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Sorghum: Nutritional Feed for U.S. and African Poultry

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As pressure for water increases and markets continue to expand sorghum will become even more important to farmers in the Great Plains

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Grain sorghum, an important dryland crop in the Central Great Plains of the United States, is adapted to growing in areas where low and erratic rainfall and high temperatures limit production of other crops such as maize and soybeans. The United States is the largest producer of grain sorghum with 6 million acres devoted to production of this crop in 2005. Kansas produces more grain sorghum, commonly known as milo, than any other U.S. state. Kansas growers value sorghum because it performs well in many types of soils and weather. More than 80% of the sorghum produced in Kansas is used as livestock feed with expansion into new uses such as fuel ethanol, human "health" foods, and starch-based biodegradable products like packaging materials.

Maize is a thirsty plant that requires large amounts of water. Sorghum offers farmers the ability to reduce costs of irrigation and other on-farm expenses and to grow a crop where other crops (such as maize) do not produce well. As pressure mounts to divert water from the Ogallala Aquifer to human municipalities, less water is available for irrigation. Thus, sorghum is a crop that will become even more important to crop farmers in the Great Plains and to the High Plains cattle and poultry feeding industries.

INTSORMIL is dedicated to the global improvement of sorghum and pearl millet. One INTSORMIL goal is to improve the yield potential, resistance to pests and diseases, and feeding value of grain sorghum through plant breeding and genetic improvement. In two INTSORMIL sponsored studies, Kansas State University (KSU), Texas A&M University, and USDA/ARS plant breeders, animal nutritionists and food

Graduate students Salissou Issa, INRAN, Niger (L) and Cynthia Monge, Costa Rica (R) with their advisor, Joe Hancock in the KSU poultry barn

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scientists are collaborating to: 1) increase the level of resistance to sorghum grain mold and 2) increase sorghum grain yield by selecting for large seed size. An added benefit of the large seeded sorghums is their greater content of protein and fat, both of which are of great importance to livestock production.

Globally, there is great interest in substituting sorghum grain for maize in poultry rations. Two INTSORMIL studies being conducted by KSU sorghum breeder Mitch Tuinstra (photo), animal nutritionist Joe Hancock, and their graduate students are targeted toward increasing the value of sorghum as feedstuff for production of poultry meat and eggs. Their research is designed to answer the questions of what effect breeding programs for grain mold resistance and increased grain yield have on the nutritional quality of the sorghum grain when fed to poultry.

Mold Resistance and Nutritional Quality

According to ICRISAT scientists, sorghum grain mold is one of the most important biotic constraints to sorghum production world wide with estimated annual losses in Asia and Africa in excess of US $130 million. Some mold pathogens are associated with loss of seed mass, grain density, and percentage germination. Yet other types of damage from grain mold can include deterioration of grain quality during storage, problematic food and feed processing, and decreased market value. Finally, some mold fungi are producers of potent mycotoxins and consumption of moldy grain by humans or animals can have significant health effects. Thus, INTSORMIL scientists are breeding sorghum for resistance to grain mold but must answer to what extent the incorporation of resistance to mold in sorghum might affect the digestibility of nutrients in sorghum grain when used as poultry feed.

Mold resistant (red grain) and susceptible (greyish) sorghum varieties
Photos courtesy of Gary Odvody

To answer this question, mold susceptible and resistant sorghums were grown at different locations in Kansas and Texas and fed to broiler chicks. Data collected were average daily gain in body weight (ADG), gain in body weight to feed consumption (G:F), and gross energy (GE) retention of the chicks.

What did the KSU scientists find? That selection for mold resistance in plant breeding programs had minimal effects on nutritional value of sorghum grain for broiler chicks. Thus, plant breeders can select sorghum hybrids with resistance to devastating mold diseases without affecting the nutritional value of sorghum as poultry feed. This is great news for sorghum and livestock producers in the U.S. and globally.

Seed Weight and Nutritional Quality

In another INTSORMIL project, sorghum lines with high seed weight was intercrossed with lines having conventional seed weight to produce sorghum hybrids. The nutritional value of the resulting sorghum hybrids was then determined in a broiler feeding assay. Treatments for the assay included a commercial corn (maize) hybrid and the experimental sorghums. Feed and fecal samples were collected, dried, ground, and analyzed to allow calculation of nutrient digestibility for the grains as well as responses of the broiler chicks in ADG and G:F ratio.

What did the KSU scientists find? The sorghum hybrids with KS115 as a parent line had the largest seed and greater protein and fat content compared to all other genetic combinations. Hybrids with KS115 as a parent line had protein contents of 14% compared to maize at 10% with greater amounts of essential amino acids than found in the maize. These advantages in content of key nutrients resulted in sorghums having equal or better nutritional value than maize as determined by response of the broiler chicks. The KS115 derived sorghums had more metabolizable energy (ME) than maize and tended to support greater average daily gain.

The good news was that selection for high seed weights not only contributed to greater sorghum grain yields, but also contributed to improved nutritional value in broiler chicks. This means greater productivity and profitability for both sorghum and poultry producers.

Implications for African Poultry Producers

Perhaps the greatest news from all of this research is that its application is not only in the U.S. Expansion of dry conditions in sub-Saharan West African continues to place a premium on crops that sip water to produce nutritious foodstuffs/ feedstuffs. Thus, high grain yields and resistance to loss of grain quality to molds have special importance for INTSORMIL scientists involved in the West African Project. Results from collaboration with West-African scientists have prompted INTSORMIL personnel to recommend sorghum as a substitute for maize in the burgeoning poultry industry. For this part of the world, sorghum is more productive than maize, it is especially well suited for their harsh, dry, growing conditions, and sorghum is a locally grown crop which need not be imported.

Multi-level poultry barn designed to improve air circulation near Maradi (upper) and poultry nutritionist Salissou Issa, INRAN visiting a poultry farm (lower) in Niger

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