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Wheat Science News

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In This Issue:

Wheat Fusarium Head Blight (FHB) Widespread in Kentucky

Don Hershman, Extension Plant Pathologist

The title of this article will not take many in Kentucky by surprise. FHB, also called head scab, has been on the front burner in wheat production circles for the past month. Presently, there are a large number of fields with 30-70% disease incidence; some have less disease and some have more. Many fields were treated with a fungicide in a timely fashion, and this has certainly helped keep disease levels down (by 30-50%). However, many applications were made late and/or under less than ideal conditions. As a result, FHB control is not very good in some treated fields. In addition, many fields were planted last fall to varieties that have reduced susceptibility to FHB; this has really helped. However, the overriding factor which seems to have played the greatest role in determining FHB level is when the field flowered relative to wet periods. The period just before to just after flowering is the time when wheat is the most susceptible to infection by the FHB fungi (primarily, *Fusarium graminearum*). Generally, fields that flowered during the last week in April through the first 10 days in May seem to have the most FHB. Unfortunately, a large percentage of the Kentucky wheat crop flowered during this period.

If you recall, there was great concern last year that we would have a lot of FHB, but it never happened. In fact, 2008 was one of the lowest FHB years on record. When I checked through weather records for Princeton, Caldwell County, KY for the period April 26 – May 28, 2008 vs 2009 (the critical period for FHB infection and development), there was not a great deal of difference in the number of wet days and total rainfall (6.82 inches of rain and 14 wet days in 2008 vs. 7.67 inches rain and 18 wet days in 2009). However, there was a significant difference in average temperature and timing and arrangement of wet days between the two years. In 2008, the average temperature for this period was 4°F ***lower*** than in 2009. Also, in 2008, most rain events were followed by warm, sunny, windy days which tended to dry the crop out between rain events. Both situations apparently kept the FHB risk down. In addition, most wheat fields in 2008 flowered when conditions were, more or less, dry and sunny. This year, there was a block of seven straight days of precipitation, with a one day break, followed by another four days of rain from April 28 - May 9. This block of nearly 11 consecutive days coincided with the onset of flowering in most wheat fields. It is no wonder we have a great deal of FHB this year compared to last.

The potential for an FHB "situation" was indicated by the FHB Risk Assessment Tool (www.wheatscab.psu.edu/), but it did not provide

producers with much advanced warning. As of May 2, the FHB Risk Assessment Tool map (Figure 1) was showing low risk for most of the state, with few small spots of moderate risk. At that time, wheat in the far southwestern part of the state was in early flowering, but most wheat in the state (including Princeton) was in various stages of head emergence or extremely early flowering (<1% of main tillers with anthers).

Two days later, on May 4, there was a significant shift towards an increased FHB risk **(**Figure 2).

By May 6, conditions deterioriated even further, and a moderate to high FHB risk existed across much of the state (Figure 3).

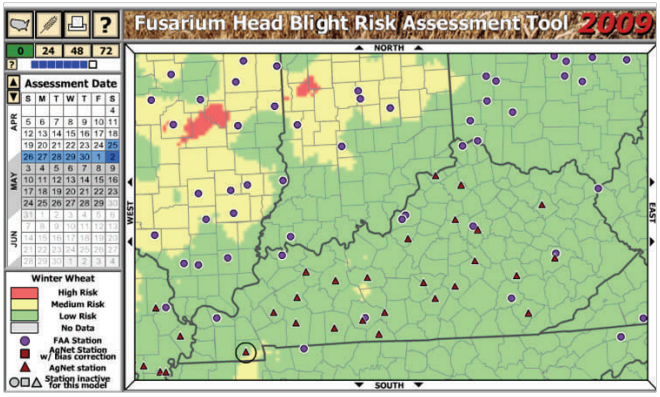

Figure 1. FHB risk as of May 2, 2009.

So, the FHB Risk Assessment Tool was accurate, but it was not very helpful because by the time the disease prediction models finally "kicked in" and showed an elevated FHB risk, fields were beginning to flower and were at peak susceptibility to infection. At the same time, wet weather greatly hindered attempts to get fields sprayed with a fungicide. As a result, many fields either did not get sprayed, or applications were compromised in some way. Fortunately, many growers were able to do a good job with applying fungicides.

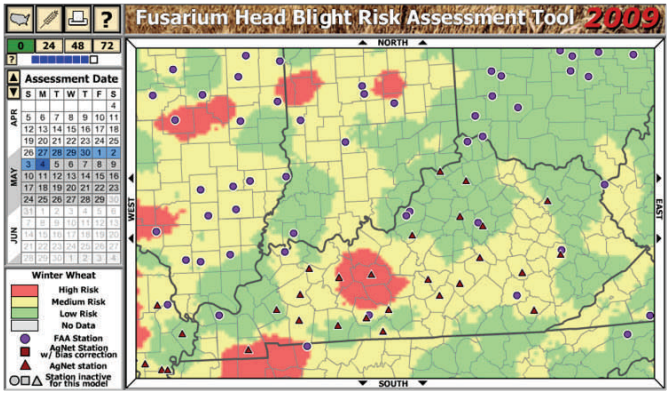

Figure 2. FHB risk as of May 4, 2009.

As of this writing, the extent of FHB damage in KY is still not known. Some fields are infected, but are still in the process of expressing symptoms. As a general rule of thumb, maximum symptom expression usually occurs 21 days after infection or the soft dough stage, whichever comes first. Once a field begins to dry down, it is nearly impossible to see FHB symptoms. However, if you take a few hand-fulls of heads from several locations in a field, crush the heads in your hands, and blow the chaff away, you will see the telltale evidence of FHB: scabby grain (Figure 4).

Grain severely impacted by FHB will be shriveled and will have a low test weight. Grain will also be contaminated with a mycotoxin called deoxynivalenol (DON). Grain with a low test weight and excessive DON can greatly limit the marketability and end-use of grain (feed and food). If the FHB problem extends beyond KY and becomes a regional concern (i.e., re-

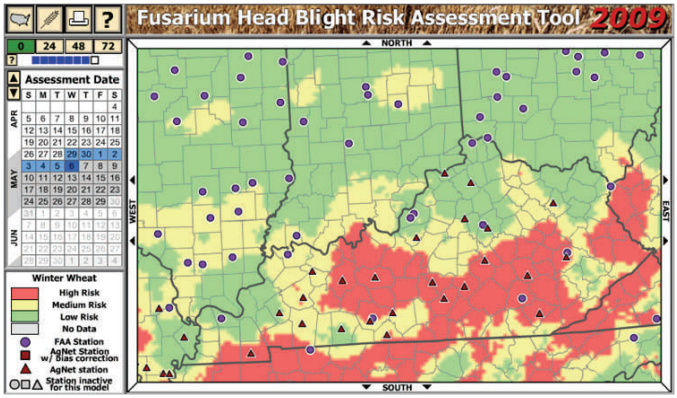

Figure 3. FHB risk as of May 6, 2009.

gional soft red winter wheat crop), grain prices received throughout the region may be negatively impacted as the market employs a "regional discount" in order to make up for increased cost (storage, blending, etc.). If FHB turns out to be a mostly Kentucky problem, elevators will apply discounts to grain lots that are substandard. Seed producers should be aware that germination and vigor are also seriously reduced in scabby grain. For non-seed producers, seed shortages of certain varieties and reduced seed quality are often common following a major FHB episode.

Figure 4. Scabby grain (left) vs. healthy, plump grain (right). Scabby kernels are shriveled and frequently have a faint pink or salmon discoloration.

At this point there is no way to alter the course of FHB in a field; however, there are several steps producers can take to minimize the impact of FHB. That is the goal of this issue of the Wheat Science Newsletter. Look for much more information to become available in the coming weeks and months to help you reduce the potential for FHB to occur next year.

Deoxynivalenol (DON) or vomitoxin, may be present in high concentrations in scabby grain. If the grower has insured the wheat crop and has determined that DON levels exceed 2 ppm, then certain insurance adjustments are possible. This information may be accessed from the special provisions portion of the RMA website: http://www.rma.usda.gov/

It is recommended, however, the growers in this situation speak to their agents and adjustors to get information that is relevant to their crop.

Check Your Wheat Hay Before Feeding

Chad Lee, Extension Agronomist

Some farmers are cutting scab-infested wheat for hay rather than taking yield losses on grain. Scab-infested wheat usually has elevated levels of deoxynivalenol (DON or vomitoxin) which can be toxic to beef and dairy cattle as well as swine. Another toxic compound is zearalenone, but it rarely is produced in wheat. There is some evidence to suggest that DON might also be a marker for several other mycotoxins as well. The U.S. Food and Drug Administration (FDA) set advisory levels for DON in feed (Table 1).

Some farmers are used to ensiling wheat forage to help reduce nitrate levels. Ensiling will do nothing for the toxin levels, but it will preserve the forage. If you regularly ensile forages, then ensiling is fine in this case. Ensiling will not affect toxin levels so a forage test conducted before or after ensiling should have similar results.

There is no method to visually determine toxin levels in wheat and any wheat cut for hay this season should be tested in a laboratory **before** being fed. Whole plant samples should be tested since toxin levels can be different in the wheat heads and straw. Ideally, collect a whole plant sample of wheat, let it dry down several days and send it to one of the laboratories for analysis (Table 2).

Please recognize that a test result is only as good as the sample sent in for analysis. If you happen to send in one sample with low vomitoxin levels, that does not mean that your entire supply of wheat hay is safe. You should pull samples from several fields and test them for toxins.

Blending wheat hay with other feed sources may be a good idea, even on wheat tested safe this season. For more information about testing wheat hay or feeding wheat hay to livestock this season, contact your county extension agent.

Table 1. U.S. FDA advisory levels for deoxynivalenol (vomitoxin) in livestock feed (Henry, 2006). (also available at: http://www.extension.org)

Class of Animal	Feed Ingredients and Portion of Diet	DON levels in Grain and Grain By-Products and (Finished Feed)
Ruminating beef and feedlot cattle older than 4 months	grain and grain by-products not to exceed 50% of the diet	10 ppm (5 ppm)
Chickens	grain and grain by-products not to exceed 50% of the diet	10 ppm (5 ppm)
Swine	Grain and grain by-products not to exceed 20% of the diet	5 ppm (1 ppm)
All other animals	Grain and grain by-products not to exceed 40% of the diet	5 ppm

Table 2. Facilities that test for vomotoxin (DON) in wheat. This is not necessarily a comprehensive list; check with your county extension agent and veterinarian for other testing facilities. Any errors in prices are the fault of the author and not any laboratory. Please call the facility before sending in samples to confirm prices.

Laboratory	Fees and other comments
Cumberland Valley Analytical Services, Inc. Hagerstown Forage Lab U.S. Postal Mailing Address Cumberland Valley Analytical Services, Inc. P. O. Box 669 Maugansville, MD 21767 Shipping Address for UPS/FEDEX Cumberland Valley Analytical Services, Inc. 14515 Industry Drive Hagerstown, MD 21742 (800) 282-7522	Full toxin screen, including vomitoxin (DON): $64.50 vomitoxin, only: $36.50
Murray State University Breathitt Veterinary Center PO Box 2000 715 North Drive Hopkinsville, KY 42241-2000 (270) 886-3959	$10 accession fee and $35 per test
University of Kentucky Livestock Disease Diagnostic Center 1490 Bull Lea Rd. Lexington, KY 40511 (859) 253-0571	One accession will cost a grower $25 when target species is a food animal (i.e. beef, dairy, poultry and swine). Multiple samples per accession are allowed as long as the samples are from the same producer. Samples at LDDC will be sent to North Dakota for testing, but billing will occur through LDDC. Billing must be to the producer.
Waters Agricultural Laboratories, Inc. 2101 Calhoun Rd. Owensboro, KY 42301 (270) 685-4039	Vomitoxin: $48.00 Zeralenone: $48.00 We have supplies (bags, boxes, etc.) available upon request. We have a 24-48 hour turnaround on results.

References: Aakre, D., G. Flaskerud, K. Hellevang, G. Lardy, M. McMullen, J. Ransom, B. Sorenson, A. Swenson. 2005. DON (Vomitoxin) in Wheat: Basic Questions and Answers. North Dakota State University Extension Service, North Dakota State University.

Henry, M. H. 2006. Division of Animal Feeds, Center for Veterinary Medicine, Food and Drug Administration, Mycotoxins in Feeds: CVM's Perspective, Presentation for Risk Management Agency, August 23, 2006, in Austin, Texas, http://www.fda.gov/AnimalVeterinary/Products/AnimalFoodFeeds/Contaminants/ucm050974.htm

Whitlow, L.W. and W.M. Hagler, Jr. 2008. Mold and Mycotoxin Issues in Dairy Cattle: Effects, Prevention and Treatment, Last updated: Nov. 12, 2008. http://www.extension.org/pages/Mold_and_Mycotoxin_Issues_in_Dairy_Cattle:_Effects%2C_Prevention_and_Treatment

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Harvesting, Drying and Storing Wheat Suspected of Vomitoxin Contamination

Sam McNeill, Extension Agricultural Engineer

Background

Fusarium head blight (FHB) has threatened this year's wheat crop in Kentucky, causing concern among growers, crop advisors and grain buyers. While the impact of this disease is yet to be determined, it more than likely will vary from farm to farm and region to region. Knowing how the disease impacts seed quality can help growers deal with it in their operation.

Wheat kernels that are infected early (while the head is maturing) will likely be smaller in size, have a shrunken appearance and slightly discolored. However, if wheat heads are infected during field dry down, kernels that may contain mycotoxins may look normal to the naked eye resulting in the possibility of leading one to a false sense of security.

Prolonged conditions in the right combination can result in elevated levels of FHB (and other diseases). Molds responsible for mycotoxin production generally prefer warm, humid conditions (temperatures > 60^{o} F and relative humidities > 70%) for extended periods of time to actually produce vomitoxin, (zearalenone or fumonisin). However, under ideal conditions that are specific to each type of mold, mycotoxins can be produced in a matter of hours!

For this reason, diligence is essential when managing any crop that is suspected of being contaminated with mycotoxins. Extra care must be taken when harvesting, handling, drying and storing the crop to minimize the cost penalties associated with discounts from excessive toxin levels or poor wheat quality. Test kits are available to determine mycotoxin levels and should be used to screen any suspected fields for damage (see accompanying article from North Dakota State University Extension Service).

Harvesting

Consider harvesting wheat early if sufficient drying capacity is available on the farm or commercially. Early harvest may help reduce the spread of head scab and other diseases within individual fields, and can also prevent field sprouting, boost test weight and perhaps most importantly, increase soybean yield when double-cropping. Also consider segregating wheat by field or variety to prevent mixing sound wheat with diseased wheat. It may be best to harvest diseased wheat last to avoid the time consuming task of cleaning out the combine, carts/wagons, trucks, conveyors and other handling equipment between fields.

Proper adjustments to the sieving and cleaning section on a combine are critical when dealing with a contaminated wheat crop. Most wheat diseases turn plump healthy kernels into small, shriveled/ "tombstone" kernels, so typical recommendations for a conventional combine are to increase fan speed and manage the load of straw, chaff, weeds and foreign material on the sieves. If the fan is set too low, the walkers/sieves will fill up with straw and all wheat kernels will ride out the back on a mat of chaff. If fan speed is too high it will blow sound and shriveled kernels out the back.

Under normal harvest, fan speed should be set to provide good separation between sound kernels and straw or chaff. With 'scabby' wheat that may contain vomitoxin, fan speed should be increased to remove light weight kernels. Operators should monitor grain in the tank often to determine machine settings for best performance, and recall that ground speed should be adjusted to match yield within fields so that a near-constant feed rate is achieved through the combine.

Drying

Wheat fields that are suspected of having high levels of vomitoxin or fumonisin should be scouted or monitored prior to harvest to determine if segregation or early harvest is needed. With the right combine adjustments, wheat can be harvested above 20% moisture if sufficient drying capacity is available on the farm or commercially. Contaminated wheat should be dried to 13% within 24 hours and held separately from the rest of the crop. High temperature bin dryers or stand-alone automatic batch or continuous flow grain dryers are all adequate for drying high moisture wheat quickly. [For bin drying, grain depth must be managed to provide a minimum airflow rate of 5 cubic feet per minute (cfm) per bushel. A general rule of thumb for a given amount of airflow is that doubling the depth of grain requires 10 times more fan horsepower. For example, delivering 5 cfm per bushel (cfm/bu) in a 30-foot diameter bin filled with 3 feet of wheat (1700 bu) requires a 2.5 HP fan…but a depth of 6 feet in the same bin (3400 bu) requires 25 HP! Thus, bin dryers are limited to small batches for timely processing with limited heat to prevent over-drying the bottom layer of

grain. Several bins are needed to add drying capacity.]

Table 1 shows the moisture content that soft winter wheat will approach with sufficient exposure to the temperature and relative humidity conditions shown. Daily average air conditions during late June and early July are generally near 75 degrees with 65 percent humidity. Under these conditions, wheat will approach 12.5 % moisture which is safe for storage.

In contrast to bin dryers, self-contained automatic batch or continuous flow dryers have inherently high airflow rates (50 to 125 cfm/bu) so drying wheat in these units is often done with little or no additional heat. If heat is used, limit drying temperatures to 120 ^{0}F (110 for seed wheat).

Storing

It is best to store sound wheat separately from diseased wheat and clean handling equipment between loads to avoid contamination. The next best option is to clean mixed wheat as it is moved into storage to remove shriveled kernels. If this isn't practical for your farm, keep in mind that lighter wheat kernels will tend to collect in the center of a storage bin during filling, which restricts airflow in this region. For wheat that isn't cleaned, core the bin soon after filling to remove trash and smaller kernels to improve airflow. Also, don't fill a bin past the top ring to allow room for adequate ventilation in the head space and for grain inspections. Always be aware of the entrapment hazards associated with flowing grain and wear dust protection masks when working inside bins and other enclosed spaces where grain is stored. More information on harvesting, drying and storing wheat is available at county extension offices and online (www.uky.edu or http://www.bae.uky.edu/ext/Grain_Storage/PDFs/Wheat_HDS_ID-125.pdf).

Table 1. Equilibrium moisture content of soft red winter wheat at different air temperatures and relative humilities.

Temperature ^{0}F	Relative Humidity, %				
	20	35	50	65	80
	Grain Moisture, % wb				
40	9.3	10.8	12.1	13.7	15.7
60	8.4	9.9	11.3	12.9	15.0
80	7.7	9.3	10.7	12.3	14.4
100	7.1	8.7	10.1	11.7	13.8
120	6.6	8.2	9.6	11.3	13.4

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PP-1302

DON (Vomitoxin) in Wheat
Basic Questions and Answers

What is DON?

Deoxynivalenol (DON), commonly referred to as vomitoxin, is a mycotoxin that may be produced in wheat and barley grain infected by Fusarium head blight (FHB) or scab. FHB may infect grain heads when wet weather occurs during the flowering and grain filling stages of plant development. The occurrence of FHB does not automatically mean that DON is present, but a high level of scabby kernels in the harvested grain means DON will likely be present. Levels of DON do not necessarily correlate with levels of physical damage in grain.

What are the critical levels of DON for use in food and feed?

The concentrations of DON in grain are expressed as parts per million (ppm). One ppm is equivalent to 1 pound in 1 million pounds, 1 penny in $10,000, 1 minute in two years, or 1 wheat kernel in 80 pounds of wheat.

The U.S. Food and Drug Administration (FDA) has established DON advisory levels to provide safe food and feed. Unlike aflatoxin in corn, DON is not a known carcinogen. Furthermore, grain with DON would have to be ingested in very high amounts to pose a health risk to humans, but it can affect flavors in foods and processing performance.

Human food products are restricted to a 1-ppm level established by the FDA. This level is considered safe for human consumption. The food industry often sets standards that are more restrictive. DON causes feed refusal and poor weight gain in some livestock if fed above the advisory levels. FDA advisory levels are as follows:

1 ppm	Finished wheat products, such as flour, bran and germ, that potentially may be consumed by humans. The FDA does not set an advisory level for raw grain intended for milling because normal manufacturing practices and additional technology available to millers can substantially reduce DON levels in the finished wheat product. However, individual millers or food industries may have stricter requirements than 1 ppm.
10 ppm	Grains and byproducts destined for ruminating beef and feedlot cattle older than 4 months and for poultry, providing that these ingredients don't exceed 50 percent of the diet
5 ppm	Grains and grain byproducts destined for swine, providing that these ingredients don't exceed 20 percent of the diet
5 ppm	Grains and grain byproducts destined for all other animals, providing that these ingredients don't exceed 40 percent of the diet

How does DON impact wheat grain quality and product performance?

FHB infection during very early kernel development can reduce yield by decreasing kernel numbers. Slightly later infections cause shrunken, chalky white or discolored scabby kernels, which often are referred to as tombstones. Kernels infected late in their development by FHB may show no visible damage, but still have elevated levels of DON. A Canadian study (Sinha & Savard, 1997, Can. J. of Plant Path. 19:8-12) of DON in FHB infected wheat kernels found an average level of 1 to 1.2 ppm in normal appearing kernels, 2 to 5 ppm in shriveled kernels, 174 ppm in white tombstones, and 274 ppm in pink tombstones.

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In cooperation with the N.D. Wheat Commission

NDSU
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The majority of the DON is present in the seed coat or bran in wheat. For the flour miller, shrunken kernels result in a loss of milling yield because damaged kernels are removed to improve flour quality and reduce DON content. Enzymes found on scabby kernels can break down protein and consequently reduce gluten strength and adversely affect the bread and pasta making properties of the flour. Processing and final product quality, however, are not significantly affected by DON *per se* when levels are below 1 ppm. In addition, the process of milling wheat into white flour or durum semolina typically results in the reduction of DON by approximately 50 percent. Therefore, many grain handlers or processors purchase grain with DON levels up to 2 ppm without discounts. Manufacturers of whole-grain foods will have specifications that are more rigid.

Most export markets have specifications built into their purchase agreements to limit DON levels. The typical standard used by the majority of world buyers is 2 ppm maximum. In Europe, some countries have lower limits, such as 1 ppm in the United Kingdom and 0.5 ppm in Norway, due to their own advisory levels. Japan has set a maximum DON level on imported wheat of 1.1 ppm. A complex formula was developed by the Japanese Department of Health to limit the per capita consumption of DON.

■ How is DON Measured?

DON is measured using several laboratory procedures. The most common method used by the Federal Grain Inspection Service (FGIS) and most grain handling and processing facilities is the immunological-antibody method called ELISA (Enzyme Linked Immunosorbent Assay) because it is relatively fast and cheap. The gas chromatography - electron capture (GC-EC) analytical method is quantitative and used to calibrate ELISA test kits. It also is the method used by the NDSU Veterinary Science Toxicology Laboratory for measuring DON presence in grain samples. Factors, such as sampling differences, wheat cleaning, sample preparation and test kit standard error, may cause differences in results between testing laboratories, but each lab and elevator follows approved methods that are periodically conformance tested.

■ Is the sampling procedure for DON analysis important?

The reliability of testing is greatly influenced by the sampling procedure. To achieve a more accurate DON level estimate, it is critical that the collected grain sample be representative of an entire truckload or bin of grain.

Grain and other particles separate based on particle size and density as it flows into a truck or bin. Typically, the smaller, denser material is near the center and the larger, lighter material is near the outside of the container. Therefore, it is expected that there will be a variation in the concentration of affected kernels in various portions of a truckload. In addition, since DON levels can vary greatly between kernels of similar size and density, it is important to take several samples from various locations within the load.

Probe samples should not be taken from the center or outer portions of a load because these areas do not reflect a cross section of the load. The samples also must represent spatially distinct areas of the load. The probe should collect the sample from as much of the entire depth of the truck as possible. Four to five probes per truck are recommended.

To obtain an accurate sample from an end gate grain stream, samples from the entire width and depth of the grain stream should be collected, not just the first and last portion of the load. A Pelican sampler or other sampling device aids in proper sample collection. At least four samples of the entire grain stream should be collected at intervals to represent spatially different portions of the load.

■ What are possible strategies for using wheat with DON?

CLEANING

Is grain cleaning economically feasible for removing DON?

FHB blight affects the kernel in a variety of ways that permit the scabby kernels to be removed from good quality wheat. The kernels may be deformed enough that they can be removed by screening. The kernels typically have a

Wheat Cleaning Examples

Wheat Sample	Test Weight (lb/bu)	DON (ppm)
Whole Field Sample	54.2	7.0
Light Portion	55.7	5.0
Medium Portion	58.4	3.1
Heavy Portion	59.9	1.5
Screenings	41.2	26.1

Factors	Original sample	Clean-out	Cleaned Sample
Bushels	1,000	110	890
Test Weight (lbs/bu)	59-61	57	61-63
Damage	2-5%	Unchecked	<0.5%
DON level	8 ppm	Unchecked	0-2 ppm
Market Price	$1.70	$1.00	$3.20
Value	$1,700	$110	$2,848

Increase in income from cleaning this 1,000 bushels of wheat was $858; $110 value of clean out + $2,848 value of cleaned sample - $400 cost of cleaning - $1,700 value of unclean sample. Cleaning cost in this example was $0.40/bushel.

lighter test weight, so the very light kernels can be removed by airflow. If screening and aspiration do not adequately remove the scabby grain, the wheat can be sorted by density with a gravity table or fluidized bed separation. The amount of scabby grain and the amount of wheat lost during cleaning is different for each lot of grain, so a small quantity needs to be cleaned to determine the economics. The cost of cleaning will typically be about 40 cents per bushel. DON can occur on kernels of normal appearance and shriveled or tombstone kernels. Therefore, it is not always possible to reduce the DON level by cleaning the grain.

Is respiratory protection needed while handling infested grain?

All mold spores, not only those of the Fusarium fungus, may cause allergic reactions and breathing problems if inhaled. Appropriate personal protective gear, such as masks designed to keep out mold spores and grain dust, are recommended when handling grain. Generally, these masks are either N95 rated masks, which typically have two straps, or respirators with HEPA filters. Masks are available at most hardware stores for about $2.50 each.

STORAGE

Does DON increase in storage?

After the grain dries below a moisture level of about 22 percent, fungal growth and DON production stops. Anytime the kernel is damaged, however, the potential for grain deterioration during storage increases. Damaged wheat should be stored at or below 12 percent moisture content. Studies show that the allowable storage time for scabby wheat is slightly less than for non-affected wheat. Therefore, recommended airflow rates to dry scabby wheat should be slightly increased above the rates recommended for good quality wheat. Affected wheat should be cooled by aeration soon after being placed in storage and further cooled periodically as outdoor temperatures decline until the wheat is about 25 F.

MARKETING

What is the best strategy for marketing wheat with DON?

The most cost effective way to market wheat with high DON levels depends on many factors, such as how much DON is in the wheat and the current discounts; ability and cost to segregate, clean and/or blend the wheat; cost of storage; contract obligations with the elevators; the loan deficiency payment (LDP); and the price outlook.

Elevator discounts generally are the most severe at harvest. Discounts usually decrease after harvest, as the marketing system is able to assimilate the lower quality grain over time. Market reaction to DON levels can vary depending on which market elevators are selling into, how much of their local draw area was affected and the availability of blending stocks. Elevators and grain exporters risk outright rejection of shipments that exceed contract specifications.

At harvest, every attempt should be made to segregate and store on-farm DON-affected and nonaffected wheat. The possibility of deferring contracted wheat in the hope that discounts will lessen with time should be explored. On-farm storage also gives the producer time to improve quality before delivery by cleaning and/or blending. To be worthwhile, the combined value of the cleanout and clean grain, less cleaning costs, must be greater than the value of the original grain. The value of cleanout varies at elevators. A one-time in/out charge of about 8.5 cents per bushel is an additional storage cost that also should be considered.

A CCC loan on wheat being stored may offer benefits. Most importantly, it provides cash flow. It also may have a lower interest charge than a commercial loan. However, any LDP that might be available cannot be taken if a CCC loan is taken. Forfeiture on the loan usually is not the best alternative since the discounts on forfeited wheat would be 50 cents for 2.1 to 3 ppm, 75 cents for 3.1 to 4 ppm and $1 for 4.1 to 5 ppm. Wheat more than 5 ppm would have a settlement value of zero.

For wheat in the bin, the cost of good quality on-farm storage is about 1.5 to 2.1 cents per month, based on interest rates of 4.5 to 7 percent, respectively. Storage into April/May could be profitable if distant futures prices are at least 12 to 15 cents higher and remain there, the basis does not deteriorate, and DON discounts are reduced or quality can be improved.

FEEDING

Can DON contaminated grain be used as a livestock feed?

In most cases, wheat containing DON can be used as a livestock feed. However, there are some classes of livestock that do not tolerate DON well.

Beef Cattle: FDA limits for cattle are similar to poultry (dietary levels of 5 ppm). Research conducted in North Dakota and Minnesota has suggested growing and finishing cattle can tolerate higher levels (up to 18 ppm based on research at the Carrington Research Extension Center).

Dairy Cattle: FDA limits the level to 2 ppm DON in the diets of lactating dairy cows.

Swine: Do not feed wheat containing DON to gestating or lactating sows or pigs weighing less than 50 pounds. Growing and finishing pigs may be fed grains containing DON, provided the level of DON in the diet does not exceed 1 ppm.

Poultry: Poultry can be fed grain containing DON. Total dietary levels should not exceed 5 ppm (e.g., 10 ppm DON in wheat could be fed at 50 percent of the diet).

Horses: No research data exists that has evaluated feeding grain containing DON to horses. Since monogastric animals tend to be more sensitive than ruminants to these type of toxins, horse owners should be extremely cautious about feeding DON containing grain to horses.

■ Recommendations for feeding wheat

In addition to the problems related to DON, feed wheat is a grain that requires diligent feeding management to be successfully included in a ration for cattle. Wheat ferments very rapidly, making it a difficult to feed at high levels. Here are a few pointers for making the most of this grain:

- Wheat is higher in protein and similar in energy to corn (see following table).
- Limit wheat to 40 percent or less of the ration in backgrounding and finishing diets.
- Limit durum to 30 percent or less of the ration in backgrounding and finishing diets.
- Gradually adapt cattle to wheat-based diets. Start with low levels (10 to 15 percent) and then gradually increasing the wheat level up to 30 percent (durum) or 40 percent (hard wheats).
- Wheat should be coarsely rolled or cracked, but not finely ground for optimum performance.
- Wheat should not be fed in self feeders.

For more detailed information on grain feeding, check out the following web sites:

- www.ext.nodak.edu/extpubs/ansci/beef/as1184w.htm
- www.ext.nodak.edu/extpubs/ansci/livestoc/as647w.htm
- www.extension.iastate.edu/Publications/PM1994.pdf

Nutrient content of various feed grains (NRC, 1996)[a]

	Wheat	Barley	Corn	Oats	Sorghum
TDN (%)	88	88	90	77	82
NEm (Mcal/kg)	2.18	2.06	2.24	1.85	2.00
NEg (Mcal/kg)	1.50	1.40	1.55	1.22	1.35
CP (%)	14.2	13.2	9.8	13.6	12.6

[a]Nutrient analysis can vary. A laboratory analysis is recommended.

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■ What can I do to prevent DON in the future?

The environment plays a critical role in the development of FHB and the production of DON. Humid and warm conditions during flowering favor FHB and DON production. When environmental conditions are ideal, multiple control practices are needed to control this pernicious disease.

Crop rotation will not eliminate Fusarium head blight and DON accumulation, but will help reduce the severity, even in epidemic years. Research studies in other states show that infections have been 5 to10 times higher when corn was the previous crop than when wheat was the previous crop. In 2005, a research study in Fargo showed that the field severity of FHB was 2 times higher with wheat planted into wheat stubble than when the same variety was planted the same day in an adjacent field of soybean stubble.

Variety resistance: No wheat varieties are totally resistant to Fusarium head blight, but some varieties show more tolerance to the disease and DON accumulation. Of varieties currently available, Glenn, Alsen and Freyr are among the most tolerant. For additional details go to www.cc.ndsu.nodak.edu/instruct/stack/FHB/FHB.html. Planting at least two or three tolerant wheat varieties with differing maturity dates will help minimize the risk of scab infection. In a wet year, large quantities of the fungus that causes scab are produced, subjecting virtually any wheat field to some degree of Fusarium infection. Check variety trial results from experimental plots to see which varieties perform best in the presence of the disease.

Fungicides can help reduce Fusarium head blight and DON levels by 50 percent to 70 percent in North Dakota in most years, when using the best available fungicides and appropriate application timings. Success is greatest when fungicides are applied to moderately susceptible to moderately resistant spring wheat varieties. Under severe epidemics, fungicides have not sufficiently reduced disease or DON levels to achieve a top market grade in barley or in very susceptible wheat and durum cultivars. For additional information on the use of fungicides to control FHB, go to www.ext.nodak.edu/extpubs/ageng/machine/ae1148w.htm. Seed treatments before planting may improve seed germination and seed vigor, but they will not prevent FHB infection or DON accumulation.

Tillage buries disease-carrying debris, allowing for microbial degradation of the Fusarium fungus and lowering the chance of fungal spore dispersal. Moldboard plowing is more successful at burying residue than chisel plowing. However, other factors such as soil or water erosion are important considerations for tillage practices and residue concerns may be more effectively dealt with by crop rotation.

For more information on this and other topics, see: www.ag.ndsu.edu