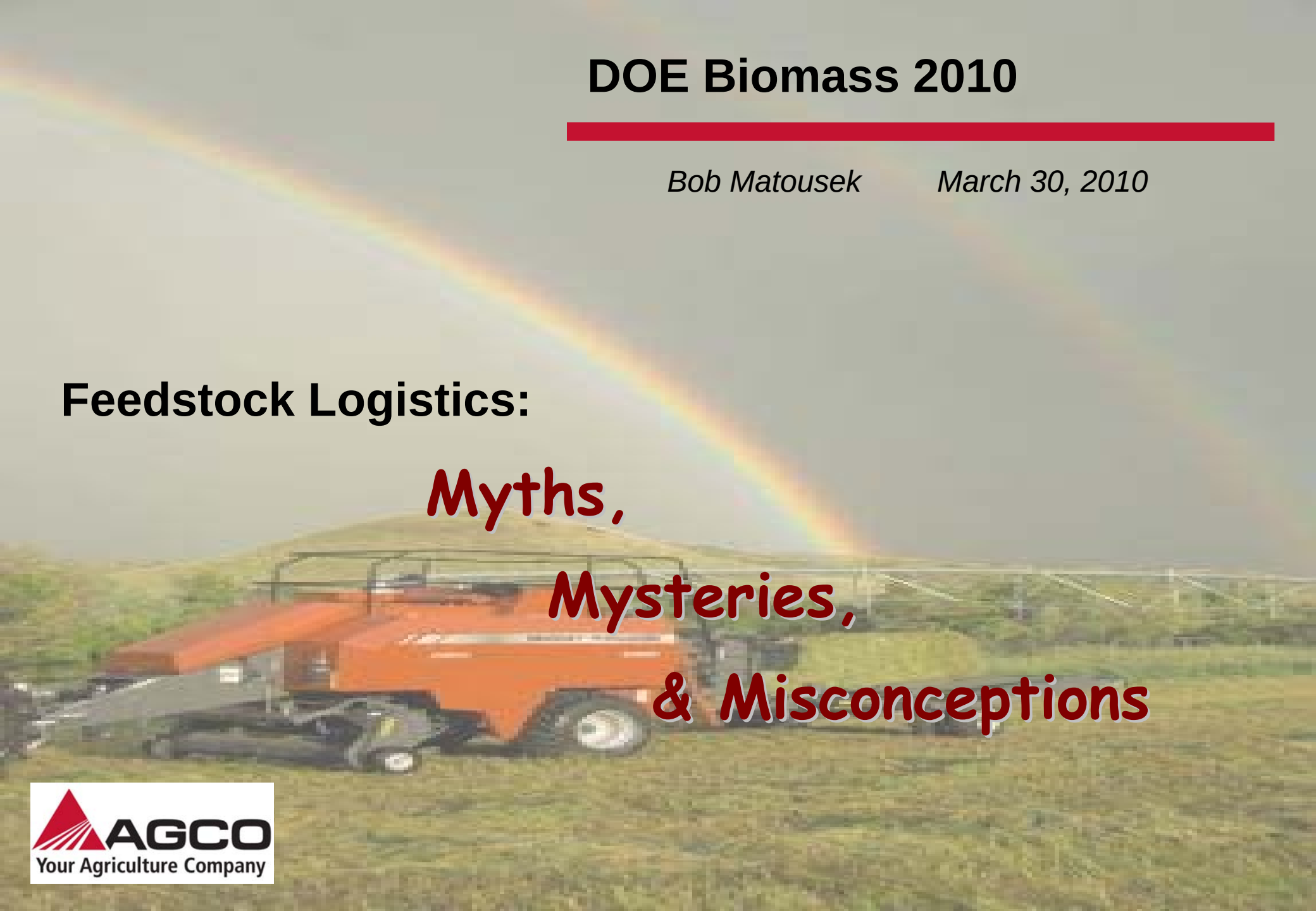
DOE Biomass 2010

Bob Matousek *March 30, 2010*

Feedstock Logistics:

Myths, Mysteries, & Misconceptions



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Topics

- AGCO & Grant Team
- Corn Residue Single Pass
- Tall Energy Crop Harvest
- Harvest Time & The JIT Clock
- Moisture Content !
- Sustainability & Irrigation
- Bulk Density vs. Transport Costs

Feedstock Logistics - AGCO & DOE

"Integration of Advanced Logistical Systems and Focused Bioenergy Harvesting Technologies to Supply Crop Residues and Herbaceous Energy Crops in a Densified **Large Square Bale** Format"

Dr. Andy Heggenstaller, MRI *May 2009*

Full Project Team

ABENGOA
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ceres the energy crop company
POET
STINGER INC
MRI
TERRABON
INL Idaho National Laboratory
KBA
ISU
ATM
OKLAHOMA STATE UNIVERSITY
NOBLE FOUNDATION

“Residue Comes from a Windrow”

Except:

Don’t Have the Time

Don’t Need the Hassle

Can’t Afford nor Find the Labor

Can’t Deal with the Dirt

It Rains Out Here

(Like ……. all the time! #%&*@)

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“You Can’t Bale Corn Cobs !!”

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“So, If You Drop It On the Ground, and Then Try to Pick it up……?”

Can You Make Ethanol from Dirt?

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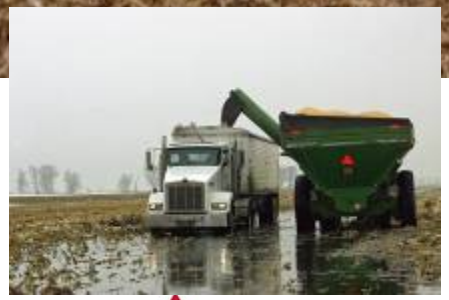
“But You Can’t Just Willy Nilly Remove All that Stuff on the Hills”

“Won’t Work When It’s Wet – I Bet!”



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"But you can't bale when it is too wet! It'll go up in Smoke! "

2008 **20%** **2 weeks after baling**

2009 **40%** **2 Weeks After Baling, + 3" Rain**

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Idaho National Laboratory/POET Corn Stover Storage Study

biomass program

On-going study:

- Objective: Evaluate stability of high-moisture bales
- November 2009
- Over 800 bales in storage
- Moistures range from 29% to 40% (wb)
- 150 monitored for moisture, density & dry matter loss
- 48 monitored for temperature
- Sampling every 2 months for dry matter loss and degradation

Visual comparison-3’ x 4’ square bale

biomass program

Preserved
- Clean
- “Fluffy”
- Sweet odor

Degraded
- Molded
- Matted
- Musty odor

Observations to date

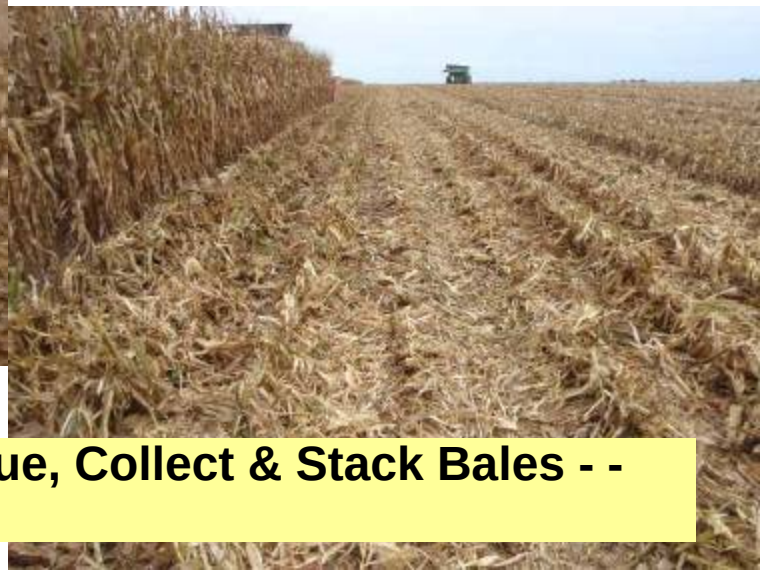
biomass program

- Wet stover bales (29% to 40% wb) can be preserved during several months of outdoor storage.
- These bales appear to have a threshold for dry storage > 25% moisture content.
- Degree of preservation at high moisture depends on stack design and location within the stack
- Elevated temperatures indicate biological activity, which implies dry matter loss—how much is yet to be determined.
- Preserved regions appear to be shrinking over time
- Even short term preservation is advantageous by extending the operational window of preprocessing systems.

40% moisture bale after 2 months of storage

Thanks to Kevin Kenney – Idaho National Lab

“Farmers won’t like it - - it’ll disrupt the grain harvest, & won’t work in the mud”



Harvest & Haul Grain, Chop Stalks, Bale Residue, Collect & Stack Bales - - Yaaaawn

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"So What! Corn Stover (Rake & Bale) Bales Aren't Dense Enough"

= 13.8 lb / ft³

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"Anyway, it's gon'na take a small army *for-ever* to get all those bales stacked"

STINGER STACKER

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The Art of Stacking and Keeping It Standing

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“So, Where You Gon’na Put All That Stuff ‘till You Need It?? “

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Increase Volume – Decrease Cost

- The necessity to collect significant volume per acre
  - Cost of Owning, Running, Supplying Baler $100/hr (??)
  - 10 acre per hour in 200 bu/acre corn
    - 0.5 ton/acre could cost about $20 / ton
    - 1 ton/acre could cost $12 / ton
    - 2 ton/acre could cost $ 7 / ton
      - Combine may be pushing MOG capacity at 2 t/a
      - Baler would be about ½ of its max capacity
      - Would be packing about 20 Ton/hr or 160 tons in an 8 hour day

- Combine Driver requires no more assistance or tending to accomplish all of this than he would for a normal corn harvest and haul operation. Bales drop to the ground and are left behind to be collected later.

Costs are SWAG's
Better ones in 2 years!

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“Oh yah, but you’re wrecking the field by removing this stuff!”

100 bu/acre yield - - 1 ton/ac removed

200 bu/acre yield - - 2 ton/ac removed

Too much trash to no-till ?

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Let's get the facts and understand the processes before we make our decisions

Case Study: Ames, IA 25 Acre Experiment

Current Analysis Approach:
Erosion alone indicates that full removal is sustainable

Removal Rate	Erosion (T=5.0) (t/acre/yr)	
	Conv Till	No Till
0%	1.3	0.11
50%	4.3	0.42
100%	4.7	2.3

Analysis with SOC:
Conventional tillage does not provide sustainable resource, limited availability through no till

Removal Rate	SOC (lbs/acre/yr)	
	Conv Till	No Till
0%	-67.76	52.55
50%	-101.95	21.69
100%	-121.26	-15.02

Implementing Innovative Management Strategies:
Consistent sustainable resource available

Removal Rate	SOC (lbs/acre/yr)	
	NT w/Rye Cover	NT w/Legume + Clover Cover
0%	116.82	204.99
50%	78.25	171.24
100%	39.12	130.25

Potential value added through other ecosystem services:
- **Carbon sequestration**
- **Reduced nutrient runoff**
- **Reduced erosion**

Managements:
- Conventional Tillage – Chisel Plow
- No Tillage
- No Till with Rye Cover Crop
- No Till with Interseeded legume and Clover Cover Crop

2009 Feedstock Platform Review 9

In Residue Collection - - Our Future Is Behind Us !

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Residue
Is
Residue
Right ?

170 Bu/Ac
4 Ton /Ac

“Food not fuel (!) & you can’t irrigate”

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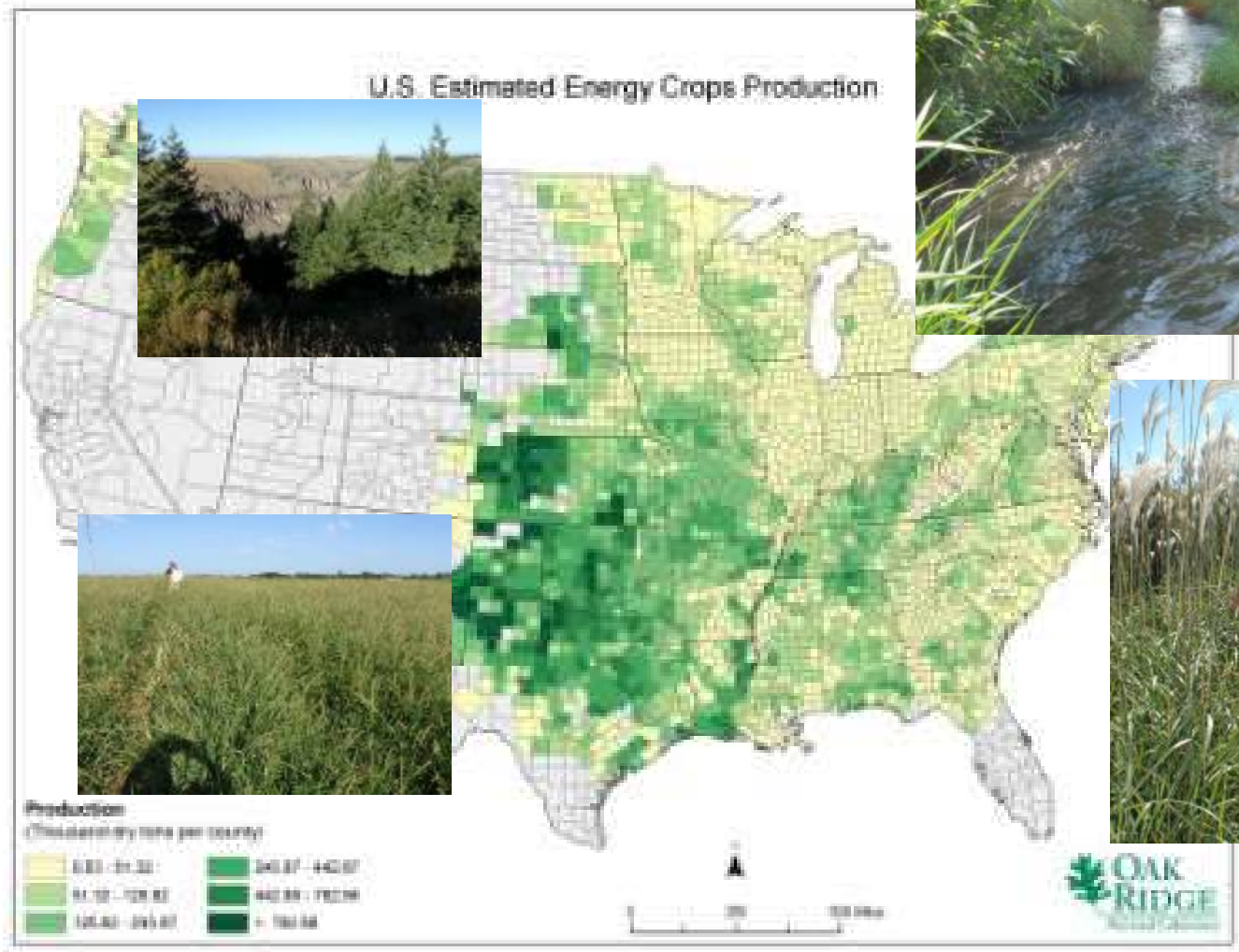
Irrigating Biomass - - What Are the Rules?



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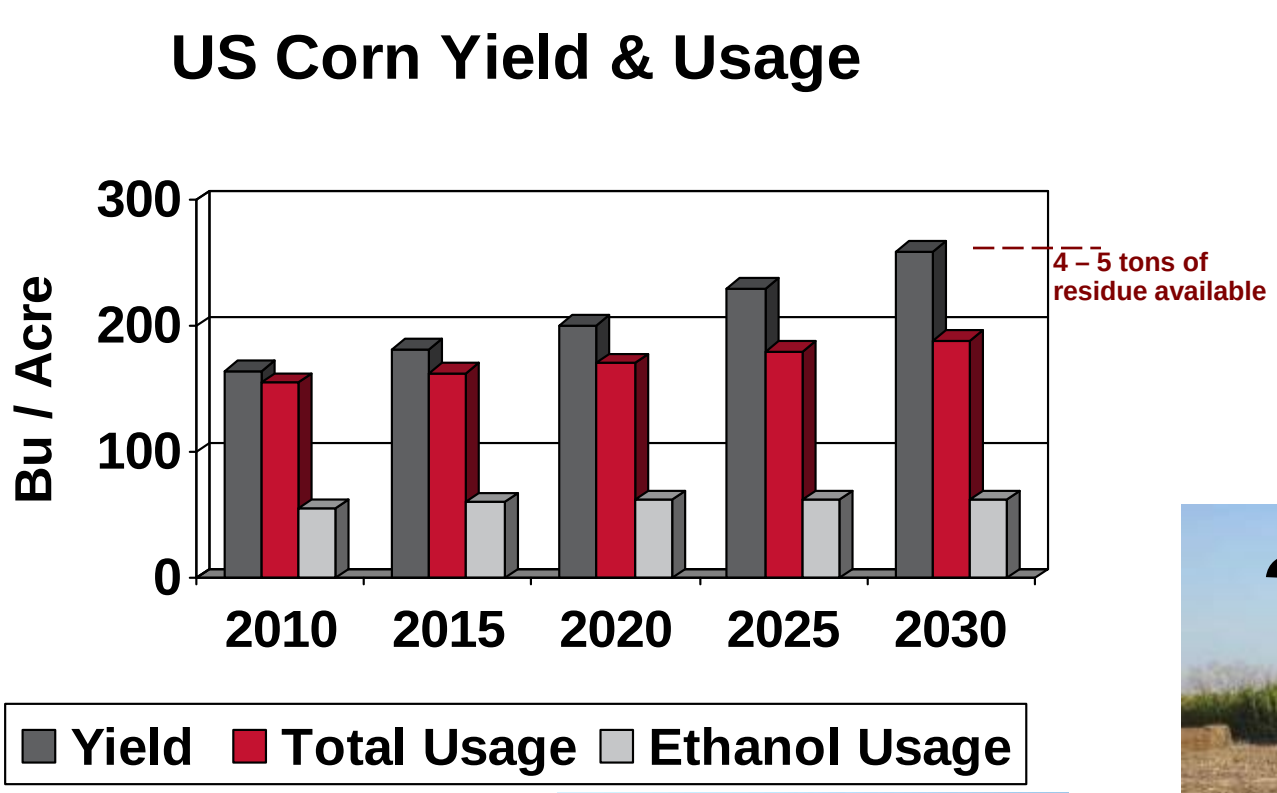
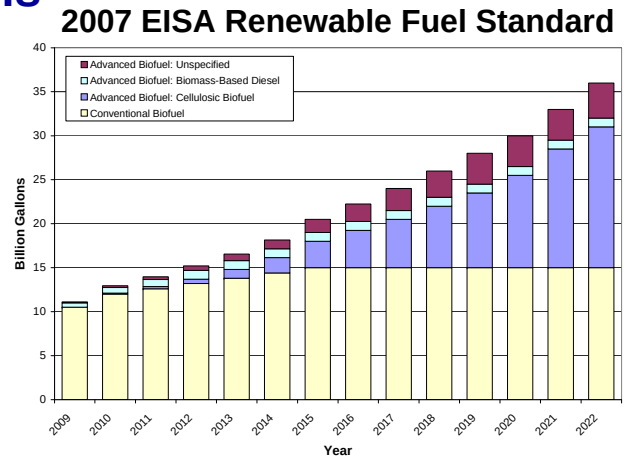
"Folks are Starving Cause You Fools are Brewing Fuels"





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“If its tall, it will take a forage harvester to make it fall”

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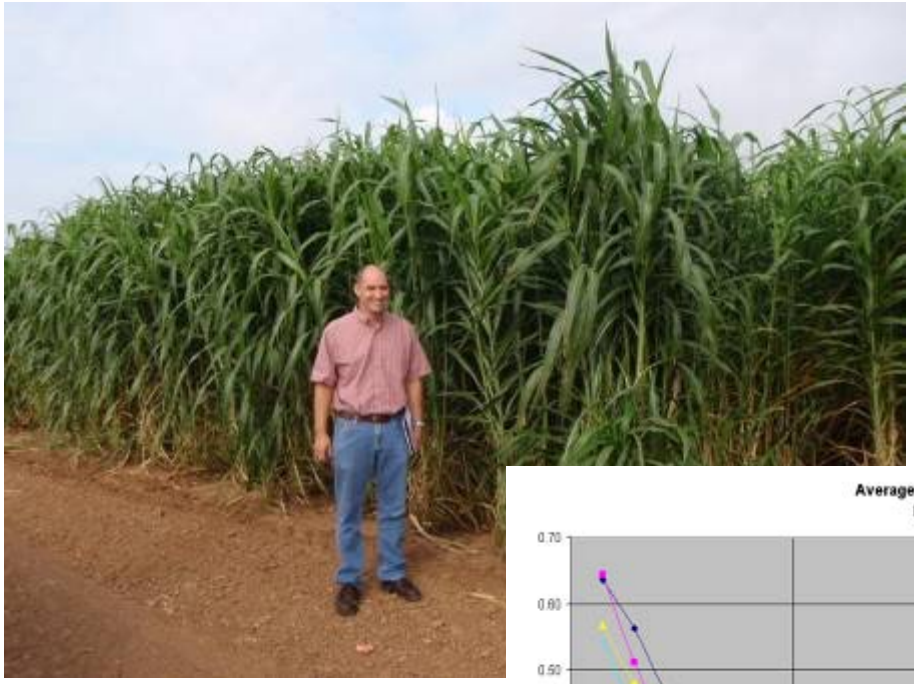
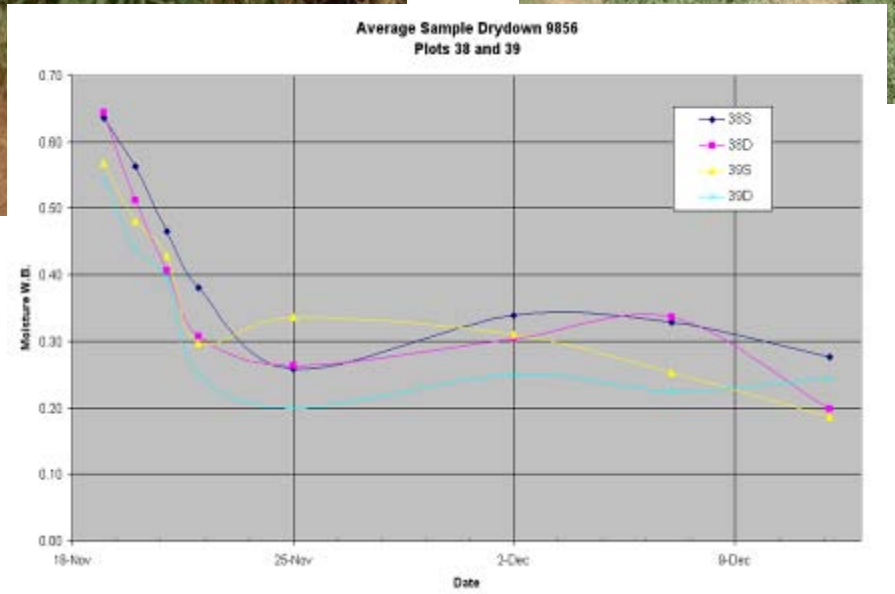
“Ok, but it isn’t going to dry down very fast……and… then it will rain…….. and….. how do you expect to get it baled and off the field?”





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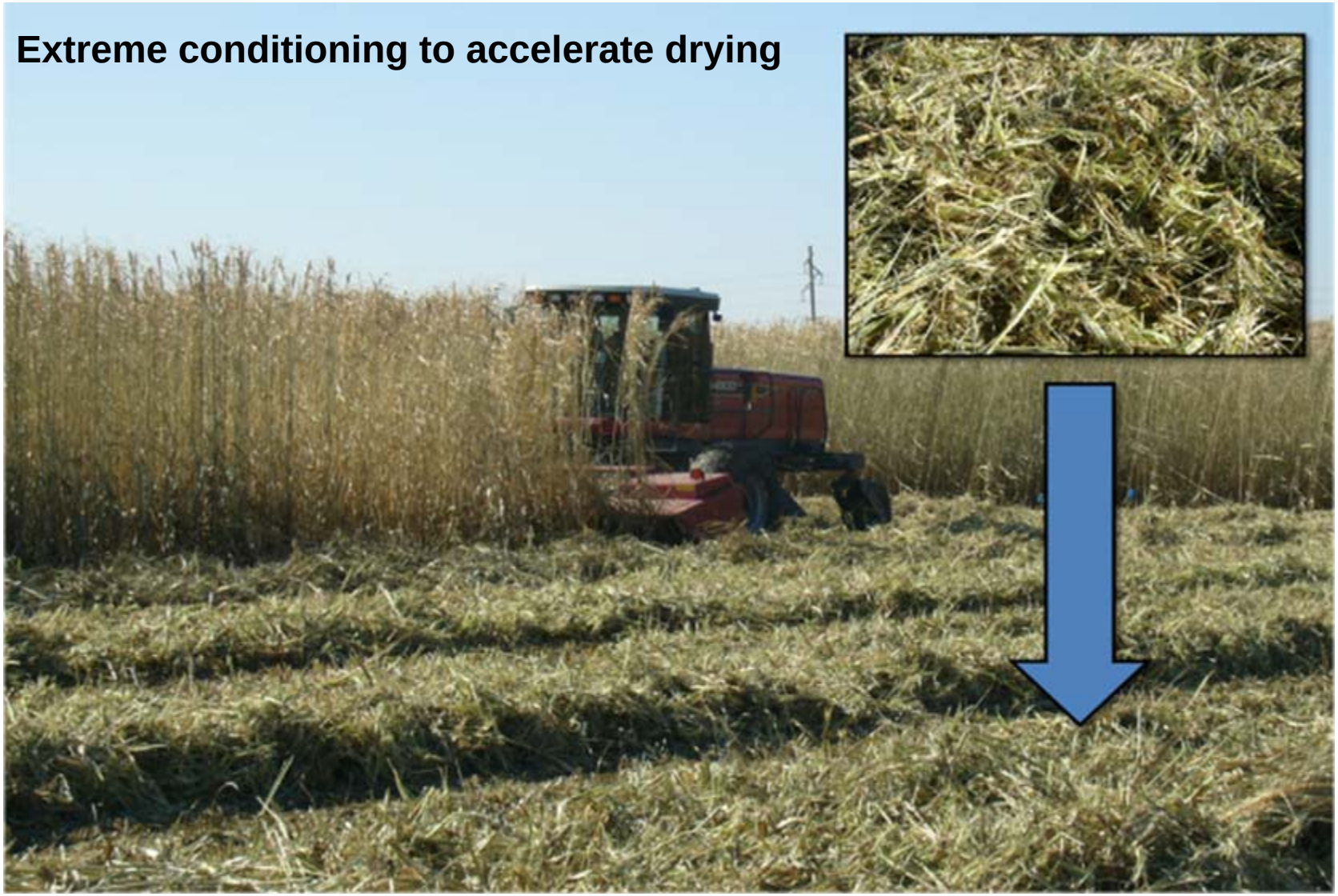

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“Yah… but, tall crops fall down and you can’t pick ‘em up”

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“We’ll just wait for these grassy crops to freeze, and then spend all winter harvesting and delivering”

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“Besides, Spring is on the way!”

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“But That Little Ole Thing Won’t Do Miscanthus, Will It?”

Late winter Miscanthus

Winter Switchgrass

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"Isn't It True That This Cellulosic Feedstock is Going to Take a Lot of Acres?"

The number of acres required to supply the cellulosic feedstock chain will be directly related to the yield per acre of the overall feedstock mix, considering both crop type and the agronomic factors per the given locations. **Bob Matousek, *today***

Why is it less acceptable to grow something that removes enough CO_2 from the atmosphere to produce 25 ton/acre of carbon based material while putting a corresponding amount of Carbon deep into the soil, than it is to let that same acreage grow up to skunk brush and kudzu, and then be left to rot, decay, and release? Same Dude in Badder Mood

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Hesston Energy Crop Machinery Test Plots

Brian Olander

Planting, Harvesting, Handling, Storage, & Husbandry

Energy Sorghum, Switchgrass, Miscanthus, Prairie Grasses, Corn, & Wheat

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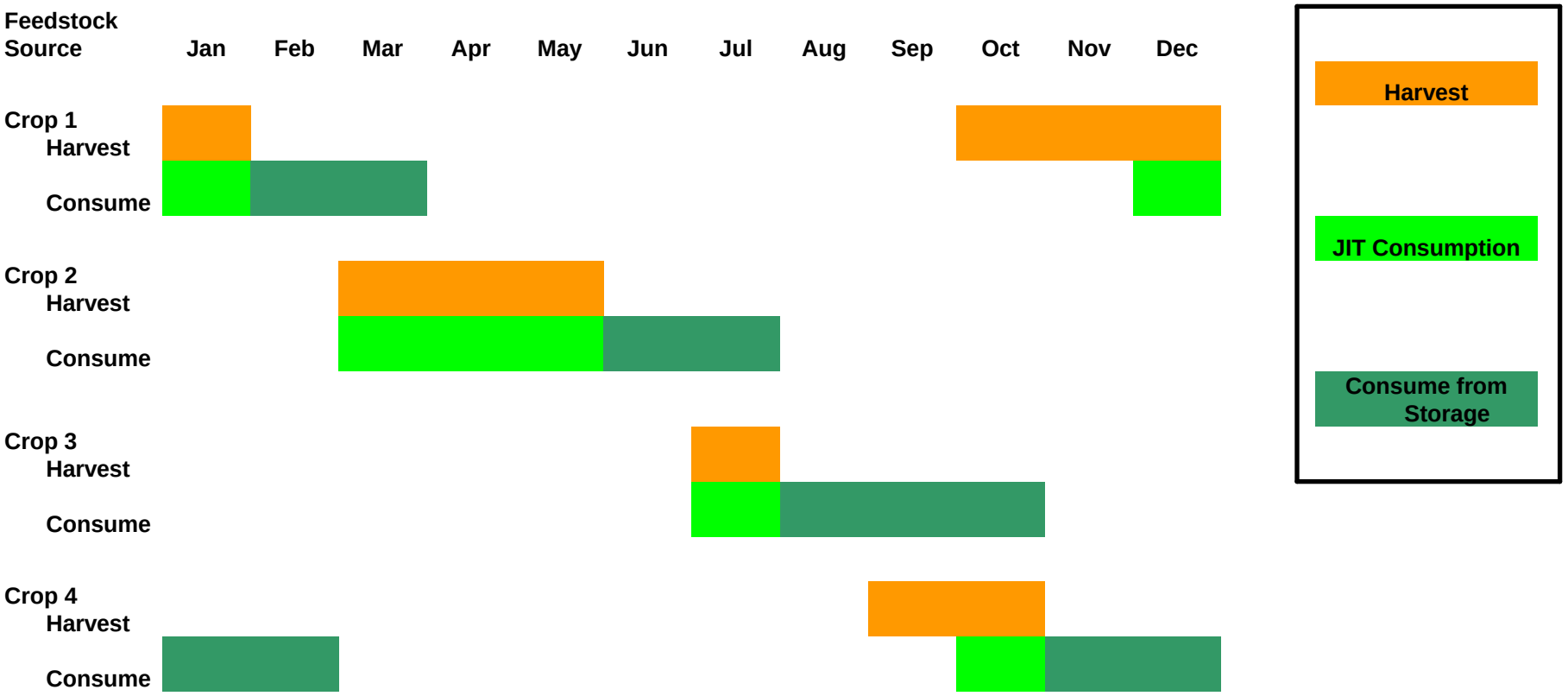
“So - - every refinery will have a favorite feedstock that they harvest and store for a year?”

The Just-In-Time BioMass Logistic Calendar



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"You can't max out a semi with common density bales, and I do not want to discuss it any further - - let's vote!"

& Little Sister

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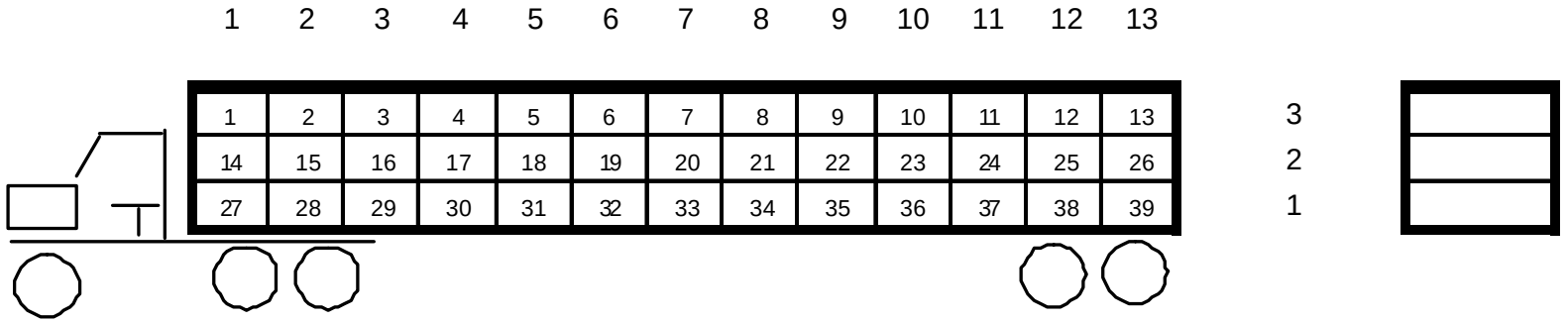
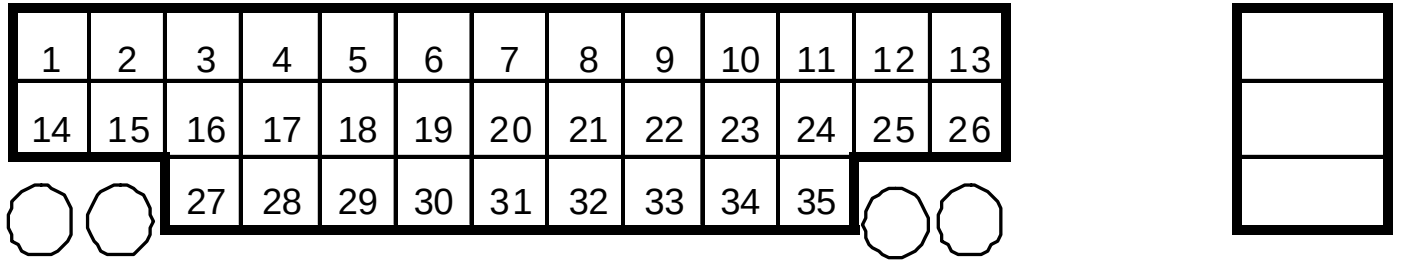
How to Haul Bales on a Semi Trailer

Assumes: 28,000 lb tare weight
52 ft trailer length
13.5 ft maximum legal height
80,000 lb max GVW

52 ft long x 13.5 ft tall loaded



39 - 3’ X 4’ X 8’ Bales = 3744 ft³ 52,000 lbs @ 13.8 lb/ft³



35 - 4’ X 4’ X 8’ Bales = 4480 ft³ 52,000 lbs @ 11.6 lb/ft³

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“It takes too long to load, hours to secure, and they’ll fall off on the road”

!

Roadrunner Squeeze Loader

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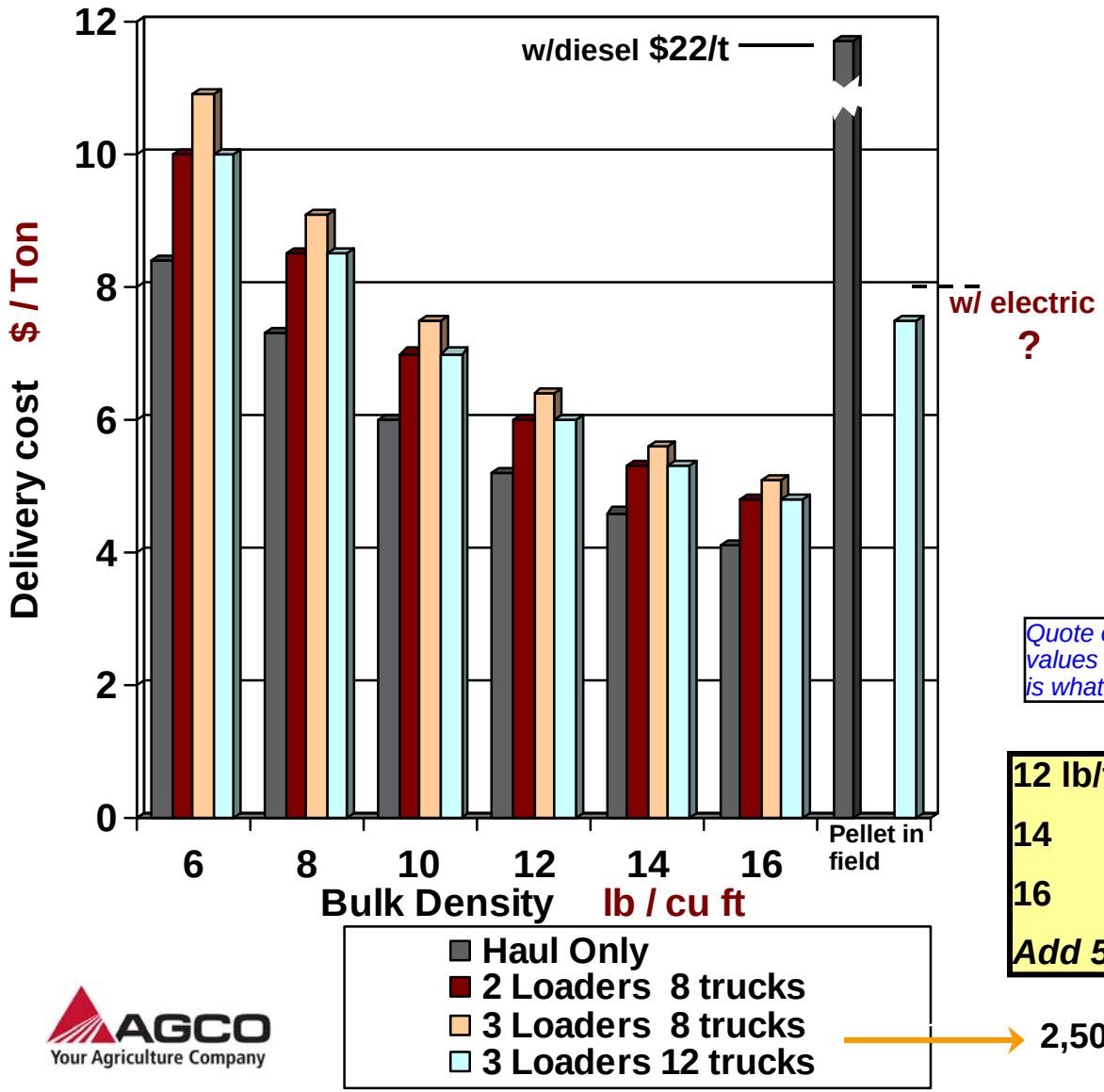
SWAG's At Biomass Transportation Costs vs. Bulk Density for Bales



Operating Assumptions

$750 /day/truck $600/day/loader

28,000 lb tare weight

25 Mile ***Avg.*** Distance

10 Minutes to Load Truck

10 Minutes to Unload Truck

10 Hour Work Day

8 Loads / Truck / Day

(75 minute cycle time)

*Quote or use these numbers at your own peril. These values are an educated guess, and quite frankly the **truth** is what AGCO and the DOE are paying to find out!!!*

12 lb/ft³ = 73,000 lb GVW

14 = 80,400 lb GVW

16 = 87,000 GVW = ***$1000+ DOT Fine !***

Add 5% moisture & 14 becomes 14.6 !

→ 2,500 tons/day @ 14 lb/ft³

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"That $750 per day may work today, but it can't stand up if the price of fuel goes way up again, that'll break the bank!"

Truck burns about 10 gal/hr

Hauls about 20 tons / hr ═► ½ gal per ton

1 ton yields 90 gallons of Ethanol ═► 180 gal Eth / gal Truck Fuel

So Truck Fuel (Diesel) doubles from $3/gal to 6/ gal ═► $3 x 100/day = $300 / day cost increase

Truck hauls 200 ton/day X 90 gal/ton = 18,000 gal/day

Ethanol Price increases from $1.60/gal to 3.20 ═► $1.60 X 18,000 = $28,800 / day revenue increase

Some of that should be able to soak up some incremental shipping cost!!

But, if our trucks are burning fuel - - and we are producing ethanol fuel……?!!

And then there are the Tier 4b emissions standards!!?

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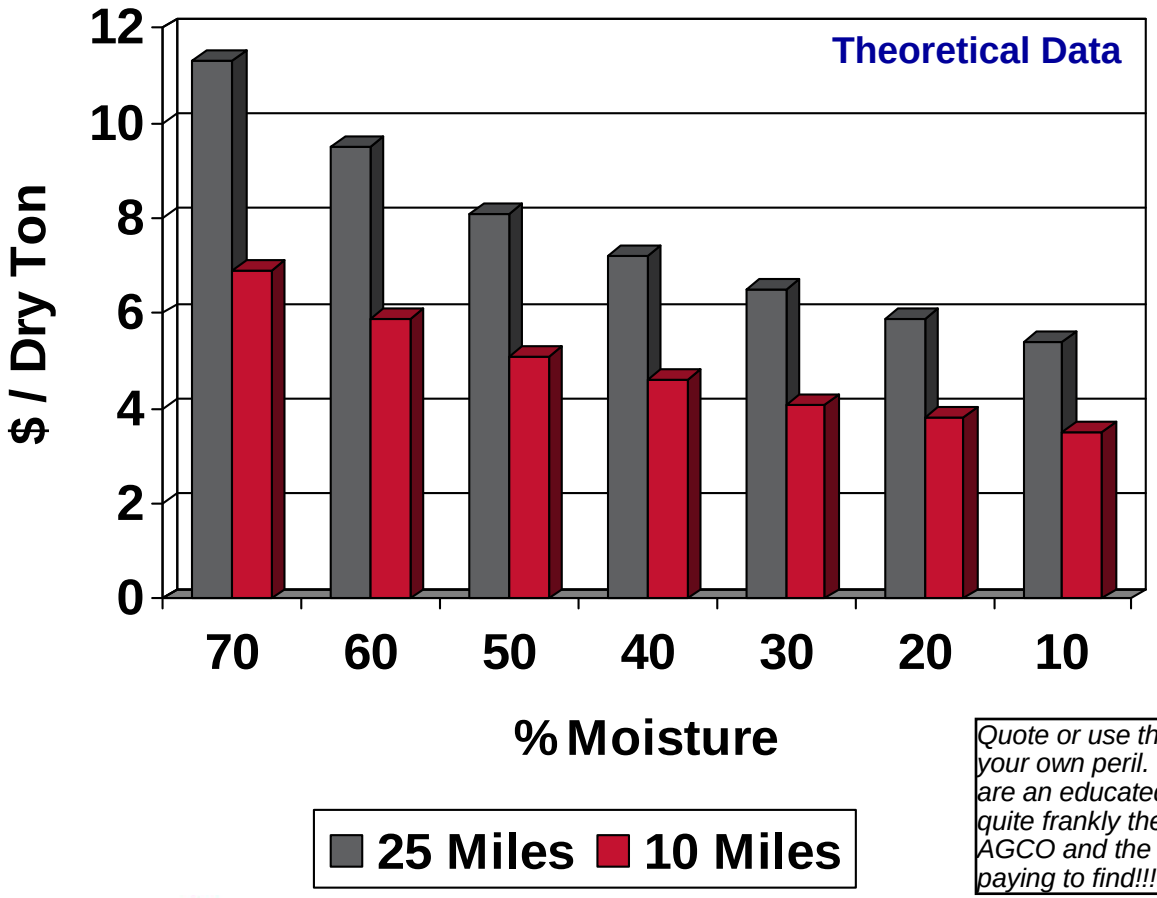
"Maybe, but bet'cha can't afford to truck it if you don't get it dried down"

Moisture Effect on Transport Costs



Assumes:

8 Trucks, 3 Loaders for 25 miles

4 Trucks, 2 Loaders for 10 miles

$750 /day/truck, $600/day/loader

10 hours/day **14 lb/ft³ @ 15%**

52,000 lb payload (80,000 GVW)

% Moisture	15% lb/ft³
70	6.3
60	7.7
50	9.1
40	10.5
30	11.9
20	13.3
10	14.7

*Quote or use these numbers at your own peril. These values are an educated guess, and quite frankly the **truth** is what AGCO and the DOE are paying to find!!!*

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INL’s Quest for the Uniform Flow-able Format

I'm done for today, but this is not ….

The End

Because…….

Real Fass Biomass !