Stored Product Protection

Cost of Good Sanitation Practices for On-Farm Grain Storage

Corinne Alexander, Yigezu A. Yigezu, Dirk E. Maier, Linda J. Mason, and Charles P. Woloshuk

Grain producers who store grain on-farm into the summer months want to maintain grain quality to maximize market value. One important practice for maintaining and maximizing grain quality is to put clean grain in bins that are free of insects. For producers, two obvious questions come to mind: 1) what does it take to ensure clean bins? and 2) how much time and what costs are involved?

To answer these questions, we conducted interviews with eight producers in Indiana and Illinois, all of whom store food-grade corn on-farm into the summer months. We asked them what specific tasks they conduct to assure grain quality, the number of labor hours for each task, what tools they used, and the estimated cost of the tools and labor (Tables 1 - 3). In this publication we report on these producers' practices and compare them to Purdue's recommendations.

Table 1. *Labor Hours for Sanitation for Each Component*

Item to Be Cleaned	Number of Hours of Labor per Cleaning		
	Minimum	Average	Maximum
Inside and outside walls and floors of a bin	0.25	1.59	5.00
Dryer	0.08	1.68	4.50
Auger	0.08	0.84	5.00
Surroundings of a bin	0.08	0.53	1.00
Combine	0.50	1.00	1.50
Trucks	0.08	0.35	1.00

See page 2 for Tables 2 and 3.

Once we have a sense of how much good sanitation practices cost for on-farm grain storage, the next question is whether the benefits outweigh the costs. The goal of good sanitation practices is to prevent discounts for contamination, insect damage, and mold damage when the grain is sold. If the grain is under contract to a food-grade buyer, there can be the additional loss of premiums if the grain does not meet the quality standards laid out in the contract. Because the premiums range from $0.15 per bushel to $0.70 or more a bushel, these lost premiums can range from $150 to $700 for a semi-load of grain. In the worst-case scenario, where the grain is also discounted at the elevator, the discounts at the elevator can be as large as $0.15 per bushel or $150 for a semi-load of grain, which would then be combined with the foregone premium for total losses between $0.30 and $0.85 per bushel.

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Table 2. *Total Sanitation Cost for Each Task*

Expenditure Item	Cost per Cleaning ($)		
	Minimum	Average	Maximum
Cleaning Inside and Outside Walls and Floors of a Bin			
Labor	2.50	15.94	50.00
Chemical & other recurring expenses	0.00	0.32	1.75
Depreciation cost for equipment used	0.02	5.15	6.90
Total	**2.52**	**21.40**	**58.65**
Cleaning a Dryer			
Labor	0.83	16.83	45.00
Chemical & other recurring expenses	0.00	0.00	0.00
Depreciation cost for equipment used	3.00	10.11	15.75
Total	**3.83**	**26.95**	**60.75**
Cleaning an Auger			
Labor	0.83	8.44	50.00
Chemical & other recurring expenses	0.00	1.75	7.00
Depreciation cost for equipment used	3.00	7.57	6.50
Total	**3.83**	**17.76**	**63.50**
Cleaning the Surroundings of a Bin			
Labor	0.83	5.28	10.00
Chemical & other recurring expenses	0.00	3.94	8.00
Depreciation cost for equipment used	3.00	5.80	8.00
Total	**3.83**	**15.02**	**26.00**
Cleaning a Combine			
Labor	5.00	10.00	15.00
Chemical & other recurring expenses	0.00	14.07	53.00
Depreciation cost for equipment used	0.00	3.81	6.50
Total	**5.00**	**27.88**	**74.50**
Cleaning a Truck			
Labor	1.25	5.19	15.00
Chemical & other recurring expenses	0.00	0.00	0.00
Depreciation cost for equipment used	3.00	5.15	5.88
Total	**4.25**	**10.35**	**20.88**

Table 3. *Number of Times Sample Producers Cleaned Their Facilities per Year*

Item Cleaned	Minimum	Average	Maximum
Inside and outside walls and floors of a bin	1.00	1.38	2.00
Dryer	1.00	1.17	2.00
Auger	1.00	1.17	2.00
Surroundings of a bin	1.00	1.00	1.00
Combine	1.00	1.50	2.00
Truck	1.00	2.17	4.00

How We Calculated the Costs

To quantify the labor cost associated with sanitation, we used the information from the interviews to identify the average, minimum, and maximum labor hours for each task and converted hours per task to cost per task using the average reported wage rate of $10 per hour. For the chemical and other recurring costs, we asked each producer to report the total amount spent per year for all of their bins, augers, driers, combines, and trucks, and then adjusted for the number of each item to arrive at an average cost per item.

For the depreciation costs, we asked the producers what equipment they use for each sanitation activity, how much the equipment cost, and how long it lasts when used for the sanitation activity (e.g., how long a broom would last if used only for cleaning the interior and exterior of all their bins). To calculate the depreciation cost of the equipment on a per-cleaning basis, we adjusted the value of the equipment for the number of service years and the number of times the sanitation activity is done per year. Where depreciation cost is zero, producers did

not use any equipment. For equipment cost, we did not include repairs, taxes, or insurance, and, while this may underestimate the cost, we believe the error is minor. The majority of tools used include brooms, leaf blowers, and other tools that are often replaced rather than repaired and would not be insured because their value is relatively low.

What We Learned

Bin Preparation

The goal of bin preparation is to remove grain residues where insects and molds can grow and infect the next crop stored in the bin. Prior to filling their bins, most of the producers interviewed clean the floor and walls of their bins with either brooms or leaf blowers. Almost all the farms have bins with perforated steel floors. The producers only spray malathion and never clean the area under the floors due to the difficulty of accessing this space. The producers also spray insecticides on the bin floor and bin exterior. (While many of the producers reported using malathion, note that Purdue no longer recommends malathion for post-harvest use.) Clearly, bin preparation will depend on the size of the bin. These costs reflect the average cost for preparing a bin that holds 36,000 bushels, which took an average of 1 hour and 36 minutes and cost $21.40.

Cleaning Area Around the Bin

The goal of having clean surroundings around a bin is to remove weeds and grain residues where insects can develop. All the producers reported they use herbicides to kill weeds, glyphosate being the most common herbicide. This task takes the producers an hour or less to complete. Most producers clean the area around the bins only when they have a large spillage of corn. On average, cleaning the bin surroundings took less than an hour and cost $13.38 per bin.

Cleaning Dryers

The goal of cleaning the dryer is to remove grain residues where insect and mold populations can grow. Producers do clean their dryers, but only once a year, and the practices varied greatly between the different farms. A few producers only open the dryer bottoms to let grain residues fall out of the dryer. Others remove dirt and other crop debris from the interior with brush, metal scraper, vacuum, and compressed air. On average, producers spent 1 hour and 40 minutes cleaning a dryer, which cost $16.83 for each dryer.

Cleaning Combines

During harvest, the producers clean the combine by using brooms and compressed air. Some farmers also flush their combines with the next grain to be harvested, when switching crops or between white and yellow corn, to prevent contamination that may result in discounts or rejection of the grain. When producers flush combines, they then sell this grain to a local elevator, losing the premium for food-grade grain. During the interviews, producers reported that they use between 0 and 100 bushels of corn to flush their combines. We estimated that the loss to the producer for using grain to flush the combine is the forgone average premium of $0.50 per bushel. Hence, the typical producer who uses about 75 bushels of corn would face a cost of $37.50 per flushing. The during-harvest cleaning takes between 30 minutes and 1 ½ hours, for an average labor cost of $27.88.

In addition, some producers do a thorough cleaning of the combine twice a year, once before harvest and a second time after harvest. The goal of post-harvest combine cleaning is to remove grain residues where insect and mold populations can grow and provide a source of contamination for the following harvest. The most thorough cleaning was reported to take 8 hours, and the cost of this cleaning does not include flushing. Thus, the labor cost alone was $80 per cleaning.

Cleaning Augers

The goal of cleaning the auger is to prevent contamination when switching between crops, such as between corn and soybeans, and to remove grain residues where insect and mold populations can grow. Some producers clean augers/conveyers with a broom and/or leaf blower. Several reported that they spray their augers with insecticides. Many reduce the time needed for cleaning by minimizing the number of times they switch between crops or between white and yellow corn. The total amount of time taken for cleaning the augers/conveyers ranged from 15 minutes to 5 hours.

The producers who spent more time on cleaning the auger were reporting a thorough end-of-season cleaning, while the producers who reported less cleaning time were reporting the in-season cleaning associated with switching crops. Some of the producers reported flushing their augers, and the cost of this flushing depends on the producers' practices. A few producers flush their augers using the same grain they used for flushing their combines and hence incur no additional cost in terms of the lost

premium on the grain. Others use about 10 bushels of corn to flush their augers/conveyers to clean residual grains and foreign material, which costs them about $5.00 in lost premiums. The cost of electricity to flush the auger is estimated at $3.00. On average, producers spent 50 minutes cleaning augers/conveyers, and it cost $17.76 if they didn't flush their auger at all, $20.76 if they used the same grain they used for flushing their combines, and $25.76 if they used 10 bushels of new grain to flush their auger.

Cleaning Trucks

The goal of cleaning the truck is to prevent contamination of the food-grade grain by the crop that was previously transported in the truck. All of the producers interviewed used semi-trucks to haul their grain, and a semi load holds roughly 1,000 bushels of corn. Several producers used a broom and compressed air to thoroughly clean their trucks. One producer used a high-pressure washer after manure was previously hauled in the truck. Other producers only lifted the truck bed or opened the hopper gates as far as possible to let all kernels and debris fall out. The amount of time required to clean a truck varies between 5 minutes to 1 hour depending on the level of cleaning activity, and the cost of cleaning a truck ranged from $1.25 to $15 per truck, with an average cost of $10.35 per truck.

How Producer Sanitation Practices Compare to Purdue's Best Management Practices

Comparing the sanitation practices of the interviewed food-grade corn producers to the sanitation practices recommended by Purdue's Grain Quality Team, there are several additional sanitation steps that producers should consider. These additional best management practices include the following.

- Most of the producers interviewed clean the bins and spray after the bin is emptied. Cleaning immediately after emptying the bins is good, but we also recommend that producers spray the bin right before it is filled with grain. If there is a pervious pest problem, we recommend the producer spray the bin after it is emptied (e.g., in the spring) and again right before it is filled (e.g. in the late summer).
- We recommend that any openings where insects and rodents can enter the bin should be permanently sealed (e.g., around unloading auger tubes, aeration fan transition, and side door openings before harvest).
- When producers flush their combines, we recommend that the flush volume should be at least equal to the capacity of a combine's grain tank (150-400 bushels depending on the machine). For more information on the recommended combine sanitation practices see *Where Grain Hides in a Combine* available at <http://www.extension.purdue.edu/extmedia/GQ/GQ-49-W.pdf>.
- We recommend that producers establish a detailed written sanitation schedule.

For more information on the recommended sanitation practices see *Maximize Grain Quality & Profits Using S.L.A.M.: The Post-Harvest IPM Strategy* available at <http://www.extension.purdue.edu/extmedia/ID/ID-207.html>.

Conclusions

Grain producers who store grain on-farm into the summer months want to maintain grain quality to maximize its market value. One important practice for maintaining and maximizing grain quality is to employ good sanitation practices. Interviews of eight producers in Indiana and Illinois show that good sanitation practices can cost on average $21.40 per grain bin and $13.38 for the bin surroundings, $26.95 per grain dryer, $17.76 per auger cleaning, $14.23 per combine cleaning, and $10.35 per truck cleaning. If we add all of these costs up and assume the farm has one 36,000 bushel bin, then the sanitation cost is less than $0.001 per bushel. If the farm has more bins or larger bins, then the per bushel cost would be even lower.

The benefit of good sanitation practices to the producer is to avoid discounts for contamination, insect damage, and mold damage when the grain is sold. These benefits can range from $0.10 to $0.85 per bushel. Given that the costs of good sanitation practices are small relative to the benefit of maintaining grain quality, producers who plan to store grain into the summer months should take care to maintain good sanitation practices.

The Authors

The authors of this publication are members of the Consortium for Integrated Management of Stored Product Insect Pests. Contact information is available at the Web site <http://www.oznet.ksu.edu/spiramp>.

Corinne Alexander, Extension Agricultural Economist, Purdue University
Yigezu A. Yigezu, Graduate Research Associate, Purdue University
Dirk E. Maier, Extension Agricultural Engineer, Purdue University
Linda J. Mason, Extension Food Pest Entomologist, Purdue University
Charles P. Woloshuk, Extension Plant Pathologist, Purdue University

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