

## **Food Security - Washington USDA-CSREES Special Grant: 2003-2008**

A secure food supply can only be achieved through healthy crops, healthy soils, and access to crop biodiversity. In the wheat-based cropping system of the Western US, food security and fuel security go hand in hand because the fuel producing canola crop is a necessary component of environmentally sound crop rotation.

### **Statement of Problem:**

In the Western US, both food and fuel production are threatened by uncontrollable environmental problems including pests and drought. Wheat is a primary component of Western cropping systems, threatened since 2000 by new races of stripe rust (costing over \$300 million annually) and stem rust. Over 80% of US wheat cultivars are susceptible to the new stem rust race UG99. Wheat root disease, crown rot, root rot, and nematodes cause yield losses of up to 30% in PNW production systems. These problems can be ameliorated with access to resistant germplasm and sustainable agriculture practices of crop rotation and conservation tillage. Canola, one of the best bio-diesel sources and an excellent rotation crop for the Western US is difficult to establish in drought-prone soils.



Since 2001, WSU has collaborated with The International Maize and Wheat Research Center (CIMMYT) to promote collaborative agricultural research between scientists in wheat based cropping systems in the U.S. and in Central Asia and the Caucasus. Benefits to the Western US from this collaboration are many and include:

- Stripe rust resistant wheat from the Republic of Georgia is being incorporated into WA wheat cultivars,
- New wheat and barley wild relatives from Kazakhstan have been collected and are maintained and available through the US National Plant Germplasm system,
- No-Till wheat fallow cropping systems that reduce soil erosion and retain soil fertility have been implemented in the Pacific Northwest and in Northern Kazakhstan and Siberia. Adoption of conservation tillage farming systems in the Western US is on the rise.

This understanding of global threats to crop production and the global relationships that we have built are necessary project components to support a new generation of researchers to enhance food and fuel security and strengthen regional agricultural systems in Washington State and the Western US.

### **Project goals.**

- Reduce crop loss due to global pests and drought in crop production systems in the Western US,
- Preserve and maintain germplasm of western region crops (wheat, barley, pea, lentil, chickpea, alfalfa, canola, apples).
- Promote environmentally sustainable food and fuel production systems through adoption of conservation tillage and sustainable agricultural production systems.

## **PROGRESS REPORT 2003-2008**

**Objective 1 – Research network:** ICAR organized and co-sponsored regional conferences including the 1<sup>st</sup> Central Asian Wheat Conference (Almaty, 2003) the International Caucasian Conference on Cereals and Legumes (Tbilisi, 2004) and the 2<sup>nd</sup> Central Asian Cereals Conference June 13-16, 2006 in Kyrgyzstan. The 3<sup>rd</sup> Central Asian Yellow Rust conference was held from June 11-13 in Kyrgyzstan, prior to the 2<sup>nd</sup> Central Asian Cereals conference with ICAR assistance in organizing. Those collaborations have resulted in new initiatives: Integrated Management of Soil-Borne Pathogens and Pests for Resource-poor Farmers of Rainfed Wheat and contributed to the efforts of the Global Rust Initiative. The ICAR project co-founded the regional journal “Agromeridian” published in Kazakhstan.

**Objective 2a. On-farm research demonstrations and germplasm improvement:** Priorities for research included testing and promotion of new varieties and sustainable agronomy practices. Several new wheat cultivars with combined resistance to disease were introduced to replace the very old wheat variety ‘Bezostaya’. Those new cultivars include Armcim, Nurlu99, Azametyl, and Mtskheta1. Alternative crops were introduced (primarily triticale). The main sustainable practices that were introduced were raised bed planting and introduction of the zero tillage concept. Area under zero tillage increased from essentially zero in 2006 to about 100,000 hectares in North Kazakhstan in 2006. In 2006 Kazakh the Ministry of Agriculture announced a program to introduce 1.5 mha of chemical fallow as a result of ICAR research activities. Oregon State University (OSU) conducted quarantine increase and distribution of wheat germplasm included in the CIMMYT Winter Wheat East European Regional Yield Trial (WWEERYT) and the Facultative and Winter Wheat Observation Nursery (FAWWON). After quarantine and increase, seed of the nurseries is distributed to US collaborators.

**Objective 2b. Competitive grants for collaborative research projects between the US and CAC:** Projects are focused on germplasm improvement for rust resistance in wheat, conservation tillage, and germplasm resources conservation. Successful projects include ‘Identification of inheritance to of resistance to yellow rust in wheat’; “New methods of soil conservation farming and crop diversification”; and ‘Conservation and use of wild relatives of cereals in breeding in Armenia’. Germplasm exchange was initiated that will contribute lasting benefits to both US and Central Asian crop improvement. A number of cooperative activities occurred because of the presence of the ICAR project in the region including: 1) Collection of cereal species in Kazakhstan; 2) a cost-benefit analysis of zero tillage in Kazakhstan funded by the FAO, and 3) Collection of wheat leaf rust samples and analysis of their virulence conducted by the USDA.

**Objective 3. Strengthening of the human resources and institutional capacity:** Lack of English language knowledge represented one of the main obstacles and challenges for cooperation so the project allocated funds for 50 people to attend English language training. Training grants were awarded to researchers actively involved in the ICAR project. That training has been implemented using local contractors in the CAC. Global awareness and international experience of US researchers was increased by supporting travel, participation in the conferences, and consultations as well as regional and international training and visits of CAC scientists to the US. The project has helped establish a network of scientists around the world who conduct research on the three cereal rusts – yellow rust, brown rust, and blade rust and to serve as a global

information network to forecast movement of rust races and gene deployment strategies.

#### **Future directions and Goals:**

1. Completion of the cooperative research projects on identification and introgression of yellow and leaf rust resistance in wheat, utilization of wild relatives in wheat breeding, use of chickpea as an alternative crop in rotations, spring wheat protection from Hessian fly, and development of Maize hybrids for Georgia.
2. Development of soil testing laboratory in Armenia..
3. Establishment of winter wheat germplasm collection resistant to Leaf, Yellow and Stem Rust.
4. Conservation Agriculture Network in Northern Kazakhstan.
5. Identification of broadly adapted high yielding winter wheat germplasm resistant to Root Rots.
6. Training and exchange visits: 3<sup>rd</sup> International Soil Borne Pathogens of Wheat Master Class, High latitude spring wheat breeding at CIMMYT-Mexico, ICAR project and research visits to Central Asia & Caucasus, N. America Wheat Workers Workshop

**IMPACT:** Through this project the US plays a positive role in addressing growing food and environmental crises in the CAC and the US. New varieties of wheat and legumes were introduced to the CAC and US researchers benefited from the increased flow of CAC germplasm into breeding programs. Plant genetic resources were collected and enriched in the CAC and in the US. Control of wheat rusts, especially stem, yellow and leaf rust is underway in both regions. New knowledge of rust virulence in the CAC contributes to the knowledge of rust populations dynamics that will have an effect on US cereal production. Global literacy has been enhanced in the CAC and in the US. The broader worldview established collaborative teams to tackle global problems that impact sustainability of wheat cropping systems. The CAC and US equally benefit from closer cooperation with CIMMYT, ICARDA and other institutions working together.

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