Deep-Banded Fertilizer Toxicity in Canola

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Stand establishment is a major challenge to increasing production of canola in Washington state, and fertilizer toxicity may be one potential cause. Previous studies have demonstrated that fertilizers can have toxic effects when banded with or below the seed. Office scanners were buried in soil in growth chamber experiments to capture images of the response of root growth to fertilizer banding. The image below (Fig. 1) shows the effects of a urea band (80 lbs N/A) on canola and wheat roots. Due to the different root architectures survivability varied between wheat and canola. The fibrous root system of wheat allowed it to survive while the canola seedlings with tap root systems died. With the high resolution images collected during these studies, symptoms of premature lateral emergence, root shrinkage, browning, and root hair dieback were observed (Fig. 2). The initial findings clearly demonstrate the toxicity deep banded fertilizers has on canola roots. Fertilizer recommendations for canola production in Washington state are currently being revised and will incorporate these results to increase the probability of successful stand establishment.

A video of time-lapse images of the root scans and more extensive commentary on roots, root hairs and fertilizer placement can be viewed at https://www.youtube.com/watch?v=eLxaKzqGc6s

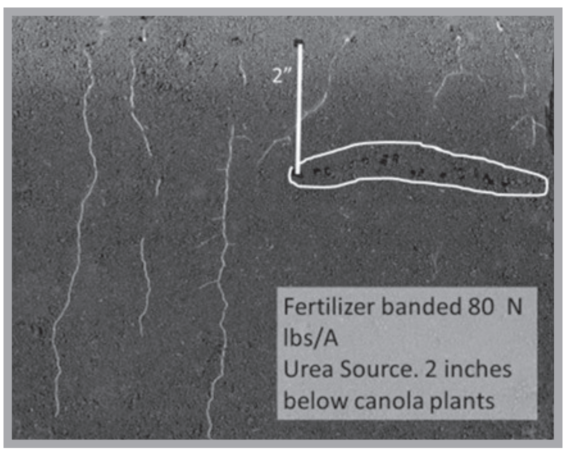

Figure 1. Urea fertilizer (80 lbs N/acre) demonstrating toxicity to the root system.

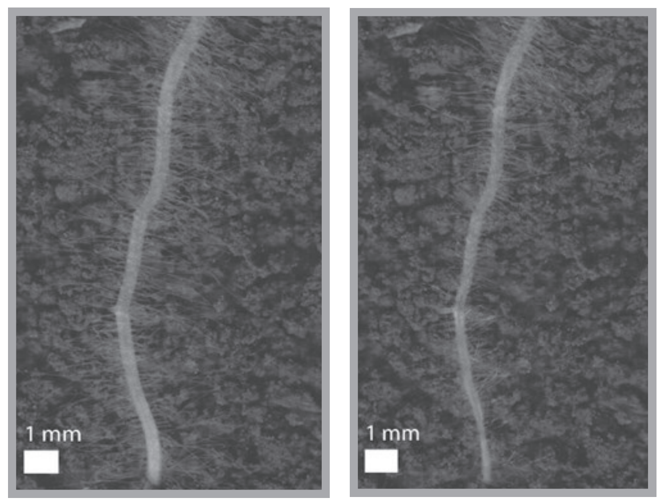

Figure 2. High resolution images of a healthy canola root (left) and a dying root showing width shrinkage, premature lateral root emergence, root browning, and root hair dieback (right).

Canola Nitrogen Fertility Management

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Fertility management of winter canola is more complex than spring canola for a couple of reasons. First, there are more potential feed, food and fuel markets for winter canola, and each market demands quality characteristics of forage, meal and oil that can be influenced by fertility management. Second, there are more growth stages affiliated with a complex range of environments and growing season conditions, and each phase requires tailored fertility management approaches to ensure the right nutrients are available at the right time and place. Breaking it down, there are three growing seasons to manage: the vegetative growth phase I (from planting to winter dieback), the winter survival phase II and then the reproductive phase III (spring regrowth to grain harvest). In phase I, we have learned that canola seedling

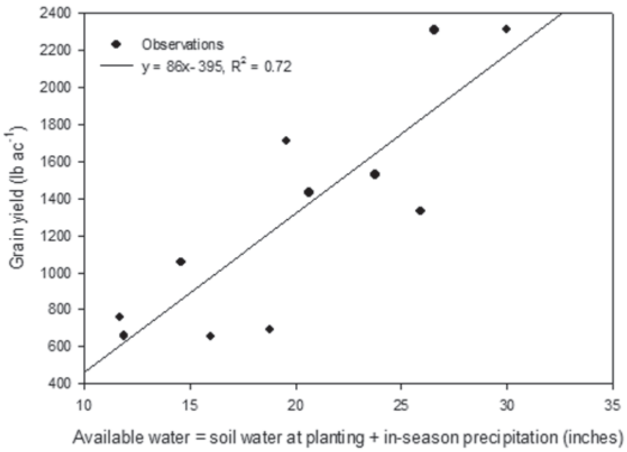

Figure 1. Available water vs spring canola yield over 11 site years.

roots are sensitive to ammonium based fertility, and we have excellent examples of root dieback from ammonia toxicity from seed or deep banded Nitrogen (N). We also have observed 30 to 130 lbs N/A vegetative N uptake during this first phase if canola is seeded late summer and plants have ample moisture and heat units to establish, using 6 inches of total moisture. In phase II, winter survivability will be affected by general plant vigor supported with balanced soil fertility, variety traits and residue management. In phase III, yield potential of a good stand of winter canola or spring canola is correlated with moisture availability (Fig. 1) and economic N supply requirements correlate with yield (Table 1). Residual soil N and estimates of N mineralization contribute to fertilizer N as a summation of total N supply. Canola is an aggressive crop that scavenges soil N, but requires a high N supply per unit of yield.

Table 1. Total N supply requirements for spring canola yield potentials.

Yield Potential (lb Gw/A)	600	1200	1800	2400	3000
Total N Supply (lb Ns/A)	110	140	175	205	235
UNR (lb Ns/100 lb Gw)	19	12	10	9	8
NUE (Gw/Ns)	Low---à High				

Be alert to potentially high soil N supply when following fallow with canola compared to lower N supply following wheat. We observed an average of 183 lb soil N/A following fallow compared to 69 lb soil N/A following wheat. When soil N supply is high and yield potential is low due to low available water, little fertilizer N will be required (Fig. 2). But when yield potential is high, total N supply requirements will also be high, and fertilizer N requirements will also be higher.

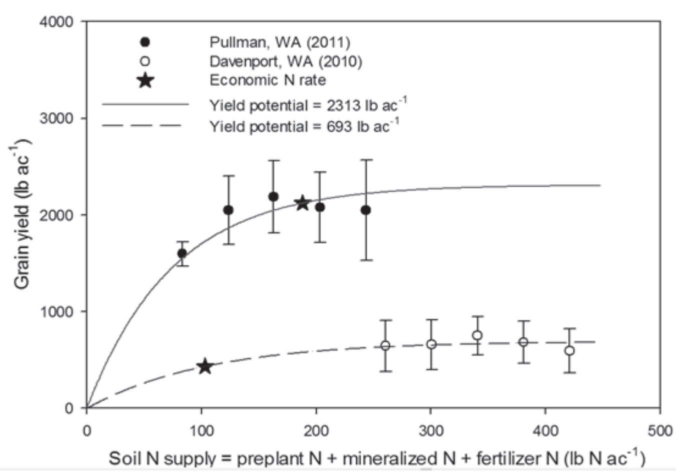

Figure 2. Examples of low yield potential, high N supply at Davenport in 2011 vs. lower N supply, high yield potential at Pullman in 2011.

Subsoil Quality: Chemical and Physical Factors

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Subsoil quality is an important factor in cropping systems due to the effects on root system growth and development, nutrient and water availability, and therefore crop yield and quality. When compaction occurs in the subsoil it can cause