taproot growth and development as observed by Pan. Spring timed application may be ideal to minimize N loss in terms of 4R nutrient management, but placement and source will need to consider ammonia exposure to maximize seedling health and overall productivity. In drier winter locations, fall N fertilization has effectively spread the N fertilization of spring wheat, while achieving better distribution of soil nitrate throughout the 4 ft root zone.

Selecting Nitrogen Source to Minimize Damage Caused by Free Ammonia

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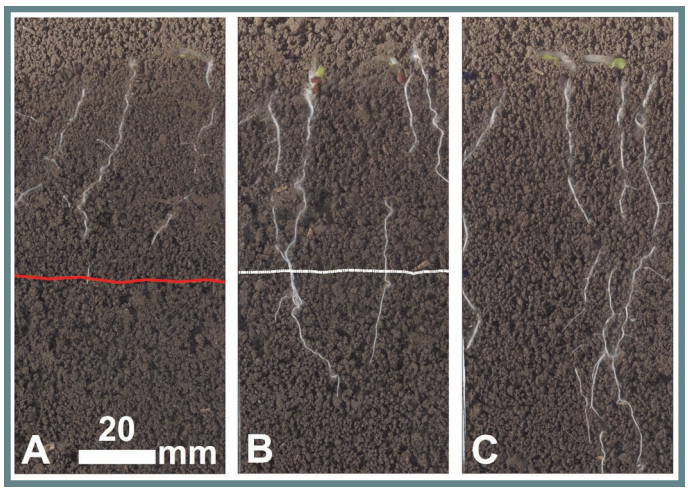
When planning Nitrogen (N) fertilizer application the source of the fertilizer should be considered in order to optimize nutrient availability as well as to avoid damaging seedling root systems. Canola root systems have been shown to be sensitive to urea banded below the seeds. The two primary considerations when choosing a safe source of N fertilizer are the salt toxicity and ammonia/ ammonium toxicity. The conversion of ammonium to free ammonia is primarily controlled by the initial pH of the fertilizer reaction. A high pH will lead to more free ammonia than ammonium. Free ammonia has been shown to be extremely toxic to plant cells. Therefore fertilizers with a high pH would be expected to release more free ammonia and consequently have a higher level of toxicity. Urea, Anhydrous Ammonia, and Aqua Ammonia all have pH greater than 8 in solution. Fertilizers with a pH lower than 8 are Ammonium Sulfate, Mono-Ammonium Phosphate, and Di-Ammonium Phosphate. In this study we compared the application of ammonium sulfate (AS) (pH = 5-6, partial salt index = 3.52) to urea (pH = 8.5-9.5, partial salt index = 1.618). Urea (Fig. 1.A) and AS (Fig. 1.B) were banded at a rate of 0.016 oz N ft^{-1} (43 lbs/A at a 6" row spacing) were compared with a control 0 oz N ft^{-1} (Fig. 1.C). Both the AS and the Urea were seen to retard tap root growth. However, the urea was seen to completely prevent root passage through the fertilizer band, whereas the roots exposed to AS were seen to pass through the band.



Take away points: It was determined that canola roots are more sensitive to urea than ammonium sulfate. This is likely because urea would produce higher levels of free ammonia following dissolution.

Effects of Mowing Early Planted Winter Canola on Yield, Survival, and Moisture Use

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A major constraint on the adoption of winter canola in the winter wheat/fallow zone of Washington is the ability to establish a uniform stand of the crop in the hot, dry growing conditions associated with the recommended seeding date of mid-to-late August. Seeding canola earlier in the summer (early-to mid-July) increases the chance for uniform stand because temperatures are cooler and soil moisture more readily available. However, large plants are less likely to survive the winter, due to exhaustion of soil moisture reserves or occurrence of stem elongation before the frost.

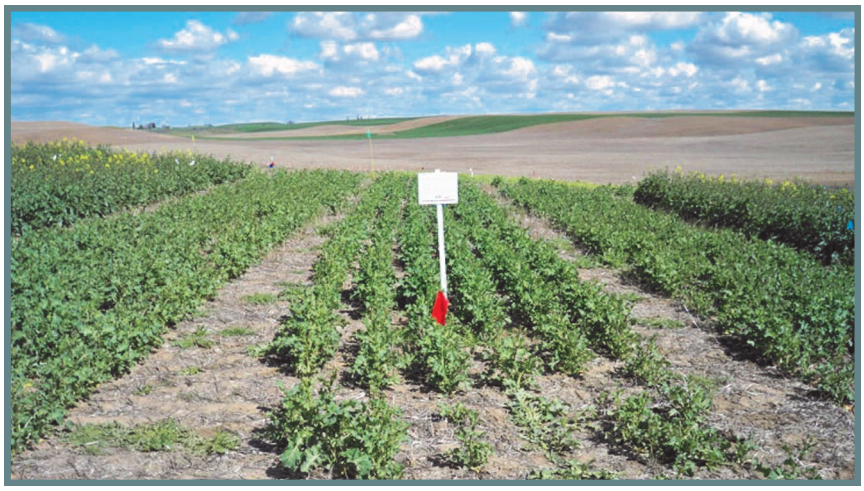

Figure 1. Different plant heights in Spring 2016.

Research conducted at the University of Idaho investigated early planting of winter canola with one to three harvests of the biomass for "canolage" (canola silage) in an irrigated system and research conducted in Australia evaluated spring and winter varieties for grazing. Canopy management with fungicides or defoliation with a mower has been recommended for growers in the UK if the leaf area of their winter canola plants is too large. However, these strategies need to be evaluated for winter wheat/fallow region in Washington because the climate condition are different from where previous studies conducted.

Figure 2. Mowing July planted canola in Fall 2015.

A study was conducted for two growing seasons in 2015-2017 to evaluate seeding date and mowing winter canola on water use and canola yield. In this study, glyphosate resistant winter canola was planted July 21, August 4, and September 14, 2015. Within the July planning, designated plots were mowed September 21, October 21, and both dates and no-mowing treatment was also included. Mowing height was set as not to damage the crown of the plant (6 to 10 inches).

The preliminary data shown that winter survival ranged from 62% to 97% in all plots. Mowing had no significant effect on winter survival when compared to the July-planted non-mowed canola. The highest yield (2825 lbs/A) was reached when canola was planted in August. Slightly lower yields (≈2700 lbs/A) were realized from canola planted in July and mowed once either in September or October. When canola was mowed twice, yield was almost 500 lbs/A less than the August planting date. There was plenty of snow cover at Davenport to protect the small plants in the September planting and survival and yield was excellent considering the planting date.

Ongoing Research: This study has been repeated for the 2016-2017 year with Haiying Tao taking over the research.

Table 1. Effect of planting and mowing date on winter canola yield and survival at Davenport, WA 2016.

Treatment date		Yield	Survival
Planting	**Mowing**	(lbs/A)	(%)
7/21/2015	none	2675	75
7/21/2015	9/21/2015	2705	63
7/21/2015	10/21/2015	2700	72
7/21/2015	both	2345	74
8/4/2016	NA	2825	62
9/14/2016	NA	2560	97