Prediction of Large-Scale Mills from a Quadrumat Jr. Mill

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Soft Wheat Quality Laboratory

Main Topics

- Allis Milling Parameters
- Prediction of Allis Milling with Quadrumat Mill
- Comparing Old Quad with New Quad

Milling Equipment

- Allis-Chalmers
- Miag Multomat
- Quadrumat Junior

Allis-Chalmers Mill
Modified 1973

100 to 150 samples are milled on the Allis Mill per year.

SWQL Testing

Larger samples for quality councils and pre-release are milled using the Miag Multomat mill -
a multi-stream commercial style flour mill.

Quadrumat Jr. Mill

Most samples are milled on the Quad Jr. Mill using sample size of 80 grams. As little as 2 grams can be milled. Milling characteristics are the single most important quality measure of soft wheat. *It must mill "soft"*.

Allis Mill Score Parameters

- Endosperm Separation Index (ESI)
- Friability (mill stock to flour efficiency)
- Straight-Grade Flour Yield

Endosperm Separation Index

- Measure of bran & flour attachment
- 5 bran-rich fractions (% of recovery)
  - 99% of bran in sample
  - - 14.5% bran
  - - 2.5% germ
- MO 011126 : 23.6% - 17% = 6.6% (flour)
- Clarkan : 31.7% - 17% = 14.7% (flour)

Pooled standard deviation = .53%

Friability

- Total wt. of stock into all mill rolls
  - Excluding wheat weight (1000g)
- St. Gr. flour wt. / total stock weight
- Mids reduction has overwhelming influence
  - Foster : 770g / 2501g = 30.8%
  - KanQueen : 726g / 3065g = 23.7%

Pooled standard deviation = .65%

Allis-Chalmers Mill Score

- ESI + Friability + St. Gr. Flour yield
- Each parameter scored
- 1 : 1 : 1 contribution
- Range 830 soft wheats
  - Mammoth Red = 17.9
  - Pioneer 26R46 = 97.4

Pooled standard deviation = 4.3

Allis-Chalmers Milling Parameters

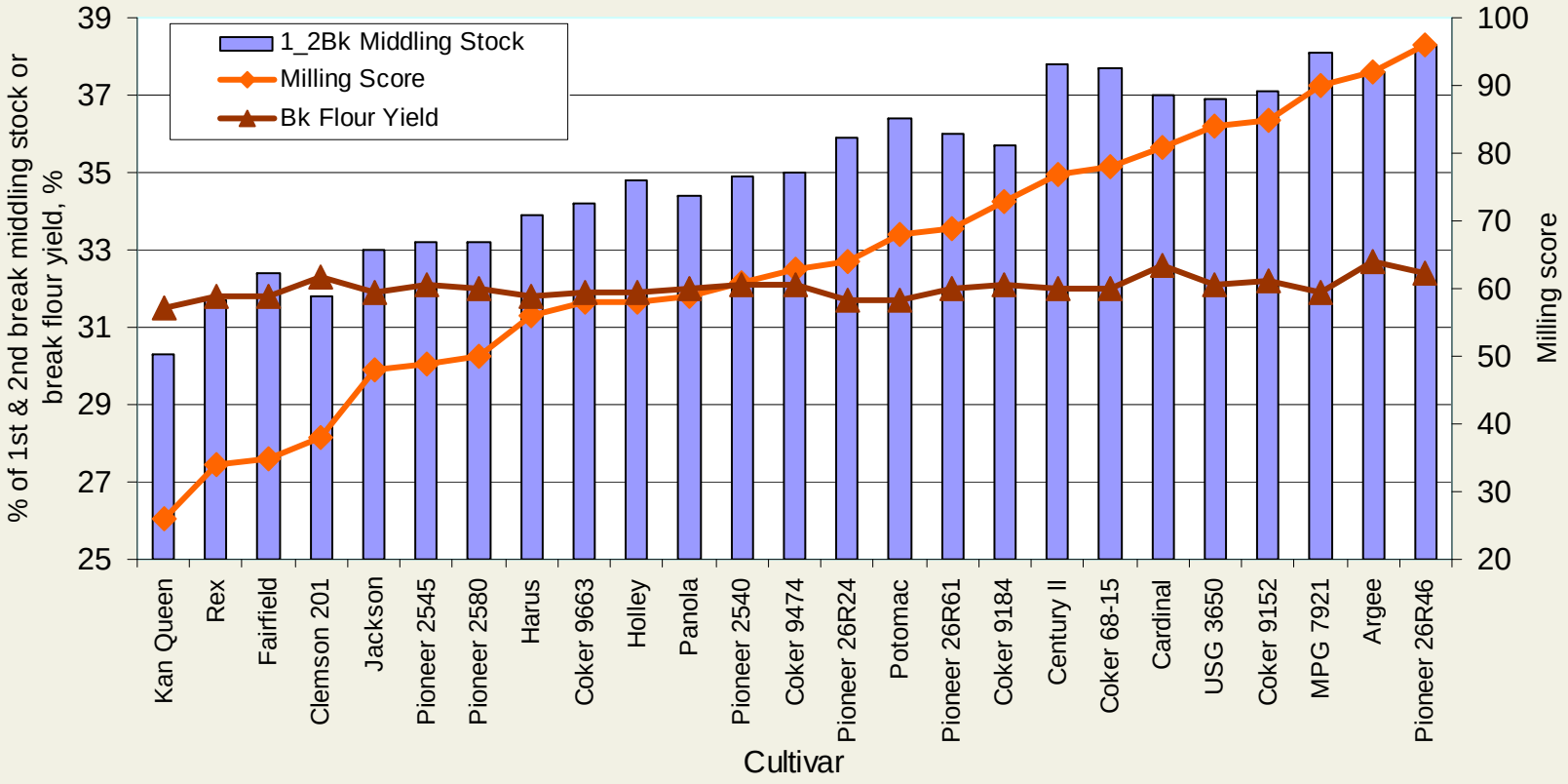
- 1. Endosperm Separation Index (ESI)
- 2. Friability (mill stock to flour efficiency)
- 3. Straight-Grade flour yield
- 4. Mill Score (cumulative index of: ESI, friability & flour yield)

- 5. 1st & 2nd Break Mids
- 6. 1st Reduction Flour
- 7. 2nd Reduction Flour
- 8. Break-Flour Yield (R2 = .0004; n = 830) vs Mill Score

1st & 2nd Break Mids

- 90% + of all mids is derived from 1st & 2nd break. Mids go to early reductions
- Graph: soft wheats with equal break flour
- Graph: All wheat classes; Excellent millers vs poor millers

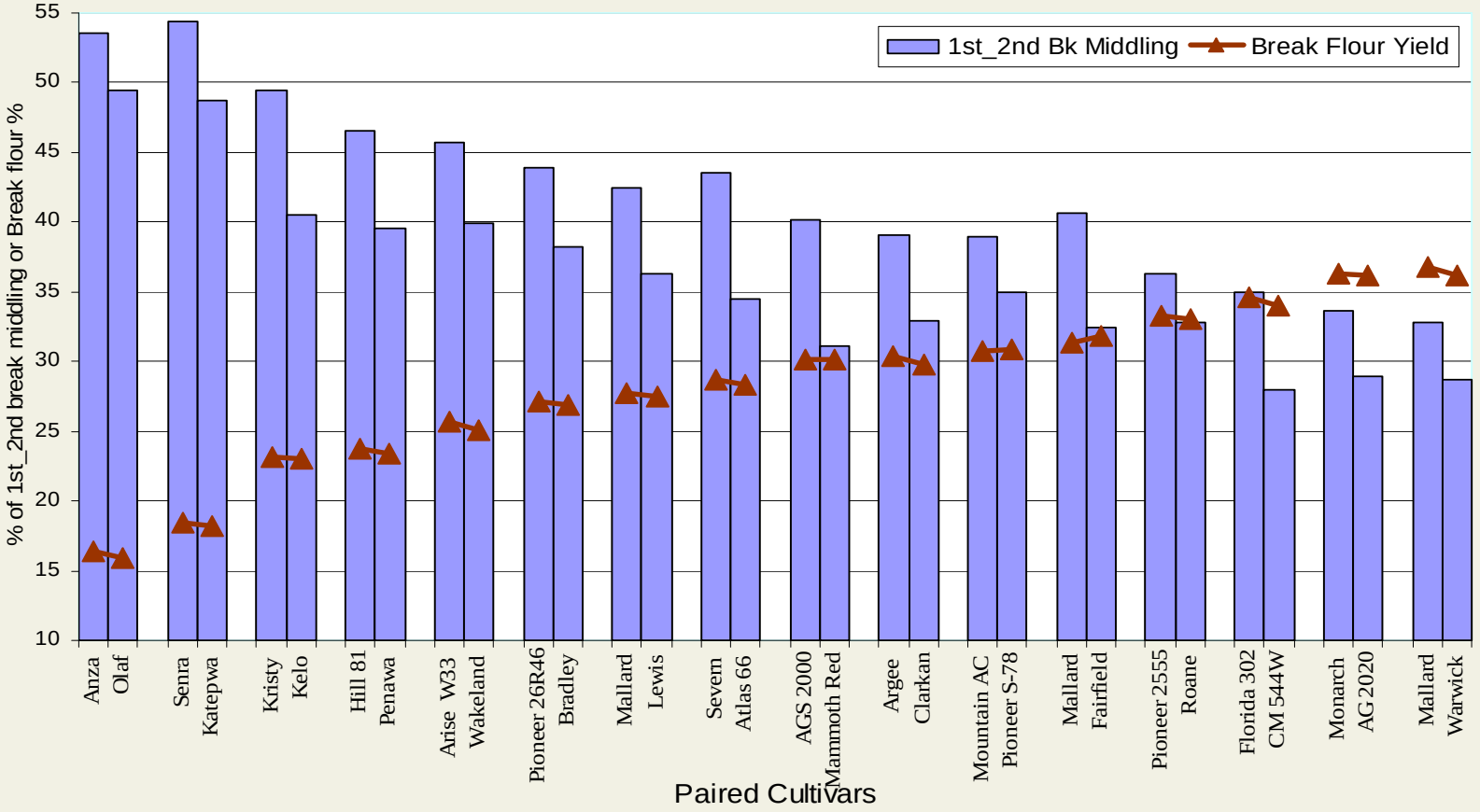
1st and 2nd Break Mids; Cultivars with Different Milling Quality; Equal Break Flour



We believe Quad can predict this

Data analysis courtesy of CJ Lin, Mennel Milling

1st & 2nd Break Mids; Paired Cultivars with Different Milling Quality (across wheat classes)

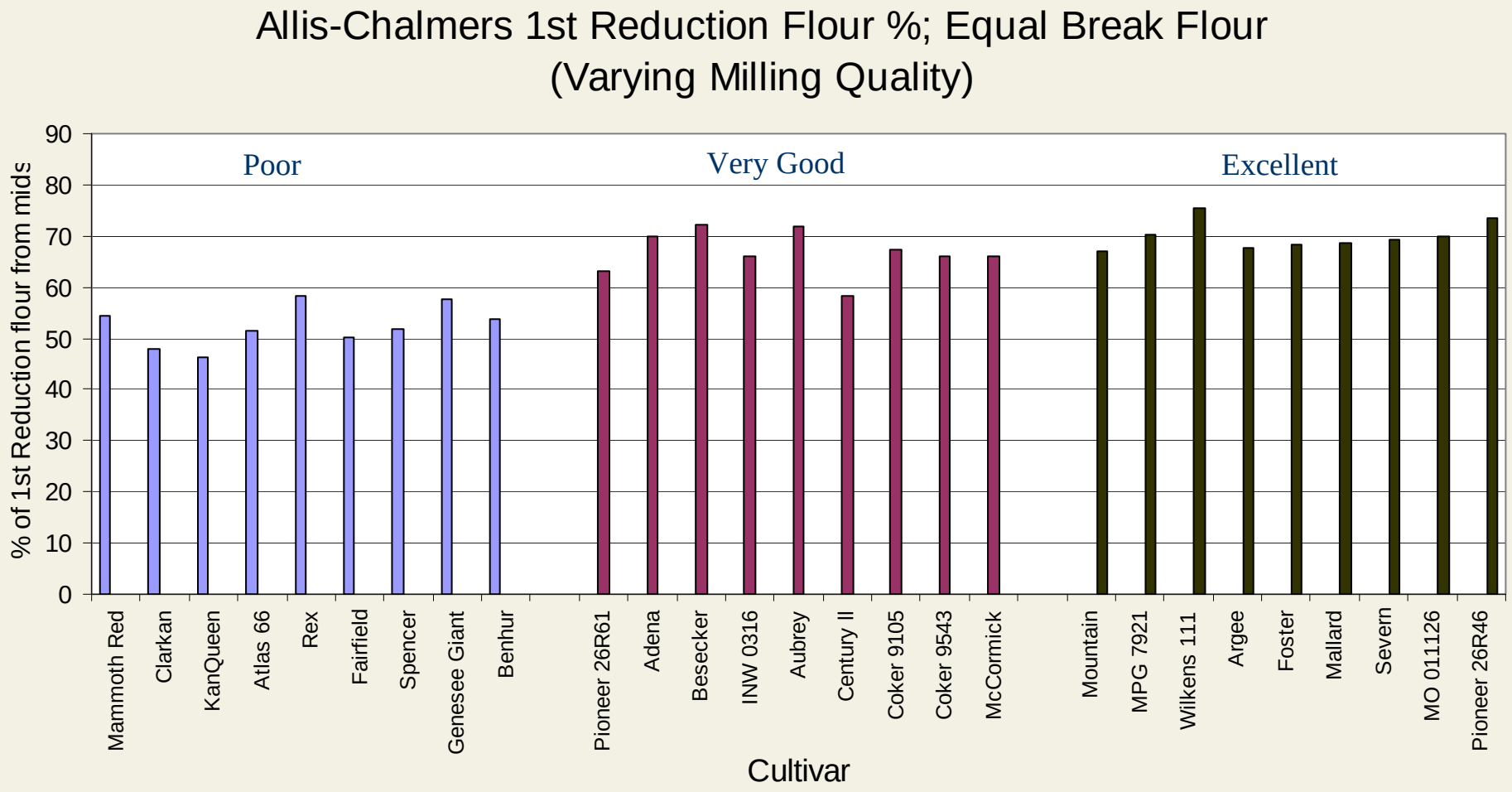


We believe Quad Can predict this

Data analysis courtesy of CJ Lin, Mennel Milling

1st & 2nd Reduction Flour %

- Want as much flour as possible
- Want small % of middling stock to subsequent reductions
- Good millers middling stock reduces easily to flour fineness.
- Poor millers have higher % mids carryover



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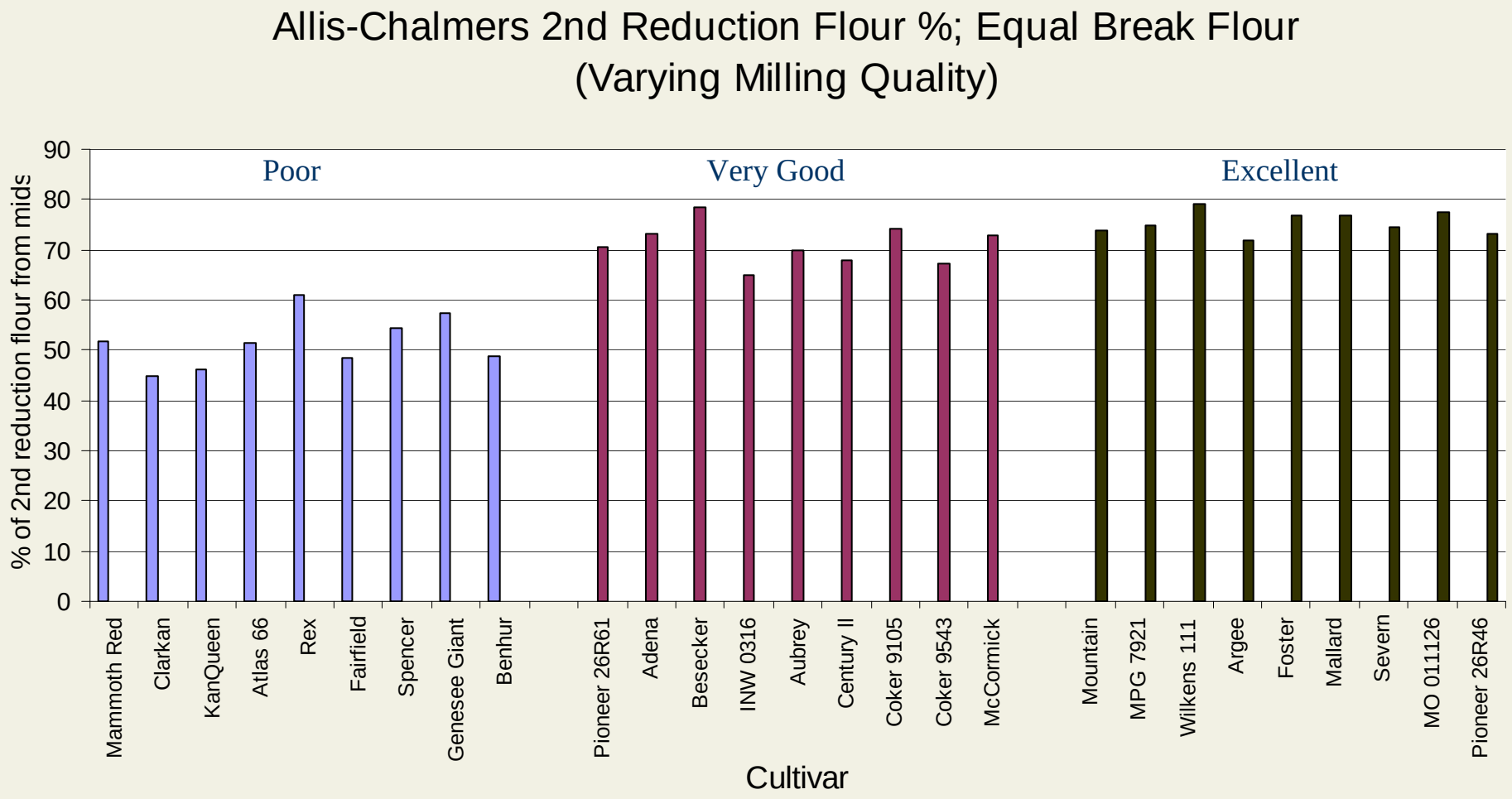

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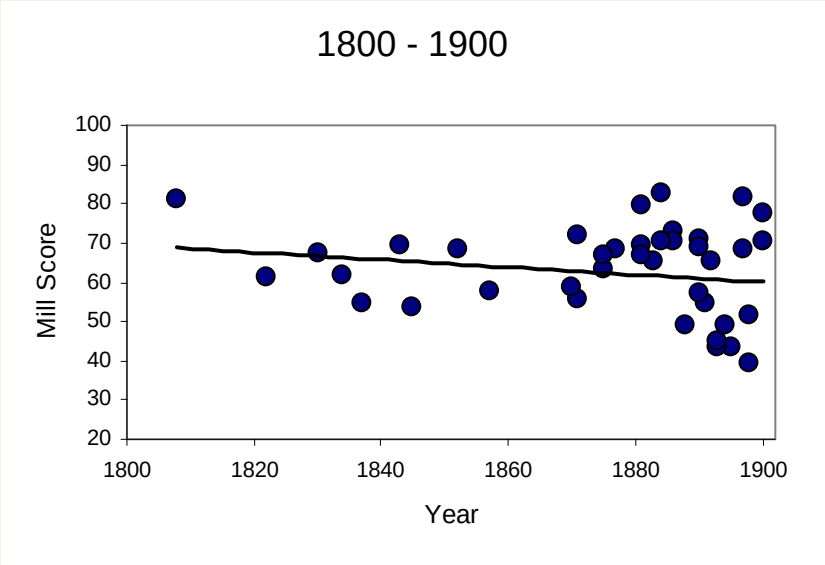
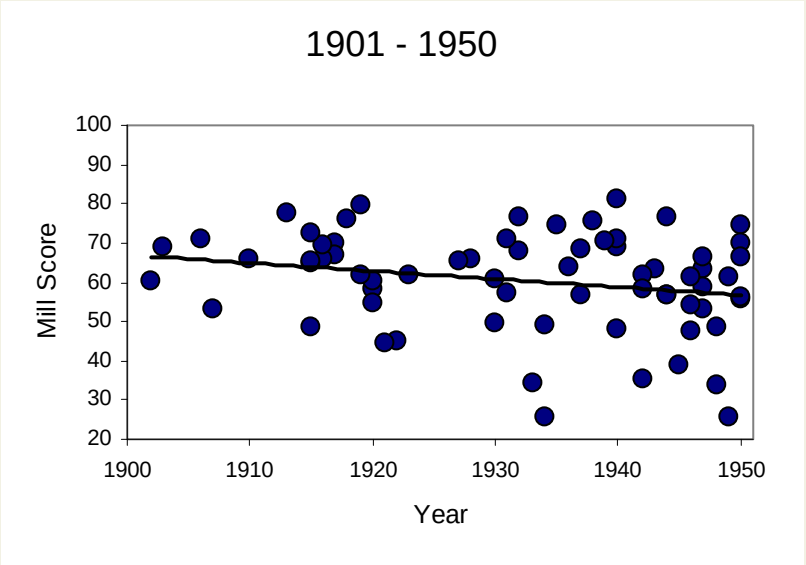
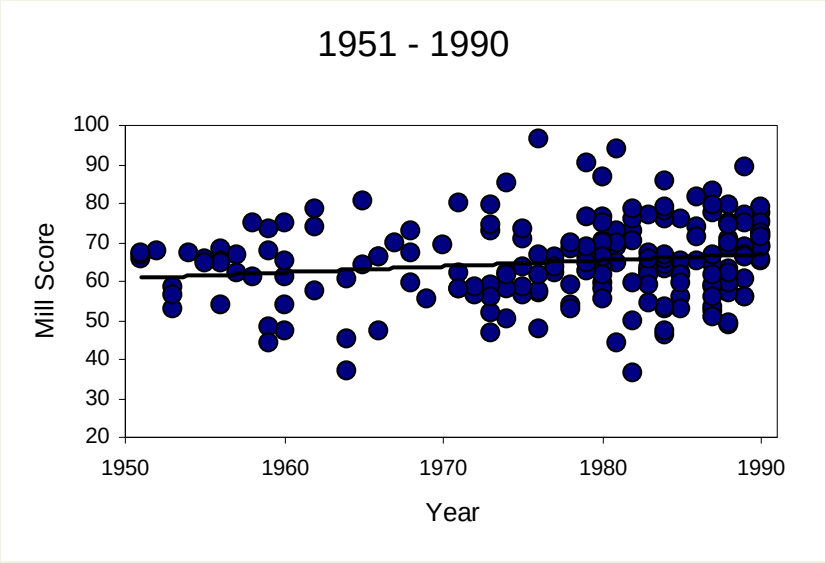
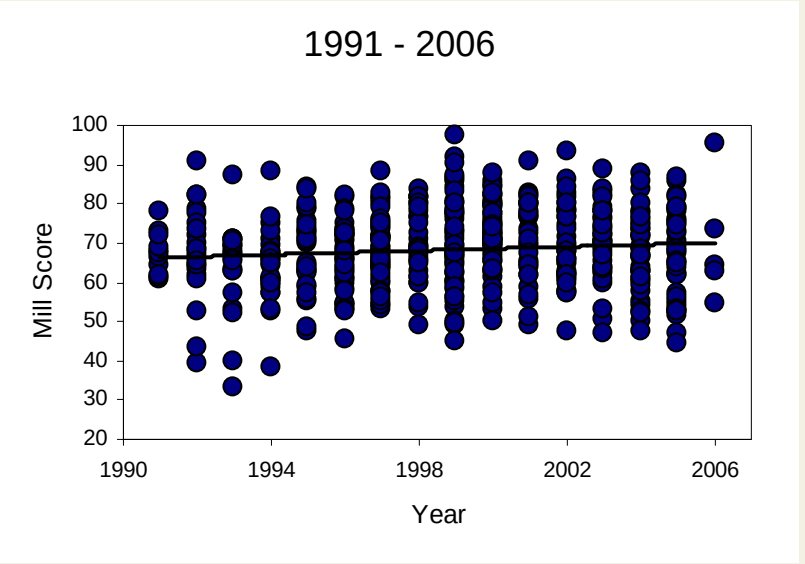
Allis-Chalmers Mill Score; 1800 to 2006









Best Milling Cultivars-
Mill Score at least 75

- 25 year periods
- 12% 1900 - 1925
- 9% 1926 - 1950
- 9% 1951 - 1975

- 10 year periods
- 20% 1976 - 1986
- 19% 1987 - 1997
- 34% 1998 - 2006

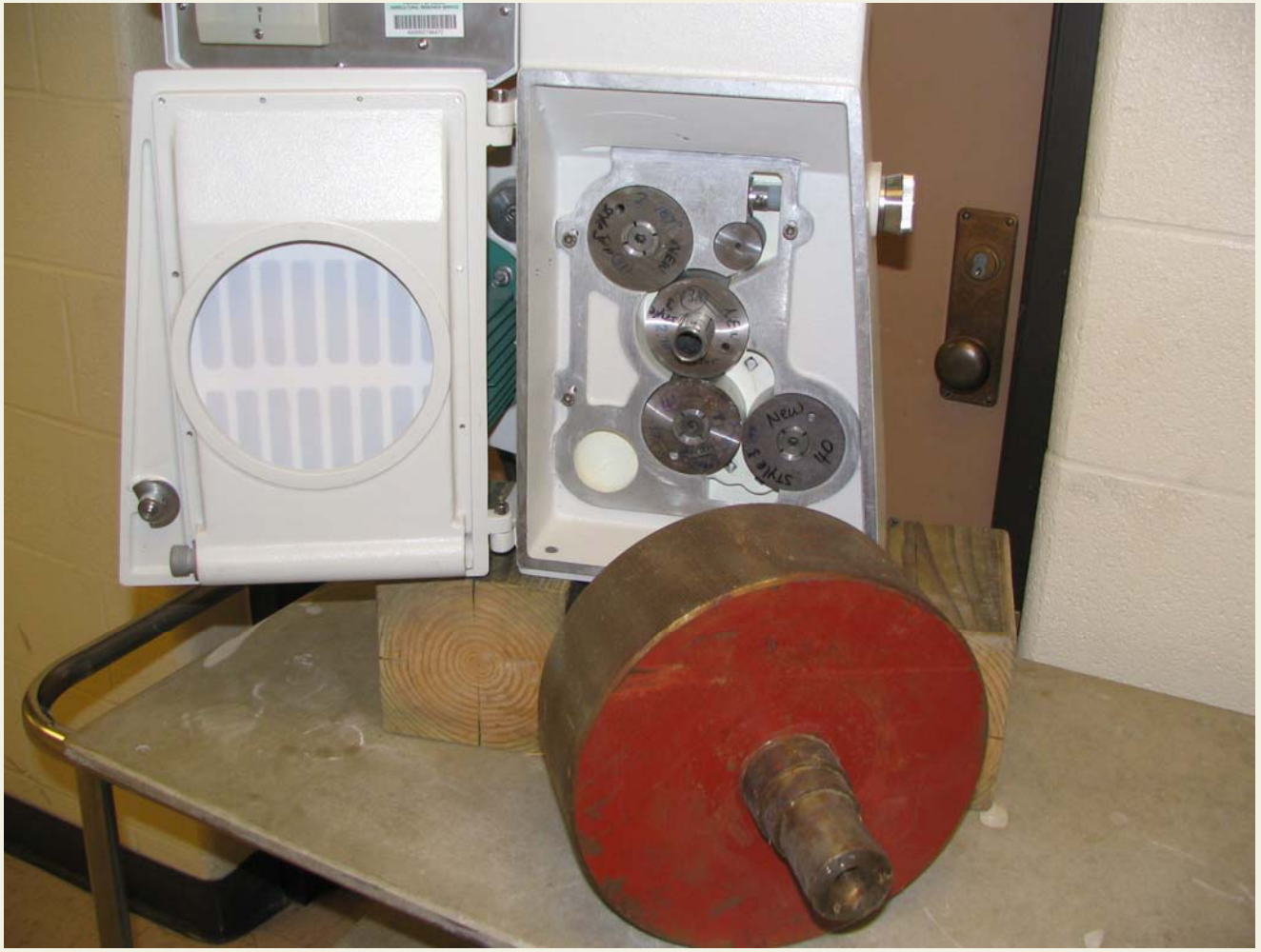
75 Mill Score

Flour yield	77.8%
ESI	8.9%
Friability	29.4%

Quadrumat Jr. Mill

- Triple high mill
- Fast roll is about 1200 rpm’s
- Milled stock is sifted separately
- Operating temperature is an important factor

New Quadrumat Jr. Mill



Mill rolls are interchangeable among Quad mills manufactured over the past 40 years and possibly longer.

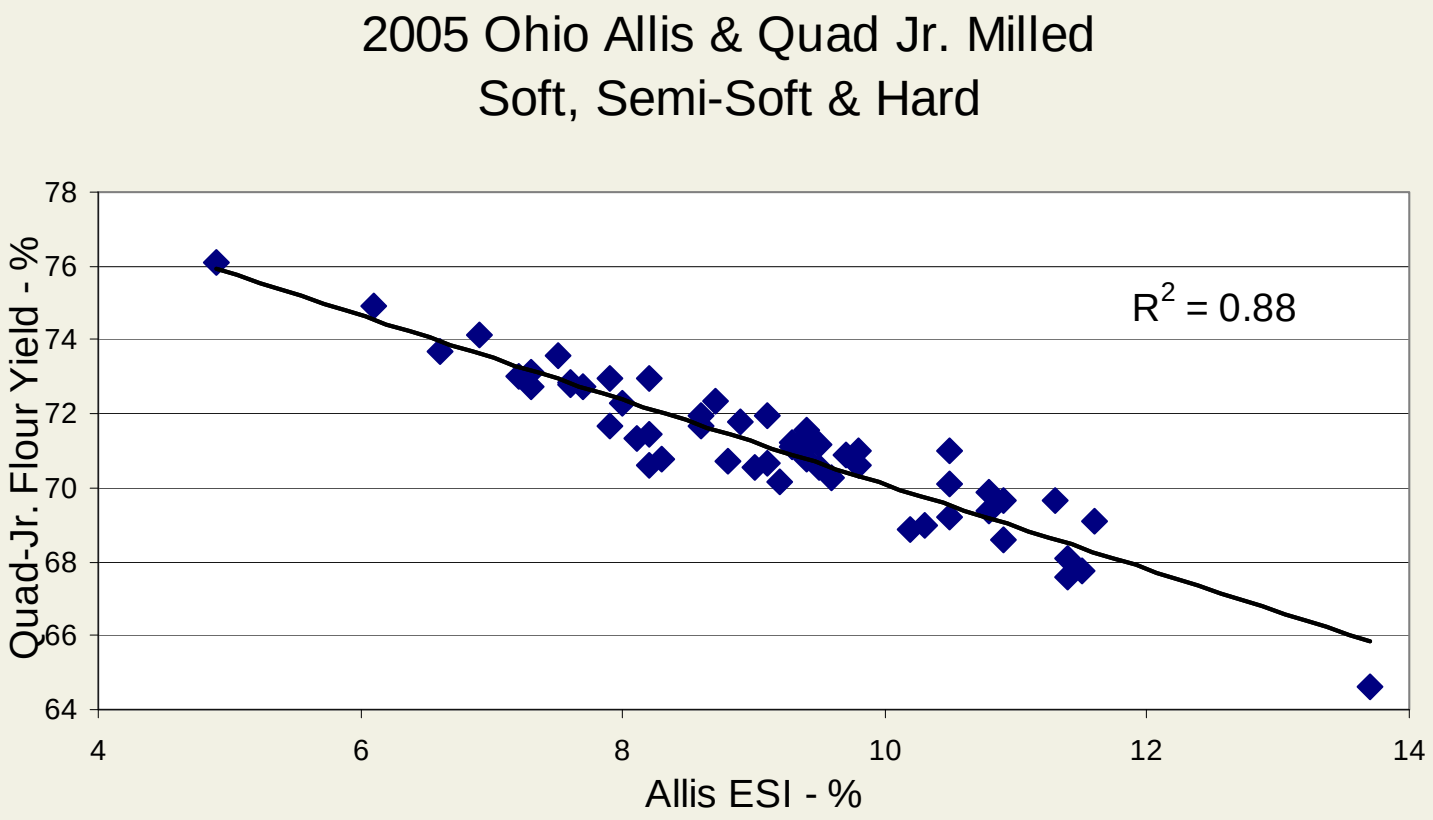
Quadrumat Mill Roll

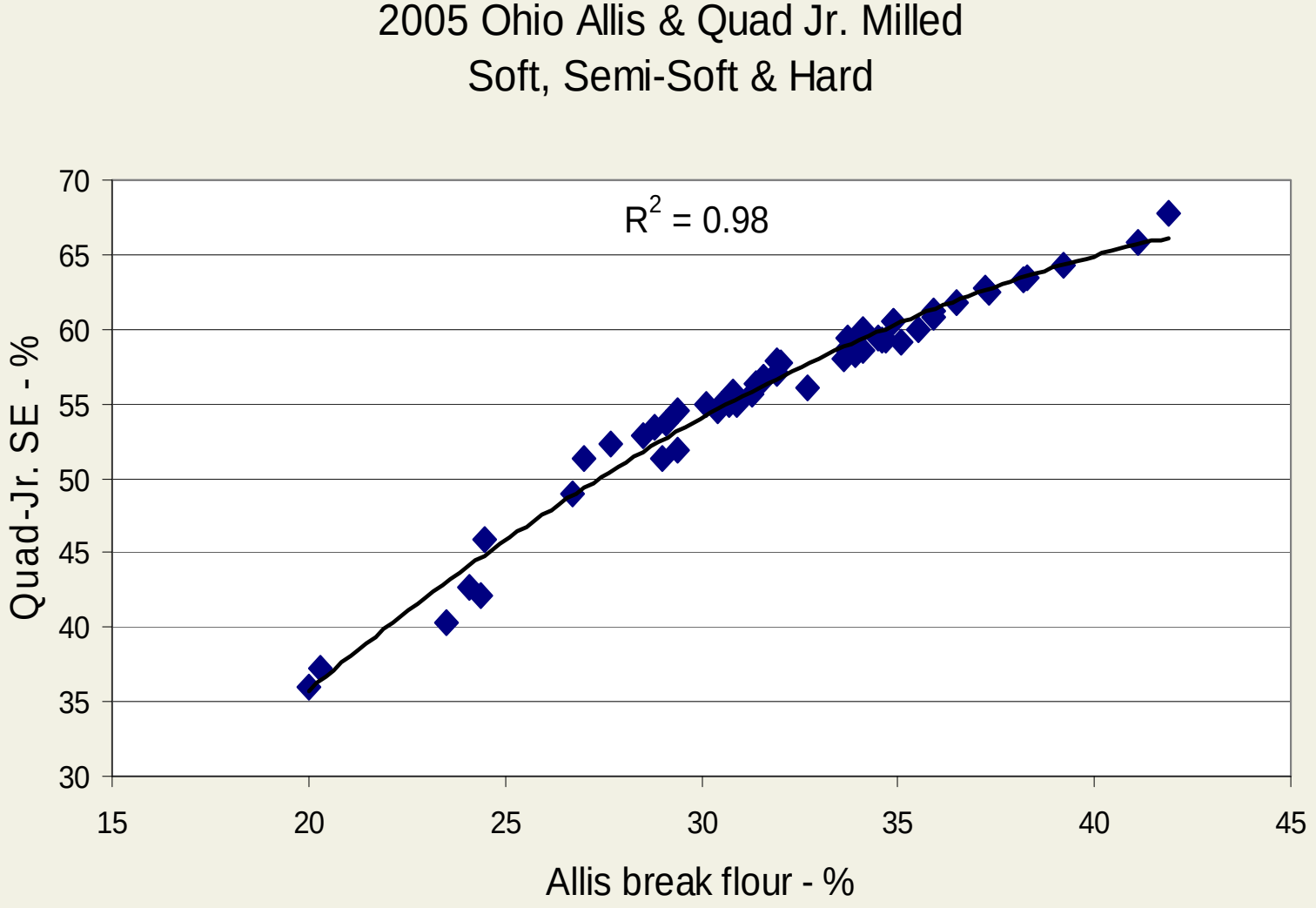
The Quad mill roll is about 2.75 inches in diameter and approximately 1.125 inches wide.

Can Allis-Chalmers be Predicted?

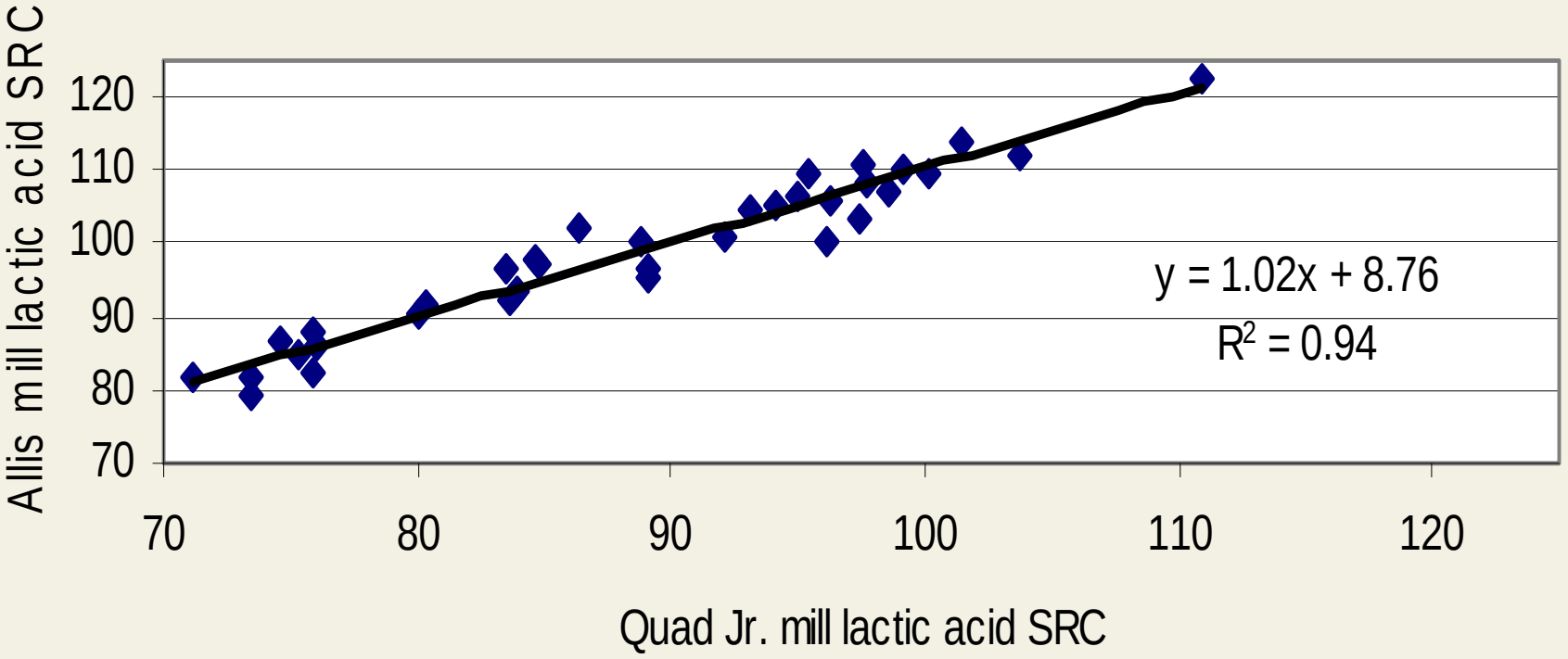
- 2005 Ohio set (Allis & Quad)
- SRW, Semi-soft, HRW (56 entries)
- Milling and softness

- 2005 Virginia set (Allis & Quad)
- SRW (36 entries)
- 4 Solvent Retention Capacity Tests


2005 Ohio Allis & Quad Jr. Milled
Soft, Semi-Soft & Hard
Quad-Jr. Flour Yield - %
78
76
74
72
70
68
66
64
4
6
8
10
12
14
Allis ESI - %
R2 = 0.88

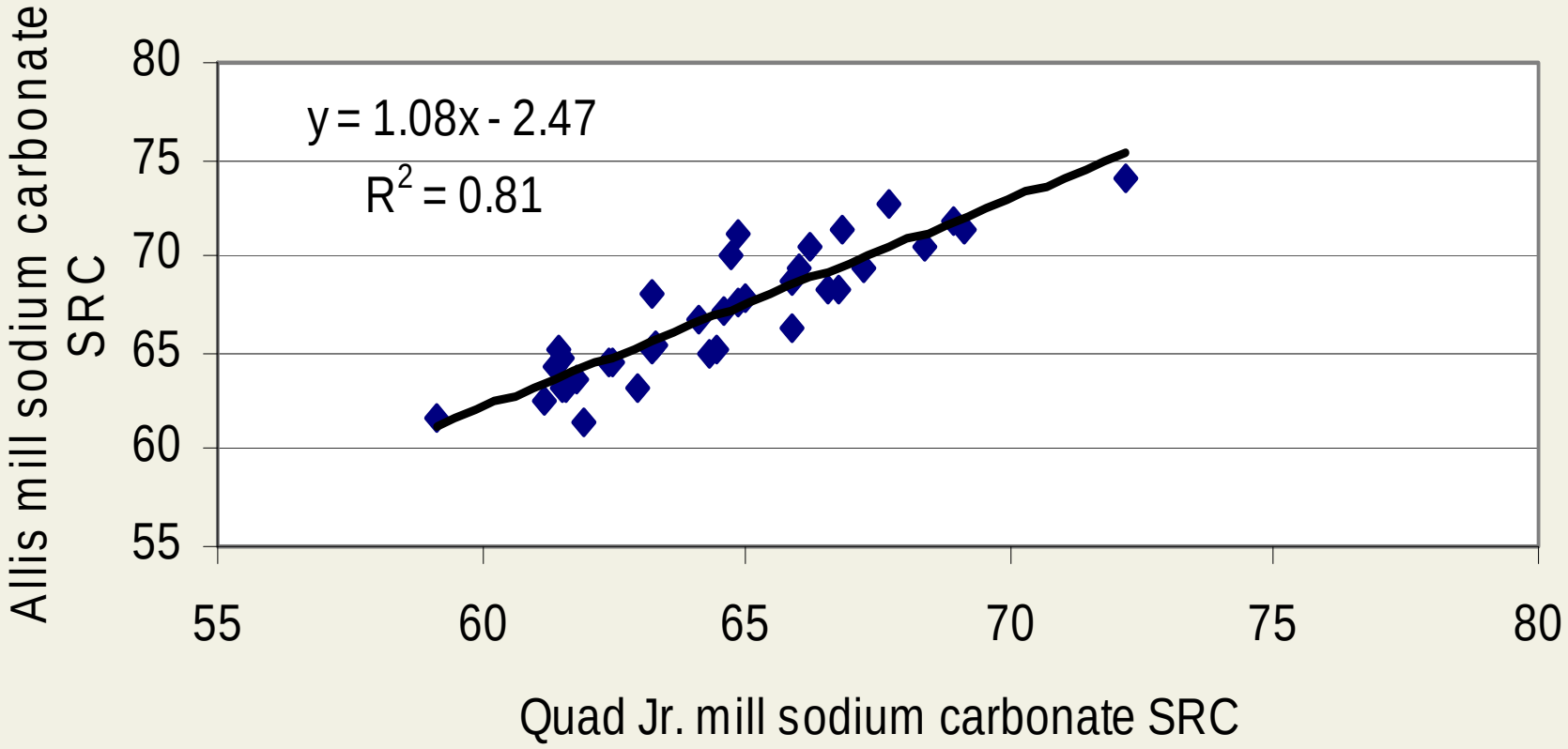

2005 Ohio Allis & Quad Jr. Milled
Soft, Semi-Soft & Hard
R^2 = 0.98
Quad-Jr. SE - %
Allis break flour - %
70
65
60
55
50
45
40
35
30
15
20
25
30
35
40
45

2005 Virginia Set - Lactic Acid – Allis & Quad Jr.



Comparison of lactic acid SRC values between Quad Jr. “flour” and Allis-Chalmers flour. The values are higher for the Allis flour than for Quad-micro flour.

2005 Virginia Set - Sodium Carbonate - Allis & Quad Jr.



Comparison of Allis-Chalmers sodium carbonate SRC values and Quad Jr. “flour”. Values are higher for the Allis-Chalmers flour which had finer flour granulation.

Comparison of soft wheat SRC milled on Allis-Chalmers mill and Quad Jr. mill.

(r values)

2005 Virginia
N = 36

	--- Quad Jr. mill flour measures ---			
	Lactic acid SRC	Sucrose SRC	Water SRC	Sodium carbonate SRC
Cookie diameter	-0.384 *	-0.609 ***	-0.629 ***	-0.483 **
Allis flour lactic acid SRC	**0.97** ***	ns	ns	ns
Allis flour sucrose SRC	ns	**0.85** ***	0.870 ***	0.818 ***
Allis flour water SRC	ns	0.775 ***	**0.91** ***	0.829 ***
Allis Na carbonate SRC	ns	0.702 ***	0.737 ***	**0.90** ***

How is Allis Data Used?

- Lab technicians mill numerous breeder sets
- Every set compared to “historical” data
- Quad milling data confirmed
- Example: 2005 Michigan entries

2005 Michigan Advanced

Cultivar	Quad Yield	Allis MS "historic"	No. for Avg.
Kristy	75.8	91.0	5
Emmit	73.6	82.1	1
Caledonia	73.0	78.3	10
Coker 9375	72.1	77.6	1
Hopewell	69.8	55.6	14

R2 = .93

Quadrumat Rolls – 2 Types

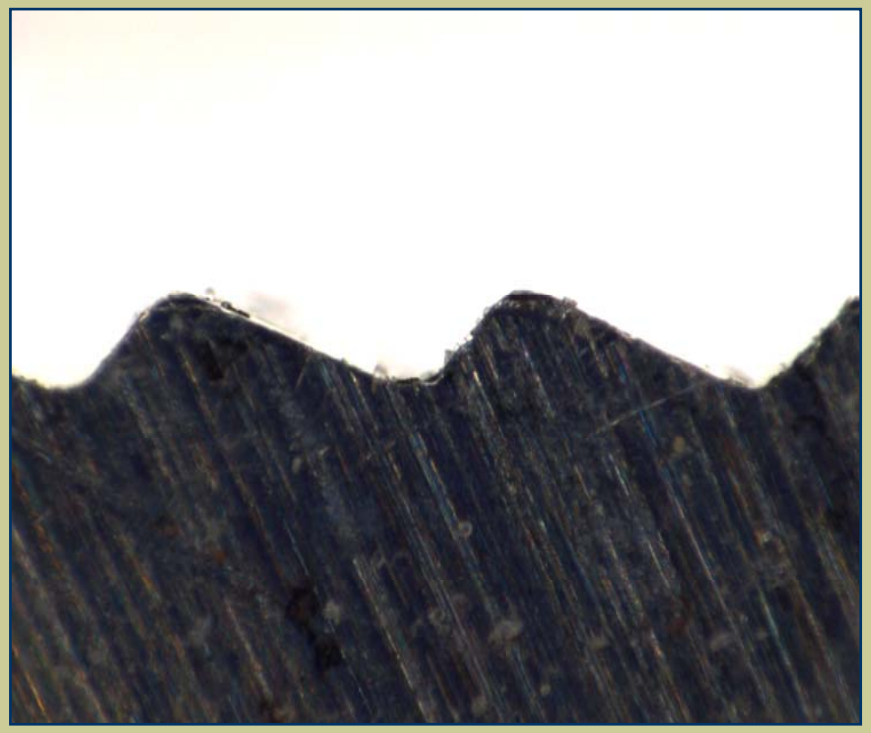
- The Quad needs to predict Allis-Chalmers
  - Important for SWQL & Milling Industry
- Modified Dawson and Shallow Getchell
  - Dawson no longer manufactured
  - Getchell currently being installed
- Their intended purpose

Quad Jr. Mill Rolls

Magnified 135 X

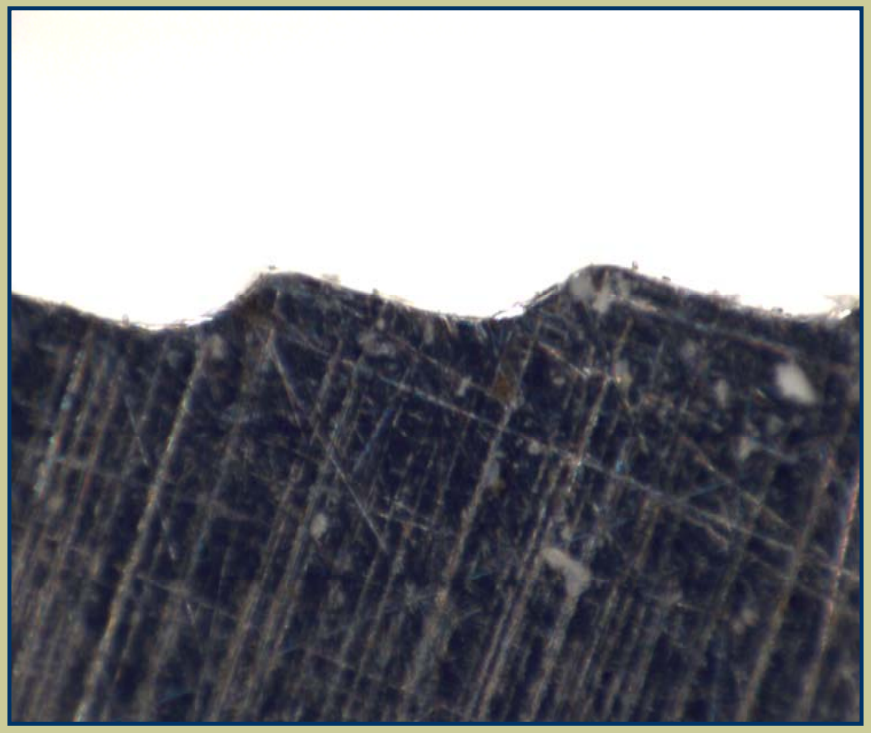
Dawson (former)

40 corrugations per inch



Getchell (new)

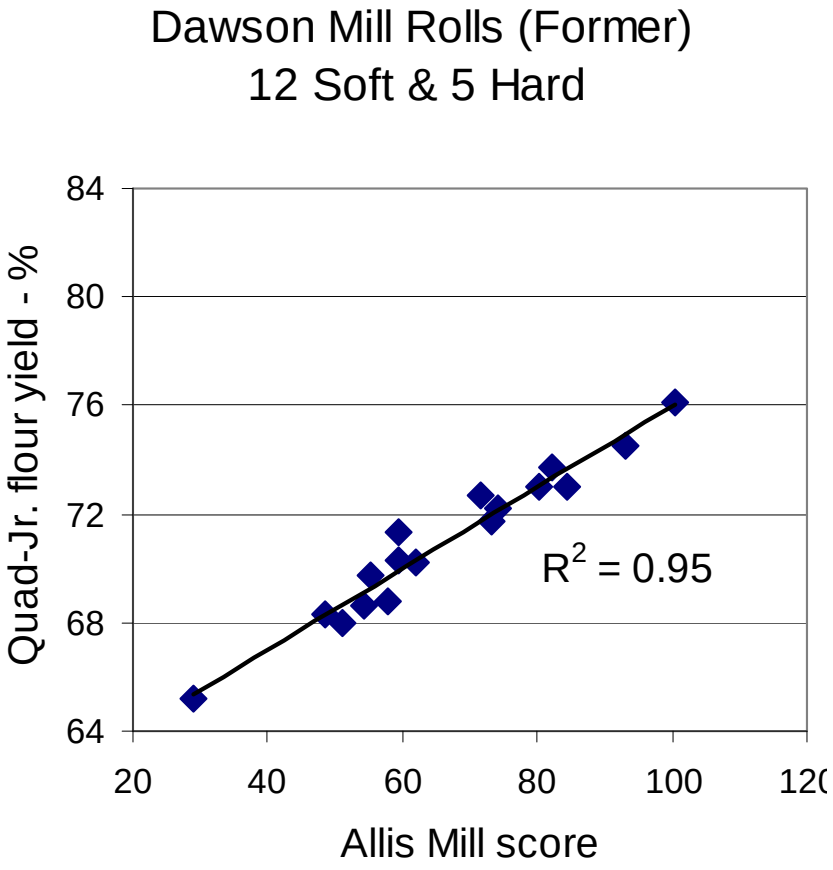
40 corrugations per inch

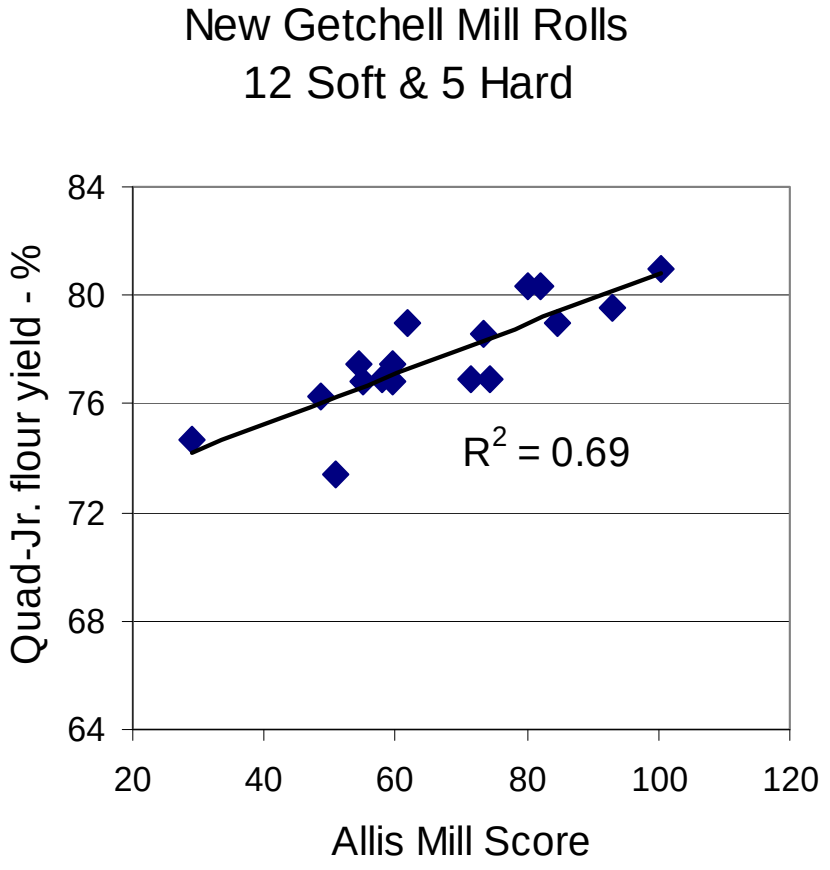


Is This a Problem?

- 12 soft + 5 hard: Modified Dawson
- Same set: Shallow Getchell
- Milling & softness

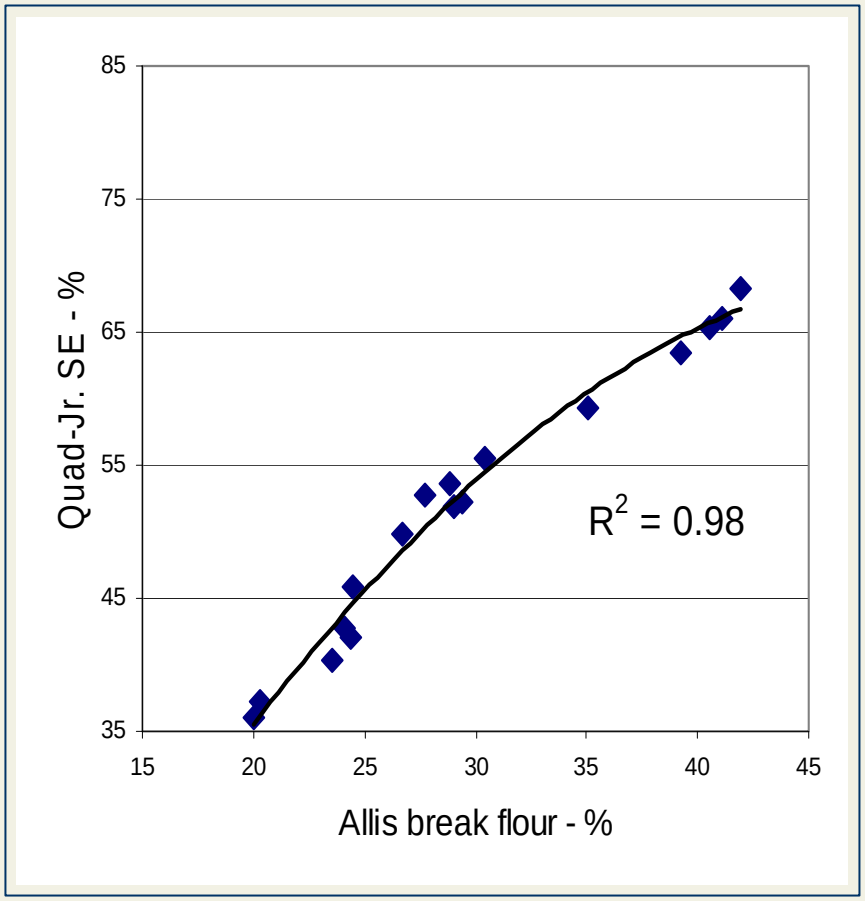
Dawson Mill Rolls Predict Allis Milling Better than Getchell Rolls



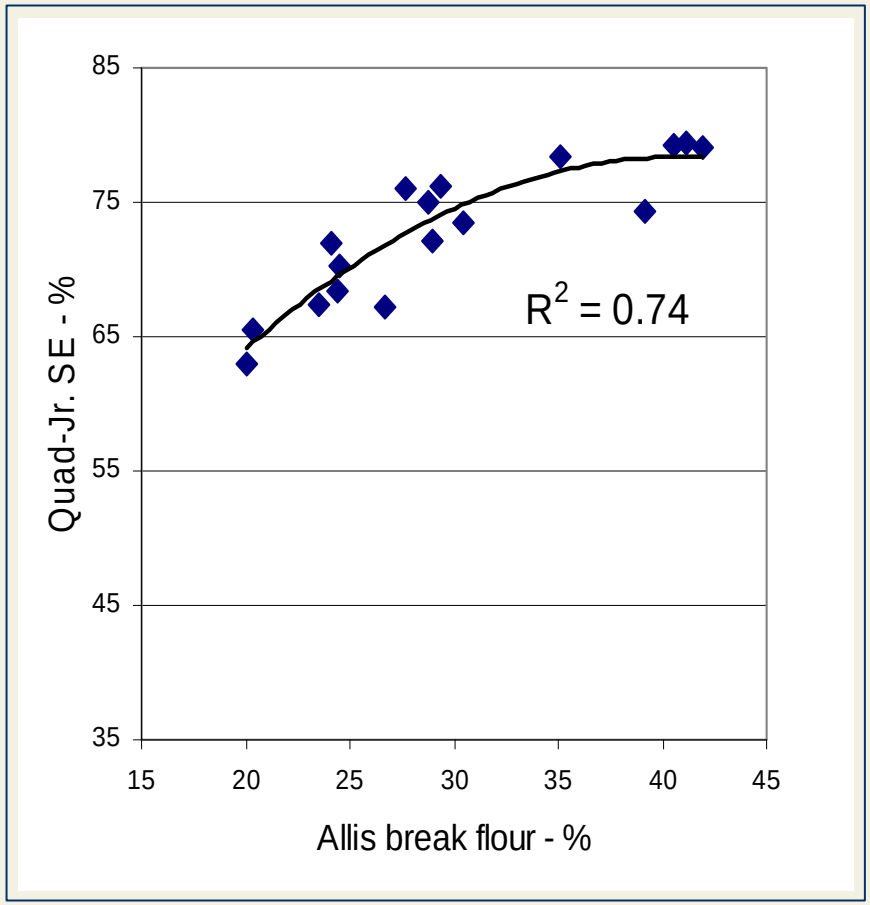


Dawson Mill Rolls Predict Allis Break Flour Better than Getchell Rolls

Dawson Mill Rolls (Former)
12 Soft & 5 Hard



New Getchell Mill Rolls
12 Soft & 5 Hard



Solution?

- Must be able to predict
- Finely corrugated rolls did not work well
- Coarser corrugated rolls?
- Brabender's response?
- Manipulate data?
- Manufacture Rolls?
- ??????????????

Thank You's to SWQL Members

- Amy Bugaj
- Sue Carson
- Sharon Croskey
- Tom Donelson
- Georgianna Kirchhofer
- Meera Kweon
- Ron Martin