

Manure in Crop Production Systems

“Manure is one of the most effective means at the disposal of the farmer to permanently improve his soil.”

--ISU Extension Bulletin from 1907

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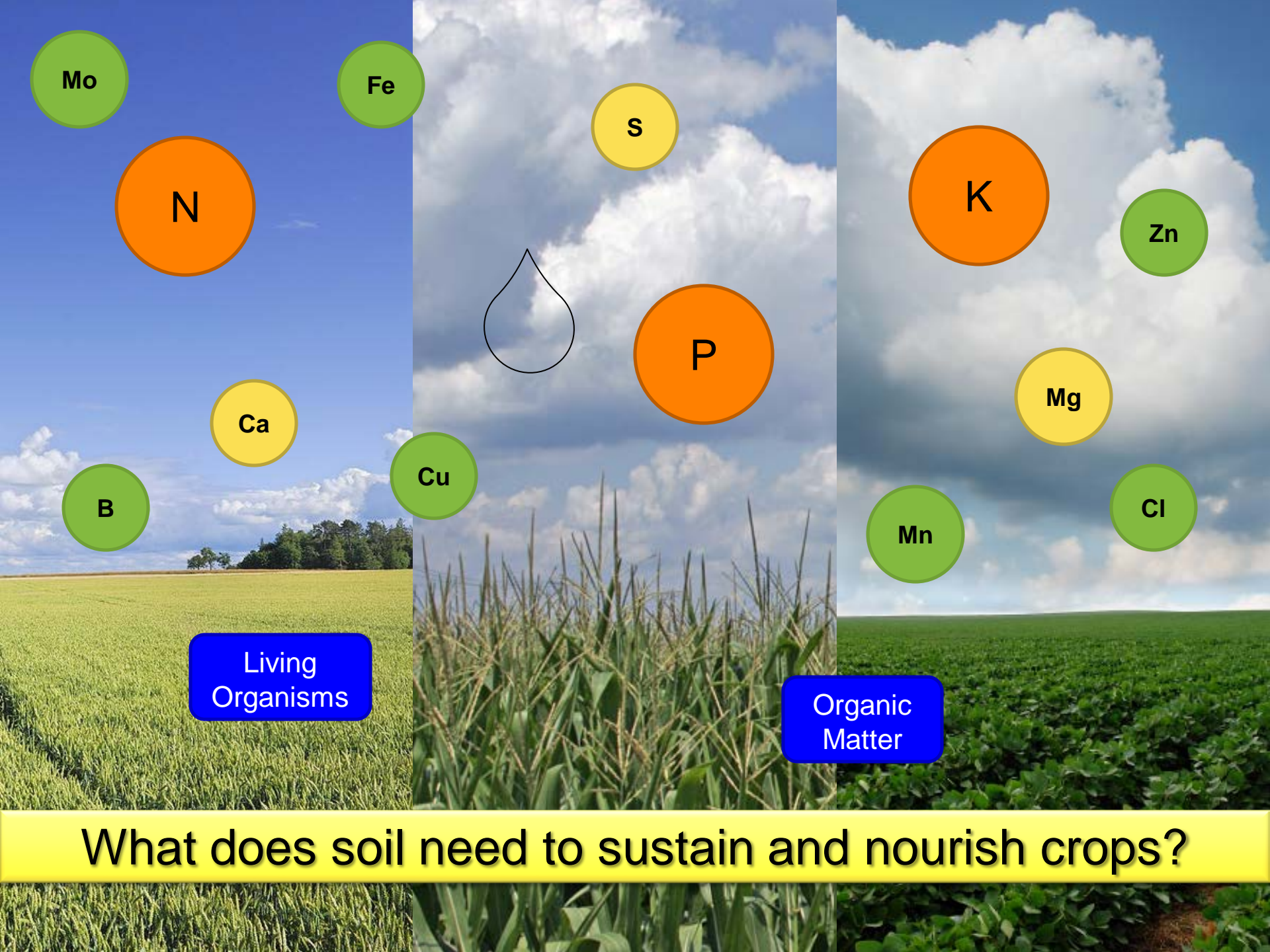




SOIL HEALTH

“As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance. So much so that we believe improving the health of our Nation’s soil is one of the most important conservation endeavors of our time.”

www.nrcs.usda.gov



Mo

Fe

N

S

K

Zn

Ca

P

Mg

B

Cu

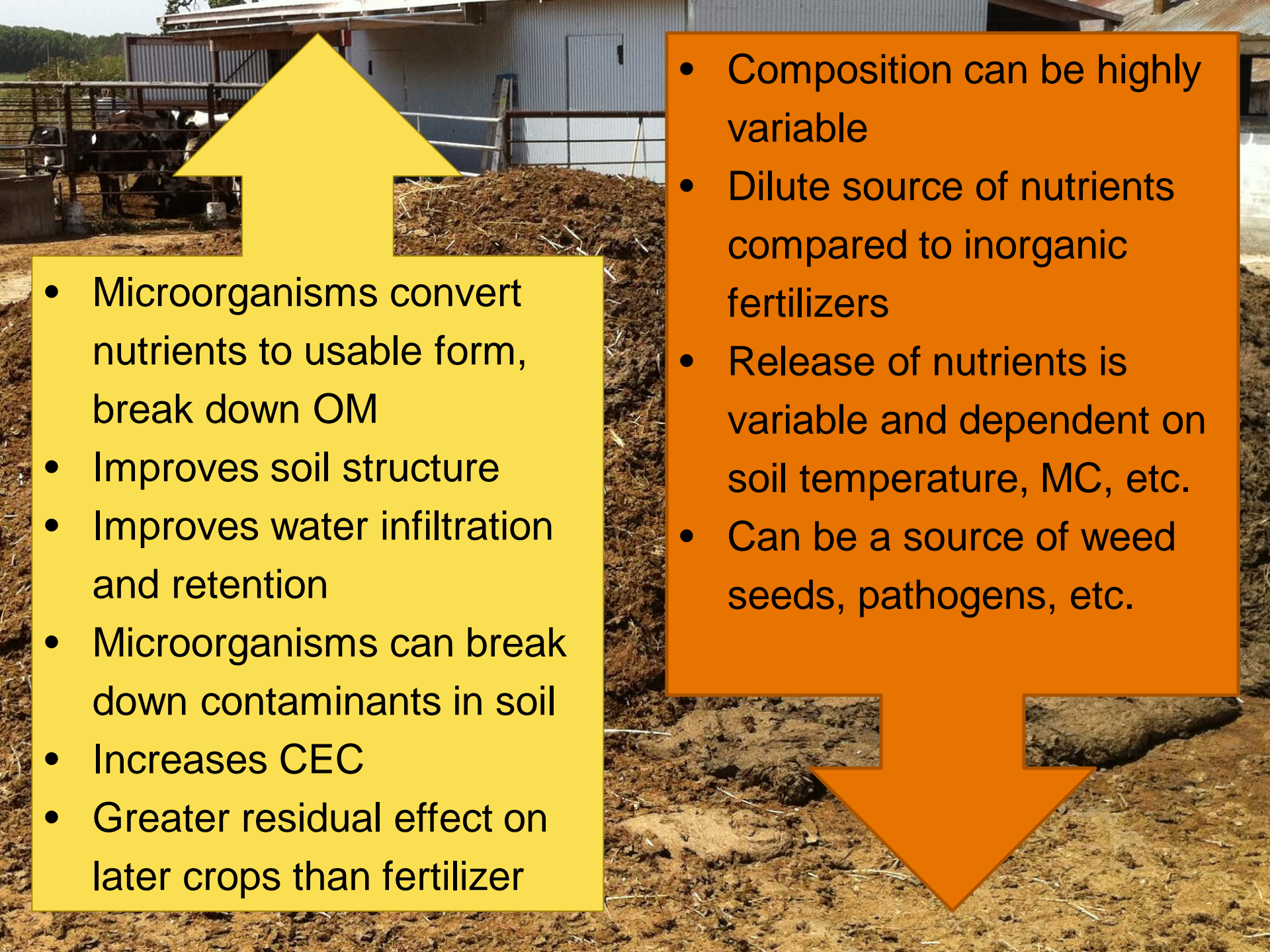
Cl

Mn

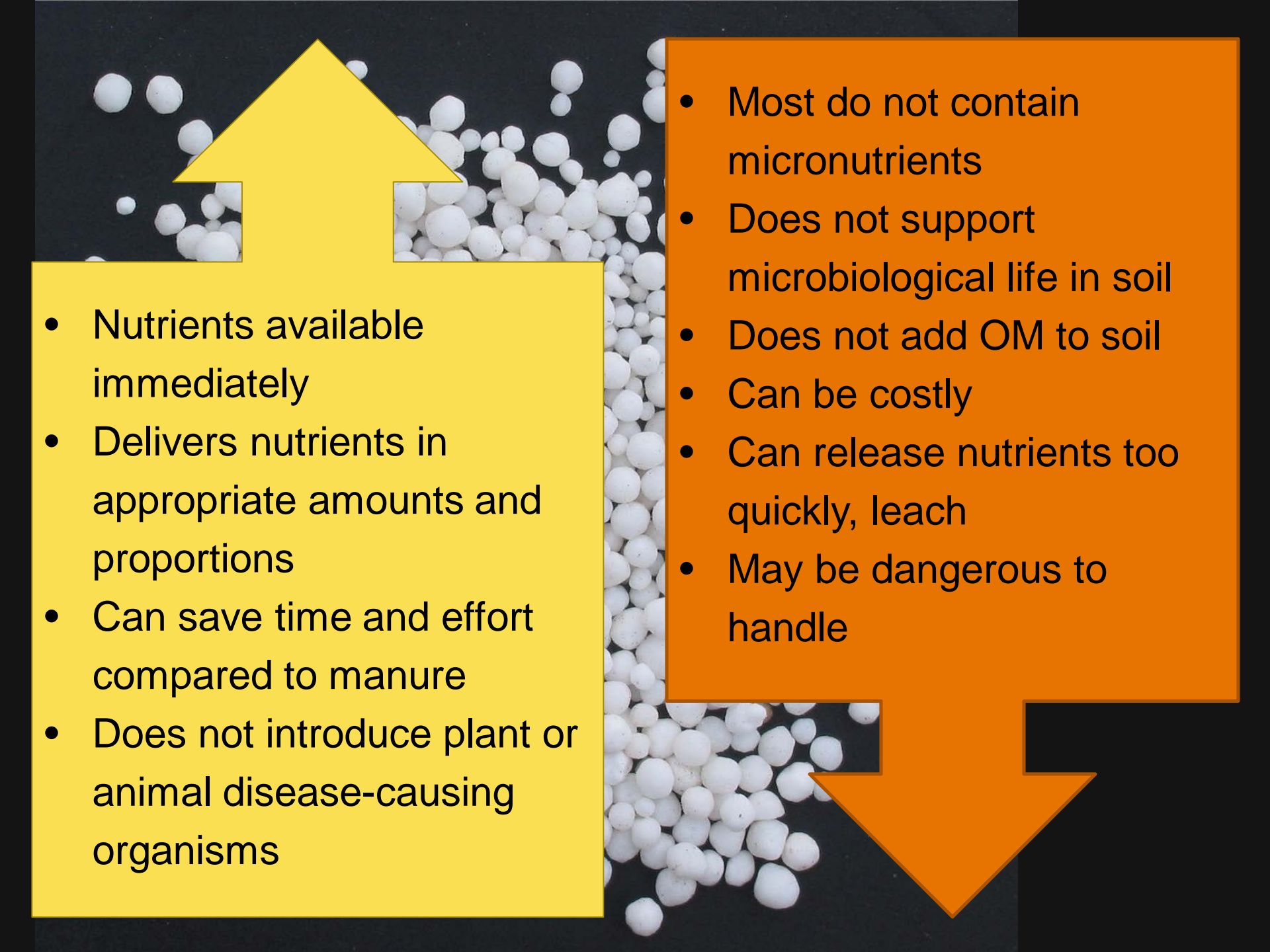
Living Organisms

Organic Matter

What does soil need to sustain and nourish crops?

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- Microorganisms convert nutrients to usable form, break down OM
 - Improves soil structure
 - Improves water infiltration and retention
 - Microorganisms can break down contaminants in soil
 - Increases CEC
 - Greater residual effect on later crops than fertilizer

- Composition can be highly variable
- Dilute source of nutrients compared to inorganic fertilizers
- Release of nutrients is variable and dependent on soil temperature, MC, etc.
- Can be a source of weed seeds, pathogens, etc.

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- Nutrients available immediately
 - Delivers nutrients in appropriate amounts and proportions
 - Can save time and effort compared to manure
 - Does not introduce plant or animal disease-causing organisms

- Most do not contain micronutrients
- Does not support microbiological life in soil
- Does not add OM to soil
- Can be costly
- Can release nutrients too quickly, leach
- May be dangerous to handle

Considerations When Utilizing Manure

- Estimating nutrient value of manure
- Determining the application rate
- Methods for applying manure
- Supplementing nutrient needs with other fertilizers



What contributes to manure's value?

- Commercial fertilizer value
- Soil and crop productivity/profitability
- Manure quality
- Demand



Estimating Nutrient Value



Nitrogen

- Easily lost during handling, storage, & application
- Should be tested shortly before application
- Availability depends on application method, OM and $\text{NH}_3\text{-N}$ content, and environmental conditions
- N loss and mineralization rates can be estimated based on “book values”

Estimating Nutrient Value



Phosphorus

- Losses minimized by manure incorporation
- Nebraska P-Index tool helps estimate risk of P runoff based on field characteristics & management
- Manure applied to meet P needs usually results in need for supplemental N.

Value of Bedded Pack Cattle Manure

Product	Org N	Avail Org N	TKN	P ₂ O ₅	K ₂ O	TOTAL
Stockpiled Beef Manure Pack	23.9 lb/ton	6 lb/ton	24.2 lb/ton	18.3 lb/ton	24.2 lb/ton	
32-0-0 UAN		\$0.32/lb				
DAP				\$0.28/lb		
Potash					\$0.28/lb	
Manure Value		\$1.92/ton		\$5.21/ton	\$6.78/ton	\$13.91/ton

Value of 10 tons/acre of manure = \$139.10/acre



Determining Application Method and Rate

Soil Sampling



Manure Sampling



Crop Needs



N or P Rate?



N Availability by Application Method (Yr. 1)

<i>Sidedress Application</i>			
Incorporated	1.00		
Sprinkler irrigation	0.50		
<i>Preplant Application and Not Incorporated</i>			
Surface-spring or fall	0.00		
<i>Preplant Application and Incorporated</i>			
		<i>Temperature at Time of Spreading</i>	
<i>Manure Form</i>	<i>Solid</i>	<i>Liquid > 50°F</i>	<i>Liquid < =50°F</i>
Not incorporated	0.00	0.00	0.00
Immediately	0.95	0.95	0.95
One day later	0.50	0.70	0.70
Two days later	0.25		0.55
Three days later	0.15	0.25	0.45
Seven+ days later	0.00	0.00	0.40

Source: UNL EC-155 *Nutrient Management for Agronomic Crops in Nebraska*



What can increase/decrease manure value?

Consistency of Product: Particle size, Uniformity

Availability of Manure: Limited or Readily Available

Timing of Application: Fall, Spring

Debris in Manure: Metal, Concrete, etc.

Micronutrients: Zinc, Sulfur, etc.

Soil Health Impacts: Org Matter, Microbes, etc.





Does nutrient source affect yield or nutritional value of the plant product?



Effects of Organic and Inorganic Fertilizers on Soil Fertility and Crop Quality – A 32-yr study

(Grandstedt & Kjellenberg, 1997)

Growing conditions:

- Mean annual precipitation = 21"
- Mean annual temperature = 42.8° F
- 6 to 8 snow-free months per year
- Fertilizer application rates adjusted to bring about comparable yields

Overview of Findings:

- Crop yield increases were significantly higher under organic treatments
- Lower crude protein content but higher protein quality for potatoes and wheat under organic treatments
- Greater resistance to stressful conditions and decomposition during long-term storage for potatoes under organic treatments
- Higher starch quality under organic treatments
- Higher soil fertility under organic treatments

Impact of Cattle Feedlot Manure on Sorghum and Triticale

	A	B	C
Yr 1	20 t/ha	20 t/ha	60 t/ha
Yr 2	25 t/ha	25 t/ha + N	N
Yr 3	20 t/ha	20 t/ha + N	N

Plus inorganic fertilizer only treatment

Three-year crop DM yield not significant among treatments

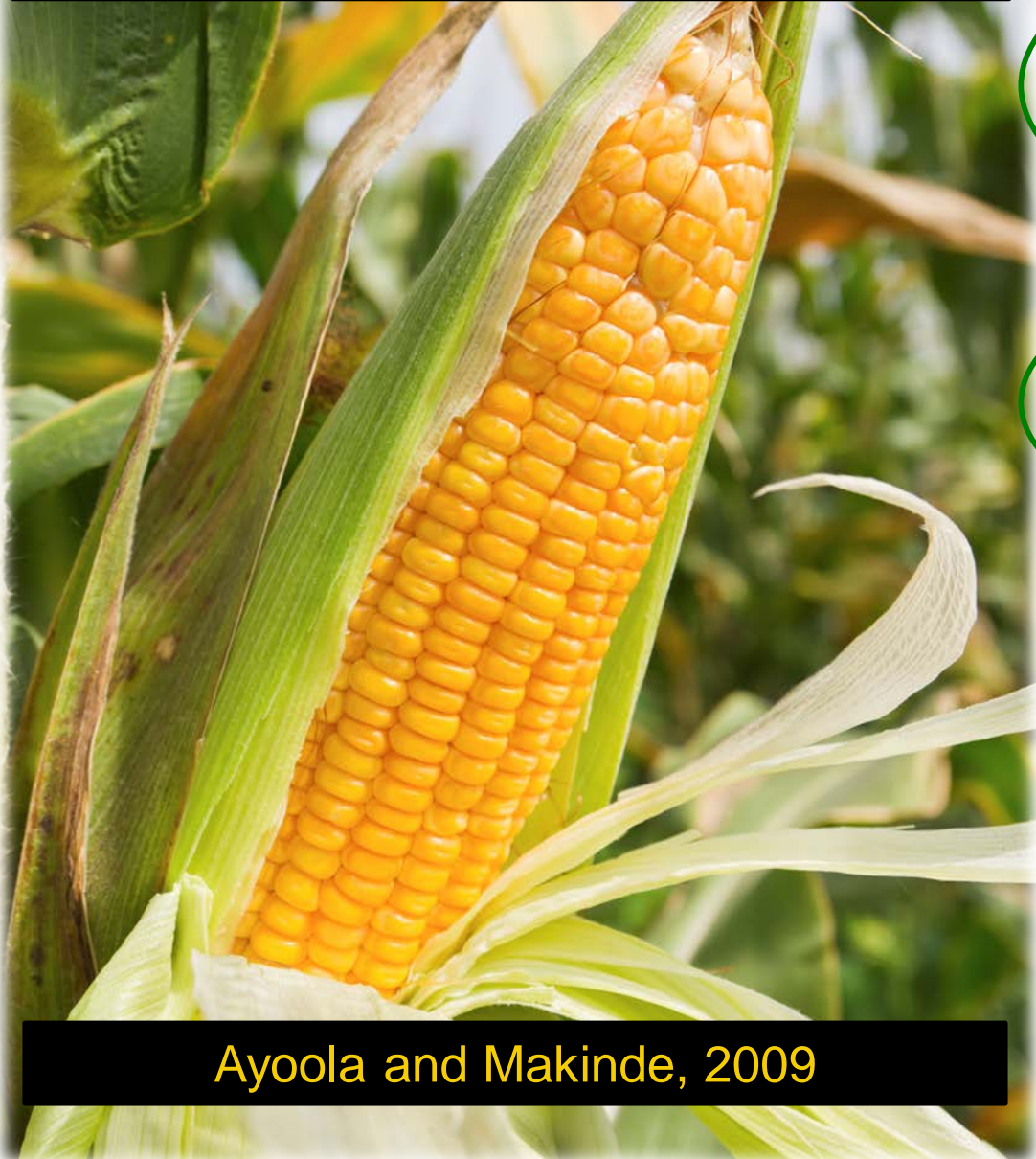
Application of manure at high initial rate vs. annually improved water infiltration

60 t/ha manure supplemented with N maximized yield & nutrient recovery, minimized runoff and dissolved nutrient losses



Klepper *et al.*, 2010

Effect of Organic and Inorganic Fertilizer on Maize Growth & Yield



Seed yields

poultry manure (3.97 t/ha) > municipal waste & cow manure (3.78 t/ha) > inorganic fertilizer (3.70 t/ha)

Plant heights

poultry manure (259 cm) > municipal waste & cow manure = inorganic fertilizer (253 cm)

Days to achieve 50% tasseling

Inorganic fertilizer (50 d) < poultry manure (52 d) < municipal waste & cow manure (53 d)

Plant leaf areas did not differ

Ayoola and Makinde, 2009



SOIL HEALTH

“Healthy soils are the foundation of agriculture, and in Nebraska, agriculture is the foundation of our entire economy. In the face of mounting challenges such as a growing global population, climate change and extreme weather events, soil health is critical to our future..”

-- Craig Derrickson,
Nebraska State Conservationist



SOIL HEALTH

“Soil health improvement...is possible when nutrients contained in different organic materials available on the farm (manures, crop residues, etc.) are applied and supplemented with mineral fertilizers to meet the nutrient requirements of the crops.

-- Singh and Ryan, 2015

Questions?



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