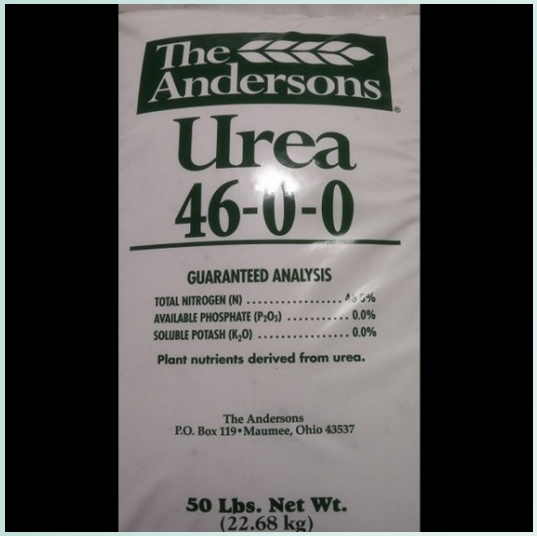
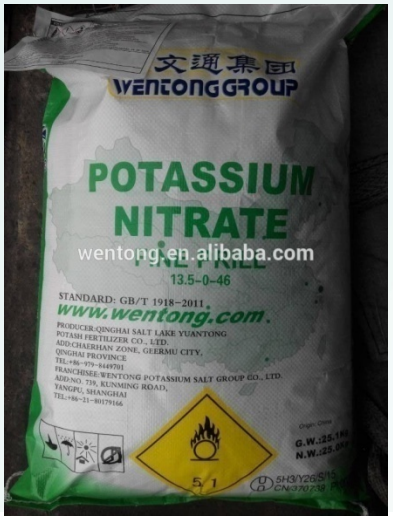
Nutrient Source for Organic Farming

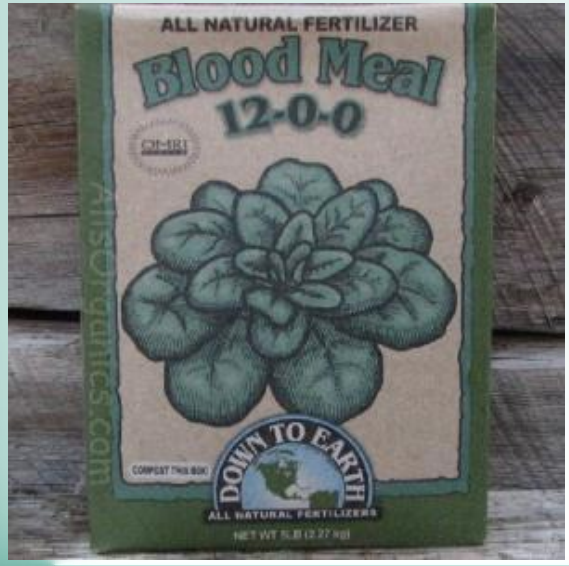
Amjad A. Ahmad, PhD
University of Hawaii at Manoa
alobady@hawaii.edu

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Fertilizer Type: Synthetic vs. Organic







Tankage

Fertilizer Application Calculation:

Apply 50 Lb. of Urea vs 50 Lb of nitrogen from Urea, Blood meal (12% N) and Sustane 8% N)

1) 50 lbs. of Urea/acre.

2)

100 50

X 50; 5000 = 50X; X = 100 lbs. of Urea.

3)

100 12

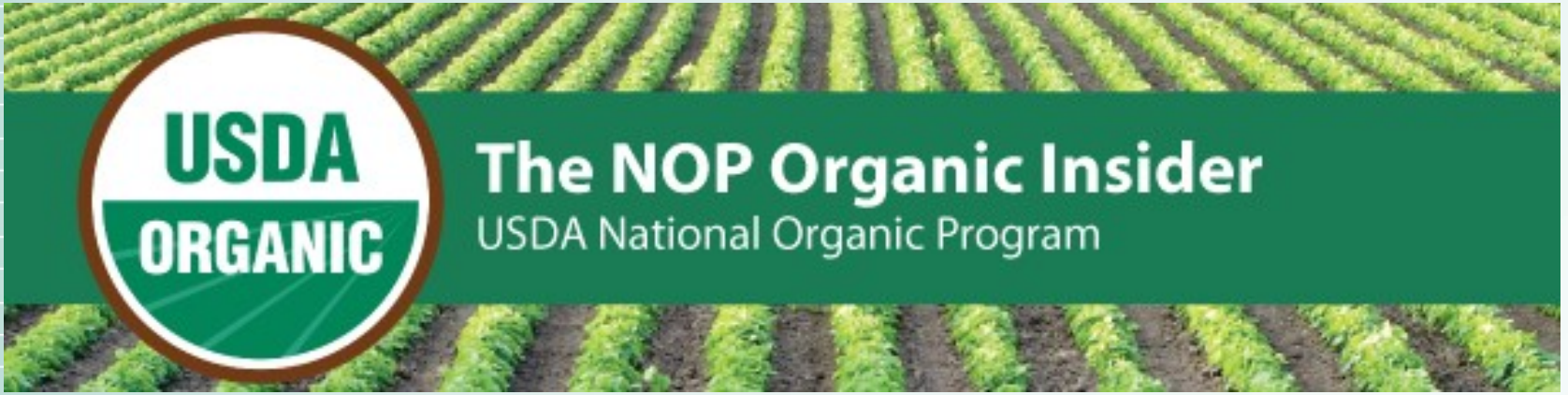
X 50; 5000 = 12X; X = 416 lbs. of Blood Meal.

4)

100 8

X 50; 5000 = 8X; X = 625 lbs. of Sustane.

What to use in organic farming?



NOP =
National Organic Program

OMRI =
Organic Materials Review Institute

products available
OMRI
LISTED
For Organic Use

Local Inputs

Composts

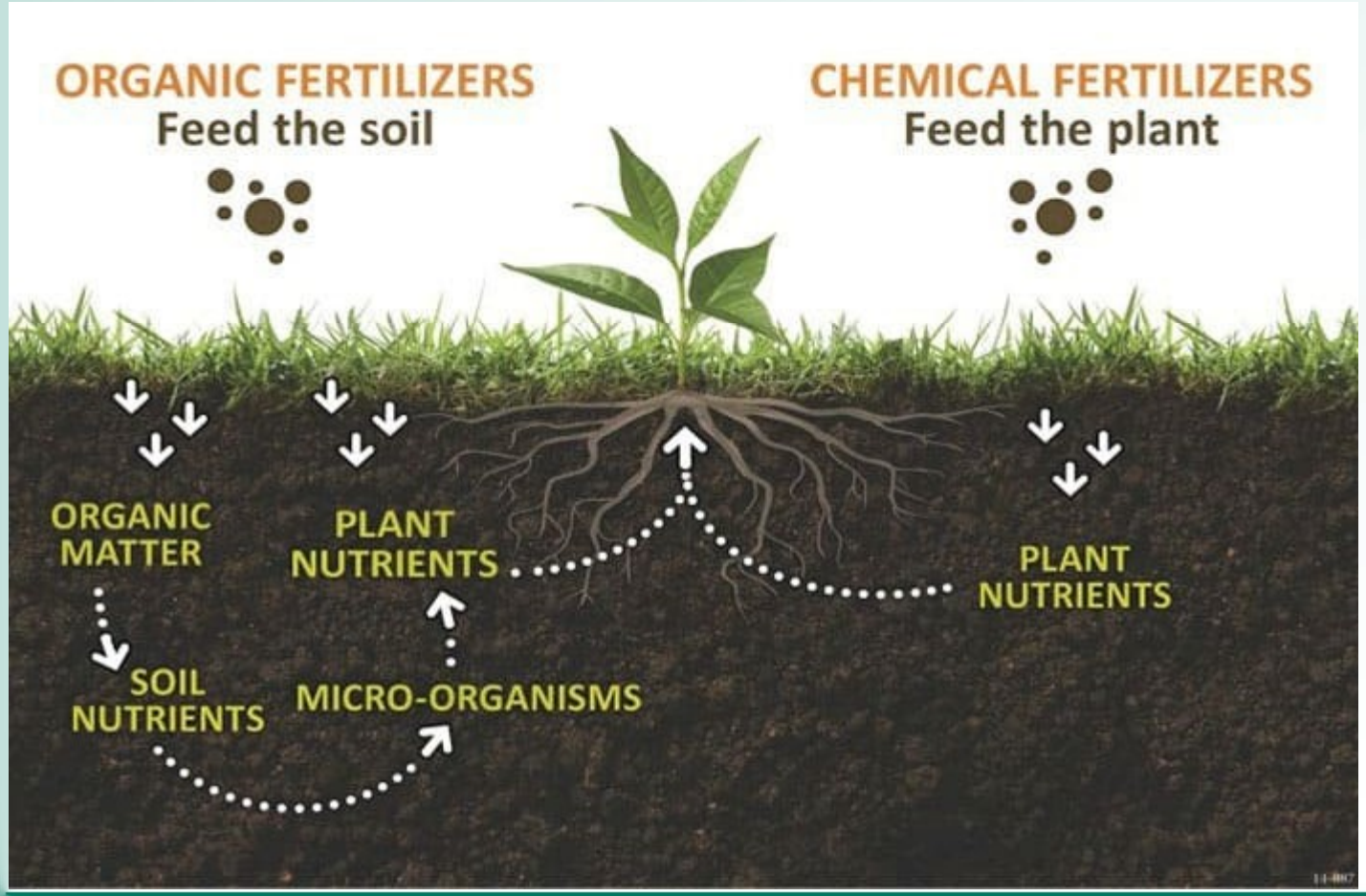
Tankage

Biochar

Invasive algae

Soil Health and Organic Fertilizers:

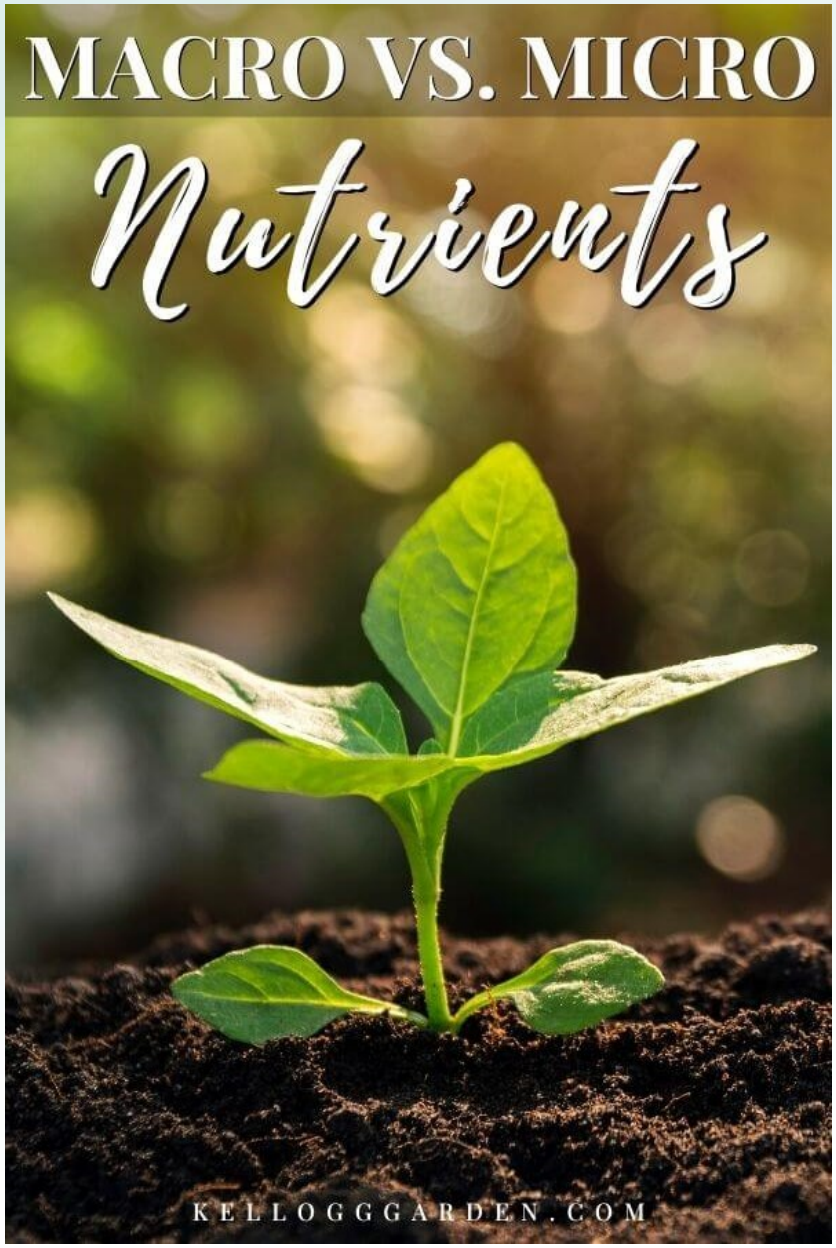
Nutrient release/availability for plant uptake from organic fertilizers is linked with soil micro-organisms/soil health.



Macro- & Micro-Nutrients:

Macro-nutrient are required by the plant with large quantities for optimum function, growth, and yield.
N, P, K, Ca, Mg, and S.

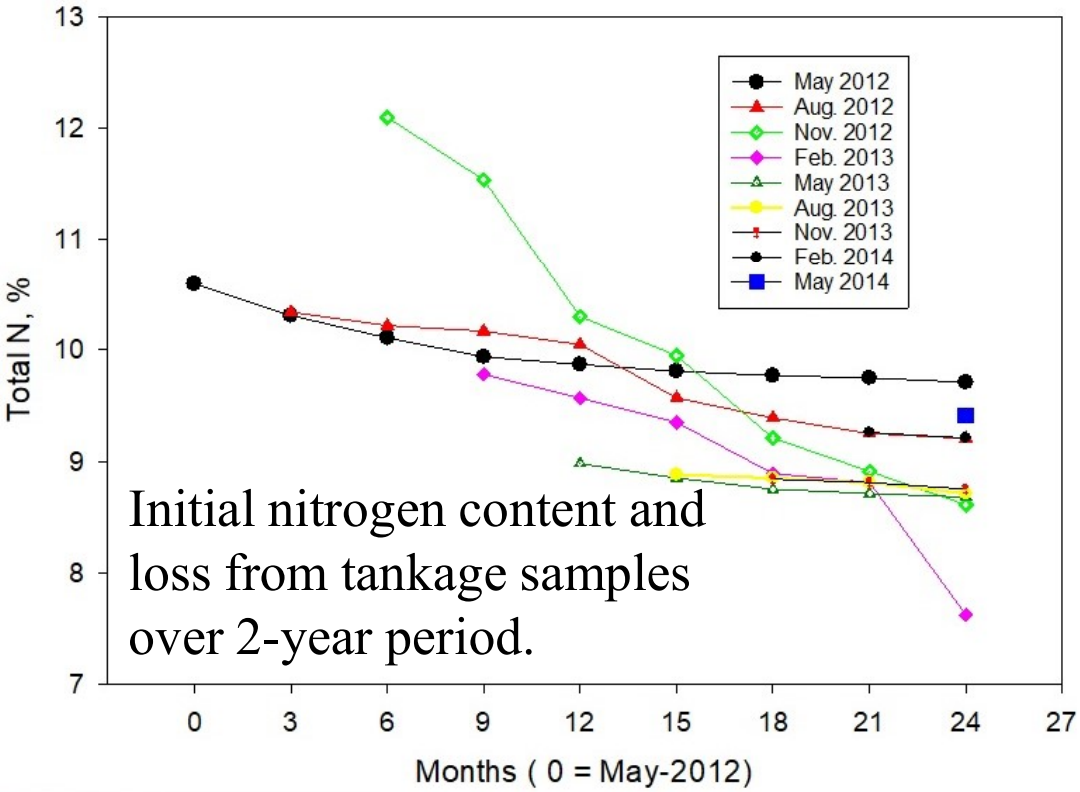
Micro-nutrient are required with small quantities for optimum function, growth, and yield.
Fe, Mn, Cu, Zn, B, Cl, and Mo.



Source of Nitrogen (N) for Organic Farming

Meat & Bone Meal (tankage):

- Approved for Agriculture
- Produced Locally
- N-P-K = 10-3-1 & C:N Ratio: 5:1



Initial nitrogen content and loss from tankage samples over 2-year period.

Locally produced meat and bone meal by-products (tankage).

Tankage-Nitrogen Application Table

Nitrogen (N) (lb/acre)	Tanakage (lb/acre)	Phosphorus (P) (lb/acre)	Potassium (K) (lb/acre)	Applying
50	665	20	6.50	All other macro- & micro-nutrient
100	1,335	40	13.50	
150	2,000	60	20.00	
200	2,665	80	26.50	
250	3,335	100	33.50	
300	4,000	120	40.00	

- Calculations in the table were made based on 75% nitrogen (N) mineralization rate and 10% N in tankage.
- Simple cross-multiply to calculate the application rates of N from tankage.
- 10% N in tankage is among the highest N content in most available organic fertilizers.

Importance of Liquid Fertilizer:

- Provide nutrient for immediate uptake.
- Suitable for long-term crops.
- Suitable for mulching.
- Suitable for drip-irrigation.

Liquid Organic Fertilizer:

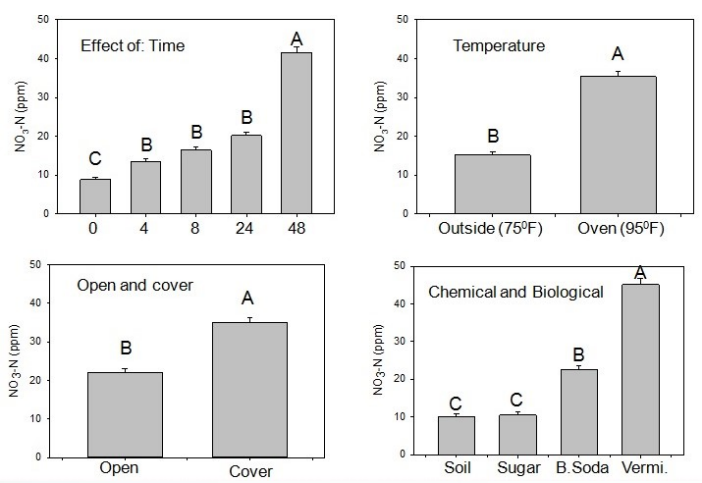
- Situation:

There's a need for liquid organic fertilizer, with high nitrogen content, that local growers can make on their own.

Tankage produced locally, relatively cheap & high N content

Time, temperature, cover & other agents were tested

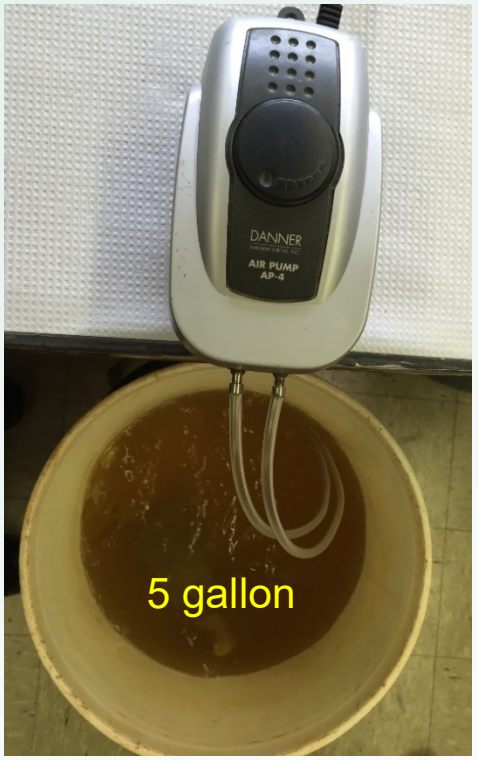
Recipe for high NO_3-N liquid organic fertilizer was achieved



Liquid Fertilizer from Tankage:

Liquid organic fertilizer recipe:

- 1.5 lbs of tankage into 10 gallon water.
- Add about 1 ounce vermicompost.
- Air for 12-24 hours.
- Strain & apply with drip irrigation.

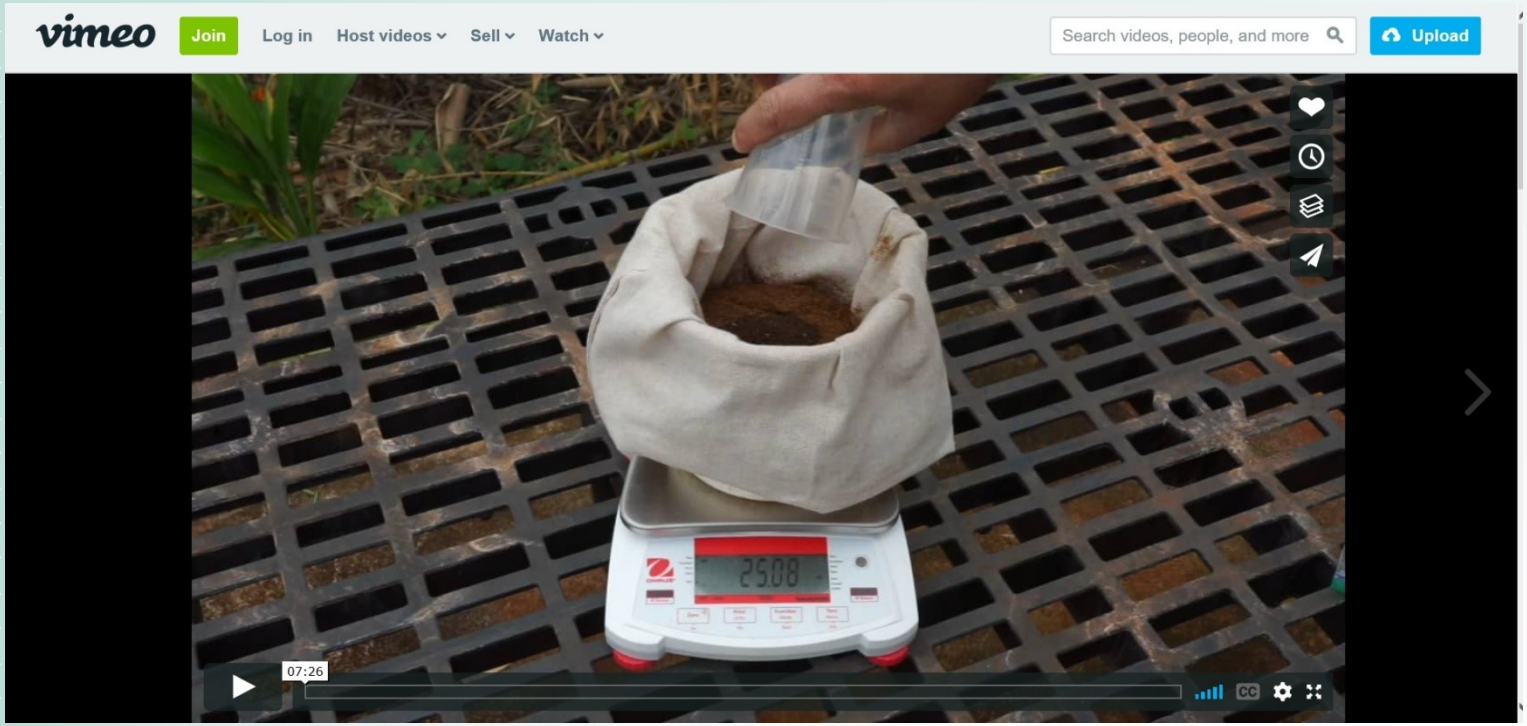



Cotton Shopping Bag


250 gallon

Video on how to make your own liquid organic fertilizer:

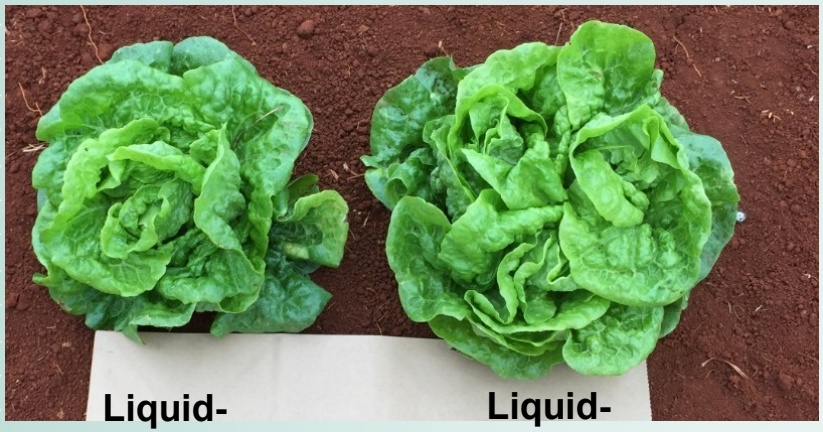
Vimeo Link: https://vimeo.com/245473495

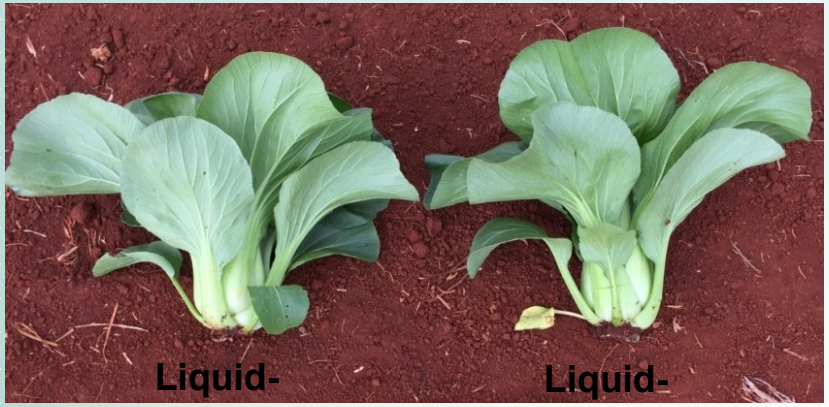


Please note:

- The liquid organic fertilizer is meant to be as a supplemental application of nutrient and not main source.
- Do not spray the liquid organic fertilizer into plant foliar, since it has high nitrogen content.

Results-Lettuce, Pak Choi, and Daikon





Lettuce and Pak choi were harvested after 4 and 5 weeks of seedlings transplant, respectively

Daikon was harvested after 9 weeks of planting

Watermelon On-Farm Trial on Molokai:



	Fruit Peduncle End	BRIX/Sample Location				Blossom Calyx End	
Melon #	Weight (lbs)	1	2	3	4	5	**Average**
1	24	10.2	12.0	12.2	12.3	12.1	**11.8**
2	19	10.8	12.0	12.2	11.8	10.8	**11.5**
3	18	11.2	13.0	13.0	13.0	12.0	**12.4**
Average	**20.3**	**10.7**	**12.3**	**12.5**	**12.4**	**11.6**	

Blood Meal and Feather Meal:

Blood meal: Slaughtering houses blood waste. Feather meal: Poultry slaughtering houses

Animal Manure:

Table: Macro-nutrients in chicken and dairy manure collected in Hawaii

Manure type	Percentage (%)						
	N	C	P	K	Ca	Mg	Na
Chicken	3.0	21	1.5	1.9	14	0.7	0.4
Dairy	1.8	15	0.5	1.8	2	1.0	0.5

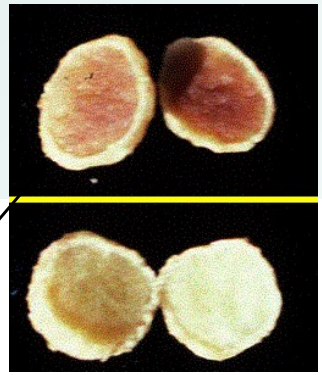
Factory Processed Animal Manure:

Concentrated nutrient content in processed animal manures.

Nitrogen fixing Rhizobium Bacteria (Biofertilizer):

76% of air is N, but it must be "fixed" in order to be available to plants.

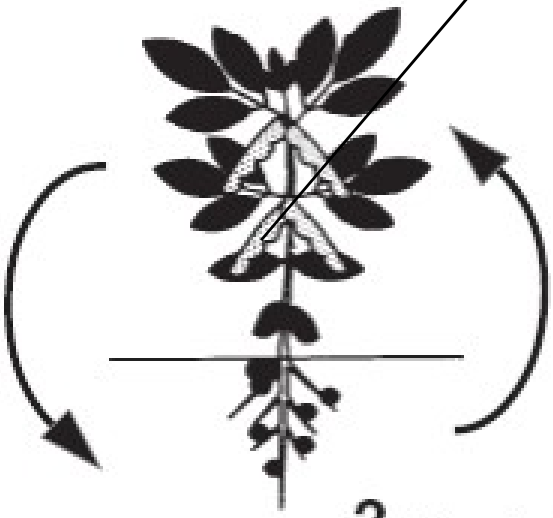
N fixation by bean plants



Fixing

Not Fixing

1 Carbon dioxide, water, and solar energy fuel plant photosynthesis



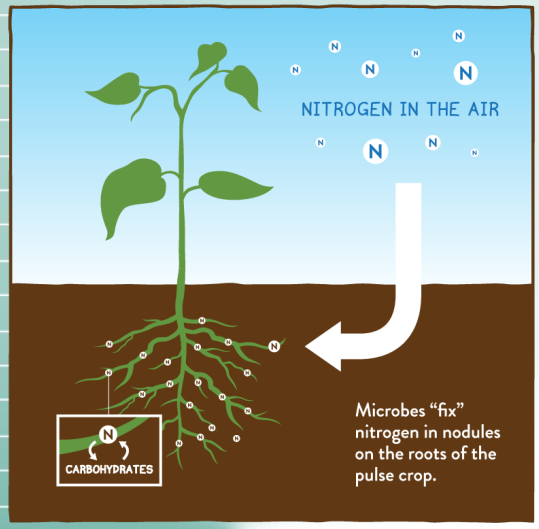
2 Products of photosynthesis from the plant fuel N_2 fixation by rhizobia in root nodules

4 Fixed N in the form of ammonia produced by rhizobia is used by the plant

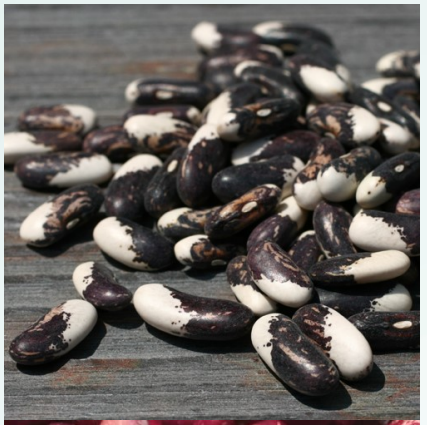
3 N_2 gas in the air is "fixed" by rhizobia

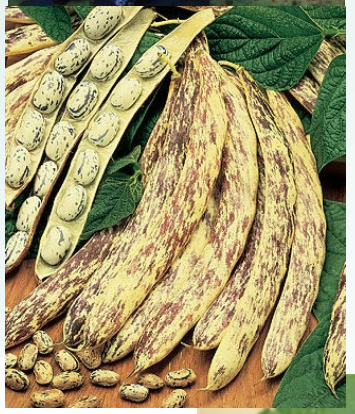
Nitrogen fixation with various Rhizobia strains:

Grain legume	N-fixing ability (kg ha^{-1})
Soybean (*Glycine max*)	71–108
Pea (*Pisum sativum*)	90–128
Pigeon pea (*Cajanus cajan*)	120–170
Lentil (*Lens culinaris*)	8–14
Rice bean (*Vigna umbellata*)	13–30
Cowpea (*Vigna unguiculata*)	14–35
Faba bean (*Vicia faba*)	23–79
Common bean (*Phaseolus vulgaris*)	20–60
Groundnut (*Arachis hypogaea*)	150–200
Chickpea (*Cicer arietinum*)	64–103
Mung bean (*Vigna radiata*)	19–54
Black gram (*Vigna mungo*)	16–79



New Project: Pigeon Pea & Bush Bean





Source of Phosphorus (P) for Organic Farming

Source of Phosphorus (P) for Organic Farming

Phosphate Rock:

The solubility of rock P is low, so its use requires some soil amending actions such as keeping relatively low pH or mixing the P rock with compost or other soil amendments before application.

Animal Manures:

Phosphorus in manures is usually between 1-5% and the release rate is relatively fast.

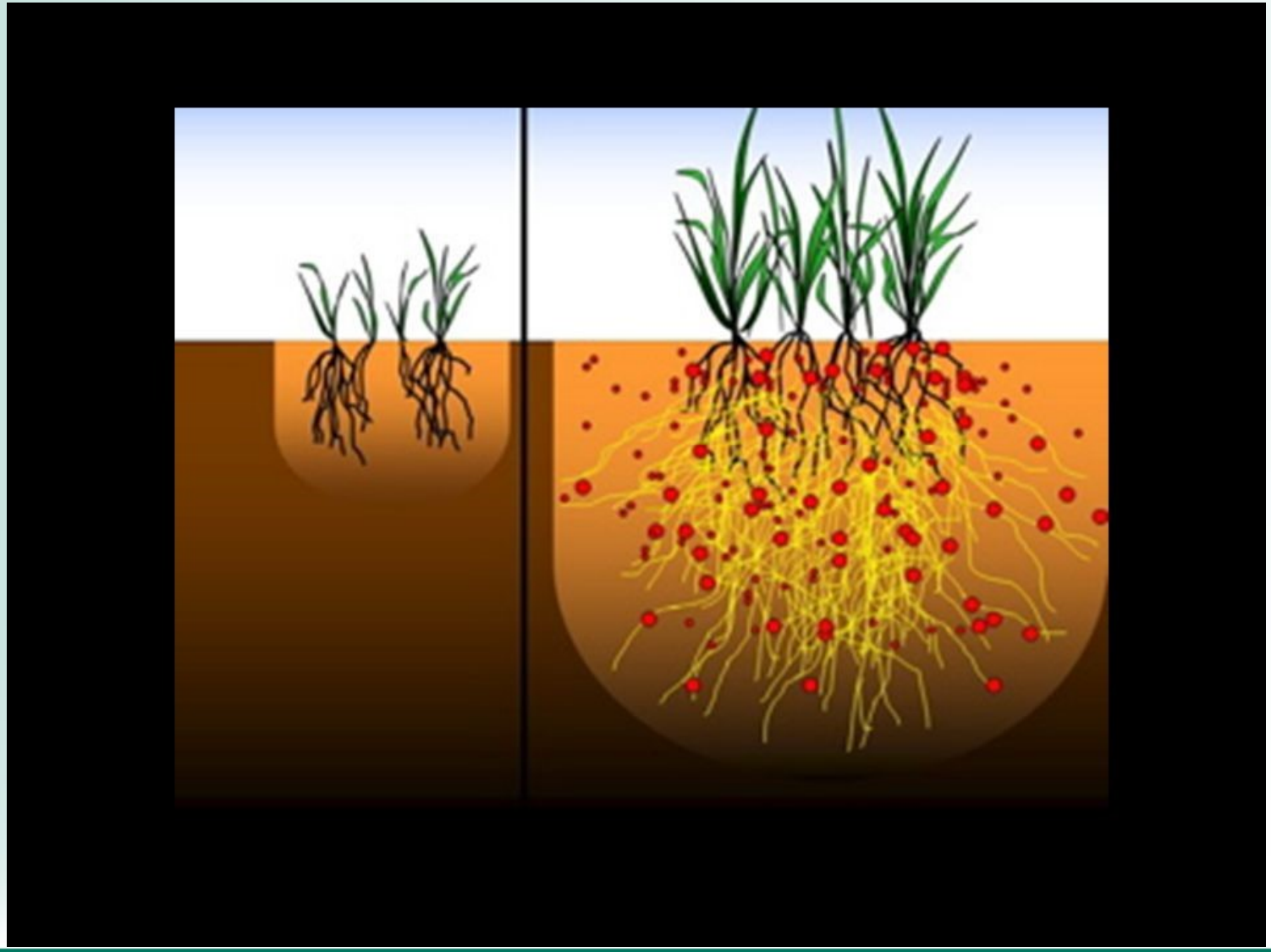
Poultry manure generally has lower N/P ratios than cattle manure due to its higher P content.

Green Manure and Compost:

In general most green manures are low in P content (0.2-0.5%).

In compost it varies based on the compost stock materials.

Biofertilizer (Mycorrhizae Fungi)**:**



Source of Potassium (K) for Organic Farming

Greensand:

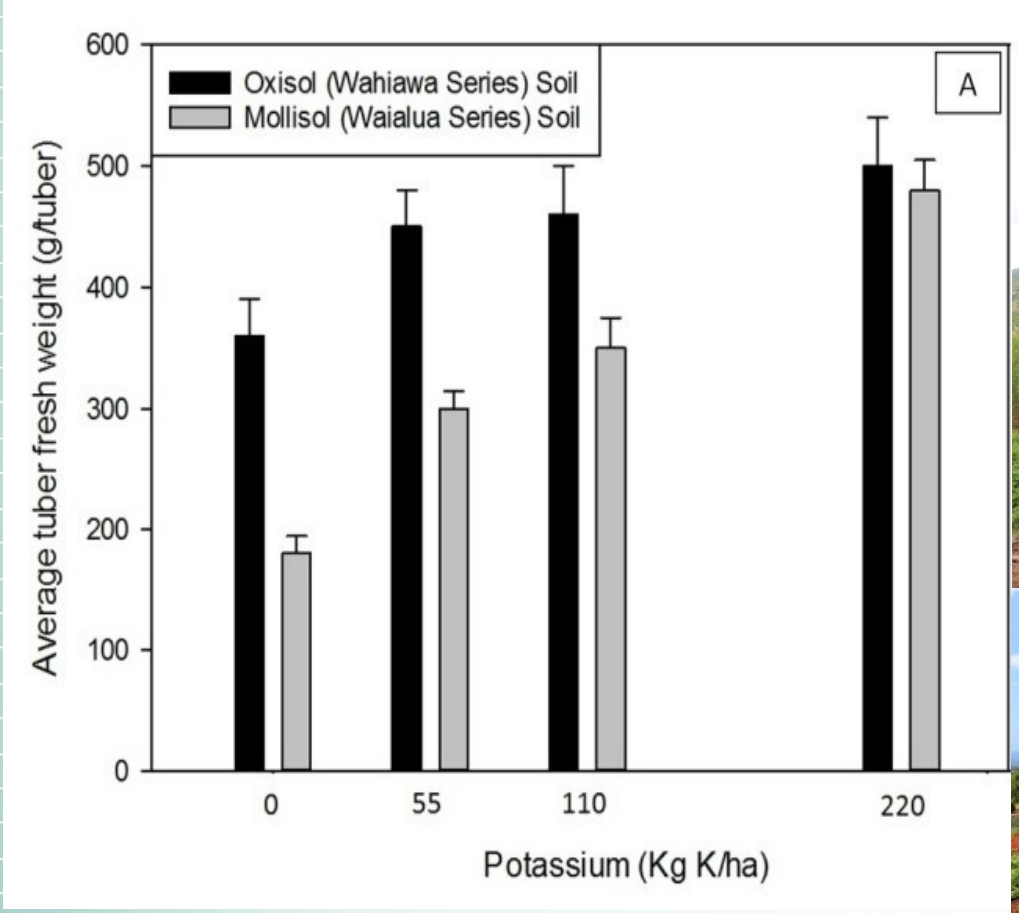
It's recommended as a natural K source (~5% K) for organic agriculture. However, K solubility is low.

Invasive Algae:

Species	Washed/ Unwashed	%			
		N	C	P	K
Ogo	Unwashed	1.4	20.4	0.11	**12.4**
Ogo	Washed	1.3	18.2	0.09	**9.1**
Eucheuma	Unwashed	1.0	21.1	0.07	**18.0**
Eucheuma	Washed	0.7	17.7	0.06	**16.9**
Kappaphycus	Unwashed	1.3	22.1	0.07	**14.8**
Kappaphycus	Washed	1.2	21.7	0.06	**14.1**

Evaluated washing on changes in nutrient & salt content.

Invasive Algae – Sweet Potato:



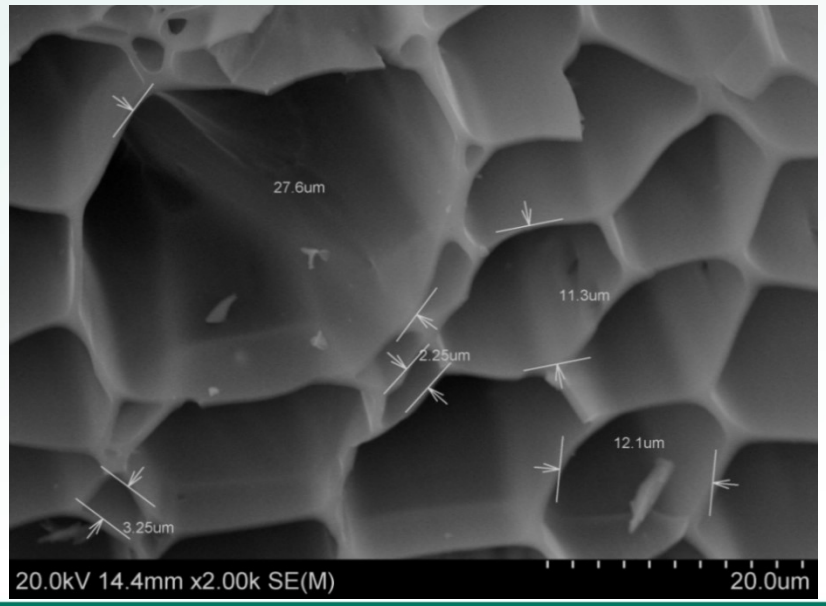
Sweet potato field trials using Algae as K source on Oahu

The effect of different Potassium (K) application rates (Kg K/ha) on average sweet potato tuber fresh (A) and dry (B) weight under Oxisol and Mollisol soils.

Biochar: organic materials (e.g., corncob, manure, scrapped wood) burned in the absence of or low oxygen.

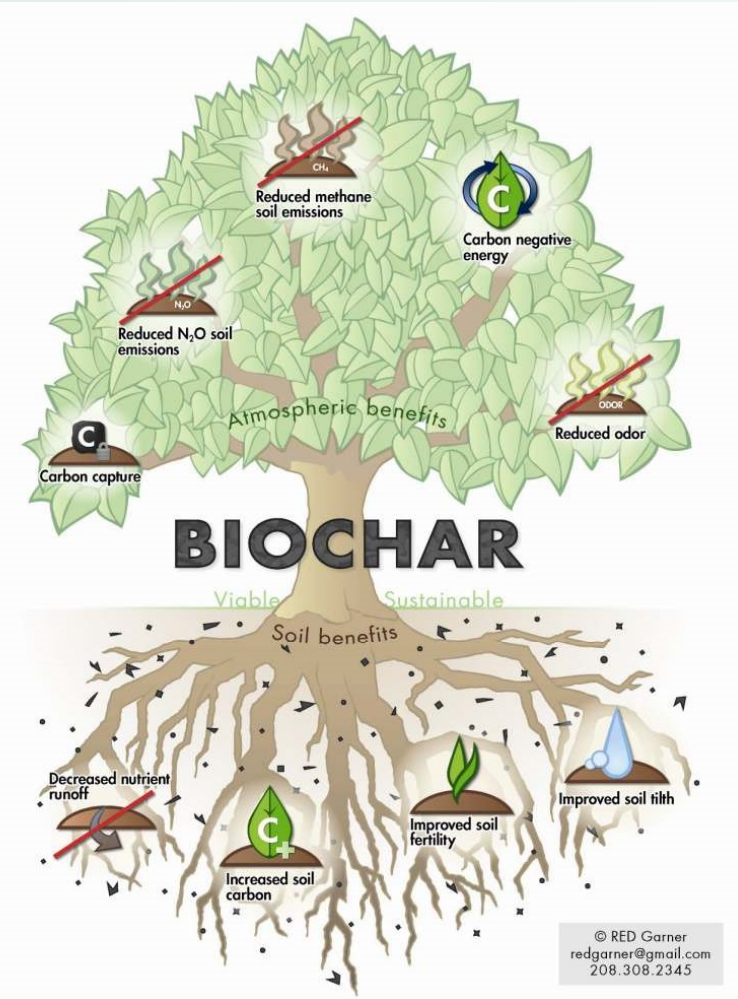
Properties and nutrient content vary with:

- Feedstock (e.g., manure vs. wood)
- Highest treatment temperature (e.g., 400 °C vs. 700 °C)



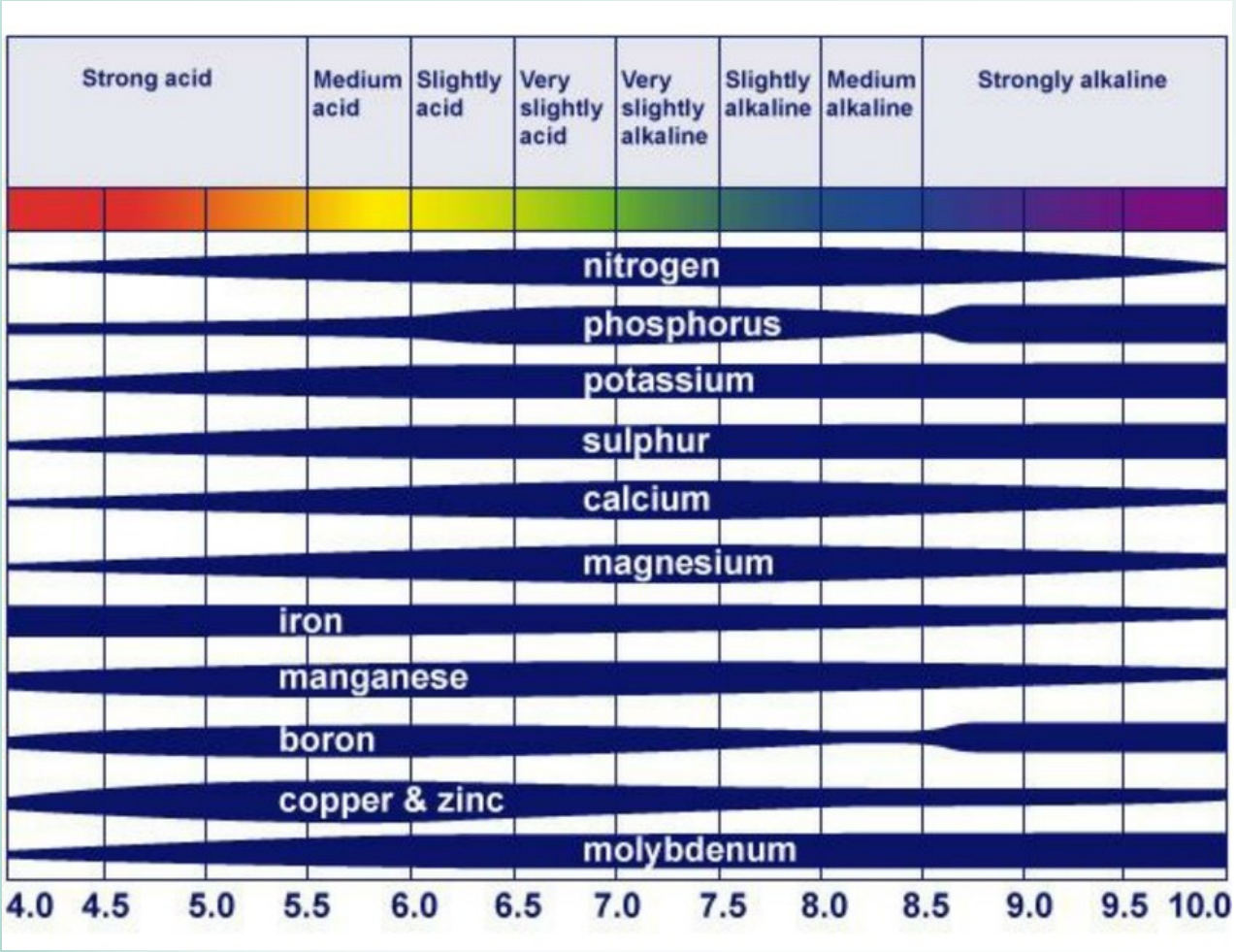
Biochar: A Soil Amendment

Biochar made locally from macadamia nut shell.



Reported to improve soil quality, nutrient balance, nutrient availability, soil water holding capacity & soil health, especially in low fertility, acidic & heavy clay soils.

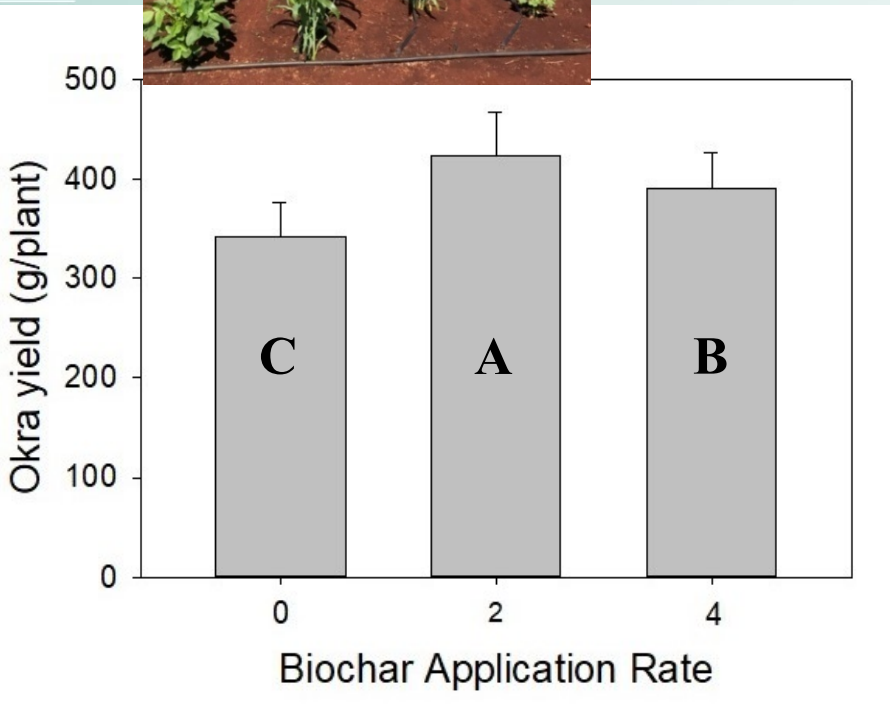
Soil pH & Nutrient Availability:



Limestone ($CaCO_3$)

Applications of Biochar in Field & Greenhouse Trials:

Okra, sweet corn & soybean crops in a field trial at Poamoho Research Station on Oahu.



Okra yield (g/plant) under different application rates of biochar.

Oka plant growing under different application rates of biochar.

Thanks for listening