

Soybean Drying and Storage



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NDSU

EXTENSION

Maximum Moisture Contents for Safe Soybean Storage with Aeration

Sold by Spring 13%
Long-term Storage 11%

EMC @ 70°F & 60% RH

- Corn 12.8%
- Hard Wheat 13.3%
- Soybeans 10.8%

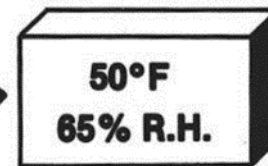


EQUILIBRIUM

14% CORN



AIR



Moisture Measurement



- **Adjust for temperature**
 - May not be accurate $<40^{\circ}$ F
- **Electronic meters more sensitive to outside of kernel**
 - Moisture variation after rapid drying
- **Meters affected by condensation**



Recommended Process

- **Place sample in sealed container for several hours**
 - ~ 6-12 hrs.
- **Warm to $\sim 70^{\circ}$ F**
- **Check moisture**

“Approximate” Allowable Storage Time for Soybeans

Moisture Content (%)	--- Grain Temperature (°F) ---					
	30°	40°	50°	60°	70°	80°
	Approximate Allowable Storage Time (Days)					
11	*	*	*	*	200	140
12	*	*	*	240	125	70
13	*	*	230	120	70	40
14	*	280	130	75	45	20
15	*	200	90	50	30	15
16	*	140	70	35	20	10
17	*	90	50	25	14	7
19	190	60	30	15	8	3
21	130	40	15	10	6	2
23	90	35	12	8	5	2
25	70	30	10	7	4	2
27	60	25	5	5	3	1

* Allowable storage time exceeds 300 days

- Allowable storage time is the storage period before quality loss is expected to affect grain quality.
- Airflow through the grain permits maintaining the grain temperature, but does not extend the allowable storage time beyond that listed in the table.
- Allowable storage time is cumulative. If 16% moisture soybeans were stored for 35 days at 50°F, one-half of the storage life has been used. If the soybeans are cooled to 40 degrees, the allowable storage time at 40 degrees is only 70 days.

Cool Stored Soybeans

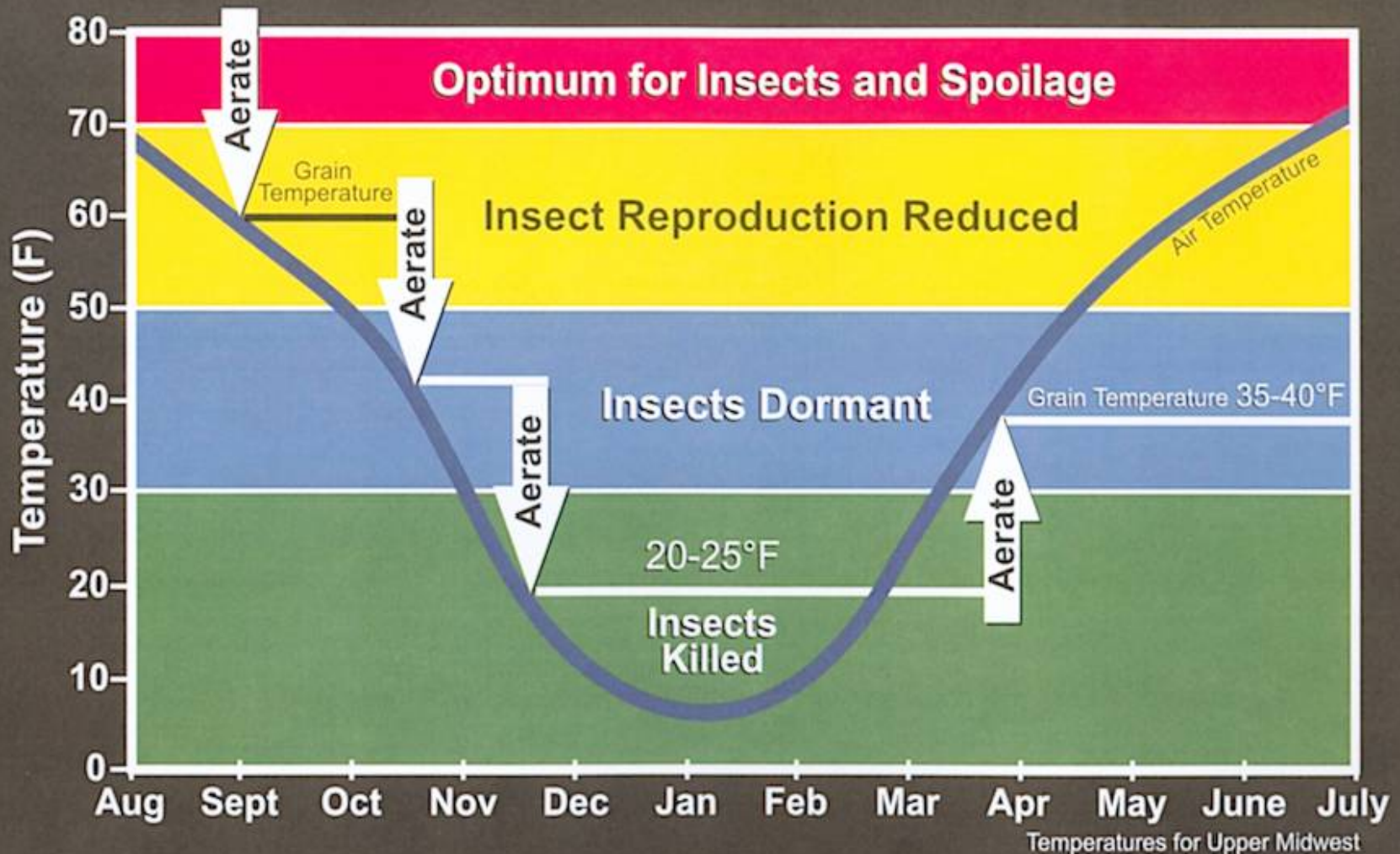
- Free fatty acids increase with moisture, temperature, and time
- Storage of 12% beans @ 70 F < 4 months to exceed free fatty acid acceptable level.
- Rapidly cool soybeans during fall
- Cool to 20 - 30 F for winter
- Keep as cool as possible spring & summer

Handle Beans Gently

- Drop height affects damage
- Damage increases at less than 12% moisture content
- Damage increases at lower temperatures



Cool Grain to Prevent Storage Problems



* Prevent crusting due to moisture migration by cooling grain to within 15°F of average outdoor temperatures.

* Cooling grain by 10°F doubles its allowable storage time

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Fans Off During Snow/Rain/Fog



Aeration Airflow Rate Selection

Estimated Cooling Time

Time (hrs.) = 15 / Airflow rate (cfm/bu.)

Time (hrs.) = 15 / 0.2 cfm/bu.

Time (hrs.) = 75 hrs.

Example:

42' diameter, 36 ft. depth, 40,000 bu. Soybeans

3 hp. Axial Fan, 0.15 cfm/bu.

Cooling time = 100 hrs.



Manage - to direct with a degree of skill



Monitor:

- Temperature
- Moisture
- Insects
- Mold

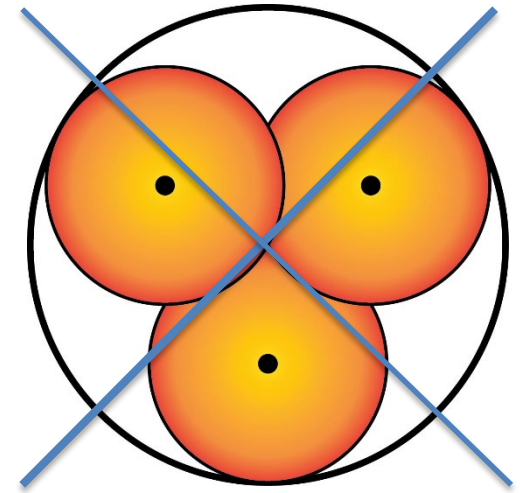
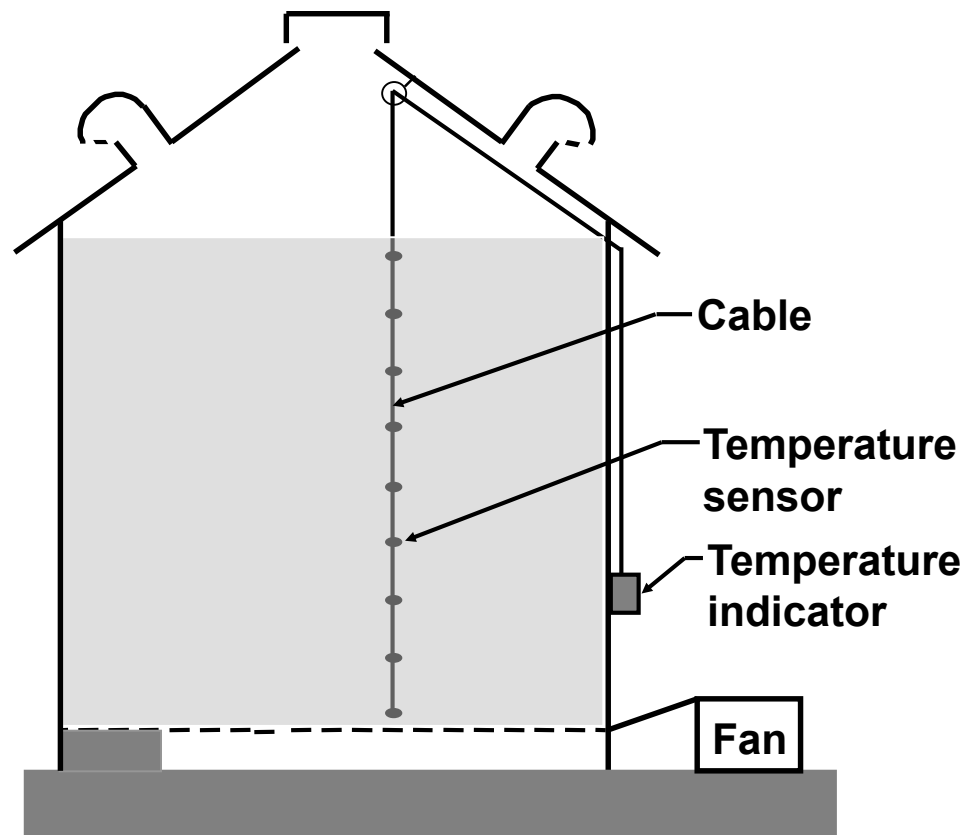
Check Grain

- 2-weeks until cooled
- 2-4 weeks during winter
- 2-weeks spring & summer

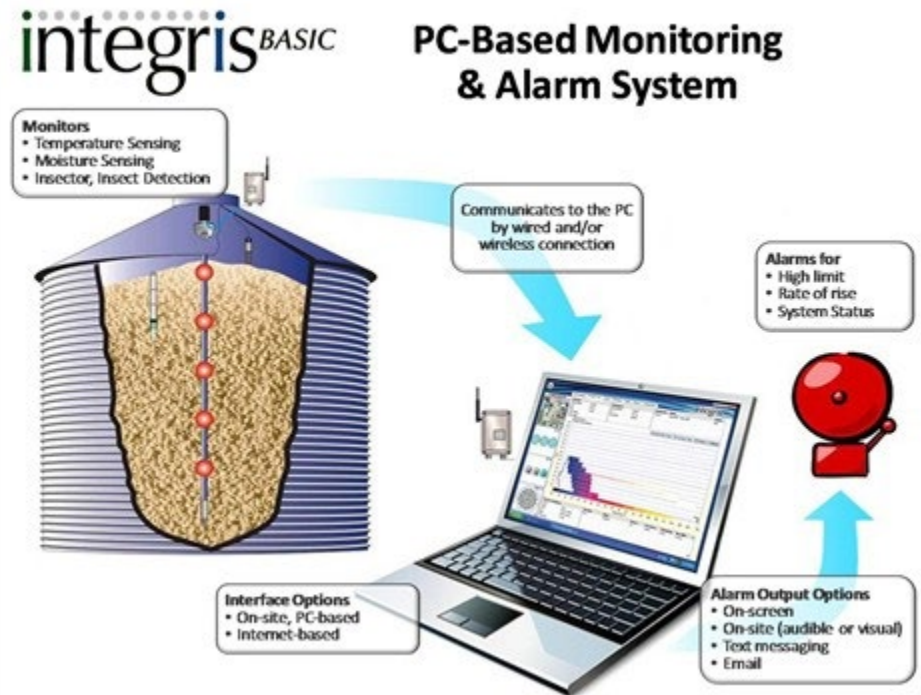
Manage: Aerate & Dry

- Temperature
- Moisture
- Insects

Senses only grain near cable



Sensors & Fan Controllers



Technology does not replace Management!

Spring Grain Temperature



Average Air Temperature.

February - 13°	NE - 27
March - 28°	NE - 37
April - 45°	NE - 50
May - 57°	NE - 60

Solar Radiation (Btu/ft²-day)

	<u>Wall</u>	<u>Roof</u>
Feb. 21	1725	1800
Jun. 21	800	2425

Periodically Cool

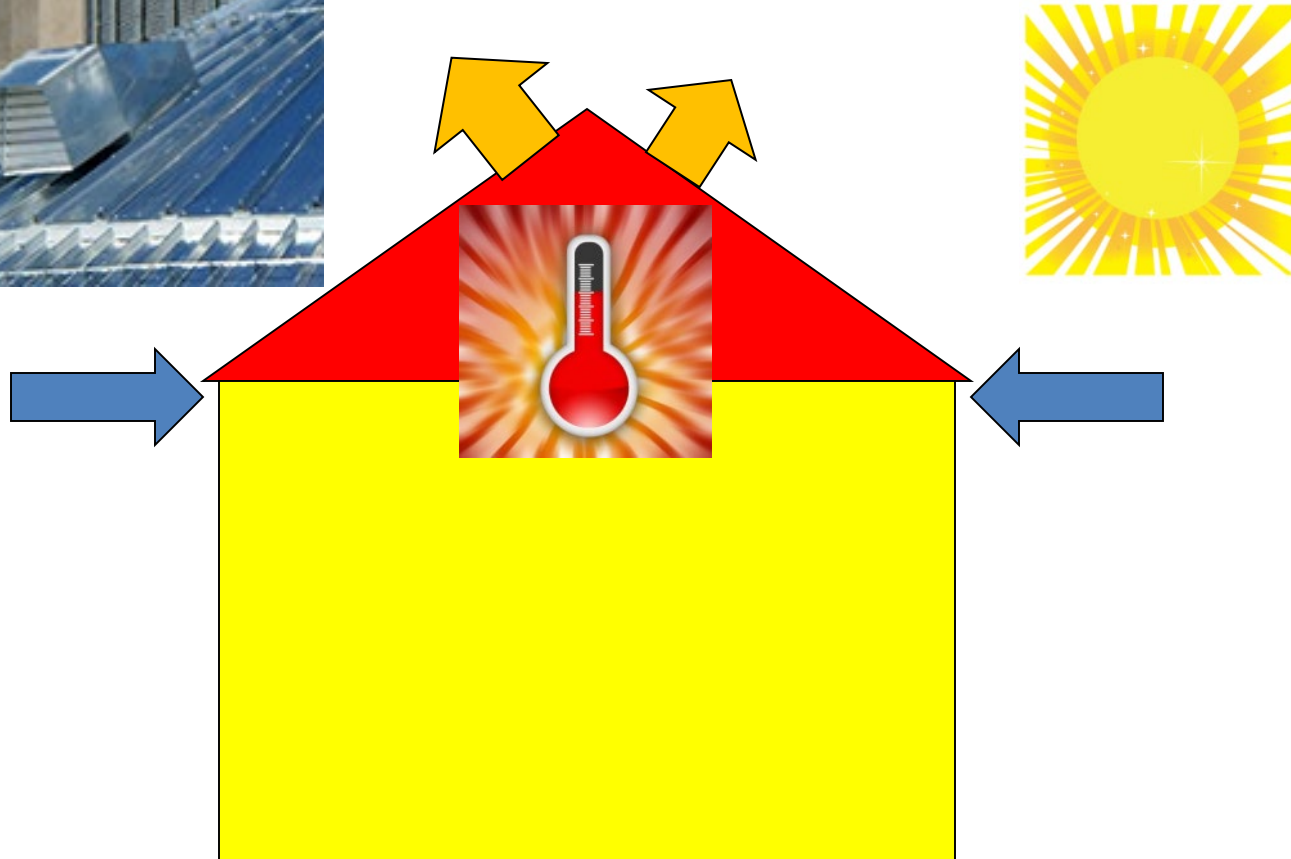


North Central Region States

Average Monthly Maximum and Minimum Temperature, (F)

		ND	SD	NE	KS	MN	IA	MO	WI	IL	MI	IN	OH
Jan	Max	16	27	36	39	19	31	38	23	36	30	32	36
	Min	-3	7	14	19	-1	14	21	6	19	17	16	20
April	Max	52	59	63	67	55	62	66	55	66	58	62	63
	Min	29	34	38	43	34	41	44	33	43	37	38	41
July	Max	80	86	88	93	82	86	88	80	87	82	84	85
	Min	57	61	65	69	61	67	67	59	66	61	62	65
Oct	Max	55	60	65	70	58	63	67	55	68	60	64	65
	Min	32	35	40	46	36	43	45	37	45	41	41	44

Ventilate Bin Headspace



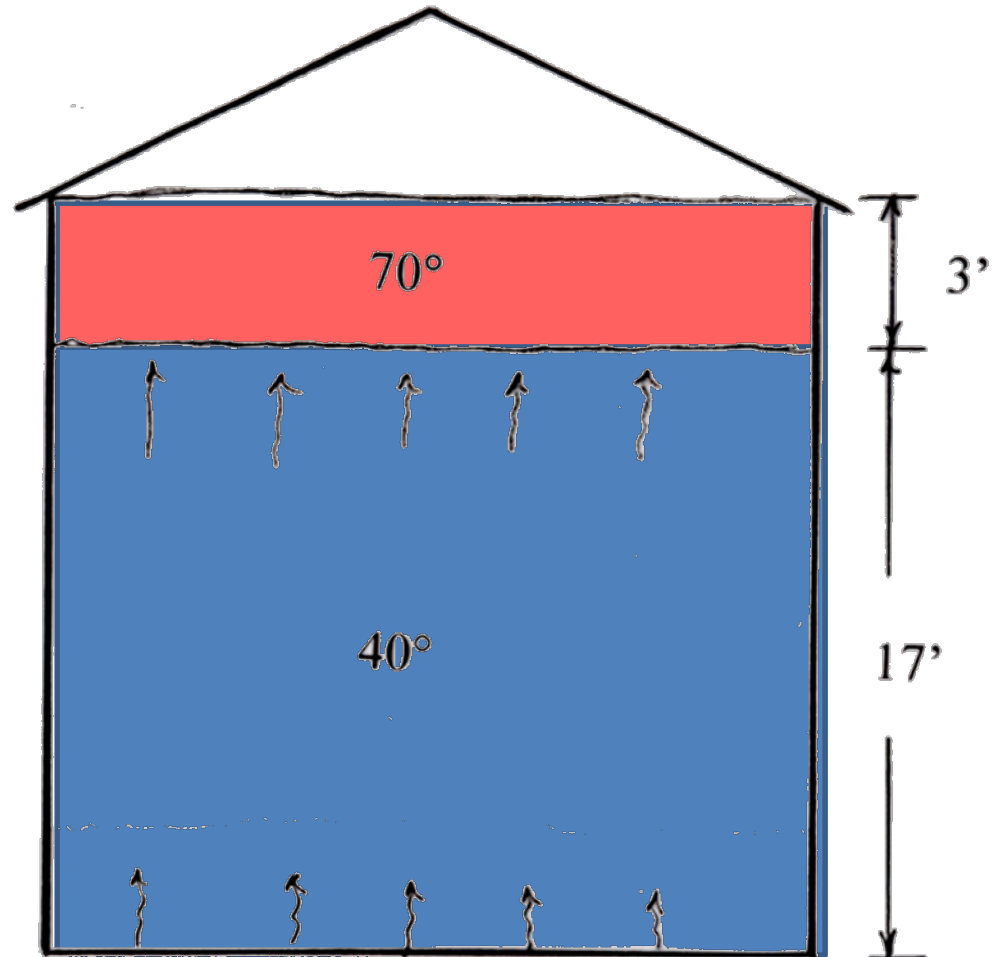
Spring & Summer Cooling

Cooling Time

$$15 / 0.2 \text{ cfm/bu} = 75 \text{ hrs.}$$

$$3/20 = 0.15 \approx 11 \text{ hrs.}$$

Coollest at sunrise



Cover Fans When Not Operating

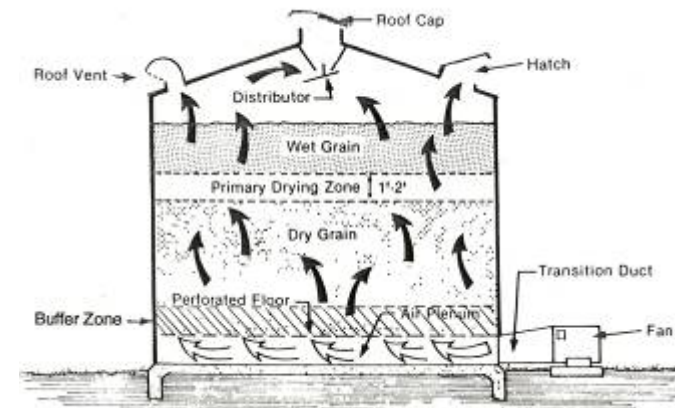


- Prevents spring warm-up
- Keep snow & pests out
- Keep damp air out

Air Drying Soybeans works in October – Not in November

October 47°F & 65% RH EMC = 12.0%

	cfm/bu	Drying Time (days)
18%	1.0	58
	1.5	39
	2.0	29
16%	1.0	50
	1.5	34
	2.0	25



October 15 - November 15 37°F & 70% RH EMC = 13.7%

	Cfm/bu	Drying Time (days)
18%	2.0	36
16%	2.0	39



April 42°F & 71% RH, May 56°F & 63% RH

Adding Heat may help in October – Not in November

October 15 - November 15 (+5°F)

42°F & 58% RH EMC = 11.0%

	cfm/bu	Drying Time (days)
18%	1.0	58
	1.5	39
	2.0	29
16%	1.0	50
	1.5	34
	2.0	25



April 42°F & 71% RH, May 56°F & 63% RH

High Temperature Drying Soybeans

- Follow dryer recommendations to start then adjust as appropriate
- Typical Maximum Drying Temperature (non-food soybeans)

Continuous flow	130° F
Batch Dryer	110° F
Seed	110° F
- Relative humidity above 40% reduces cracks.



Damage Occurring to Soybeans as Function of Drying Temperature

Drying Temperature (°F)	Skins Cracked (%)	Beans Cracked (%)
100	10 - 60	5 - 20
130	50 - 90	20 - 70
160	80 - 100	30 - 80



Fire Hazard Drying Soybeans

- Pods and trash become lodged and combustible
- Keep grain flowing
- Keep dryer clean
- Monitor dryer



Poly Bag Storage



- Sealed bag does not prevent mold growth or insect infestation.
- Run bags north-south
- Select an elevated location with excellent drainage
- Monitor regularly
- Use for winter storage – grain is at average temp.

Uncovered Piles



- 1-inch rain increases moisture content of 1 ft of corn & soybeans by 9 percentage points



Grain Piles



- Prepared surface
- Negative pressure holds cover
- Examine for Perforations
- **Designed and managed aeration is critical for piles.**



For More Information



**Internet Search: NDSU Grain Drying
and Storage**

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