North Central Ohio Agronomy Report

Issue 7

Dear Ag Provider,

Corn performance trial results are in from Crawford County with phenomenal results. Average yield for the test was 240 bushels per acre. Go to this site http://www.oardc.ohio-state.edu/corntrials/regions.asp?year=2007&region=NE and review the data before selecting corn hybrids for 2008.

Finally, please note Agronomy Day is December 11th in Willard – see the flyer for program details.

Best Regards for a peaceful Thanksgiving and joyful holiday season,

Steve

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http://crawford.osu.edu
http://agcrops.osu.edu
http://www.oardc.ohio-state.edu/ohiofieldcropdisease
http://www.ipm.iastate.edu
http://fcn.agonomy.psu.edu/farm
http://precisionage.osu.edu
http://www.ipm.uiuc.edu/bulletin
http://www.entim.purdue.edu/Entomology/ext/targets/newslett.htm

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North Central Ohio Agronomy Report

Reconditioning Overly Dry Soybeans

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Using aeration technology to manage the moisture content of a stored grain mass for the purpose of raising its moisture content has long been a controversial subject. Frequently, soybeans are harvested at low moisture contents (8 to 10%), and during artificial drying, corn is frequently overdried. Crops sold at less than market moisture weigh less and thus provide less revenue than crops sold at market moisture. Any moisture added back to overdried grain increases the weight of the grain sold. Direct addition of water to any grain for the purpose of increasing its weight for marketing is considered an illegal adulteration by U.S. regulatory authorities. Incidental addition of moisture during aeration and intentional conditioning of grains and oilseeds to optimum moisture levels for processing have not been challenged.

There are significant economic incentives to recondition grain to higher moisture contents for producers and elevator managers. (**Figure1**). Conditioning of low moisture grain during periods of high humidity is economically desirable but has been considered by many as technically infeasible. A temperature front moves through grain about 20-30 times faster than a drying or wetting front. Thus, a typical aeration airflow rate of 0.1 cubic feet of air per minute per bushel of grain (cfm/bu) that is adequate to complete a temperature change in one week of fan operating time may take six months to complete a desired moisture change throughout the same lot. However, research reported by Purdue University and the University of Minnesota shows that it is technically feasible to increase moisture contents in grains and oilseeds using automatically controlled aeration systems within a shorter time period.

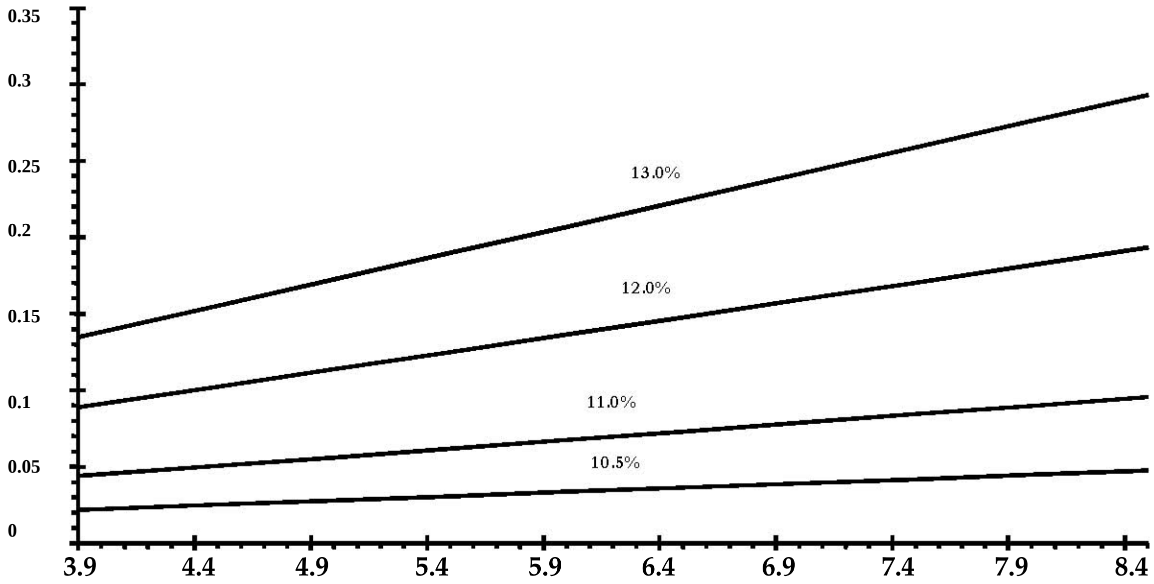

Figure 1. Economic incentive for adding moisture to soybeans (assuming a constant test weight of 60 lb/bu).

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A primary motivation for research into the conditioning of grains and oilseeds stems from the need of processors of popcorn, food corn, soybeans, and other crops to achieve moisture contents that are optimum for processing. For example in popcorn, the popping volume is maximized when kernels are uniformly conditioned to around 13.5% moisture, while soybean processors prefer an optimum moisture content around 10.5% for the flaking of beans for oil extraction. A recent Purdue University study confirmed that overly dry soybeans are undesirable for soybean crushers because they result in poor cracking and flaking performance and lower oil extraction yields.

Aeration Systems and Fan Controllers

Aeration is the forced movement of ambient air through stored grain to decrease or increase the grain temperature to the desired level. Although standard design airflow rates of 0.1 cfm/bu or less are generally too low to significantly change grain moistures by more than 0.5 percentage points, excessive aeration can shrink grain, or cause swelling of grain kernels near the air inlet.

The primary conditioning technology available to farmers and elevator managers is the use of forced ambient air from drying or aeration fans installed on grain bins, tanks, flat storages, and concrete silos. The success of a conditioning strategy to achieve a significant moisture change in a bulk of grain depends on the right combination of aeration system design, airflow rate, air and grain conditions, available time, and direction of airflow.

As grain is aerated, its moisture content gradually comes into equilibrium with the surrounding (interstitial) air relative humidity (r.h.). If air temperature increases while r.h. is constant, the grain's equilibrium moisture content (EMC) will decrease. If r.h. increases at constant temperature, EMC will increase. Knowing the relationship between EMC and air conditions is important in properly managing aeration systems to prevent overdrying, condensation, or absorption.

Aeration based on the EMC of grain is critical for achieving the conditioning objective. A microprocessor (or computer) can be used to calculate EMC from the measured ambient temperature and relative humidity. EMC equations for corn and soybeans are available. Microprocessor- and computer-based aeration controllers are commercially available and can be programmed to achieve a specific target moisture content either by operating fans to reduce or increase the average moisture in the grain mass. The success of such a strategy depends primarily on exposing the grain to the right combination of ambient conditions (temperature and r.h.) for a sufficient length of time.

In order to accomplish a desired outcome, a microprocessor-based controller must reliably sense the air temperature and r.h. to determine the EMC, and be able to provide the right amount of fan operating time for the airflow rate of the system to produce the desired grain temperature and moisture. These sophisticated control strategies require not only reliable sensors that are regularly calibrated, but also programmable microprocessors that are well understood by the user.

A New Approach to Reconditioning

A new approach to reconditioning overly dry soybeans was evaluated as part of a Purdue University research experiment. It involved directing the airflow through the grain from the top to the bottom. This was chosen for several practical reasons. First, pulling air through the grain avoids any prewarming of the air due to fan compression, which would lower the actual air EMC. Second, during conditioning it was possible for the grain to swell. It was assumed that swelling of the grain could take place in the upper layers of the bin more readily than in the lower portions, which carry the weight of the grain above. Thirdly, any problem of spoilage or heating of the grain was expected to occur most readily in the rewetted grain. Managing such problems is easier when the rewetted layer is near the top of the bin than when it is near the bottom. Fourth, because conditioning fronts move slowly, rewetting grain from the top down is more effective because it allows for the partial unloading of the conditioned grain assuming there is a funnel flow pattern during unloading of the bin (last in - first out). If grain was conditioned from the bottom up, the benefit of rewetting would generally not become apparent until the last part of the bin was unloaded because of the relatively slow movement of a moisture front.

Site-Specific Weather Analysis

Four U.S. Corn Belt locations were investigated to determine the number of hours available to recondition soybeans. The primary concern with respect to setting certain temperature and relative humidity limits for moisture conditioning with an automatic fan controller is whether adequate fan run time is available to achieve the desired moisture content. Weather

data between October and June for the years 1961 to 1990 were analyzed for the number of available hours when ambient conditions were such that the EMC for soybeans was above 13% and temperatures were between 26 and 60°F (**Table 1**). Indianapolis generally had the greatest amount of suitable fan run time and Des Moines had the least.

Table 1. Total run time, range, and standard deviation (hours) for four Corn Belt locations and storage periods when reconditioning soybeans (Air EMC > 13% and ambient temperature within 26 to 60°F) for 29 years of weather data (1961-1990).

	10/1 - 4/1	10/1 - 6/1	11/1 - 4/1	11/1 - 6/1
Indianapolis, IN	2079 1702-2787 273	2512 2014-3199 307	1760 1302-2448 249	2019 1555-2690 276
Des Moines, IA	1614 816-2457 343	2054 1005-2949 400	1330 573-2016 304	1602 721-2309 337
Peoria, IL	1975 1249-2595 284	2438 1463-3196 336	1654 875-2195 275	1923 1020-2467 312
St. Louis, MO	1868 1249-2595 351	2234 1463-3196 424	1613 875-2195 315	1837 1020-2467 367

The limits on the temperatures were chosen to prevent air that was significantly below freezing from entering the bin in the winter and excessively warm air from entering and spoiling wetter soybeans during the spring. An ending date of April 1 was chosen because the number of available hours to run the fan decreased rapidly in the late spring/early summer (**Figure 2**). Extending the conditioning period beyond June resulted in limited additional run time.

Figure 2. Accumulated run time for the minimum, maximum and average years for Indianapolis, IN, when rewetting soybeans with an EMC >13% and temperatures between 26 to 60°F.

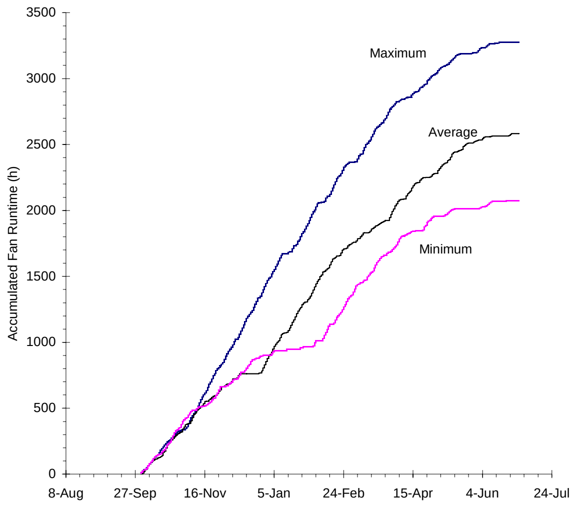

Table 2. Net gain and final average moisture content when rewetting soybeans in a farm bin (30 ft diameter, 30 ft grain depth, 16965 bu) in Indianapolis and Des Moines at two airflow rates (0.13 vs 0.56 cfm/bu at 30 ft grain depth) and for three unloading schedules (results are average, range, and standard deviation over 29 years).

	Low Airflow Rate			High Airflow Rate		
Location	6 unloads	3 unloads	1 unload	6 unloads	3 unloads	1 unload
IN net gain $/bu	0.133 0.084-0.208 0.029	0.13 0.082-0.206 0.028	0.0122 0.080-0.193 0.028	0.428 0.273-0.552 0.065	0.416 0.323-0.513 0.048	0.410 0.319-0.505 0.046
IN final MC, % w.b.	11.8 11.2-12.7 0.37	11.7 11.1-12.7 0.36	11.6 11.1-12.5 0.35	15.9 14.0-17.4 0.80	15.8 14.6-17.1 0.61	15.7 14.6-17.0 0.58
IA net gain, $/bu	0.096 0.013-0.170 0.035	0.081 0.020-0.173 0.031	0.074 0.019-0.164 0.029	0.356 0.158-0.500 0.073	0.334 0.147-0.480 0.068	0.329 0.163-0.478 0.066
IA final MC, % w.b.	11.3 10.2-12.3 0.45	11.1 10.3-12.3 0.40	11.0 10.3-12.2 0.38	14.9 12.3-16.8 0.95	14.7 12.2-16.6 0.90	14.6 12.4-16.6 0.87

For example, in Indianapolis the average net gain was $0.13/bu, yielding an average moisture content of 11.7% over twenty-nine years with the low airflow rate and three unloads. In comparison, the average net gain was only $0.081/bu in Des Moines with an average moisture content of 11.1%. When reconditioning was done in a bin with a high airflow rate, the final average moisture content on April 1 was approximately 15.8% in Indianapolis and 14.7% in Des Moines. By using a higher airflow rate, reconditioning could have been stopped earlier when the average moisture content had reached the desired market moisture of 13%. The standard deviation (and thus variability) when reconditioning soybeans was always greater in Des Moines.

Simulated Conditioning of Soybeans in a Commercial Tank

The same general trends occurred when reconditioning soybeans in a commercial tank (**Table 3**). It is interesting to note that using three unloads instead of one unload at the low airflow rate led to a slightly lower net economic gain in both Des Moines and Indianapolis. This could be due to the fact that the airflow rate was too low, and as a result, it took too long to establish a moisture front. However, with one unload the moisture gradient within the bin was much greater than with three unloads. When the bin was unloaded six times, the net gain was greater than either the one unload or three unload cases. The airflow rate increased fast enough that the frequent unloading of the bin did not interfere as much with moisture fronts becoming re-established.

Table 3. Net gain and final average moisture content when rewetting soybeans in a commercial tank (60 ft diameter, 60 ft grain depth, 135700 bu) in Indianapolis and Des Moines at two airflow rates (0.11 vs 0.22 cfm/bu at 60 ft grain depth) and for three unloading schedules (results are average, range, and standard deviation over 29 years).

	Low Airflow Rate			High Airflow Rate		
Location	6 unloads	3 unloads	1 unload	6 unloads	3 unloads	1 unload
IN net gain $/bu	0.100 0.039-0.155 0.032	0.086 0.050-0.142 0.021	0.089 0.054-0.145 0.022	0.218 0.109-0.310 0.053	0.202 0.134-0.295 0.039	0.198 0.137-0.292 0.038
IN final MC, % w.b.	11.5 10.7-12.2 0.42	11.3 10.8-12.0 0.29	11.3 10.9-12.1 0.30	13.2 11.8-14.4 0.69	13.0 12.1-14.3 0.52	13.0 12.2-14.3 0.52
IA net gain $/bu	0.063 0.0-0.124 0.027	0.050 0.005-0.118 0.023	0.051 0.01-0.125 0.024	0.154 0.032-0.266 0.051	0.133 0.037-0.255 0.045	0.127 0.041-0.256 0.0439
IA final MC, % w.b.	11.0 10.1-11.8 0.37	10.8 10.1-11.7 0.32	10.8 10.2-11.8 0.33	12.3 10.6-13.8 0.69	12.1 10.7-13.8 0.63	12.0 10.7-13.8 0.62

For example, in Indianapolis the average net gain was $0.086/bu, yielding an average moisture content of 11.3% over twenty-nine years with the low airflow rate and three unloads. In comparison, the average net gain was only $0.05/bu in Des Moines with an average moisture content of 10.8%. Using the high airflow rate allowed for soybeans to be reconditioned to 13.0% moisture in Indianapolis by April 1. The soybeans were only reconditioned to approximately 12.1% in Des Moines by April 1.

Importance of Frequent Partial Unloading

In general, by increasing the unloading frequency, the final average moisture content and thus the average net gain increased. With one complete unload, the airflow stayed constant. However, as the bin was partially unloaded more frequently, the airflow rate per unit volume of grain increased, which resulted in more moisture added per hour of fan operation.

Another advantage of more frequent partial unloading was the increase in uniformity of the final moisture content. During rewetting of soybeans, only about the top third of the bin wasrewetted when using one unload (**Figure 3**). The bottom two-thirds of the bin remained unchanged at approximately 10%. However, when three partial unloads were used, the soybeans had a more uniform final moisture content of 12.5, 11.5, and 10.7%. Also, the soybeans during the one unload reached a higher moisture content in the top portions of the bin; soybeans wetter than 13% moisture have a higher risk of spoilage.

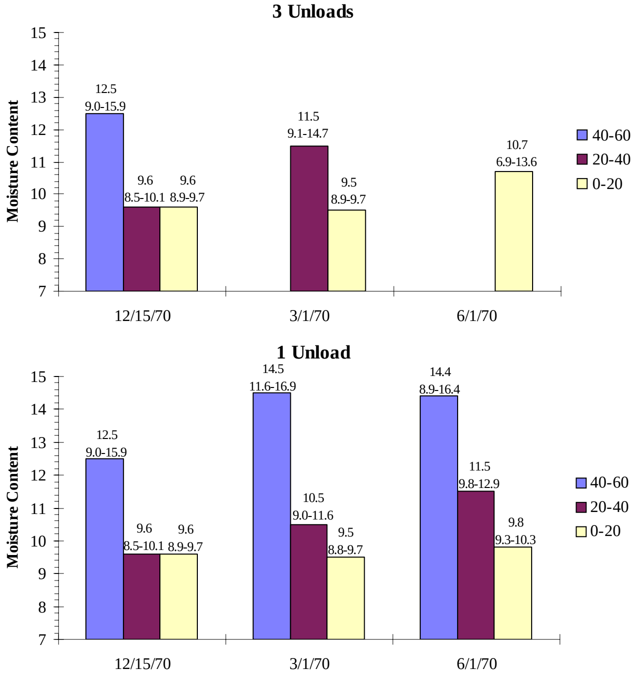

Figure 3. Average moisture contents and ranges at different depths above the floor in a commercial 135700 bu soybean tank when using a single unload versus three unloads and two 20-hp fans in Indianapolis, IN during 1969-1970.

Effect of Electricity and Soybean Prices

The price of electricity and the value of the soybeans influence the average net economic gain. **Table 4** shows the effect of market price and electricity cost on the net economic gain of soybeans when rewetting in a commercial tank at the low airflow rate with three unloads. If the price of soybeans decreased by $0.50/bu, then the average net economic gain decreased by $0.007/bu. If the electricity price increased by $0.02/kWh, the average net gain decreased by $0.005/bu.

Effect of Fan Control Limits

For each combination of airflow rate, location, and allowable conditioning time, an optimal lower limit for the EMC window can be determined. For example, a commercial tank unloaded once on April 1, using an airflow rate of 0.11 cfm/bu would have an optimal EMC minimum limit setting of 10% for soybeans in Indianapolis (**Table 5**). However, if the airflow rate was 0.29 cfm/bu, the optimal EMC minimum limit would be around 12%. The inter relationship of time, airflow rate, location, and controller limits has not been fully investigated.

Table 4. Sensitivity of average net economic gain ($/bu) over twenty-nine years when reconditioning soybeans in a commercial tank with three unload schedules and the low airflow rate (Indianapolis, IN).

Electricity ($/kWh)	4.50	5.00	5.50	6.00	6.50	7.00
0.03	0.060	0.067	0.074	0.081	0.088	0.096
0.05	0.055	0.062	0.069	0.076	0.084	0.091
0.07	0.051	0.058	0.065	0.072	0.079	0.086
0.09	0.046	0.053	0.060	0.067	0.075	0.082
0.11	0.041	0.048	0.055	0.063	0.070	0.077

Table 5. Effect of EMC minimum limit on net economic gain ($/bu) during the reconditioning of soybeans in a commercial tank unloaded once (Indianapolis, IN, 1971-72).

Airflow (cfm/bu)	Low Limit of EMC Window			
	10	11	12	13
0.04	0.016	0.017	0.018	0.018
0.11	0.089	0.088	0.087	0.084
0.19	0.180	0.179	0.176	0.169
0.29	0.239	0.246	0.250	0.249
0.39	0.178	0.199	0.223	0.239

Obviously, the examples explored here do not represent an exhaustive analysis of the potential economic gain matrix. When implementing a specific conditioning strategy for a site, the operator must consider historic weather data in combination with the proper settings for an automatic fan controller, down flow aeration, and intermittent unloading of farm bins and commercial tanks. Even at the same airflow rate of 0.1 cfm/bu, a higher net economic gain can be achieved in the farm bin compared to the commercial tank. The reason lies in the advantage of conditioning a shallower depth of grain, which requires less fan power to achieve the same airflow as in a deeper bin. Final moistures and moisture uniformity would also be higher in shallower bins. Thus, it would be preferable and more profitable to condition grain to optimum market moisture in shallower bins for commercial as well as farm installations.

Additional Precautions

Caution should be exercised because the potential for spoilage is significant, especially when conditioning extends into the late spring and early summer period. In the examples explored, safe storage moistures were generally exceeded in the upper grain layers and fairly significant gradients developed within the bin. Stirring machines in on-farm bins are a tool that could be used to achieve better moisture uniformity during conditioning. This would also avoid the need to reverse the airflow in push aeration systems. Another physical challenge (and safety concern) of grain conditioning is leveling grain surfaces especially in larger diameter bins.

The complexity of the automatic controller needs to be fully understood by the operator. Setting limits for the programmable variables can create an operational window that can be too narrow or too wide. The reliability of an automatic fan controller also should be considered. Air temperature and humidity sensors must be regularly checked for accuracy, and calibration procedures should be carefully followed.

Summary

Reconditioning soybeans using aeration and an automatic fan controller is technically and economically feasible. For the scenarios evaluated, average net economic gains varied from 0.051 to $0.43/bu when reconditioning 10% soybeans. The ability to recondition is dependent on location. The Western Corn Belt is less conducive to reconditioning than the Eastern Corn Belt. The average moisture content increase in soybeans was 0.5 to 0.6% percentage points less at low airflow rates for Des Moines than for Indianapolis. Large yearly variations are to be expected in the net economic gain when reconditioning soybeans. In Indianapolis, the average net gain varied from 0.08 to $0.193/bu in soybeans over twenty-nine years in the farm bin with only a single unload and low airflow. A shallower bin is more economical for reconditioning than a deeper tank because greater grain depths require disproportionately higher horsepower fans to achieve the same airflow rate, which negatively affect the net gain.

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Temporary Grain Storage Considerations

Dirk E. Maier, Agricultural & Biological Engineering,
Purdue University,
William F. Wilcke, Biosystems and Agricultural Engineering, University of Minnesota

Sidewall Loading - Dry grain exerts a pres-sure on walls of about 23 pounds per foot of grain depth. Unless the building was specifically designed to withstand the pressure of grain or some other granular product, it will need to be reinforced by using cables between walls, or self-supporting interior walls. If the building was designed and erected by an ag building company, a "grain package" may be available from them. If not, an engineering consultant should be hired to design the necessary building modifications. Another option is to set free-standing bulkheads inside the building to keep grain away from the walls. Refer to AE-84 or AE-92 for the design of a self-supporting portable wall. The wall-pressure problem can also be avoided by buying metal grain bin rings (without roofs), and installing these partial bins inside the building. Grain could also just be placed in the center of the building in sloping piles that do not touch the walls. Obviously, the storage capacity of the building would be significantly reduced.

Storage Capacity - When trying to decide whether it is worth using an existing building for grain storage, one should first estimate how many bushels can be stored. It is disappointing to find how few bushels can actually be stored in some flat buildings, especially when buildings have low ceilings or when grain is not piled against the sidewalls. For example, consider a typical 60 ft wide by 80 ft long shed with 16 ft sidewalls. If the sidewalls are only sufficiently reinforced to retain 2 ft of grain safely, the total storage volume using a 1:2 side slope for the dry corn is about 19,293 bu (the end sections hold a total of 10,129 bu and the center section 9,164 bu; multiply total cubic feet by 0.8 or divide by 1.25 to get bushels). On the other hand, if eight 21 ft diameter bins (without roofs), each with a 16 ft sidewall height, were placed inside the building, a total of about 35,638 bu of grain could be stored. Four bins placed along each sidewall would allow for a sufficiently wide alley to drive a truck (or tractor and wagon) into (or through) the building and load the bins with an incline conveyor. If two additional bins could be placed in the alley in the center of the building the storage capacity would increase to 44,550 bu. The bins could be equipped with fans and ducts (or floors) for aeration cooling. Unloading augers could be placed at an angle through the sidewalls in order to feed the hopper of a second inclined conveyor that feeds into a truck or wagon. One other provision would have to be adequate roof venting to prevent condensation on the underside of the roof, especially during aeration.

Flat Storage Capacity

Grain Drying, Handling and Storage Handbook
Midwest Plan Service

To estimate the capacity of a level filled flat storage building use **Eq. 4-2.**

Eq. 4-2.

$$LFC = L \times W \times D \times 0.8$$

LFC = level filled storage capacity, bu
L = storage length, ft
W = storage width, ft
D = grain depth at sidewall, ft
0.8 = conversion factor, ft^3 to bu, bu/ft^3

For example, a 100’ long by 40’ wide flat storage filled to a level depth of 6’ holds an estimated 19,200 by (100’ x 40’ x 0.8 bu/ft^3).

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To store more grain in a flat storage building, grain can be peaked. Although this allows for more storage capacity, it is more difficult to properly check and monitor grain in storage. It is considerably more difficult to walk on peaked grain than level grain for checking.

Most dry grains peak at an angle of 18° - 28°, **Table 4-1**. The actual angle depends on grain type, moisture content, the amount of fines and foreign material in the grain, and height of drop. Minimum and maximum values are shown in the table to illustrate the range of filling angles that can occur in peaked grain storage. The actual peak height and storage capacity depends on the filling angle. The peak height can be estimated from **Eq. 4-3**. For estimating grain capacity, use the average slope factor. The maximum filling angle should be used when evaluating the structural strength of a building used for grain storage.

Eq. 4-3.

$$\text{Peak} = (1/2 \text{ x } W \text{ x } SF) + D$$

Peak = height of peaked grain, ft
W = storage width, ft
SF = slope factor, **Table 4-1**
D = grain depth at sidewall, ft

For example, the peaked grain height in a 40’ wide building filled with soybeans or hard red spring wheat to a depth of 6’ at the sidewall can be calculated with **Eq. 4-3**. From **Table 4-1** the average filling angle is 25° and the slope factor is 0.47. The calculated peaked grain height is 15.4’ (1/2 x 40’ x 0.47 + 6’).

The grain volume in a typical peaked flat storage building can be estimated by breaking it into three separate volumes, **Fig. 4-3**. Use **Eqs. 4-4 to 4-7** to calculate the separate volumes. Multiply to total volume (V) by 0.8 bu/ft^3 to estimate the storage capacity.

Eq 4-4.

$$V1 = W \times L \times D$$

Eq 4-5.

$$V2 = \tfrac{1}{4} \times W \times W \times (L - W) \times SF$$

Eq 4-6.

$$V3 = \tfrac{1}{12} \times W \times W \times W \times SF$$

Eq 4-7.

$$V = V1 + V2 + (2 \times V3)$$

V = total volume, ft^3
V1 = level fill volume, ft^3
V2 = middle triangular peak volume, ft^3
V3 = peak volume at one end, ft^3
W = building width, ft
L = building length, ft
D = grain depth at sidewall, ft
SF = slope factor, Table 4-1

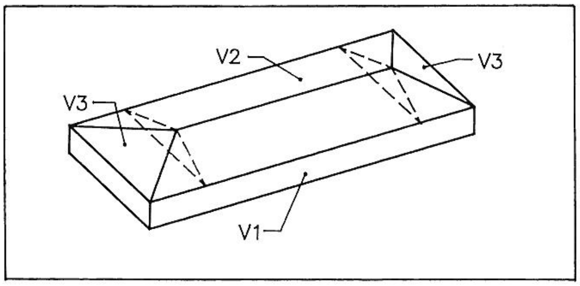

Fig 4-3. The three grain volumes of a flat storage.

Example 4-1:
Calculate the volume of a 40’ wide by 100’ long flat grain storage building with corn 6’ deep at the sidewalls and peaked at an average filling angle of 23°. From **Table 4-1**, the slope factor is 0.42.

Solution:

$$V1 = 40' \times 100' \times 6' = 24{,}000 \text{ ft}^3$$

$$V2 = \tfrac{1}{4} \times 40' \times 40' \times (100' - 40') \times 0.42 = 10{,}080 \text{ ft}^3$$

$$V3 = \tfrac{1}{12} \times 40' \times 40' \times 40' \times 0.42 = 2{,}240 \text{ ft}^3$$

Total volume = 24,000 + 10,080 + (2 × 2,240) = 38,560 ft^3

Estimated storage capacity = 38,560 ft^3 × 0.8 bu/ft^3 = 30,848 bu

Estimated peak height = (½ × 40′ × 0.42) + 6′ = 14.4′

If grain is stored against the walls, they must be adequately reinforced to resist the large outward grain pressure. Structural failures not only cause building and grain losses, but can also cause death.

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Hibernating your Field Crop Sprayer

Mark Madden, Sullivan County Extension
Penn State Crop Management Extension Group
Penn State University

Diligent equipment care and good maintenance practices are key management habits for optimizing the usefulness of agricultural implements and for controlling equipment costs over time. Few things are as frustrating as working on equipment when the time could otherwise be spent putting the equipment to productive use.

Cleaning and winterizing your sprayer now that its duties are done for the year is a simple process that can have you field-ready in the short-hour days of Spring. A few easy steps to follow include:

1. Start with a sprayer as empty as possible and choose a location away from water sources and drainage channels.

2. Begin the process with a thorough tank cleaning using a cleaning solution suggested by the pesticide label. While circulating the cleaning solution, check for plumbing leaks and cinch up any loose connections. Flush all lines by removing end plugs and nozzles being sure to remove all residues. Clean all nozzle screens and clean, or replace if necessary, all filters. Flush the system with clean water until the cleaning solution is removed and reinstall all nozzles and screens.

3. Pressure wash the entire outside of the sprayer using a detergent removing any residues or substance that could hasten corrosion.

4. Use a 50:50 mix of antifreeze and water to protect the plumbing, components and pump from frost damage. A five gallon mix should be added to the tank and circulated throughout the system. You can capture this solution as it free drains from the system and reuse in later years.

5. Drain any foam marker system. Compressed air can aid with clearing the lines to the end of the booms.

6. Lubricate wheel bearings and all moving joints and inspect for structural integrity particularly where the tank rests on the running gear and at the boom pivots. Torque all fasteners to recommended limits and inspect tires for problems.

7. Clean and protect electronic connections and store controllers at a suitable location. A soft brush can be used to clean the connectors and a dab of electrical grease will prevent corrosion and ensure a more reliable union next time it is used. Tether the connecting cable to the sprayer so that the plug is up off the ground.

When the job is done, park your sprayer out of the weather and wait for Spring with confidence you're ready to rock when its time to roll.

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Rootworm Control Options, 2007 Efficacy Results

Christian Krupke, John Obermeyer, and Larry Bledsoe,
Purdue University Extension

- Four delivery methods for rootworm protection, none provide 100% control.
- Product efficacy compared by delivery method.

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Listed below, by application method, are the current registered control products and their efficacy in protecting roots in 2007 Indiana and Illinois university rootworm trials. Products are grouped by application technology for ease of comparison. There is no consideration of other insect pests (e.g., wireworms, white grubs, cutworms) in these evaluations – rootworms are the focus of these trials. Before deciding to use any of these options, be sure that you actually need it in your growing area – many areas of the state have little rootworm pressure and can get by simply by continuing to rotate corn with other crops in alternating years. Know your pressure levels and don't buy protection you don't need.

Insecticide Coated Seed Root-Rating Performance[1], 2007

Location	Best[2] Rating	Poncho 1250	Check
Lafayette, IN	0.03	0.11	1.36
Wanatah, IN	0.15	0.29	2.25
Farmland, IN	0.21	0.63	2.20
Dekalb, IL	0.08	1.18	2.18
Monmouth, IL	0.03	0.90	1.14
Urbana, IL	0.13	1.49	2.74

[1] Node Injury Scale 0-3. 0=no damage, 3=severe root pruning, 0.25 or greater=plants likely predisposed to a significant yield loss

[2] The "Best Rating" is the least amount of rootworm damage for any registered product in the plot.

Liquid Soil Insecticide Root-Rating Performance[1], 2007

Location	Best[2] Rating	Capture LFR	Regent	Lorsban 4E	Force CS	Check
Lafayette, IN	0.03	0.16	0.22	0.13	0.16	1.36
Wanatah, IN	0.15	1.51	1.53	0.36	0.99	2.25
Farmland, IN	0.21	1.07	1.85	1.25	1.35	2.20
Dekalb, IL	0.08	-	-	0.55	0.45	2.18
Monmouth, IL	0.03	-	-	0.25	0.23	1.14
Urbana, IL	0.13	-	-	0.34	0.36	2.74

[1] Node Injury Scale 0-3. 0 = no damage, 3 = severe root pruning, 0.25 or greater - plants likely predisposed to a significant yield loss

[2] The "Best Rating" is the least amount of rootworm damage for any registered product in the plot.

Granular Soil Insecticide root-Rating Performance [1,2],2007

Location	**Best[3] Rating 2.1G**	**Aztec 4.67G**	**Aztec 3G**	**Force 2.5G**	**Fortress**	**Fortress 5G**	**Lorsban 15G**	**Check**
Lafayette, IN	0.03	0.13	-	0.20	-	0.12	0.16	1.36
Wanatah, IN	0.15	0.46	-	1.06	-	0.32	0.65	2.25
Farmland, IN	0.21	0.36	-	1.37	-	0.21	0.63	2.20
DeKalb, IL	0.08	0.81	0.66	0.74	0.96	-	0.90	2.18
Monmouth, IL	0.03	0.34	0.12	0.22	0.10	-	0.20	1.14
Urbana, IL	0.13	0.31	0.21	0.41	0.15	-	0.40	2.74

[1] Node Injury Scale 0-3. 0 = no damage, 3 = severe root pruning, 0.25 or greater - plants likely predisposed to a significant yield loss

[2] Aztec 2.1, Force 3, and Lorsban 15 were applied in T-band. Fortress 2.5G was placed in-furrow. Aztec 4.67 and Fortress 5 were applied through SmartBox.

[3] The “Best Rating” is the least amount of rootworm damage for any registered product in the plot.

Bt Corn Rootworm: Side-by-side root rating comparisons of Bt-CRW hybrids with different events (i.e., Agrisure, Herculex, YieldGard) are not possible. Plant genetics that determine a hybrid’s root mass, architecture, and rooting depth make direct root rating comparisons between the Bt events virtually impossible – the plants are different in many ways, not just the presence or absence of Bt. The advancement in Bt events has created challenges for university researchers in order to compare rootworm efficacy between not only transgenic hybrids but the chemical controls as well. Imagine having 40 treatments replicated 4 times for one hybrid and then repeating that for each and every hybrid with the rootworm Bt – this is an impossible task. However, what we have listed below are the best comparisons available, taking data from multiple sites and states. Though the locations and planting may have occurred the same day, the plots were and should be compared separately. The take-home message is that overall the YieldGard RW and Herculex RW gave excellent performance when compared to the genetically-similar isoline lacking rootworm protection.

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Location	YGRW& P250	Isoline & Insecticide & P250	Isoline	Herculex RW & P250	Isoline & Insecticide & P250	Isoline & P250
Lafayette, IN	0.03	0.16	1.36	0.09	0.13	0.23
Wanatah, IN	0.15	0.41	2.25	0.12	-	1.72
Farmland, IN	0.54	0.56	2.20	0.11	1.92	1.98
DeKalb, IL	0.20	0.81	2.18	0.08	-	1.89
Monmouth, IL	0.03	0.34	1.14	0.05	-	0.84
Urbana, IL	0.84	0.31	2.74	0.49	-	2.36

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Using Yield Monitor Data for On-Farm Experiments

Terry W. Griffin, Jess Lowenberg-DeBoer,
and Bruce Erickson
Agricultural Economics, College of Agriculture
Purdue University

With harvest now winding down in many areas, some of the major questions about management practices such as the performance of specific hybrids and varieties, the timeliness of certain field practices, and even the local effects of Mother Nature are already well known. But more detailed analyses will follow, some using yield monitor data in a computer-intensive and knowledge-intensive process. Performing spatial analysis requires more time, effort, and human capital than other analysis procedures, but our experience through research and practice shows that pre-planned on-farm experiments combined with spatial analysis leads to more reliable decisions.

STEPS IN USING YIELD MONITOR DATA FOR FIELD EXPERIMENTS

- Plan the Experiment
    - Apply Treatments
- Calibrate Yield Monitor
- Prepare the Data
- Assimilate Data into a Geographic
- Information System (GIS)
- Perform Statistical Analysis
- Compare Results
- Make Management Decisions

For the last five or so years Bob Wade has been intensively studying the yield monitor data generated on his farms. “In this part of the world our topsoil depth changes dramatically across the field, and that changes our crop yield potential,” said Wade, who farms near Sonora, KY, about an hour’s drive south of Louisville. “So as a result we vary both planting rates and nitrogen in corn. Being able to do the spatial analysis has convinced me that varying these inputs has been profitable for me.”

It would be expeditious if a single farm mapping software package could perform these yield data analyses, but the current state of technology involves moving files between software packages. The process described (see sidebar) uses a combination of farm mapping software, professional geographical information system (GIS) software, and professional statistical software. The specific software mentioned in this article is in the public domain and free to users.

Plan the Experiment The experimental design should be chosen based upon the treatments tested, the field, and the farmer--one size does not fit all field research purposes. Most on-farm trials are implemented as strip trials or split-planter trials although many farmers opt for split-field trials due to constraints of treatments to be applied, i.e. tillage. Elaborate experimental designs such as randomized blocks are rarely implemented due to time requirements; therefore simpler designs are preferred.

Apply Treatments Typically, categorical experiments are simpler to set up than rate trials. Categorical trials include treatment(s) of each product that the researcher desires to test. Rate trials include a range of rates that include a very low or even zero rate and a very high rate in addition to two or three rates that are in what is expected to be the "adequate range." The very low and very high rates are expected to be extreme enough to reduce crop yield in order to properly estimate the crop response curve.

Calibrate Yield Monitor It is recommended that the combine yield monitor be properly calibrated prior to harvesting the on-farm experiment.

Prepare the Data In nearly all cases, yield monitor data must be rectified before use in spatial analysis. The term "filtering" is used to describe the process of removing erroneously measured observations and relocating data to the appropriate location. Yield Editor filtering software can be downloaded free from USDA-ARS (Drummond, 2006). From research conducted at Purdue (Griffin, 2006), it was determined that filtering yield monitor data prior to analysis led to different production recommendations.

Assimilate Data into a GIS Once data has been filtered, the data are assimilated with supporting data such as treatments, soils, elevation, and other yield affecting factors with professional GIS software. In order for data to be analyzed by the statistical software, it must be in a single file format.

Perform Statistical Analysis With all of the data in a single dataset, it is ready for spatial statistical analysis with software such as GeoDa (Anselin, 2003) or R (R Core Development Team, 2007), both of which can be downloaded and used free. Although several statistical analysis methods exist, we suggest using one of the spatial statistical methods. Any appropriate statistical analysis of a spatial dataset can be thought of as spatial statistics. We typically use regression analysis which can be thought of as a functional relationship between correlated variables that can be estimated from a given dataset. Regression can be used to predict values of one variable when given values of other variables. Spatial statistics expands upon traditional regression to address the problems of spatially dependent data. Once statistical results are available, the interpretation and economic analyses are conducted in order to make production recommendations and farm management decisions.

(Yield monitor calibration (photo Kansas State Univ.)

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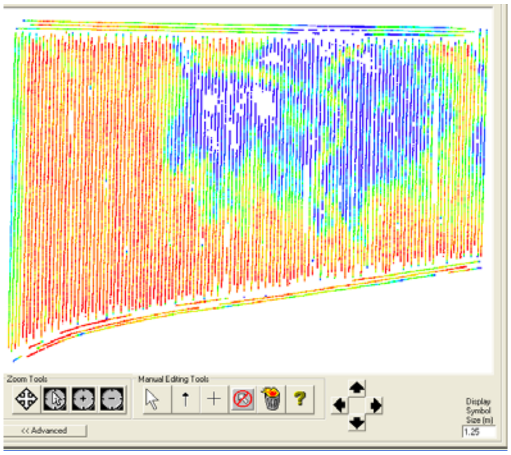
Compare Results It is our practice to take the regression results and graph them in a spreadsheet so the results can be easily communicated with decision makers. Using the estimated coefficients from the statistical analysis, we calculate the dependent variable, typically yield, over a range of the covariates such as soil clay content, elevation, or other continuous variables for each treatment and/or other discrete categories such as soils in a spreadsheet. From these calculations a scatterplot is created. These graphs are useful in intermediate interpretation of the results with the farm management decision-maker.

Categorical Trials and Partial Budget Analysis For economic analysis of side-by-side or categorical treatments, a partial budget is sufficient. For field-scale experiments, the difference in revenue may only include the difference in revenue for each treatment. The difference in costs may include the seed costs if a hybrid trial or the machinery costs if a tillage trial.

Revenue = yield x market price



Yield monitor data that is not filtered – note zig-zag patterns in center of field and at end rows where data has not been properly geo-referenced.

Rate Trials and Economic Analysis For rate trials such as nitrogen rates or seeding rates, the model coefficients are used to calculate yield maximizing levels of input, or what is commonly known as agronomic maximum. However, yield maximums are not profit maximums unless the input is free. Each planned comparison may have a completely different model, costs, and treatments and the analyst should be prepared to adjust their own protocol accordingly.

Profit = (yield x market price) – input cost

Make Decisions The result of a spatial analysis should be a production recommendation and not just a map. Maps can sometimes be used for communication and validation purposes, but never as the ultimate end product of a spatial analysis. Bob Wade adds his own perspective: “Time is precious so I’m not out here trying to split pennies by collecting all of this information. I set up field studies and utilize yield monitor data to get a big picture view of how well some of our management practices are working.”

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Critical Soil Test Levels (CL) for Various Agronomic Crops

Crop & Soil Conditions where Secondary & Micronutrient Deficiencies May Occur

Approximate Fertilizer Nutrient Values of Animal Manure at Time Applied to Land – Solid Handling Systems

Approximate Fertilizer Nutrient Values of Animal Manure at Time Applied to Land – Liquid Handling Systems

Corn, Soybean, Wheat and Alfalfa Field Guide
Ohio State University Extension

CRITICAL SOIL TEST LEVELS (CL) FOR VARIOUS AGRONOMIC CROPS

Crop	**Critical Soil Test Levels**				
	P	**K at CEC**[1]			
		5	**10**	**20**	**30**
	ppm (lb/acre)	**ppm (lb/acre)**			
Corn	15 (30)[2]	88 (175)	100 (200)	125 (250)	150 (300)
Soybean	15 (30)	88 (175)	100 (200)	125 (250)	150 (300)
Wheat	25 (50)	88 (175)	100 (200)	125 (250)	150 (300)

Alfalfa	25 (50)	88 (175)	100 (200)	125 (250)	150 (300)
1 Critical level for ppm K = 75 + (2.5 x CEC) for all crops					
2 Values in parenthesis are lb/acre.					
Note: A CEC of 15 is used to calculate the K_2O recommendation for calcareous soils (soils with pH equal to or greater than 7.5 and a calcium saturation of 80% or greater) and organic soils (soils with an organic matter content of 20% or greater or having a scooped density of less than 0.8 grams per cubic centimeter).					

CROP & SOIL CONDITIONS WHERE SECONDARY & MICRONUTRIENT DEFICIENCIES MAY OCCUR

Micronutrient	**Soil**	**Crop**
Boron (B)	Sandy soils or highly weathered soils low in organic matter	Alfalfa and clover
Calcium (Ca)	Very low pH soils	Alfalfa
Copper (Cu)	Acid peats or mucks and black sands	Wheat, oats and corn
Iron (Fe)	High pH, wet poorly aerated soil, cool temperature	Soybeans, navy beans, millet, milo
Magnesium (Mg)	Low pH, high K, sandy soils	Corn
Manganese (Mn)	High pH, high organic matter	Soybeans, navy beans
Sulfur (S)	Low organic matter, sandy, cold, wet soils	Alfalfa
Zinc (Zn)	Peats, mucks, and mineral soils with pH > 6.5, high P, heavily manured	Soybeans and Alfalfa

APPROXIMATE FERTILIZER NUTRIENT VALUES OF ANIMAL MANURE AT TIME APPLIED TO LAND - SOLID HANDLING SYSTEMS[a]

		Nutrient Content				
Type of Livestock	**Bedding vs No Bedding**	**Dry Matter (%)**	**Total**			
			N^b	**NH_4^c**	**$P_2O_5^d$**	**K_2O^e**
			(lb/ton)			
Swine	Without Bedding	18	10	6	9	8
	With Bedding	18	8	5	7	7
Beef	Without Bedding[f]	52	21	7	14	23
Cattle	With Bedding	50	21	8	18	26
Dairy	Without Bedding	18	9	4	4	10
Cattle	With Bedding	21	9	5	4	10
Sheep	Without Bedding	28	18	5	11	26
	With Bedding	28	14	5	9	25
Poultry	Without Litter	45	33	26	48	34
	With Litter	75	56	36	45	34
	Deep Pit (compost)	76	68	44	64	45

Turkey	Without Litter	22	27	17	20	17
	With Litter	29	20	13	16	13
Horses	With Bedding	46	14	4	4	14

a Manure spreader capacity: 1 bu = 40-60 lb

b Ammonium N plus organic N, which is slow releasing.

c Ammonium N, which is available to the plant during the growing season.

d To convert to elemental P, multiply by 0.44.

e To convert to elemental K, multiply by 0.83

f Open dirt lot.

Refer to OSU Extension Bulletin 604, Ohio Livestock Manure and Wastewater Management Guide

APPROXIMATE FERTILIZER NUTRIENT VALUES OF ANIMAL MANURE AT TIME APPLIED TO LAND - LIQUID HANDLING SYSTEMS[a]

		Nutrient Content				
Type of Livestock	**Bedding vs No Bedding**	**Dry Matter (%)**	**Total**			
			N[b]	**NH_4**[c]	**P_2O_5**[d]	**K_2O**[e]
			(lb/1,000 gal)			
Swine	Liquid pit	4	36	26	27	22
	Lagoon	1	4	3	2	4
Beef	Liquid pit[f]	11	40	24	27	34
Cattle	Lagoon	1	4	2	9	5
Dairy	Without Bedding	8	24	12	18	29
Cattle	With Bedding	1	4	2.5	4	5
Veal calf	Without Bedding	3	24	19	25	51
Poultry	Without Litter	13	80	64	36	96

a Application conversion factors: 1,000 gal = 4 tons; 27,154 gal = 1 acre-inch

b Ammonium N plus organic N, which is slow releasing.

c Ammonium N, which is available to the plant during the growing season.

d To convert to elemental P, multiply by 0.44.

e To convert to elemental K, multiply by 0.83

f Includes feedlot runoff water and is sized as follows: single cell lagoon - 2 cu ft/lb animal wt; two-cell lagoon - cell 1, 1-2 cu ft/lb animal wt and cell 2, 1 cu fl/lb animal wt.

Refer to OSU Extension Bulletin 604, Ohio Livestock Manure and Wastewater Management Guide

North Central Ohio Agronomy Report

Ohio Corn Performance Trials Results and Observations

Peter Thomison, Rich Minyo, Allen Geyer, Bert Bishop, David Lohnes

Results of the 2007 Ohio Corn Performance Test results are now available online at http://www.oardc.ohio-state.edu/corntrials/.

In 2007, 237 corn hybrids representing 35 commercial brands were evaluated in the Ohio Corn Performance Test. Testing was conducted in three regions of Ohio - Southwestern/West Central (SW/WC); Northwestern (NW); and North Central/Northeastern (NC/NE), with three test sites established within each region. Testing was also conducted at Coshocton, an area with high gray leaf spot incidence. Entries in the regional tests were planted in either an early or full season maturity trial. These test sites provided a range of growing conditions and production environments.

Grain yields of hybrid entries were outstanding despite what appeared to be a less than ideal growing season. Test sites averaged more than 200 bu/A except for Hoytville, which averaged 180 and 182 for the early and full season trials, respectively.

Environmental conditions varied greatly across trial locations during the 2007 growing season, especially with regard to the amount and distribution of precipitation. Temperatures were above normal and rainfall below normal at planting. These warm, dry conditions promoted crop establishment and probably deeper root development.

Warm, dry weather persisted through maturity at the test locations near S. Charleston and Washington CH in SW Ohio. However, drought stress damage was averted by timely rains. Rainfall deficits at the other test sites were alleviated by above average rainfall in August. Rainfall accumulation was 7 to 8 inches above normal at NW test sites and 1 to 2 above normal at NE sites. These above normal August rains coincided with grain fill and contributed to high grain yields. Hot, dry conditions in September and October resulted in rapid grain dry down and unusually low grain moisture at harvest at several locations. Despite periods of drought stress, stalk quality was excellent and stalk lodging negligible across locations. Disease and insect pests were not a significant factor at test sites.

“Traited” hybrids (i.e hybrids with Bt insect resistance and herbicide resisitance) now dominate the Ohio Corn Performance Test and close to half the entries are triple or quad stacks. In 2002 less than 15% of the hybrid entries were traited. In 2006, 59% were traited, and this year, 84% of the 237 entries are traited. Of these, 114 hybrids are triple or quad stacks, 46 are double stacks, 44 contain a single trait. Overall triple stack hybrids generated the highest yields. In the OCPT regional summary (see the table showing performance of hybrids entered in the three regions, i.e. 9 test sites), eight of the top ten yielding hybrids are triple stacks, one is a double stack, and one contains a single trait. However, stacked traits did not necessarily ensure the highest yields. Of the bottom ten hybrids, nine are triple stacks and one is a double stack.

Tables 1 and 2 provide an overview of 2007 hybrid performance in the early maturity and full season hybrid trials by region. Averages for grain yield and other measures of agronomic performance are indicated for each region. In addition, the range in test sites averages is shown in parentheses.

Summary tables can be found at: http://corn.osu.edu/story.php?issueID=212&layout=1&storyID=1295

Agronomy Day and Pesticide Applicator Recertification

Tuesday, December 11, 2007
9:00 am – 4:00 pm
at
Moose Lodge
220 E Walton St, (SR 224W)
Willard, Ohio 44890

Sponsored by Ohio State University Extension

You are invited to participate in the 2007 Agronomy Day. Dr. Robert Mullen, Bruce Eisley, Mike Gastier, Dennis Mills, and Dr. Steve Prochaska from Ohio State University Extension will present on topics listed below.

Topics:

- Fertility Short Course – Corn & Soybeans
- Potential for Variant Western Corn Rootworm To Damage 2008 Corn
- Will Soybean Aphids Return in 2008
- Management to Reduce Glyphosate Resistant Weeds on Your Farm
- Use of Corn & Soybean Health Fungicides
- Private Pesticide Applicator Credits (4hr) – Core, 1, 2, 8, 9, 10, and 12

Cost: $25.00 Pre-Register by Friday, December 7

(Cover $15.00 PAT OSU Rebate Charge and Lunch)

$30.00 at the Door

Please return this registration form and fee by December 7th, to: OSU Extension Crawford County, 112 East Mansfield Street, Suite 303, Bucyrus, OH 44820 or OSU Extension Huron County, 180 Milan Ave, Suite 1, Norwalk, OH 44857. Checks should be made payable to "OSU Extension."

Name____
Address____ City__________________
Zip______________ Phone____

THE OHIO STATE UNIVERSITY EXTENSION

A Grain Marketing Short Course

THE OHIO STATE UNIVERSITY
EXTENSION

When:	February 12, 19, 26 and March 4, 2008 7:00 to 9:30 pm
Where:	Crawford County Courthouse Lower Level Conference Room Bucyrus, Ohio
For:	Farmers interested in making money
Instructors:	**Dr. Steve Prochaska, Extension Educator** **Dr. Chris Bruynis, Extension Educator**

- **February 12 ....Where to Begin**
  - Cost of Production
  - Basis Facts
  - Overview of Hedging
  - Overview of Options
- **February 19 .... Cash Marketing Alternatives**
  - Cash
  - Delayed Price
  - Forward Contract
  - Basis Contract
- **February 26 .... Developing a Grain Marketing Plan**
  - Hedge To Arrive
  - Options Contracts
  - Using a Combination of Grain Marketing Alternatives
- **March 4................................... Crop Insurance & Marketing Outlook**

Cost: $20 for all sessions or $5 per single session
Call OSU Extension to register:
Crawford County at 419/562-8731 or Wyandot County at 419/294-4931