

FERTILIZING WITH URINE



WHY and HOW

The Natural Fertilizer Market Evaluation Project
was made possible with a grant from
Western Sustainable Agriculture Research & Education



WHY URINE?

Ultimate in Recycling or Upcycling



Puts Us Back in the Ecosystem

“Fork to Field” closes the loop



Valuable Resource

Sterile

Immediately useful on plants

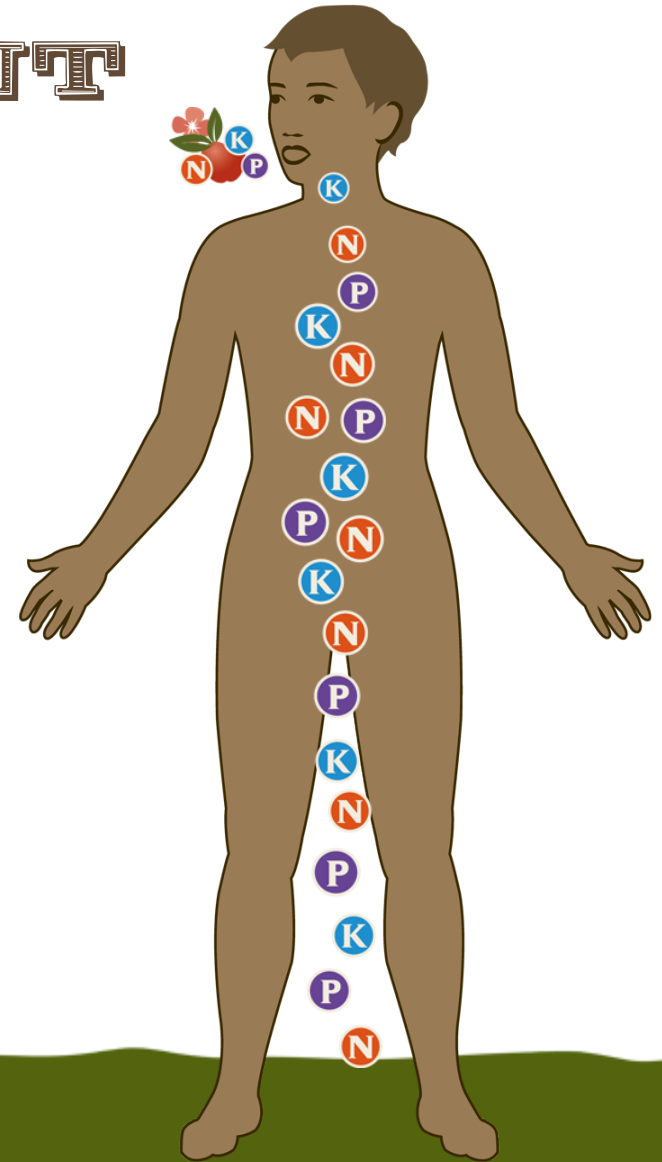
Contains valuable nutrients

Universally available

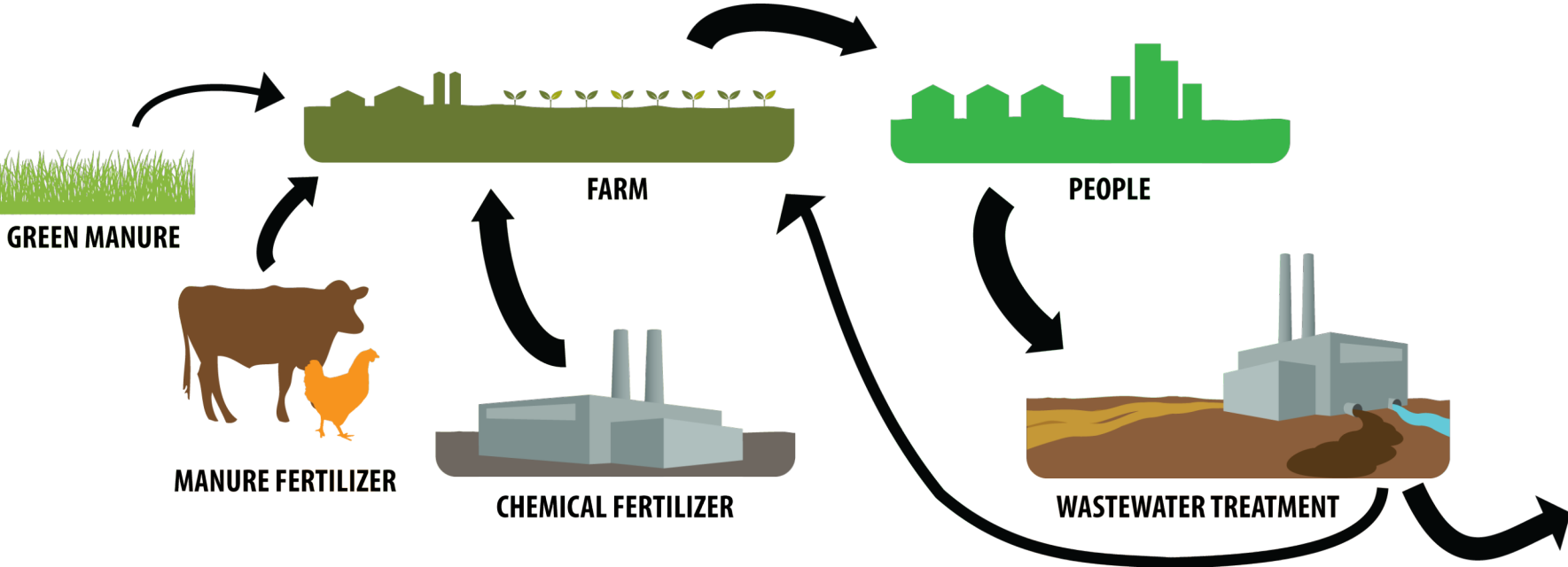


HUMAN NUTRIENT CYCLE

When we consume plants, or animals that consumed plants, the majority of nutrients embedded in the plants exit our bodies in our urine.



CURRENT NUTRIENT FLOW



HUMAN NUTRIENT CYCLE



URINE CAPTURE

Urine Diverting Toilets



URINE CAPTURE

Urine capture with urine diverting toilets:
Apartment complex, Sweden

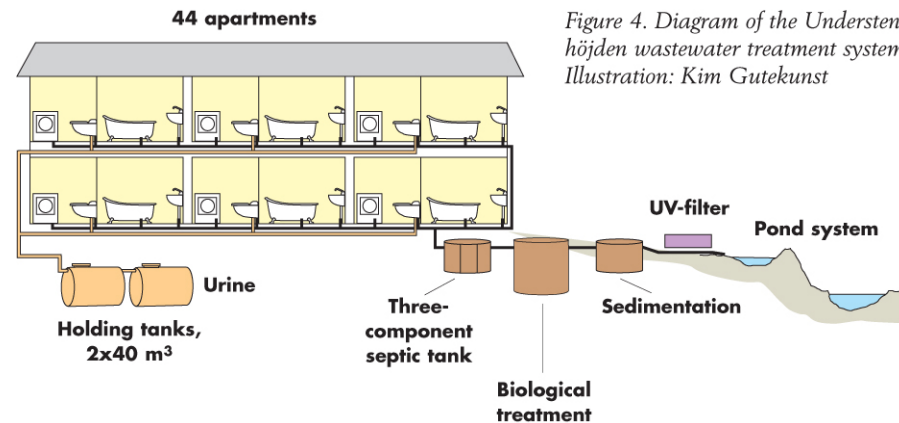


Figure 4. Diagram of the Understenshöjden wastewater treatment system.
Illustration: Kim Gutekunst

URINE CAPTURE

Portable toilets and urinals, France



URINE CAPTURE

Krons Urinal for men and women



URINE CAPTURE

Krons Urinal - Amsterdam



URINE CAPTURE

Unique Urinals



URINE CAPTURE

Urinal for women



FORK TO FIELD

Productive Sanitation

Agriculture is historically linked with human derived fertilizers.

For centuries, farmers replaced the organic matter and nutrients, removed from the soil through harvested crops, with human excreta.



Night Soil Collector, China



Night Soil Distribution,
China, 1994



Biosolids Distribution, USA

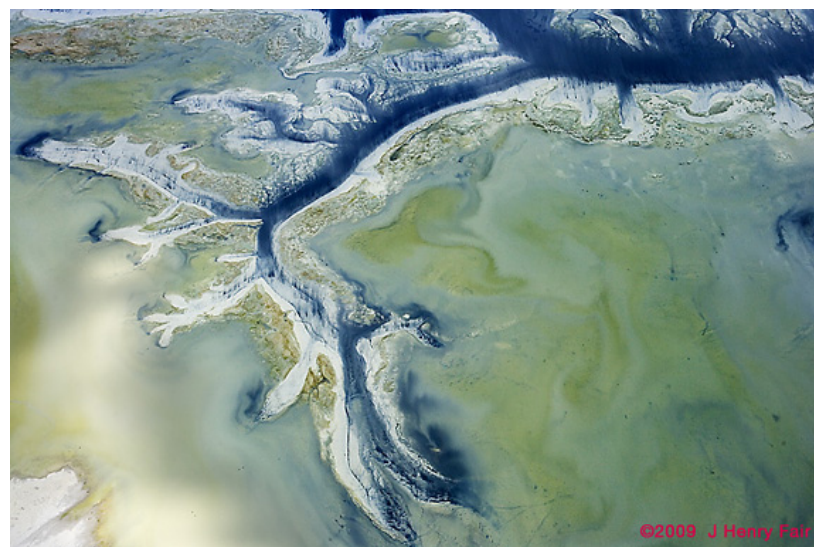
FORK TO FIELD

Urine Nutrient Cycling – Benefits to Environment

- Reduces dependence on synthetic nitrogen fertilizer
- Alleviates dependence on finite phosphorus reserves and impacts from phosphorus mining operations.



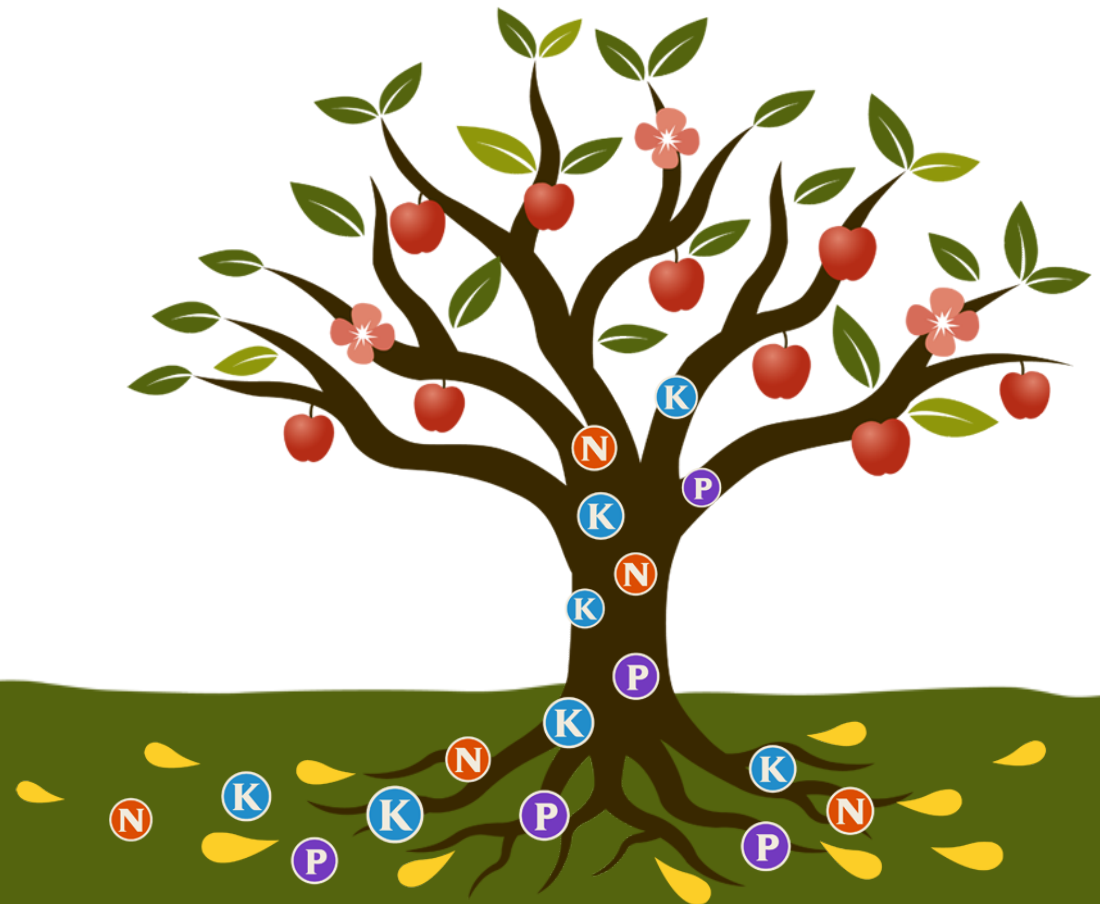
New \$1.8 Billion Fertilizer Plant, Iowa



Phosphate Fertilizer Mining Waste, Florida

URINE BENEFITS TO AGRICULTURE

The composition and bioavailability of nutrients in urine makes it a viable fertilizer for plants.

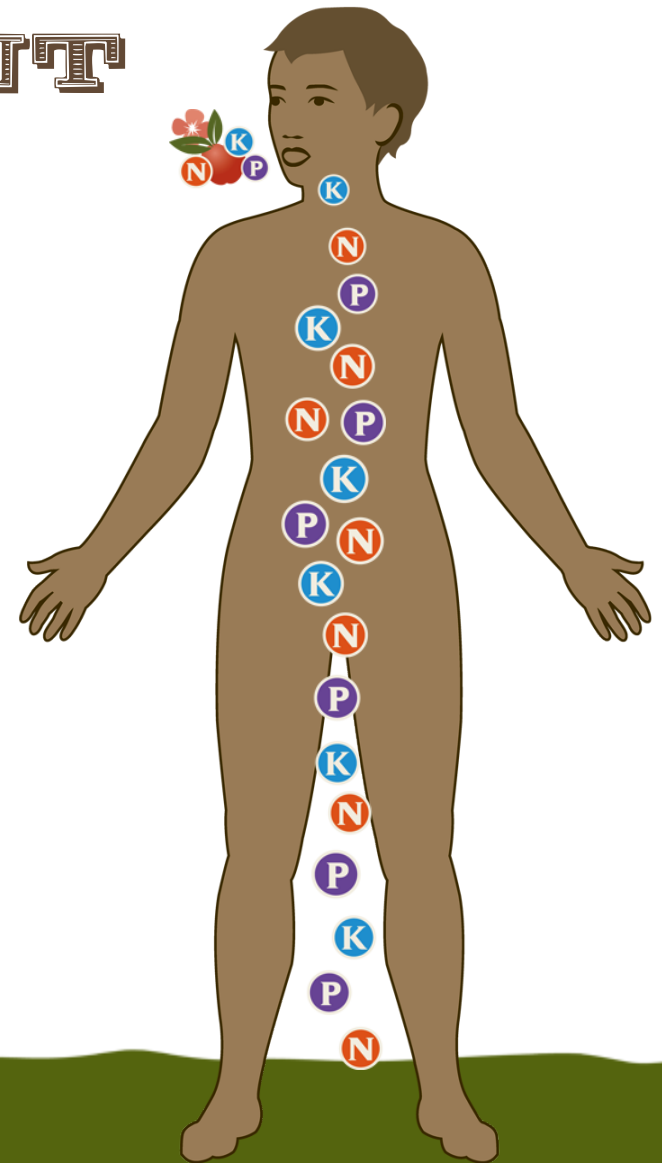


HUMAN NUTRIENT CYCLE

A person releases an estimated 1.5 liters of urine a day.

Each liter contains an estimated 5g of nitrogen.

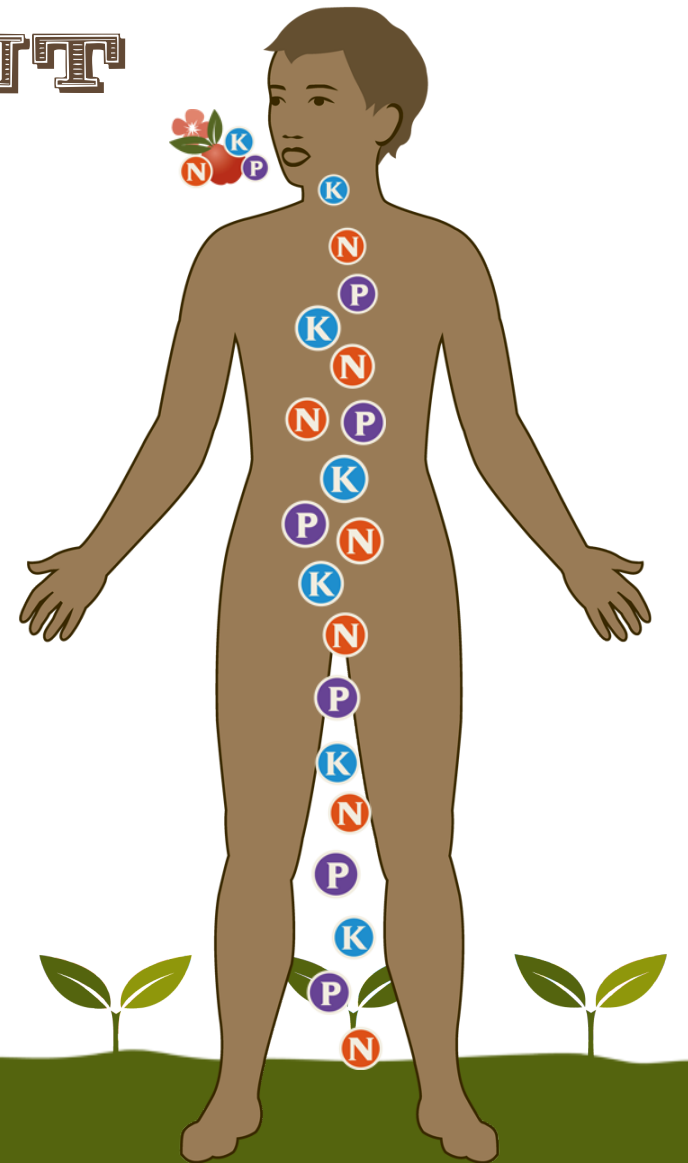
Each person produces about 6lbs of nitrogen a year.



HUMAN NUTRIENT CYCLE

One person's urine can fertilize about .09 acres/year, depending on the crop.

If all of one's urine was captured over the year, it could fertilize enough crops to meet 60-90% of one's annual food needs.



URINE BENEFITS TO AGRICULTURE

Primary Macronutrients - NPK

Nitrogen (N)

Phosphorus (P)

Potassium (K)

Secondary Macronutrients

Sulphur (S04-S) Calcium (Ca)

Magnesium (Mg)



URINE BENEFITS TO AGRICULTURE

Urine NPK levels will vary depending on diet and exercise

In its original state, with 95% water, urine's average NPK is
0.5 : 0.15 : 0.22

Evaporating the water would result in a dry weight NPK of
10 : 3 : 4



URINE BENEFITS TO AGRICULTURE

Urine volume compared to Chicken Manure

Application rate 180lb N/acre

Urine NPK 0.5 : 0.15 : 0.22 = 4300 gallons/acre

Chicken Manure NPK 3:2:2 = 6000 lbs/acre

Urine dried NPK 10:3:4 = 1800 lbs/acre



URINE BENEFITS TO AGRICULTURE

Urine also contains **micronutrients**, essential for plant growth, but usually missing in fertilizers:

Boron (B)

Chlorine (Cl)

Copper (Cu)

Iron (Fe)

Manganese (Mn)

Molybdenum (Mo)

Zinc (Zn)



URINE BENEFITS TO AGRICULTURE

Urine Composition

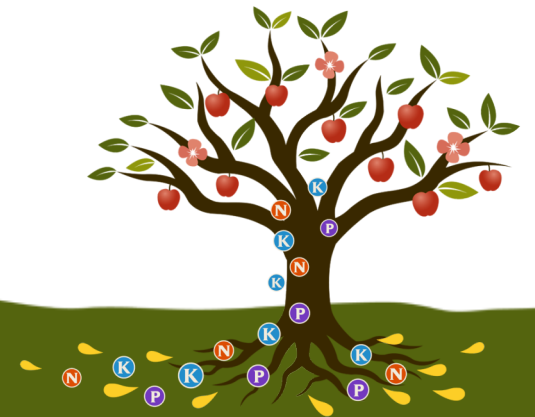
DAY 1

75-90% urea
10-25% ammonium and creatinine

DAY 2

75-90% urea converts to ammonium and carbon dioxide
10-25% ammonium and creatinine

The phosphorous and potassium are in ionic forms which can be readily taken up by plants.



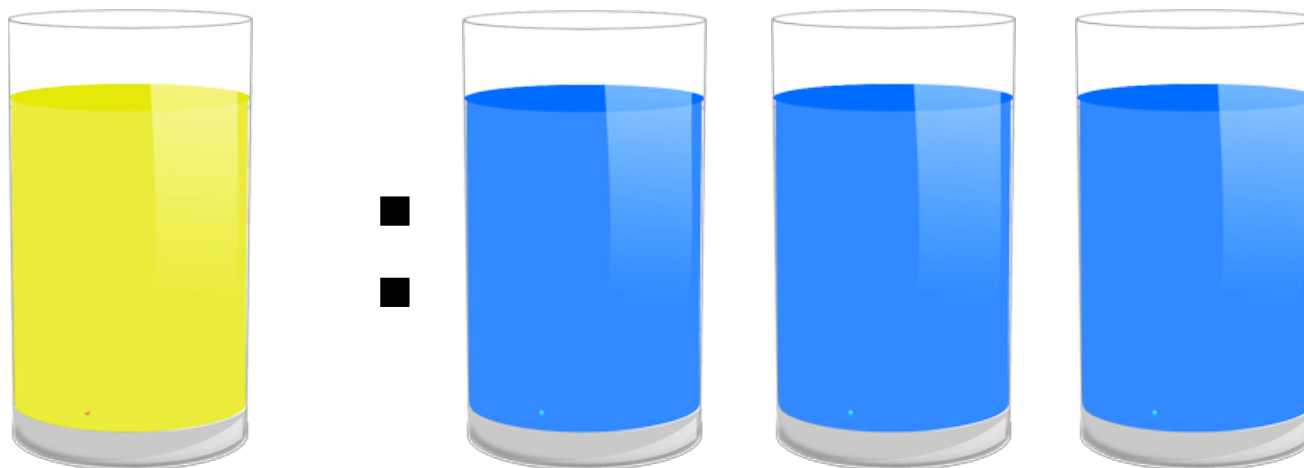
URINE APPLICATION

Dilution Rate

Urine can be applied neat or diluted, depending on the crop and the timing.

Dilution rates range from 1:1 up to 1:15 urine to water ratio.

A 1:3 ratio is the most common.



URINE APPLICATION

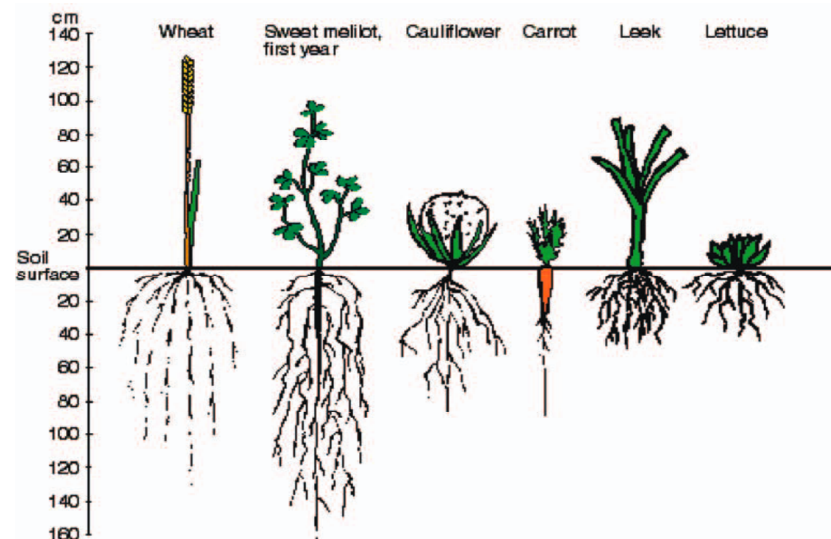
Rate of Application

Frequency depends on plant, its root size and soil

Apply at seeding time or disperse between seeding up to 30 days prior to harvest

Multiple smaller applications are good for:

- Sandy or fast draining soils
- During periods of heavy rainfalls
- Plants with small root systems such as lettuce and carrots



URINE APPLICATION

Method - Feed the Soil: Farm Scale

Urine should be incorporated into the soil as quickly as possible, to minimize ammonia volatilization.

For farm scale, equipment like this slurry spreader could be used.



URINE APPLICATION

Method - Feed the Soil: Small Scale

For small scale/garden scale, urine should be applied in a small furrows or holes near but not touching the seed or plant.

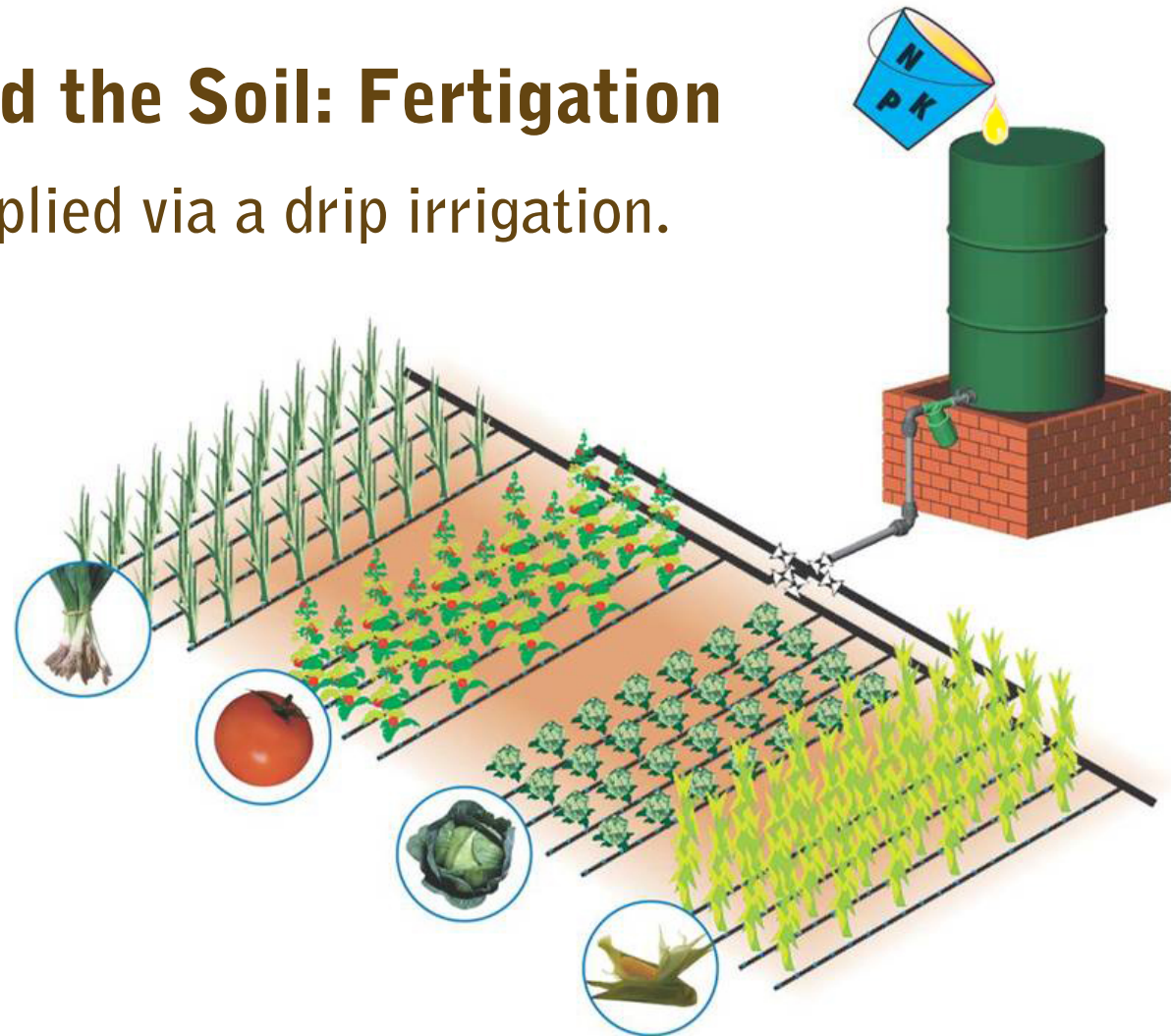


Towa Urinal Watering Can

URINE APPLICATION

Method - Feed the Soil: Fertigation

Urine can be applied via a drip irrigation.



URINE APPLICATION

Storage in Mulch

The urine can be “stored” in woody mulch (3” or more deep). The high carbon mulch will slow the release of the nitrogen.



FAQs

Pathogens

Urine is primarily sterile when it exits the body. Any potential pathogens can be eliminated through extended storage, in an air tight container, for 6 months, at 68F.

When the urine is used on personal plots, no storage is needed.

WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 4: Excreta and greywater use in agriculture. World Health Organization, Geneva, Switzerland, 2006



FAQS

Pharmaceuticals

“The micro-pollutants can be degraded better in the aerobic, biologically active soil layers with long retention times than in water bodies whose ecosystems are much more sensitive.”

Richert, A., R. Gensch, H. Jönsson, T.-A. Stenström, L. Dagerskog, with contributions from: M. Kjellén et al. (2010). Practical Guidance on the Use of Urine in Crop Production. SEI, EcoSanRes series: 2010-1.



FAQS

Salts

Urine is a solution of salts, and salt stress can be a major constraint to plant production in arid areas.

Given the high degree of precipitation in the Pacific Northwest, the concentration of soluble salts in urine should not be a problem.



FAQs

Metals

To a small extent urine contains trace metals.

The amount of harmful heavy metals in urine is miniscule and much lower than in wastewater sludge or even farmyard manure.

WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 4: Excreta and greywater use in agriculture. World Health Organization, Geneva, Switzerland, 2006





THANK YOU

