GMPRC
GRAIN MARKETING AND PRODUCTION RESEARCH CENTER

RESEARCH Kernels

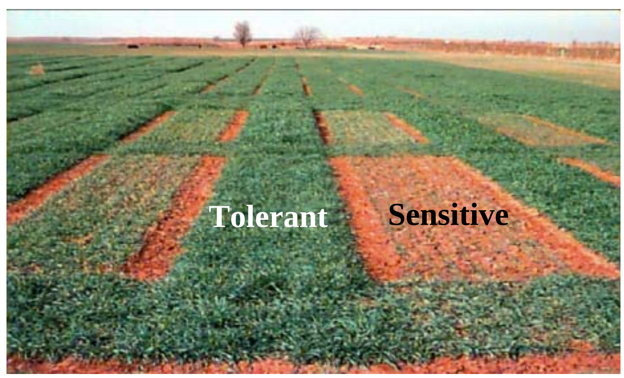
www.gmprc.ksu.edu July 2005

Top Layer Treatment of Bins with Diatomaceous Earth May Not Give Complete Control. Stored wheat is often treated for insect control with the inert dust, diatomaceous earth (DE), by mixing the dust into the top surface of the wheat mass. We placed 6, 9, and 12-inch layers of treated wheat on top of untreated wheat in vertical columns that represented grain storage bins. We then released live adult lesser grain borers on the surface of these grain masses. Adult mortality increased with the increasing depths of the DE-treated layer as expected. However, we still found live lesser grain borer offspring in the untreated wheat. Adults apparently were able to penetrate through the DE-treated layers and lay eggs before they died. These results suggest that surface-layer treatments with DE may not give complete control of the lesser grain borer. (Frank Arthur, telephone: 785-776-2783; email: frank.arthur@gmprc.ksu.edu)

Success in GMPRC Regional Small Grains Genotyping Laboratory Will Lead to Faster Development of Wheat Varieties That Can Improve Producer Profits. In 2002, Congress appropriated funds for the establishment of the Regional Small Grains Genotyping Laboratory that was to provide DNA mapping and fingerprinting services to wheat, barley, and oat breeding programs. Dr. Guihua Bai joined GMPRC to direct this work. This past year, Dr. Bai and his group have discovered new molecular markers (small pieces of DNA) for important resistance genes to diseases like Fusarium head blight (scab) and powdery mildew. In collaboration with Dr. Carver from Oklahoma State University, they have also found new genes and molecular markers that are strongly associated with wheat quality and yield factors such as test weight, kernel weight, and kernel diameter; grain yield; heading and maturation dates; and aluminum tolerance (see next article). These DNA markers can be used by breeders in marker-assisted selection of new varieties to shorten the development time. They also allow breeders to select for varieties that have multiple beneficial traits that will increase production and improve the return to producers. Currently, marker results from this laboratory are being used in 12 public and private wheat breeding programs. Breeders wishing to take advantage of this service can contact Dr. Bai or visit the lab's webpage (www.oznet.ksu.edu/wheatgenotyping). (Guihua Bai, telephone: 785-532-7116; email: guihua.bai@gmprc.ksu.edu)

Dr. Guihua Bai, Plant Geneticist

Will the Real Aluminum-Tolerant Wheat Varieties Please Stand Up! Aluminum toxicity is one of the major factors that limits wheat yields in acidic soils. Molecular markers for tolerance to aluminum could make variety screening faster and easier. Atlas 66 is a cultivar that is tolerant to high levels of aluminum in the soil. We identified two genes or quantitative trait loci (QTLs) responsible for its tolerance to aluminum toxicity. These two genes/QTLs were located on wheat chromosomes 4DL and 3BL, respectively. In another study, we examined a set of lines of Chinese Spring wheat (a moderately tolerant cultivar) that had one



Plots of Wheat Demonstrating Aluminum Sensitivity and Tolerance

chromosome arm removed and found several that were more sensitive to aluminum stress. Results showed that three genes enhanced root growth in the presence of aluminum and made the plants more tolerant to acidic soils in Chinese Spring. Several DNA molecular markers were identified in this study that may be useful for marker-assisted pyramiding (adding more than one resistance gene/QTL into the same plant) of different genes for aluminum tolerance in the development of new wheat varieties. (Guihua Bai, telephone: 785-532-7116; email: guihua.bai@gmprc.ksu.edu)

Treatment of Flour with Glucose Oxidase Changes Proteins. Chemical oxidants are routinely added to flour to modify dough properties (shorten mixing time, improve gas retention, lower energy requirements for dough mixing, etc.) and enhance breadbaking performance (increase loaf volume and improve crumb structure). The elimination of potassium bromate, and possibly other chemical oxidant additives, presents a challenge to the baking industry. Oxidoreduction enzymes such as glucose oxidase have been proposed as alternative improvers. We generated wheat flour with and without the presence of glucose oxidase and the different classes of proteins were extracted and analyzed. The most significant effects were observed to occur in the albumin (water soluble) and gliadin (alcohol soluble) protein groups. A significant increase in protein concentration and molecular weight distribution was observed in the albumin fraction. Further analysis revealed that this was due to changes in the gliadin solubility. Gliadins are generally not soluble in water, however, the inclusion of glucose oxidase enzyme in the mixing renders the gliadins more water soluble. The mechanisms responsible for the solubility changes are currently under investigation. (Michael Tilley, telephone: 785-776-2759; email: michael.tilley@gmprc.ksu.edu)

How Can We Measure the True Quality of Wheat? Over the past several decades, many tools have been developed to differentiate wheat with good baking quality from wheat with poor baking quality. Two commonly used instruments are the farinograph and the mixograph. Both involve the mixing of dough-water systems in bowls that contain permanently mounted pins and the instruments measure changes in the resistance to this mixing as the dough is formed. The mixograph mixes the dough on a vertical axis while the farinograph mixes the dough on a horizontal axis in a gentler process. Until recently, the minimum amount of flour required for the farinograph was 50 g while only 10 g were needed for the mixograph. We investigated the mixing quality of four Hard Winter wheat flour samples having protein levels of 6.9, 12.6, 12.7, and 14.8%. We also compared the farinograph results obtained using the new mini bowl (10 g of flour) and at four different mixing speeds with results from the mixograph. For the farinograph, water absorption increased (average of 6.2%) whereas the mix time, stability, and time to break all decreased as the speed of the farinograph increased. Farinograph results collected at the same speed (88 rpm) as mixograph results showed a slightly higher water absorption value but a mix time over twice as long (6.84 min) compared to that from the mixograph (3.30 min). We are continuing to investigate the farinograph using the mini bowl as a potential tool for evaluating the quality of breeders samples. (Okkyung Kim Chung, telephone: 785-776-2703; email: okkyung.chung@gmprc.ksu.edu)

Where Do Insect Fragments in Flour Come From? The milling industry routinely checks flour for the presence of insect fragments to determine whether the number found is below the defect action level of 75 fragments per 50 g flour of the Food and Drug Administration (FDA). In this study, we milled wheat that had been infested with either larvae, pupae, or adults of the lesser grain borer. We determined that wheat infested with a single adult contributed 28 times as many fragments in the flour as that infested with a larva stage and 10 times as many fragments as wheat infested with a pupa. From these data, we predict that 1-kg samples of wheat with more than 20 kernels infested with adult lesser grain borers would produce flour that exceeded the FDA limit for insect fragments. Similarly, if the wheat were infested with pupae, 300 infested kernels per kg would be needed to exceed this FDA limit and 500 kernels containing larvae would be needed to exceed the FDA defect action limit. (James Throne, telephone: 785-776-2796; email: james.throne@gmprc.ksu.edu)

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