



LAKEVIEW ORGANIC GRAIN
Box 361, 119 Hamilton Place
Penn Yan, NY 14527 315-531-1038
www.lakevieworganicgrain.com

GRAIN HARVEST IS COMING . . . TO A FARM NEAR YOU!

Mary-Howell R. Martens

As the barley, triticale, wheat and oats start to head out and ripen, now is time to think about harvest. At Lakeview, we contract with New York farmers to supply virtually 100% of our organic small grains, corn and soybeans. In order to provide the high consistent quality that our feed customers expect, we strongly emphasize grain quality, at harvest and in storage. We hope that all farmers supplying grain to Lakeview or to anyone else, or growing their own grains, will consider this advice carefully. All of these factors are important to those growing/handling feed-quality grains, but they are doubly important for the farmers trying to hit the exciting emerging food-quality grain market.

PREPARING FOR A SUCCESSFUL HARVEST - for you AND your buyer!

Standing out in your field, surrounded by those amber waves of grain or rustling corn stalks, it is hard to imagine that the value of that beautiful grain could be spoiled by mishandling during harvest, transport, and storage. Unfortunately, growing the crop is only half the battle. Now comes the second half of the challenge -- maintaining that fine grain quality from the point of harvest to the moment an organic animal or a discerning human eats it!

Several years ago, the plant manager of a soybean cleaning facility spoke to our group of organic farmers about soybean quality. At the front table, he brought out samples of soybeans that he had received that year, samples that he called 'the good, the bad, and the silly'. Moving down the table, he held up the jars for all to see, graphically describing how he could tell which ones were damaged by harvesting equipment, improper storage moisture, rough handling, inadequate storage conditions, and weed staining. It was indeed a rogues' gallery of avoidable mistakes. The farmers edged closer cautiously, half hoping, half dreading that Skip would name names, preparing to be proud, or embarrassed, or carefully indifferent. But the truth was, they hadn't the slightest idea which of the samples were theirs, nor which category their beans had fallen into.

At Lakeview, we buy grain from many Northeast organic farmers, since most of the grain/feed we sell is grown in New York. Over the years, we've seen some truly beautiful organic grain - heavy, bright, and clean, and many loads that were salvageable with careful drying and cleaning. Unfortunately every year, there are a few loads that are neither safe nor reasonable for us to buy and resell. Being organic MUST mean a higher level of conscientious attention to quality - this is our responsibility to our buyers, for which they pay the premium price.

In the field and in storage, our best and most effective control is to prevent problems before they begin. We organic farmers can't spray if weeds and insects get away from us in the field, and we can't use chemo-therapy to control insects, rodents or mold in storage. **Like with everything else in organics, we must rely primarily on our careful management, observation and attention to detail, rather than on purchased inputs.**

CLEAN, BRIGHT AND SHINY! - All equipment, combines, augers, trucks, wagons and bins, should be cleaned prior to harvest to remove any old grain that could be a source of mold and insects. **Cleaning out bins is not pleasant, we know!** In the intensity of harvest, it is hard to take the time to climb into the bin to shovel, sweep, vacuum, and perhaps even scrape and hose down. It is hot, uncomfortable, dull work that feels very unproductive. **But you should never put new, clean grain into a bin on top of old grain or debris.** If the old grain was infested with mold or bugs, the problem will spread upward into the new grain and extensive damage may occur before it is apparent at the surface.

Don't just dump the cleanout on the ground outside the bin - remove it from the area so insects don't just hop back into the newly filled bin. This is particularly important with summer-harvested small grains because it will be a long time before cold winter temperatures will slow down mold and insect growth. **Clean around the bins too, removing high grass, weeds, spilled grain, old machinery, scrap lumber etc.** that attracts insects, rodents, woodchucks and other undesirable wildlife. Removing external 'cover' for pests will make a huge difference.

While cleaning, check that the bins are tight with no cracks or leaks. Check sides and roof for leaks, corrosion and broken bolts, and repair and replace damaged areas, especially if they will allow moisture, insects and rodents to enter the bins. **It's a good idea to stand in your nice clean empty bin and look for any light that is leaking through holes and cracks.** Caulk and repair damaged areas. It is much easier to fix broken unloading augers, fans and aerators before the bin is full! If you are not using dedicated organic harvesting and handling equipment, your certifier will expect you to maintain a cleanout log, showing that the equipment was thoroughly cleaned and purged of conventional grain before any organic grain was introduced

HARVESTING CRITICALLY - Our inputs of seed, land, labor, equipment, fertilizer, tiling, irrigation etc, along with whatever the weather brings, results in a big mature crop (we hope!). **But, once grain reaches physiological maturity, that is as good as the grain is going to get. The longer the grain stays out in the field past physiological maturity, the greater the yield loss and decline in quality,** test weight, yield, and, for small grains, the increasing possibility of sprouting. Waiting for the crop to reach optimal storage moisture in the field before beginning to harvest can result in yield and quality loss, especially if rain or snow delay harvest. It is better to artificially dry good quality grain at the beginning of harvest than to have to dry damaged grain at the end of harvest.

Older, well-worn combines are very common on many organic farms. While older combines can do a good job, they will not perform adequately unless they are very well maintained. **There is absolutely no substitute for a well-adjusted combine in good repair,** with the knives, guards, raspbars, and concave replaced when needed, and with all parts straight and in good condition so the grain will feed in evenly, quickly and with minimal damage. Rasp bars and concaves can be worn-out long before they appear to be. Worn auger flighting reduces capacity and cuts seed coats. For some crops like barley and grass seed, fillers should be installed in the concave to do an optimal job. It is best to keep the combine running at full capacity to prevent grain from rubbing against iron. The right air speed will greatly reduce debris and unthreshed grain. Select a ground speed that will not overload combine or overrun the header's capabilities, but keeps grain moving.

Iowa State engineers found that **poorly adjusted combines can do far more damage** than generally thought. At common combine settings, an average of 30% corn kernels can be damaged. Much of this damage is not apparent in the field or in wet grain, but will lead to grain breakage during drying and can result in increased shrink, insect and mold damage during storage. Most combine operators over-thresh grain, damaging the grain and increasing the amount of fines. The percent damage rises dramatically when the threshing mechanism or cylinder are run too fast. Most operators' manuals list suggested optimal settings for each type of grain. Use these suggestions as a good starting place for making the right adjustment to maintain grain quality and machinery life.

In a perfect world, we wouldn't have to include in our contracts that "grain contaminated with metal or glass will be rejected." But then, in a perfect world, equipment wouldn't break while it is running, dropping bolts and shards of metal that inexplicably cows seem to like to eat. In a perfect world, we wouldn't need to install powerful magnets over our grain-intake augers and at numerous places throughout the mill. We've caught all sorts of your metal treasures over the years, from the usual bolts and nuts to screw drivers, bungee cords, and utility knives! Had they gone through the grinder, they would have done substantial damage to our equipment and to our customers' animals. Please keep in mind that if your combine breaks during harvest and not all the metal parts or tools are accounted for, they are likely in the grain. Ingested metal can kill a cow - it is commonly called 'hardware disease' and it's a pretty nasty way to go. Please tell your buyer if you suspect stray metal in your grain so they can run it over a magnet.

MYCOTOXIN ALERT! - Mycotoxins are toxic chemicals produced by certain types of fungi that grow on plant material, both in the field or in storage. Mycotoxins are a common problem worldwide, indeed, it is estimated that globally, over 25% of field crops are affected annually with mycotoxins. In Europe, Napoleon's defeat in Russia may not have been due as much to cold or military skill but rather to mycotoxin-contaminated grain fed to their animals which resulted in a catastrophic loss in horses. Here in the northeast, we often are not aware of serious mycotoxin problems, although a recent study from Vermont estimates that over a 10 year period, nearly all dairy farms in that state will experience mycotoxin-related issues, even though most will not connect symptoms to actual cause. The cool wet conditions and stressed crops in 2009 made it difficult for many of American farmers to not notice mycotoxins - serious animal health problems, poor quality forage and rejected grain brought the issue front-and-center for many people.

Many types of feedstuffs can develop fungal toxins, or mycotoxins, including grains, haylage, baleage, silage, dry hay, and high moisture corn. Infection is most common on plants grown under stress, especially when damaged by insects, birds, mites, hail, early frost, heat and drought stress, windstorms, and other unfavorable weather. Mycotoxins can also form or increase when grains and forages are harvested and stored at undesirably high moisture levels, when grains are put into storage dirty, if plastic ag bags get torn or damaged, or if storage facilities leak.

Experts estimate there are over 300 fungal toxins can contaminate crops, but several are distressingly common and damaging. In the Northeast, the common soil fungus, Fusarium, causes ear-rot in corn and scab or head blight in wheat, barley, oats, and rye and produces several mycotoxins, including vomitoxin (DON), fumonisin, and zearalenone. **Fusarium can also infect ensiled/bagged forage and silage.** The risk increases when corn/forage is harvested late (especially after frost), gets moldy or lodged in the field, is rained on or sours in the windrow, or is not adequately packed to exclude oxygen. Silage corn cut after a frost or late in the season is often too dry to pack well, impairing normal fermentation and allowing Fusarium, already present on the corn, to proliferate. Several species of the Aspergillus fungus produce aflatoxin, but that is more likely a problem in hotter areas than in the Northeast. Greenish-colored Penicillium is most commonly seen in silage and can produce several different toxins.

How do you know whether your grain/forage contains mycotoxins? If feed is visibly moldy, that is a pretty good clue –just as you wouldn't eat moldy food, neither should your animals. However, it usually isn't that simple. Not all molds you can see produce toxins, and not all grain/forage containing toxins looks moldy. For that reason, although we rarely see moldy grain, we do often test often for mycotoxins. There are accurate lab tests available - our state forage lab does a nice 6 mycotoxin scan for \$65, but this are expensive and slow, tests are only as accurate and representative as the sample was, and they are usually not done unless there is good reason to suspect a problem. **What makes us suspicious?** We generally test grain that is light test weight, poorly matured, off-color, musty, dusty, harvested excessively late, has many broken or damaged kernels, or just doesn't look/smell/feel right. We also randomly test other samples of each grain during the season to get a baseline and to check our assumptions. A slight pink coloration to the grain can indicate the presence of Fusarium. We usually recommend testing all on-farm feed supplies if a farmer complains of 'typical' mycotoxin symptoms in their animals. Traditionally, aflatoxins have been detected by placing grain under a 'black light', but that is not a reliable test for the Fusarium toxins.

At high levels, mycotoxins can cause liver damage, internal hemorrhaging, cancer, and reproductive failure in animals, but even a fairly low levels, they can strongly suppress an animal's immune system, resulting in other opportunistic infections, such as salmonella, clostridia, and E coli to 'break through', causing diarrhea, mastitis, and other production/health problems. Often before more dramatic symptoms are seen, feed with mycotoxins can result in reduced feed intake, impaired rumen functioning, poor vaccine take, reduced milk yield, reduced weight gain, and impaired reproductive function. The problem here, of course, is that other factors can cause similar low-grade symptoms, which is why farmers may not connect symptoms to cause. But, if you see such symptoms, mycotoxins in feed are one of the first things to address.

There are 'threshold' levels of concern for different mycotoxins depending on the animal species being fed. According to the forage lab in New York, ruminants can tolerate a total toxin level of

around 5 ppm of vomatotoxin while other experts caution not to exceed 1-2 ppm. Pigs and chickens are much more sensitive. The acceptable threshold for organic human food grains is essentially zero. Animals under stress for other reasons tolerate lower levels of mycotoxins than healthy animals.

It is important for livestock farmers to recognize that as far as the animal is concerned, ***it is the total cumulative intake level of all mycotoxin-infected feed that counts***. Even if each individual feed/forage item tests 'below threshold levels' (including baleage, silage, grain, ground feed, high moisture corn etc), if eaten together by one animal, the overall level may exceed the threshold and adverse effects will be seen. Also, frequently contaminated feed/forage contains more than one toxin, further complicating the decision of whether you have reached a level for concern.

While there are products available to 'bind' or adsorb toxins, none are 100% reliable, so it is best to avoid feeding suspect feed whenever possible. ***If you need to use a toxin binder***, try to match the correct binder to the toxin present. In the feed industry, mycotoxin binders are often termed 'flow agents' to avoid making actual efficacy claims. ***Those allowed under organic standards fall into 2 primary categories*** - the clay (or silicate)-based products (Desert Dynamite, Redmond conditioner, bentonite etc) which are most effective against aflatoxins; and the newer lower-inclusion rate oligosaccharide/beta-glucan products (Check M, Immunowall, FloMatrix, Fuse 207, Mycotex etc) which are much more effective against the Fusarium toxins. If you suspect a mycotoxin problem and can't avoid using the feed/forage, the best approach would probably be to use a 'combination' type product (i.e. FloMatrix) or use a couple of products with different efficacy (i.e. Fuse 207 + Mycotex).

Steps to minimize mycotoxin levels in grain and feed

- 1.** Always use cleaned, high quality seed that is not carrying seedborne diseases. If you plant back your own small grain seed, make sure it was not infected with scab or head blight (Fusarium) the previous year. Even if seedborne diseases that do not produce mycotoxins can weaken the plant, making it more vulnerable to mycotoxin-causing fungi. Whenever possible, use scab resistant varieties.
- 2.** Harvest at maturity , as soon as the moisture content allows minimum grain damage. This means harvesting shelled corn at 23 - 25 % moisture, ear corn at 25-30 %, small grains at 12-17%, and soybeans at 11-15%. Dry suspected grain to at least 14% moisture as rapidly as possible, at least within 24 - 48 hours after harvest. Safe, long-term storage can only be achieved at a moisture level of 13 percent or below. Cool grain after drying so hot grain doesn't absorb moisture from the air.
- 3.** Adjust the harvesting equipment for minimum grain damage and maximum cleaning. Especially where scab/head blight is evident in the field, the combine should be set for maximum cleaning, with higher blower speeds to remove the small shriveled diseased kernels
- 4.** If harvested grain contains wet weed or plant material, run it through a rotary cleaner soon after harvest so the moisture doesn't migrate into the grain. Rotary cleaning also will remove broken and diseased kernels and fines which are more vulnerable to insect and mold damage in storage, and removal of chaff and debris will reduce the possibility of dryer fires. During harvest, we routinely use the rotary cleaner between truck/wagon and grain bin to make sure that grain goes into storage as clean as possible.
- 5.** Roasting does NOT deactivate mycotoxins, but it may reduce the level by blowing off surface mold. If you roast moldy grain, make sure you run a mycotoxin test after roasting to check if the level is safely reduced.
- 6.** Thoroughly clean all bins before storage to remove dirt, dust, and old grain. Store in water-, insect-, and rodent-tight structures. Keep grain well-aerated and monitor regularly.
- 7.** For ensiled forages in bags or silos, make sure forage is tightly packed, that oxygen is excluded and the 'package' is kept sealed since mycotoxin-causing fungi require oxygen to live. Be prepared to discard forage from around torn areas of ag bags, as it are more likely to be contaminated.
- 8.** If you have reason to suspect mycotoxin problems, contact a forage testing lab and test before feeding it or representing it to a buyer as sound grain. If you must feed contaminated grain, identifying the toxins present will help you choose the most effective toxin binder.

DRYING AND STORING THE GRAIN - The moisture level of the grain going into storage is the most important key to success.

See the chart below for the maximum grain moisture needed for successful storage. Note that this percentage refers to the highest moisture in the bin, not the average moisture. As little as 0.5 percent moisture can mean the difference between safe storage and a damaging invasion by storage fungi. For lesser quality grain, such as grain produced under drought or moisture stress or with a large amount of damaged or immature kernels, the recommended maximum moisture levels should be at least 1 percent lower.

MAXIMUM GRAIN % MOISTURE FOR AERATED GRAIN STORAGE

Grain Type	<6 months	6-12 months	> 12 months
Shelled Corn	15 %	14 %	13 %
Soybeans	14 %	12 %	11 %
Wheat	14 %	13 %	12 %

For most farmers, drying the crop is the major bottleneck in the harvest process. Too often the combine must wait for the drying to catch up, and the grain dryer is the major limiting factor in harvest speed. Sometimes it is tempting to try to hurry the drying process by increasing the temperature. It is important to monitor the temperature carefully when drying with heat. Excessive heat can break down protein, oils and starches, reduce germination, and can result in cracks and damage that will increase storage insect and mold problems. With as little as five minutes exposure to high heat, it is possible to cause 100% of the soybeans to crack. Excessive heat, especially if the dryer stirring mechanism is faulty, can also cause dryer and barn fires.

In the bin, it is important that the headspace air is sufficiently ventilated. If you pack a bin to the roof, condensation on the inside of the roof where the grain touches will likely result in mold and can spread downward through the grain. Warm, moist headspace air can activate mold growth, causing grain to crust and seal over, especially when grain is peaked. Mold can spread over kernel surfaces and results in caking near the surface in about three weeks. The mold produces CO₂, water and heat, raising the humidity and causing further mold growth. Crusting and caking is not just a grain quality issue - the chunks can get stuck in augers making unloading the bin really difficult.

DON'T LEAVE IT ALONE! - Aeration in the bin is the best way to maintain a seasonally cool and uniform grain temperature. In the fall, aeration is necessary to remove dryer heat and equalize moisture levels throughout the grain. In the winter, operate the fans only when the air temperature is the same or colder than the grain. Operating fans on warm winter days can cause moisture to condense on the cold grain. If grain is stored into the following summer, run fans only at night when the temperature is fairly cool. Remember that proper aeration also requires proper ventilation so make sure there are no obstructions for air movement through the grain.

The chance of grain becoming insect-infested or moldy increases if it is left undisturbed for several months. A regular monthly inspection routine throughout the grain storage time is important, especially during the summer and early fall months when grain temperatures are right for rapid insect and mold development. **It is a good idea to routinely take a load out within a month of filling the bin to equalize moisture and break up any crusting.** During warm weather, insect infestations generally begin near the grain surface, especially directly 6 -12 inches below the grain surface, especially at the point of entry where dust, broken kernels and chaff accumulated during filling. Walk out onto the grain - your feet should sink in slightly. If the grain feels hard, this could indicate caking. Smell the grain for mold, look for insects, stick your hand, a shovel handle or a long probe thermometer down into it at least 10 inches to check for heating and caking. If you catch grain just as it is starting to "go", sometimes just removing several loads will redistribute the moisture enough to stop further deterioration.

If you store grain into the spring and summer, check more frequently as weather warms up. If grain is frozen during the winter, it may be necessary to warm the grain up evenly in the spring with aeration to prevent condensation on edges and top. Running fans continuously when thawing frozen grain will prevent

refreezing on condensed moisture and will prevent damp spots.

WHEN THE WEATHER MAKES IT DIFFICULT TO DO THINGS RIGHT

At Lakeview, handling many hundreds of tons of grain in often difficult weather has pushed our equipment, our knowledge, and our skills to new levels. Here are a few things that we have learned.

1. Equilibrium moisture -- temperature and relative humidity (RH) of the air -- plays a major role in grain storage. Stored at a given temperature and RH, grain will naturally hold certain amount of moisture. For example, at 50° F, soybeans will equilibrate to 9.5% moisture at 50% relative humidity. But, at the same temperature, soybeans will equilibrate at 13.2% moisture at 70% RH and will equilibrate at 19.4% at 90% RH. Raising the air temperature or increasing air pressure around the grain will increase the amount of moisture that the grain releases into the passing air. Charts are available that show grain equilibrium moisture for different crops, temperatures and relative humidities. These are valuable to predict whether aeration alone will be effective under given conditions. Generally air-drying a bin of almost-dry grain can work well in the fall, as long as the relative humidity is low, but trying to achieve air-drying under typical Northeast summer or moist fall conditions is likely to be much less successful.

2. When the humidity is continually a little too high to run the bin fans without raising the grain moisture, we set a **small LP gas heater or camp stove** in front of the fan to warm the air by just a few degrees. This isn't enough to warm the grain, but it does lower the humidity of the air drawn in by the fan which facilitates grain drying.

3. Using relatively hot (more than 10° over ambient temperature) air to dry stationary grain **creates a 'drying front' in the bin where a layer of wet grain forms as moisture is pushed up through the grain**. The grain below this layer is often overdried while the grain at the top of the bin doesn't lose any moisture or may even get a wetter for a while. When the front finally gets all the way to the top, the grain at the top can suddenly go from being too wet to being way too dry!

4. Wet grain that that isn't moved can develop hot spots that begin to heat and mold. Even with a perforated floor and a fan, these spots continue to heat and spoil because the forced air goes around, rather than through, the grain. **Moving such grain out of one bin and into another** breaks up hot spots and spoilage.

5. Grain stored in a **wooden bin** or touching wood will keep longer than grain stored in metal. Some farmers will even stick wooden fence posts into wet grain in the bins to keep it from spoiling – amazing, and not enough for really wet grain, but it helps!

6. What is ‘Falling Number’? The food-grade milling market has recently introduced a simple test to measure the amount of sprout damage. Enzymes formed in sprouted grain affect milling and flour quality by breaking down starch and protein. Bread made from such flour does not rise correctly. In this test, grain is weighed and ground, then mixed with water and heated. A plunger is dropped through the wheat/water paste. Sprouted grain makes a much thinner paste than unsprouted wheat. The number of seconds required for the plunger to hit bottom is the falling number. A number of 350 seconds or higher indicates a low enzyme activity and very high quality wheat. Values below 200 seconds indicate significant sprout damage. Generally a falling number of 250 or higher is required for food-grade wheat.

A FEW THINGS WE WISH MORE FARMERS WOULD THINK ABOUT!

Each season at our mill, we receive many loads of grain from different sources of widely varying quality. We dry and condition the grain, storing it often for months, and usually, through some pretty amazing alchemy, are able to turn all those different loads of grain into high quality, fairly consistent animal feed that is worth the organic premium price. Over the years, consistently there are 4 things we wish 'our' farmers would think about before harvest begins.

1. Prepare the destination of the grain before you start harvesting! If you are delivering the grain to the buyer directly out of the field, be sure you let them know when it is coming before you start harvesting and **give them an accurate, HONEST assessment of grain moisture, cleanliness, quantity and condition**. It may not seem like a big deal to tell your buyer the grain is 14%

moisture when it is really 14.9 %, or that there are 'a few weeds' in it when it is really quite dirty, or that you are contracted for 10 tons but have 20 tons on the truck, but it might make an enormous difference in labor and time demands, dryer usage, and cleaning/storage requirements once the grain is delivered and whether your buyer is ready to do what is needed when you arrive. If you find mold, insects, or other problems when you start unloading a bin, let your buyer know before delivery. Selling one quality and delivering something different is not good for anyone!

2. Get a good moisture meter and learn how to use/calibrate it accurately! It is important to read and interpret samples accurately and honestly for % moisture with appropriate temperature calibrations. **Check moisture often as you harvest.** Far too much grain goes into farm bins too wet or dirty for successful storage and then comes out in poor condition.

3. Clean dirty grain quickly! If grain is harvested above about 2% foreign matter, especially with weeds and other wet plant material, **run it through a rotary cleaner as soon as possible** to prevent the moisture from migrating into the drier grain. This cleaning will also cool the grain and give you a little more time to get it in good condition. **Please be aware how critical TIME can be after harvest, especially during the summer.** If you leave wet grain on a wagon and don't remove the wet weed debris quickly, it WILL start to heat within 12 hours and may be slimy in a few days! Being prepared in advance, with the right equipment and the right knowledge, can make all the difference.

4. Diatomaceous Earth! - organic farmers actually have available one of the better tools to control storage insects. Diatomaceous Earth, or DE, consists of microscopic fossilized sea animals that act like tiny shards of glass, slicing and killing tender insect larva. After cleaning an empty bin, close all doors, run the fan on high, and slowly empty one bag into the air intake to 'fumigate' the bin. Wear a dust mask and avoid breathing the highly irritating powder! Then, add approximately 1 pound DE per ton of grain, directly into auger with the grain as the bin fills, using a little more at the top where insect damage generally starts. Be sure to tell your buyer if you have used DE, as they may need to remove it with a cleaner before they handle, grind or sell the grain.

Many thanks to Klaas Martens, Daniel Hoover, Dan Leiterman (Crystal Creek), Pete Karnezos (The Old Mill), Jeff Mattocks (Fertrell) and many others for valuable information and insight.

