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Lisa Brown Jasa
*University of Nebraska-Lincoln*, ljasa@unlnotes.unl.edu

CROP WATCH
University of Nebraska Cooperative Extension
Institute of Agriculture and Natural Resources
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No. 2005-21, September 16, 2005

# Tips for reducing energy costs for grain drying

With prices for most energy sources up dramatically in the past two years, grain producers are asking how to reduce the cost of drying grain on the farm. Like most management decisions, the grain drying method chosen usually is a trade-off between time and money. The least cost, but slowest, drying method is natural (unheated) air in-bin drying. Next lowest in cost will be heated air in-bin drying. High temperature, high capacity column or continuous flow dryers will dry grain the quickest but have the highest energy costs. This article will discuss these drying systems and describe some management techniques that can reduce costs and result in higher grain quality.

All mechanical grain drying systems use a fan to push air through the grain mass to remove moisture. In deep bed, in-bin drying systems, a drying zone is established and moves through the grain in the direction of airflow. One can monitor the movement of the drying zone through the bin by sampling with a grain probe. Grain above the drying zone remains unchanged or may be slightly wetted by the saturated air that has passed through the drying zone. Grain below the drying zone will eventually come into a state of equilibrium with the incoming air.

### In-bin drying

**Natural air drying.** As stated, natural air drying uses unheated air to dry grain. The time required to push a drying zone through a bin of grain with natural air can be several days to several weeks, depending on the initial and final moisture content of the grain, airflow (cubic feet per minute per bushel, cfm/bu) and air properties (temperature and relative humidity).

Research has found stirring grain being dried with natural air actually prolongs the time required to dry grain because it disrupts the drying zone, resulting in exhaust air leaving the grain mass less saturated.

If a stirring device is installed in a bin being dried by natural (unheated) air, the stirring device should be run during the filling period to reduce the pack factor from the filling operation, redistribute fines and level the grain. Stirring

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## Inside



# *USDA funds grants for innovative ag*

Farmers and ranchers are born innovators. Most have a wealth of ideas for improving their profits and the health of their farms, ranches, and communities, but turning those ideas into reality requires access to information and finances. Both resources are available through the North Central Region (NCR) Sustainable Agriculture Research and Education (SARE) Program.

NCR-SARE awards competitive grants to farmers and ranchers for on-farm research, demonstrations, and education projects. Individuals can apply for grants of up to $6,000, and groups of three or more can apply for grants of up to $18,000. Grant recipients have up to 21 months to complete their projects, and must share their findings with others through reports and outreach activities such as field days and presentations.

Grant recipient, Grant Gillard of Jackson, Missouri says, "Every innovation or dream involves risk. The SARE program gave us boldness because we had the financial support to take the risks in moving to sustainable practices." With his grant, Gillard explored how to locate and raise bees that are resistant to insects and diseases.

In 2004, NCR-SARE received 171 proposals and funded 51 grants totaling $391,678. Roughly $400,000 will be available in 2005 for farmers and ranchers who live in the 12 states of the North Central Region – Illinois, Indiana, Iowa,

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# Ag briefs

**Doug Anderson, Extension Educator in Nuckolls and Thayer counties:** Very few dryland corn fields will be harvested for grain. Silage cutting is the main field activity. Soybean yields will be okay -- nothing great but probably profitable. Sorghum is looking good and expected to have average yields. The irrigation season has eneded.

**USDA's National Agricultural Statistics Service, Nebraska Field Office**: Warmer than normal temperatures and high winds last week reduced soil moisture levels and pushed crop maturity. Temperatures averaged almost 10 degrees above normal with highs reaching the low-to-mid nineties. Accelerated crop maturity led producers across much of the state to stop irrigating. Scattered rainfall totals of 1 inch or more were recorded across portions of southern Nebraska, while much of the northern half received little or no moisture.

**Crop condition**

**Corn** conditions rated 5% very poor, 10% poor, 22% fair, 43% good, and 20% excellent. Irrigated fields rated 83% good or excellent while dryland fields rated 33%. Ninety-four percent of the crop had dented, ahead of 76% last year and 88% for the average. Twenty-four percent of the crop had reached maturity, ahead of 10% last year but behind 31% for the average. Corn harvest, at 2%, had begun in parts of the state, ahead of 1% last year but behind the average at 4%.

**Soybean** coloring had progressed to 79%, ahead of 60% last year and 66% for the average. Twenty-five percent of the crop had begun dropping leaves, ahead of 19% last year and almost 26% for the average. Conditions rated 5% very poor, 12% poor, 30% fair, 40% good, and 13% excellent.

**Sorghum** conditions rated 4% very poor, 11% poor, 28% fair, 47% good, and 10% excellent, better than last year and average. Sorghum coloring was at 90%, well ahead of last year at 63% and average at 74%. Six percent of the crop had reached maturity, just ahead of 5% last year but behind 20% for the average.

**Wheat** seeded was at 21%, behind 25% last year but ahead of average at 20%. Four percent of the crop had emerged, in line with last year and the average.

**Dry bean** conditions rated 2% very poor, 8% poor, 23% fair, 54% good, and 13% excellent. Eighty-three percent had turned color, ahead of last year at 51% and the average at 73%. Thirty-nine percent of the dry bean crop had begun dropping leaves, ahead of 15% last year but behind 46% for the average. Thirteen percent had been harvested, ahead of 6% last year, but behind the average at 21%.

**Proso millet** harvest continued at 33%, ahead of last year at 15% and the average at 30%.

## Farmer rancher grants

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Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

The Call for Grant Proposals is available by contacting NCR-SARE at 1-800-529-1342 or *ncrsare@unl.edu*. Proposals are due in the NCR-SARE office by December 1, 2005.

Nebraskans seeking help writing grants or exploring grant ideas for this program that are ecologically sound, profitable and socially responsible, contact:

**Jim Peterson**
UNL Extension Educator
1718 Washington St
PO Box 325
Blair, NE 68008
Phone: 402.426.9455
Email: *jpeterson2@unl.edu*

Farmer Rancher grants have funded a variety of research topics, including pest and disease management, crop production, education/outreach, networking, quality of life issues, livestock production, marketing, soil quality, waste management, water quality, and more. To view reports from previous projects, go to: www.sare.org

**Joan Benjamin, Farmer Rancher Grant Program Coordinator NCR-SARE**

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Lisa Jasa, Editor; Email: ljasa1@unl.edu

## Grain drying *(Continued from page 191)*

should then be discontinued to allow a drying zone to develop in the grain. Since the bottom of the bin will be somewhat over-dried, a final stirring just before the drying zone is pushed completely through the bin will help equalize the moisture content of the grain.

**Heated air drying**

Drying time can be significantly reduced by adding heat to the process. Heating air does not reduce the quantity of water vapor in the air but it does increase the amount of water vapor the air can hold by lowering the relative humidity. Therefore heated air has the potential to pick up more moisture per unit volume passing through the grain than unheated (natural) air.

When adding supplemental heat, the relationship between temperature rise and relative humidity is not linear (*Table 1*).

Table 1. Effect on relative humidity of raising air temperature.

| Air Temperature | Relative Humidity |
|---|---|
| 50 | 72 |
| 60 | 50 |
| 70 | 35 |
| 80 | 25 |
| 90 | 18 |
| 100 | 13.5 |
| 110 | 10 |
| 120 | 7.6 |
| 130 | 6 |
| 140 | 4 |

**Assumptions:** Elevation 1,000 feet. Dew point 41.4°F.

A rough rule of thumb is the relative humidity drops by one-half for each 20 °F rise in temperature. For example, natural air at 60°F and 50% relative humidity will have a relative humidity of 25% if heated to 80°F. Adding another 20°F to raise the temperature from 80°F to 100°F cuts the relative humidity by about half again and results in a drop to 13.5%. The third 20°F rise to120°F lowers the relative humidity by about half again to 7.6%. The notable point is the second 20°F increment of added heat results in half as much reduction in relative humidity (half of half) and the third increment results in only one-eighth as much reduction (half of half of half). To minimize energy cost for drying grain, keep the temperature rise to a moderate level. The biggest savings in drying time versus energy input for in-bin drying systems is achieved with the first 20°F to 40°F increase in air temperature.

*Table 2* presents the results of a computer simulation comparing the electrical and propane energy costs for batch-in bin drying with natural air at 60°F and 50% relative humidity compared to heating the air to 80°F or 95°F. Note the drying time versus total energy cost comparison in the last column. Boosting initial air temperature by 20°F to 80°F resulted in a drying time only 42% as long as natural air with an energy cost penalty of 39%. Boosting initial air temperature by 35°F to 95°F resulted in a drying time only 31% as long as natural air drying but with an energy cost penalty of 74%.

Management of stirring devices is different for heated air drying than natural air drying, especially for high temperature drying (over 40°F temperature rise). The relative humidity of the incoming air is so low with heated air drying, the grain on the bottom of the bin is over-dried by several percentage points by the time the drying front is pushed through the full depth of the grain. Stirring devices, if installed, should be run continuously with high-temperature heated drying systems to help equalize the moisture content of the grain mass and avoid over-drying at the bottom of the bin.

**In-bin layer drying**

If a producer has several bins equipped with drying fans and is able to switch over from filling one bin to another in a reasonably short time, filling and drying several bins in layers could reduce drying time and energy consumption by 20-35% as compared to completely filling each bin in turn before beginning to fill the others.

Aeration fans operate on a static pressure (measured in inches of water) versus air output (cfm) curve. Static pressure increases with greater depths of grain in the bin and with higher airflow (cfm) per bushel. The higher the static pressure the fan must overcome, the fewer cfm the fan can push through the grain.

Since drying time is a function of the airflow per bushel (cfm/bu), both factors work in our favor when drying in layers as opposed to starting with a full bin - whether using natural or heated air for in-bin drying.

For example, consider the advantages of filling and drying a bin in four layers as opposed to the usual practice of filling the entire bin from the start. The first layer will have far greater total airflow moving through only one-forth as many bushels. This cuts the drying time substantially. The reduced drying time advantage continues as the second and third layers are added, with diminishing effect as the grain depth increases. Layer drying results in much shorter total drying time for the bin of grain and therefore a big reduction in energy consumption. For more information, see September 17, 2004 *Crop Watch* article, Layer grain placement to speed up drying, available at *cropwatch.unl.edu/archives/2004/crop04-21.htm#layers*

Stirring devices should not be used in layer drying systems until the final layer of grain is added. Long distances to the grain mass

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## Grain drying *(Continued from page 193)*

and unsupported shafts can cause unpredictable behavior that could damage the stirring device or the bin sidewalls. As the final layer is being added, consider blending the wet and dry grain with the stirring device then use unheated air to help the migration of moisture from the moist kernels to those that are likely over-dry due to the heated air drying.

**High speed - high capacity dryers**

High speed batch or continuous flow dryers have the highest bushel capacity per hour of any of the systems mentioned in this article. Temperature, grain bed depth and airflow rates are vastly different in high speed, high-capacity dryers compared to deep-bed, in-bin drying systems. Air temperatures of 120°F to 140°F are typical in high capacity dryers. Column widths of grain being dried are measured in inches (10 to 20 inches) in batch or continuous flow dryers as opposed to feet (4 to 20 feet) for in-bin drying systems. Airflow rates of 50 to 100 cfm/bu are common in high speed dryers as opposed to 1.25 to 2.5 cfm/bu for deep bed in-bin systems.

There are two limiting factors that affect the efficiency of high capacity systems. The first limiting factor is the rate moisture can migrate from the interior of the kernels to the surface where it can evaporate into the air stream. The second factor is the short contact time the air stream has with the grain. High volumes of very hot and dry air moving through shallow beds of grain result in the air leaving the grain mass much less saturated compared to deep-bed, in-bin drying systems. This is reflected in higher energy cost per point of moisture removed per bushel as compared to in-bin systems. Some high capacity dryers recover some energy by channeling the air used to cool the grain back into the drying chamber air stream or by re-circulating a high percentage of the previously heated air back through the grain mass.

High air temperatures and uneven moisture content within the kernel result in a much higher incidence of stress cracks in the kernels. Stress cracks created in the dryer result in a much higher percentage of broken kernels upon subsequent grain handling as compared to in-bin drying.

A variation using high capacity dryers is known as dryeration. Dryeration is the name given to a system where hot grain is removed from the dryer a point or two above desired storage moisture then transferred to a bin where it is allowed to temper for four to six hours before starting the fan for final drying and cooling. The final one or two points of moisture are easily removed in the process of cooling the grain because the moisture deep inside the kernels has had time to redistribute during the tempering period. This method of grain drying increases the capacity of the dryer and results in higher quality grain with fewer stress cracks than drying followed by rapid cooling.

Another intermediate system using both the high temperature dryer and in-bin aeration is called combination drying. With combination drying, you "take the edge off" high moisture corn by drying to 20-22 percent with the high temp-high speed dryer and then move the grain hot to a bin where the aeration fan can push at least two cfm/bu of unheated air through the grain mass to complete the process. This cuts the reliance on heat and decreases the load on the high temp dryer even more than dryeration. It also cuts the energy cost if the heating fuel is the higher cost energy source.

As stated in the lead paragraph, the grain drying method chosen often is a trade-off between time and money. The bottleneck for many farming operations at harvest is time. However, when energy costs are escalating at the current rate, perhaps it is time to consider spending some time to save energy cost.

**Tom Dorn, Extension Educator**
**William P. Campbell**
**Agriculture Systems Specialist**

Table 2. Comparison of total energy consumption and cost vs drying time for three drying scenarios.

| Initial and final air temperature | kWh - cost $ (for aeration fan ) | Gal. LPG - $LPG | Drying time (hr) | Total cost of energy | % Time - % cost (vs. natural air drying) |
|---|---|---|---|---|---|
| Natural air 60°F and 50% RH | 3,073 - $246 | 0 - $0.00 | 94.6 | $246 | 100% - 100% |
| Heated to 80°F | 1,279 - $102 | 191.2 - $239 | 39.4 | $341 | 42% - 139% |
| Heated to 95°F | 952 - $76 | 280.4 - $351 | 29.3 | $427 | 31% - 174% |

Assumptions: Fan = 25hp centrifugal. Grain = Corn, Initial = 20.5% - Final = 15.5% moisture. Bin diameter = 30 feet, Grain depth = 8 feet, Bushels per batch = 4500 bushels. Electrical: 32.5 kWh per hour for fan operation at $0.08/kWh = $2.60 per hour. Propane: $1.25 /gallon, 90,000 BTU per gallon.

# UNL engineer offers fuel-saving tips for harvest

As fuel prices keep rising, a University of Nebraska-Lincoln engineer said energy conserving tips can keep combines running smoothly and minimize grain drying this harvest season.

Paul Jasa, UNL Extension engineer, recommends not getting overeager to harvest early.

"Grain that is harvested too early will be too wet and too much money will be spent on drying it in the bin," he said. "Let grain dry as much as possible in the field naturally."

However, this means producers will have to pay extra attention to the weather this fall so crops aren't damaged by strong winds or become wetter from rain or an early snow. To make drying in storage bins more efficient, producers can make sure their combines are set properly to clean the grain or use a grain cleaner. This will minimize foreign materials that wind up in the grain bin. Residue and trash in the grain bin restrict airflow and make drying more difficult.

Depending on the crops and rotation, producers also may want to consider not harvesting all of the corn before switching to soybeans, which would allow corn to continue drying and give grain driers a chance to catch up.

Farmers also should scrutinize grain hauling costs this season.

"Make sure you have marketing and storage plans to minimize hauling costs," he said. "Some farmers look at the current grain price, and if they can get a nickel more at another elevator further away they may haul it there. This year, they'll need to make sure it's worth it to make up for higher fuel prices. If it costs 10 cents more to haul it, they would actually be losing a nickel."

While it's probably too late for this year, producers should consider securing diesel, propane and natural gas prices in the future.

Another money saver is skipping fall tillage. As the combine is going through the field harvesting the crop, make sure it is properly processing and spreading residue for next year. This eliminates the need to go through the field to shred stalks.

"It's best to skip fall tillage all together to conserve soil moisture, residue and energy," Jasa said.

Jasa also recommended:

**Do routine maintenance on the combine.** Make sure the engine is in top shape, filters are clean and everything is properly lubricated.

**Avoid rounded edges on augers and conveyers.** Replace rounded and worn edges to maintain proper flow of materials.

**Be sure chains and paddles are in good shape** so the combine handles grain properly and money is not wasted on grain and residue slipping through the combine.

**Don't set the thresher more aggressively than necessary to remove grain.** An aggressive thresher breaks kernels and uses extra energy.

As crops dry throughout the harvest season, adjust the thresher because grain becomes easier to thresh the drier it gets.

**Read the owner's manual** when making adjustments.

**Make sure all other pieces of equipment, such as grain carts, wagons and augers, are in good shape.**

**Don't get fatigued.** A sleepy machinery operator will miss adjustments they should be making.

**Sandi Alswager Karstens**
**IANR News Service**

# Farm Beginning class offers opportunities

Farm Beginning™ is coming to Nebraska to help meet the challenge of rural repopulation. Started in the mid-1990s in southeast Minnesota by the Land Stewardship Project, Farm Beginnings™ is a training course that provides an opportunity for people to learn firsthand about low-cost, sustainable farming methods.

Scheduled to begin in November 2005 in Syracuse, the program hopes to mimic the eight-year Minnesota track record of over 220 graduates, 60% of whom are now engaged in farming, said Jim Peterson, Extension Educator.

The program consists of three components: classes, tours, and a mentoring program. Nine classroom sessions will be held approximately two weeks apart, beginning on the first Saturday of November. In the summer of 2006, a mentoring program will fit participants with farmers engaged in the enterprise of interest to the participant. In addition, there will be several tours of alternative farm enterprises.

"This is an important program for Nebraska," said Paul Rohrbaugh, Executive Director of the Nebraska Sustainable Agriculture Society. "A strong commitment to Farm Beginning™ has been the bedrock provided by the members of the steering committee, made up of representatives of UNL Extension, the Nebraska Department of Agriculture, the Center for Rural Affairs, the Nebraska Sustainable Agriculture Society, and the Land Stewardship Project."

"The Farm Beginning™ Program provides beginners with the 'How to' for a successful career in agriculture while the existing programs provide the tools for reaching that goal. Farm Beginning™ is the missing link that brings together state, federal and private farming startup programs" said Martin Kleinschmit, Center for Rural Affairs Sustainable Agriculture Specialist.

"This program fits the needs of rural and urban folks," Peterson said.

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Benefits are long-term and extend beyond nutrient value

# *An often overlooked nutrient resource: manure*

The predicted increase in nitrogen costs for the next cropping season reinforces the need to carefully assess plant nitrogen needs and the value of manure as a nutrient resource. In areas where livestock manure is readily available, this resource can be a very viable means of meeting your crop's nutrient needs. A story in the Sept. 2 *CropWatch* addressed how to test corn stalks for nitrogen this fall to provide feedback for your fertility program. This week's issue addresses manure application to field crops.

*Manure offers many benefits beyond adding nutrients. It improves soil structure, increases the water infiltration rate, and reduces water and soil loss in runoff events.*

As fertilizer costs increase, the potential profitability of manure use increases. Manure is an excellent source of nutrients. While nitrogen may be of primary interest to many producers, manure is also a valuable phosphorus resource for fields testing low or very low in this nutrient. One manure application can supply enough phosphorus to meet plant needs for two to five years. When manure is applied to meet the nitrogen needs of a corn or milo crop, the amount of other nutrients applied (P, K, S, Zn, etc.) typically matches that removed by several years of crops.

Some types of manure have a liming effect – applying one ton of a typical feedlot manure is like applying 60 lb of ag lime. This can be a significant benefit as soil pH in many fields is approaching or already at levels where a yield response to lime application can be expected.

Manure application amends many soils to improve soil structure, increase the water infiltration rate, and reduce water and soil loss in runoff events. In a study at the UNL Agricultural Research and Demonstration Center near Mead fields where manure had been applied had less than half the runoff and erosion of field where manure had been applied. This effect was found during the years of manure application and afterward – persisting for at least four years after the last application. Irrigators often observe improved water infiltration during sprinkler irrigation and a reduced irrigation requirement following manure application.

On many soils, crop yield increases with manure application as compared to only fertilizer use. A survey of many on-farm trials showed an average yield increase of about 7 bu/ac for corn and 2 bu/ac for soybean in the year of application, with some yield increase expected the following years. Yields are increased much more on some fields than on others. The yield increase may be due to improved nutrient supply, reduced soil acidity, and improved soil structure and water availability.

Two tools are available for calculating the dollar value of manure applied to a field:

- Calculating the value of manure for crop production (G03-1519) and
- The Nebraska Manure Value Calculator (an Excel spreadsheet).

Both are available online at cnmp.unl.edu. These calculators consider the nutrient content of the manure as well as expected nutrient needs for a crop in a particular field, the value of expected yield increases, as well as the costs of manure use. These tools help the producer determine a dollar value for manure from a particular source and applied to a particular field.

**Charles Wortmann, Extension Nutrient Management Specialist**

## Learn more about the value and use of manure

UNL Cooperative Extension, with the Nebraska Corn Board and the Nebraska Environmental Trust, is offering training to crop producers related to manure use. Four events were held this summer in Pender, Adams, Phillips and Scottsbluff. These events provided an opportunity to learn how:

1. to determine the value of manure for specific fields;
2. to calculate manure N availability;
3. about recent research results on fertilizer use; and,
4. from other crop producers of the benefits and difficulties to using manure.

If you are interested in helping organize such as event in your area, please contact Charles Wortmann, Extension Nutrient Management Specialist, (402) 472-2909, *cwortmann2@unl.edu*

*Adjust for next year*

# Examine ears now for clues to earlier stresses

Since corn is near or at physiological maturity, it is a good time to evaluate ear fill since yield reductions will only occur if lodging develops.

Inevitably, some yield factors are beyond your control. Investigating your crop now, however, can alert you to stresses that you may be able to reduce or eliminate next year.

Final yields can be somewhat deceiving if this is the only variable you use to evaluate the crop's performance. For example, two fields may produce 100 bu/ac, which is less than you would like. Upon investigation you may discover that one field had yields reduced due to severe rootworm clipping while the other field was limited by a nitrogen deficiency. The ears from these two fields would have different fill characteristics and without looking at them now, you may incorrectly assume the fields were stressed similarly, based on the yield data.

Note that in the figure below ears 1-4 lack ear-tip fill, while with ears 5-6, the ear is filled to the tip. The tips are not filled due to two possible causes: a pollination problem occurred or photosynthate (nutrient) availability for the developing kernels was limited. Silks attached to basal kernels typically emerge first while tip silks emerge last. Since silks emerge at different times this creates the possibility for variability in the fill pattern based on environmental conditions. If pollen shed occurred before all of the tip silks had emerged, the ovules would not have been pollinated. It is also possible that the silks did receive pollen and were fertilized, but the new developing kernels had to be aborted. Kernels are aborted during R2 and R3. Depending on the stress level experienced by the plant it will continue to abort tip kernels until it can support the remaining kernels with adequate photosynthates.

When an ear is completely filled, such as with ears 5 and 6, it shows that the plant was fully able to support all kernels throughout the grain filling process. Although this seems good, it is very likely that nutrients and water were leftover and unused during grain fill. If ears are filled out to the very edge, you should consider increasing your plant population next year so that supply is slightly less than demand.

In ears 1 and 5 we see sporadic areas with smaller than average kernels. If stresses occur for long

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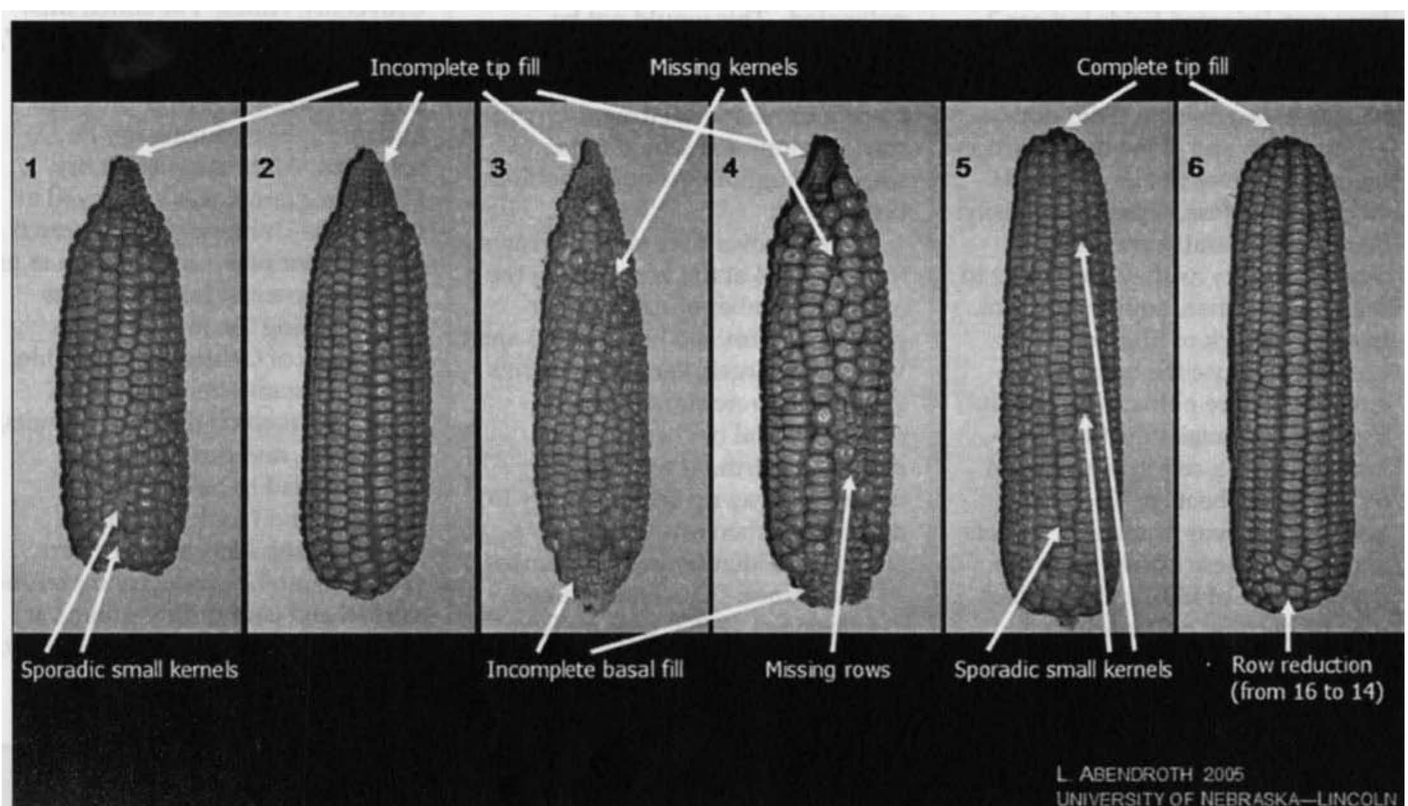

## Farm Beginnings

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"Approximately 20% of Farm Beginnings™ graduates have moved from urban to rural areas to pursue their farming dream."

If you are interested in learning more about Farm Beginnings™, contact Paul Rohrbaugh, Executive Director for the Nebraska Sustainable Agriculture Society, at *nesusag@alltel.net* or 402-869-2396; Jim Peterson, (*jpeteson2@unl.edu*) at 402-426-9455; or Martin Kleinschmit, Center for Rural Affairs, *martink@cfra.org* at 402-254-6893; or go to *www.landstewardshipproject.org/programs_farmbeginnings.html.*

## Corn clues

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periods of time and are general in nature, we see the tip of the ear not developed, as mentioned earlier. However, if stresses are short term and severe, a sporadic loss in kernels may occur anywhere on the ear. Compare ears 1 and 2; both are from non-irrigated fields but ear 2 has greater consistency in seed size and fill than ear 1. Ear 1 must have had stress(es) that ear 2 did not.

In ears 3 and 4, the basal portion on each ear does not have kernels. Abortion of these kernels is unlikely because the basal kernels always receive priority as they are closest to the photosynthate supplying plant. Instead the lack of fill here is possibly because the basal silks emerged before pollen shed began. If pollen was available, the silks may have been selectively clipped by rootworm beetles. These ears also exhibit areas of missing kernels and rows. These barren areas are due to a lack of fertilization, which may be because pollen shed occurred before all of the silks had emerged. Pollen shed is accelerated by drought. Silks may have also become desiccated due to severe water stress and were no longer able to receive pollen.

The lack of fill in the middle of ear 4 sometimes occurs when that part of the ear is facing downward (on the bottom side of the ear). It is possible that the silks attached to these kernels were covered up by other silks and simply did not get pollinated. This would not be expected though to occur frequently throughout a field. Also in ear 4, there is some overall irregularity in row development which is due to stress throughout the entire pollination period.

Ear 6 shows a reduction of rows from 16 to 14 at the very base of the ear. The number of rows, or ear girth, is determined between V8 and V12 and is largely set by the plant's genetics. Severe stresses, such as environmental or chemical, can reduce ear girth. If rows are reduced partway up on the ear, try to determine when this would have occurred to identify possible causes.

Reference: "Corn growth and development. What goes on from planting to harvest?" R. Nielsen. 1997. *www.agry.purdue.edu/ext/pubs/AGRY-97-07_v1-1.pdf*

**Lori Abendroth, Research and Extension Associate, Agronomy**

# Wegulo joins plant pathology team

We would like to introduce a new member of the UNL Extension Plant Pathology team: Dr. Stephen Wegulo. Dr. Wegulo is based on UNL's East Campus in Lincoln and has an appointment that is 75% extension and 25% research. His work will cover diseases of small grains, forages, and ornamental plants. Prior to coming to UNL he was an extension specialist at the University of California, Riverside, for three years and covered diseases of ornamental plants. He shared the following about his education and experience:

**Stephen Wegulo**
**Extension Plant Pathologist**

I grew up in Kenya and after high school attended Kenya Science Teachers College in Nairobi where I obtained a degree in Science Education in 1985. I taught math and biology in high school for three years before coming to Davidson College, North Carolina, to study biology. I graduated in 1991 with a B.S. in Biology and returned to Kenya where I taught math in high school.

In 1992 I returned to the United States to begin my graduate studies in plant pathology at Iowa State University, Ames. I obtained M.S. and Ph.D. degrees in 1994 and 1997, respectively. I conducted research on corn during my M.S. program and on soybean during my Ph.D. program. After completing my Ph.D. program, I was employed at Iowa State University as a research associate for one year and then as an assistant scientist for three years before joining the faculty at the University of California, Riverside. As an assistant scientist at Iowa State, I worked on diseases of fruits, vegetables, and turfgrass.

I am glad to be back in the Midwest and I look forward to working with Nebraska growers, crop consultants, industry representatives, and commodity groups as well as extension educators, faculty, staff, and students at UNL.

**cropwatch.unl.edu**

*Downy brome, jointed goatgrass, and feral rye*

# Controlling winter annual grass weeds in winter wheat

Downy brome, jointed goatgrass, and feral rye were prevalent in winter wheat fields this past spring and growers are concerned that they could be a problem again this year. These winter annual grass weeds are very competitive with winter wheat because they compete with the crop throughout the growing season. Additionally, jointed goatgrass and feral rye may cause dockage and/or foreign material discounts when contaminated grain is delivered to the elevator. In order to minimize losses, growers must control these weeds in a timely manner.

Only in the last few years has it been possible to selectively control winter annual grass weeds in winter wheat. Control of these weeds is best when herbicides are applied in the fall, shortly after emergence, when the plants are growing rapidly but before they become well tillered. Winter wheat fields that look like a lawn probably have winter annual grassy weeds filling in between the rows of wheat.

**Downy Brome**

Maverick®, Olympus™, and Olympus™ Flex herbicides provide selective control of downy brome and other *Bromus* species in winter wheat. Maverick and Olympus provide similar control of downy brome when applied in the fall. Downy brome control with these products applied in the fall has ranged from about 70% to 95% in University of Nebraska trials. Spring applications have been less consistent and have ranged from 35% to 85% control. Plant growth rate and stage of development at the time of application, and weather conditions following application, influence the level of control.

Olympus is priced slightly lower than Maverick, with 0.9 oz/ac of Olympus costing about $9.90/ac and 0.67 oz/ac of Maverick costing about $10.70/ac. Olympus Flex, applied in the fall, has provided slightly better control (5-15% better) of downy brome than Maverick or Olympus, but 3 to 3.5 oz/ac will cost $12-$14/ac. When applied in the spring, Olympus Flex does not appear to provide better control than Olympus or Maverick.

All three products have significant soil residual concerns that restrict crop rotation options. Olympus Flex has a little less soil residual than Olympus, which allows a few rotational crops to be planted a little sooner than with Olympus, but the differences are small and may be of little practical significance in Nebraska.

**Clearfield Wheat**

Growers who seeded a Clearfield wheat variety can use Beyond™ herbicide to selectively control downy brome, jointed goatgrass, and feral rye. Of these three weeds, feral rye control has proven to be the most difficult and least consistent. The best control of feral rye has been achieved by applying 5 oz/ac of Beyond in the early fall before rye plants have formed a tiller. At this rate the cost is about $22.65/ac. It is recommended that UAN and surfactant be added to the spray mixture for improved control. In University of Nebraska trials, fall control of feral rye with Beyond has ranged from 70% to 90%. Some growers have reported poor control while others have been very happy with the level of control. Control of feral rye with spring applications of Beyond have been very inconsistent and are not advised in most situations.

Unlike feral rye, the control of jointed goatgrass with Beyond has been very good and consistent. Fall and spring applications of Beyond at 4 oz/ac generally have achieved 85-100% control. Four oz of Beyond will cost about $18.10. Surfactant and UAN should be added to the spray mixture. Herbicide resistance is a concern with jointed goatgrass, so growers should be careful not to overuse this technology or it may soon lose its usefulness. We recommend growers not use Beyond herbicide more than once every three years.

Although downy brome control with Beyond is usually good, downy brome can be controlled more economically with the previously discussed herbicides.

If winter annual grass weeds are a regular problem in fields, change the crop rotation. Including a spring-seeded crop such as corn, sorghum, oat, proso millet, or sunflower in the rotation with winter wheat and fallow provides an additional year in which to prevent seed production and allows the soil seed bank to gradually decrease.

Late spring-seeded crops are more effective than early-seeded crops in reducing problems with winter annual grassy weeds. Also, crop production practices that promote germination of winter annual grass weeds and their subsequent control are required to make progress in controlling these winter annual grasses. The tillage required to plant the weed seed and promote germination may reduce the success of some summer crops. Additional information on controlling these three winter annual grasses in winter wheat is in the online UNL resource, the Wheat Production Systems Handbook at: wheatbook.unl.edu.

**Drew Lyon, Extension Dryland Cropping Systems Specialist**
**Panhandle REC**
**Robert Klein, Extension Cropping Systems Specialist**
**West Central REC**

*Provide a fresh start and the utmost protection*

# Clean bins, equipment before starting harvest

With fall harvest just around the corner, it's important to check the condition of harvest equipment and grain bins. Keeping equipment and bins clean and in good working order is a critical first step in the harvest process.

Your grain crop is a major investment that needs to be protected. Grain quality does not improve in storage. At best, the initial quality can only be maintained. If you take the extra time to make sure conditions are good for storing grain, then you are protecting that investment. Proper storage begins with the condition of the harvested grain, including moisture level and its condition as it leaves the combine and is transported and handled.

• **Before harvest, thoroughly clean equipment** and make adjustments to minimize grain damage and maximize the removal of foreign materials. Many storage problems, including insects, are the result of damaged grain. Producers need to minimize the amount of grain that is cracked during combining and handling. Proper adjustments and management, such as combine adjustments and making sure transfer augers run at full capacity, help reduce damage and make grain more storable.

Grain carts, augers, trucks, combines and other harvest equipment should be free of all traces of old grain. Old grain can be a source of mold or insect infestation. Over time even a small number of insect eggs or mold spores can contaminate a full bin of grain, especially if the grain is a little on the wet side.

Grain bins should also receive a thorough checkup and cleaning before harvest, including removal of all old grain. Never mix new and old grain. You can keep and manage old grain, but it should be kept in a separate storage bin. There is a high risk for insect development over time. It's unusual for major insect infestation in the first year, but after that the risk goes up dramatically.

Store grain in several small bins rather than a few large ones. Smaller bins provide for better management. It gives producers more options for moving and storing grain, and if one bin goes bad, the loss is not as great.

• **Check under the perforated floors for accumulations of broken kernels** and other materials that can be a breeding ground for insects and mold. A few simple tools such as brooms, shovels, and a good shop vacuum are effective in cleaning equipment and bins, and a high pressure air hose is good for those hard-to-reach spots. The use of power washers on bins and harvest equipment is discouraged because they can create moisture and corrosion problems.

Ideally, perforated bin floors should be removed for cleaning. If that is not possible, and there is evidence of insect activity, the empty bin should be fumigated. Fumigation should be done as early as possible, because after application some chemicals require a waiting period of up to two weeks before grain can be added.

Since fumigation materials are restricted-use pesticides, the applicator must be licensed to buy and apply the chemicals. It is absolutely essential that applicators follow the label on these chemicals. Only a very few are appropriate for soybeans. Most are labeled specifically for corn or sorghum. With improper use you risk contamination of food materials and loss of time and money.

• **Check around the bin site before harvest and remove spilled grain** and other debris such as old boards or tall grass that might provide hiding areas for rodents and insects. If necessary, re-grade the soil around the foundation to ensure water drains away from the bin.

• **Inspect the bin foundations for cracks or other structural problems.** Anchor bolts should be tightened, and any gap that could provide entry for rodents or insects should be sealed. Electrical wiring also should be checked for wear, and all wiring at entry and exit points should be sealed against weather and pests.

• **Check fans, heaters, transitions, and ducts for corrosion and damage.** Remove any accumulated dust and dirt. Be sure all joints in the duct-work are tight, otherwise the aeration or drying air will short-circuit, reducing the operating efficiency.

Preparing bins and equipment for harvest is not a major effort, but it does take time and perseverance.

It needs to be done right now because when you start harvesting you don't want to be surprised by a bin that is corroded or dirty, or equipment that doesn't work correctly.

For more information, see NebGuide G94-1199, *Management to Maintain Stored Grain Quality*

**David Shelton**
**Extension Agricultural Engineer**
**Haskell Agricultural Laboratory**

Keep watching in future issues of *CropWatch* for more ag engineering stories on:

• Monitoring bin temperature and moisture in stored grain;
• Decommissioning wells; and
• Identifying beneficial conservation measures