

# Bag Silos: Densities and Losses

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# Introduction

- Increasingly common
  - More than 30% of all dairy farms use bag silos
- However little research on bag silos to confirm sales literature

# Objectives



- Monitor filling and emptying of bag silos to:
  - Measure densities and losses
  - Determine factors affecting each

# Methods

- 3 research farms in area (Arlington, Prairie du Sac, West Madison) have used baggers for several years
- 3 machines: 9-ft. Kelly-Ryan, 8-ft. Ag-Bag, 9-ft. Ag-Bag (rental)

# 9-Foot Kelly-Ryan



# 8-Foot Ag-Bag



# Filling

- All loads:
  - Weighed
  - Marked on bag and length measured
  - Sampled for moisture
  - Compositing samples across loads for particle size, CP, NDF, ash



# Emptying



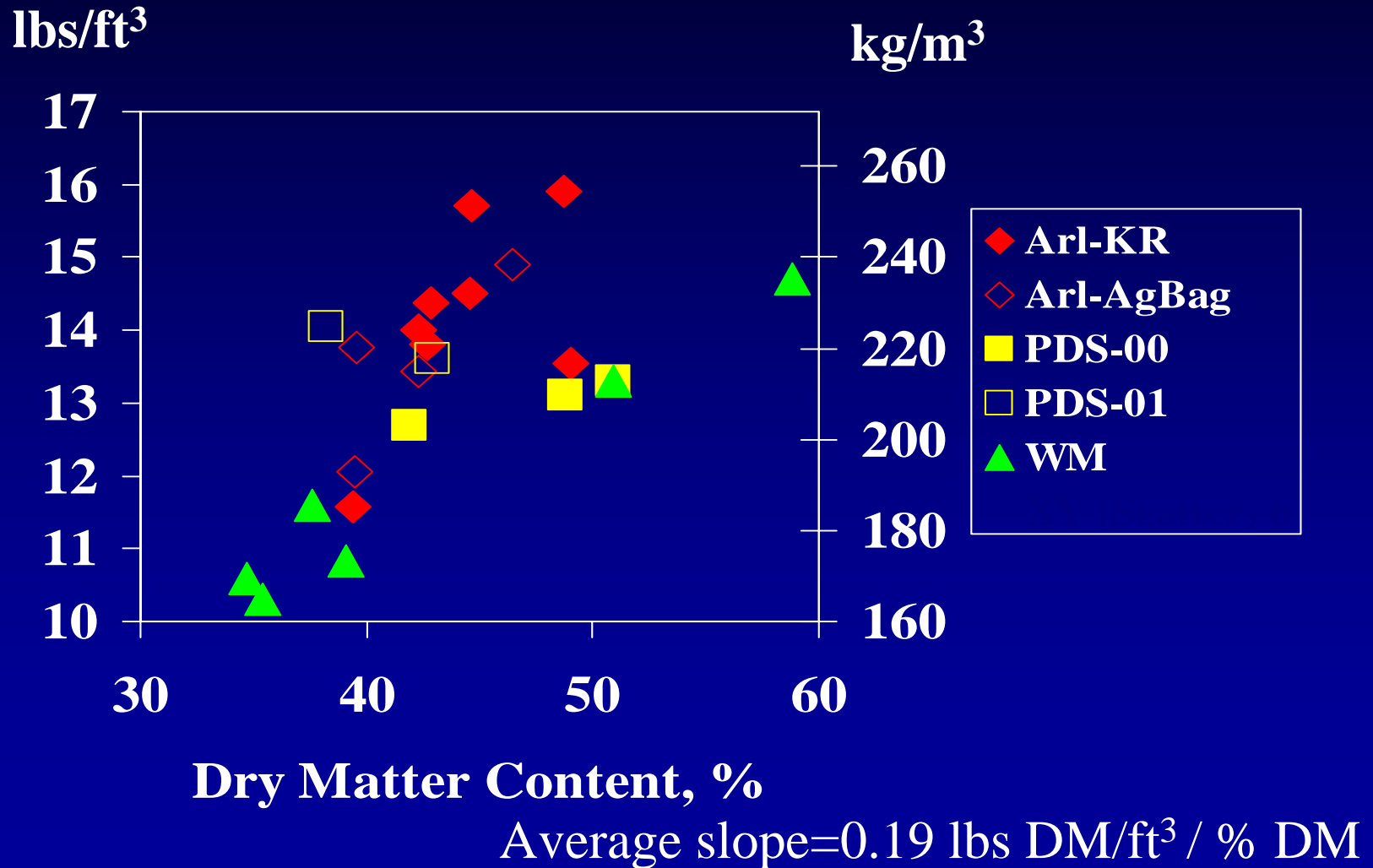
- All silage weighed (both good and spoiled)
- A sample per filling load: moisture and quality characteristics



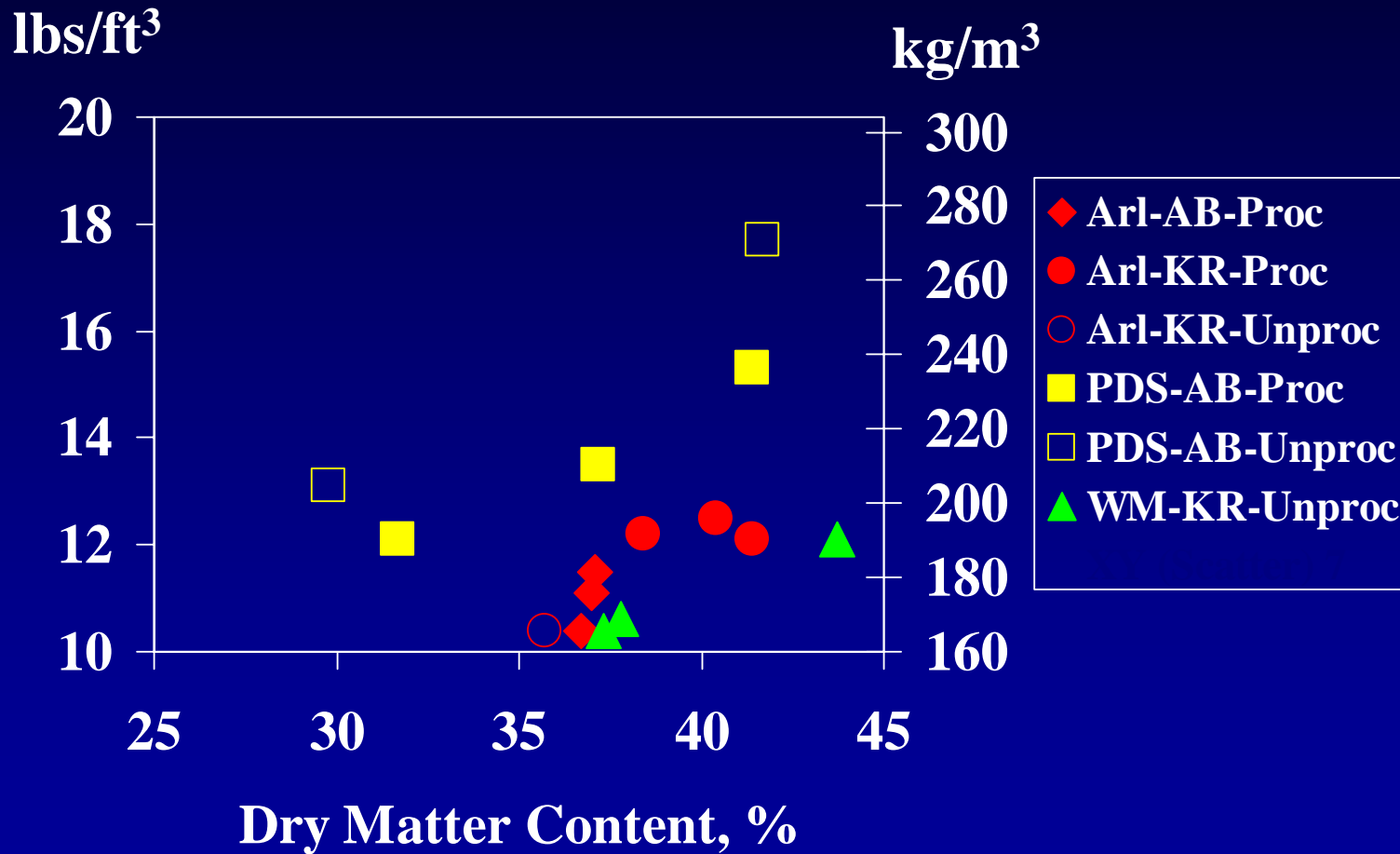
# Number of Bags Losses Analyzed/Filled

Bagger	Research		
	Station	Hay	Corn
8' Ag Bag	Prairie du Sac	4/5	5/6
9' Ag Bag	Arlington	4/4	3/3
9' Kelly Ryan	Arlington	6/8	5/8
9' Kelly Ryan	W. Madison	6/7	6/6
Total		20/24	19/23

# Dry Matter Densities in Hay Crop Silages

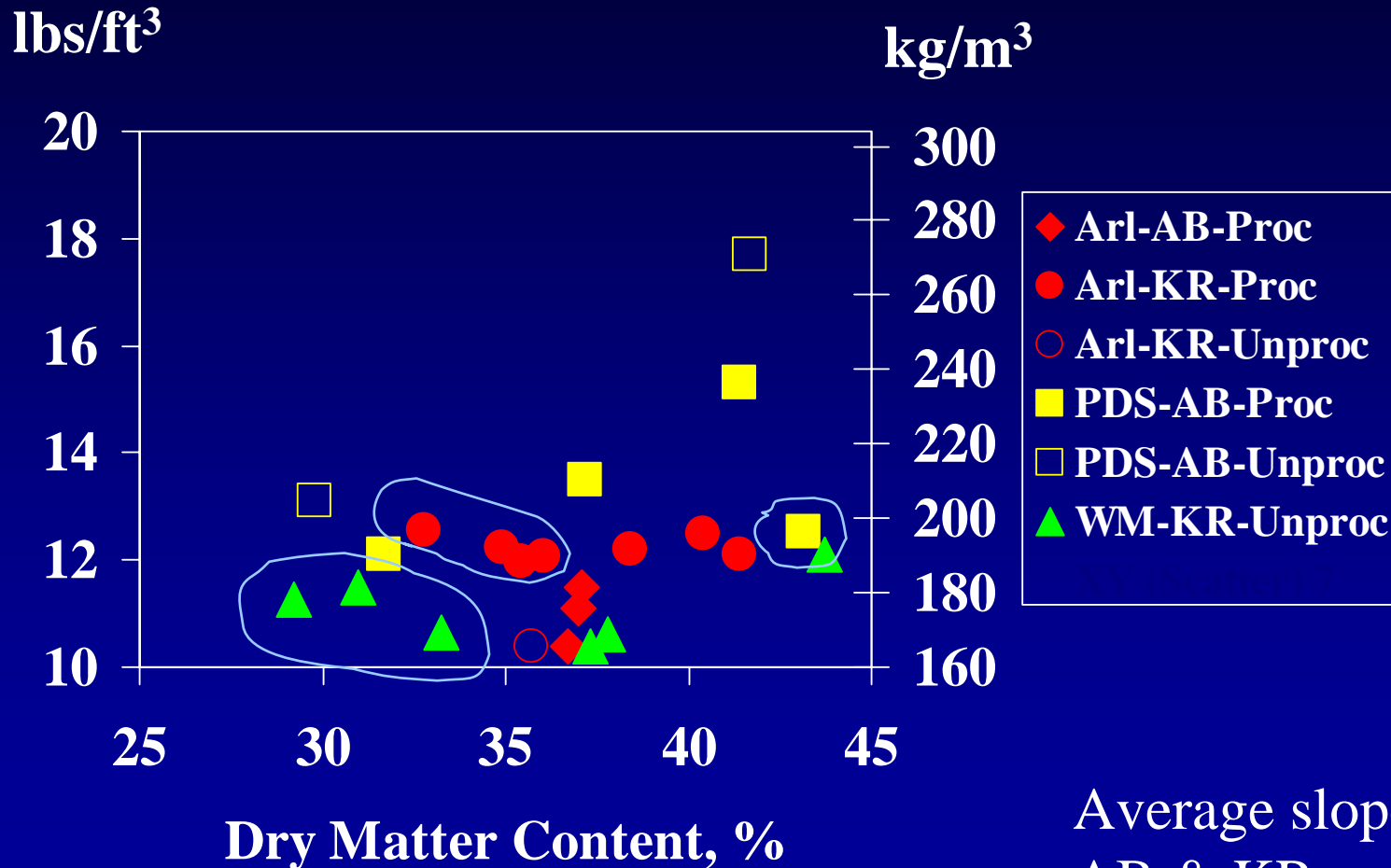


# Dry Matter Densities in Corn Silages - 2000



Average slope=0.33 lbs DM/ft³ / % DM

# Dry Matter Densities in Corn Silages - 2000, 2001

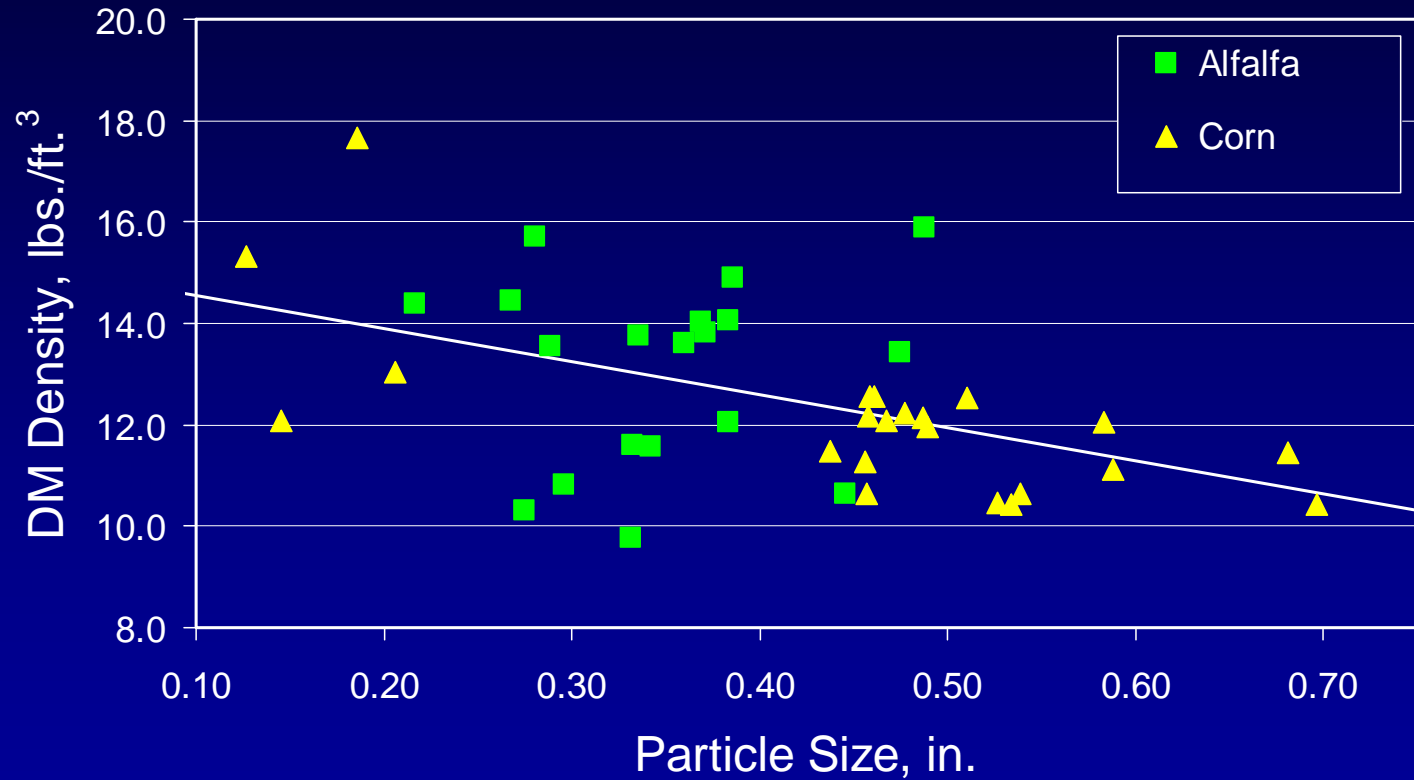


Average slope=??  
 AB & KR may have  
 different slopes

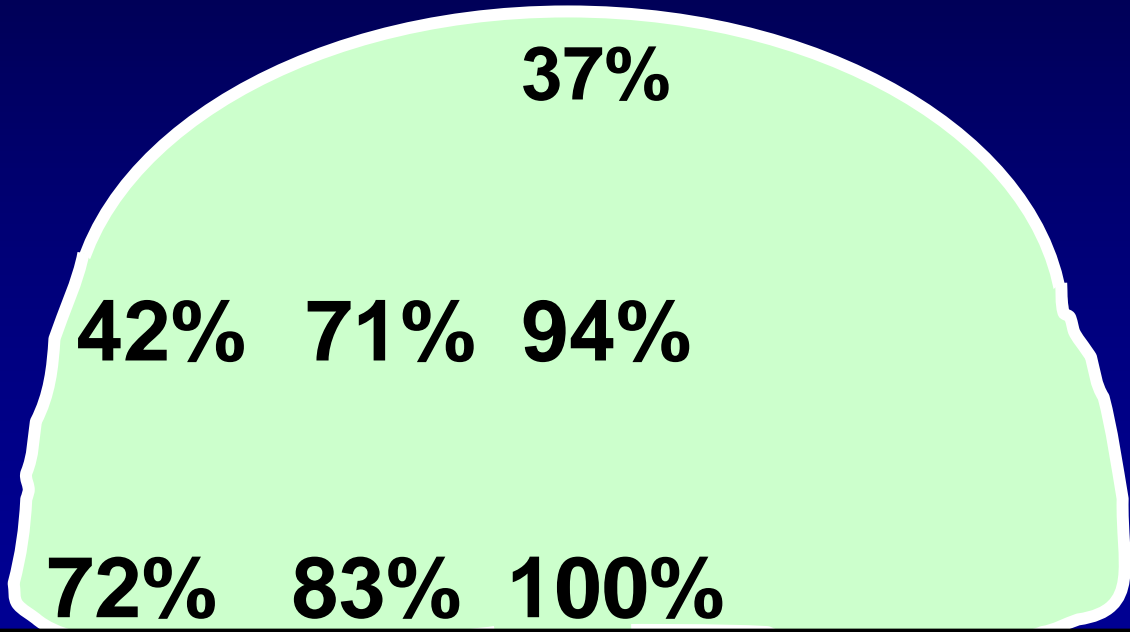
# Average DM Densities (lb/ft<sup>3</sup>)

Bagger	Station Processed		Hay	Corn
8' Ag Bag	PDS	Yes		13.3
		No	13.1	15.4
9' Ag Bag	Arl	No/Yes	13.5	11.0
9' K R		Yes		12.2
9' K R		No	14.1	10.4
9' K R	WM	No	11.6	11.1

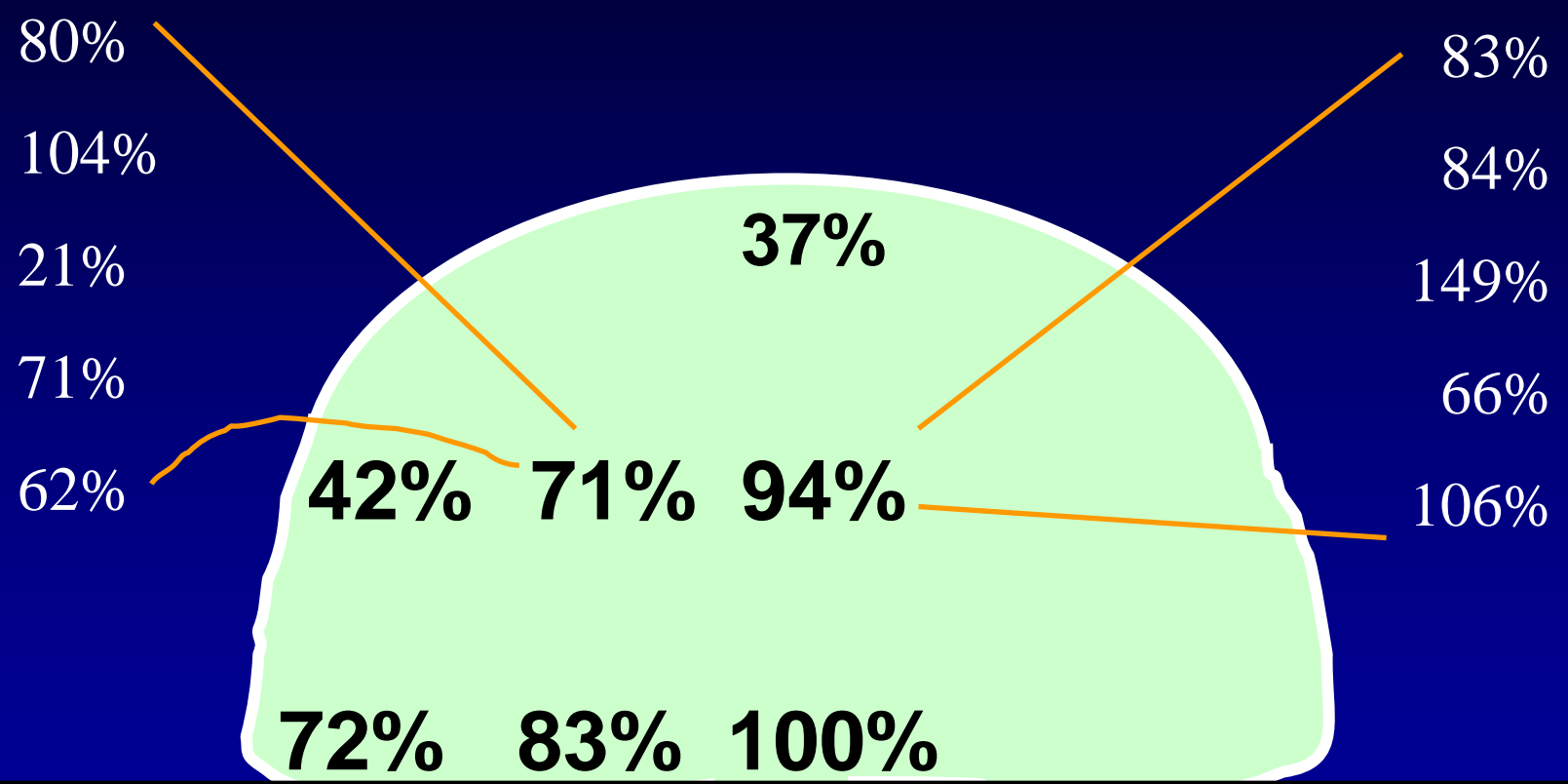
# Influence of Particle Size on Density



# Density Variation on the Face



# Density Variation on the Face





# Losses

- **Invisible & Uncollected** = Filling + Removal + Gaseous + Seepage (Not Collected) =  
**Total DM in - Total DM removed**
- **Spoilage** = Silage not fed (moldy)
- **Total Loss** = Invisible & Uncollected + Spoilage

# Range of Losses (% DM)

## 39 Bags

Type	Loss		
	Loss Range	Loss Average	Loss Average w/o Worst 6*
Inv. & Uncol.	0 to 23	9.2	8.7
Spoilage	0 to 25	5.4	2.9
Total	0 to 40	14.6	11.6

\* 15% spoilage loss or more

# Issues With The Worst Six

% Loss	% Spoiled	% DM	When Fed	in./d	Comments
39.9	17.2	40.4	27 June	29	<b>Bag burst</b>
38.2	25.4	42.3	30 March	23	Damage?
30.6	21.9	43.7	12 March		<b>Bird damage</b>
27.1	19.3	35.7	3 July	28	Heat, damage?
26.9	16.6	48.8	1 May	8	Similar bag - 11%
25.9	15.7	48.7	20 Aug	53	Heat, damage?

# Summary of Losses (% DM) by Farm

Farm	Invisible	Spoilage	Total
Arlington	11.0	6.5	17.4
Prairie du Sac	10.7	3.8	14.5
West Madison	5.4*	5.1	10.5

\* Significantly lower

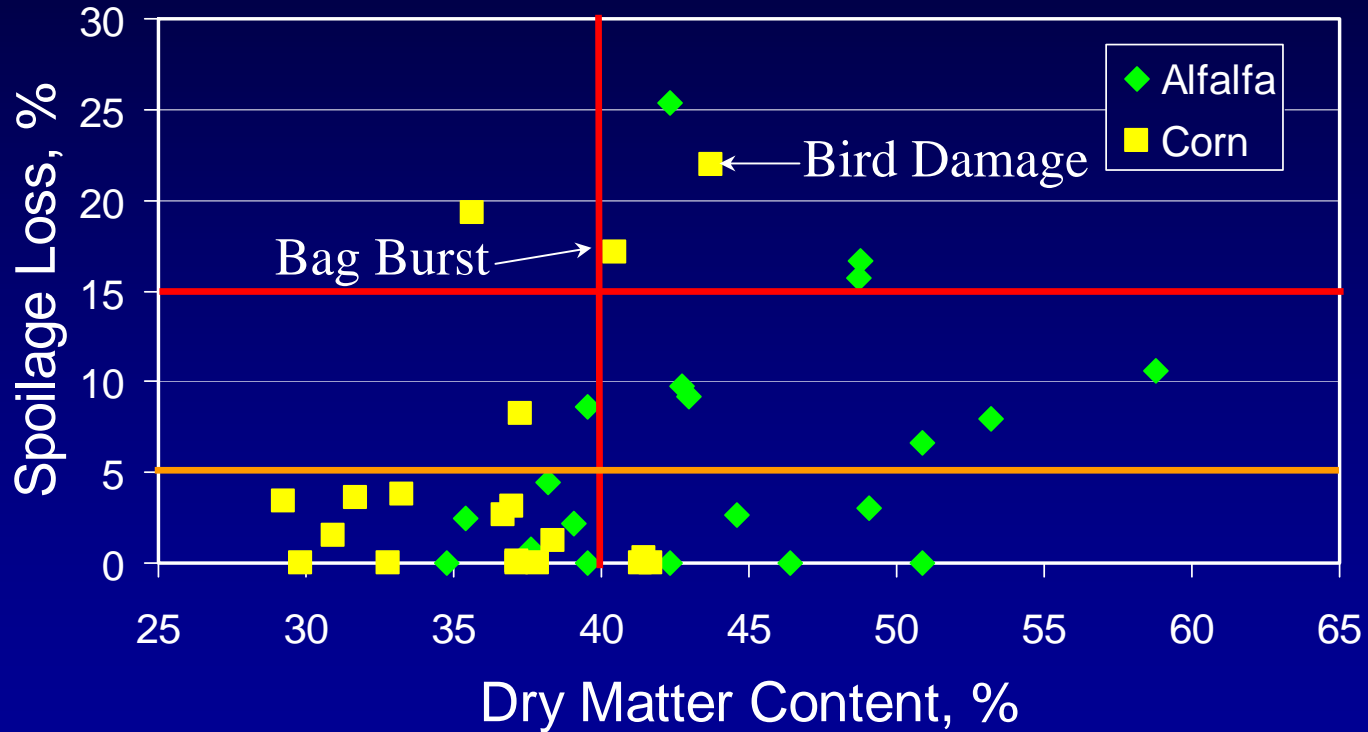
# Summary of Losses (% DM) by Bagger

Machine	Invisible	Spoilage	Total
Ag-Bag 8	10.7	3.8	14.5
Ag-Bag 9	10.0	2.0	12.1
Kelly-Ryan	8.3	7.1	15.5

# Summary of Losses (% DM) by Crop

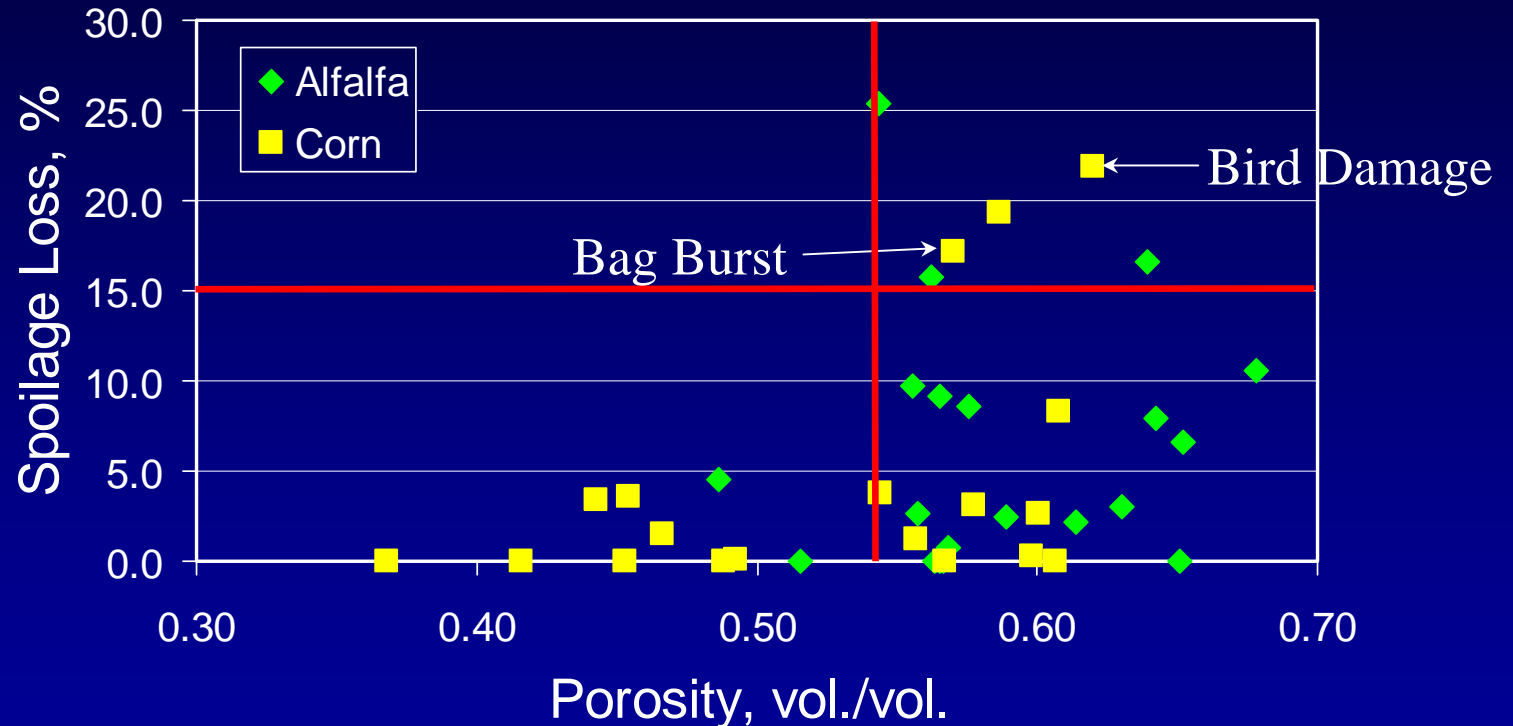
Crop	Invisible	Spoilage	Total
Alfalfa	8.7	6.3	15.0
Corn	9.7	4.3	14.0

# Spoilage Losses vs. Dry Matter Content at Ensiling



More spoilage above 40% dry matter (or less than 60% moisture).

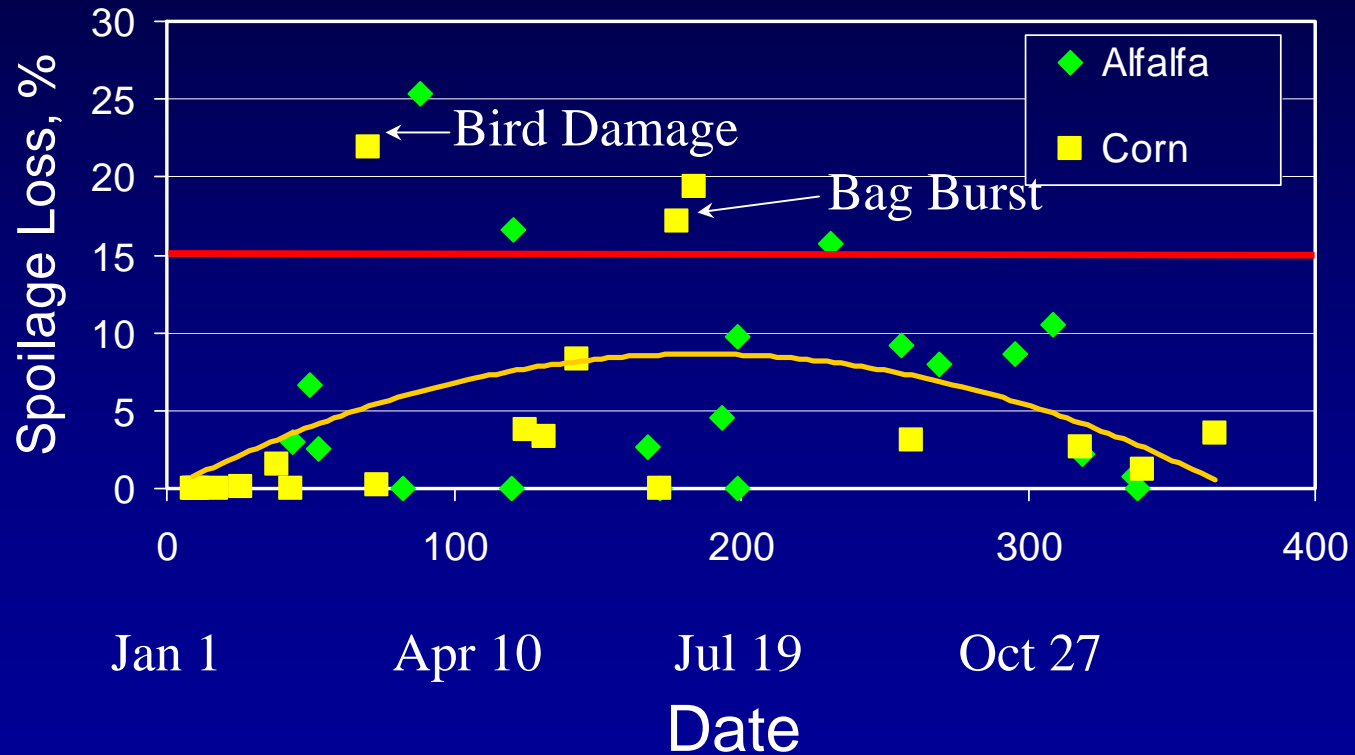
# Spoilage Losses vs. Porosity



More spoilage when porosity is above 0.54.

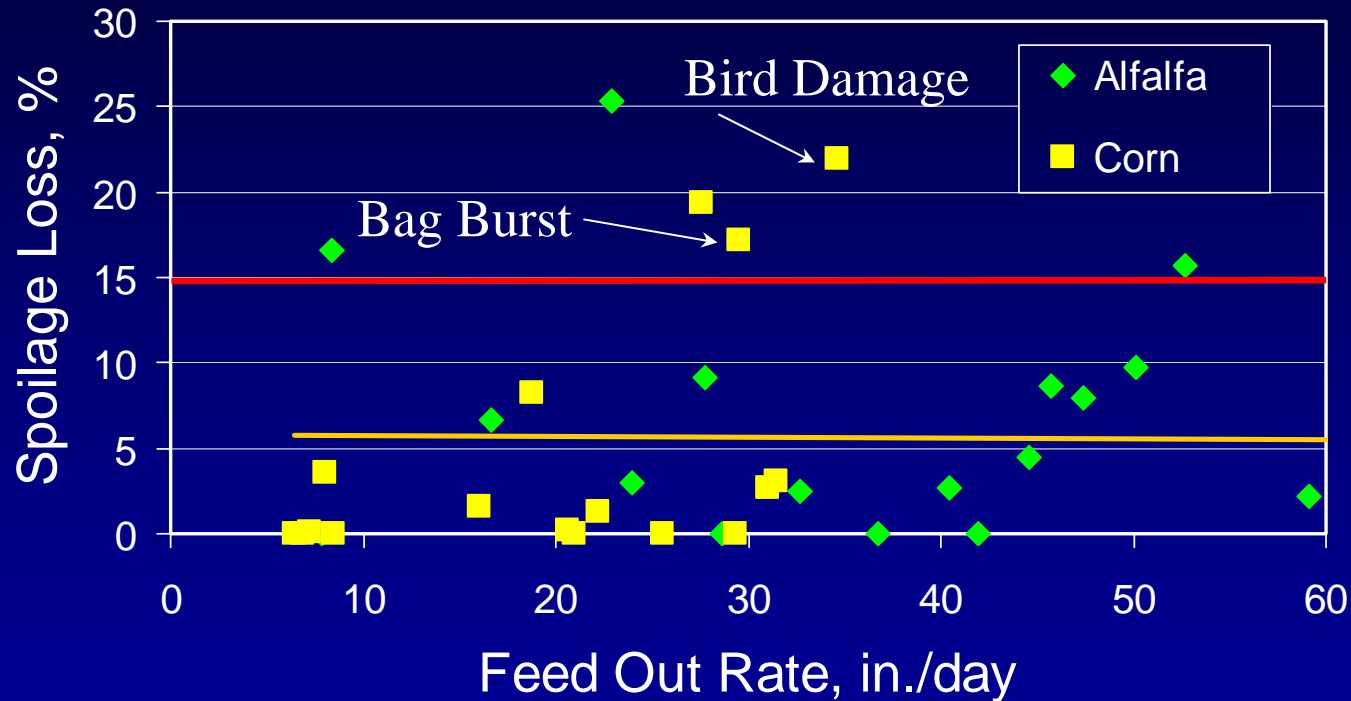


# Spoilage Losses vs. Julian Mid-Point Date of Emptying



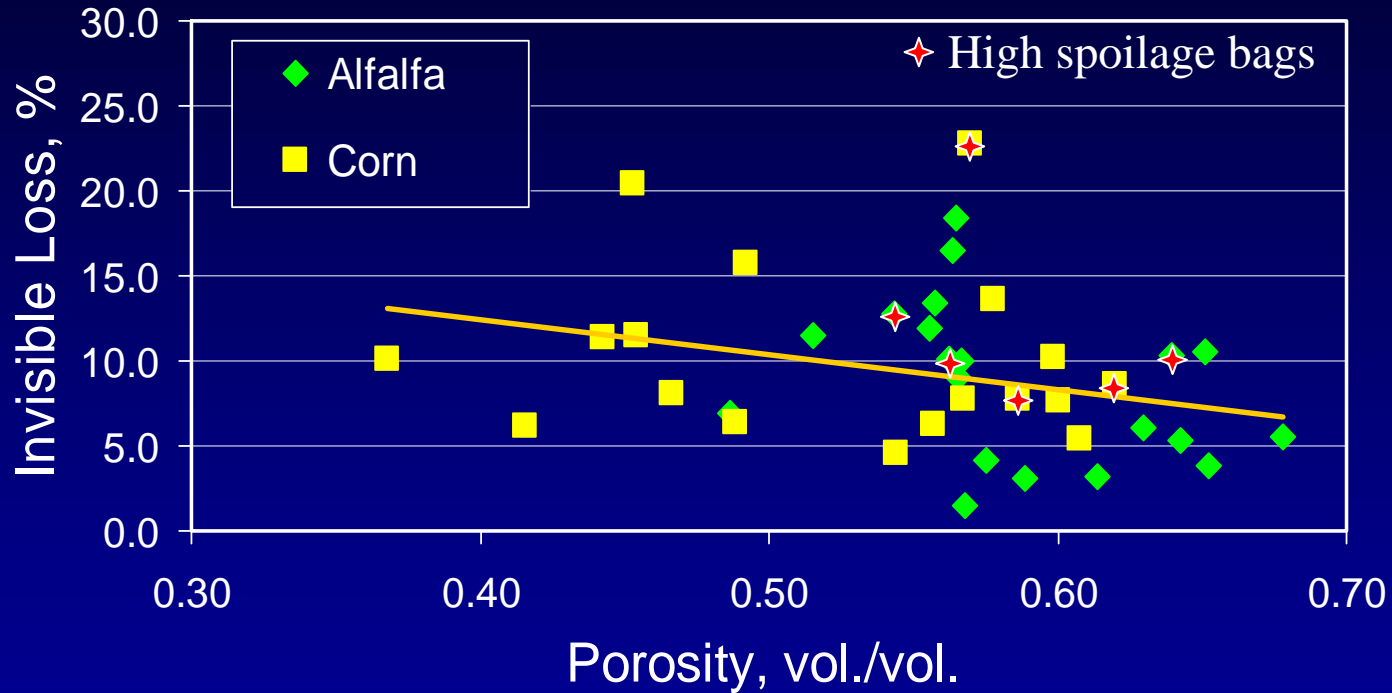
More spoilage in warm weather.

# Spoilage Losses vs. Feed Out Rate



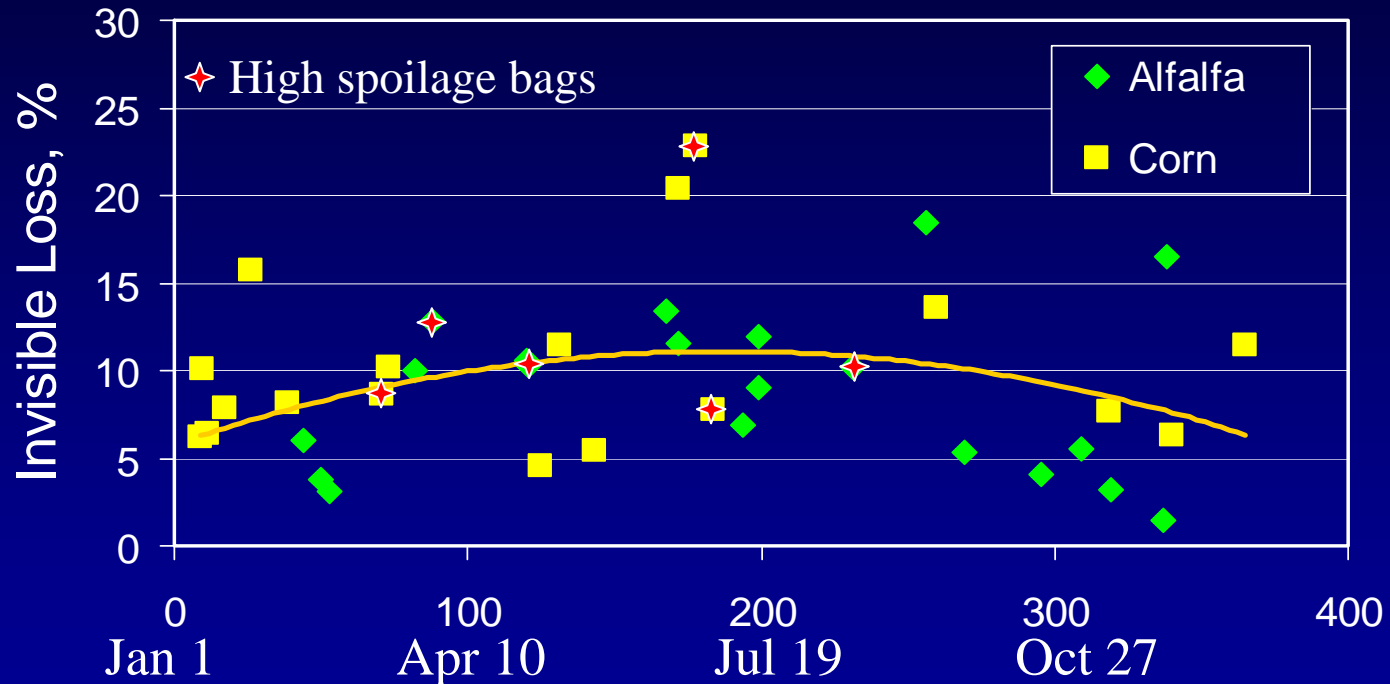
No trend - a surprise

# Invisible Losses vs. Porosity



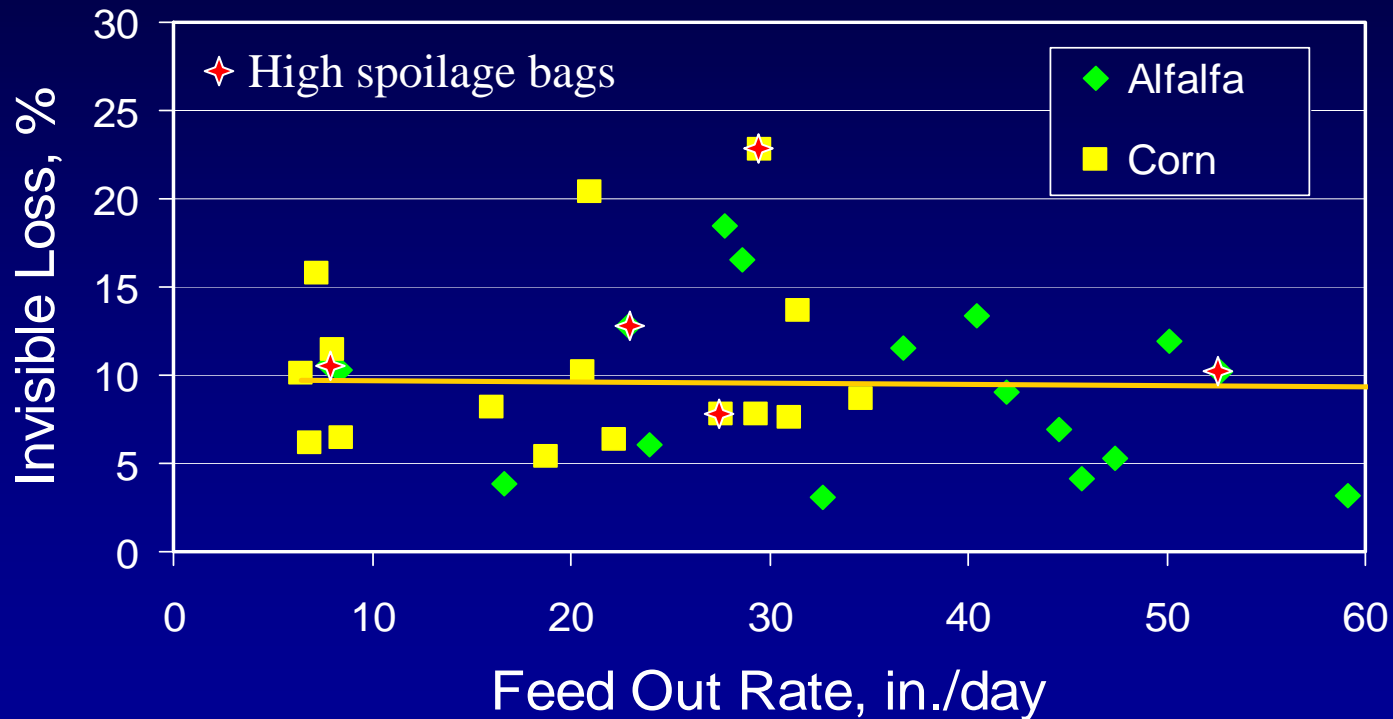
Invisible losses decrease with high porosity because there is more visible spoilage.

# Invisible Losses vs. Julian Mid-Point Date of Emptying



More invisible losses in warm weather.

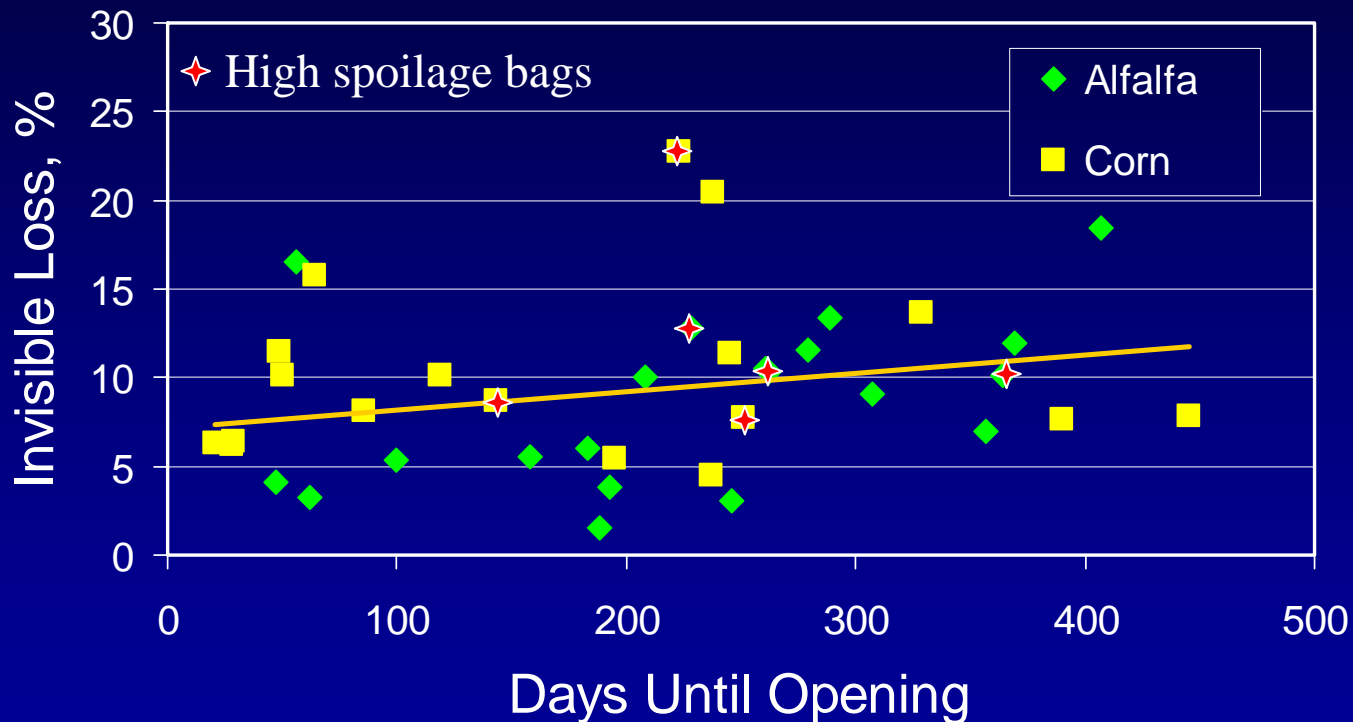
# Invisible Losses vs. Feed Out Rate



No trend.

# Invisible Losses vs. Days

## Between Filling and Opening



Slight trend, stronger in alfalfa than corn.

# Summary

- Densities ranged from 10 to 18 lbs. DM/ft.<sup>3</sup>
- Density is lower the wetter the hay crop; less certain relationship in corn.
- Density reduced the longer the particle size, approx. 0.6 lbs. DM/ft.<sup>3</sup> per 0.1 in.
- Density affected by operator.

# Summary

- Average total losses were 14.6% with a range of 0 to 40%.
- Most spoilage in dry (>40% DM), porous silages.
- Higher total losses from emptying in warm weather; save the best bags for summer feeding.
- Low losses (<10%) are achievable if bag silos are well managed.



# Spoilage Loss - Regression Analysis

$$\text{Loss, \%} = -9.5 + 1.1 F + 0.18 \text{ DM} + 0.041 J - 0.000086 J^2; \quad r^2 = 0.38$$

Where F = Farm

DM = Dry matter content, %

J = Julian mid-point date of emptying

# Invisible Loss - Regression Analysis

$$\text{Loss, \%} = 19.8 - 23.6 P + 0.055 J - 0.00014 J^2 - 4.4 E; \quad r^2 = 0.45$$

Where P = Porosity, fraction

J = Julian mid-point date of emptying

E = Empty method (daily = 0; 1 = periodic)