Proposal for 2010-2011
Northwest Columbia Plateau PM_{10} Project

Objective 5: **Wind Erosion and PM_{10} Emission Control Methods**

Title: ***Wind Erosion Control Research for Dryland Cropping Systems***

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Objectives

1. Continue long-term dryland cropping systems research at Ritzville and Lind to develop and test alternatives to winter wheat – summer fallow.
2. Investigate various ways to enhance emergence of winter wheat when sown deep into summer-fallowed soils.
3. Determine the soil physical processes involved in seed-zone moisture retention as affected by frequency of rodweeding operations during summer fallow.
4. Measure the rotational benefits of winter canola on soil characteristics and subsequent winter wheat performance.
5. Evaluate camelina as an alternative crop for the typical winter wheat – summer fallow production region.
6. Measure residue, surface roughness, seed-zone water, and grain yield of winter wheat as affected by rodweeding frequency and timing during fallow.
7. Determine whether the current 16 and 18 inch row spacing of deep-furrow drills can be effectively widened to allow better residue clearance in tilled summer fallow without affecting grain yield and weed pressure.

Planned Research

Several new and ongoing studies in the 6- to 12-inch annual precipitation zone in eastern Washington will be funded by this project. These studies are:

Project 1

Row spacing for deep-furrow planting into fallow. A 3-year field study will be conducted at three locations to evaluate row spacing effects on winter wheat grain yield, grain yield components, straw production, and in-crop weed pressure. Row spacing treatments will be 16, 18, 20, 22, 24, and 32 inches. John Deere HZ openers will be fitted onto an 8-ft-wide toolbar that will be constructed this winter (2009-10) at the WSU Dryland Research Station at Lind. Loosening just four bolts per opener and sliding the opener assembly along the tool bar will easily adjust the spacing. A Valmar air cart and Honda motor will be mounted on the tool bar to deliver seed to the openers. Funds to construct this drill are already available and will not be charged to this project.
Sites will be located each year at Lind (Adams County), Douglas County, and Franklin County. Experiments will be established on tilled summer-fallowed soil in late August–early September

in 2010, 2011, and 2012. Sowing rate for all row-spacing treatments will be 40 lbs/acre. Individual plots will be 200 feet by 8 feet. Stand establishment will be measured 21 days after planting. Experimental design will be a randomized complete block with four replications (i.e., 24 plots per site). The cooperating grower will conduct in-crop herbicide application in the spring.

Weed species will be identified, counted, and collected in mid-to-late July just before grain harvest with a six-foot-square (i.e., 36 square feet) sampling frame randomly placed in each plot. Grain yield will be determined by harvesting the grain from the middle rows of each plot with a Hege 140 plot combine with 5-ft-wide cutting platform. Head density and residue production will be measured by hand-cutting the above ground portion of plants from 3-ft-long row segments in each plot just before harvest. Plants will be placed in a low-humidity greenhouse for seven days then weighed. Kernels per head will be calculated on the basis of heads per square foot and 1000-kernel weight after passing heads through a hand-fed thresher. Straw production will be determined by subtracting the weight of the grain from the whole aboveground plant weight.

Project 2

Optimum Rodweeding Frequency to Maintain Seed-zone Moisture. A 4-year study is underway at the WSU Dryland Research Station at Lind to evaluate the frequency of rodweeding operations on (i) seed-zone moisture retention, (ii) surface residue retention, (iii) surface cloddiness, and (iv) subsurface cloddiness just before planting winter wheat in late August. After winter wheat is planted, stand establishment is assessed in September and grain harvested from plots the following July. Experimental design is a randomized complete block with four treatments. Each plot will be 30 by 200 feet, thus the experiment will cover 2.2 acres.

Winter wheat stubble in the experiment area is sprayed with 18 oz./acre of glyphosate in mid March. In late March – early April, primary spring tillage is conducted to a depth of 5 inches with a Haybuster undercutter V-shaped sweep with attached 3-bar tine harrow. Aqua nitrogen fertilizer is injected into the soil at a rate of approximately 45 lbs/acre with the undercutter during the one-pass primary tillage. All subsequent rodweeding operations are conducted at the 4-inch depth with a Calkins center-drive rodweeder. The following rodweeding treatments are then be established in a perpendicular direction to that of primary spring tillage:

1. No rodweeding (i.e., check). Weeds in this treatment are controlled with a high rate of glyphosate with a backpack sprayer as needed to maintain weed-free plots.
2. Rodweed only when required to control weeds (this will range from 1 to 3 rodweedings, depending on the year).
3. Rodweed immediately after primary spring tillage, but thereafter only as required to control weeds (as per treatment no. 2, above).
4. Rodweed immediately after primary spring tillage and then at one-month intervals until late July-early August. This is a total of five rodweedings.

Soil volumetric moisture in the 6-foot soil profile is measured prior to primary tillage and again in late August before planting. Additionally, in late August, volumetric water content in the seed zone will be determined in each plot in 1-inch increments to a depth of 10 inches using an incremental soil sampler.

Surface residue at the end of the fallow cycle is measured by collecting and weighing all aboveground drymatter within a 3-foot-diameter sample hoop randomly placed in each plot. Surface soil cloddiness is determined at the end of the fallow cycle by measuring the diameter of individual soil clods within a 3-foot-diameter sampling hoop randomly positioned in each plot. Wheel tracks (and foot tracks for the check treatment) are avoided. All clods with diameters greater than 2 inches are sorted into 0.5-inch size increments and the mass of each size group determined. Subsurface soil cloddiness is measured before planting by gently sieving 0.01 m^3 of soil from the 0-to 4-inch dry mulch layer through stacked 2 $inch^2$, 1 $inch^2$, and 0.5 $inch^2$ mesh screens. Mass of clods not passing through each of the three mesh screens is then measured.

In late August-early September, the entire experiment area is planted to soft white winter wheat with a John Deere HZ drill with 16-inch row spacing (or an International 150 drill with 18-inch row spacing if surface residue levels are high). Planting direction is perpendicular to that of the rodweeding operations. Winter wheat stand establishment is measured 21 days after planting. Grain yield is determined in July by harvesting a 5-ft-wide swath through each 200-ft-long plot with a Hege 140 plot combine.

Project 3
Long-Term Dryland Cropping Systems Research at Ritzville. We are now in the 14th year of a long-term study to compare various no-till annual cropping systems at the Ron Jirava farm near Ritzville, WA. In the first four years of the study (1997-2000) the crop rotations were: (*i*) a 4-year safflower/yellow mustard/wheat/wheat rotation; (*ii*) a 2-year wheat/barley rotation, and (*iii*); continuous wheat. During the second phase of the project (2001-2004), treatments were: i) a 4-year winter wheat/winter wheat/spring wheat/spring wheat rotation; ii) a 4-year winter wheat/spring barley/yellow mustard/spring wheat rotation; iii) a 2-year spring wheat/spring barley rotation; iv) a 2-year hard white spring wheat/spring barley rotation; v) continuous soft white spring wheat; and vi) continuous hard white spring wheat.

For phase three (2005-2008), field treatments are: i) a 4-year winter wheat/spring barley/spring wheat/chemical summer fallow rotation, ii) a 4-year winter wheat/spring barley/spring wheat/ tilled summer fallow rotation, iii) a 2-year soft white spring wheat/spring barley rotation, iv) a 2-year hard white spring wheat/spring barley rotation, v) continuous annual soft white spring wheat, and vi) continuous annual hard white spring wheat.

A grower advisory meeting for this experiment was held on October 14, 2009 in Ritzville to develop rotations for Phase IV. Rotations for Phase IV are as follows: i) a 3-year winter wheat-safflower-tilled fallow, ii) a 3-year winter wheat-spring wheat-tilled fallow, iii) winter triticale-spring wheat-chemical fallow, iv) a 2-year winter wheat-tilled fallow, v) a 2-year spring wheat-spring barley, and vi) continuous spring wheat. All crops are planted using no-till unless “tilled fallow” is designated. The experiment contains 56 plots, each 30 ft x 500 ft, and covering 20 acres of land.

Project 4
Winter Wheat Seedling Emergence. Growers in the low-precipitation regions need winter wheat varieties that can emerge from deep planting depth with marginal soil water potential.

Since 1994, this project has annually evaluated the emergence of winter wheat varieties and numbered lines in replicated trials at Lind. We concurrently measure coleoptile and first leaf lengths of all entries. One hundred seeds of each variety or numbered line are sown in 17 ft-long rows with a 4-opener deep-furrow drill with a 15-inch spacing between rows. The drill delivered seed of individual entries to separate openers. Seeds were sown 6 inches below the summer fallow soil surface and an average of 5 inches of soil covered the seed. Winter wheat cultivars are compared for *(i)* seedling emergence percentage for every sampling date; and *(ii)* length of coleoptile and length of first leaf.

Project 5
Camelina as an Alternative Crop in the Winter Wheat – Summer Fallow Region. Camelina is an ancient oilseed crop from Eastern Europe. Limited research from Montana in the past few years indicates that camelina is drought tolerant, does not require much nitrogen fertilizer, and does well on shallow or otherwise marginal soils. Several people feel that, if camelina has a fit in the Pacific Northwest, it will likely be in the low-precipitation region where winter wheat – summer fallow is the dominant crop rotation.

Four studies are proposed
Study 1: Planting date. Location: Lind. Two planting methods: direct drilling and broadcast + packing. Six planting dates: (1) As soon as rains start in the fall (generally around mid October or later), (2) November dormant (Thanksgiving week), (3) Winter dormant (Jan. 15 – Feb. 1), (4) Early (mid February), (5) Mid (March 1), and (6) Late (March 15). There are four replications of each planting date and planting method. We will plant Calena variety at 5 lbs/acre with nitrogen @ 25 lbs/acre. Stand counts will be made using quadrant method. Assure II herbicide will be used to control downy brome. Grain yield will be determined with a plot combine. We will take samples from each treatment for oil content evaluation.

Study 2: Cultivar Evaluation. Location: Lind. We will evaluate 15 – 20 cultivars and numbered lines of camelina. There will be four replications with individual plots 5 x 20 ft. March 1 planting date. Nitrogen will be applied 25 lbs/acre. Grain yield will be determined with a plot combine.

Study 3: Fertilizer Rates. Location: Lind. Nitrogen rates are: 0, 10, 20, 30, 40, 50 lbs/acre. Sulfur will be applied to rates 2 and 4 (i.e., 10-0-0-8 and 30-0-0-8). We will use Calena variety @ 5 lbs/acre. March 1 seeding date. Four replications.

Note: The three camelina studies (above) will be conducted for a duration of three years.

Study 4: Cropping systems. Location: Lind. A new 6-year study was initiated in fall 2007 with a WW-C-SF rotation compared to WW-SF. Experimental design is a randomized complete block with four replications. All phases of all treatments will appear each year. There are a total of 20 plots. Individual plot size is 30 x 250 ft. We are especially interested in finding out whether we can maintain adequate residue during fallow after camelina for adequate control of wind erosion.

Project 6

Rotational Benefits of Winter Canola on Subsequent Winter Wheat. Winter canola is one of the few crops that can compete economically with winter wheat in the low-precipitation zone. Spring canola, yellow mustard, and other oilseeds are not agronomically or economically viable in the low-precipitation zone with current technology. In addition to economically viable grain yield from winter canola, several farmers have reported that the winter wheat crop following winter canola (with a year of summer fallow between crops) often has considerably higher grain yield compared to monoculture winter wheat (i.e., a 2-year winter wheat – summer fallow rotation). However, this rotational benefit of winter canola on winter wheat has never been documented, nor have soil physical or biological factors that may account for the wheat yield increases been measured, in winter wheat – summer fallow region.

A 6-year on-farm experiment is underway near Ritzville, WA. Seed-zone water content is adequate most years for establishment of winter wheat and winter canola. The experiment compares the 2-year winter wheat – summer fallow rotation to a 4-year winter wheat – summer fallow – winter canola – summer fallow rotation. In late August, winter wheat and winter canola is planted into summer fallow in 16 by 200 foot plots with a John Deere HZ deep-furrow drill. Seeding rate for winter canola is 3 lbs/acre and for winter wheat 45 lbs/acre. Experimental design is a randomized complete block with 6 replications. Grain yield of winter wheat and winter canola is determined with a plot combine. After grain harvest, the entire experiment area is in summer fallow for the next 13 months, after which the entire experiment area is planted to winter wheat. Grain yield of winter wheat, which two years earlier was planted to either winter wheat or winter canola, will be determined by plot combine.

In addition to grain yield, soil volumetric water content is measured in all plots at time of planting in early September, in mid March, and again at grain harvest. During the winter following the harvest of winter wheat and winter canola, ponded water infiltration rate is determined within a 2-foot-diameter infiltrometer ring, and soil biological analysis will be conducted by A.C. Kennedy to compare dehydrogenase enzyme activity, whole-soil fatty acid methyl esters, and phospholipid fatty methyl esters between the treatments.

The study will be established on different summer fallow fields for three consecutive years. Thus we plan to have six site years of data collection for this experiment.