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Stored Grain Losses Due to Insects and Molds and the Importance of Proper Grain Management

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According to a 1990 survey of extension specialists throughout the United States, stored grain losses exceeded $500 million for the year. Most of these losses resulted from infestation by several species of insects and damage by numerous molds and mycotoxins.

Most of the insects currently infesting grain are species that thrive primarily on mold, such as the rusty grain beetle, *Crypotelestes ferrugineus* (Stephens); the foreign grain beetle, *Ahasverus advena* (Waltl); and the hairy fungus beetle, *Typhaea stercorea* (Linnaeus) (Barak and Harein 1981, Subramanyam and Harein 1989). These species thrive anywhere in the environment where adequate temperatures and moisture conditions support mold growth. Undoubtedly, old grain within a bin orspilled grain near a bin site are common sources of insect reinfestation. These mold-feeding insects do not rely on weevils or borers to infest grain initially because there are sufficient broken kernels and similar debris in the grain mass for externally developing beetles to survive.

Losses resulting from insect infestations are widespread and involve more than loss of quality. Damaged kernels are of lighter weight and result in discounts when marketed. Insect infestation also causes a reduction in nutrients in the grain. Controlling insects with insecticides, including fumigants, rather than using preventative methods incurs great cost. In addition, infestation generally results in dissatisfied customers and related marketing problems that develop from a poor reputation in marketing channels. The most unfortunate consequence of not managing grain properly is the loss of money, time, and effort to produce the grain (i.e., seed, fertilizer, field pest management, harvesting).

In 1987, IDK (insect damaged kernels) was established as a grading factor for wheat. As a result of a memorandum of understanding between the Food and Drug Administration (FDA) and the Federal Grain Inspection Service (FGIS), wheat containing 32 or more IDK per 100 grams would result in the wheat being designated as Sample grade. Restricting the sale of wheat for livestock feed is a significant loss-a loss that some sellers attempted to reduce by claiming the damage occurred in shipment and should be covered by insurance. This claim is not justified since this type of damage (primarily adult insect emergence holes) could not occur in the short shipment period (7 to 14 days). The insects producing IDK damage require 30 to 45 days for development and emergence from the kernels.

Infestation by fungi will cause losses by lowering the grade of grain due to damage by dry matter loss and by odor, both of which relate to a grading factor. The higher

Table 1. Rate of dry matter loss (DML) in soybean seeds as related to kernel moisture content, temperature, and time.

		DML(%) Through Time			
Temp (C)	Initial MC(%)	O-60 Days	61-120 Days	121-180 Days	Total at 180 Days
15	13.94	0.00	0.06	0.18	0.24
	17.38	0.12	0.17	0.26	0.55
	19.84	0.10	0.19	0.96	1.25
25	14.18	0.00	0.16	0.23	0.39
	17.13	0.30	0.32	0.68	1.30
	20.37	1.05	1.23	1.74	4.02

[a] Each figure is an average of four tests.

Table 2. Dry matter loss (DML) resulting from invasion by storage fungi on corn held 180 days at beginning moisture contents of 14.5 to 19.5 percent.

	Moisture Content (%)				
Days Stored	At Start (Av.)	At Test Period Av.	At Test Period SD	DML(%) Av.	DML(%) SD
30	14.5[a]	14.6	0.11	ND[b]	-
	15.5	15.7	0.09	0.37	0.18
	16.5	17.1	0.31	0.82	0.37
	17.5	18.2	0.05	1.06	0.09
	18.5	19.4	0.07	1.29	0.11
	19.5	20.5	0.16	1.56	0.21
				r^2=0.949[c]	
60	14.5	14.6	0.24	ND	-
	15.5	15.7	0.22	0.18	0.35
	16.5	17.7	0.12	1.66	0.03
	17.5	18.8	0.25	2.03	0.29
	18.5	20.2	0.22	2.61	0.31
	19.5	21.3	0.24	3.58	0.94
				r^2=0.978	
90	14.5	14.5	0.06	ND	-
	15.5	15.9	0.20	0.46	0.17
	16.5	17.6	0.20	1.76	0.18
	17.5	19.3	0.22	2.86	0.37
	18.5	20.9	0.23	3.69	0.37
	19.5	22.4	0.23	4.55	0.37
				r^2=0.994	
120	14.5	14.4	0.10	ND	-
	15.5	15.9	0.18	0.55	0.16
	16.5	17.8	0.46	2.17	0.35
	17.5	19.9	0.50	3.69	0.68
	18.5	21.5	0.52	4.80	0.90
	19.5	22.7	0.34	5.37	0.37
				r^2=0.992	
150	14.5	14.6	0.13	ND	-
	15.5	16.1	0.12	0.73	0.14
	16.5	18.4	0.29	2.88	0.28
	17.5	20.4	0.11	4.54	0.38
	18.5	22.4	3.52	5.80	0.74
	19.5	23.7	0.65	6.66	0.57
				r^2=0.994	
180	14.5	14.6	0.09	0.24	0.28
	15.5	16.3	0.17	1.00	0.23
	16.5	18.7	0.41	3.30	0.39
	17.5	21.9	1.46	5.44	0.75
	18.5	23.0	0.04	6.78	0.35
	19.5	24.8	0.22	7.96	0.51
				r^2=0.994	

[a] Initial moisture content of all samples was within + 0.3% of those indicated.
[b] Not detectable.
[c] Regression analysis (r^2 value) of the average moisturecontent at the test period on the average dry matter loss.

the moisture content over time, the greater the dry matter loss in both soybeans (Lazzari 1988) and in corn (Christensen and Meronuck, 1988) (Tables 1 and 2). By the time the dry matter loss has reached 0.5 to 1.0 percent, the germs of most kernels are heavily invaded by fungi, especially *Aspergillus glaucus,* and it would seem probable that corn in farm or commercial storage that had suffered that amount of dry matter loss would be at risk of developing grade-reducing damage during subsequent storage or shipment.

Perception of United States grain quality, especially in comparison with grain grown in Canada and Australia, stems from the numerical grade system which grades grains as U.S. Number 1, 2, 3, or Sample grade. This system allows buyers to purchase the grain best suited to their needs and the amount they agree to pay. The cut-off levels on grading factors are established by the USDA-FGIS in cooperation with grain industries and Congress. The FGIS is not a regulatory agency as is the USDA-Animal Plant Health Inspection Service (APHIS), and consequently it cannot dictate changes in the grading system to improve export quality.

Adequate management of insects and molds that attack and destroy harvested grain has always received less attention than pest management efforts on crops in the field. There is no justification for such behavior, as losses of grain in storage are often equal to cereal grain losses in the field. In addition, production losses can be reduced by replanting when no such avenue exists following damage after harvest.

Recent drought years and increased world markets have resulted in relatively low carry-over grain stocks. Unfortunately, some stored-grain managers believe that this situation reduced or even eliminated stored-grain pest problems. Consequently, even less attention has been given to these stored-grain pest problems. It also appears that, at least in certain areas, the grain that could meet buyers' standards was marketed, leaving the poor quality grain in storage to continue its degradation as a result of poor stored-grain management practices.

The distorted perception that U.S. grain quality and cleanliness is inferior to Canadian or Australian grain is a direct result of the regulatory intervention within the marketing system in those countries. The U.S. marketing system is not regulated by the U.S. Department of Agriculture with respect to receival standards, export standards, or pricing. Consequently, a wider range of quality enters the U.S. grain marketing systems based on the simple principles of supply and demand. This quality diversity enhances the U.S. marketing system because buyers and sellers may negotiate grain quality and price. As a result, U.S. export quality may differ from other exporting countries, but U.S. exporters are able to fulfill the buyers' quality expectations at acceptable prices.

References

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