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RESEARCH Kernels

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- **Gluten-Free Bread from Grain Sorghum.** In the U.S., over 2 million people have difficulty eating cereal products that contain wheat flour. We investigated nine different food grade sorghum hybrids for their performance in making bread using flour containing 70% sorghum and 30% corn starch. Our standardized baking procedure included an adaptation of water:flour ratios to achieve uniform batter consistency as measured by extrusion, and proofing the dough to a constant height. While specific loaf volumes obtained varied little, there were wide variations in crumb grain and texture. High quality sorghum cultivars produced breads with finer crumb grains and more gas cells per slice than lower quality varieties. These high quality varieties are suitable for the production of breads free of wheat flour. (Scott Bean, telephone: 785-776-2725, email: scott@gmprc.ksu.edu)

- **What Makes Aluminum Tolerant Wheat Tolerant?** Aluminum toxicity in acidic soils causes major difficulties for wheat producers in the southern Great Plains primarily due to decreased yields and lower plant health. Aluminum tolerant wheat varieties exist, but the mechanisms that are responsible for this tolerance are not well understood. We studied wheat plants from two very similar lines - one contained an aluminum tolerant gene from Atlas 66 and the other was susceptible to aluminum toxicity. Comparison of genetic expression patterns between the two lines showed that some genes were highly expressed in the tolerant line, but not expressed in the susceptible line when grown in soil containing significant levels of aluminum. These genes have a wide variety of functions and results indicate that tolerance to aluminum toxicity may be a complicated process. Future studies will focus on further gene characterizations so that these can be used in breeding programs to improve aluminum tolerance. (Robert Bowden, telephone: 785-532-2368, email: rbowden@plantpath.ksu.edu)

- **Field Test of a New Biological Insecticide Shows Excellent Results.** In collaboration with Kansas State University, we conducted field studies in Kansas to compare the effectiveness of controlled aeration and a new biological insecticide, spinosad, to control insect pests in bins of stored wheat. After a 6-month storage period, almost no live lesser grain borers, red flour beetles or rusty grain beetles were found in bins treated with spinosad. Aeration also controlled the level

of insect pests, but not as effectively as spinosad. The numbers of beetles found in aerated bins during the same 6-month storage period were below the level of 2 live insects per kilogram used in the official inspection system to declare a sample "infested." During this same study, in untreated control bins, the average insect density increased to 78 insects per 2 kilograms of grain. The results of this study are especially exciting because spinosad was so effective against the lesser grain borer, the primary cause of insect-damaged kernels (IDK) in stored wheat. (Paul Flinn, telephone: 785-776-2707, email: flinn@gmprc.ksu.edu; Frank Arthur, telephone 785-776-2783, email: arthur@gmprc.ksu.edu)

- **Where Did All Those Insects Come From?** The distribution of insect pests in and around food processing and storage facilities and the influence of the seasonal changes or various management practices on the levels of these pests aren't clearly understood. Use of traps to monitor insect pest levels is increasing, but it is often difficult to relate numbers of insects caught in traps with actual infestation levels. We studied the seasonal trends in the number of insect pests captured both inside and outside of a wheat flour mill and a food processing facility. Results showed that both the Indianmeal moth and warehouse beetle were found in larger numbers on the outside of the facilities than on the inside and both indoor and outside trap captures cycled in a seasonal pattern. Fumigations of the inside didn't consistently influence the trap captures for these two pests. In contrast, the trap captures of red flour beetles were higher inside the facilities than outside. Levels of red flour beetles on the inside decreased sharply after fumigation with a subsequent steady increase (0.002 to 0.005 beetles/trap/day) until the next fumigation. These results suggest that monitoring the level of insect pests both inside and outside of a facility may be necessary for accurate assessment of pest management procedures. (James Campbell, telephone: 785-776-2717, email: campbell@gmprc.ksu.edu)
- **Heat Kills Flour Beetles.** When commercial facilities are heated to control insect infestations, there is a lag time (acclimation period) before the target temperature is achieved, which could affect the numbers of insects killed. Different life stages of the red flour beetle and confused flour beetle were exposed to increasing temperatures for short time intervals by gradually raising the temperature of test chambers to the target temperature. As temperatures increased, the time required to kill the beetles correspondingly decreased, especially as temperatures approached 120 to 130oF. The acclimation period increased the amount of time required to kill flour beetles, which could have implications for use of heat sanitation for commercial field control. (Frank Arthur, telephone 785-776-2783, email: arthur@gmprc.ksu.edu)

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