Proposal for 2004 - 2005  
Northwest Columbia Plateau Wind Erosion / Air Quality Project

Objective 5: Wind Erosion and PM-10 Emission Control Methods

Title: Wind Erosion Control Research for Dryland and Irrigated Cropland

Personnel:  Principal Investigator: William F. Schillinger, WSU;  
Co-Investigators: Ann Kennedy, USDA-ARS; Douglas Young, WSU; Tim Paulitz, USDA-ARS; Harry Schafer, Bruce Sauer, Robert Papendick, WSU; Don Wysocki, OSU; Steve Schofstill, and Cindy Warriner, WSU.

Dryland Research
Several studies in the 6- to 12-inch annual precipitation zone in eastern Washington are funded by this project. These studies are:

1. Alternative Annual Crop Rotations Using No-Till. We are now in the 8th year of a long-term study to compare various no-till annual cropping systems. 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. Experiment sites are located in Adams and Douglas counties. Rotations at the Adams county site since the 2001 crop year are: 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. This experiment contains 56 plots, each 30 ft x 500 ft, covering 20 acres of land. One referred journal article on economics of alternative no-till spring crop rotations has already been published in Agronomy Journal in 2004.

2. Long-Term Dryland No-till Research at Lind. Annual cropping systems research using direct seeding has been ongoing at the WSU Lind Dryland Research Station since 1998. Annual spring cropping was not economically competitive with winter wheat - summer fallow at Lind from 1998 to 2001.

A committee of growers and researchers met at the Lind Station in February 2002 to discuss and design the next phase of the experiment. The recommendation of the committee was to keep continuous annual soft white spring wheat (the most competitive annual spring rotation) and add several new treatments. Beginning in 2002, the crop rotations for the next six years are the following:
1. Continuous annual soft white spring wheat (no-till).
2. Continuous annual hard red spring wheat (no-till).
3. Continuous annual hard white spring wheat (no-till).
5. Winter wheat - spring wheat - spring wheat (no-till).
6. Winter wheat - spring wheat - chemical summer fallow (no-till).
7. Winter wheat - spring wheat - summer fallow (tillage).

Each phase of all treatments appears every year. The experimental design is a randomized complete block with four replications, thus a total of 56 plots. Individual plots in the original experiment were 45 ft X 500 ft, whereas plot length in the second phase is 225 ft with a 50 ft alley in the middle. All no-till plots are 15 ft wide, and tillage plots are 30 ft wide. Thus, all seven of the new treatments fit within the area of the original experiment. Grain harvest will be with a plot combine equipped with chaff spreader, then the entire experiment area will be "blanket harvested" with a commercial-scale combine to uniformly spread straw and chaff. Tillage (in treatments 4 and 7 above) is with a wide-blade undercutter sweep, both to control Russian thistle after harvest (if needed) and for primary spring tillage, followed by two rodweedings (i.e., minimum tillage). All other treatments are direct seeded and fertilized in one pass with a Cross-slot drill.

We are excited about this new experiment and hope that it will provide comprehensive information to growers in low-precipitation regions of the inland Pacific Northwest. This project is shown and discussed with an average 170 people at the annual Lind Field Day in mid June.

3. Polymer Seed Coatings for Late Fall Dormant Planting of Cereals. Fall or dormant seeding is a management practice where spring crops are sown in the fall instead of the traditional March or April. The list of benefits of dormant seeding include faster spring growth to compete with Russian thistle and other broadleaf weeds, reduced heat and water stress, and higher yields. Dormant seeding is not without risks. Warm temperatures after late-fall seeding may result in germination and emergence of spring wheat seedlings that may easily winter kill. In this study, we are evaluating hard red spring wheat (Scarlet), soft white spring wheat (Alpowa), spring barley (Baronesse), and soft white winter wheat (Eltan) planted in late November with and without polymer seed coating. The polymer "Extender™" has been developed to prevent seed from imbibing water until soil temperatures begin to warm in late winter - early spring. The trial is planted in late November at Lind. The four cereal entries are planted with and without the polymer coating into undisturbed spring wheat stubble with a Cross-slot drill equipped with a cone seed feeder. Planting rate for all entries is 70 lbs/acre and fertilizer rate is 40 lbs N, 10 lbs P, and 10 lbs S per acre. Experimental design is a randomized complete block with four replications. The same exact procedure is repeated on a "normal" seeding date of mid-March.

4. Winter Wheat 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.

5. **Post-Harvest Management of Russian Thistle.** Russian thistle is the most problematic broadleaf weed in wheat in the dryland region. We are now in our 6th year of a long-term study to test post-harvest management on the control and ecology of Russian thistle. There are two fundamental questions. Question 1: Given the high Russian thistle seed density throughout the low-rainfall dryland region, does it even pay to control Russian thistle after harvest? Question 2: Using a V-shape sweep to kill Russian thistles is less expensive than using herbicides, but is over-winter water storage greater when sweeping is not conducted? In the first four years, controlling Russian thistle after harvest either mechanically or with herbicide significantly reduced Russian thistle soil water use, dry matter production, and seed production, resulting in subsequent higher grain yield most years compared with the uncontrolled check treatment. We plan to continue this study for at least two more years.

6. **Residue Effects on Surface Soil Crusting and Winter Wheat Emergence.** A portable rainfall simulator that belongs to the USDA-ARS will be completely overhauled and outfitted with new pump, nozzles, and rubber seals. Summer fallow strips with high, medium, and low residue amounts will be prepared using conservation-tillage and conventional-tillage equipment available at the Lind Station. The experimental design is a split plot in randomized complete block arrangement with four replications. In late August, winter wheat (either ‘Eltan’ or ‘Edwin’, depending on soil moisture conditions) will be planted across the summer fallow tillage strips with a John Deere HZ deep furrow drill. An International model 150 deep furrow drill will be used to plant all plots if surface residue in the conservation tillage fallow treatment is too much for the John Deere HZ drill to handle. Beginning one day after planting, the rainfall simulator will be used to apply 0.05, 0.10, and 0.15 inches of rain over 2, 4, and 6-hour time periods, respectfully. It will take six days to apply the simulated rain to all treatments (3 residue levels x 3 rainfall levels x 4 replications). The rainfall simulator is equipped with two booms, so rain will be applied to two plots simultaneously. Winter wheat emergence will be measured by counting seedlings (planted by the same opener) in all plots.

**Irrigated Research**

**No-Till Planting into Standing Irrigated Stubble Instead of Burning.** The objective of this long-term (6-year) project is to determine the feasibility of direct seeding into high levels of residue as a substitute for burning in irrigated cropping systems. Specific objectives are to:

1. Test a 3-year crop rotation of winter wheat - spring barley - winter canola. Crops will be sown with a Cross-slot no-till drill into (a) standing stubble, (b) after mechanical removal of stubble, and (c) after burning the stubble. An additional treatment of annual winter wheat sown after stubble burning + moldboard plowing (sown with a double-disc drill) will be included as a check.

2. Evaluate and develop effective techniques for sowing crops into heavy surface stubble using no-till methods.

3. Document cumulative effects of a diverse no-till crop rotation under three stubble
management practices on soil physical and biological properties, water use efficiency, diseases, weed ecology, and farm economics. Compare these effects to those under the check treatment (i.e., continuous winter wheat after stubble burning + moldboard plowing).

The problem is that many deep-well irrigators in east-central Washington practice a continuous winter wheat rotation (i.e., grow winter wheat on the same field every year). Irrigated wheat grain yields range from 90-to 140-bushels per acre with residue production of 10,000 pounds or more per acre. After grain harvest in August, the traditional practice is to burn the stubble and invert the surface soil with moldboard plow tillage in preparation for sowing in September. Generally, growers feel they need to burn their fields because high residue levels hamper sowing. Alternatives to field burning are needed to reduce smoke emissions and maintain air quality. Another reason why irrigated growers burn and moldboard plow winter wheat stubble is to control downy brome, a winter annual grass weed. Previous research has shown that long-term control of downy brome is very difficult in continuous irrigated winter wheat using no-till. Therefore, new crop rotation and stubble management strategies are needed to make no-till (without burning) work.