October 2003

Red River Valley Agricultural Research Center

RESEARCH NEWS FROM THE VALLEY

USDA-ARS-RRVARC Fargo, ND

Inside this issue:

From the Director

Welcome to FY2004!!!

I'm sure most of you are aware that the Federal Government's new fiscal year began on Oct. 1. We are looking forward to exciting new research findings during the next 12 months. As you read some of the brief articles in this edition of "Research News From the Valley" I'm sure you will get a better understanding of the breadth and diversity of our research. Our scientists and their staffs have exceptional programs underway designed to answer many of the urgent needs of United States agriculture. We hope you will find their activities interesting and useful as you look towards the future.

FY2004 also marks a historic time for the USDA Agricultural Research Service (ARS). On November 2, 2003, ARS will reach its 50th anniversary milestone. The following quote is from a memo sent out by Dr. Ed Knipling, Acting Administrator of ARS. "Although ARS as a Government entity can trace its heritage back to the early 19th century seed collection activities of the U.S. Patent Office, as an Agency by our current name we are only 50 years old. In 1953, the Department of Agriculture (USDA) consolidated most of its research functions into the newly named Agricultural Research Service. Our anniversary is an excellent opportunity for us to reflect on the core values that have made ARS a success - scientific quality, relevance, and outstanding customer service - while looking forward to the next 50 years and beyond." Over the next several months there will be many planned events that will provide the public with an opportunity to celebrate our Anniversary with ARS employees. We will keep you informed of significant activities that will occur here in Fargo and we hope you will be able to participate if at all possible.

Finally, I again want to thank you on behalf of the Center for your continued support of our research efforts. We appreciate your willingness to let us know how we are doing. Feel free to contact us at any time.

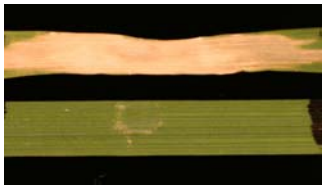
Have a great Fall and upcoming Holiday Season!!!

Larry Chandler
Center Director

PASS IT ON!!!!

Feel free to pass on this issue of *News from the Center* to others interested in agricultural research in the Northern Plains Area. To be added to our mailing list contact Alicia Thompson by phone (701-239-1370), fax (701-239-1395), or e-mail (thompsoa@fargo.ars.usda.gov).

High Resolution Mapping of the *Tsn1* Gene in Wheat



Wheat leaves (toxin sensitive on top, insensitive on bottom) treated with Ptr ToxA.

Tan spot is a foliar disease of wheat and durum caused by the fungus *Pyrenophora tritici-repentis*. The fungus produces a protein toxin (Ptr ToxA) that causes severe necrosis on leaves of sensitive wheat genotypes. Host sensitivity to ToxA is associated with disease susceptibility. Sensitivity to the toxin is controlled by a single gene in the host plant designated as *Tsn1*. *Tsn1* is located on the long arm of wheat and durum chromosome 5B. The objectives of this research were to identify DNA markers tightly linked to the *Tsn1* gene and to develop a high-resolution map of the *Tsn1* region for the purpose of cloning the gene. Using various molecular methodologies in combination with wheat and durum cytogenetic stocks, scientists in the Cereal Crops Research Unit saturated the *Tsn1* region with molecular markers. Two large segregating populations of wheat were used to construct high-resolution maps of the *Tsn1* region, and markers tightly linked to *Tsn1* were identified. Comparisons with rice DNA sequences indicated that this region is not well conserved through evolution, and therefore rice would not be a useful model for cloning this gene. This work provides the information base needed for the cloning of the *Tsn1* gene directly from wheat, and once cloned, molecular aspects of the wheat-tan spot pathogen interaction can be characterized. Better knowledge of these types of host-pathogen interactions eventually may aid in the development of more highly resistant wheat and durum cultivars as well as provide insights into host-toxin interactions in general.

For more information, contact Dr. Michael C. Edwards, Research Leader, Cereal Crops Research Unit, at edwardsm@fargo.ars.usda.gov

Plant Scientists Investigate Dormancy of Leafy Spurge Seeds

Flower and seed production in leafy spurge

Leafy spurge seeds

Leafy spurge, a serious perennial weed of rangeland in the Northern Great Plains, reproduces asexually through a multitude of adventitious buds on the crown and root system and sexually by seeds. While most attention had been focused on asexual or vegetative reproduction, several researchers in the last 50 years have demonstrated that leafy spurge seeds can remain dormant and viable in the soil from 3 to 8 years depending on the location and other factors. Recently, Plant Science researchers studied the biological basis for dormancy in leafy spurge seeds. Their investigations revealed that removal of the hard seed coat facilitated rapid germination of the exposed embryo. Thus, leafy spurge displays coat-imposed dormancy, which is one of the two common form of seed dormancy. Additionally, they discovered that leafy spurge seeds afterripen, that is overcome dormancy, best under moist conditions. In contrast, some seeds like wild oat afterripen best under dry conditions. A hard seed coat is likely one of several key factor leading to the persistence of leafy spurge seeds in the soil.

For more information, contact Dr. Michael E. Foley , Research Leader, Plant Science Research Unit, at foleym@fargo.ars.usda.gov

Bacteria Responsible for Distinct Northern Corn Rootworm Populations

Wolbachia are a large group of bacteria that live inside the cells of many insects. They do not kill the insects whose cells they inhabit, which classifies them as endosymbionts. Wolbachia can create a reproductive barrier between insects of the same species that are infected versus those that are not infected. The northern corn rootworm (NCR) is a major pest of corn production. DNA markers have detected three genetically distinct populations of NCR in the US with relatively limited interbreeding between them. Additional DNA tests designed to specifically identify Wolbachia strains have uncovered two divergent strains of the bacteria that are mutually incompatible. NCR from the east carry one strain of Wolbachia, NCR in Illinois harbor a second strain, and NCR from the Great Plains have no Wolbachia. The agricultural community needs to be alert to the possibility that qualitative or quantitative differences may arise among these populations that could cause them to react differently to control measures. Wolbachia infections are also capable of spreading into uninfected areas which could change the distributions of specific NCR traits. This research is being conducted by Dr. Richard Roehrdanz, Research Geneticist, Fargo with help from Dr. A Szalanski, Univ. of Arkansas and Dr. Eli Levine, Illinois Natural History Survey.

For more information, contact Dr. Dennis R. Nelson, Research Leader, Insect Genetics & Biochemistry Research Unit, at nelsond@fargo.ars.usda.gov

Northern Corn Rootworm adult feeding on corn silk.

Searching for Sunflower Insect Resistance

In recent years acreage of sunflower production has greatly expanded in the Central Plains region of the United States into the states of Nebraska, Colorado, and especially Kansas. Unfortunately, the insect problems that plague the sunflower crop have also invaded this region. One pest, the sunflower moth, deposits eggs on the sunflower heads and the developing larvae consume the seeds, reducing yield. In addition, two other pests infest the sunflower stem and can cause the plants to lodge or fall over before harvest. These include the sunflower stem weevil and the long-horned sunflower stem girdler. In 2001, Larry Charlet, the Sunflower Research Unit entomologist, was asked to assist in developing management solutions to these problems. Initial efforts were directed to the sunflower stem weevil to evaluate germplasm that might offer resistance to this pest, to determine if altering planting dates could reduce damage, and to determine the best timing for insecticide treatment when it is required. Jerry Miller, Research Geneticist, and Gerald Seiler, Botanist, joined the research effort in 2002 to evaluate sunflower germplasm for resistance to these pests. The team evaluated ARS sunflower lines, interspecific crosses, and germplasm from the USDA, ARS, Plant Introduction Station at Ames, Iowa, to search for lines offering resistance to the sunflower moth, the sunflower long-horned stem girdler, and the sunflower stem weevil. Once identified, this germplasm can then be incorporated into sunflower breeding lines to reduce economic losses from insect damage in the central Great Plains. In conjunction with these studies, the species of parasitoids attacking the insect pests and their relative impact is also being evaluated to ensure that any promising germplasm identified with resistance to the pest is not detrimental to natural enemy activity.

For more information, contact Dr. Brady A. Vick, Research Leader, Sunflower Research Unit, at vickb@fargo.ars.usda.gov

Plant Pathologist, Tom Gulya, with *Helianthus californicus* near Mt. Diablo east of Walnut Creek, CA.

Managing Potato Sugar-End Defect

Over 70% of the U.S. Fall potato crop is placed into long-term storage to meet the demands of the processing and fresh market industries. Locally (MN & ND) that figure often exceeds 90%. Maintenance of market quality is of paramount importance to potato producers and processors. Of the physiological disorders negatively affecting product quality, sugar-end defect is one of the more serious costing the potato industry hundreds of millions of dollars annually. On going studies at the East Grand Forks Potato Research Worksite have demonstrated that sugar-end defect is really a group of physiological disorders with different causes and potential outcomes. In particular, the severity of one type of sugar-end defect can be minimized by using specific postharvest reconditioning treatments. The ability to correctly identify the specific type of sugar-end defect present in harvested tubers and to alter storage conditions to minimize its severity will result in improved potato market quality and greater profitability to all segments of the potato industry.

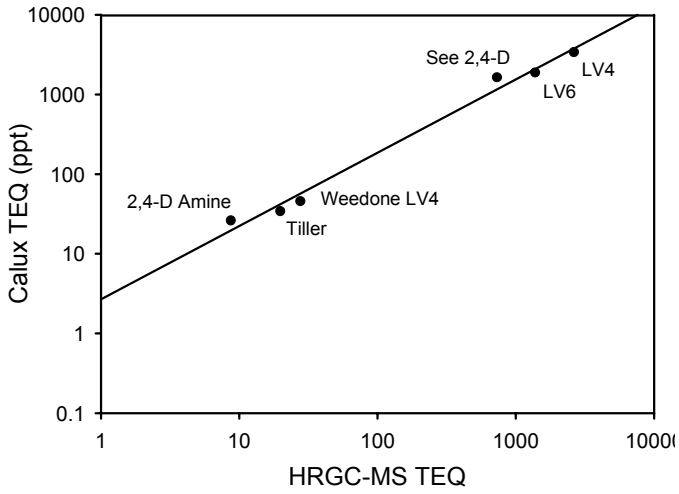
For more information, contact Dr. Jeffrey C. Suttle, Research Leader, Sugarbeet & Potato Research Unit, at suttlej@fargo.ars.usda.gov

Effects of postharvest reconditioning treatments (bottom panels) on early-season (left) and mid-season (right) sugar end defect. Only mid-season defect can be 'rescued'.

Dioxin Screening Tool Developed

Drs. Janice Huwe of the Animal Metabolism -Agricultural Chemicals Research Unit, George Clark of Xenobiotic Detection Systems, and Vincent Garry of University of Minnesota confirmed the presence of and provided congener profiles of dioxins in chlorophenoxy (2,4 - D) pesticide formulations commonly used in the Red River Valley of Minnesota. The presence of dioxins in these formulations was indicated by a reporter gene bioassay (CALUX) and the results of the CALUX were compared to dioxins levels found by high-resolution gas chromatography/high -resolution mass spectrometry (HRGC-MS) analysis. It was concluded that the CALUX bioassay appeared to be a good screening tool for dioxin-like activity in a variety of pesticides and may provide a more accurate assessment of the potential biological activity of pesticide formulations than the highly selective HRGC-MS method.

For more information, contact Dr. Gerald L. Larsen, Research Leader,



Searching for Biological Control Agents of Sunflower Insect Pests

The search for new natural enemies of sunflower pests in native sunflowers is comparable to the classical biological control strategy of exploring for natural enemies in the pest's native home. However, rather than exploring for natural enemies in a foreign country, the search for enemies of sunflower pests is directed to locations in North America.

Adult Sunflower Stem Weevil.

The potential exists to locate new or potentially useful parasitoids and introduce these beneficial species to increase either the diversity of parasitoids or their population levels where insect pests are causing economic losses. A few years ago a survey of parasitoids of the red and gray sunflower seed weevil revealed the presence of species in native sunflowers that did not occur on the weevils in cultivated sunflower.

Two collecting trips were recently conducted to search for new parasitoids of two important sunflower crop pests, the banded sunflower moth and the sunflower stem weevil. In late August 2003 Larry Charlet and Theresa Gross, along with Paul Ode of the Department of Entomology at NDSU, spent two days collecting sunflower heads from wild sunflowers in western South and North Dakota. Larvae of the banded sunflower moth were then extracted from the heads in the laboratory and chilled to break diapause before being reared to recover and identify parasitoids.

Adult Banded Sunflower Moth.

Native Sunflower Plant (*Helianthus annuus* L.).

During the last week of September, Larry Charlet, Gerald Seiler, and Paul Ode traveled over 2100 miles in North and South Dakota, Nebraska, Kansas, Colorado, and Wyoming, collecting stems from two to four species of sunflowers. Seeds also were recovered, as well as samples of leaves with sunflower rust for Tom Gulya to evaluate.

The target pest in this case was the sunflower stem weevil, a major pest in the sunflower production regions of the Central Plains. The stems (where the weevil overwinters) were dug from the ground and returned to the NCSL cold room. After 6 weeks of chilling, the stalks were split to extract the weevil larvae. The larvae were then sustained in the laboratory to allow the parasitoids to emerge from the weevils. The sunflower entomology team is now in the process of identifying these parasitoids collected from the stem weevil and evaluating their potential for biological control of this pest.

For more information, contact
Dr. Brady A. Vick, Research Leader,
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Northern Plains Genotyping Laboratory

We are very pleased to announce the "birth" of the Northern Plains Genotyping Laboratory. With the publication of this newsletter, construction is virtually complete and we will welcome our first geneticist to staff the new facility in October. Perhaps it is fitting that both of these events come during 2003, the 50th anniversary of the discovery of the structure of DNA.

Small grains researchers, industry, and grower representatives have been discussing the concept of regional genotyping laboratories for a few years now. Various small grains stakeholder groups, including the National Barley, Oat, and Wheat Improvement Committees, North Dakota Wheat Commission, North Dakota Barley Council, and the American Malting Barley Association, have supported this concept. In FY2002, Congress provided initial funding for the establishment of an ARS regional genotyping laboratory in Fargo to develop and utilize high-throughput molecular marker technology to facilitate the introgression of desirable traits into small grains (wheat, barley, and oats). In FY2003, additional funding was provided and thus far three regional labs have received at least partial funding: Fargo ND, Raleigh NC, and Manhattan KS. Another lab has been suggested for location in Pullman, WA.

A vast array of molecular genetic data is being generated through individual genetics research programs and various consortia such as the International Triticeae expressed sequence tag (EST) consortium (ITEC), the ARS wheat endosperm sequencing project, the NSF Wheat Genome Project, the North American Barley Genome Project, and the USDA-NRI funded barley EST project. However, a gap exists between the discovery of molecular genetic information and the practical application of that information in breeding programs. We envision this facility to function as a bridge between basic genetic research programs and plant breeding programs. The laboratory may identify new DNA markers associated with disease resistance or end use quality, develop and deploy breeder-friendly markers for traits of interest, create marker profiles of cultivars, and collaborate in basic genetics research.

What does this mean? Basically, we now have the ability to develop genetic markers that will allow us to identify or tag specific genes of interest whether they are for disease resistance or quality traits. These markers can then be used in genetic tests to rapidly screen plants to see if they possess the trait of interest. This is particularly valuable if markers can be developed that alleviate the need for phenotypic tests on adult plants, post harvest tests (both of which take a lot of time), or to do tests that are difficult to perform.

More rapid variety development and better access to advances in molecular genetics should enhance breeders' abilities to produce superior cultivars and thereby better serve the needs of small grains producers.

Interior of one of the new genotyping labs. Two labs, offices, and storage areas have been renovated to provide a home for the new facility.

For more information, contact
Dr. Michael C. Edwards, Research Leader,
Cereal Crops Research Unit, at
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New Research Associates in Sugarbeet & Potatoes

The Sugarbeet & Potato Research Unit has had the good fortune to recruit four new research associates. These scientists will work on aspects of sugarbeet and potato pathology and postharvest physiology in the laboratories of Karen Klotz, Jeff Suttle and John Weiland.

Dr. Darrin Haagenson joined the unit in June and will be working in the laboratory of Dr. Karen Klotz. Darrin's research is directed toward the identification of genetic and environmental factors influencing raffinose accumulation in sugarbeet. Prior to his arrival, Darrin was a postdoctoral research associate at the University of Guelph in the laboratories of Drs. Thys Tolenaar and Elizabeth Lee examining physiological mechanisms influencing maize yield. Darrin received his Ph. D. from Purdue University and his M.S. degree from North Dakota State University.

Dr. Rebecca Bargabus-Larson joined the laboratory of Dr. John Weiland this summer and will be working on the identification and development of novel mechanisms of resistance to beet necrotic yellow vein virus (the causal agent of Rhizomania disease) through gene silencing techniques. Rebecca obtained her Ph.D. from Montana State University in 2003. Her thesis research concerned the mode of action of *Bacillus mycoides*, a biological control agent for *Cercospora* leaf spot on sugarbeet, in the laboratories of Drs. John Sherwood and Barry Jacobsen.

Dr. Alan Dyer also joined the laboratory of John Weiland this summer. Alan's project involves the identification of novel mechanisms to control sugarbeet diseases including *Aphanomyces* root rot and other storage pathogens. Alan comes to us from a post-doctoral research associate position in the laboratory of Dr. Dean Malvick at the University of Illinois where he conducted research on the impact of *Aphanomyces* root rot on Alfalfa. Alan received his Ph.D. from University of Minnesota in the laboratory of Dr. Carol Windels. His thesis topic examined the factors affecting survival of *Aphanomyces* oospores.

Dr. Luis Destefano-Beltrán joined the laboratory of Dr. Jeff Suttle in August. Luis' research project will involve the molecular cloning and expression analysis of genes coding for key enzymes in the biosynthesis of abscisic acid, one of the principal dormancy regulating hormones in potatoes. Prior to his arrival, Luis was a visiting professor at the Universidad de La Frontera, Temuco, Chile where he conducted research on the genetic bases of cold tolerance in hair-grass, the only monocot native to the Antarctic. Luis obtained his Ph.D. from Louisiana State University where his thesis concerned the genetic engineering of plant disease resistance using lytic peptides.

For more information, contact
Dr. Jeffrey C. Suttle, Research Leader,
Sugarbeet & Potato Research Unit, at
suttlej@fargo.ars.usda.gov

New Scientist Joins Cereal Crops Research

Dr. Shiaoman Chao joined the Cereal Crops Research Unit in early October as a Research Molecular Geneticist. Dr. Chao comes to Fargo from the University of California/Berkeley where she served as Data Curator for the Wheat Genome Project. Dr. Chao has considerable experience in wheat and maize genetics, and prior to her tenure at Berkeley, spent time at the Institute of Botany in Taipei, the University of Missouri in Columbia, the Institute of Plant Science Research in Cambridge, and Montana State University in Bozeman.

Dr. Chao will provide leadership for the new genotyping laboratory to be housed in the newly renovated area of the Biosciences Research Lab. This lab will be responsible for the development and utilization of high-throughput molecular marker technology to facilitate the introgression of desirable traits into small grains. Dr. Chao's overall goal will be to identify and develop robust markers, particularly for quality and disease resistance, that will facilitate high-throughput marker-assisted selection of superior genotypes. Specific lines of her research may include the development of markers for novel genes/QTLs derived from the target cereal species, their non-cultivated relatives, and/or other germplasm resources; collaboration in the production of BAC libraries and development of local BAC contigs to facilitate marker identification, fine mapping, and sequencing of gene-rich regions related to quality or disease resistance; and collaboration in the identification and characterization of candidate genes underlying agronomically important traits.

For more information, contact Dr. Michael C. Edwards, Research Leader, Cereal Crops Research Unit, at edwardsm@fargo.ars.usda.gov

Jerry Miller, 2003 Technology Transfer Awardee

Recently, Dr. Jerry F. Miller, Research Geneticist in the Sunflower Research Unit, received a USDA-ARS Technology Transfer Award "for development of NuSun sunflower germplasm which has had a profound economic benefit to the U.S. sunflower industry." In 1995 representatives of the U.S. sunflower industry approached Jerry to explore whether sunflowers could be bred to produce an oil with 55 to 75% oleic acid, in contrast to traditional sunflower oil which has only about 17% oleic acid content. The representatives theorized that a sunflower oil with the higher oleic acid content would have optimal frying performance, superior taste acceptance, and excellent health benefits. Based on Jerry's advice, a consensus was reached within the sunflower industry (under the leadership of the National Sunflower Association) to aggressively explore ways to convert the entire U.S. production of traditional, high-linoleic sunflower to mid-oleic sunflower, which eventually came to be know as NuSun. A NuSun Sunflower Task Force was formed with Jerry named as the USDA research expert to oversee the hybrid testing and quality evaluation of NuSun hybrids. Jerry's previous research in the 1980s on the inheritance of oleic acid content in sunflower oil had shown that at least 2 genes were involved in determining oleic acid composition. With this knowledge he advised the sunflower industry that it was possible to genetically manipulate sunflower to produce an oil with the desired 55 to 75% content. During the 1996 growing season, a sunflower seed company used the information from Jerry's genetic studies to produce NuSun hybrid seed. Several farmers grew the crop, and an oilseed processor bought the seed and extracted the oil. The oil was refined, used to prepare potato chips, and the chips were consumer-tested. Since that time the NuSun oil that was introduced into the market has been widely accepted by the restaurant and snack food industries. In 2001, Proctor and Gamble announced that it would use NuSun oil in the production of its popular Pringle potato chip product, and in 2003 Frito-Lay advertised that it would use NuSun oil in a new line of "All Natural" snack foods. Since 1996 Jerry has continued to assist the sunflower industry in the development of NuSun by organizing and conducting hybrid field trials at 10 locations throughout the central Great Plains. The results of these trials helped sunflower seed companies fine-tune the oleic acid content of their NuSun lines and provide high yielding hybrid seed for commercial production. By 2002 NuSun accounted for 40% of the total oilseed sunflower production in the U.S. We congratulate Jerry for winning this prestigious award and for his tireless efforts in support of the sunflower industry.

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RED RIVER VALLEY AGRICULTURAL RESEARCH CENTER

Vision Statement

An internationally recognized center of excellence for integrated agricultural research on high priority problems to ensure a safe and abundant food supply.

Upcoming Events:

EVENTS AT THE CENTER

NOVEMBER 2003

3: ARS 50th Anniversary Celebration Kick-off.

6: NDSU Entomology Dept. Seminar, 1pm, NCSL-LCR.

13: NDSU Entomology Dept. Seminar, 1pm, NCSL-LCR.

20: NDSU Entomology Dept. Seminar, 1 pm, NCSL-LCR.

DECEMBER 2003

2: USDA-ARS Research Partners Mtg, NCSL-LCR.

4: NDSU Entomology Dept. Seminar, 1pm, NCSL-LCR.

5: Research Partners Annual Mtg., 8:30 am, NCSL-LCR,

11: NDSU Entomology Dept. Seminar, 1pm, NCSL-LCR.

18: NDSU Entomology Dept. Seminar, 1pm, NCSL-LCR.

SUMMER 2004

ARS & Center 50th Anniversary Celebration.

EVENTS ELSEWHERE

NOVEMBER 2003

2-6: ASA-CSSA-SSSA Annual Mtg., Denver, CO.

9-11: Natl. Science Foundations Wheat Genome Mtg., Washington, DC.

14: Northern Plains Potato Grower Assn Annual Mtg., East Grand Forks, MN.

19: R&E Board Research Reporting Session, Holiday Inn, Fargo, ND.

DECEMBER 2003

2-3: Potato Workshop, Beltsville, MD.

5-12: 6th Intl. Symposium on *Septoria/Stagonospora* Diseases of Cereals, Tunisia, Africa.

8-11: Pierce's Disease Research Symposium, San Diego, CA.

9-12: Canadian Fusarium Head Blight Wksp., Winnipeg, CA.

12-13: Scab Initiative Mtg., Holiday Inn Select, Mpls, MN.

13-15: National Fusarium Head Blight Forum, Mpls, MN.

JANUARY 2004

6: R&E Board Research Reporting Session, Holiday Inn, Fargo, ND.

7-8: ND Weed Control Assn., Minot, ND.

8-10: Barley Scab Mtg., Minot, ND

10-14: Plant/Animal XII Genome Conf., San Diego, CA

14-15: National Sunflower Assn. Forum, Ramada Inn Suites, Fargo, ND.

20-22: 2nd Annual NDSU/ USDA-ARS Sclerotinia Initiative Mtg., Holiday Inn Select, Mpls, MN.

21-23: USDA-ARS Research Leadership Conf., New Orleans, LA.

23-27: Natl. Wheat Industry Research Forum, Atlanta, GA.

FEBRUARY 2004

4-6: ARS National Program 304 Workshop, Beltsville, MD.

9-12: Weed Science Society of America, Kansas City, MO.

23-26: Wheat Quality Council Mtg., Kansas City, MO.

MARCH 2004

10-11: Intl. Sugarbeet Institute, Alerus, Grand Forks, ND.

SUMMER 2004

May 25-28: 3rd Intl. Symposium on Plant Dormancy, Wageningen, The Netherlands.

June 6-11: 5th Intl. Post Harvest Symp., Verona, Italy.

July 31-Aug. 4: American Phytopathological Society Mtg., Anaheim, CA.

Aug. 29-Sept. 2: 16th Intl. Sunflower Conf., Holiday Inn & Convention Ctr., Fargo, ND.

August 2004: Potato Assn. of American Annual Mtg., Scotts Bluff, NE.