University of California

Nitrogen Management Training

for Certified Crop Advisers

MODULE 4

Nitrogen Sources

PART 1

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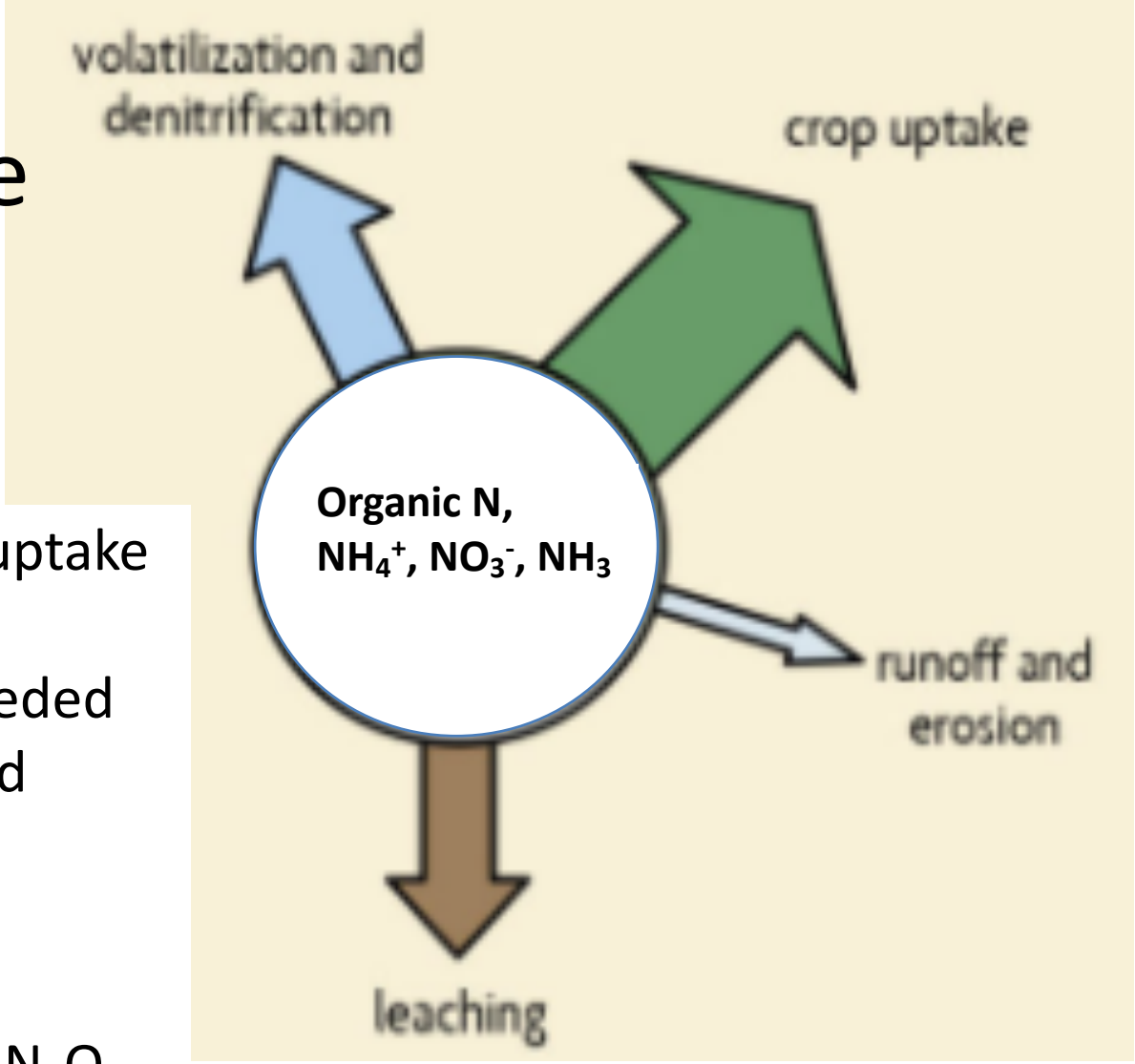
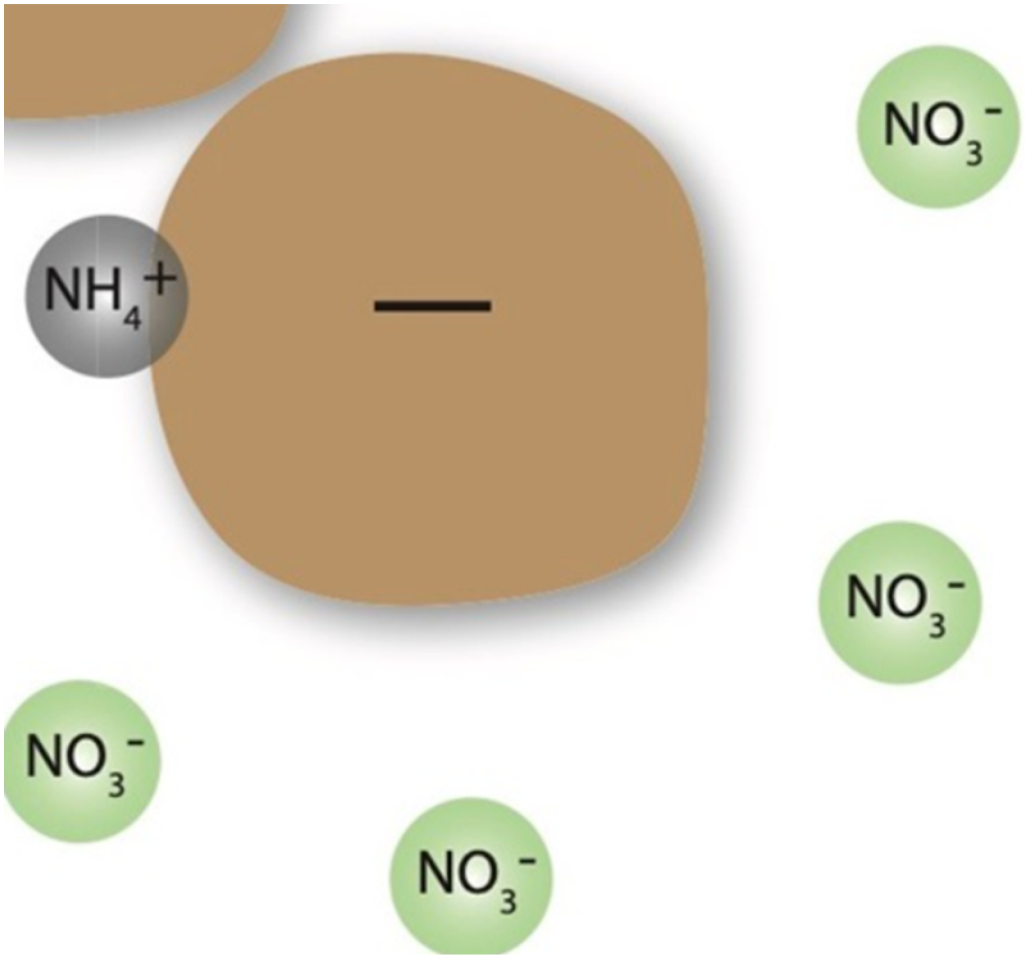
Nitrogen sources require proper management



- N is essential for crop uptake and growth
- Good management needed to prevent excesses and losses via:
- Leaching: NO_3^-
- Volatilization : NH_3
- Denitrification: NO & N_2O

Nitrate



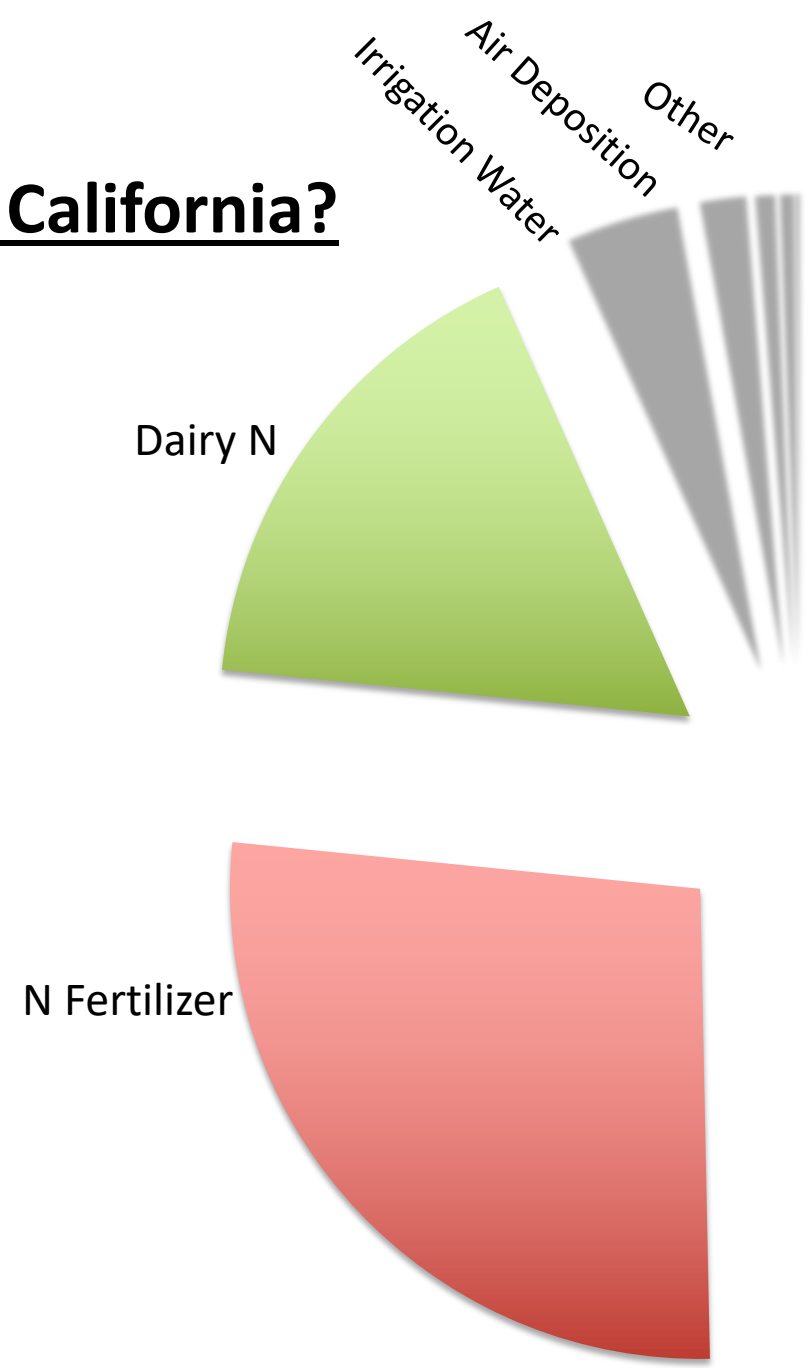
- negatively charged ion does not adsorb to the neg. charged soil particles found in most soils
- nitrate ions move freely with drainage water and are easily leached

- Excess N in all nitrogen sources can be lost as nitrate

Where is Nitrate Coming From in California?

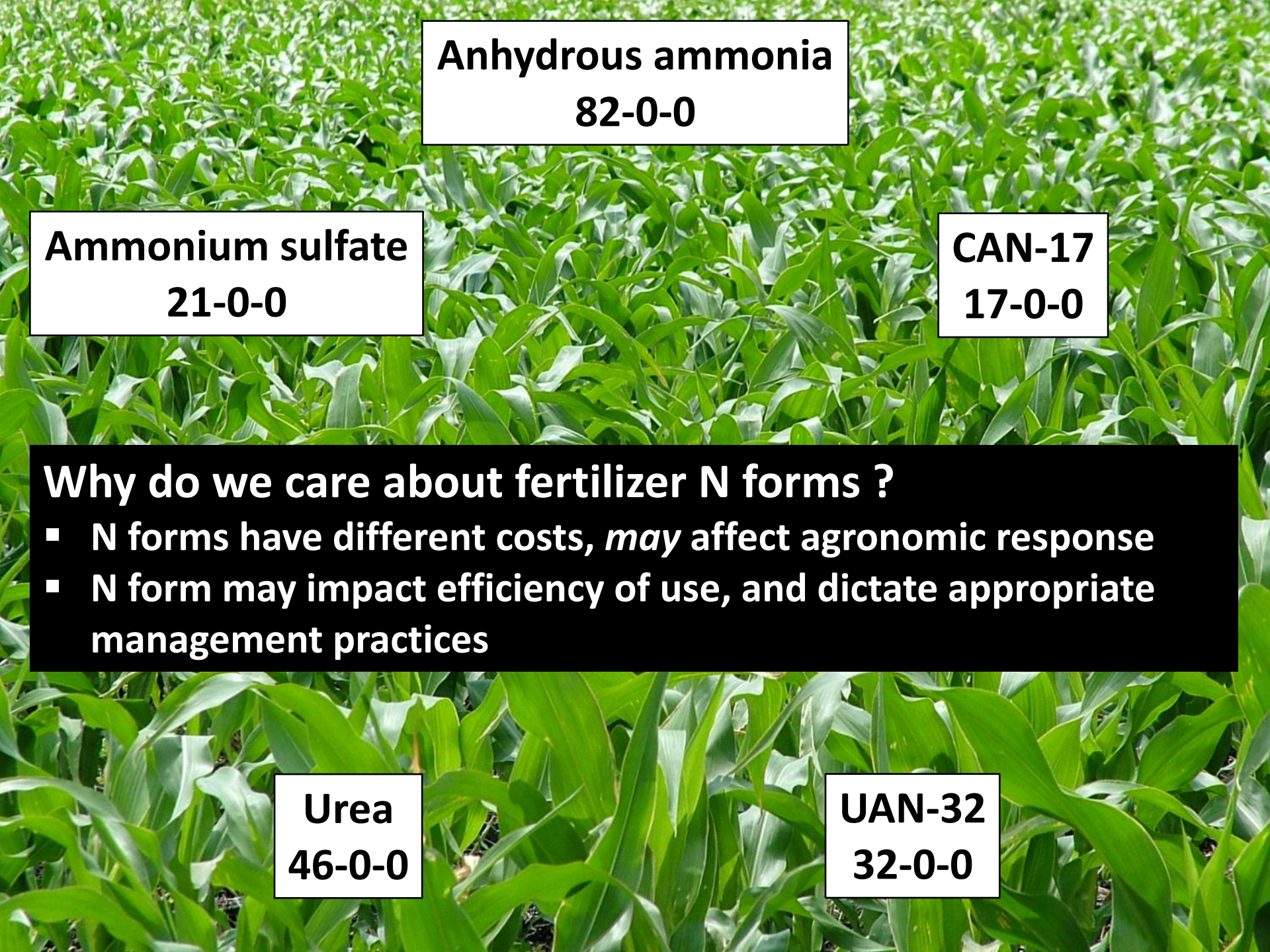
The two major N inputs on cropland are:

Synthetic fertilizer **53%**
Dairy Manure **33%**



Data from Salinas Valley and Tulare Lake Basin

Synthetic Nitrogen Fertilizer Forms


Anhydrous ammonia
82-0-0
Ammonium sulfate
21-0-0
CAN-17
17-0-0
Why do we care about fertilizer N forms ?
N forms have different costs, *may* affect agronomic response
N form may impact efficiency of use, and dictate appropriate management practices
Urea
46-0-0
UAN-32
32-0-0

Ammonium-forming Fertilizers

- **Anhydrous ammonia**
  - More slowly mineralized to NH_4^+ and oxidized to NO_3^-
  - Lowest leaching and denitirification potential among synthetic fertilizers

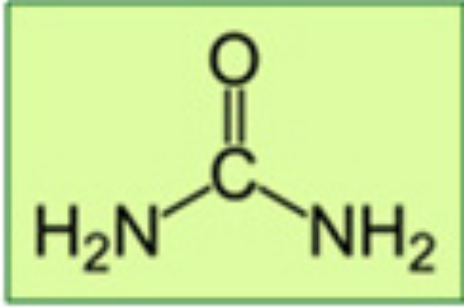
Anhydrous ammonia application to soil or water :

$$NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$$

↑

Temporarily raises pH

Ammonium-forming Fertilizers



- **Urea**

- **Highly soluble, uncharged, moves freely with water**

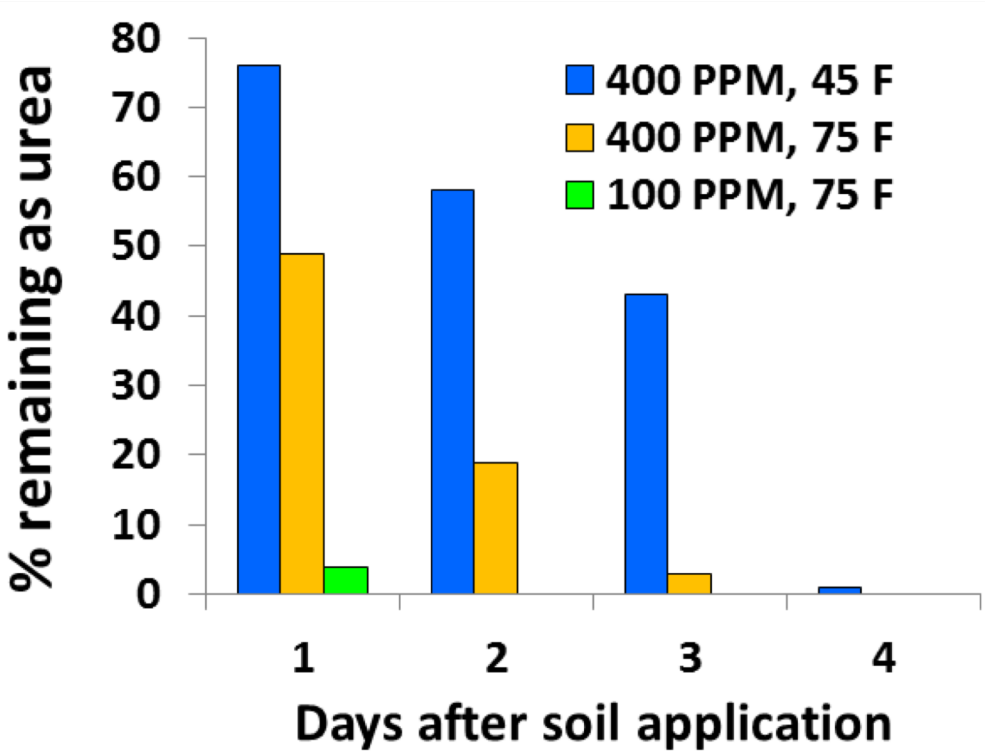
- **Enzymatic hydrolysis produces NH_4^+ and alkalinity**

$$CO(NH_2)_2 + 2\,H_2O + H^+ \xrightarrow{\text{urease}} 2\,NH_4^+ + HCO_3^-$$

urea | acid | ammonium | bicarbonate

Ammonium-forming Fertilizers:

Urea hydrolysis occurs rapidly:



Rate of hydrolysis …

- Increases as temperature increases
- Decreases as concentration increases

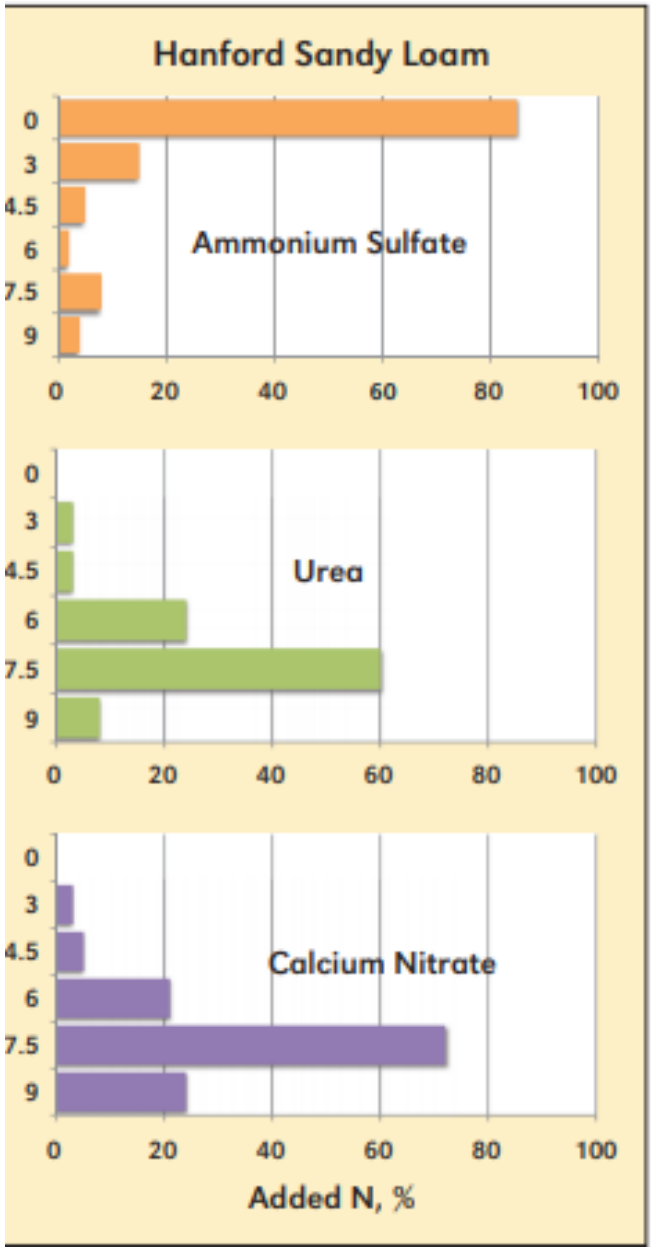
(Broadbent et al., Proc. SSSA 22:303-307, 1958)

Ammonium Fertilizers

- No immediate effects on soil or water pH
- Are temporarily resistant to leaching

- Ammonium sulfate [$(NH_4)_2SO_4$]

- Ammonium/phosphorus combinations
  - Monoammonium phosphate (MAP)
  - Diammonium phosphate (DAP)
  - Ammonium polyphosphate (10-34-0)



(Broadbent et al., Proc. SSSA 22:303-307, 1958)

Combination Fertilizers

- **Ammonium nitrate (NH_4NO_3)**

- **Calcium ammonium nitrate (CAN-17)**
  - **32% of N as NH_4^+, 68% as NO_3^-**

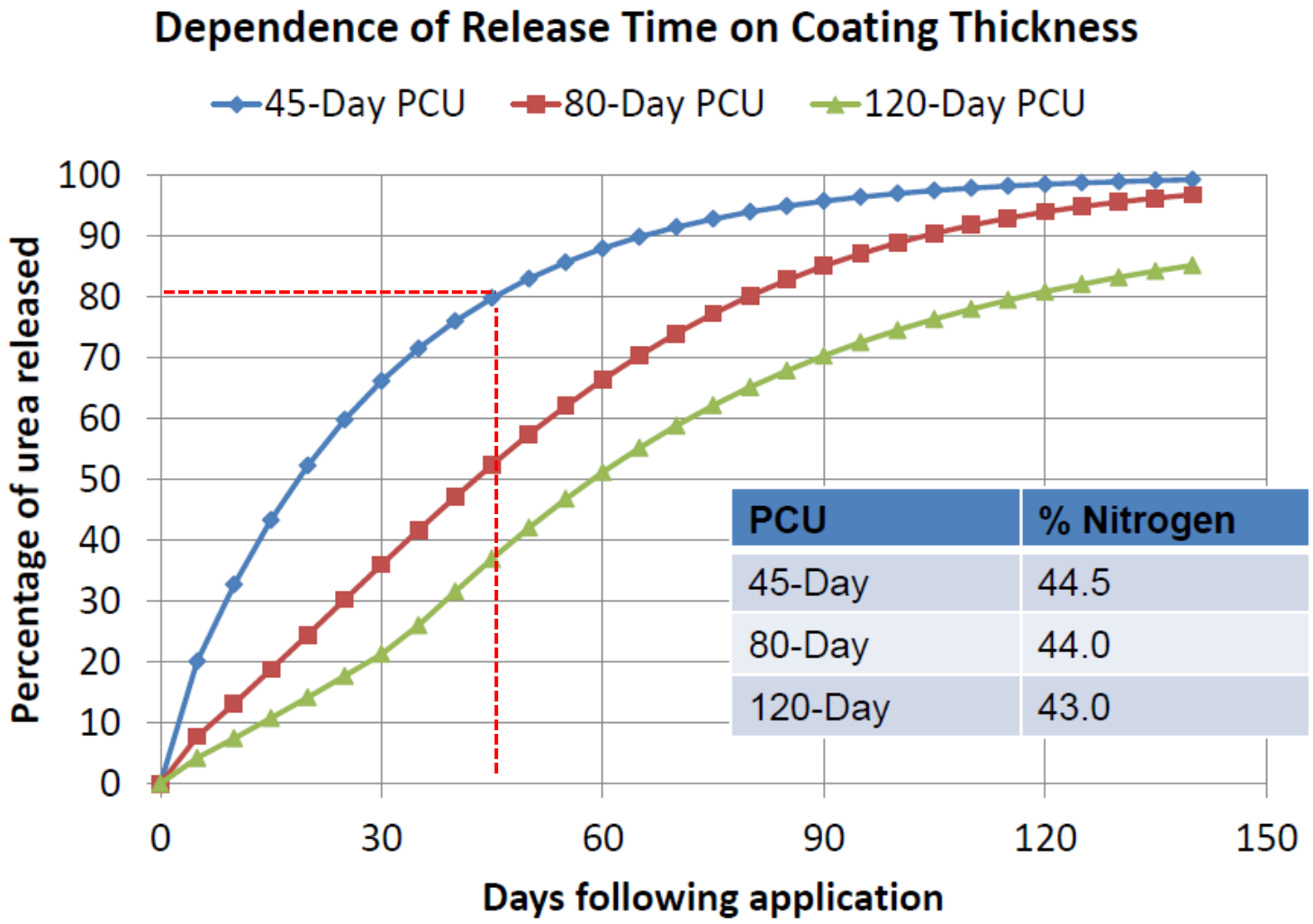
- **Urea ammonium nitrate (UAN) solutions**
  - **50% of N as urea, 25% NH_4, 25% NO_3**
  - **different concentrations (UAN-28, UAN-32, etc.)**

Controlled Release Fertilizers

Fertilizer Type	Nutrient Release Mechanism	Properties
Polymerized/ reacted urea	Microbial Action	• Ureaform, IBDU, and triazone • solid or liquid forms • common products include Coron, N-fusion, Nitamin and N-sure
Sulfur-coated urea	Microbial Action	• coating can have lower integrity leading to a faster release compared to other coated fertilizers, solids
Polymer-coated fertilizer	Diffusion then microbial action	• can contain any soluble fertilizer • common products include Agriform, Duration, ESN, and Polygon

Controlled Release Fertilizers

Release rating is based on time to release 80% of N at a standard temperature:



PCU	% Nitrogen
45-Day	44.5
80-Day	44.0
120-Day	43.0

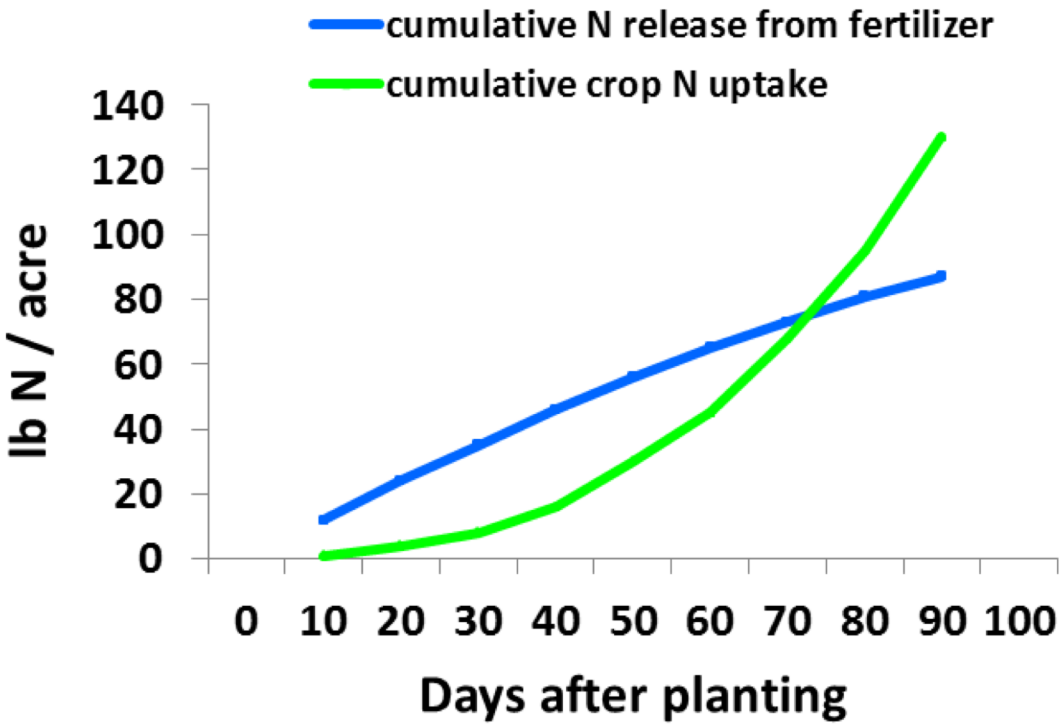
Controlled Release Fertilizers:

Benefits:

- **May reduce leaching potential compared to preplant or single sidedress systems; field circumstances determine whether this benefit is realized**

Drawbacks:

- **Higher cost per unit of N**
- **Match between N release and crop N uptake is often imperfect**
  - **more appropriate in some cropping scenarios than in others**

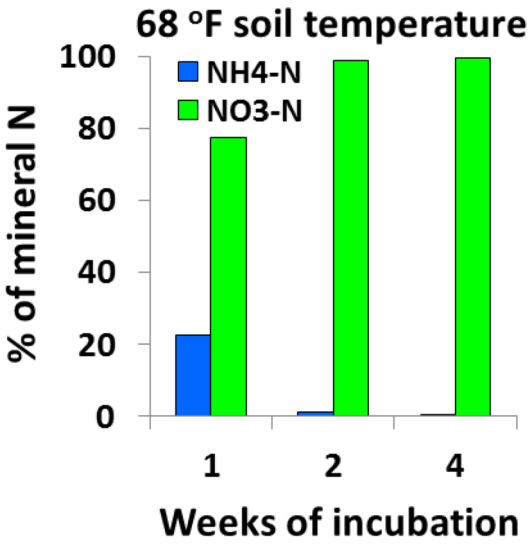


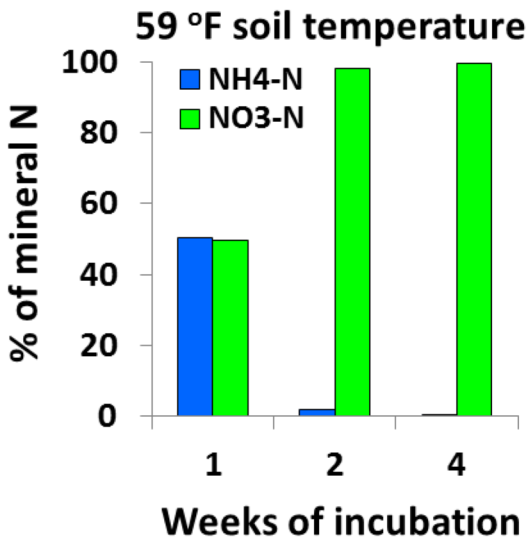
Organic Materials

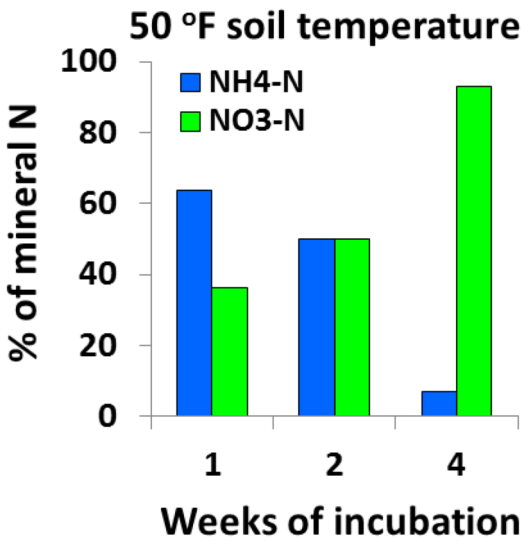
- Manure and other animal byproducts
- Compost and green waste
  - Contain small amounts of mineral N (immediately available) and organic N (slowly available after microbial conversion)
  - Organic N initially mineralizes to the NH_4^+-N form and is then nitrified

UCD organic fertilizer N mineralization project:

- Feather meal incubated in typical ag soils at different temperatures
- Mineralized N was initially in NH_4 form, but nitrification was relatively rapid







Source: Hartz and Johnstone, HortTechnology 16:39-42, 2006

Fertilizer Nitrogen Sources Summary:

- Regardless of N fertilizer form applied, rapid conversion to NO_3-N is likely
- Some combinations of N fertilizer form and application technique are more prone to environmental N loss
- N transformations can be manipulated to minimize environmental loss, but success is variable
- N from sources other than mineral fertilizers can significantly affect crop nutrition, and must be accounted for on a field-specific basis

University of California

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Course materials available at:

ciwr.ucanr.edu/NitrogenManagement

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