Best Management Practices for Dairy Manure Nitrogen Fertilization of Forage Corn

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Kearney Agricultural Research and Extension Center

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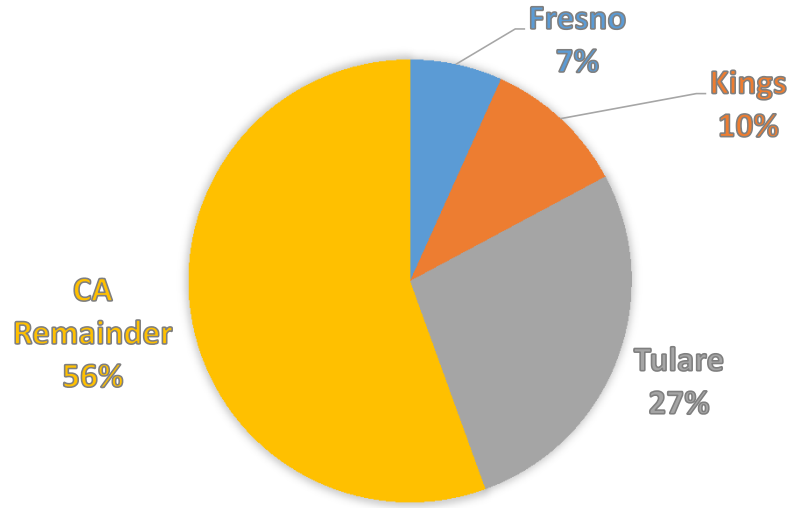
Manure is: A milk burden…

- ~ 1,300 dairies regulated by the 2013 Dairy General Order (R5-2013-0122)
- 2014 CA milk production was 21.2 million tons
- Tulare, Kings, and Fresno 2014 milk production was 9.4 million tons
- Tri-county value in 2014 = $4.1 billion
- **Tri-county manure excreted ≈ 27 mil tons***

*(From ASAE *Manure Production and Characteristics*, 2005)

2014 CA MILK PRODUCED



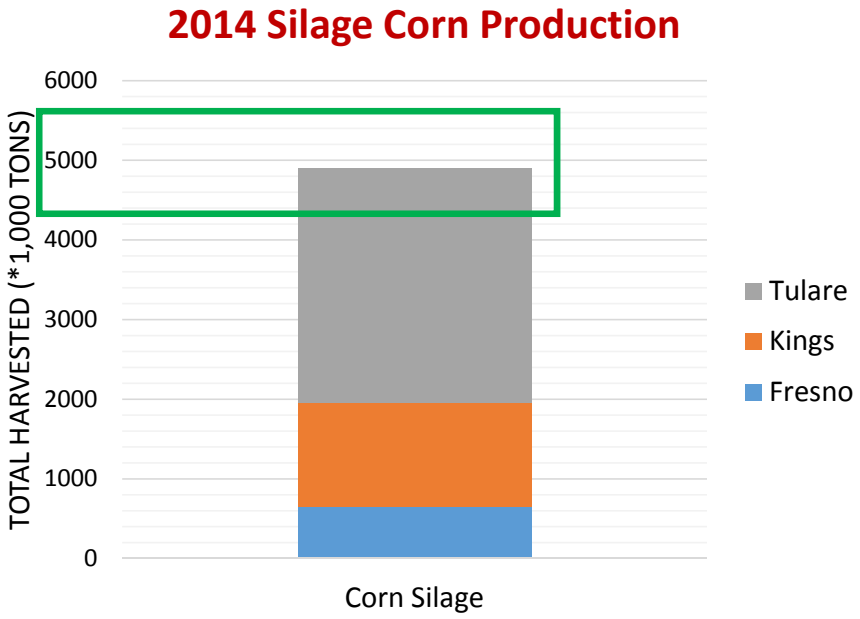
(From CDFA, 2014-15 Ag Stats and County Annual Crop Reports)

...and a crop asset.

2014 CA Equivalent Tons of Nutrients Excreted from Tri-County Milk Cows and Replacements

Animal	Nitrogen	Phosphorus	Potassium
Replacements	38,000	5,200	13,000
Milk Cows	40,000	7,300	17,000
Total	*78,000*	*12,500*	*30,000*

(From ASAE *Manure Production and Characteristics*, 2005)



There's plenty N to go round (example)

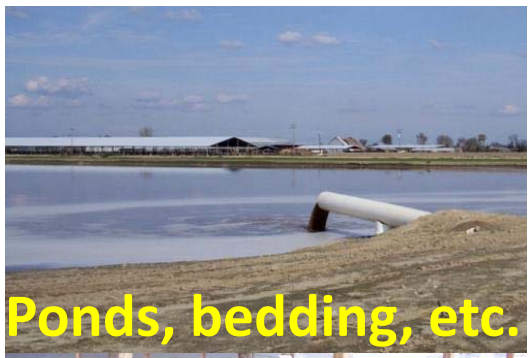
$$\frac{\text{5 million tons corn X 9.5 lbs N applied}}{\text{1 ton corn}} = \text{23,750 tons N applied}$$

That leaves

78,000 tons N excreted - 23,750 tons N applied = 54,250 tons N remaining

54,250 tons N remaining to be…

Used, exported, stored, or “lost”



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Forage Corn Nutrient Management

Prescribing and following a plan

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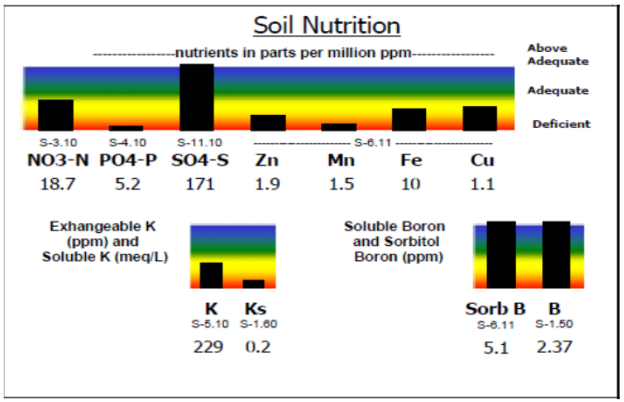
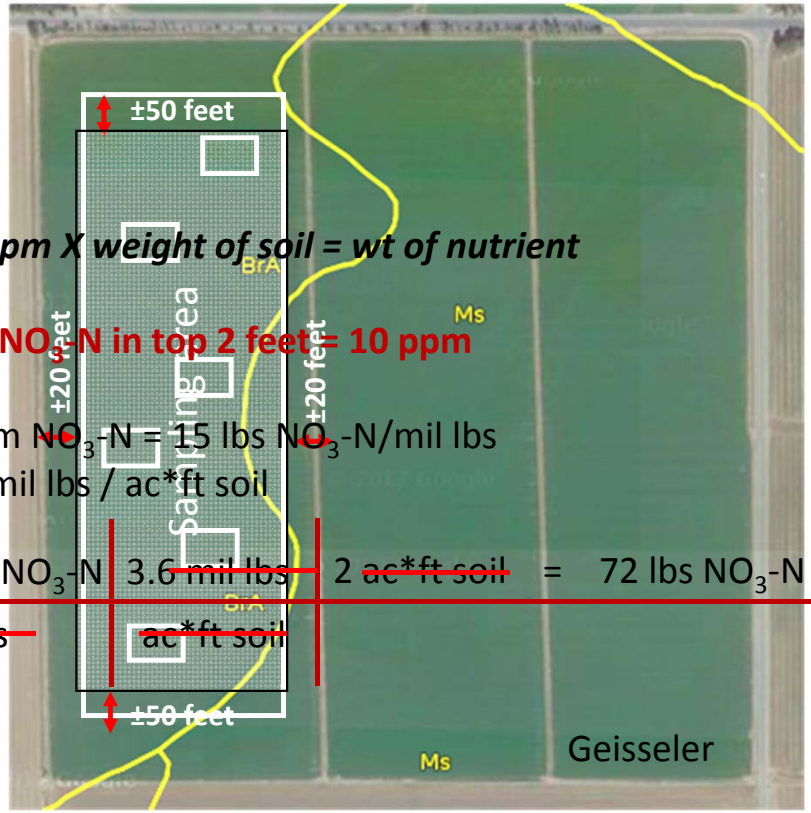
Where to begin – TESTING

- Soil preplant test
  - All macros, salinity, pH, and micros only if a problem is suspected





Soil test ppm X weight of soil = wt of nutrient

e.g: **NO_3-N in top 2 feet = 10 ppm**

1. 15 ppm NO_3-N = 15 lbs NO_3-N/mil lbs
2. ≈ 3.6 mil lbs / ac*ft soil
3. $\frac{10 \text{ lbs } NO_3\text{-N}}{\cancel{\text{mil lbs}}} \times \frac{3.6 \cancel{\text{ mil lbs}}}{\cancel{\text{ac*ft soil}}} \times 2 \cancel{\text{ ac*ft soil}} = 72 \text{ lbs } NO_3\text{-N}$

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Irrigation water as a nitrogen source

- Irrigation water testing
  - For NO_3-N, salinity, pH, and heavy metals
  - Whenever a new source is used
  - At the beginning of the cropping season
  - Depth change of well pump

water test NO_3-N = 0.23 lbs NO_3-N / ac*in H_2O

e.g: **H_2O [NO_3-N] = 2 ppm; will apply 30"**

1. $\frac{2\ \text{ppm } NO_3\text{-N}}{} \times \frac{0.23\ \text{lbs } NO_3\text{-N}}{\text{ac*in } H_2O} \times \frac{30\ \text{ac*in } H_2O}{\text{ac}} = \frac{13.8\ \text{lbs } NO_3\text{-N}}{\text{ac}}$

Know your manure's N value

Liquid and solid manure **N** source sampling (as per 2013 Dairy Order MRP)

Lagoon Manure

- Each application of lagoon manure, measure volume and note the date.
- Quarterly, during lagoon manure application – ammon. N and TKN
- Annually, before irrigation blending – NO_3-N, ammon. N, and TKN

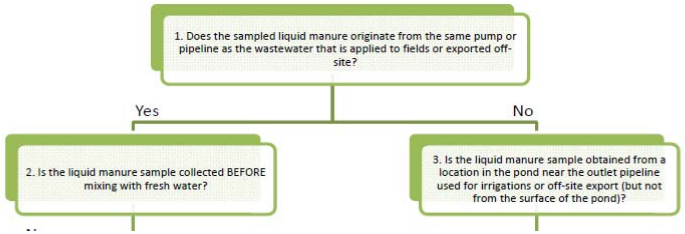
Solid Manure

- Each application to each area, weight applied and % moisture
- 2X per year, total N and % moisture

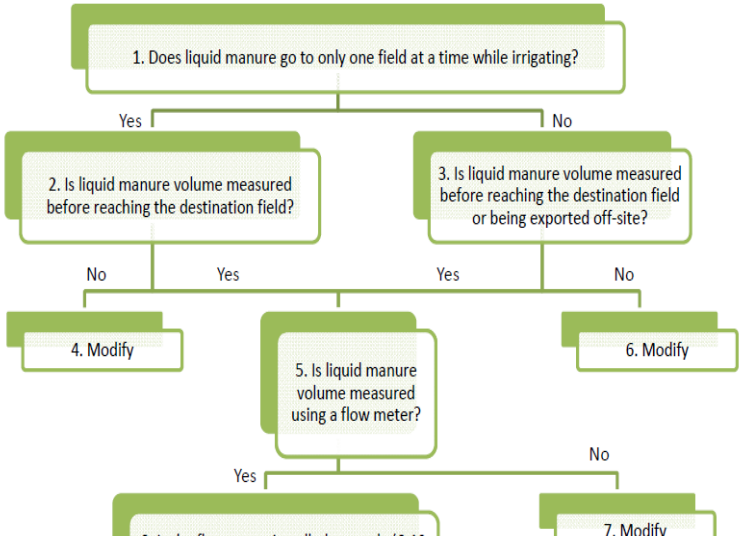
Can you accurately measure applications?

- Check out Deanne Meyer et al.'s work on proper sampling and measuring of manure:

Tree 2 – Obtaining a Representative Sample of Liquid Manure



Tree 1 – Measuring Liquid Manure



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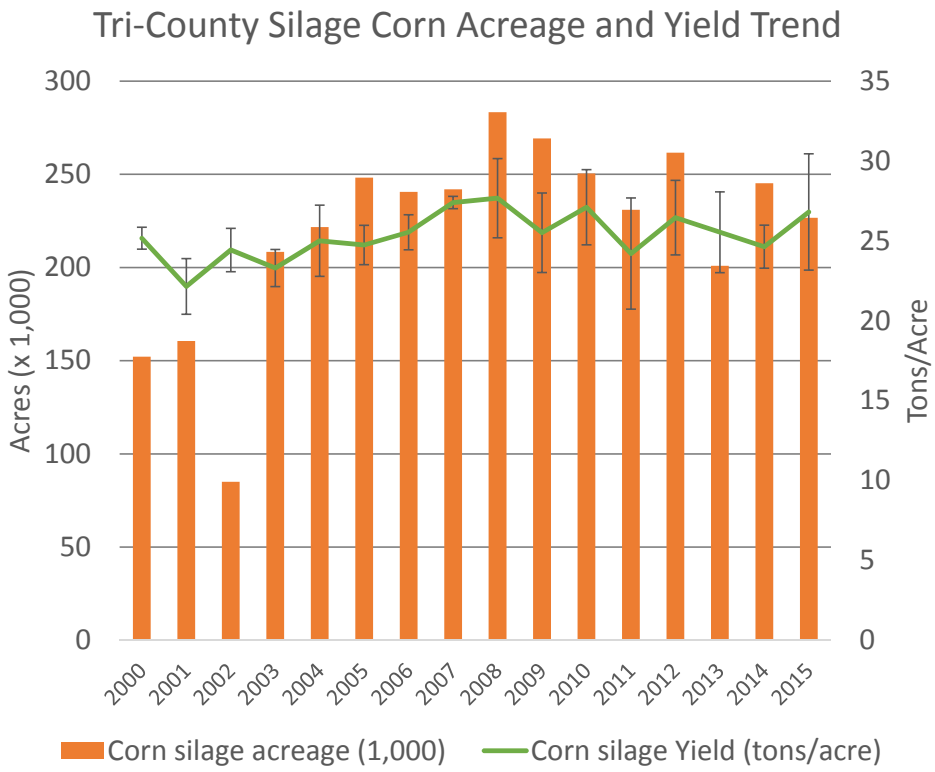
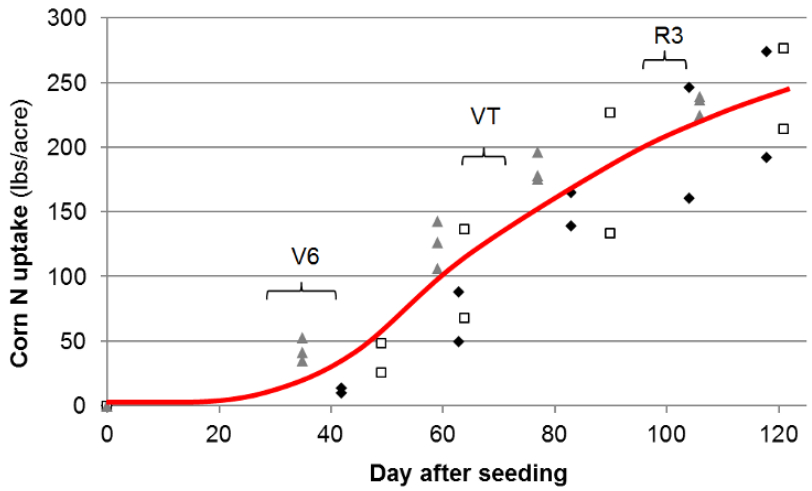
Setting a Goal

- Realistic yield goals
  - Field by field crop history should indicate attainable yields
- Address yield limiting factors
  - Soil and irrigation water salinity, background soil fertility, disease pressure, etc. should be managed



Plan Your Nitrogen to Match Your Yield

- N application dependent on yield expectation

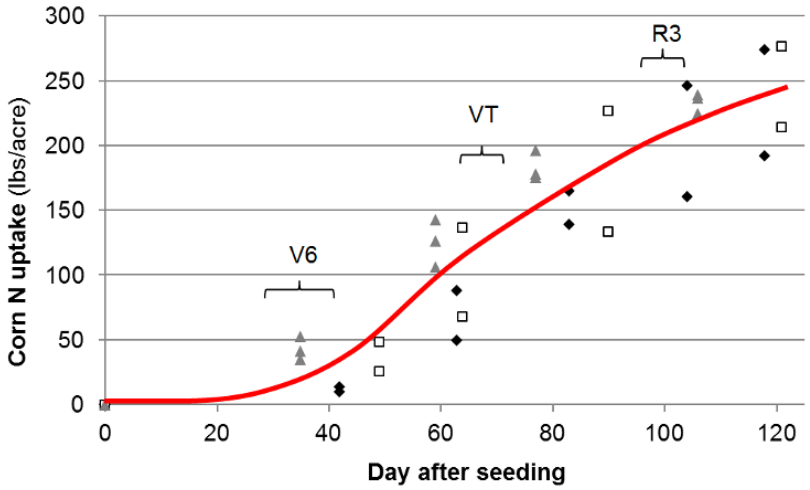


Geisseler et al., 2012

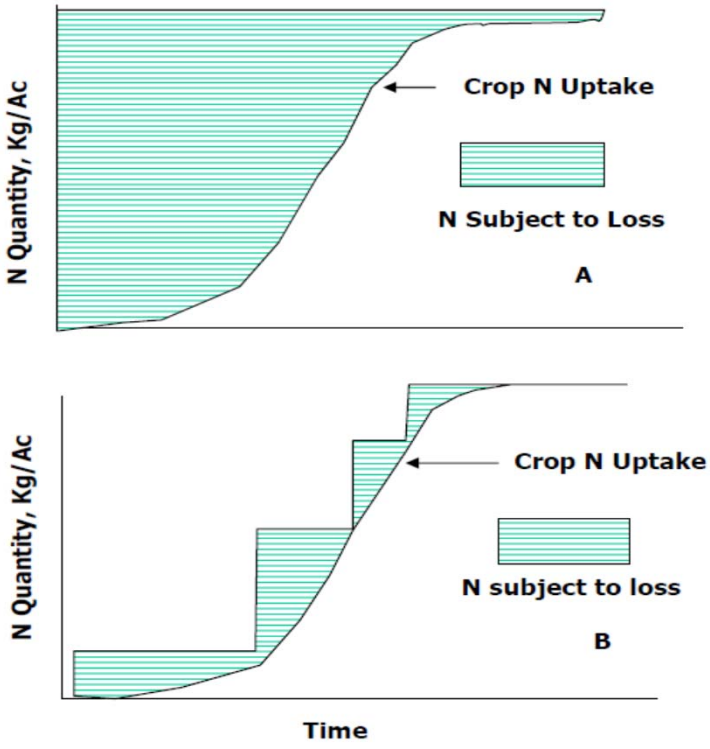
Silage Corn Nitrogen Removal and N Use Efficiency			
Silage Yield in Tons/Acre	25	30	32
Lbs. N/Acre Removed	208	249	266
Assuming 70% applied-removed efficiency	297	355	380

Removal rates based on 2002 *Western Fertilizer Handbook 9th ed.*, WPHA, estimations.

Match the Supply of N to Crop Need



Geisseler et al., 2012



Timing Manure Applications to Plant Availability

Table 1. Guidelines for animal manure N mineralization in California.

	Year 1	Year 2
	- % applied organic N mineralized-	
Dairy lagoon water	**40-50**	**15**
Dairy lagoon sludge and slurry; corral manure	**20-30**	**15**
Dairy mechanical screen solids	**10-20**	**5**

1. 40-70% of mineralization value will occur within the first 4-8 weeks following application (Andrews & Foster, 2007; Gale et al., 2006). It is suggested that the lower value (40%) be used for late fall or winter applications.

Pettygrove, Heinrich, and Crohn, 2009

Some K+ and P_2O_5 Considerations

Managing soil accumulation

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Macro-nutrient ratios of manure and silage corn

Total dairy excretion

N	P_2O_5	K_2O
2.7	1	1.3
1.9*	1	1.3

ASAE; Crop reports; Pettygrove 2010
* After 30% N loss by NH_3 volatilization

Manure as solids*

N	P_2O_5	K_2O
2.2	1	0.7

Pettygrove 2010
* % dry wt. basis from corral, pond, mech screen and compost at 11 CV dairies

Manure as liquid*

N	P_2O_5	K_2O
2.2	1	3.6

Pettygrove 2010
* Median values from 9 CV dairies

Corn removal

N	P_2O_5	K_2O
2.3	1	2.3

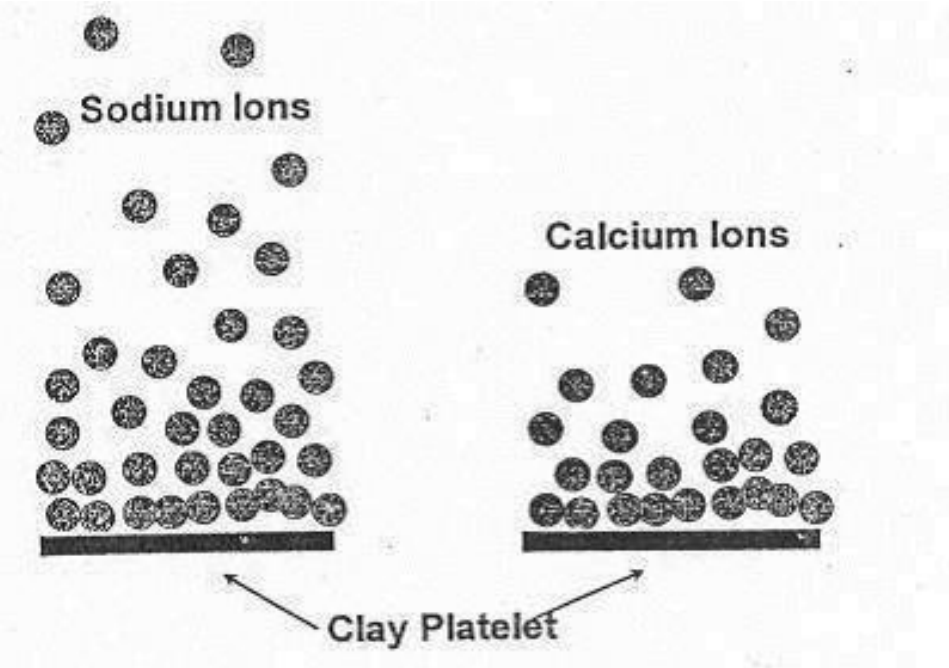
WFH 9th ed. 2002; Pettygrove 2010

- Crop N need based applications will accumulate P

- Crop N or P based Lagoon applications will accumulate K

Mitigating Excess K+

- Excess K+ may act like Na+, reducing infiltration.
  - Gyp and leach like Na+
- Excess K+ alfalfa may cause milk fever
  - Balance at TMR or gyp and leach like Na+
- P_2O_5 based manure fertility plan



P_2O_5 Erosion and Induced Zn++ Deficiency?

Erosion

- Not generally a concern in the San Joaquin Valley

Induced Zn++ deficiency

- Likely not a problem in manured fields
  - Zn++ chelation by organic acids from manure
  - High [Zn++] associated with manure application (Leytem et al., 2011; Moore et al., 2014)

Summary

- There is enough N, P, and K in a dairy forage system for the crops grown
- Well managed nutrients will be an asset
- Testing soil, irrigation water, and manure is key to planning
- Make data-based yield goals and address limitations
- Applications are as precise as the metering method
- **Matching manure N application to crop N need ≠ easy + precise**
  - We can always improve
- Consider P fertility-based manure application + N fertilizer/legume rotation

Thank You. Questions?