CORE LAB METHODS AND INTERPRETING GROWER SHEETS

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OUTLINE

- COMPARE LOUISIANA CANE SAMPLING & PAYMENT METHOD – PAST & PRESENT
- NEEDS OF CANE SAMPLING SYSTEM
- USDA METHOD (UP TO 1974)
- ORIGINAL CORER (1975 - 1997)
- REVISED CORER (1998 – PRESENT)

OUTLINE (CONT'D.)

- LAB METHOD
- CORER PREDICTIONS
- AFFECT OF VARIABLES ON TRS
- PAYMENT METHODS

CANE SAMPLING SYSTEM

1. Obtain representative, unbiased sample
2. Prepare sample for processing
3. Process sample
4. Analyze processed sample
5. Express cane quality in terms suitable for cane payment

CANE VARIABILITY

1. Cane is a non-homogeneous material

2. Variations between cores of same load have coefficient of variation of 7% (i.e., for a load of 200 TRS cane, 95% of individual samples will be in range of 173-227)

3. However, assuming 600 samples over a crop, variation drops to 199-201

4. Core lab coefficient of variation is 1.4%

IDEAL SYSTEM

1. Eliminate judgment in sample selection and processing
2. Standardize sample procurement and processing equipment
3. Minimize personnel requirements
4. Divorce sampling system from mill operation
5. Reflect effect of juice quantity and quality
6. Accurately predict recoverable sugar
7. Provide cane analysis for comparison with mill results

ORIGINAL CORER

- CORE CANE
- SHRED CANE
- PRESS CANE
- ANALYZE JUICE & BAGASSE
- PREDICT CANE ANALYSIS
- PREDICT SUGAR YIELD
- 60% OF SUGAR TO GROWERS


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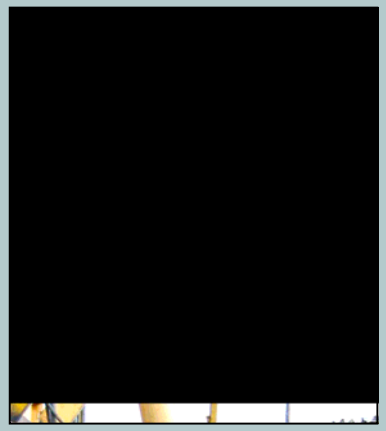
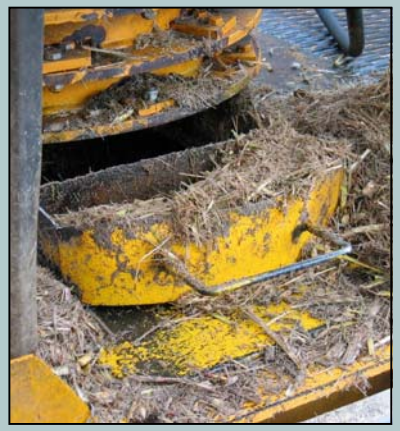
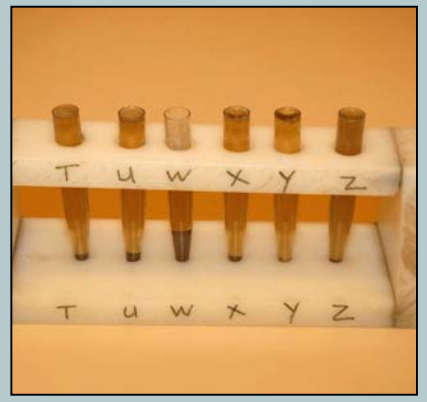
CAMECO
INDUSTRIES
CAUTION
CAUTION






Bellingham + Stanley Ltd.


120 VOLTS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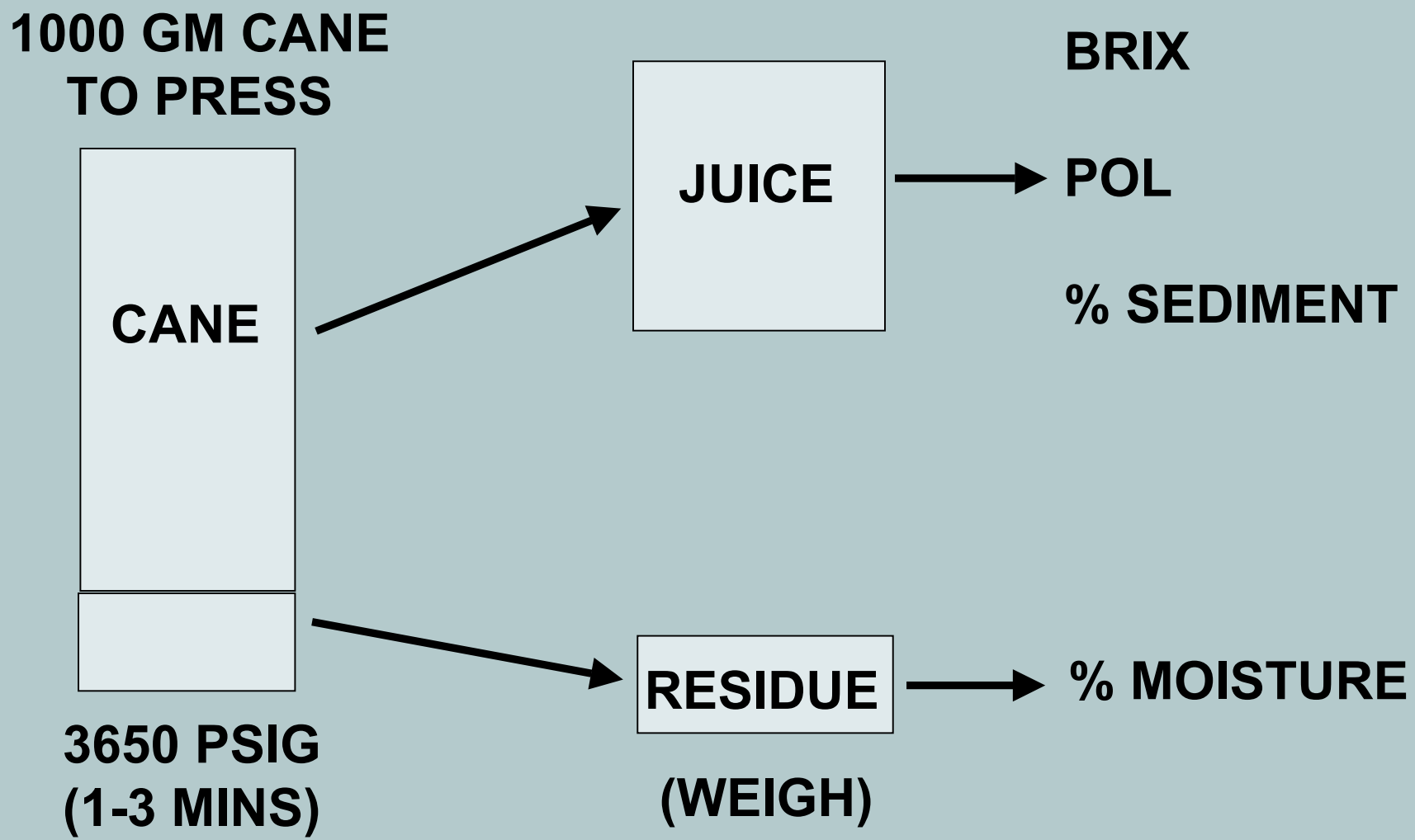

1000 GM CANE
TO PRESS
CANE
3650 PSIG
(1-3 MINS)
JUICE
BRIX
POL
% SEDIMENT
RESIDUE
(WEIGH)
% MOISTURE

CALCULATIONS

Assuming juice extracted has same composition as residual juice in residue,

Brix % cane

Pol % cane

Fiber % cane

are calculated

THEORETICAL RECOVERABLE SUGAR (TRS) PREDICTION

CANE ANALYSIS → TRS

Reduced Extraction = 91.9 Assumed

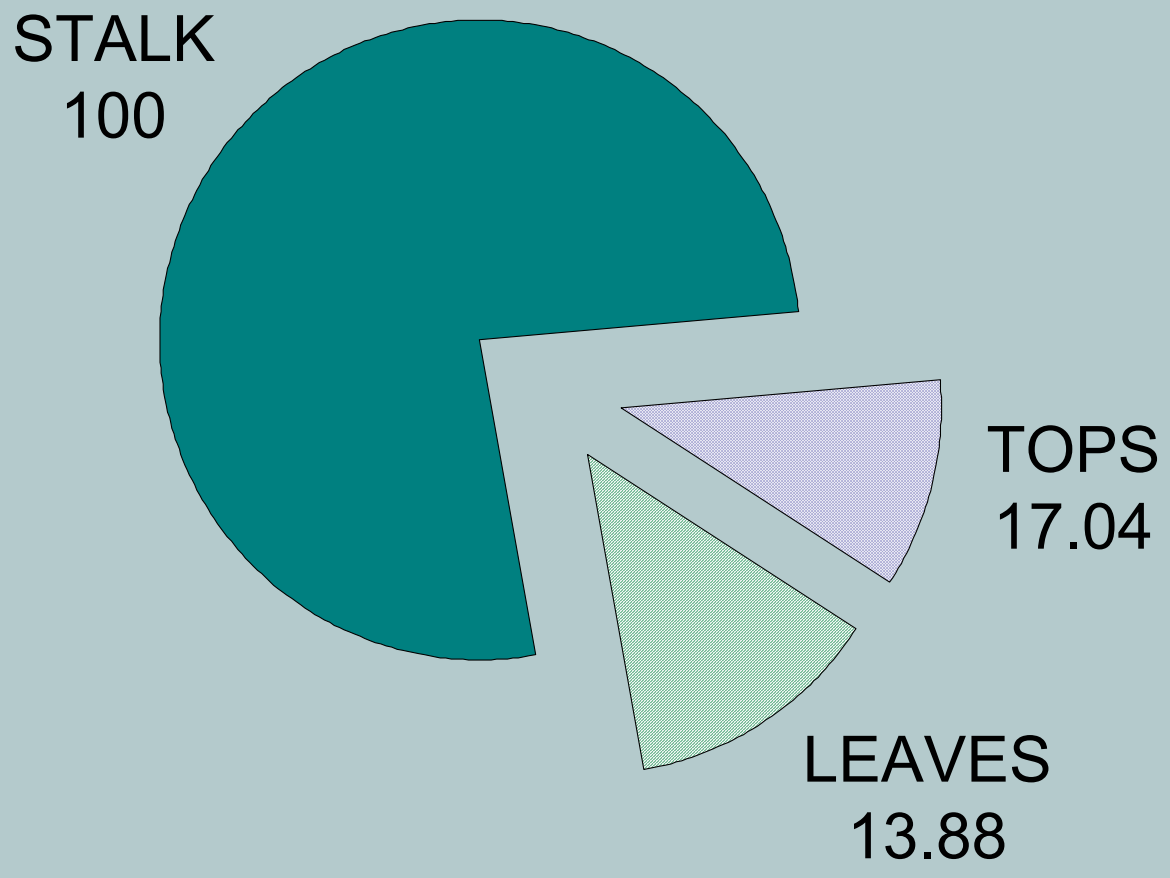
Boiling House Efficiency = 96 Assumed

$$TRS = (0.28\ Pol - 0.08\ Brix) \times \left(100 - \frac{56.67\ Fiber}{100\text{-}Fiber}\right)$$

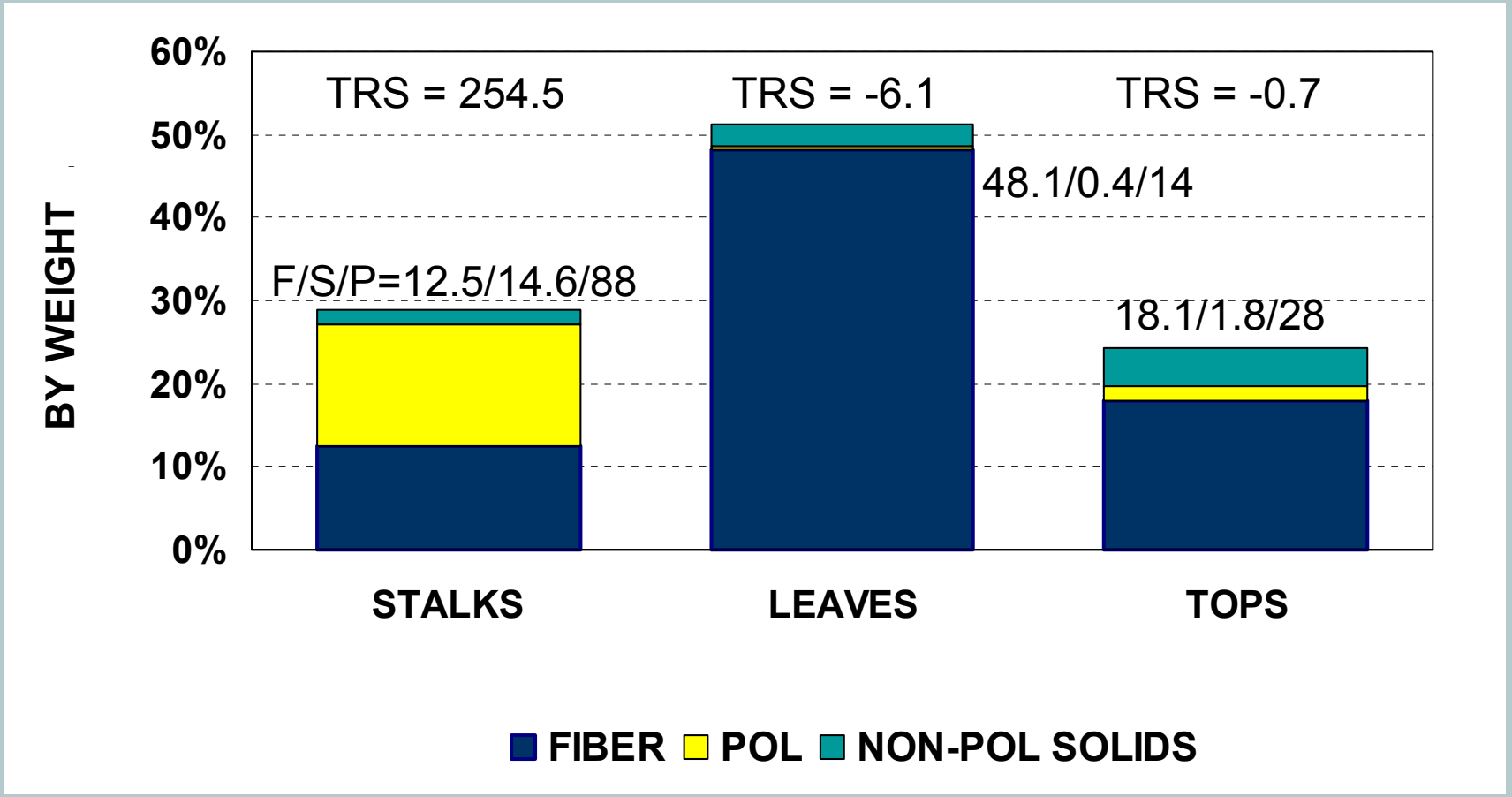
$$Liquidation\ Factor = \frac{Factory\ Lbs\ 96/TC}{Corer\ Lbs\ 96/TC} \times 100$$

Payment for cane = Corer TRS X Liq. Fac. X Grower Share

TYPICAL COMPOSITION OF CANE



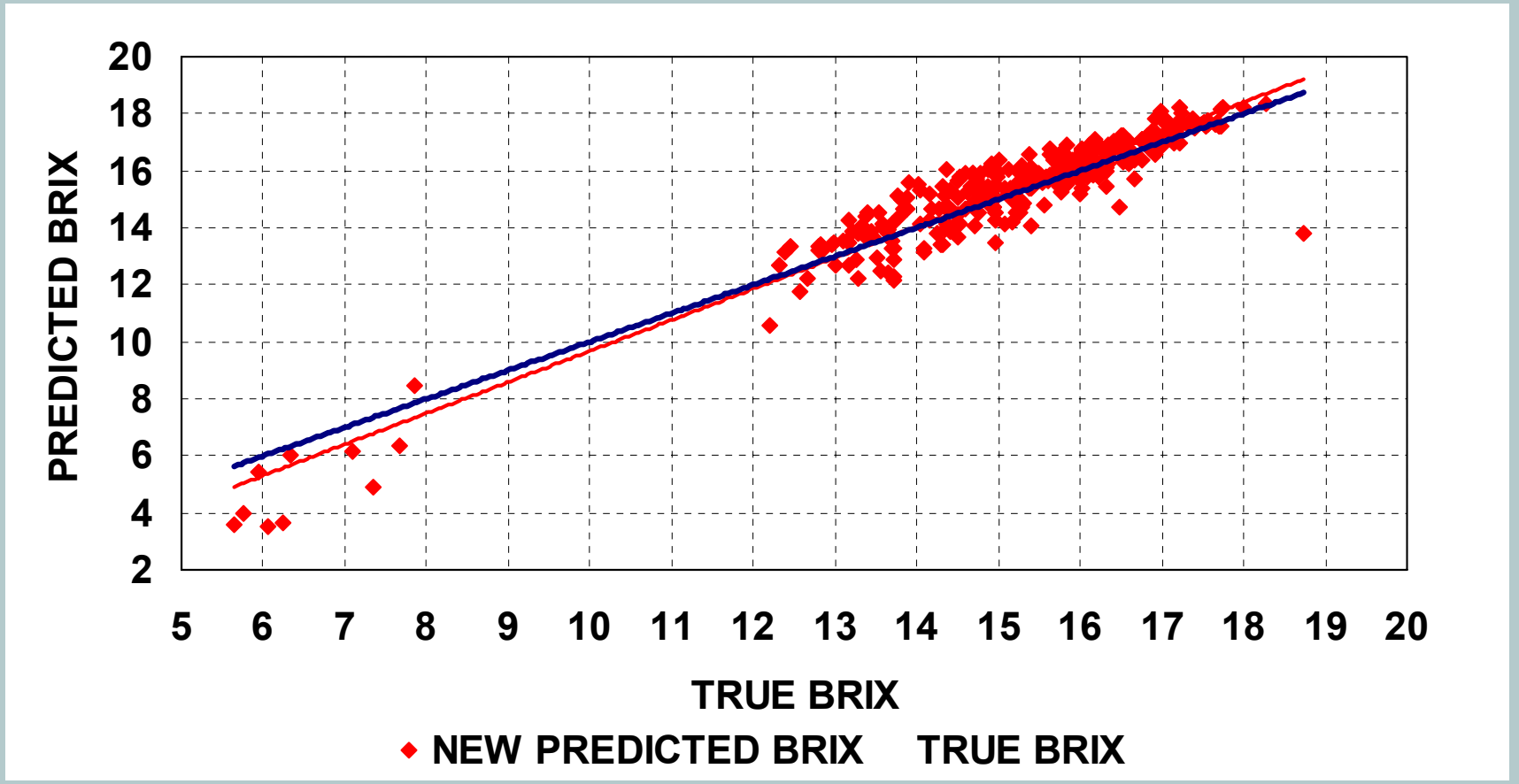
STALK, LEAVES AND TOPS TYPICAL ANALYSIS & TRS



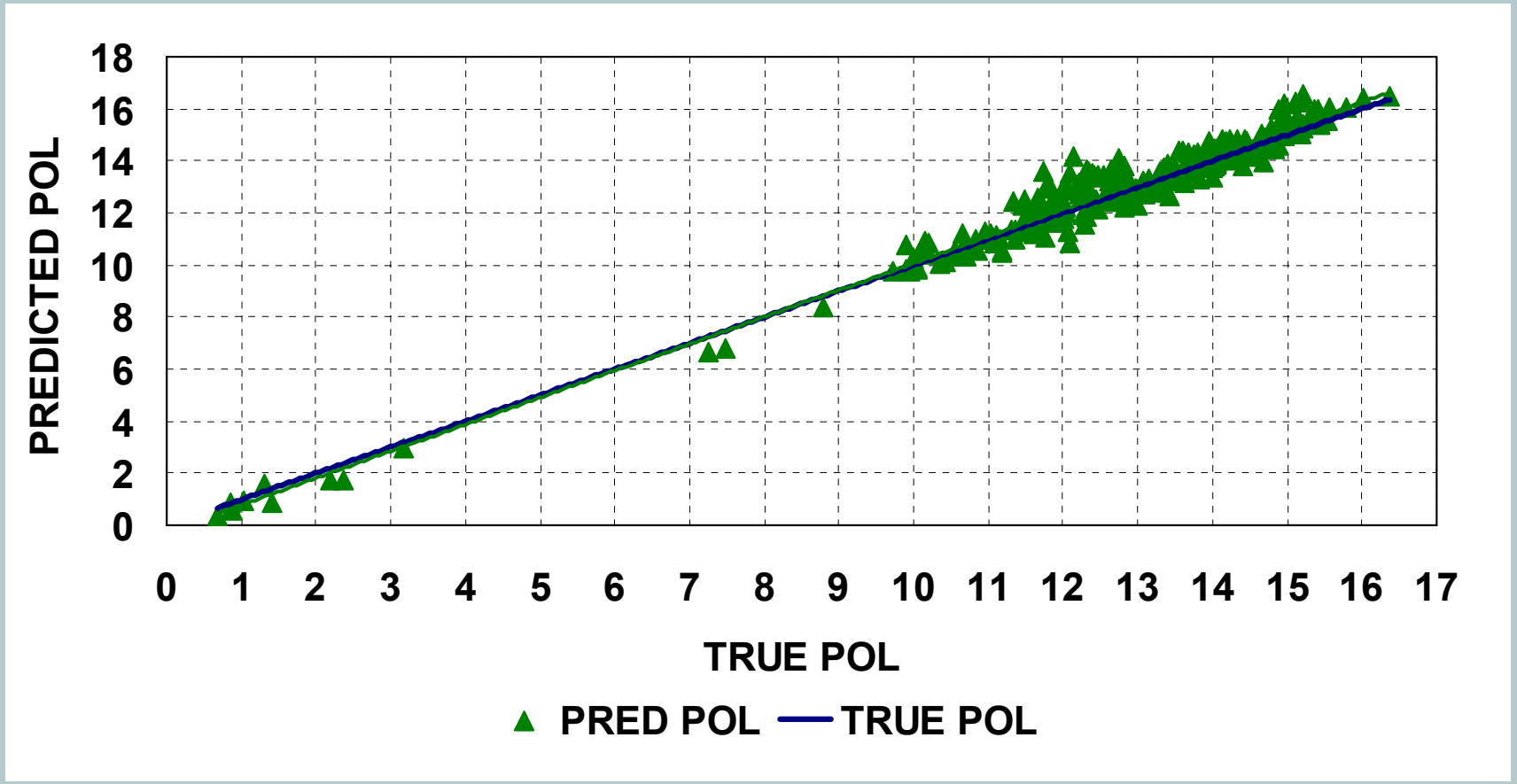
REVISED CORE FORMULA

- Fiber changed to fibraque (Fiber x 1.3)
- Z factor to correct extracted juice purity to absolute juice
- Brix and pol predictions are very good

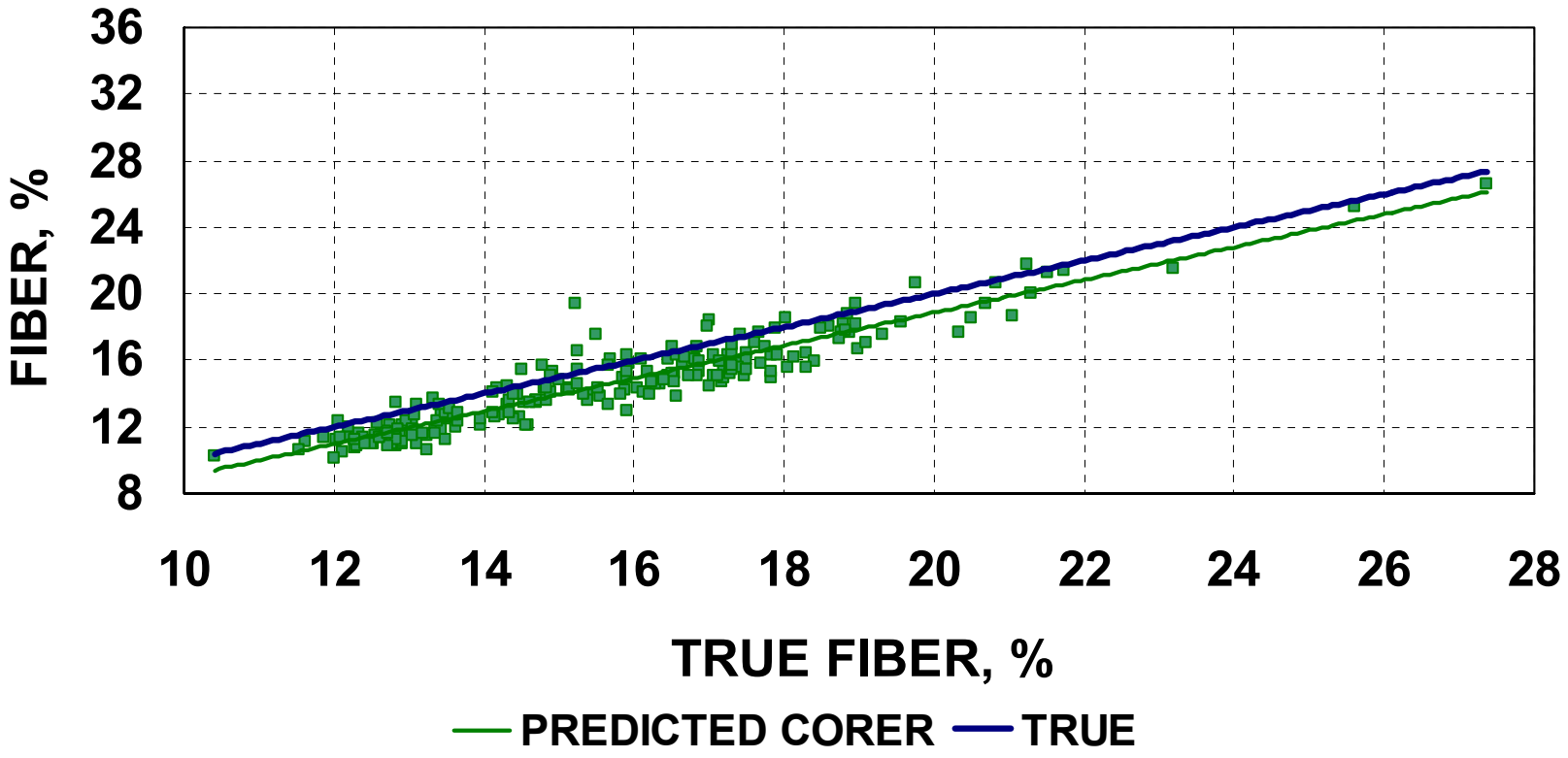
TRUE BRIX VS NEW PREDICTED BRIX
(% CANE)



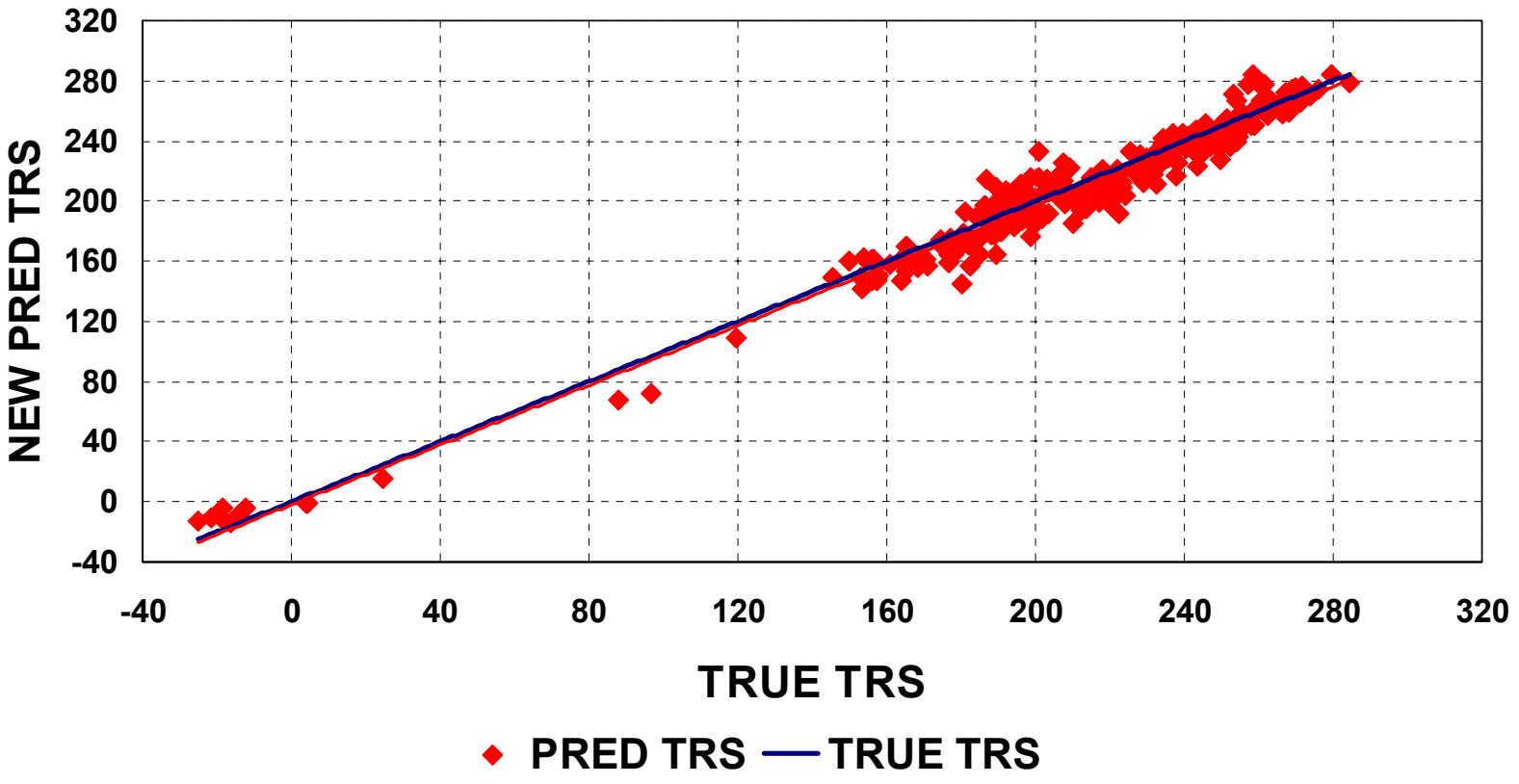
TRUE POL VS NEW PREDICTED POL
(% CANE)



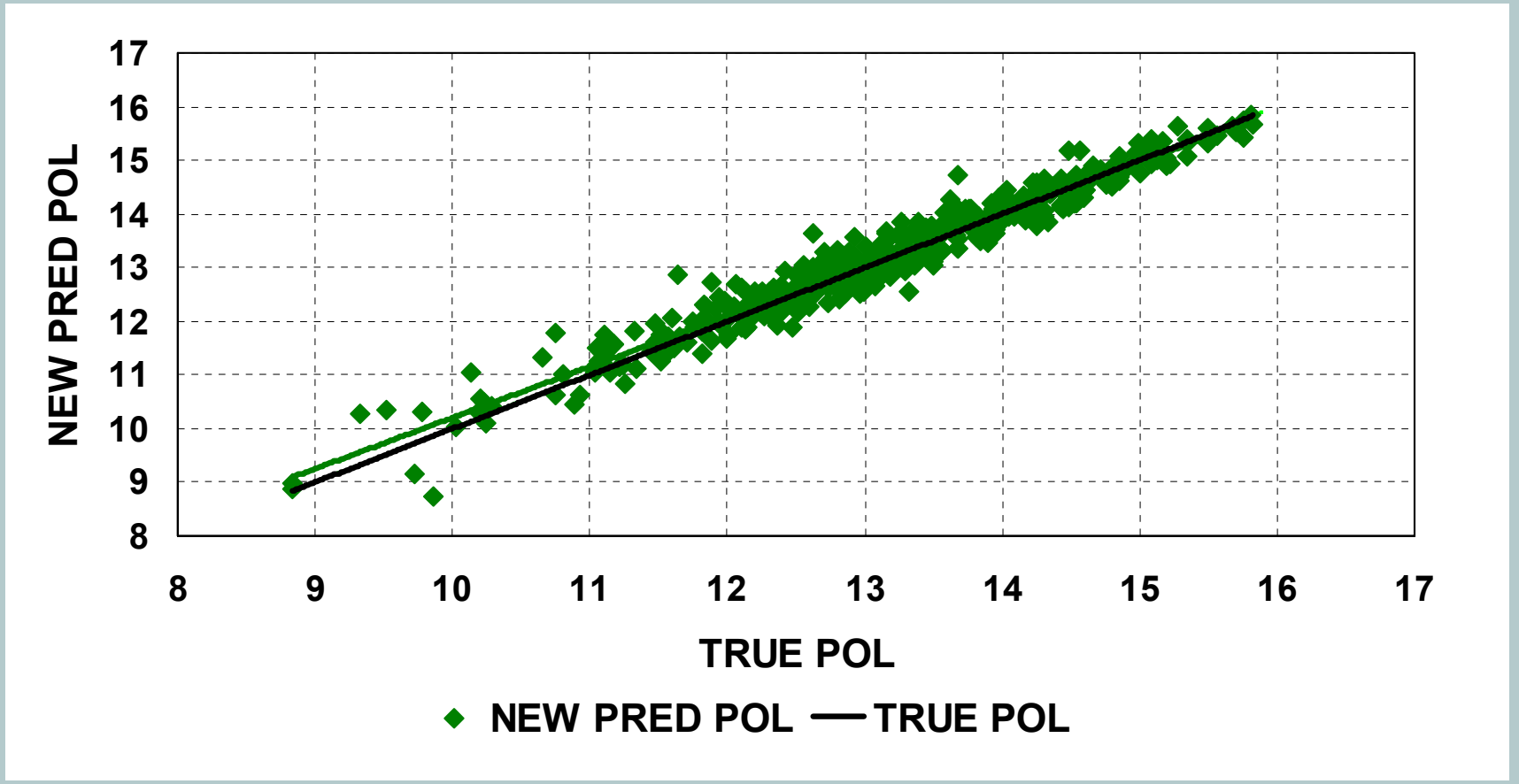
TRUE FIBER VS PREDICTED CORER FIBER
(% CANE)



TRUE TRS VS NEW PREDICTED TRS
(% CANE)



TRUE POL VS NEW PREDICTED POL
FACTORY VALIDATION



St. Martin 2000

GROWER SHEET

INPUT DATA

RESIDUE WT.	JUICE BRIX	JUICE POL	% SEDT.	% MOIST
427.6	18.2	16.29	7.5	53.55

CALCULATED RESULTS

CANE BRIX	CANE POL	FIBQ.	TRS	CRS @ 100 L.F.
15.23	12.96	20.45	205.88	205.88

GROWER SHEET

VARYING INPUT DATA

	RESIDUE WT.	JUICE BRIX	JUICE POL	% SEDT.	% MOIST
VARY	+10	+1	+1	+1	+1
Δ TRS	-2.2	-4.7	+19.0	-0.9	+3.3

GROWER SHEET

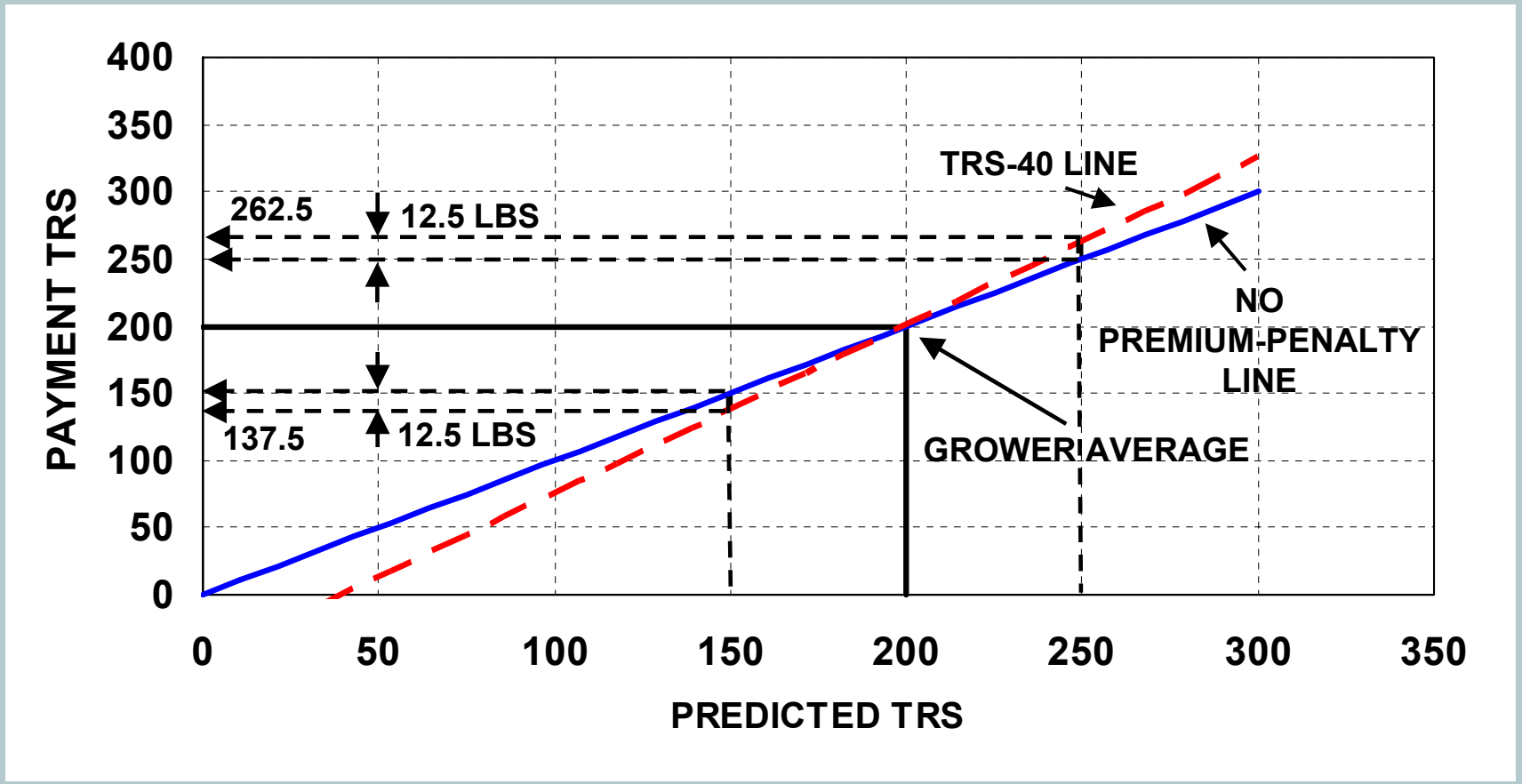
CALCULATED RESULTS

	CANE BRIX	CANE POL	FIBQ.
VARY	+1	+1	+1
Δ TRS	-6.8	+23.9	-4.7

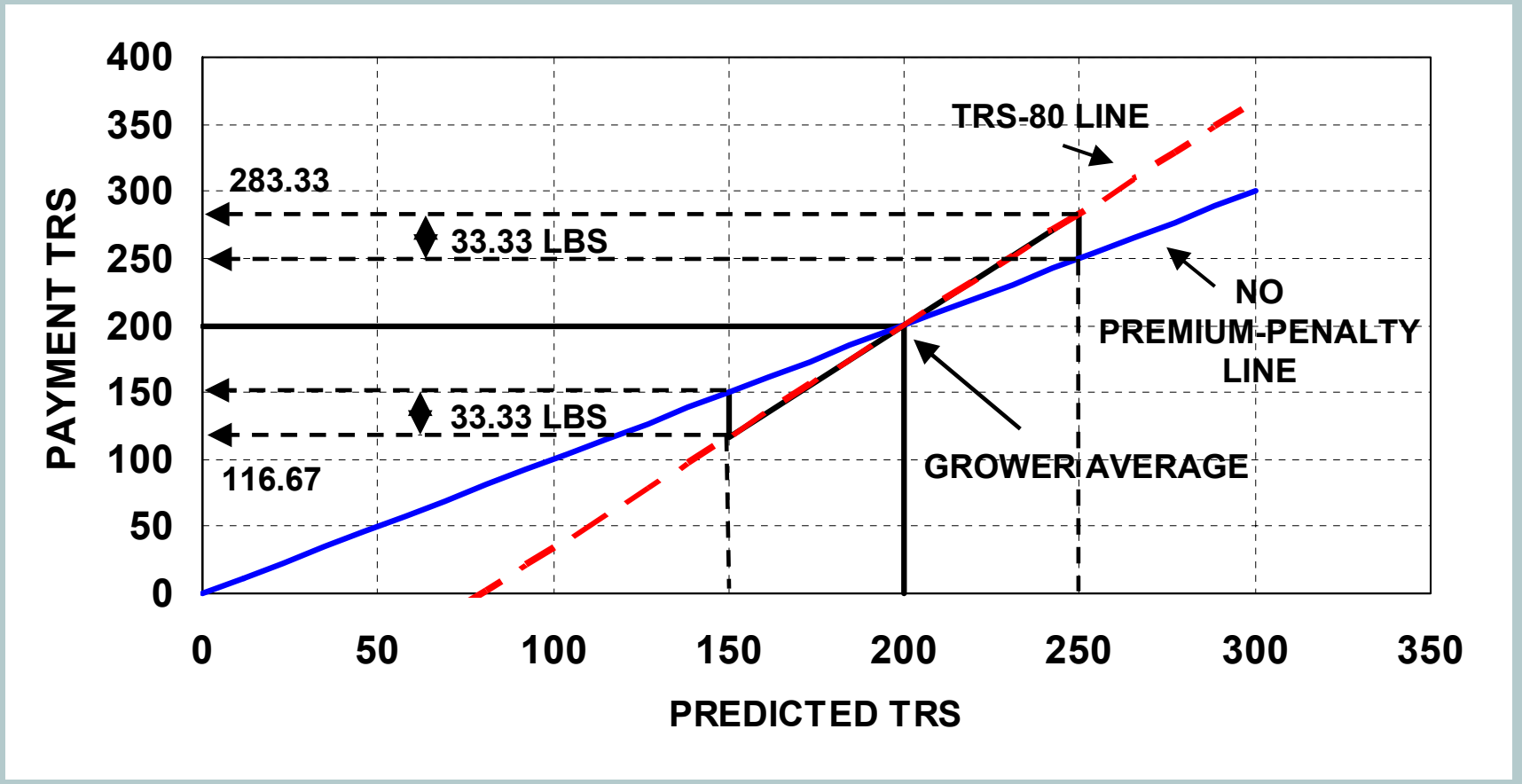
INCENTIVE SYSTEMS

1. Cost of processing 1 ton cane constant
2. High sugar content cane profitable
3. Low sugar content cane unprofitable
4. Need to raise cane quality

COMPARISON OF TRS VS TRS-40 FORMULAS



COMPARISON OF TRS VS TRS-80 FORMULAS



SUMMARY

1. Cane is non-homogeneous, solid material (difficult to obtain representative sample).

2. Pre-1974 USDA payment system based on cane quality, but over predicts quality of poor quality cane and under predicts quality of high quality cane. Sampling frequency about every 65 tons.

3. Original corer system improved on cane quality prediction, but over predicted cane quality. Sampling frequency about every 25 tons.

SUMMARY

4. Revised corer method (1998) accurately predicts pol, Brix and fiber % cane. Sampling frequency about every 25 tons.

5. Increased use of incentive systems likely to improve cane quality and profitability of sugar industry.

ACKNOWLEDGMENTS

AMERICAN SUGAR CANE LEAGUE
LOUISIANA SUGAR FACTORIES
USDA – HOUMA STATION

CORE SAMPLING CALCULATION METHOD

DATA REQUIRED

1. Residue Weight % Cane (by weighing)
2. Moisture % Residue (by weighing)
3. Extracted Juice Brix (by refractometer)
4. Extracted Juice Pol (by polariscope)
5. Sediment Volume % Juice (by centrifuging)

SEDIMENT CORRECTION

Dry Sediment **%** Juice =

Sediment Volume % Juice x Factor

Factor = 0.302

Dry Sediment **in** Juice =

Juice Wt x Dry Sediment % Juice / 100

Juice Wt = 1000 Gm Cane - Residue Wt

CORRECTED RESIDUE

$$\text{Extra Residue} = \frac{\text{Dry Sediment Weight}}{\left(1 - \frac{\text{Moisture \% Residue}}{100}\right)}$$

This extra residue is added to residue weight from press and used to calculate residue % cane.

FIBER % CANE

$$\text{Fiber \% Residue} = 100 - \frac{\text{Moisture \% Residue}}{(1 - \text{Extracted Juice Brix}/100)}$$

$$\text{Fiber \% Cane} = (\text{Fiber \% Residue}) \times (\text{Residue \% Cane})/100$$

$$\text{Absolute Juice \% Cane} = 100 - \text{Fiber \% Cane}$$

BRIX % CANE AND POL % CANE

Brix % Cane = B =

(Juice % Cane) x (Brix % Juice)/100

Pol % Cane = P =

(Juice % Cane) x (Pol % Juice)/100

THEORETICAL SUGAR YIELD =
(LBS 96 SUGAR/GROSS TON CANE)

$$\frac{2000 \text{ lbs}}{\text{ton}} \times \frac{\text{Pol \% Cane}}{100} \times \frac{\text{Extn.}}{100} \times \frac{\text{Reten.}}{100} \times \frac{1}{0.96}$$

POL EXTRACTION

$$\text{Pol Extraction} = 100 - \frac{56.67 \times (\text{Fiber \% Cane})}{(100 - \text{Fiber \% Cane})}$$

Expression for pol extraction predictions depend on fiber content of the cane, for example:

Fiber % Cane	Pol Extraction
0	100.00
10	93.70
12.5	91.90
15	90.02
20	85.86

RETENTION

Retention (obtained by using the Winter-Carp formula and the Boiling House Efficiency (BHE)) =

$$\left(1.4 - \frac{40}{\text{Extracted Juice Purity}}\right) \times \text{BHE}$$

CORER TRS PREDICTION (1975-1997)

Substituting

- reduced extraction expression developed for pol extraction,
- Winter-Carp formula for boiling house retention, and
- assuming a boiling house efficiency of 96, the sugar yield expression reduces to:

$$TRS = (0.28P - 0.08B) \times \left(100 - \frac{56.67F}{100-F}\right)$$

where TRS = Theoretical Recoverable Sugar, lbs 96 sugar/ton cane

P = Pol % Cane

B = Brix % Cane

F = Fiber % Cane

CORER TRS PREDICTION (1998-)

Using the fibraque correction, the following calculations should be used:

New Fiber = NF = F x 1.3
New Pol = NP = P x (100-NF)/(100-F)
New Brix = NB = B x (100-NF)/(100-F) x Z

where $Z = 1.15 - 0.0018\left(\frac{1000 - \text{Corrected Residue Weight}}{10}\right)$

$$TRS = (0.28NP - 0.08NB) \times \left(100 - \frac{56.67NF}{100-NF}\right)$$

where TRS = Theoretical Recoverable Sugar, lbs 96 sugar/ton cane
NP = Pol % Cane
NB = Brix % Cane
NF = Fiber % Cane

OTHER EQUATIONS OF INTEREST

$$\text{Liquidation Factor} = \frac{\text{Actual Factory Sugar Production, lbs 96}}{\text{Total lbs TRS Calculated for All Cane}}$$

Commercial Recoverable Sugar, CRS =

TRS x Liquidation Factor

New Absolute Juice Analysis:

Brix = (NB / (100-NF)) x 100

Pol = (NP / (100-NF)) x 100

Purity = NP/NB x 100

USDA METHOD (UP TO 1974)

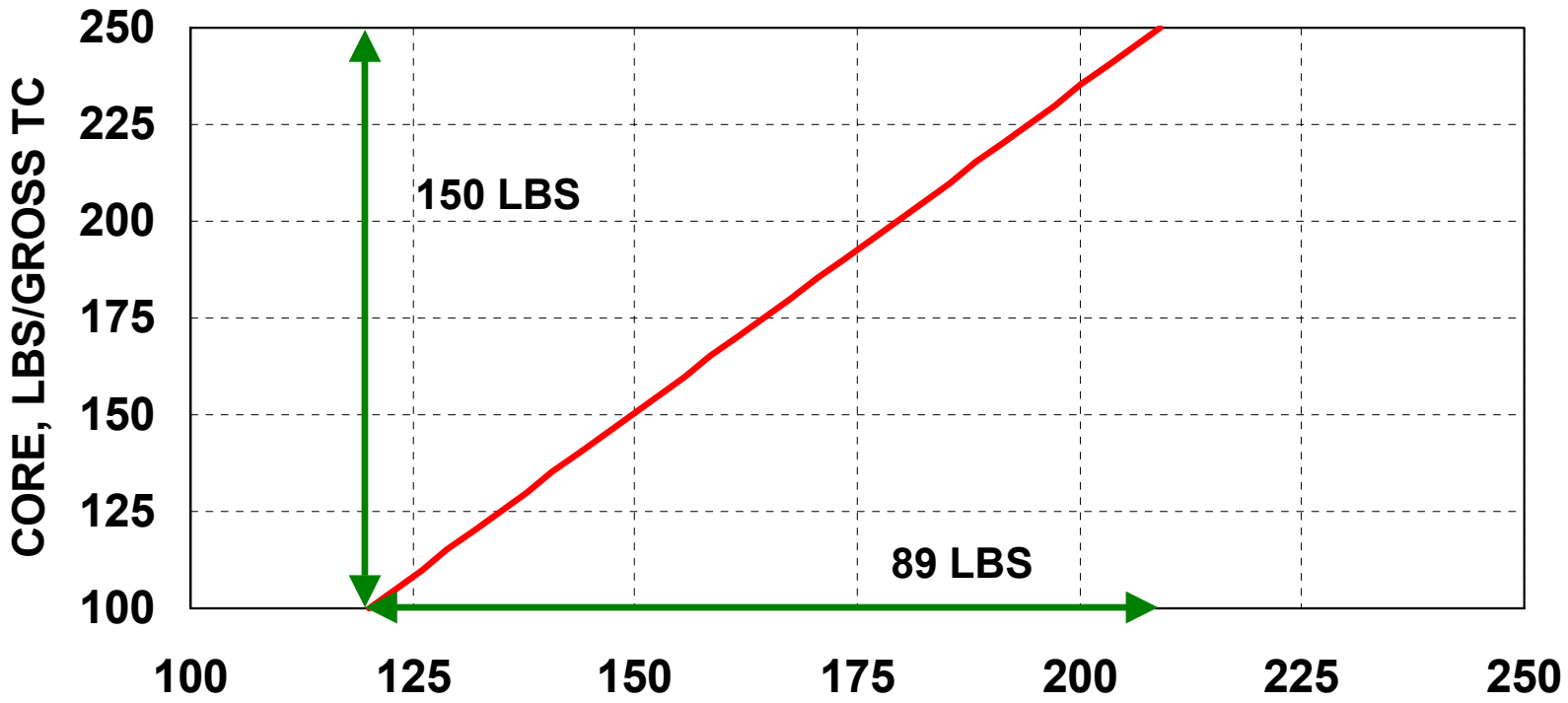
- Based on normal juice analysis, trash and conversion to standard tons for cane payment (106 lbs sugar/standard ton to growers and remainder to mill)

- Implemented using a sample roller mill and required:
  - Sample mill sucrose factors
  - Sample mill Brix factors
  - Dilution compensation factors
  - Trash content determination
  - Factors for conversion of above to standard tons

USDA METHOD PROBLEMS

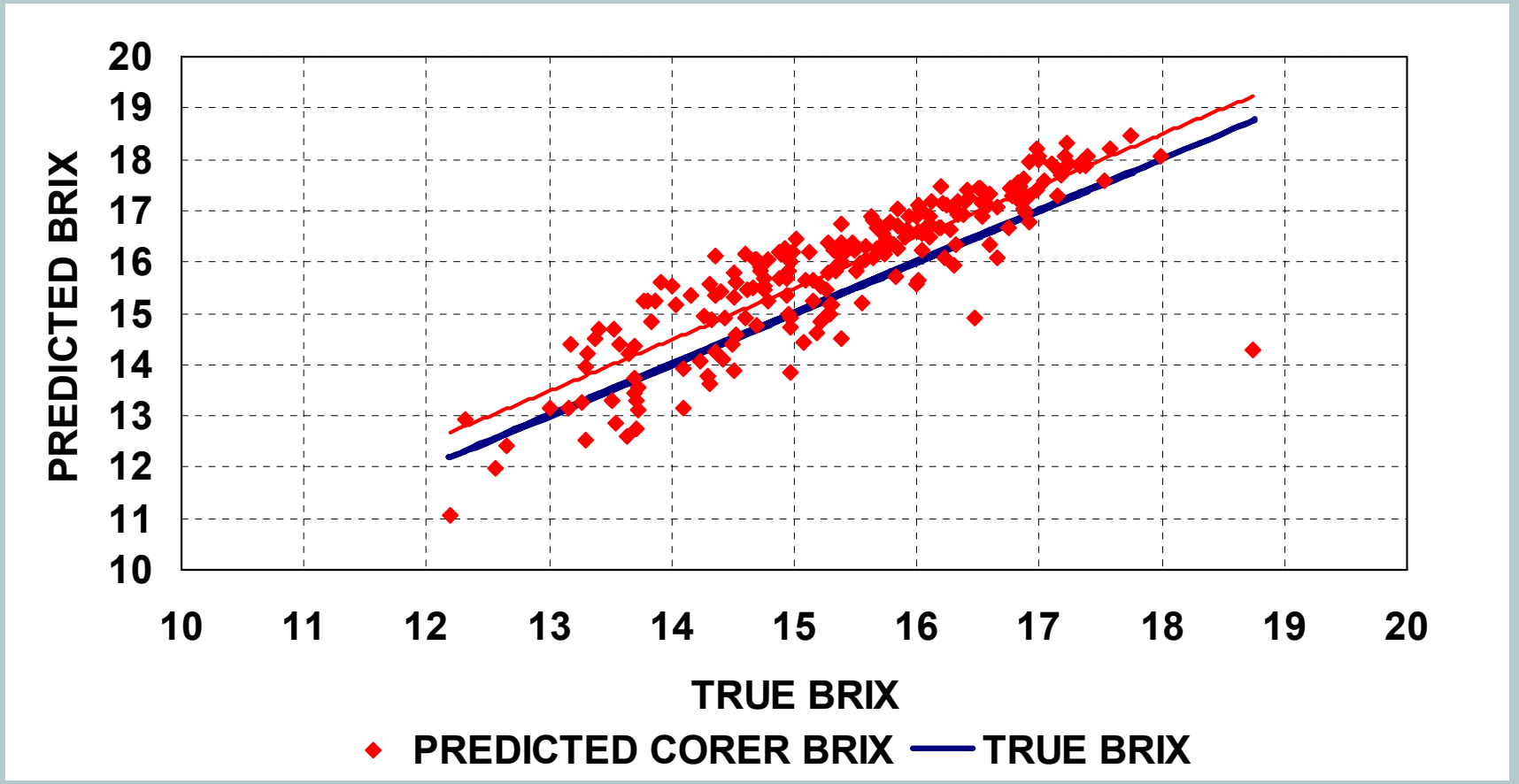
1. Did not take into account fiber (i.e., juice quantity)
2. Subjective (arbitrary) sample selection
3. Overpaid for cane in wet years, underpaid for cane in dry years
4. Many grower/processor complaints

COMPARISON OF PREDICTED CRS BY CORE AND CONVENTIONAL (STANDARD TON) SAMPLING METHODS

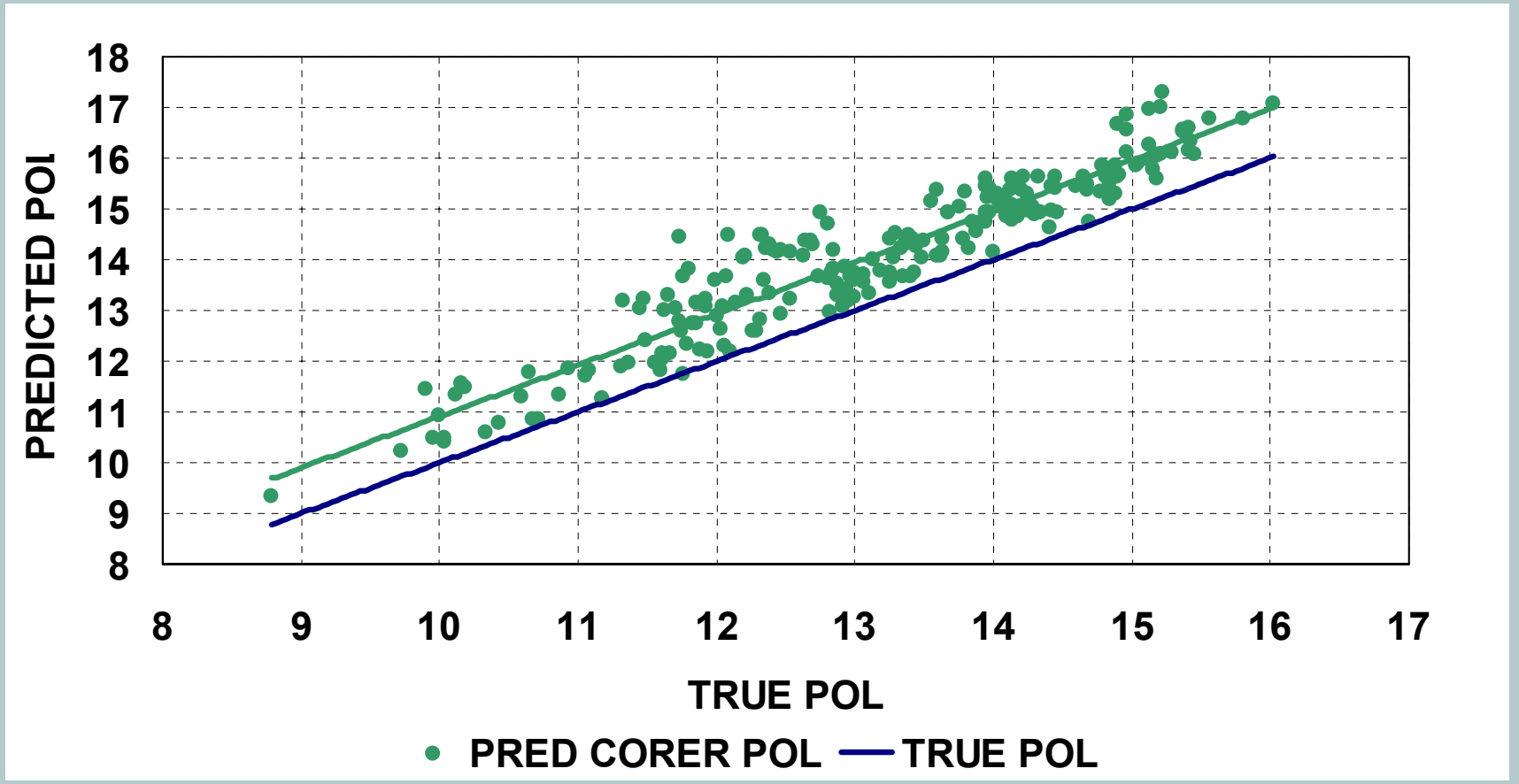


1974

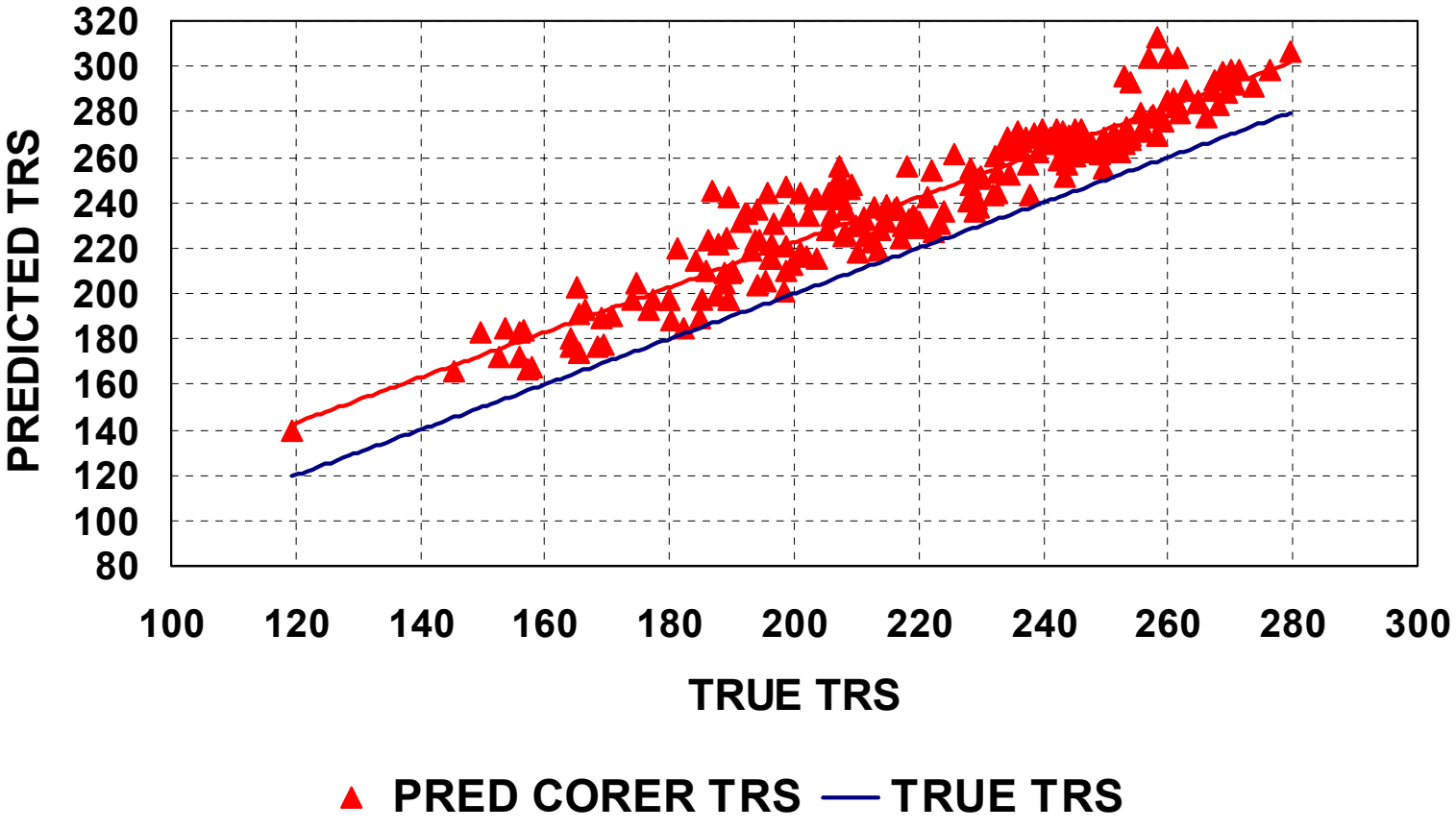
TRUE BRIX VS PREDICTED CORER BRIX
(% CANE)



TRUE POL VS PREDICTED CORER POL
(% CANE)



TRUE TRS VS PREDICTED CORER TRS
(% CANE)



COMBINE HARVESTING

- Driven by high yielding LCP 85-384
- Cane burning declines
- Green leaves increase
- Tops increase

- Affect of above on TRS with increased green trash