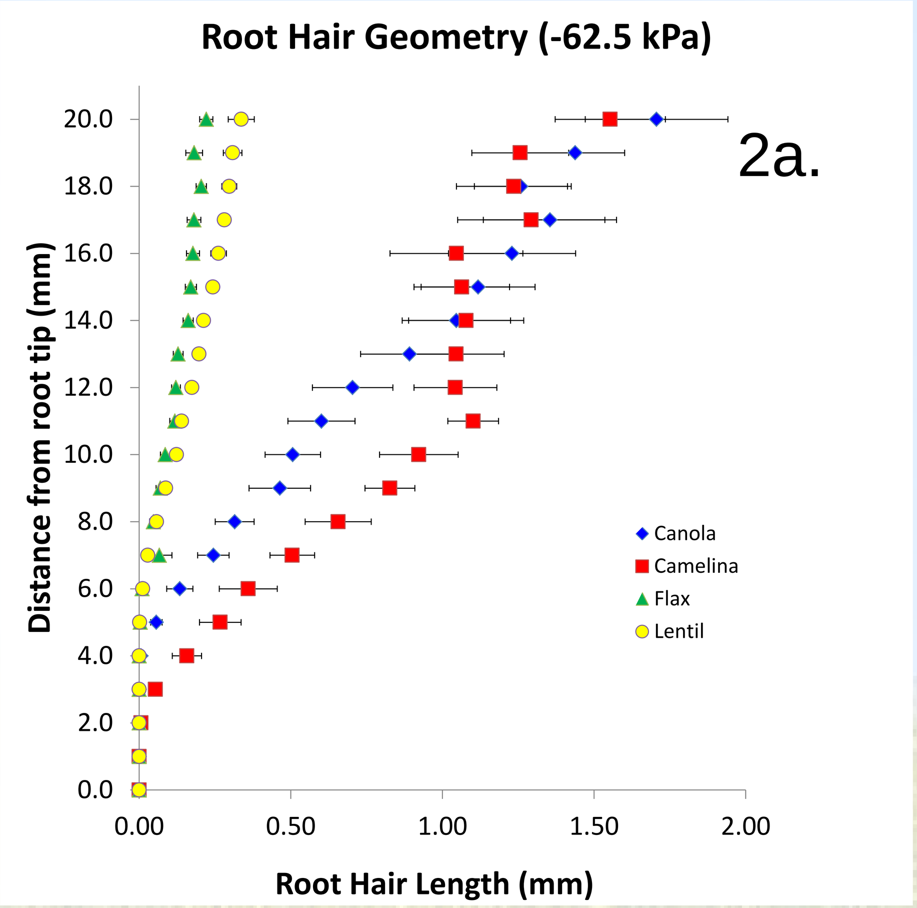
Root hairs: Single cell protrusions from epidermal root cells that extend the root absorptive surface area. Oilseed root hairs are longer, but less dense than wheat, flax or lentil, suggesting oilseeds may have greater ability to extract soil immobile nutrients such as ammonium, phosphate and potassium (Fig. 2a). Canola root hairs may be more drought tolerant (Fig. 2b).

Root Apex (apical meristem): Growing point of main root axes. Both species exhibit apical susceptibility to NH3 toxicity when growing into a urea fertilizer band (Figs. 3a and 3b), but the multiple seminal root axes of wheat provides better opportunity for some axes to avoid the toxic zone (Fig. 3c.)

Root Exploration. A 2012 winter canola root excavation (see monolith) and nitrate/water depletion curves by spring canola (Pullman, Davenport 2011) indicate root activity extends 90 to 150 cm deep. The vertical exploration, long root hairs and lateral roots correlate with very efficient water and nutrient use.

Results and Discussion

Root Hairs



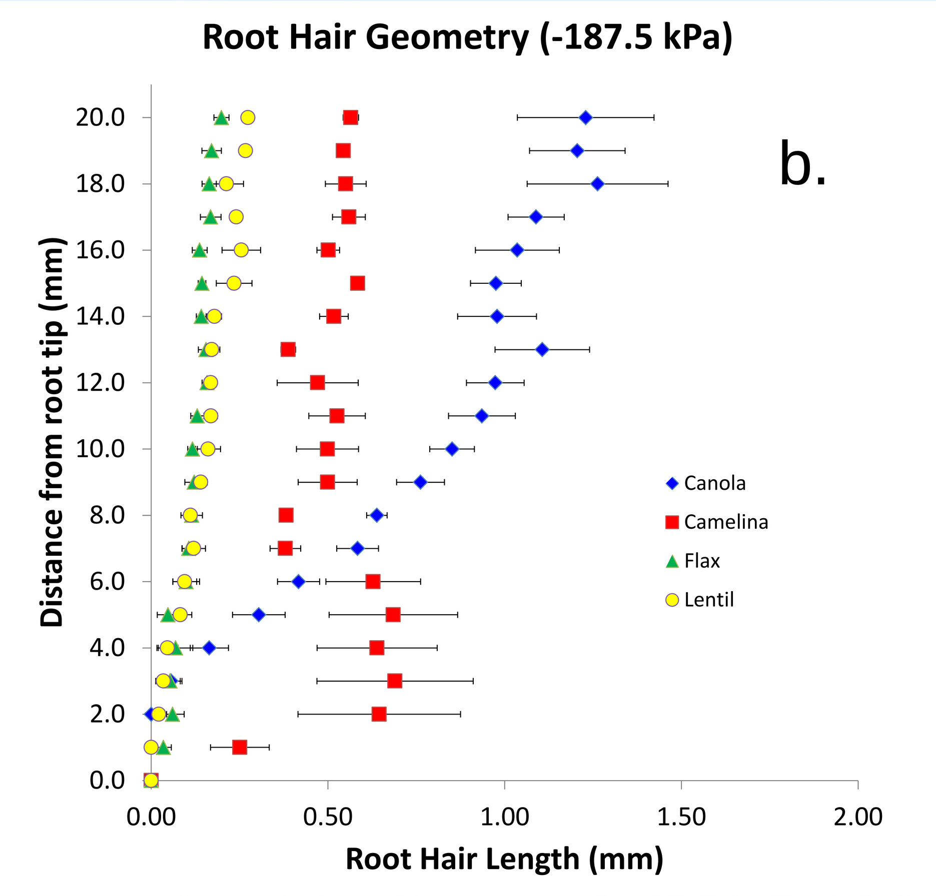
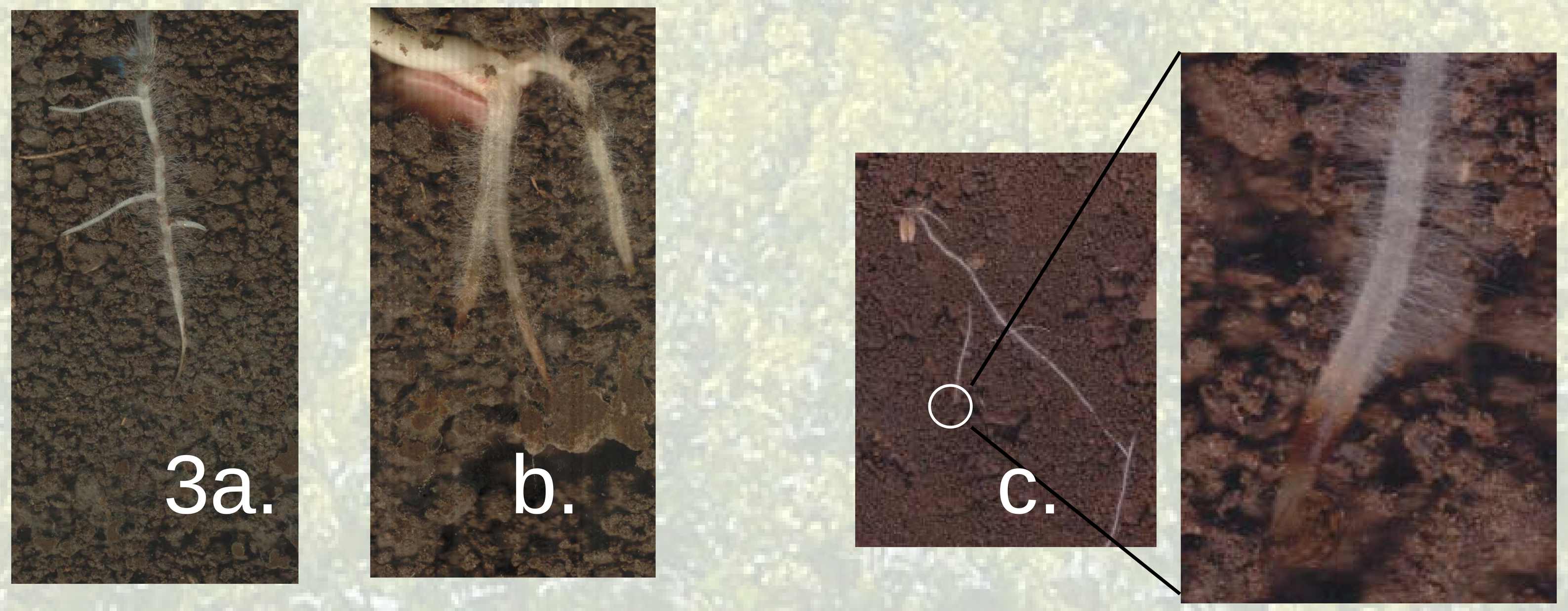


Figure 2. Root hair lengths at distance from axial root apex, under a) well watered, and b) dry soil conditions.

Root Apex NH_3 Toxicity



Soil monolith on display

Vertical Profile Root Exploration

	Pullman, WA			Davenport, WA		
Soil Depth	Preplant + In-season H_2O	Post-harvest H_2O	H_2O depletion	Preplant + In-season H_2O	Post-harvest H_2O	H_2O depletion
cm	mm water					
30	220	54	166	180	32	152
60	144	60	84	92	36	59
90	145	55	89	83	43	42
120	126	63	63	87	52	38
150	112	80	32	96	NA	NA
	Preplant + inseason N	Post harvest N	N depletion	Preplant + inseason N	Post harvest N	N depletion
	kg inorganic N/ha					
30	139	16	123	114	14	100
60	16	2	14	7	3	4
90	16	1	14	4	3	1
120	17	1	16	7	3	4
150	38	3	35	19	NA	NA