

Grain Storage Management

To minimize mold & mycotoxins

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Grain quality

- **Nothing can be done to improve the quality of grain in storage.**
- **The best that can be achieved is to maintain the quality that exists presently.**



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Grain quality

Molds

- Many species of fungi cause molding in grain.
- Most become associated with the grain in the field but may continue to grow and reproduce if grain is stored under the wrong conditions of moisture and temperature in the bin.



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Mycotoxins

- **Not all grain mold fungi produce mycotoxins.**
 - **Two species of *Aspergillus* produce aflatoxin.**
 - **A few species of *Fusarium* produce fumonisin, vomitoxin and zearalenone.**
 - **Ochratoxin is produced by species of two genera of fungi. *Aspergillus* and *Penicillium*. (*Aspergillus alutaceus* and *Penicillium spp.*)**



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Grain quality

Fusarium ear rot

Pink kernels or white starburst



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Grain quality

Fusarium scatter

Pink kernels or white starburst



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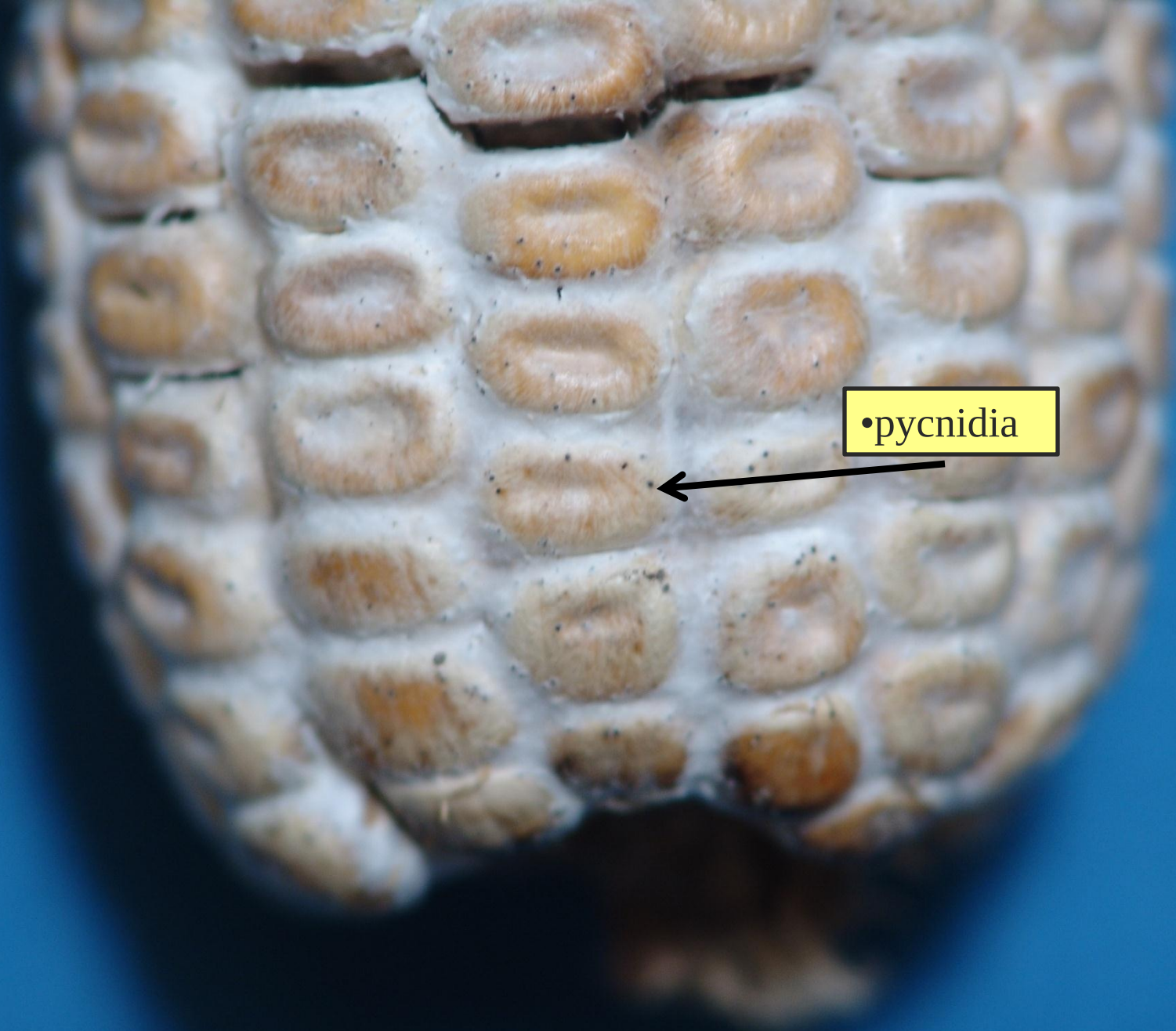
Grain quality

Diplodia ear rot



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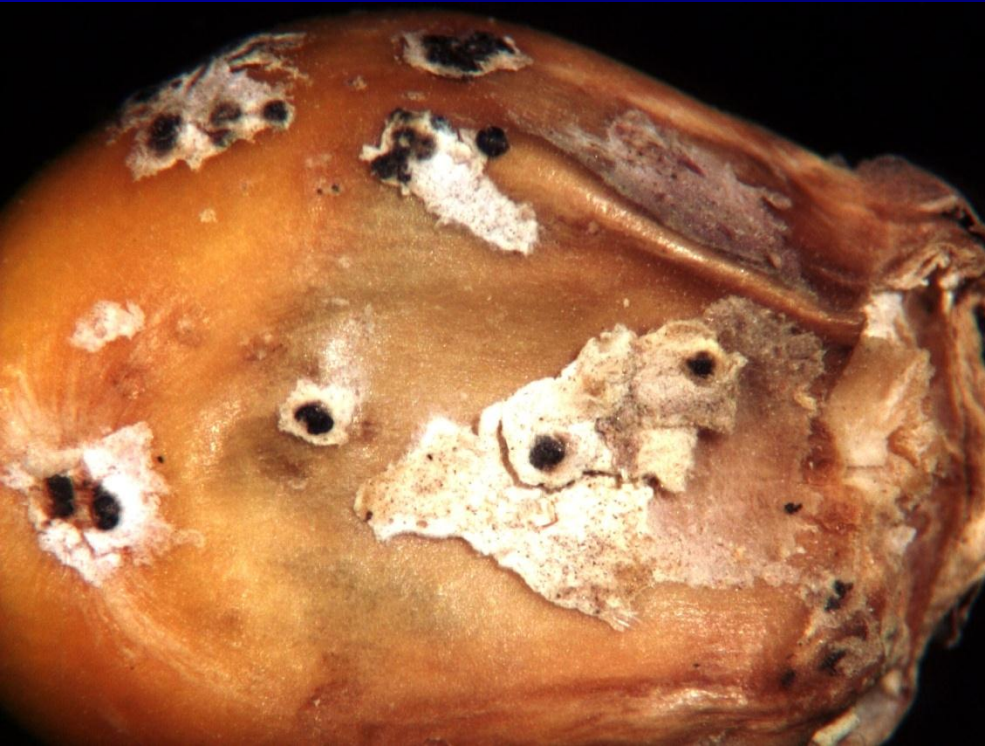
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•pycnidia

Grain quality

Diplodia ear rot



Enlargement of pycnidia



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Aspergillus ear rot (can produce aflatoxin)



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Grain quality

Aspergillus ear rot

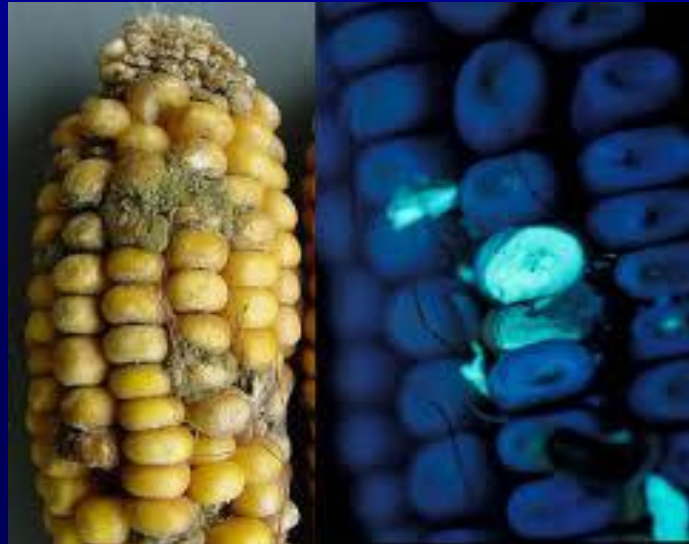
Aspergillus fungal spores are olive-green



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Aspergillus flavus under black light



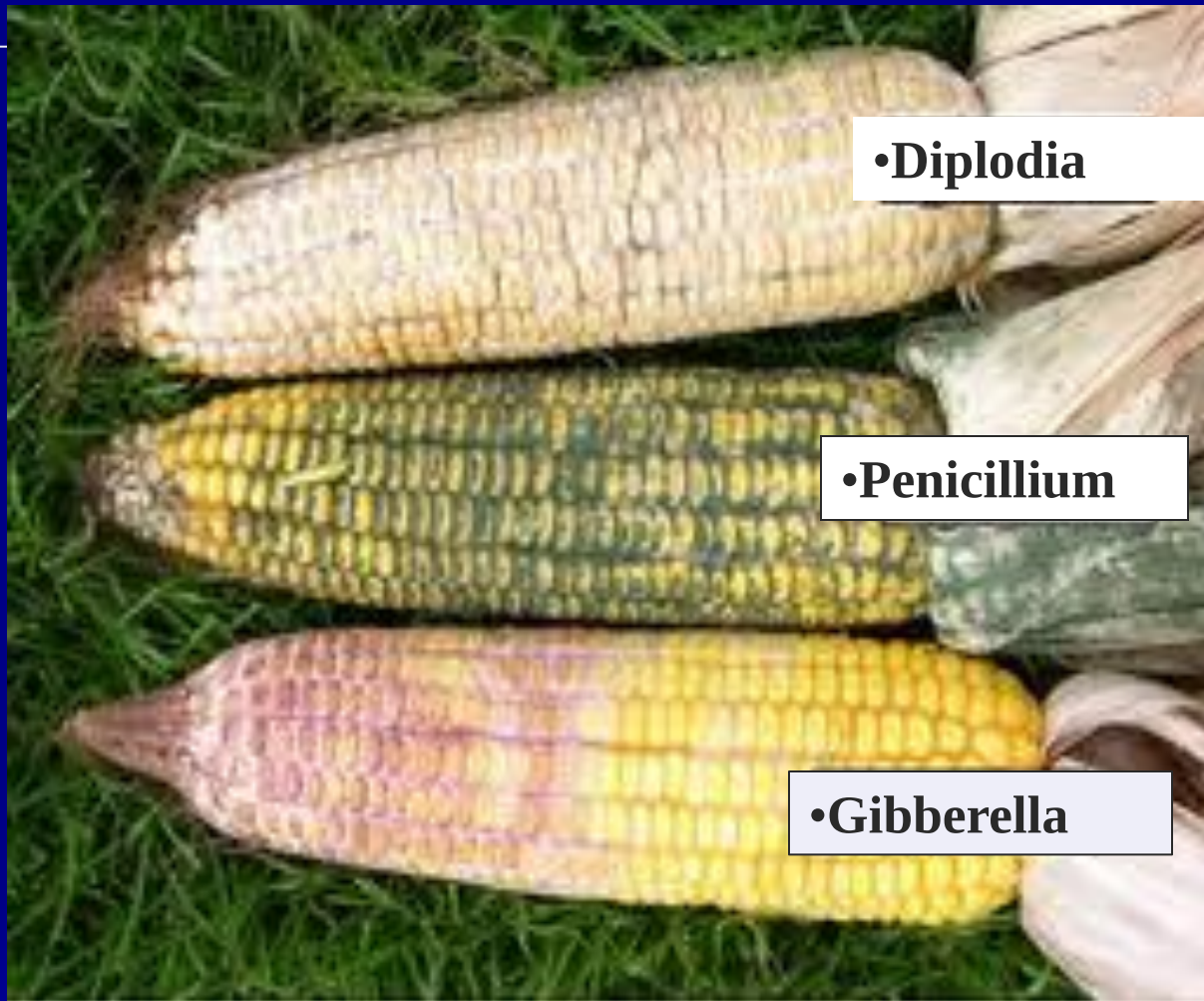
- The bright kernels are kojic acid. It fluoresces under a black (ultraviolet) light. According to Tamra Jackson-Ziems, UNL Plant Pathologist, kojic acid is not a measure of aflatoxin.
- “This test has a high rate of error and should NOT be used exclusively for making decisions about rejecting grain due to aflatoxin contamination.”



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Grain quality - Ear rots



•Diplodia

•Penicillium

•Gibberella



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FDA recommended maximum concentrations

Fumonisin

- 5 ppmHorses
- 10 ppmSwine
- 50 ppmCattle

Vomitoxin

- 1 ppm..... Human
- 5 ppmSwine
- 10 ppmCattle
- 10 ppm.....Chickens



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FDA aflatoxin action levels

- 0.5 ppb..... Milk
- 20 ppbDairy feed
- 100 ppb.....Mature breeding cattle
- 100 ppbSwine
- 100 ppb Poultry
- 200 ppb.....Finishing swine
- 300 ppb..... Finishing cattle



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Grain storage management

- Recommendation. If you suspect you might have aflatoxin in your corn, have your crop insurance company representative take samples, especially in the more stressed spots of each field to screen for the presence of aflatoxin. If found, have quantitative tests run on your samples to determine the parts per billion of aflatoxin before binning your grain!



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How to minimize growth of storage molds

- **Get corn dry ASAP.**
- **Shelf life of corn is about twice as long at 14% vs 15% when at the same temperature.**
- **When aflatoxin is detected and if the corn will be stored more than a month or two, dry down to 13%.**



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Get grain dry ASAP in 2012

If natural air drying:

Run fan continuously (rain or shine) until grain is below 17% moisture.

When below 17%, run fans even if foggy or raining to carry away heat buildup in the bin at least every 3 days until the moisture content throughout the bin is below 15%.

When grain is below 15%, may run intermittently when the equilibrium moisture content table indicates additional drying is possible. See next slide



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Equilibrium moisture

Table 6

°F	Air Relative Humidity %					
	40	50	60	70	80	90
	Moisture Content (%)					
30	12.7	13.9	15.2	16.7	18.6	21.1
40	11.9	13.1	14.5	16.0	17.9	20.5
50	11.2	12.5	13.8	15.4	17.3	20.2
60	10.6	11.9	13.3	14.8	16.8	19.7
70	10.0	11.4	12.7	14.3	16.3	19.3

* Subtract one percentage point for rewetting



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How to minimize molds in storage

- **Aerate to cool grain whenever grain temperature is 10° F higher than air temp**
- **Eventual goal: 30°F (+ or - 5 °F)**
- **Continue to maintain at 30° F (+ or - 5° F) with aeration through the winter months to halt mold growth. But existing aflatoxin remains!**



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Get grain cool ASAP

- Uniform air movement through entire grain mass is essential to avoid hot spots where molds can continue to grow (level grain, reduce or evenly distribute fines).



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Preserving grain quality

Reducing mechanical damage

- Cracked seed coats and broken kernels allow entry of fungal organisms (molds) into the kernel.
- Damage during drying
 - Avoid kernel temperatures $> 140^{\circ}\text{F}$ in high speed driers.
 - Do not over-dry
 - Avoid flash cooling
 - Don't over-use stirring systems in bin drying systems.



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How to minimize growth of storage molds – sanitation

- Clean out grain and grain dust from bins and harvest equipment when empty.
- If following moldy grain, spray disinfectant on all inside surfaces in empty bin.



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How to minimize growth of storage molds – sanitation

- An effective disinfectant mix for fungal contamination on non-porous surfaces like grain bins is 1/2 gallon of household bleach to 10 gallons of water. Wait several days and then rinse the area where the mixture was applied.
- Chlorine vapors are dangerous. Have plenty of ventilation when working in the bin and never mix bleach with ammonia or vinegar!



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Shelf life (months) for normal aerated, shelled corn

Corn Temperature °F	Corn Moisture Content					
	13%	14%	15%	16%	17%	18%
40	150	61	29	15	9.4	6.1
50	84	34	16	8.9	5.3	3.4
60	47	19	9.2	5.0	3.0	1.9
70	26	11	5.2	2.8	1.7	1.1
80	15	6	2.9	1.6	0.9	?

Based on 0.5% maximum dry matter loss –
calculated on the basis of USDA research at Iowa State University



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Storage management

- Guidelines
 - Grain should be clean
 - Screen out fines and broken kernels.
 - Depth must be uniform.
 - Surface must be level.
 - Airflow must be sufficient.
 - Heat is removed by air.
 - Moisture is removed by air.
 - Don't skimp on airflow!

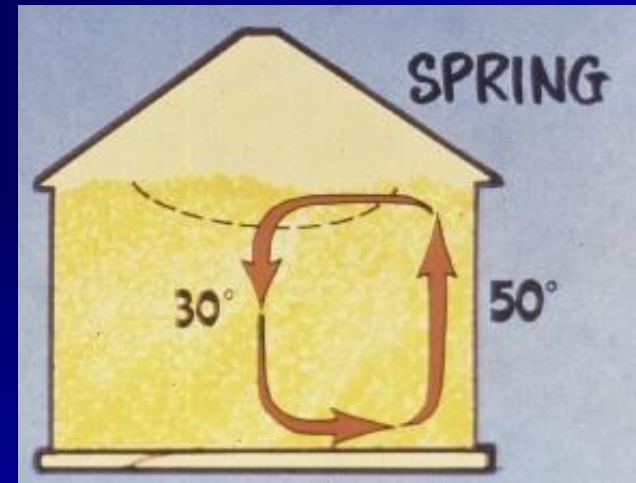


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Why Warm Grain in Spring ?

- The convection currents travel in the opposite direction in spring than they do in fall and winter. This can result in a wet spot developing in the top middle of the bin. In this case, warm air from the headspace is drawn down into the colder grain where it can go below the dew point and lose moisture into the grain, once again creating a wet spot in the top middle of the bin.

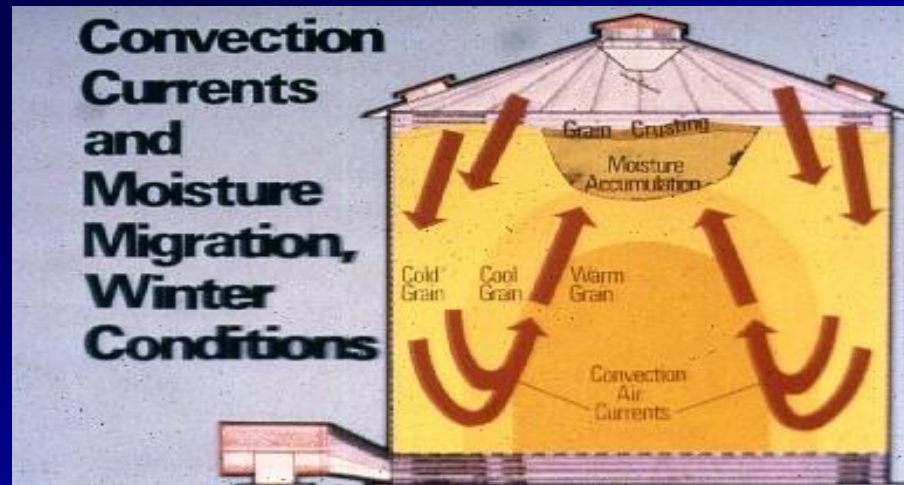


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Why Cool Grain in Fall and Winter ?

- If grain temperature is not uniform, warm convection currents rise up in the top middle of the bin. This results in condensation and a wet spot developing in the top middle of the bin. The rising air is replaced by cold air that sinks down through the grain next to the cold perimeter of the bin. This can be prevented by aerating the grain every month or so to equalize the grain temperature.



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Official FGIS grain inspection offices

http://www.gipsa.usda.gov/fgis/svc_provid/providers.html

Nebraska FGIS offices

Lincoln Grain Inspection Service

- http://www.gipsa.usda.gov/fgis/svc_provid/oa-fee-schedules/Lincoln.pdf 402-435-4386

Fremont Grain Inspection Service

- http://www.gipsa.usda.gov/fgis/svc_provid/oa-fee-schedules/Fremont.pdf 402-721-1270



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Nebraska FGIS offices, continued

Hastings Grain Inspection Service

- http://www.gipsa.usda.gov/fgis/svc_provid/oa-fee-schedules/Hastings.pdf

Omaha Grain Inspection Service

- <http://www.gipsa.usda.gov/fgis/oa-dirdp.html#om.pdf>
- 402-341-6739



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For More Information

- Lancaster County Extension Acreage Farm & Ranch Page
 - <http://lancaster.unl.edu/ag/>
- Lancaster Extension Grain Storage Page
 - <http://lancaster.unl.edu/ag/crops/storage.htm>
- UNL Drought Resources website
 - <http://droughtresources.unl.edu/>
- CropWatch
 - <http://cropwatch.unl.edu>
- University of Minnesota Post Harvest Handling of Crops
 - <http://www.bae.umn.edu/extens/postharvest/>



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For More Information

- Contact Tamra Jackson-Ziems, Ph.D.

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