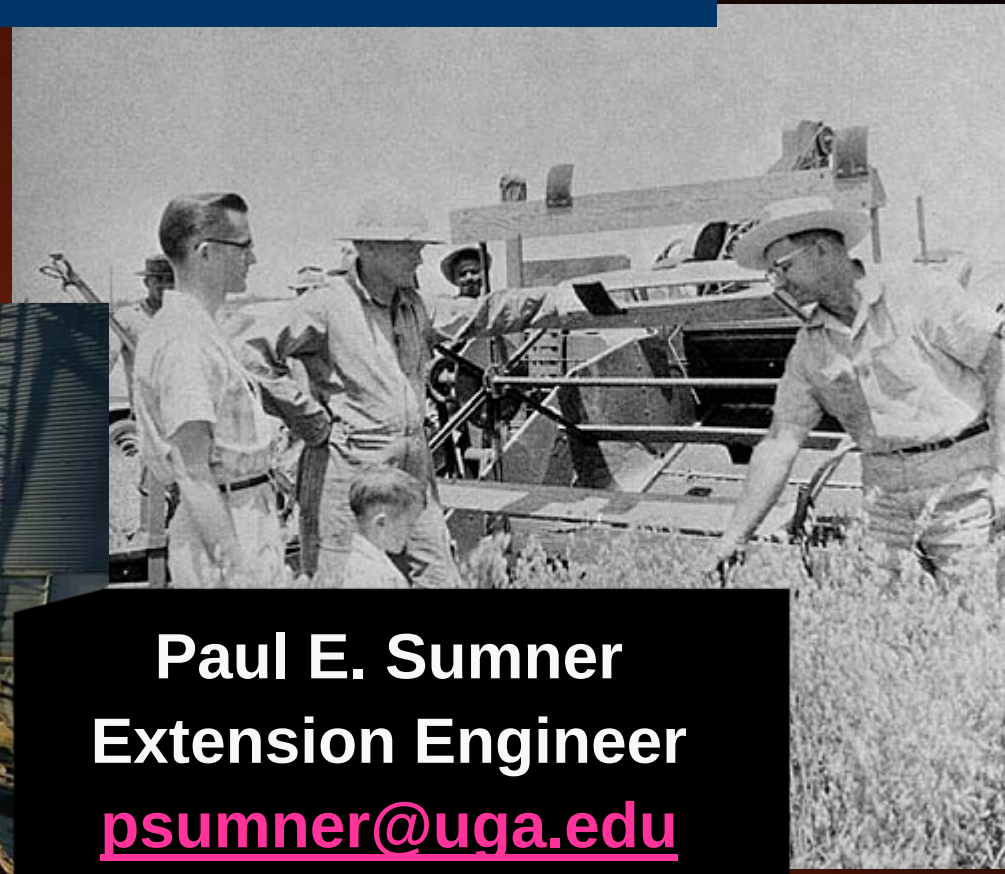
Timely Harvest, Drying and Aeration of Grain



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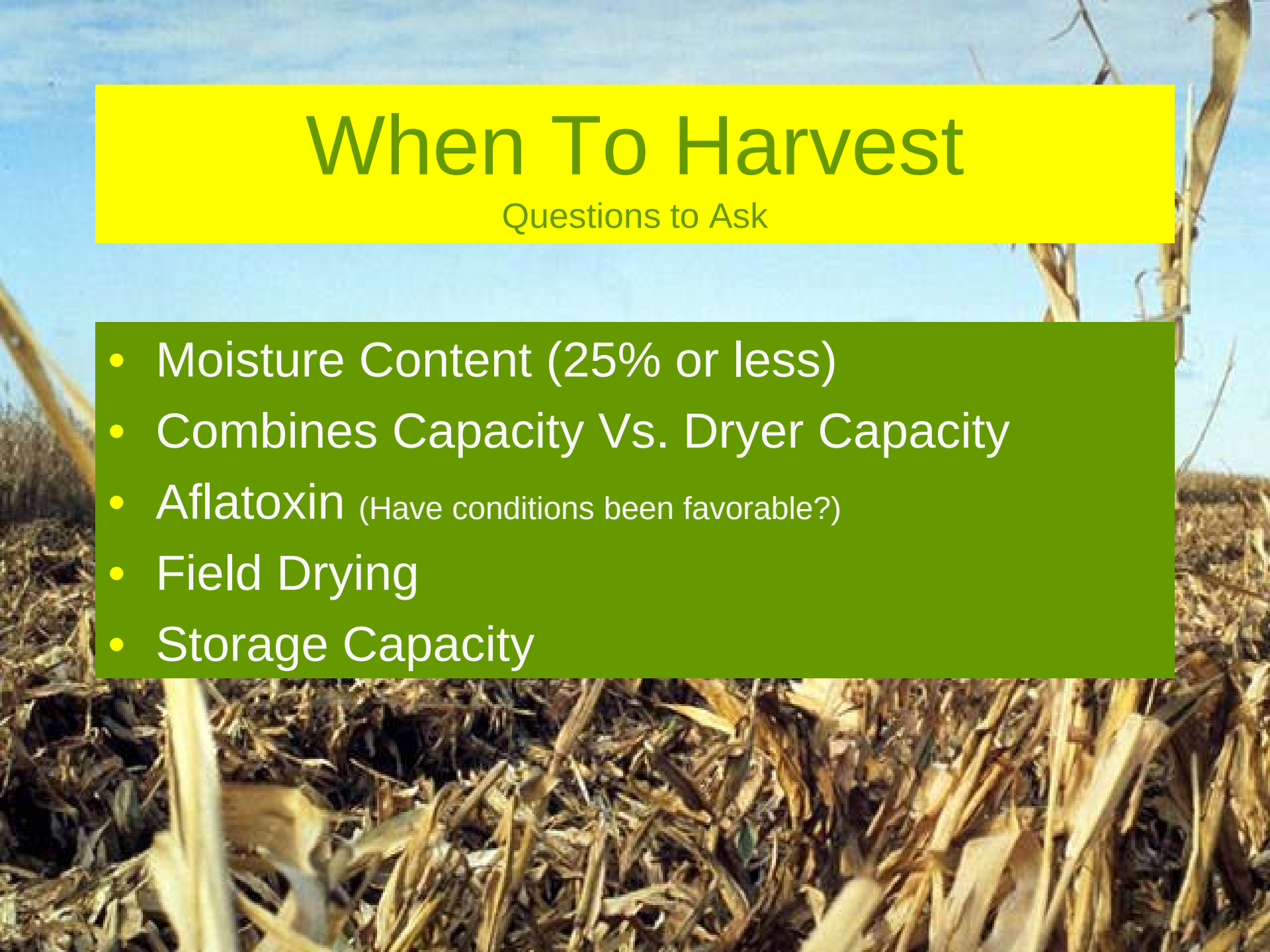


When To Harvest

Questions to Ask

- Moisture Content (25% or less)
- Combines Capacity Vs. Dryer Capacity
- Aflatoxin (Have conditions been favorable?)
- Field Drying
- Storage Capacity

Handling High Moisture Corn

- **Drying on the Farm**
- **Deliver to Elevator to Dry**
- **Custom Drying (Neighbor, Peanut Facility, Etc)**

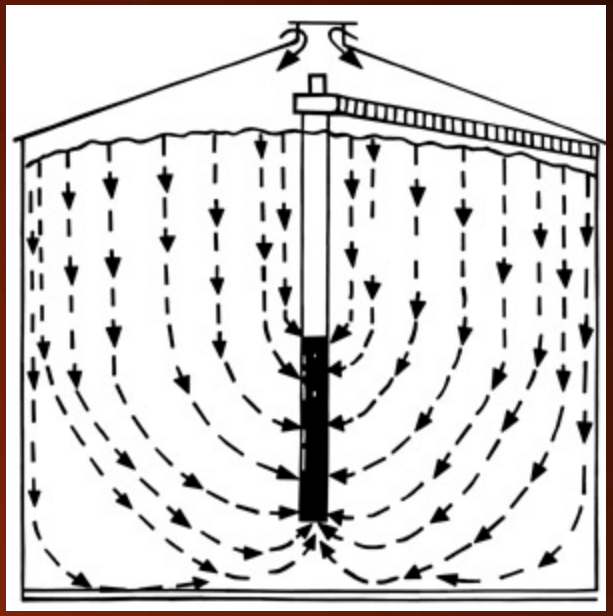
Selecting Drying Equipment

- Match Drier to Harvest Rate
- Time required for drying
- Type of grain
- Drying temperature
- Air flow rate
- Heat required

Aeration

- Cools grain
- Maintains uniform grain quality
- Prevents moisture migration
- Low airflow rate
- No heat required

Moisture Movement in Metal Bins



- air near the bin walls cools moving downward
- air in the center portion of the bin is heated –rise
- warmer air has greater moisture-holding capacity
- cooled and loses some of its water-holding capacity - condensation.

Air Flow Requirements

upright storage - 1/10 to 1/20 CFM per bushel

flat storage - 1/5 to 1/10 CFM per bushel

Do not use lower rates unless moisture content is less than 12 percent (wet basis)

Direction of Air Flow

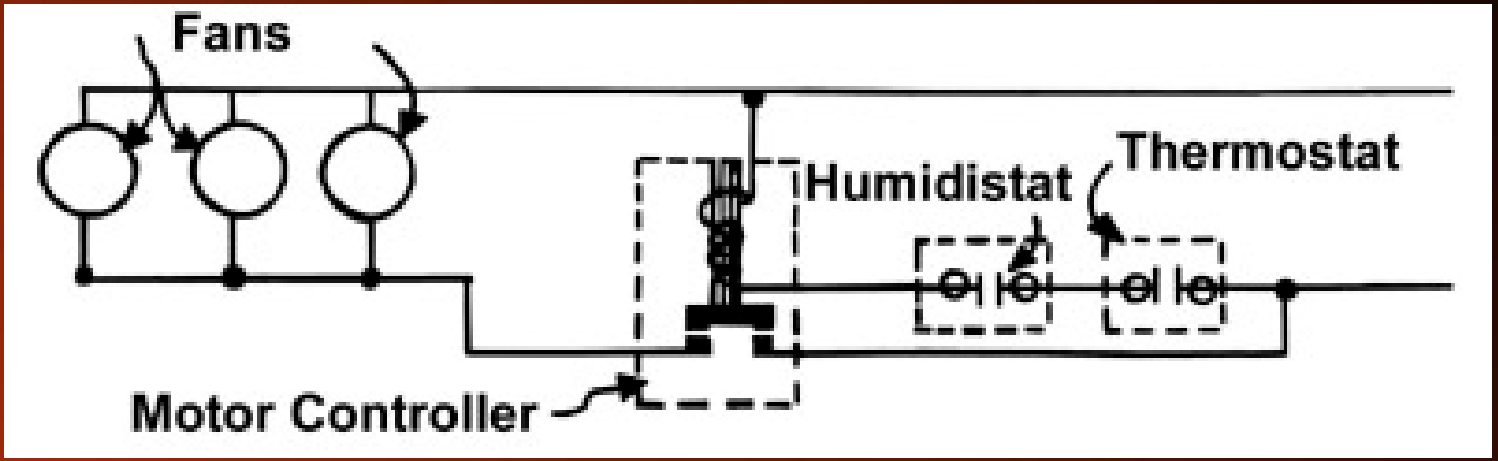
- Normally, the air should be drawn downward through stored grain, counteracting the tendency of the warm air to rise
- When air flow rate is high, the direction of air flow is not critical

Fan Operation

- Aeration should begin when outside air temperature is approximately 10 degrees F below the grain temperature
- Grain temperature of 50 degrees F is generally satisfactory
- Lowering the temperature below 50 degrees F will give better insect and mold control

- Crop drying fans, if used for aeration, have considerable capacity and should not be operated when humidity is extremely high or low.
- The higher air flow cools the grain rapidly. It is desirable to aerate with these fans only when the humidity is below 60 percent and the grain is 10 to 15 degrees F warmer than outside air temperature under these conditions.
- During warm periods, aerate during the cooler part of the day (evening or early morning). Operate the fan continuously for a few days to remove harvest heat.

Controls



Moisture Content for Safe Storage (12 months)

- 12 months
  - 11-12% for North Georgia
  - 10-11% for South Georgia
- Over winter
  - 15% if grain temp. held below 65^{o} F

Natural Air Drying

Table 1. Equilibrium moisture content of shelled corn at various relative humidity and air temperature.

Air Temp (°F)	Relative Humidity (%)									
	30	35	40	45	50	55	60	65	70	80
30	10.3	10.8	11.3	12.2	13.1	13.8	14.6	15.5	16.4	18.7
50	8.8	9.7	10.5	11.3	12.0	13.0	13.9	14.8	15.7	17.9
60	8.5	9.3	10.1	10.9	11.7	12.5	13.3	14.2	15.1	17.2
70	8.1	8.9	9.7	10.5	11.2	12.0	12.8	13.6	14.5	16.6
80	7.8	8.6	9.3	10.1	10.8	11.6	12.4	13.2	14.0	16.0
90	7.6	8.3	9.0	9.7	10.5	11.2	12.0	12.7	13.6	15.5
100	7.3	8.0	8.7	9.4	10.1	10.9	11.6	12.4	12.2	15.1

Table 2. Estimated maximum quantities of grain that can be dried per batch per fan horsepower for minimum air flow rates and grain depths using natural air.

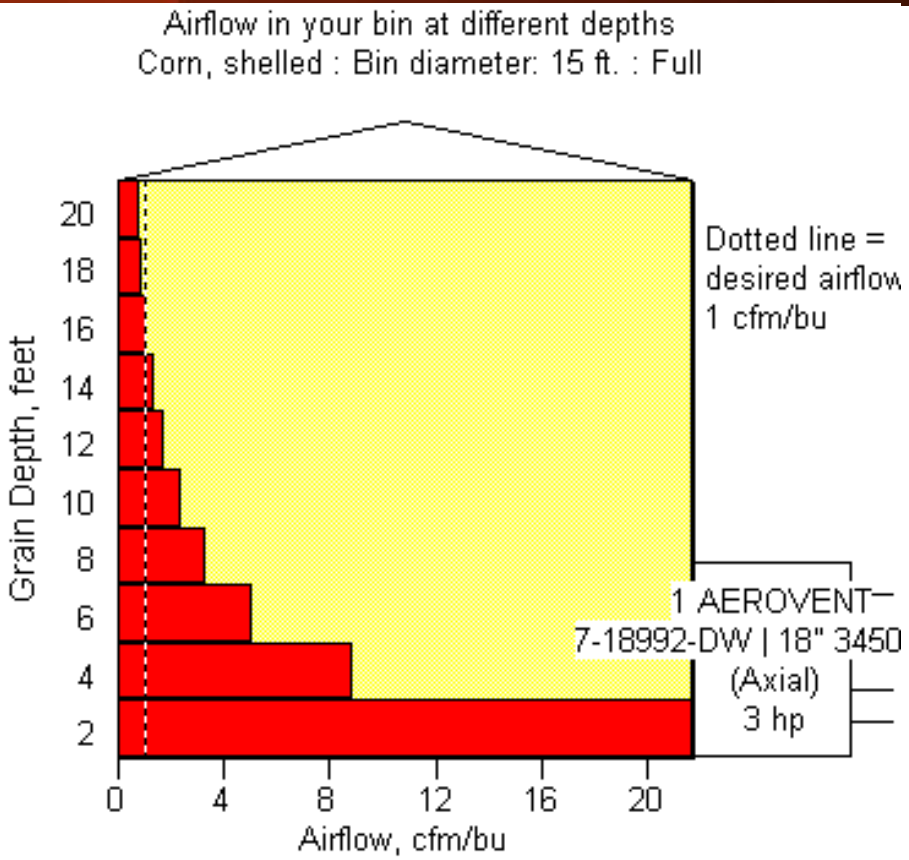
Grain	Air Flow Rate per Bushel (CFM)	Initial Moisture Content (Percent)	Grain Depth (Feet)	Static Pressure (Inches Water Gage)	Maximum Quantity That Can Be Dried Per Fan Horsepower (Bushels)
Corn (Shelled)	6	25	3	0.60	885
			5	1.50	360
			7	3.20	170
	5	22	5	1.00	635
			7	2.40	265
			8	3.40	190
	3	18	7	1.27	835
			9	2.14	495
			10	2.65	400
	2	15	7	0.81	1965
			9	1.33	1200
			11	1.95	815

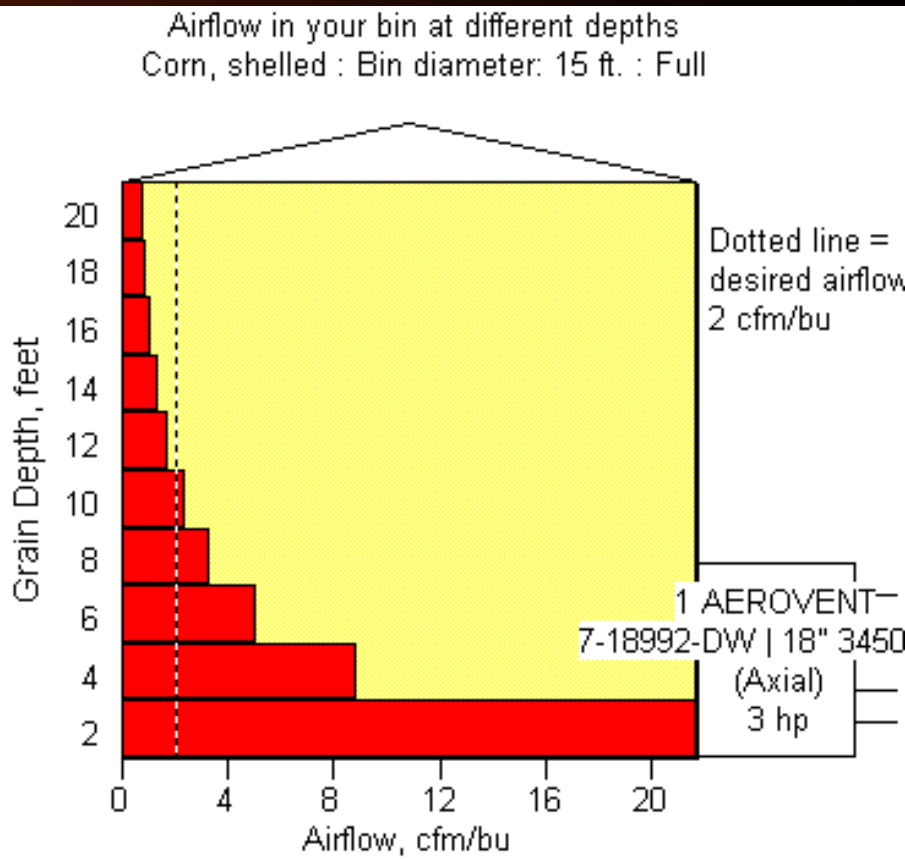
Table 3. Approximate drying time (days) for shelled corn at different initial moisture contents for 2.5ºF temperature rise and 2 CFM/bushel.

Final Moisture (%)	Drying Time (hours)							
	Initial Moisture (%)							
	20	19	18	17	16	15	14	13
20	0							
19	6	0						
18	13	7	0					
17	19	13	6	0				
16	25	19	12	6	0			
15	31	25	18	12	6	0		
14	37	31	24	18	12	6	0	
13	43	37	30	24	18	12	6	0
12	48	42	35	29	23	17	11	5
11	53	47	40	34	28	22	16	10
10	58	52	45	39	33	27	21	15

Table 5. Approximate drying time (days) for shelled corn at different initial moisture contents for 2.5ºF temperature rise and 5 CFM/bushel.

Final Moisture (%)	Drying Time (hours)							
	Initial Moisture (%)							
	20	19	18	17	16	15	14	13
20	0							
19	2	0						
18	5	3	0					
17	8	5	2	0				
16	10	8	5	2	0			
15	12	10	7	5	2	0		
14	15	12	10	7	5	2	0	
13	17	15	12	10	7	5	2	0
12	19	17	14	12	9	7	4	2
11	21	19	16	14	11	9	7	4
10	23	21	18	16	13	11	9	6


Airflow in your bin at different depths
Corn, shelled : Bin diameter: 15 ft. : Full
Grain Depth, feet
20
18
16
14
12
10
8
6
4
2
0
4
8
12
16
20
Airflow, cfm/bu
Dotted line =
desired airflow
1 cfm/bu
1 AEROVENT
7-18992-DW | 18" 3450
(Axial)
3 hp


Airflow in your bin at different depths
Corn, shelled : Bin diameter: 15 ft. : Full
Grain Depth, feet
20
18
16
14
12
10
8
6
4
2
0
4
8
12
16
20
Airflow, cfm/bu
Dotted line =
desired airflow
2 cfm/bu
1 AEROVENT
7-18992-DW | 18" 3450
(Axial)
3 hp

Stirring and Recirculating Devices

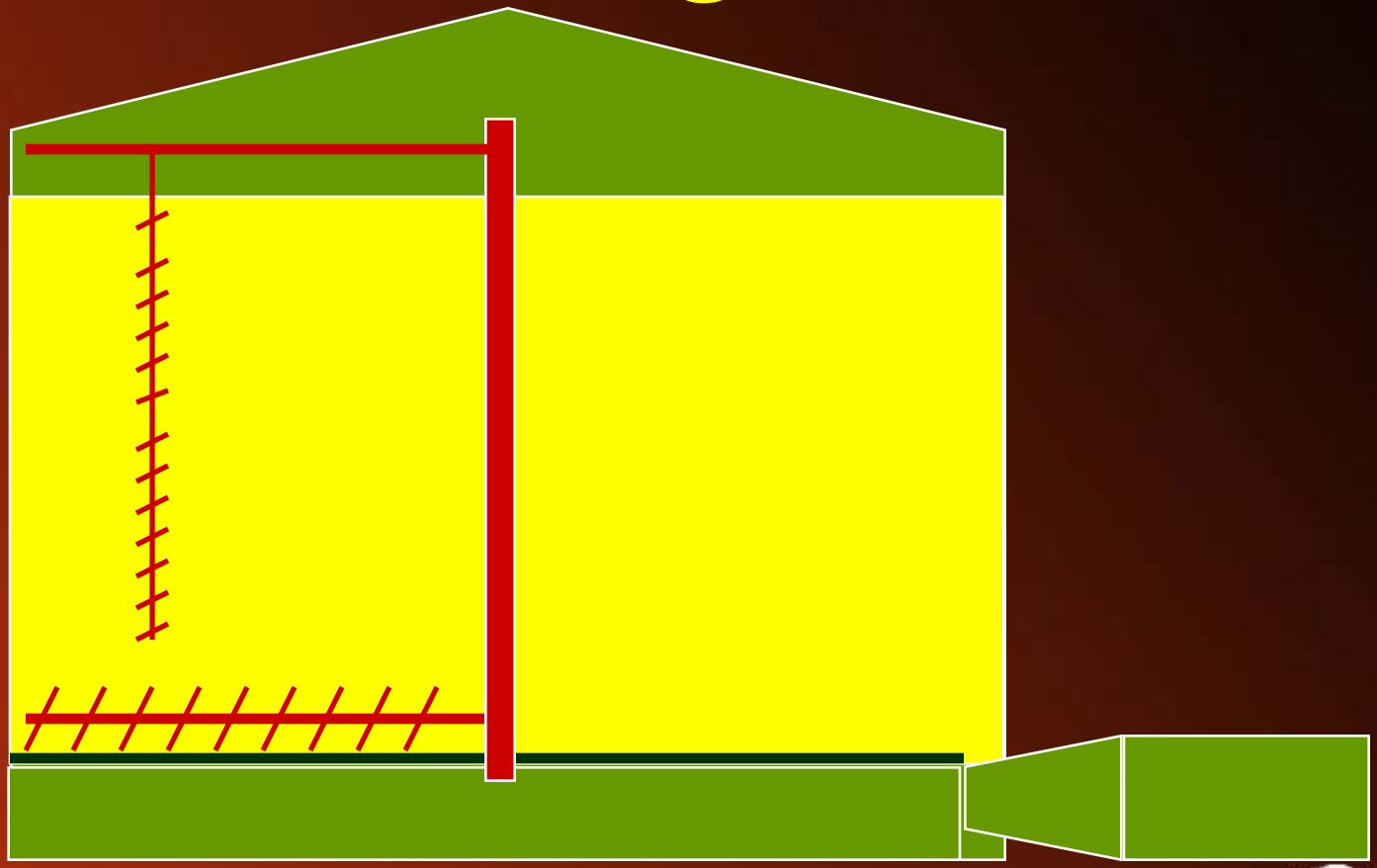


Table 2. Safe storage time in days for corn at various temperatures and moisture.

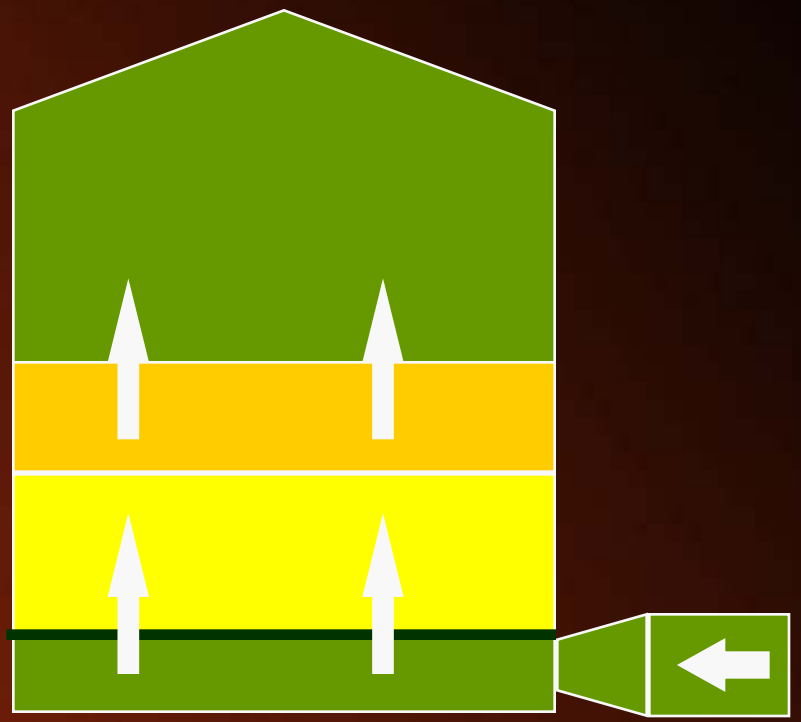
Storage Air Temperature (F)	Corn Moisture Content			
	15%	20%	25%	30%
	Days			
80	109	10.0	3.4	2.1
75	116	12.1	4.3	2.6
70	155	16.1	5.8	3.5
65	207	21.5	7.6	4.6
60	259	27.0	9.6	5.8
55	337	35.0	12.5	7.5
50	466	48.0	17.0	10.0
45	725	75.0	27.0	16.0
40	906	94.0	34.0	20.0
35	1,140	118.0	42.0	25.0

Typical fan/dryer

Methods of In-Bin Drying

Layered Drying

- Drying one layer at a time (3-6 feet)
- Successive Layers should be thinner.
- Slow
- 25 cfm/ft^2
- 90 to 110^{o}F
- Not over 110^o F for seed

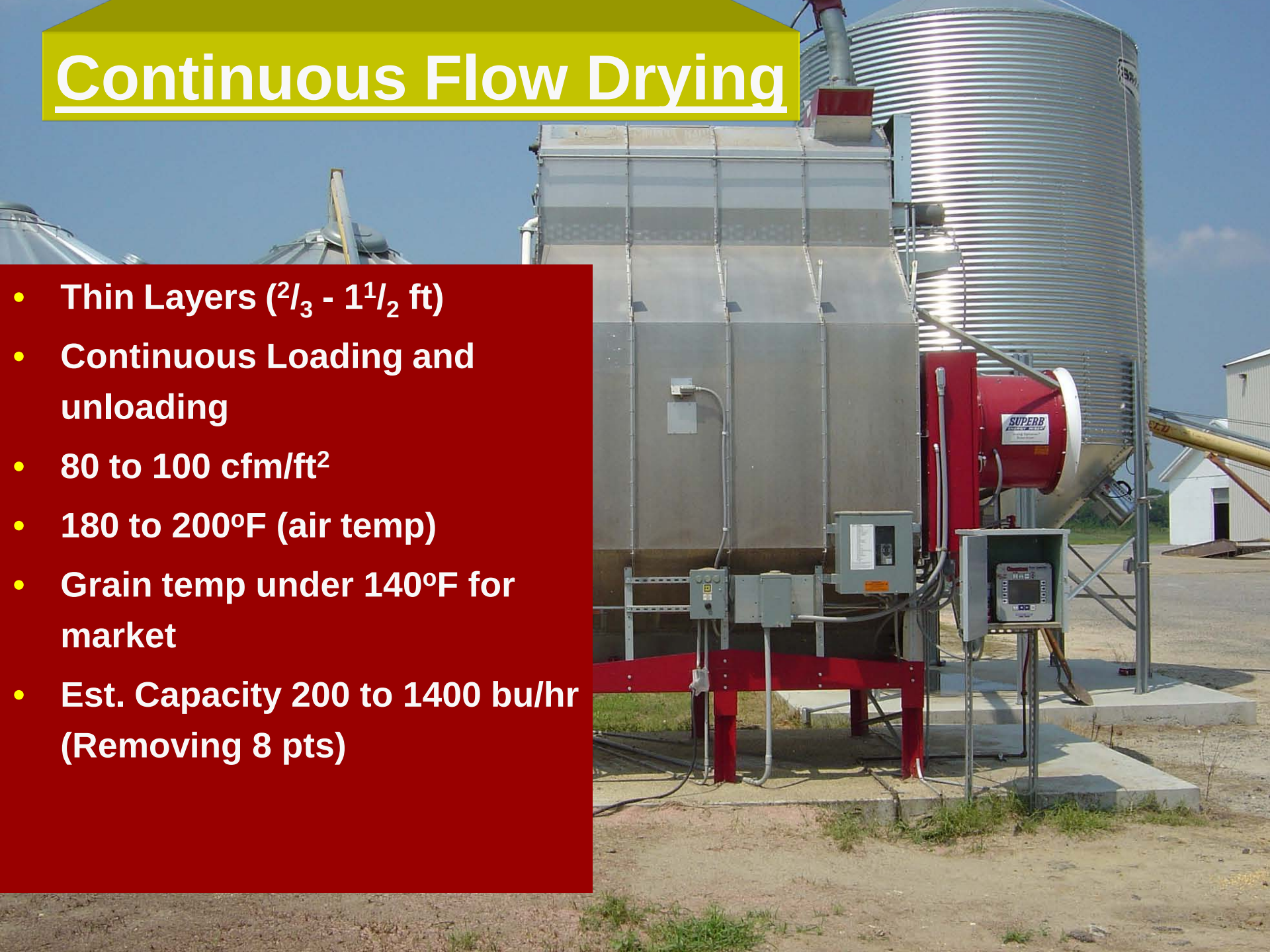


Batch-In-Bin

- Layers no more than 4 ft deep
- Move to another bin at 15-17%
- Not over 110^{o} F for seed
- 40 cfm/ft^{2}
- 120 to 140^{o}F

Top Dry or Easy Dry

Continuous Flow Drying

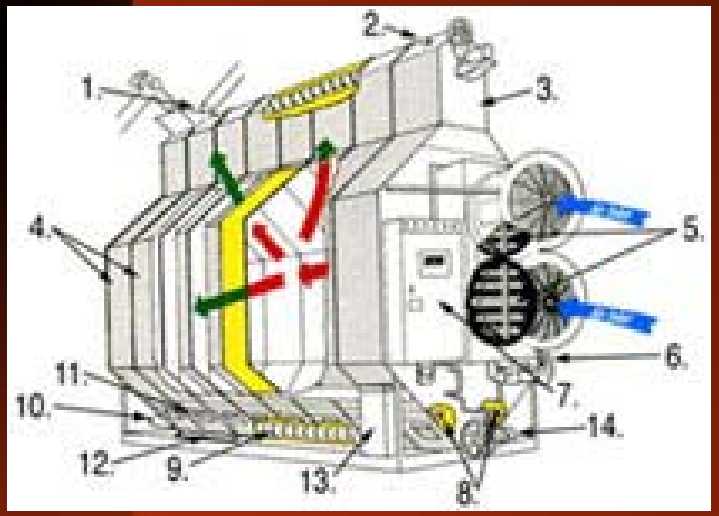


- Thin Layers ($^{2}/_{3}$ - $1^{1}/_{2}$ ft)
- Continuous Loading and unloading
- 80 to 100 cfm/ft^{2}
- 180 to 200^{o}F (air temp)
- Grain temp under 140^{o}F for market
- Est. Capacity 200 to 1400 bu/hr (Removing 8 pts)

Continuous/Batch dryers

SUPERB ENERGY MISER

BROCK



1. **Inlet Grain Hopper -** can be located at either end
2. **Freeze-proof Mercury Switch**
3. **Perforated Wet Garner Bin -** for preheating
4. **Compartmentalized Variable Grain Columns**
5. **Full Flamewall Burners -** provide more square footage of flame surface for maximum efficiency
6. **Fuel Flow Control Stabilizer -** "weans" fuel flow and controls drying temperatures
7. **Weatherproof Automatic Control Center**
8. **Heavy-duty Metering Rolls -** with electric SCR drive
9. **Heavy-duty Augers -** with woodblock intermediate Split Bearings
10. **Discharge Tube -** with cast industrial bearing - can be located at either end
11. **"Quick Cleanout" -** slide doors
12. **"Toe Trip" -** swing down cleanout doors
13. **Factory Installed Disconnect**
14. **TEFC Totally Enclosed Electric Motors**

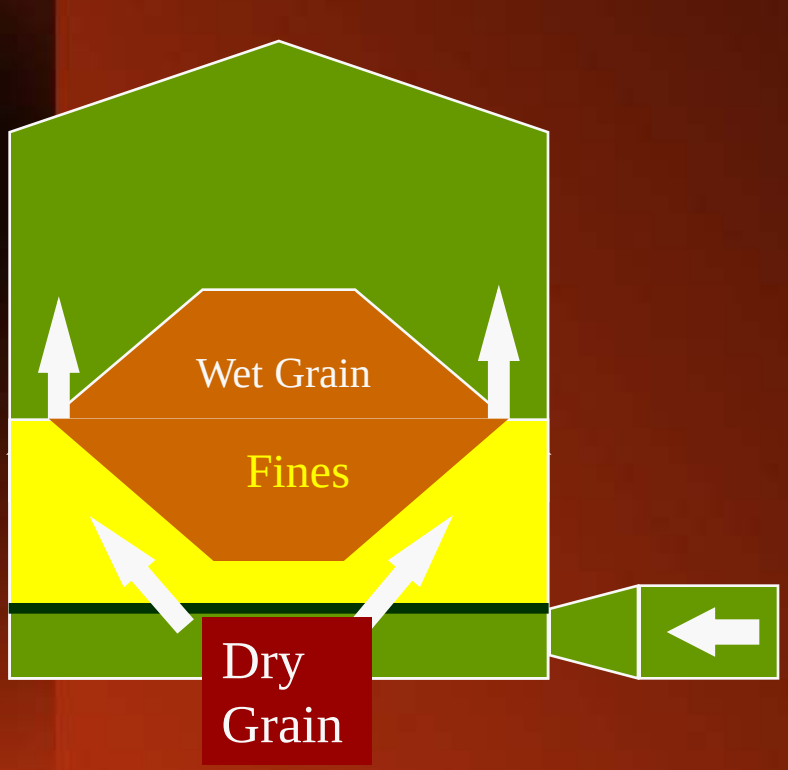
Grain Spreader

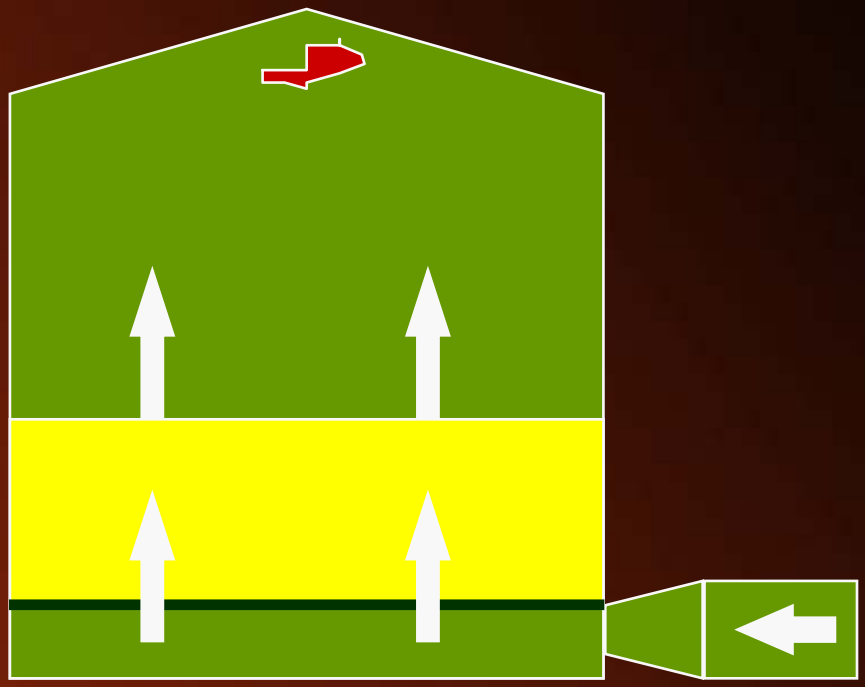
- Level grain
- Distribute fines more evenly
- Fines should be screened if more than 5%
- Fines promote air channeling and slow drying

In-Bin Drying/Aeration

No Grain Spreader

With Grain Spreader





STATIC AIR PRESSURE

- 1 to 2.5 inches of water* (30 to 60 cfm/ft^2) — Shelled Corn or Soybeans
- 1.5 to 2.5 inches of water — Small Grains

For Depths of 4 feet

Static Pressure is the force required to push air through grain.

FAN CAPACITY

Air Volume at Indicated Static Pressure (CFM)					
0.50”	1.0”	1.5”	2.0”	2.5”	3.0”
12,000	11,200	10,300	9,450	8,500	7,400

Depth of Grain Increases

Air Volume Decreases

Peanut Drying Equipment

- Driers – Several Sizes and Capacities
- Dryers – sized according to wagon sizes (14, 21, 28 and 45 feet in length)
- Airflow – Ranges from 50 – 100 cfm/ft^2

(2” Static Pressure)

Peanut Drying Equipment

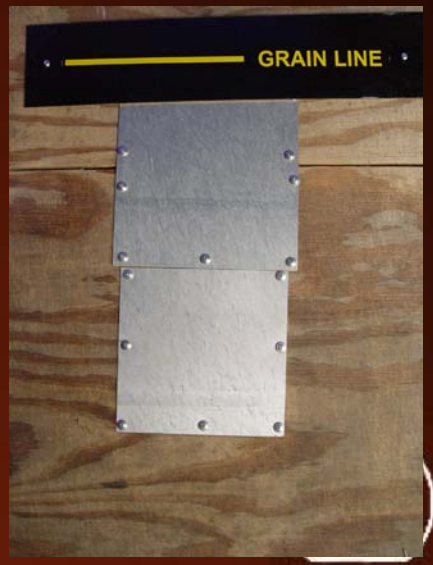
- LP Burners – Designed to heat air to 95ºF.
- LP Burners – expect to receive a 50-70ºF temperature rise.
- Ambient air 85ºF expect 135-155ºF drying air.

Peanut Drying Equipment

- Fill to Grain Line - Semi
- Trailers fill to 2 feet/or grain line
- Trailers can be overloaded

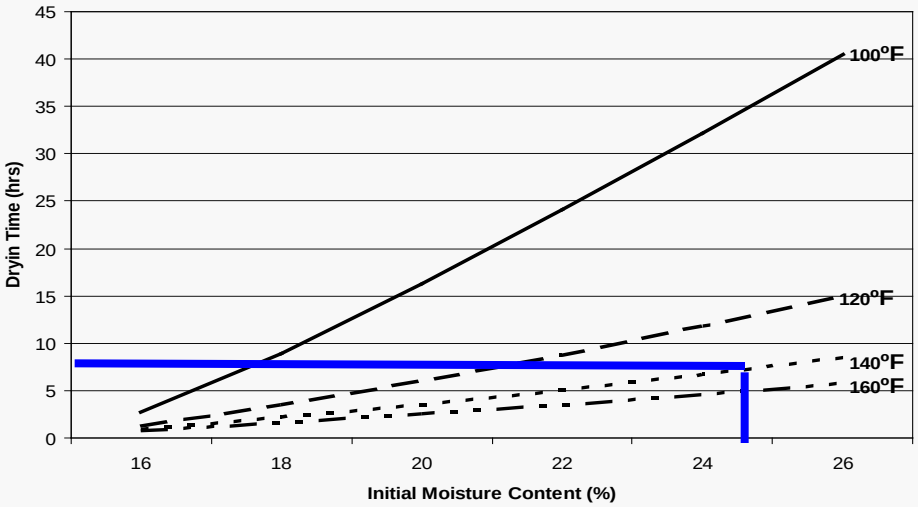
Length (feet)	Capacity (Bushels)
14	180
21	270
28	360
45	580

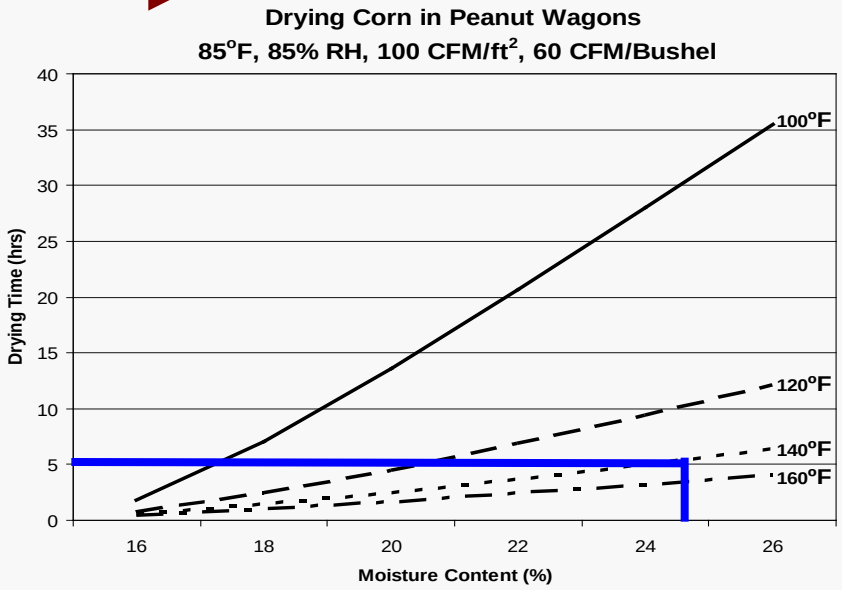
*Depth 2 feet dry (15%)



Drying Time

Increase Airflow





7 hours

Grain Depth 2 Feet

5 hours

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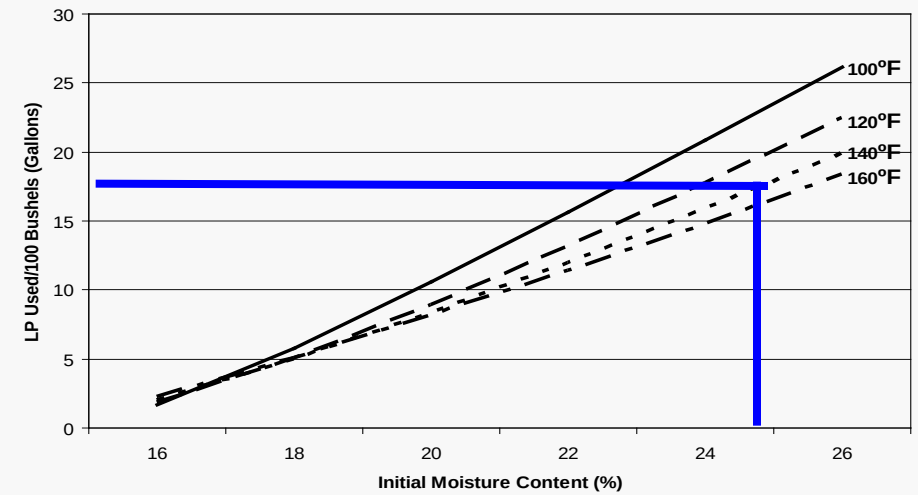
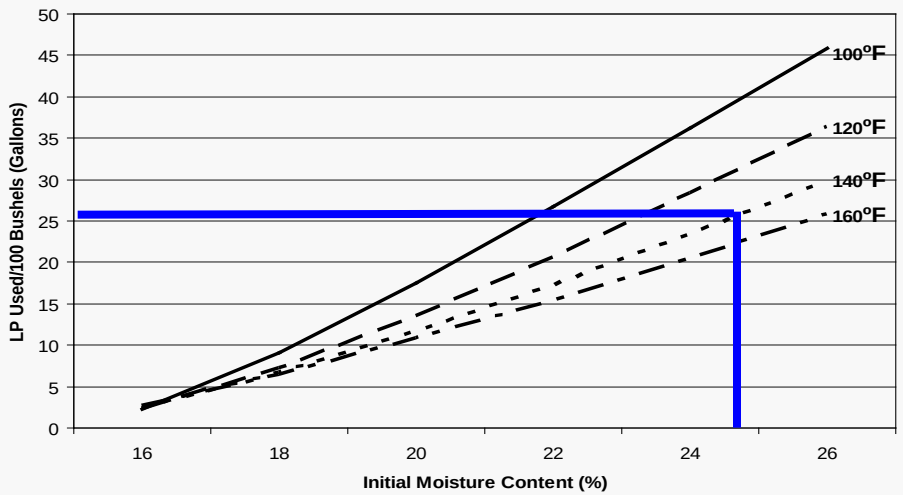
Drying Cost

Increase Airflow





17 gal/100 bushels

25 gal/100 bushels

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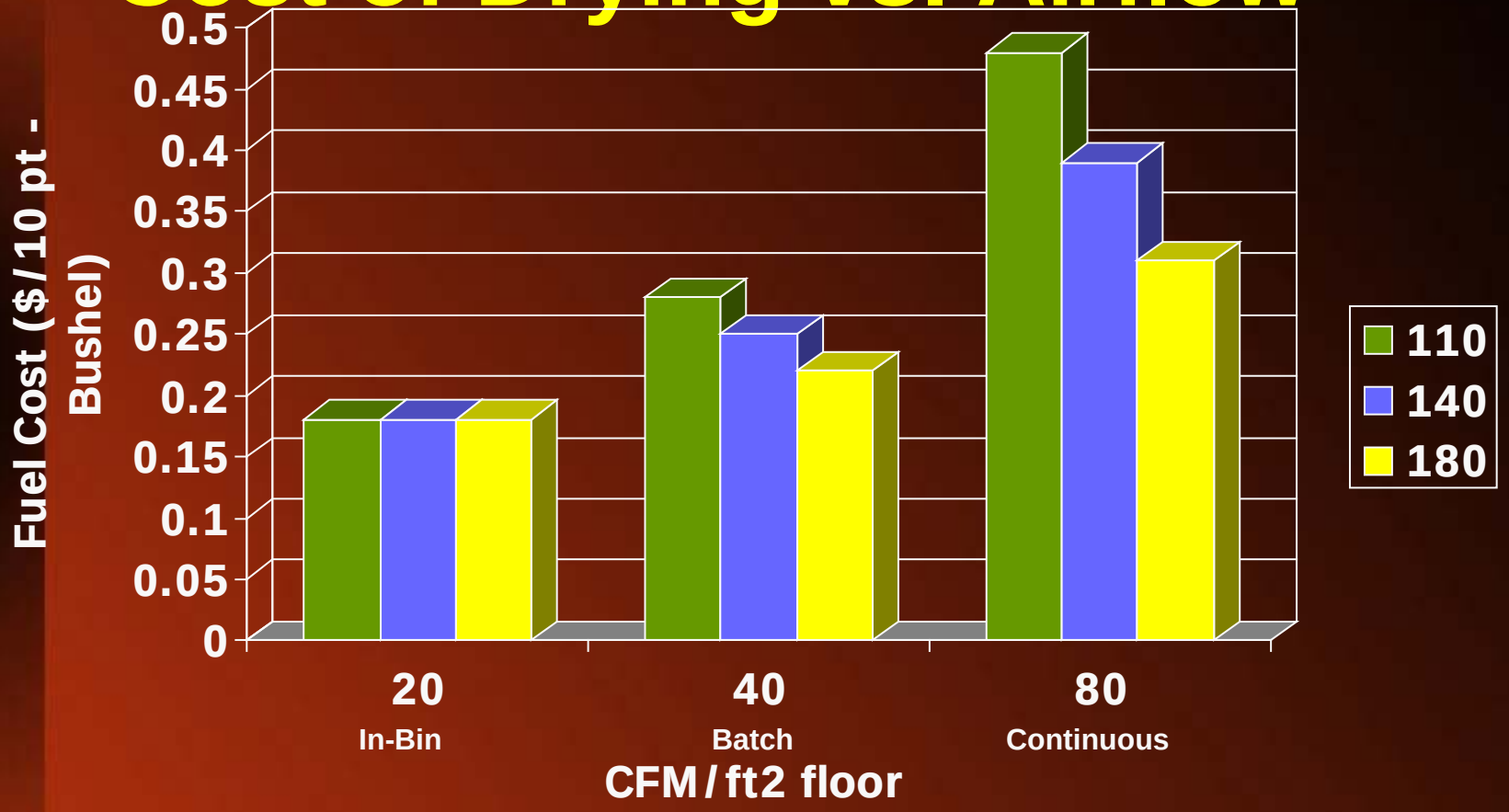
Grain Depth 2 Feet

Moisture Content for Safe Storage (12 months)

- 12 months
  - 11-12% for North Georgia
  - 10-11% for South Georgia
- Over winter
  - 15% if grain temp. held below 65^{o} F

Cost of Drying vs. Airflow



Cost LP = $1.25/gallon, 80ºF Ambient, 55%RH

Grain Shrinkage

$$\text{Intial weight X} \frac{100 - \text{initial \% moisture}}{100 - \text{final \% moisture}} = \text{final weight}$$

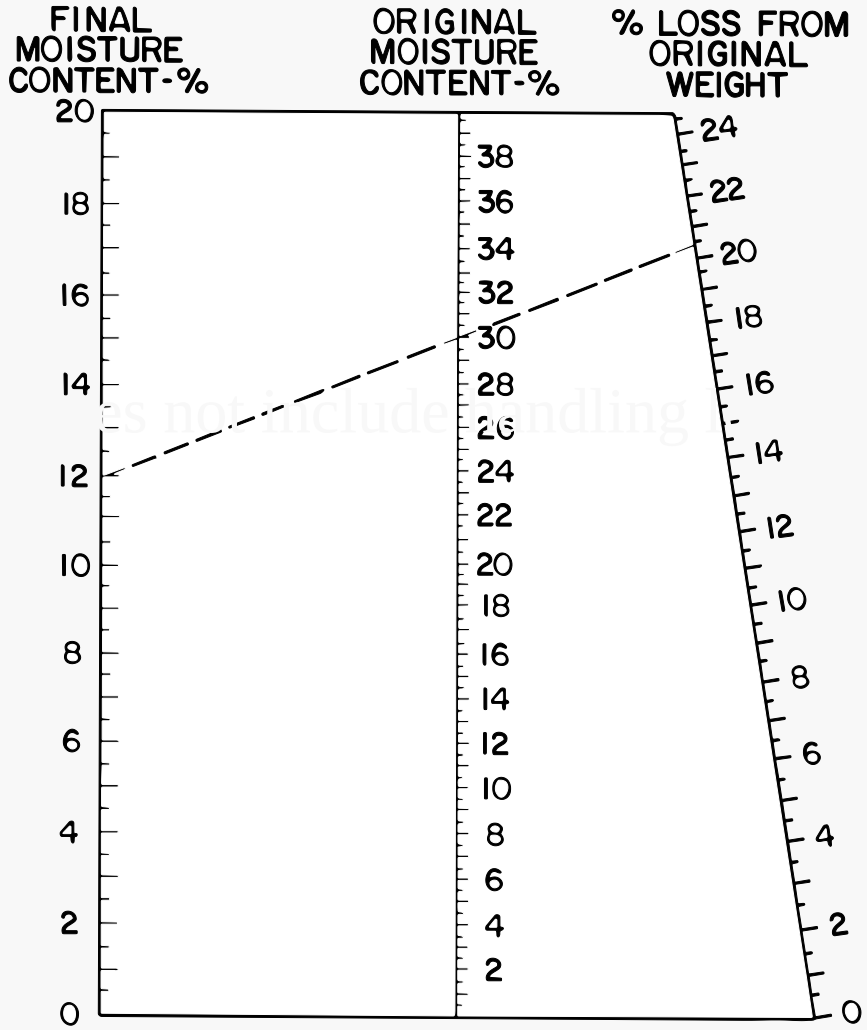
Table 1. Weight loss due to drying grain.

Initial Moisture Content (%)	Final Moisture Content (Percent)				
	15½	14	13	12	10
	Percent Shrinkage				
30	17.2	18.6	19.6	20.4	22.2
25	11.2	12.8	13.6	14.8	16.7
20	5.4	7.0	8.1	9.0	11.0
17	1.8	3.5	4.6	5.7	7.8

Does not include handling losses

Grain Shrinkage

Does not include handling losses



Questions