Farm Views

Discussion on Crop Biotechnology

Weed and insect control has been a challenge for farmers for centuries. Following World War II, pesticides were developed and rapidly adopted by farmers. While most were safe and effective if used properly, some were not, and in isolated cases, were removed from the market.

Genetic engineering offers a way to alter crops to resist insect pests or become tolerant to less toxic and environmentally safer herbicides.

In 1996, Monsanto, and affiliated seed companies, launched the commercial sale of Round-Up Ready soybeans. By 1999, 57 percent of the U.S. soybean acreage was planted to soybean varieties with this herbicide-tolerant trait. Compared to the soil incorporation of some conventional herbicides, this seed technology encourages no-till farming practices, which can help reduce soil erosion and water pollution. The gene that encodes tolerance to the herbicide glyphosate (Roundup), using the techniques of genetic engineering, was transferred from Agrobacterium sp. strain CP4, a soil bacterium. The gene is a single dominant gene and is stable over several generations.

Bacillus thuringiensis (Bt) is a soil bacterium that has been used for several decades by gardeners and organic farmers to control insects. Using the tools of genetic engineering, scientists have inserted the gene that codes for this protein into several crops including corn, cotton, and potatoes. The crystalline protein has a complex molecular structure. This allows scientists to select the specific molecular structure that targets a specific insect such as European corn borer in corn, pink budworm, and boll weevil in cotton, and Colorado potato beetle in potatoes. Once the target insect ingests a few bites of the plant tissue that contains the Bt protein, the insect's digestive system converts the protein into a toxin that destroys the cell membrane of its stomach and kills the insect. However, when an animal or a human consumes the Bt protein in the plant, the acid environment of the stomach promotes digestion of the protein, without any toxic effects.

In 1999, about one-third of the corn acreage in the United States was planted to transgenic varieties. This has resulted in a reduction in insecticide use, primarily for cotton. However, since the high-dose strategy if insect management, if widely adopted, could place extreme pressure on the target insect population, insect resistance management (IRM) programs are essential to minimize the development of insect resistance to Bt. In January 2000, the U.S. Environmental Protection Agency approved a refuge management strategy for corn that requires Midwestern farmers to plant a 20 percent refuge to non-Bt corn varieties within one-quarter mile of the Bt corn. Entomologists have determined that resistance to Bt is a recessive trait. If some European corn borer survive in the 20 percent refuge portion of the field and mate with those adults in the portion of the field planted to Bt corn, it is expected that a viable number of European corn borer will survive without the recessive trait, and insect resistance to Bt will be at least delayed, if not avoided.

Besides the input traits such as insect-resistance and herbicide-tolerance, a number of output traits are being introduced into crops. Through genetic engineering, scientists have added vitamin A into rice. Rice is the primary food grain eaten as a staple in the diets of millions of people, especially in the developing world. World health experts hope that these vitamin A enhanced rice varieties will reduce by about 500,000 the number of people who go blind each year and by two million the number of children who die each year due to vitamin A deficiency.

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Other examples of output traits include phytase in corn that increases the availability of phosphorus in hog rations and reduces the amount of phosphorus added to feed premix. With greater utilization of phosphorus in the hog's digestive system, there is less phosphorus in the hog manure and a reduction in the amount of phosphorus applied to fields. This should help reduce hog production costs and offer an environmental benefit.

"Farmaceuticals" such as genetically engineered tobacco to produce cancer-treating drugs are under development. Also crops such as bananas and potatoes have been engineered to deliver selected vaccines against childhood diseases.

The development of output traits through biotechnology will require producers to follow strict identity preserved practices including cultural practices, careful cleaning of harvesting equipment, and separate storage facilities, in order to keep the crop identity preserved (IP). Those who are able to do this

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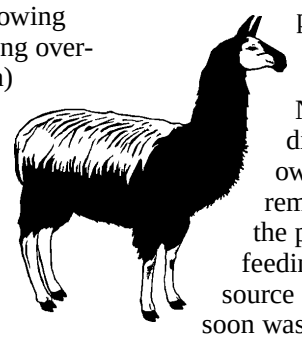
Fescue Endophyte Toxicity Found in the County

In mid-August, the extension office received a request from an acreage owner for someone to make a field visit to look at a herd of llamas. When I arrived at the acreage, one adult male was "down" showing symptoms of becoming overheated (hyperthermia) and weakness in the legs. As I visited with the owner, I learned that a female had spontaneously aborted a late-term fetus the previous day and the herd of 13 females and two males had never produced a live offspring in the three years they had been on the acreage. In every case of pregnancy, the fetus spontaneously aborted at various stages of development from quite small to nearly full term.



Naturally, one would suspect extreme nutritional deficiency or chronic poisoning, in such cases. The owner was very aware of the need for good nutrition. After walking the pasture, the only substantial potential source of toxin appeared to be the grass the animals were grazing, a nearly solid stand of Kentucky 31 tall fescue.

Fescue is widely used for pasture in states to the south and east of Nebraska with tens of thousands of acres of tall fescue pasture in eastern Kansas, Missouri, Arkansas, and other southern states. Fescue is used as a turf grass in Nebraska but seldom as a forage grass for animal production. Consequently, little or no research has been conducted in Nebraska on grazing or haying fescue.

Fortunately, I had heard about a potential problem with toxicity in fescue. Fescue itself is not toxic. The toxicity is associated with a fungus that can be present in the plant. Since this fungus grows only within the plant, between plant cells, it is known as an endophyte fungus. *("In"[endo] the plant [phyte])* I was able to locate some information from the University of Missouri which listed symptoms and seemed to confirm my suspicions that the fescue could be the source of toxin in the llama herd. Research has shown that under certain conditions, the endophyte can produce ergot-like alkaloids, that when ingested, can produce toxic reactions in the animal, (symptoms described below).

Based on our conversation and the results of a necropsy performed on the aborted baby llama by the University of Nebraska veterinary diagnostic lab, the owner immediately removed the herd from the pasture and began feeding hay as the only source of forage. The male soon was able to stand again and has returned to health over time. Shortly before this article was written, some six weeks after the llamas were removed from the fescue pasture, the owner reports three live births. Obviously, these females were pregnant at the time the owner switched from fescue pasture to hay, but they had not aborted yet.

Fescue Toxicity Syndrome in cattle.

Three separate syndromes appear to be associated with tall fescue toxicity.

1. Summer slump. Livestock show poor gains, reduced conception rates, intolerance to heat, failure to shed the winter hair coat, elevated body temperature, and nervousness.

2. Fescue foot. The clinical signs are rough hair coat, weight loss, elevated body temperature and respiration rate, leg tenderness, and actual loss of hooves and/or tail switch. Fescue foot occurs mainly in winter and may be noticed a few days after the first real cold snap. Cattle must be eating infected grass or hay at the time.

3. Bovine fat necrosis. Cattle with this syndrome have hard masses of fat in the abdominal cavity. This syndrome, which results in upset digestion and difficult births, has been associated with very high nitrogen fertilizer or manure rates applied to the fescue.

Fescue Toxicity Syndrome in Horses.

Fescue toxicity has serious reproduction effects on mares. Specific indicators are abortion, prolonged gestation, difficult birth, thick placenta, foal death, retained placenta, little or no milk production, and sometimes, death of mares during foaling. Foals that survive in utero will generally be larger than normal, have overgrown hooves, poor suckling reflexes, incoordination, and lowered body temperatures.

Fescue Toxicity Syndrome in Sheep.

Sheep appear to be less affected by the endophyte in tall fescue, possibly because they are inherently hardy. However, sheep are prone to "fescue foot," hyperthermia, poor wool production, and reproductive problems, as well as, lowered intake and the resulting poor weight gains.

Symptoms observed in the Llama herd.

Hyperthermia, (over heating), weakness, retention of the winter hair coat, and spontaneous abortion.

Is all Tall Fescue Infected with the Endophyte Fungus?

No, the fungus is spread only in the seed. Seed from infected plants will produce infected plants and seed from fungus-free plants will remain fungus free—even when the plants are present in the same pasture. The fungus cannot be identified visually in the field. The fungus is not present on the plant surface and causes no visible symptoms or growth abnormalities, in fact, the fungus may actually help the tall fescue plant survive and improve its durability. It has been found to improve insect resistance and drought tolerance.

The most obvious method of determining the presence of the endophyte in tall fescue is poor animal performance and the characteristic health problems described above. Because the endophyte grows within the plant tissue, it is necessary to submit a sample to a laboratory for testing to verify the presence of the endophyte.

For more information on Tall Fescue Toxicity, point your browser to the Ag/Acreage section of the Lancaster County Extension website. The information will be found on the Nebraska Production Agriculture–Crops–Forages page. Or point your browser directly to http://www.ianr.unl.edu/ianr/lanco/ag/crops/forages.htm. The information is under the heading "Tall Fescue as a Forage Source, What You Should Know?" I will continue to add to this site as I locate additional resources. (TD)

Crop Protection Clinic Scheduled for January 3

Lancaster County is slated to serve as a host site for a Crop Protection Clinic. This very popular clinic offers many topics of interest to crop producers and agribusiness professionals. Among this year's topics are: New Herbicides and the Weed Management Guide, Plant Viruses and Their Vectors, Stewart's Wilt, Herbicide Application Technology, On-Farm Research and the Nebraska Soybean and Feed Grain Profitability Project, Transgenic Corn Hybrids and Resistance Management, Value-Added Grains and the new SNAP Cooperative, and many more. Commercial Pesticide Applicators will be able to renew their General Standards and Ag Plant certification by attending the entire workshop session. Registration begins at 8 a.m. with sessions continuing from 9 a.m. to 4 p.m. The $20 registration fee includes proceedings, publications, refreshments, and the noon meal. Advanced registration is not required; however, it saves standing in line. (TD)