Key achievements and contributions of WBCS in 2012:

In 2012, WBCS research and extension projects primarily involved winter and spring canola, camelina and safflower. Most results are a compilation of research initiated when this project began, while others are preliminary from trials established for the first time in 2011-2012. Crop and chemical rotation benefits, soil fertility and the economics of including an oilseed crop in predominantly cereal-based rotations were main areas of focus in 2012. Highlights of the most recent findings to date include:

Regions 1 and 2: High, Intermediate and Low Rainfall Zones of Eastern Washington

- ***Positive bottom line with canola in rotation.*** Enterprise budgets developed for typical eastern WA rotations show that canola can be a profitable addition to traditional cereal-based rotations with current canola and wheat prices. Many growers have valid concerns about variable canola yields, or the negative trade-offs from growing canola in place of wheat (or at the expense of wheat) in high wheat price situations. These budgets consider low canola yield scenarios and higher wheat price scenarios, and still find that rotations with canola can be as or more profitable than traditional systems, especially when rotational impacts such as increased wheat yields following canola are considered. In an ongoing study near Reardan comparing 3-year rotations with and without winter canola, yield of winter canola (3720 lbs/acre) and winter wheat (105 bu/acre) were both excellent. With market prices in August, gross returns were $1079/acre for canola versus $851/acre for wheat.

- ***Spring canola as a viable alternative crop in rotation with winter wheat.*** Spring canola can be another tool for weed control, particularly of cereal rye infestations, in the intermediate rainfall region along Highway 2. At the WSU Wilke research farm near Davenport, spring canola inserted into a 4-year rotation versus a continuous cereal rotation or 3-year rotation with no-till fallow yielded 1,542 lbs/acre and resulted in a $341/acre return over variable costs in 2012. This was second only to a plot of hard white wheat that generated $353/acre. Unfortunately, a spring canola row spacing and variety performance trial in north central WA had to be abandoned due to a rain event in late April that caused extreme soil crusting, preventing the canola from emerging.

- ***Rotational benefits for wheat production.*** The majority of oilseed producers in eastern WA have observed increased wheat yield following an oilseed crop in rotation. Multi-year results from a study in the high rainfall zone with eight different spring crops grown before winter wheat show the highest winter wheat yield after legumes, followed by brassicas, and small grains. These data suggest that growers may be able to assign rotational benefits to oilseed crops due to increased productivity of winter wheat and reduced nitrogen (N) fertilizer costs to obtain those yields. In another study in the low rainfall region, data from five years indicate that spring wheat yields are similar on winter canola or winter wheat stubble (following fallow). The same study found that winter canola and winter wheat use the same amount of soil water during the crop year.

- ***Soil N + canola yield potential = refined fertilizer recommendations***. The five-year canola fertility experiment in dryland, silt loam soils indicates that accurate estimation of soil N supply and canola yield potential is critical in determining proper N fertilization rates. Canola accumulates high N per unit grain, but it can aggressively utilize soil N supplies if available, meaning N fertilizer rates can be reduced. Variation in oil concentration with N and S management appears to be minor, but variation amongst site years could be related to fall vs. spring canola. Fall/spring timing and S treatments had minimal effects in these AEZs. Banding N fertilizer is not recommended due to potential ammonium toxicity to canola tap roots. Efficacy of KCl fertilization in increasing cold tolerance and winter survival is still being evaluated.

- ***Evaluating winter canola variety performance.*** With the increasing interest in canola production in eastern WA, there are areas where variety trials have never been established such as in the wheat-fallow region of north central WA. Winter canola variety trials seeded there in 2011 resulted in an average yield of the harvested varieties of over 1700 lbs/acre, while at a second site the average yield was just under 1300 lbs/acre. The variety trial was expanded to three locations (Pomeroy, Ralston and Bridgeport) in 2012 with five more varieties added. First time and experienced oilseed growers have expressed an interest in variety performance and winter survival/cold tolerance at the various locations.

- ***Avoiding herbicide resistant weeds.*** With the popularity of canola varieties that offer weed control options, it is important to consider chemical rotation at the same time as crop rotation not only to avoid plantback restrictions, but to lessen the chance of weed resistance from continual use of the same herbicide chemistry. Data from the second year of a study in north central WA comparing Roundup, Assure II and Select for control of feral rye in winter canola showed a 75% reduction in feral rye seed production with fall applications of Roundup and Assure II, while Select reduced seed production by 47% compared to the control. Despite low canola yields in 2012 due to a late seeding date, yield was 26% greater in plots where Roundup and Assure II were applied in the spring versus plots with a spring application of Select. Feral rye reduced yield from 900 lbs/acre in treated plots to 245 lbs/A in untreated plots, demonstrating the importance of weed control in the canola crop that also provides a head start on weed control in subsequent fallow and wheat crops.

- ***Residue management to improve moisture management.*** A long-term study initiated two years ago at Ralston is investigating the potential of replacing traditional tilled fallow with chemical fallow to increase soil moisture. The use of tall cereal varieties and harvesting with a stripper header will trap snow and provide more shade during fallow. If soil moisture moves within two inches of the soil surface, winter canola could be no-till planted into chemical fallow at an optimal time to take advantage of stored soil moisture.

- ***Herbicide tolerant camelina to overcome residual chemical.*** In extensive herbicide rate trials, herbicide tolerant (HT) camelina lines carrying the SM4 mutation were considered sufficiently tolerant to Beyond® to prevent damage when following a Clearfield® wheat crop. Improved early seedling vigor will also provide better competition against weeds during seedling establishment. The release of HT camelina varieties should improve acceptance of the crop to growers by reducing the risk of encountering herbicide carryover damage. This will be particularly true of growers who are not currently growing oilseed crops, or non-cereal rotation crops in general. These growers have not avoided herbicides with long residual activities in the soil and are likely using a wider variety of chemistries in their weed control programs.

- ***Successful camelina establishment.*** We have found the best planting date for camelina in the PNW is from late February to early March. This time frame allows for weed control with a non-residual herbicide prior to planting to give camelina a competitive edge against weeds during germination and early growth.

- ***Camelina responds to fertilizer.*** Two camelina trials were conducted near Dusty in 2012. The camelina variety trial had 17 entries and 4 replications, with an average yield of 1370 lbs/A, and no significant differences among the lines tested. A fertilizer trial had an average yield of 1320 lbs/A, with the 80 lbs N/A fertilizer rate yielding significantly higher than lower rates of fertilizer. This indicates that camelina responds to applied fertilizer application and reinforces previous N fertilizer results from the SunGrant work on camelina (see previous progress reports).

- ***Increased seed size to increase yield potential.*** Establishment of camelina and canola can be difficult in both deep-furrow planting and direct seed systems due primarily to the small seed size. Extensive lab and greenhouse breeding studies have resulted in camelina lines that are producing larger seeds that have better establishment, and higher yields than commercial camelina varieties.

- ***Identifying pathogens of canola and camelina:*** Blackleg, a significant pathogen of canola in Canada, was discovered in a canola field in northern Idaho in 2012. Testing of putative isolates gave a high level of disease, showing a high level of virulence. Blackleg is a seedborne fungus, and may pose a threat to the two major vegetable and oilseed Brassica seed production areas of Washington: the Skagit River valley of western Washington and the Columbia Basin area of central Washington. In addition, the susceptibility of PNW varieties of canola and other Brassica oilseeds is largely unknown. Presentations were made at grower meetings in 2012 to increase awareness of the dangers of planting non-certified seed that has not been tested with a phytosanitary certificate, especially if seed is traded among growers or imported from Canada. With the conclusion in earlier studies that downy mildew in camelina is seedborne, further research showed that conditions in the Palouse in early summer are generally

not conducive to asexual spread of the disease, but if seed continues to be imported from other regions it is likely additional incidences of the disease will occur. Furthermore, oospores that form in infected plants are long term survival structures in soil, so fields that have been planted to camelina now harbor the disease. An effective seed treatment will likely keep the disease under control but we will continue to explore other options.

- ***Adjusting safflower seeding date:*** Safflower is another feasible oilseed crop for use in cereal-based rotations in eastern WA. Grain yield in a large-scale field trial in 2012 was 880 lbs/acre, compared to yields of 30 bu/acre spring wheat and 1960 lbs/acre spring barley in the same cropping systems experiment near Ritzville. Cool soil and air temperatures in April and part of May caused sporadic and delayed emergence of the safflower, so the planting date in 2013 will be moved to at least May 1 depending on soil water conditions to allow for additional weed control before seeding, which should help with more rapid and uniform emergence.

Region 3: Irrigated Central Washington

1. ***Canola + peas for silage and grain in Columbia Basin.*** In the first year of this study, average green pea (shelled) yield was 6.5 ton/A. A lack of significant differences between applied N or S compared to control plots indicates that N mineralized from pea residue was adequate for the vegetative growth at least until the forage harvest date. The N contribution from the green pea to the biennial canola and subsequent crop would result in savings of $30/acre. Analysis of forage quality parameters showed an increase in ADF and protein with increased N or S rates, while TDN was reduced with higher N or S rates.

2. ***Improving residue management in irrigated canola.*** Most, if not all, irrigated canola producers in the Odessa deep well district burn winter wheat stubble following harvest, followed by several tillage passes before seeding canola, or do not burn but practice heavy tillage. Their concern is that without tillage diseases such as *Rhizoctonia* will a detriment to canola yield. A field experiment was established in 2012 within a center pivot-irrigated circle with the hypothesis that fresh wheat stubble is not phytotoxic to winter canola and that canola can be successfully produced in a direct-seed system after wheat harvest as a viable alternative to field burning plus heavy tillage. Canola stand establishment was satisfactory, and soil and plant samples were taken to analyze for fungal root pathogens.

Overall Project

- ***Reaching larger audiences.*** Research, outreach and extension efforts reached nearly 2000 people at events in 2012, including the following:
  - Oral and poster presentation at 10 local, regional and national events including:
    - American Society of Agronomy annual meeting, Cincinnati, OH
    - American Geological Union annual meeting, San Francisco, CA

        - Western Society of Crop Science annual meeting, Pullman
        - Bioenergy Research Symposium and Future Energy Conference, Seattle
        - Far West Agribusiness Association annual conference, Pasco
        - WSU Oilseed Crop Production Workshops, Colfax and Odessa
        - Washington Grain Commission meeting, Spokane
        - WSU and industry field days and tours
        - PNDSA Direct Seed breakfasts

    - WSU and USDA-ARS attended quarterly Washington Canola and Rapeseed Commission meetings, keeping the Commission updated on current WCRC-supported oilseed research, and submitting proposals for financial support of additional research.

- ***Increasing online interest.*** Visits on the Biofuels website increased in 2012, from 21 countries and 31 states, most of which came from 45 cities in Washington. The number of visits from neighboring states (ID, OR, MT) increased from 2011.

- ***Industry and community collaboration.*** After attending an industry field tour for several years, WBCS faculty were invited to speak during a lunch gathering following the 2012 canola field tour in the intermediate rainfall area. Collaboration with canola seed suppliers resulted in identifying locations for additional field trials, connecting with more oilseed growers, increasing contact throughout the year on oilseed-related matters, and invitations to client field days and meetings. Relationships were also established with oilseed processors and crop consultants, particularly during and after the 2012 WSU Oilseed Workshops. WBCS faculty continued to provide advice to the Colville Confederated Tribes (CCT) on oilseed production in north central WA.

Providing research and educational materials. The WBCS research team published Extension fact sheets about dryland camelina production; canola growth, development and fertility; winter canola feasibility in rotation with winter wheat; and a second set of case studies about oilseed producers in the low to intermediate rainfall zone. Ten refereed publications (scientific journal articles) were published or in review in 2012, with several more in preparation for submission in 2013.