Management of Fresh Wheat Residue for Irrigated Winter Canola Production

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The two major objectives of this experiment are: (i) to understand the physiological mechanism(s) governing winter canola (WC) health when planted soon after the harvest of winter wheat (WW), and (ii) to learn how to effectively and profitably produce irrigated winter canola without burning or excessive tillage of wheat stubble. Our hypothesis is that fresh wheat stubble is not phytotoxic to WC and that WC can be successfully produced in a direct-seed system after wheat harvest as a viable alternative to field burning plus heavy tillage.

Four winter wheat stubble management treatments were established in August and September 2012 at the Jeff Schibel farm SW of Odessa, WA. The experiment is embedded in a circle of irrigated winter canola belonging to Mr. Schibel. Irrigated WW stubble in the plot area was burned in treatments I and III (below) on August 20 and irrigation water immediately applied to promote germination of volunteer wheat. Glyphosate was applied to the entire plot at a rate of 24 oz/acre on September 4. Land was prepared as required by protocols for each treatment (i.e., straw chopping, disking, moldboard plowing; see list of treatments below) on September 4-6. Winter canola was planted and fertilized in one pass on September 7 using a Kile no-till hoe drill. Assure II herbicide for grass weed control was applied on October 6. All field equipment used in establishment of the experiment was transported to the site from the WSU Dryland Research Station. Treatments established at the Schibel site are: (i) stubble burned + disked, (ii) stubble chopped + moldboard plowed, (iii) stubble burned, then direct seeded and, (iv) direct seeding into standing and undisturbed stubble. Experimental design is a randomized complete block with four replications of each treatment for a total of 16 plots. Individual treatment plot widths range from 8-to 10-ft depending on the tillage implement (if any) used. All plots are 100 ft long. Application of irrigation water, which will total about 15 inches for the crop year, is managed by Mr. Schibel.

As this experiment was initiated 2012, there is yet little data to report. Winter canola stand establishment in all treatments is satisfactory (Fig. 1). We obtained good control of volunteer WW with Assure II grass weed herbicide applied at a half rate (8 oz/acre) to the entire experiment on October 6. Plant and soil samples from all treatments were obtained on October 23, 2012 and again on April 24, 2013. These samples are currently being processed for fungal root pathogens in the laboratory. We suspect that *Rhizoctonia solani* AG 2-1 may be a limiting factor in establishment of WC in fresh WW residue. In a previous study conducted at Lind, WA, removing the pathogen significantly increased WC stands and dry weights. Leaving the straw intact on the soil surface (which is done in a direct-seed system), did not increase disease or reduce plant dry weights. If fresh WW straw had an allelopathic effect, we would have expected that WW residue on the surface would have leached compounds and reduced WC growth, but this did not happen. However, incorporating fresh WW straw into the soil can immobilize N, because of the high C/N ratio of the straw.

Fig. 1. Collaborating grower Jeff Schibel inspecting winter canola that was direct seeded into newly-harvested (i.e., fresh) irrigated wheat stubble. The stubble in this treatment was left standing and undisturbed prior to planting winter canola. Photo was taken in April 2013.

Nitrogen Use By Pacific Northwest Dryland Canola (Brassica napus)

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Nitrogen (N) fertility recommendations vary widely within canola production regions including the Pacific Northwest. Canola has a high N uptake efficiency (unit of total plant N per unit of supplied N) but a low N utilization efficiency (unit of grain per unit of total plant N), leading to an overall low N use efficiency (NUE) (unit of grain produced per unit of N supplied) compared to wheat. Therefore, canola is able to take up nitrogen from the soil very well, but is poorer at allocating that nitrogen to its seeds. Calculations for estimating the N requirement for canola based upon maximum theoretical yields have proven unsuccessful in our region. Recent research indicates that spring canola can root up to 5 ft, and efficiently scavenges high levels of residual soil N thereby minimizing responses to N fertilizer. Though rainfall gradient largely determines yield potential of canola in Pacific Northwest, yields at economically optimum N supply (EONS) are consistently lower than maximum theoretical yields and reached at a relatively lower total N supply (Fig. 1). The N requirement of canola at EONS can vary among years, but a single unit N requirement (UNR) of 11 kg N per kg seed was determined by considering multiple years and locations within a rainfall gradient.

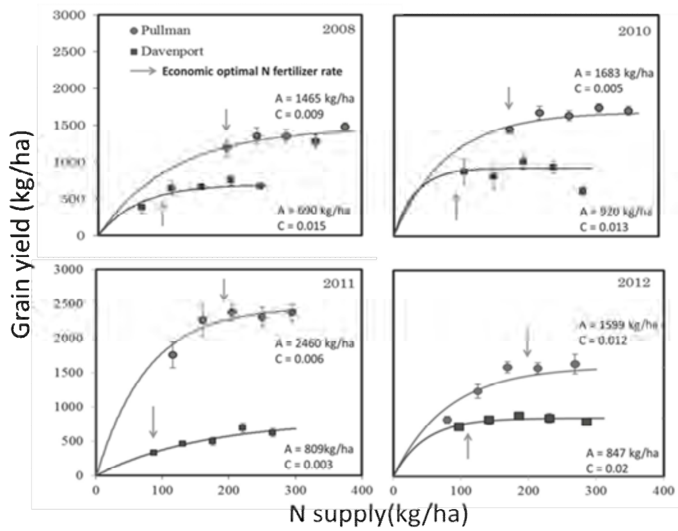

Fig. 1. Maximum yields (A) and efficiency factors (C) for spring canola at Pullman, WA, and Davenport, WA.

Assessing Crop Rotational Nitrogen Use Efficiency Using an N Balance Approach

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In annual cropping systems, N use efficiency is typically estimated on a single crop basis. However, this approach ignores the dynamic nature of N cycling within multi-year crop rotations featuring a diverse set of crops. We developed a component analysis of NUE of an entire cropping sequence of featuring canola (spring canola-spring pea-winter wheat). This approach provided insight into the propensity of cropping systems to retain and recycle N within a rotation by factoring in crop yields, grain and residue N, fertilizer N, N mineralization estimates, and changes in soil residual inorganic N within the intermediate and high rainfall zones of Eastern WA. The inclusion of peas led to positive N balances (N output exceeding N inputs) due biological N fixation (Fig. 1). Interestingly, N balances were also more positive for sequences that received higher rates of N fertilization during its spring canola cropping. This result suggests elevated N mineralization due to the return of canola residues with higher N concentrations, as well as contributions of fertilizer carry-over to the overall rotational NUE. By tracking changes in soil N supply between crops, the rotational NUE will help us evaluate and adopt alternative cropping systems with the propensity to retain and recycle N within a rotation.

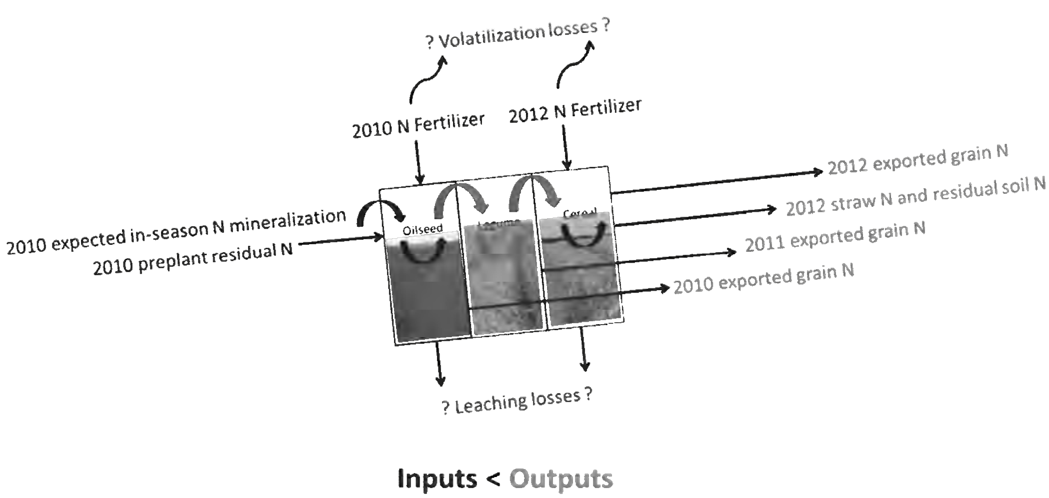

Fig 1. A positive N balance indicates N gains in the cropping system due to biological N fixation or enhanced N mineralization during the cropping sequence.