



**University of California**  
Agriculture and Natural Resources

Making a Difference for California

# **Corn Silage: Key Harvest Practices for Reducing Losses**

---

**Noelia Silva-del-Rio** – UC Cooperative Extension  
Veterinary Medicine Teaching & Research Center

**Jennifer Heguy** – UC Cooperative Extension  
Stanislaus & San Joaquin Counties

# Outline

---

- **Harvest Date & Dry Matter (DM)**
  - Challenges & Proposed Solutions
- **Packing & Silage Density**
  - Challenges and Proposed Solutions
- **Monitoring During Harvest**
  - DM
  - Length of cut
  - Kernel processing
- **Future Research**



# Survey of Corn Silage Management Practices

In spring 2013, a survey was mailed to all dairy producers in the **San Joaquin Valley**.

- 14.5% response rate
- Herd size (milking)
  - Average: 1,512
  - Median: 1,200



Select results will be presented.

# Setting a Harvest Date Dry Matter (DM)

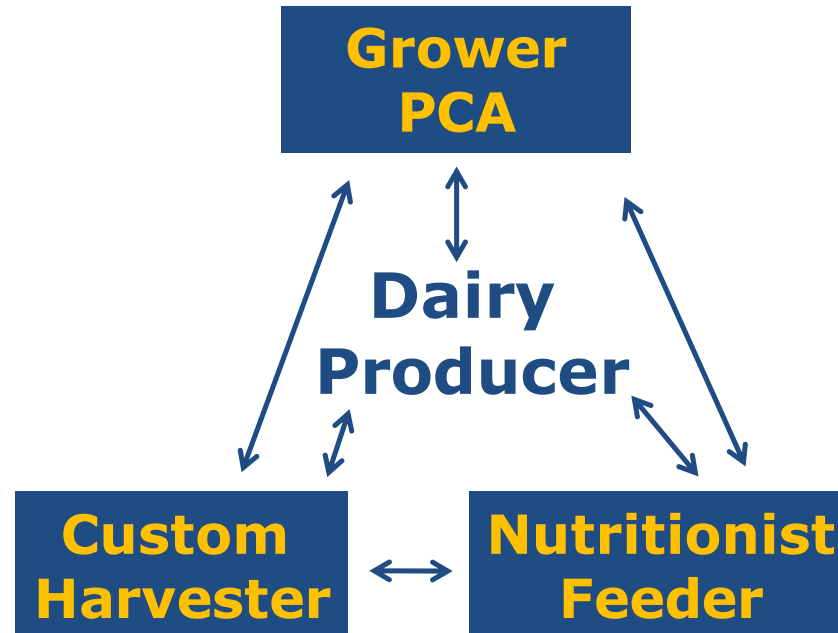
# Setting a Harvest Date

---

**Challenges**

# Communication Silage Team

---

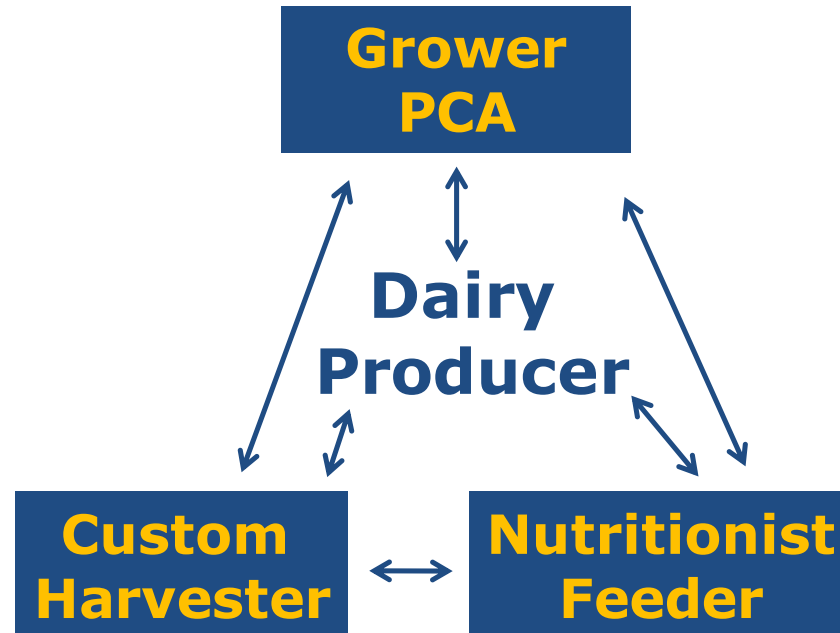


---

The **nutritionist** - match the herd's needs (starch, fiber?).  
The **grower** - timing the last irrigation and maximizing yield.  
The **custom harvester** - schedule the harvest, maturity that makes the crew comfortable at harvesting.

# Communication Silage Team

---



---

**Setting harvest date – who are the decision makers?**  
1<sup>st</sup> dairy producers, 2<sup>nd</sup> custom harvesters, 3<sup>rd</sup> growers, and occasionally the nutritionists.

# Large DM Variation within and Across Fields

---



Dry matter can range widely  
(19% to 27%; Heguy et al. 2010)

---

Differences in soil type, fertilization, irrigation and variety genetics within and across fields may explain the large variation in DM observed.

# Large DM Variation within and Across Fields

---

## **Harvest window:**

21% of dairies reported harvest window to last 8 to 16 d - two dairies reported 30 d and one dairy 60 d.

Dry matter can increase 0.5 to 1% per day during the heat of summer.

## **Number of fields:**

30% of dairies put six or more fields in the same silage structure (up to 21 fields, 3,000 cow herd).

## **Number of varieties:**

23% of dairies planted three to five varieties.

# Timing Last Irrigation

---



---

It may take 10 to 20 days before the harvesting equipment can enter the field after the last irrigation. The soil type, field length, and ground preparation of the field are factors that affect irrigation timing.

# Custom Harvester Schedule

---



---

Harvest time is quite stressful for the harvest crew. They have to work long days. They might face conflicting schedules when clients have the same desired harvest date. Planning is important!!

# Setting a Harvest Date

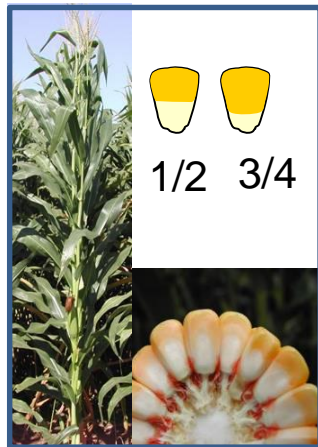
---

**Proposed  
Solutions**

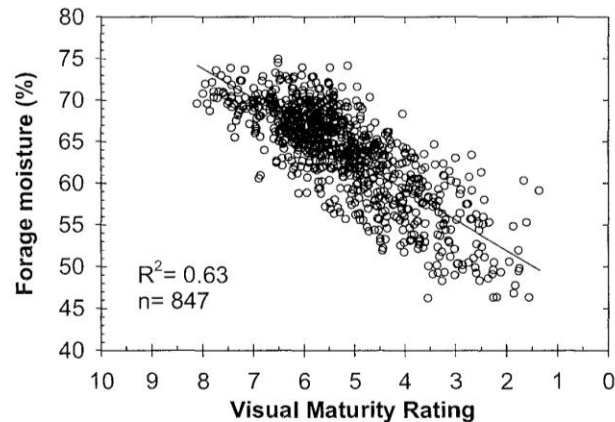
# Dry Matter Estimation

---

## Milk Line (2/3) Stover Maturity



## Visual maturity vs dry matter



(Lauer, 2006)

---

Maturity can be evaluated visually based on the kernel milk line and stover maturity. However, visual maturity rate (kernel and stover maturity) does not explain forage dry matter very well (R-square was 0.63).

# Dry Matter Determination

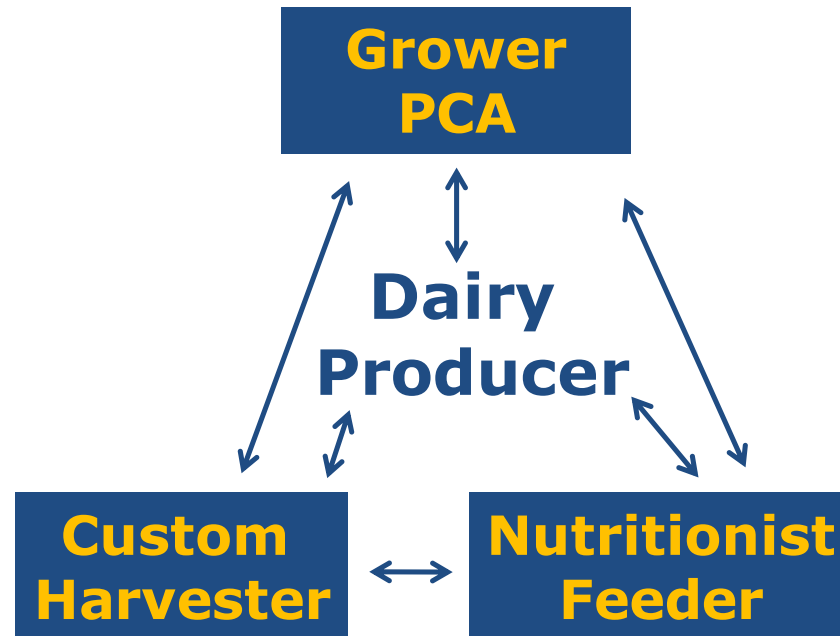
---



Dry matter can be determined prior to harvest. Several (10 - 20) representative plants are collected and chopped to get a composite sample (**See Appendix I**).

# Communication Silage Team

---



# Segregate Forage

---



---

If during harvest obvious differences in DM are observed within or across fields, it might be beneficial to: 1) build two silage structures (maybe use bags) or 2) blend forage.

# Segregate Forage

---

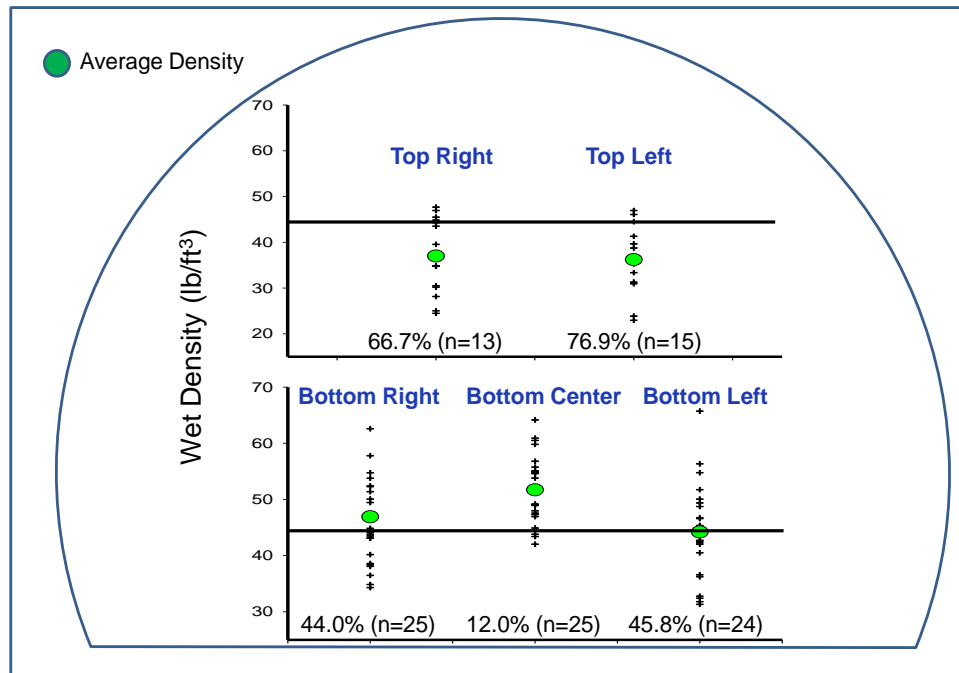


---

If during harvest obvious differences in DM are observed within or across fields, it might be beneficial to: 1) build two silage structures (maybe use bags) or 2) blend forage. NIR technology can make this task easier.

# **Packing and Silage Density**

# Silage Density



Silva-del-Rio and Heiman, 2011

Wet silage density in 25 structures in California dairies (22 piles, 2 drive over pile, 1 bunker).  
Most samples in the upper part of the silage structure are below the desired 44 ft<sup>3</sup> benchmark.

# Packing and Silage Density

---

## Challenges

# Delivery Rate

---



- In 50% of the dairies, delivery rate ranges from **150** to **200** tons/hour.
- Most dairies are still using a single packing tractor.

---

“800 lbs” rule of thumb – 800 lbs of packing weight for each ton of crop delivered/h.

Delivery rate of 150 tons/h = 120,000 lbs of packing tractor weight needed.

# Delivery Rate

---



---

Forage delivered at unequal time intervals. Several trucks arrive at the same time to unload forage.

# Layer Thickness

---



---

Ideal layer thickness = 6 inches. A truck loaded with 20,000 lbs would need to spread the forage over  $\approx 2,400$  ft<sup>2</sup> before packing.

# Packing and Silage Density

---

**Proposed  
Solutions**

# Adjust Delivery Rate

---



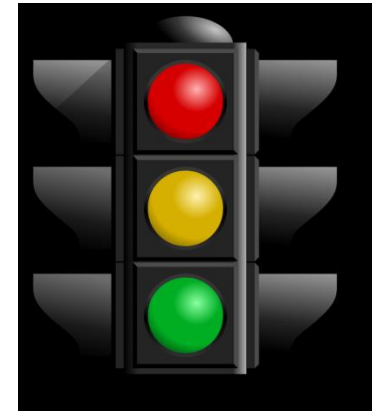
- In 25% of the dairy operations, harvest capacity is 16 rows or more (up to 40 rows)

---

The number and size of choppers should match the packing capacity at the silage structure. Discuss this with your custom harvester prior to harvest, and plan accordingly.

# Adjust Delivery Rate

---



---

Ensure trucks are delivering forage at a constant rate to avoid clusters that overwhelm the packing tractor.

# Enough Packing Time

---



---

If there is enough space, adding a tractor could be the difference between a silage structure reaching the desired density or not.

# Packing Tractor Efficiency

---



---

Check to see if the packing tractor(s) is constantly driving on the pile, and not merely pushing up feed and waiting for the next load to arrive. Ensure tractor drivers compact the entire surface, and pay special attention to the top half.

# Monitoring

---

## Dry Matter Kernel Processing & Length of Cut

### **Importance –**

corn silage is fed year round, but put up in a week's time

# Dry Matter

---

## Why monitor DM?

- Payment when buying/selling
- Inventory
- Regulations
- Variety trials



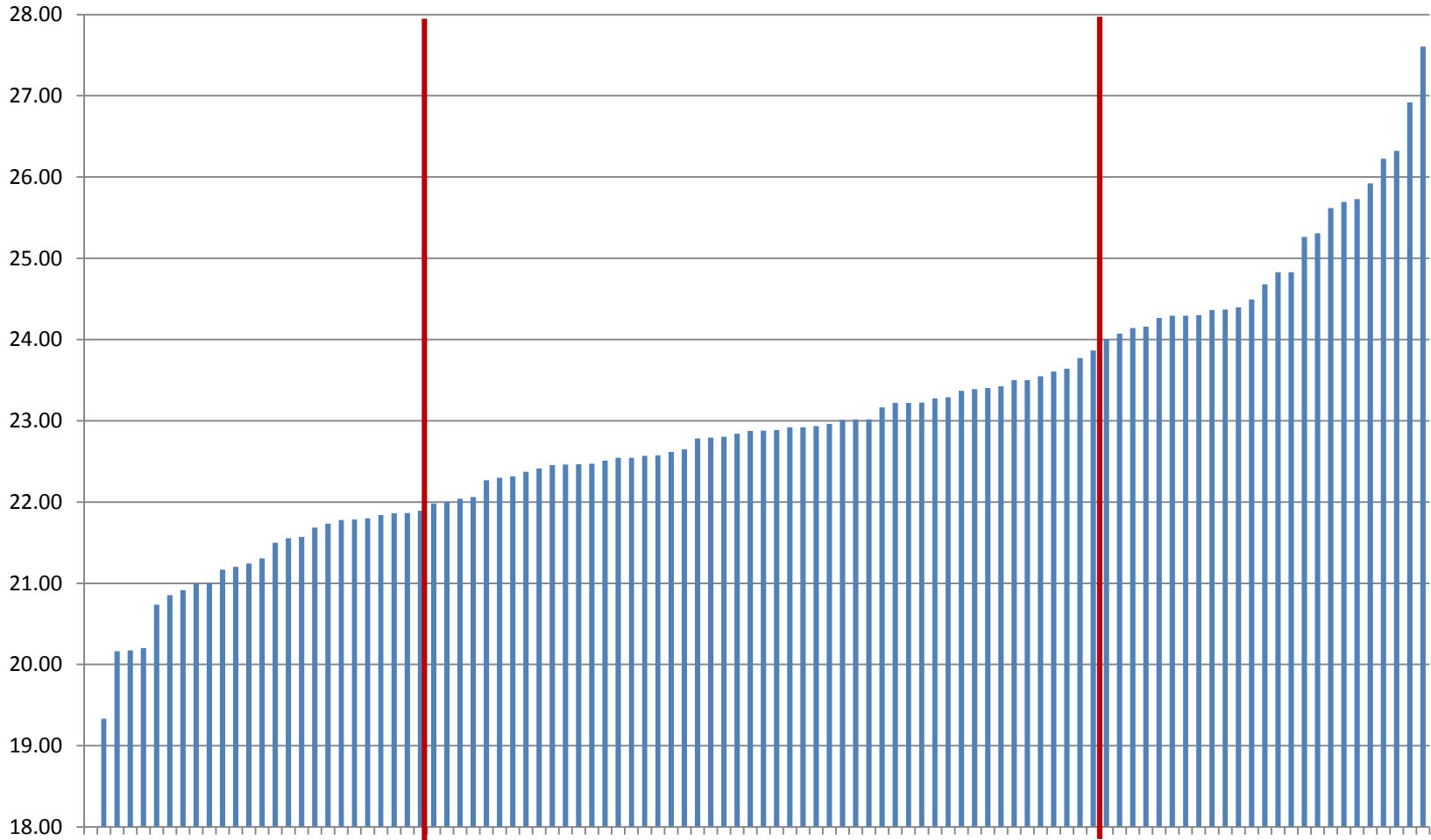
## On-farm measurement options

- Koster
- Microwave
- NIR



# Dry Matter Variability

---



# How to Reduce Error in Estimating DM and Yields

---

Differences between estimated field DM removal and actual field DM removal based on method of sampling on one cooperator dairy.

	<u>Single Sample</u>	<u>Consecutive sampling (1 hr)</u>	<u>Hourly sampling</u>
% difference	-21.5 to + 20.4	-5.14% to + 5.15	-2.71% to + 2.40
DM difference (lbs)	± 135,000	± 33,000	± 16,500

# Particle Length

---

- **General Considerations**
  - Too short – impaired rumen health and function
  - Too long – easily sorted out of the TMR
- Desired particle length is dependent on other forages in the ration, DM at harvest, etc.
- Important to include the silage team, especially the herd nutritionist, in this decision.



# On Farm Monitoring

## Penn State Shaker Box

	3/4 TLC Processed	3/8 TLC Unprocessed
<b>Top</b>	5-15	3-8
<b>Second</b>	>50	45-60
<b>Third</b>	<30	30-40
<b>Bottom</b>	<5	<5

## Tape Measure



# Kernel Processing

---

## Kernel Processing Improves:

- Handling and Packing
- Starch Digestion
- Fiber Utilization
- Feed Intake
- Reduces Feed Sorting



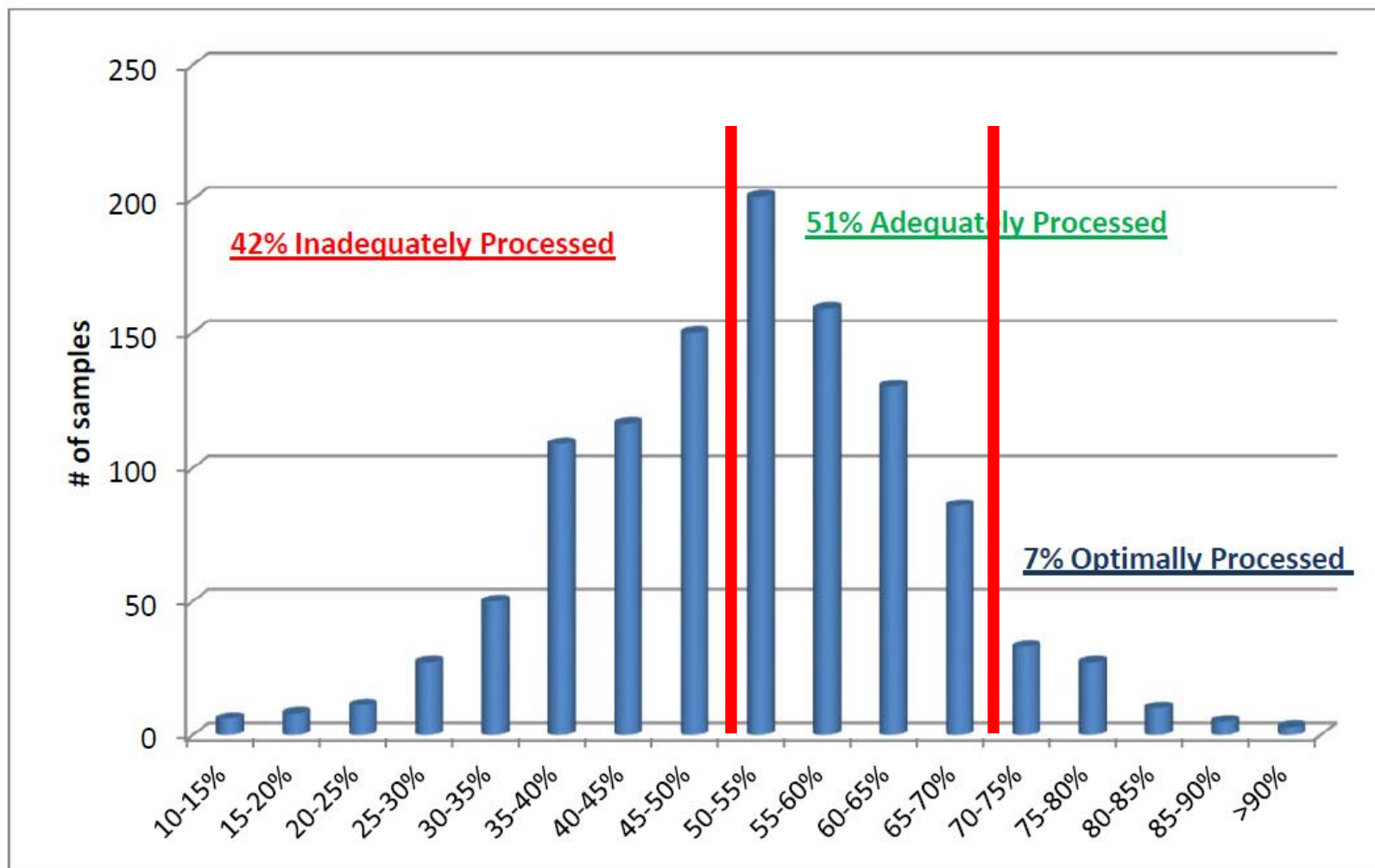
## Too Much Processing:

- Decreases effective fiber
- Favors rapid fermentation -> rumen acidosis

## Too Little Processing:

- Kernels lost in feces
- Difficult Packing
- Sorting increased

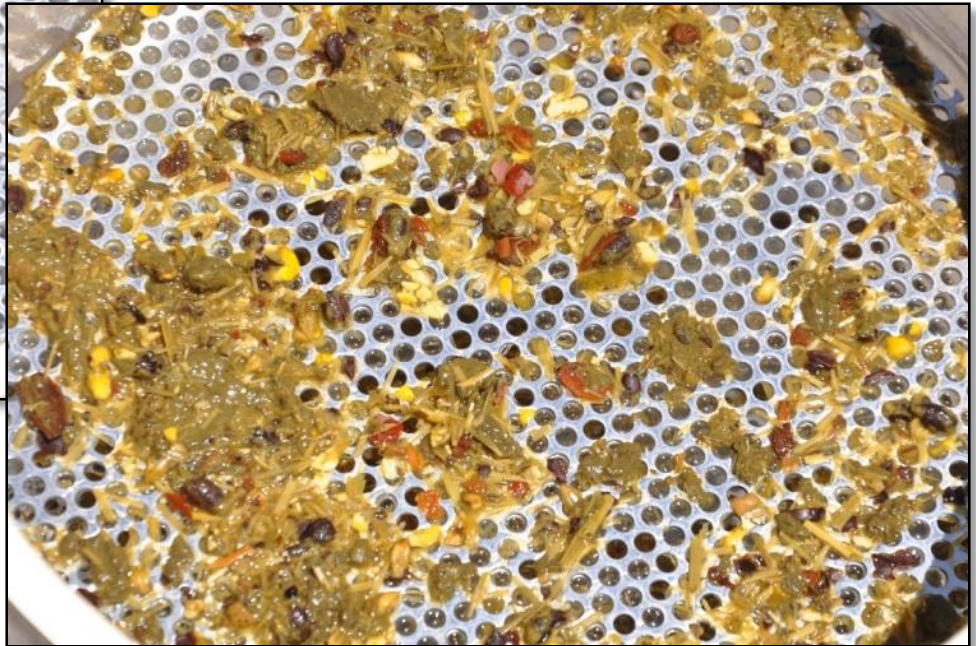
# Corn Silage Processing Score



**Cumberland Lab, 2009 -2011 (n=1131)**

# Result of Poor Kernel Processing

---



# On Farm Monitoring

## Evaluate the Broken Kernels



Separate kernels in a bucket of water –  
*Appendix II*



## Guidelines:

- 90 - 95% cracked
- 70% smaller than  $\frac{1}{4}$  of a kernel

*Nicking and Crushing is not enough*

*(Mertens, 2005)*

# Suggested Monitoring

---

Hourly, sample a truckload of forage for:

## 1. DM

- On-farm (microwave, koster tester, NIR)

## 2. Length of cut

- Penn State Shaker Box
- Tape measurement

## 3. Kernel Processing

- Bucket method (Appendix II)
- Cup method



# Future Work

---

## **Spring/Summer, 2014**

- Custom harvester survey
- Nutritionist survey

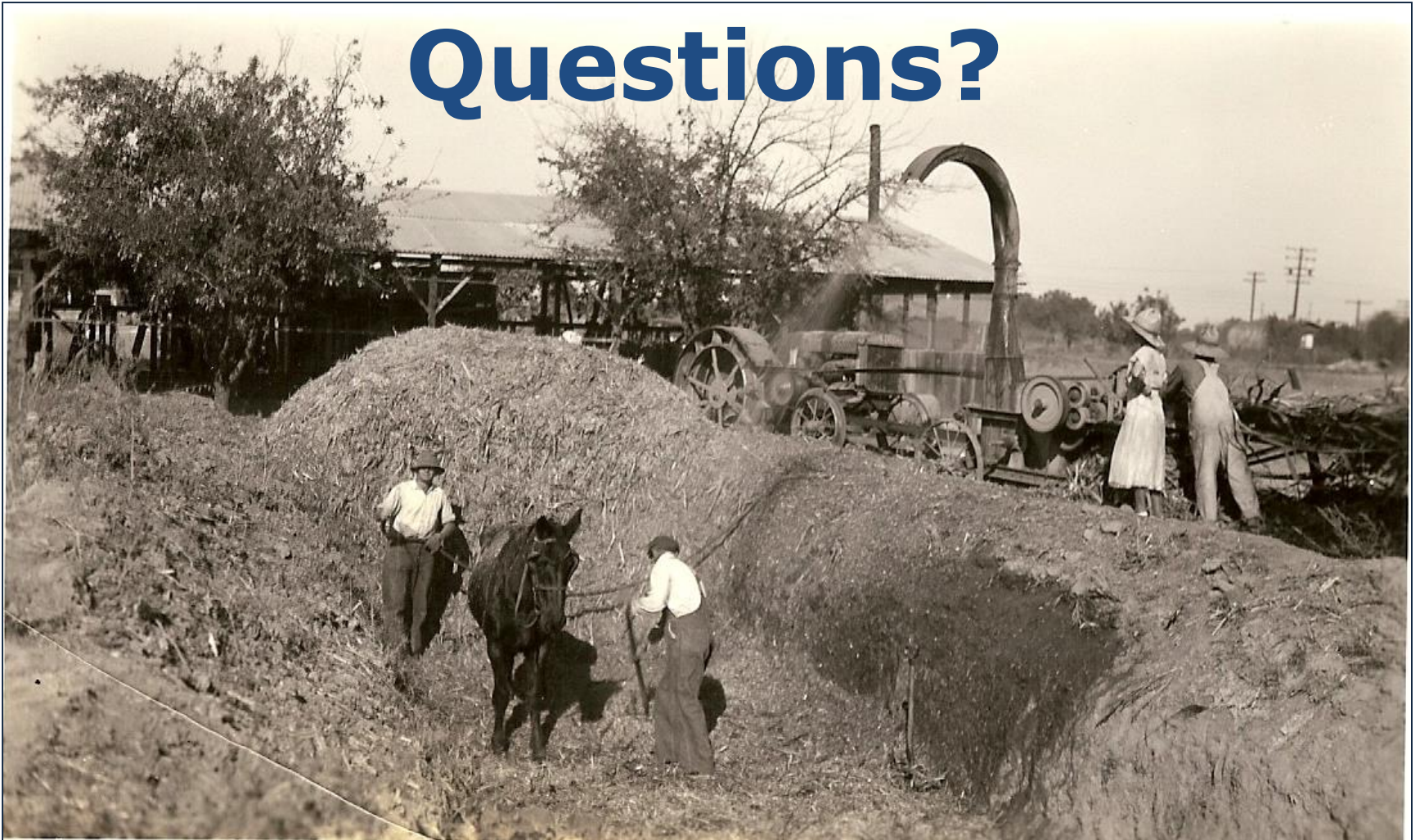
## **Summer, 2014**

- Corn silage audits
  - Follow up to the producer survey
  - Data collection and identification of bottle-necks in the system.

## **Winter, 2014**

- Silage management booklet

# Questions?



**Silage pit in the Central Valley (late 1930's)**

*Photo Courtesy of Alan George, retired UCCE Farm Advisor in Tulare County*



**University of California**

Agriculture and Natural Resources

Making a Difference for California

**Noelia Silva-del-Río**

UCD Vet Med Specialist

[nsilvadelrio@ucdavis.edu](mailto:nsilvadelrio@ucdavis.edu)

(559)688-1737, ext. 255

**Jennifer Heguy**

Farm Advisor, Stanislaus & San Joaquin Counties

[jmheguy@ucdavis.edu](mailto:jmheguy@ucdavis.edu)

(209)525-6800