College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa

Korean Natural Farming: Does it work? How does it work?

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Outline

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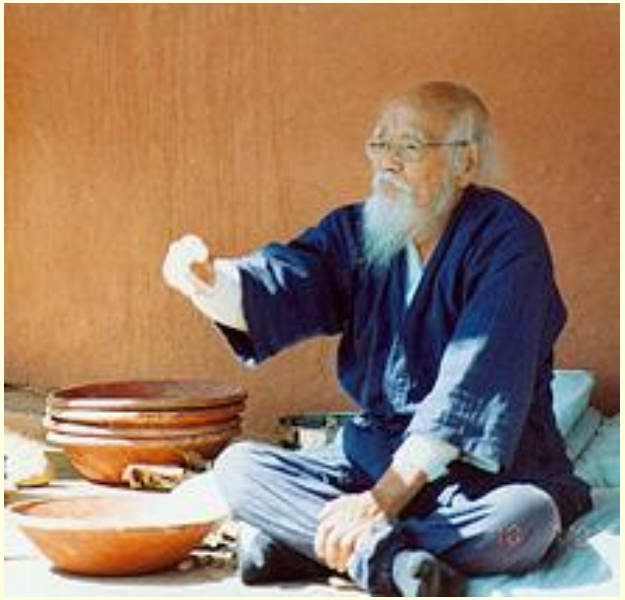
University of Hawaii at Manoa

- Introduction to Natural Farming
- How does Korean Natural Farming (KNF) work?
- Does KNF work?
- Cost comparison
- Challenges?

Natural Farming

Originate as an ecological farming approach established in Japan (Masanobu Fukuoka, 1913–2008). It is related to

- Organic farming
- Sustainable agriculture
- Agroforestry
- Ecoagriculture
- Permaculture

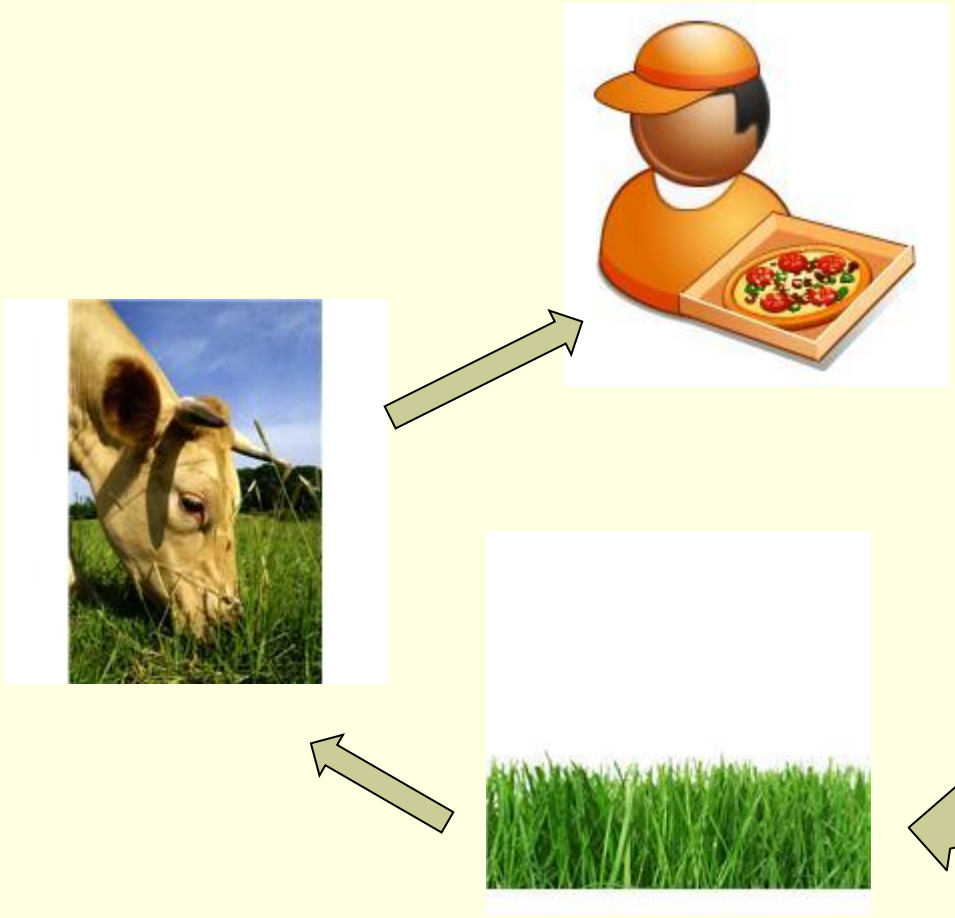


Masanobu Fukuoka

Principles of Natural Farming

- avoidance of manufactured inputs and equipment,
- exploits the complexity of living organisms that shape each ecosystem,
- “the cultivation and perfection of human beings”,
- close observation of local conditions,
- demands no inputs and mimics nature.

Food Chain



Biodiversity

Build the System

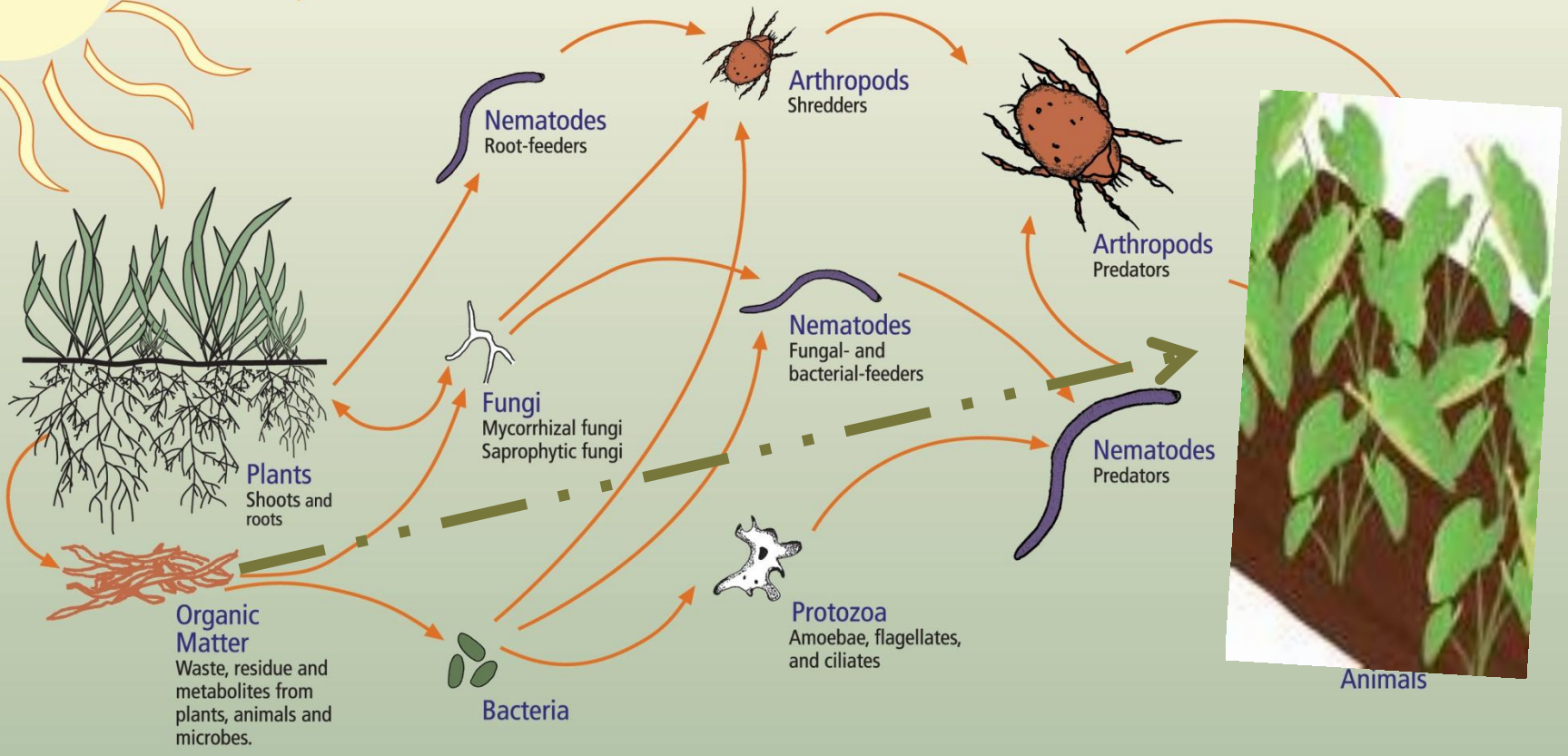
http://www.rodaleinstitute.org/20040401/Hamilton

"Now, few farmers import hawks to strengthen their farm ecosystems. You just can't insert something that high up the food chain and expect it to survive. Instead, build the system that supports it, and the hawks will come on their own" (Gil Caradang, a full time farmer in Phillipine, Full Bright Scholar).

Sugar, vodka, milk, garlic, mango, rice ….to cultivate microorganisms in compost piles or foliar sprays.

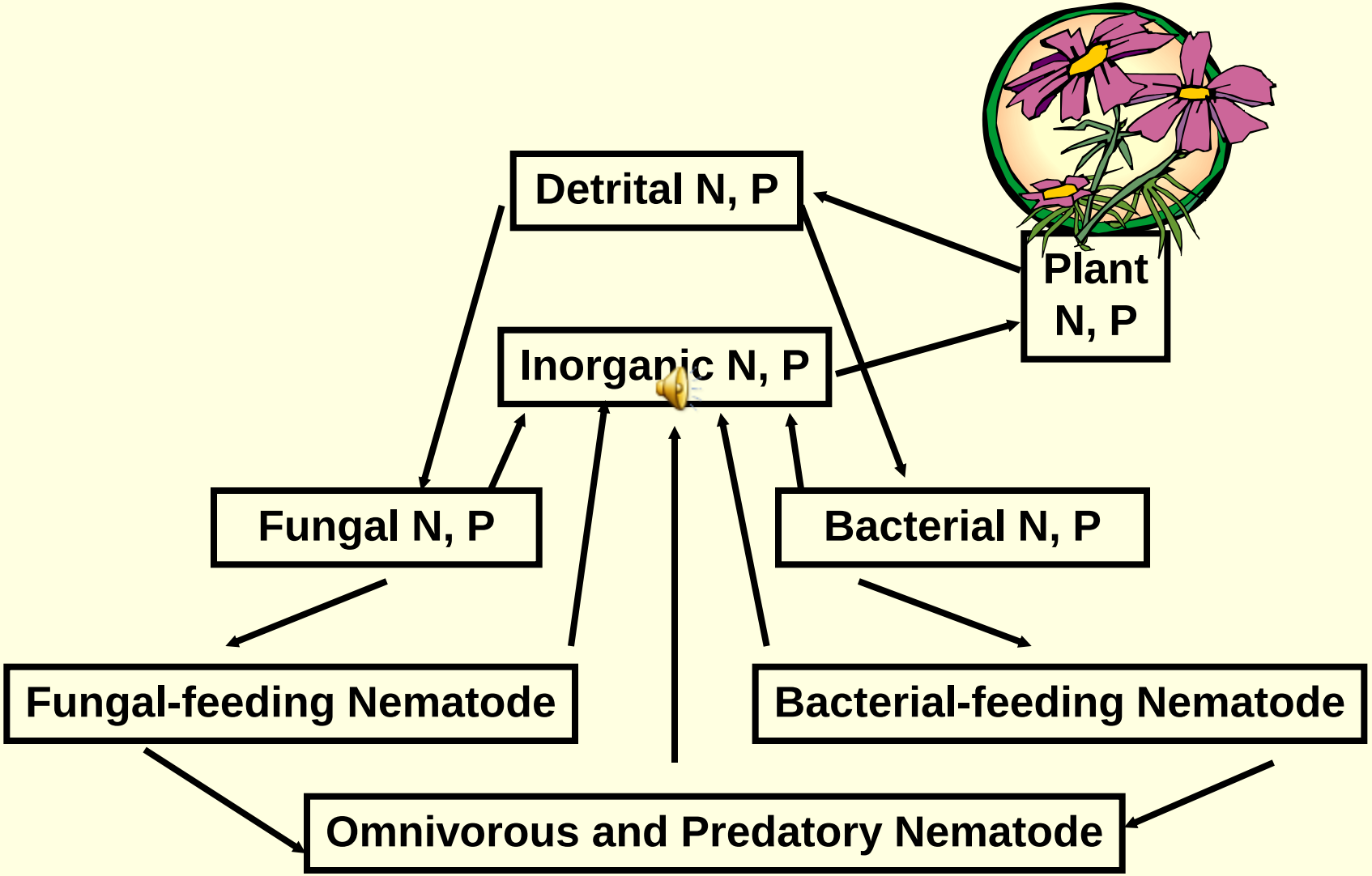
Biodiversity in Natural area vs Monoculture

Building the Soil Food Web in Agroecosystem



First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

Soil Nutrient Cycling



(modified from Ingham *et al*., 1985)

Basic Theories of Korean Natural Farming

Master Cho
(Han-Yu Cho)

- Use of indigenous microorganisms (IMOs)
- Maximize the potential of natural environment
- Minimize the use of synthetic fertilizers
- Practice no till
- Eliminate emission of livestock waste effluent
- Increase production with less inputs

Benefits of KNF

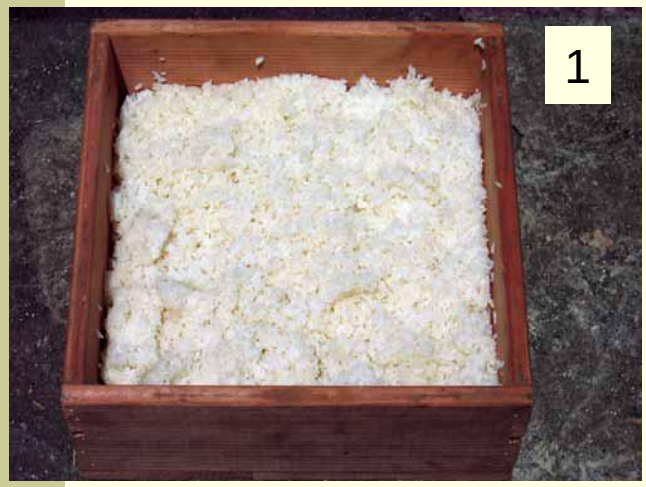
- Lower costs to the farmer (by as much as 60 %)
- More desirable crops
- Stronger, healthier and more nutritious plants
- Higher yield
- Better quality
- Farmer friendly
- Zero waste emission
- The inputs are made from natural materials, which are not only safe for the environment, but actually invigorate and rehabilitate the ecology.

(Han-Yu Cho, J. Prell)

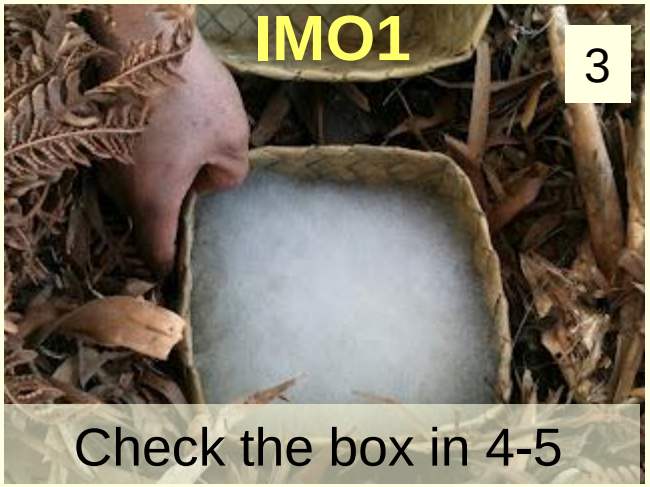
How does it work?

1. Soil treatment: Indigenous microorganisms
   - Make your own IMO4
2. Foliar spray: nutrients inputs

How to prepare IMO4?



2/3 full steam rice in a box



Check the box in 4-5 days for white mold

Seal with paper towel.
Container 2/3 full.
Ferment for 7 days

Cover the rice box and scattered with bamboo leaves

Add brown sugar 1:1 (w/w)

How to prepare IMO4?

Under shade, soil underneath

6

2 oz IMO2 + 60 lb mill run + 5 gal water (with 120 ml of SES)

Compost for 7 days, < 110°F

8

7

IMO3 + field soil + soil from natural area (2: 1: 1) + 5 gal water (with 120 ml of SES), cover and composted for ~7 days.

9

How to apply IMO4?

30 lb IMO4 + soil treatment solution (SOS) /1000 ft^2

How does it work?

1. Soil treatment: Indigenous microorganisms
   - Make your own IMO4
2. Foliar spray: nutrients inputs

- BRV: brown rice vinegar
- FPJ: fermented plant juice
- LAB: lactic acid bacteria
- FAA: fish amino acid
- OHN: oriental herb nutrients
- WCAP: water soluble Ca-Phos
- MA: Mineral A
- SW: sea water

Benefits of Foliar Nutrient Inputs

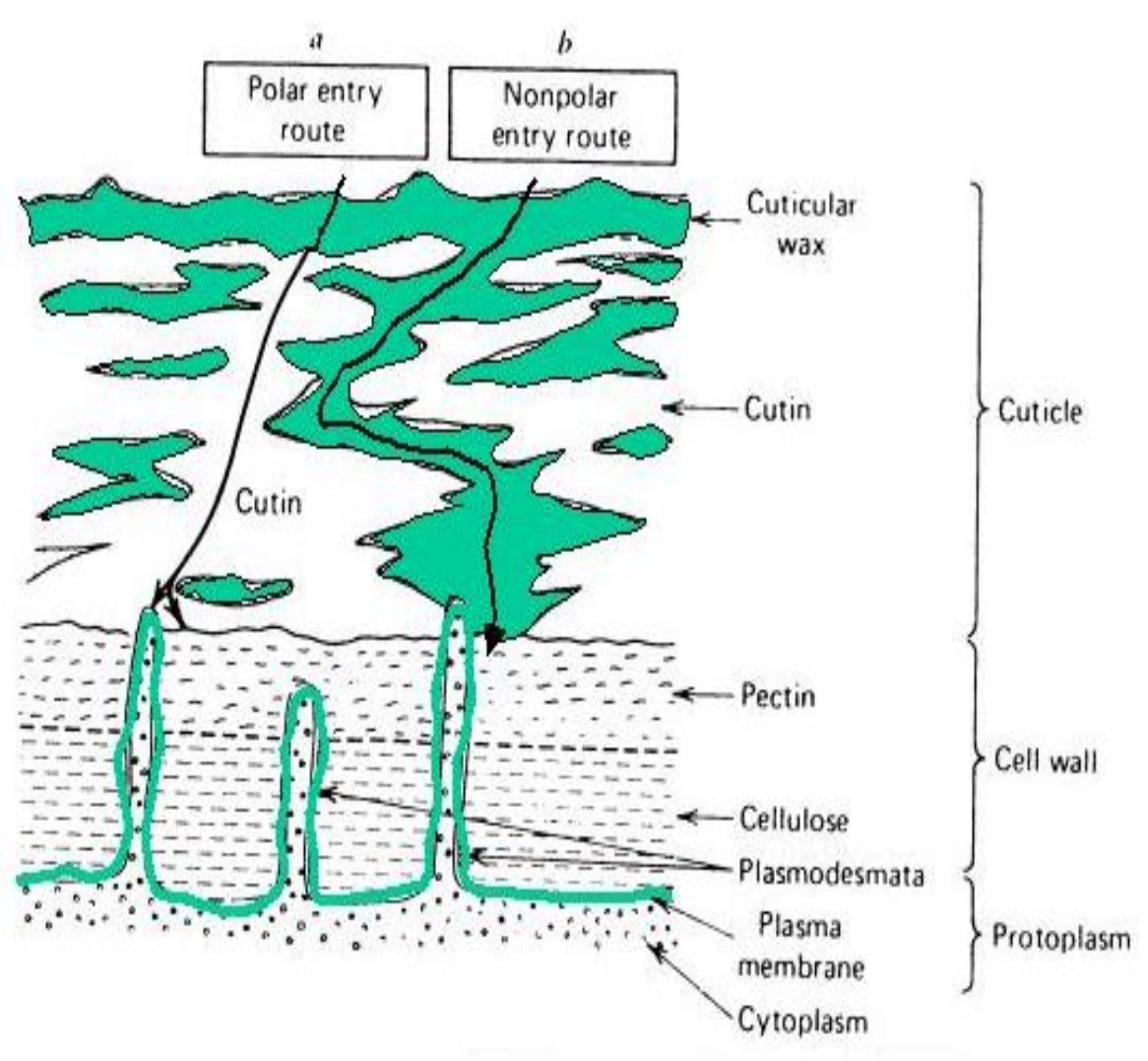
- Benefit young seedlings with small root system;
- Reduce the amount of N application;
- ❖ Minimize N runoff, more environmental friendly.
- Grower can modify the nutrient inputs accordingly

Algae bloom

Draw back:

- response to foliar sprays is often variable and not reproducible

How does foliar spray be absorbed by plant cells?



- More absorption during late afternoon or evening.
- More absorption on young growth than old leaves (more waxy cuticle).
- Absorption also varies by crop type.

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Testimonies Regarding the Benefits of KNF

Web resources in Hawaii:

- Hawaiian Homegrown Food Network: http://hawaiihomegrown.net/reports/97-natural-farming-primer
- Richard Ha: http://hahaha.hamakuasprings.com/
- Drake Weinert: http://naturalfarminghawaii.net/

Articles:

- Jackie Prell: http://www.acresusa.com/toolbox/reprints/Jan10_Prell.pdf
- Honolulu Star Bulletin: http://www.staradvertiser.com/news/20110118_Natural_selection.html?id=114074644

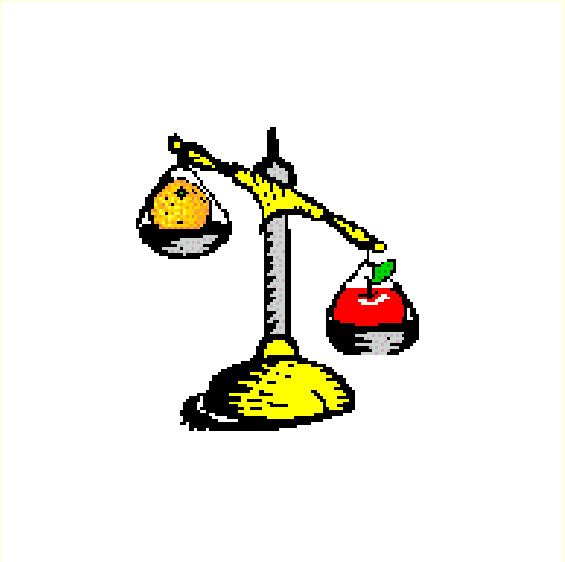
Questions remain……

- Scientific evidence is lacking.
- What made IMO4 and other KNF practices so great?

Side by Side Comparison of KNF vs CONV

Measurement:

- Plant health
- Soil health
- Soil tilth
- Mycorrhizae
- Weed pressure



Measurements

- Plant health
  - Crop yield
  - Leaf weight
  - Chlorophyll meter
- Soil health
  - Nematode analysis
  - Enchytreid worm
  - Mycorrhizae
  - Soil compaction tester

SPAD Chlorophyll meter

Soil compaction tester

Why do we use nematodes as soil health indicator?

Bacterivore **Fungivore** **Herbivore** **Omnivore** **Predator**

EI=Enrichment index

CI=Channel index

SI=Structure index

+ richness, diversity

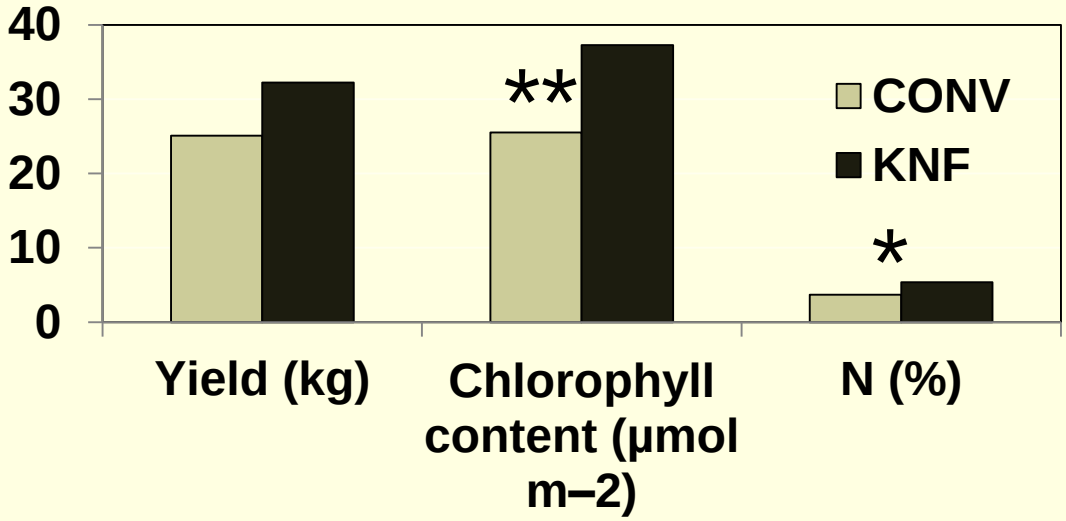
Materials and Methods

- Three farmers in Pahoa area conducted independent trials at their farm comparing KNF to their choice of conventional (CONV) practice in Dec 2011- May 2012.

Farm	Crop(s)	Plot size (# plots/treatment)	Surface mulch
Farm #1	soybean	8×20 ft^2 (4/treatment)	Sunn hemp cover crop
Farm #2	kabocha squash	2×2 ft^2 (10/treatment)	Wood chips
Permaculture Farm	kale, beet, broccoli, onion, leek	4×100 ft^2 (2/treatment)	Macademia nut husks

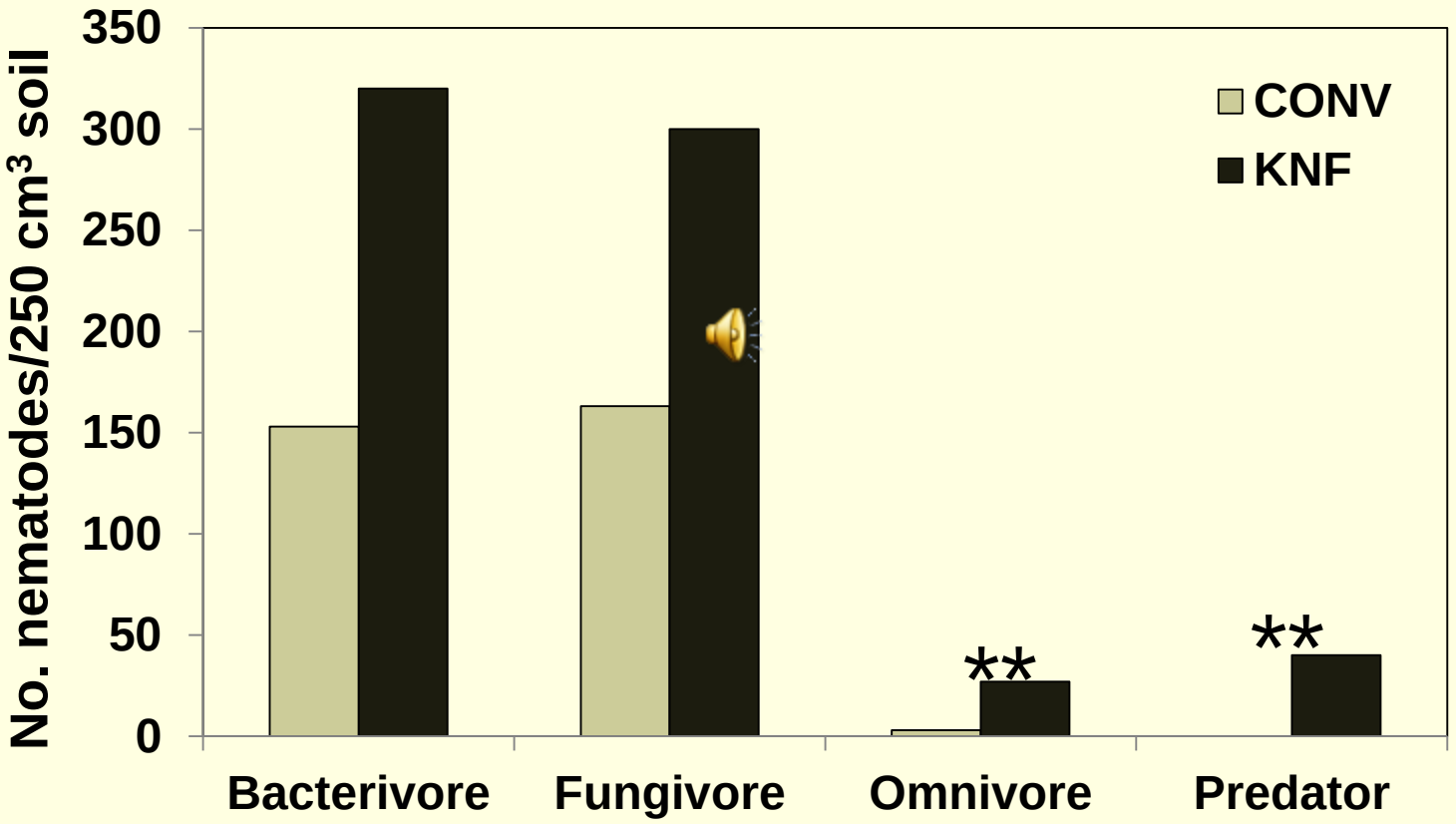
Farm #1 (Soybean)

Results (Plant Health)



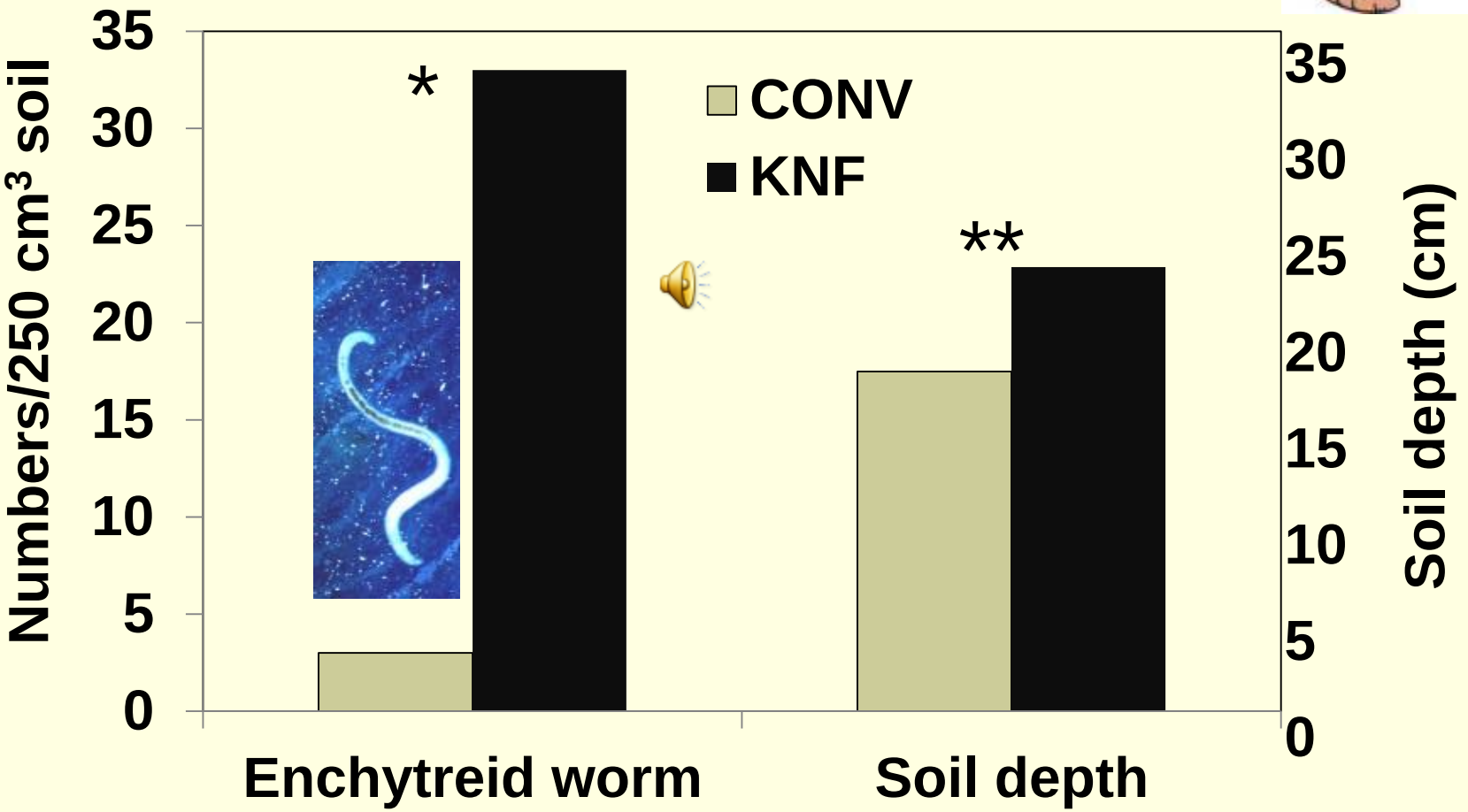
Farm #1

Results (Soil Health)



Farm #1

Results (Soil tilth)



Farm #1

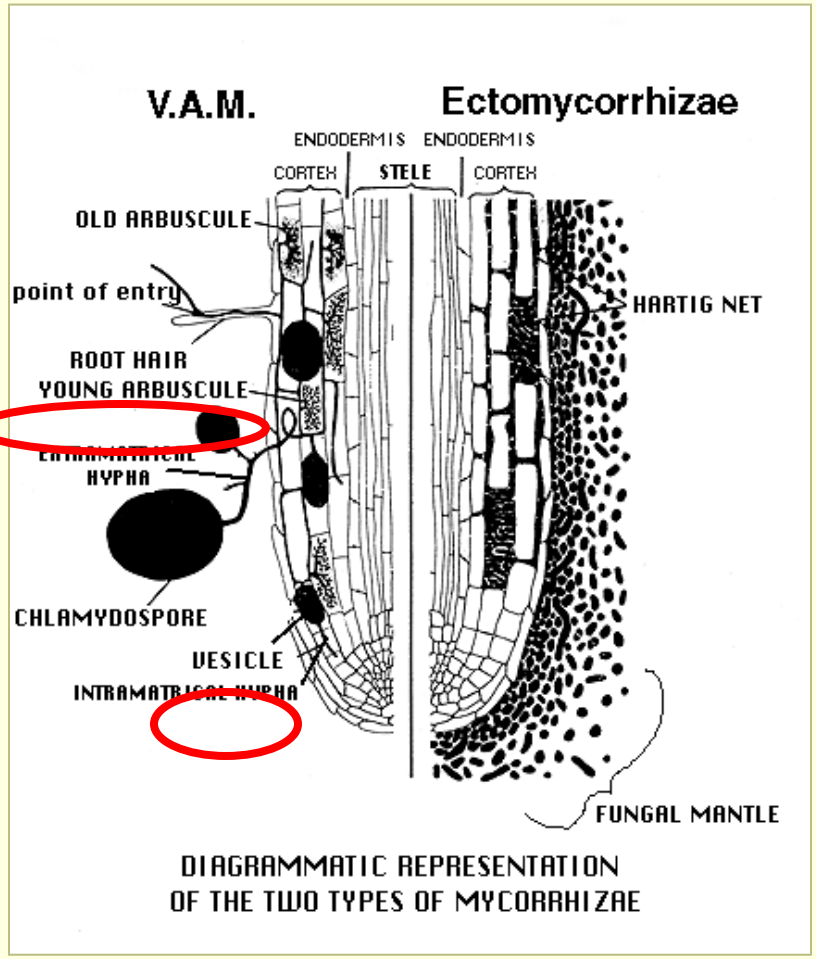
Results (Weed Pressure)

After soybean harvest

KNF

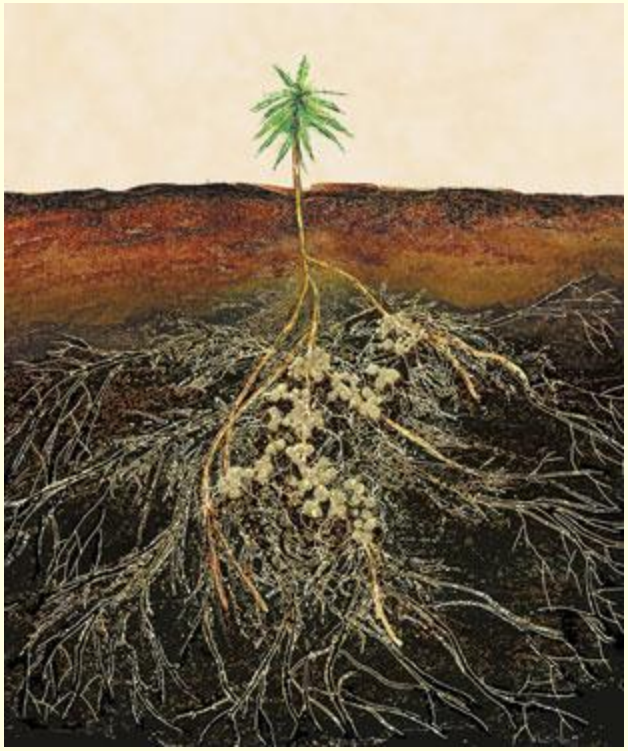
CONV (with herbicide)

Mycorrhizae



- a mutualistic association between a fungus (Myco) and the roots (rhiza) of the plants.
- Endomycorrhizae (vesicular-arbuscular mycorrhizal, VAM), generally associated with grasses, row crops, vegetables, and shrubs.
- Ectomycorrhizae generally associated with trees.

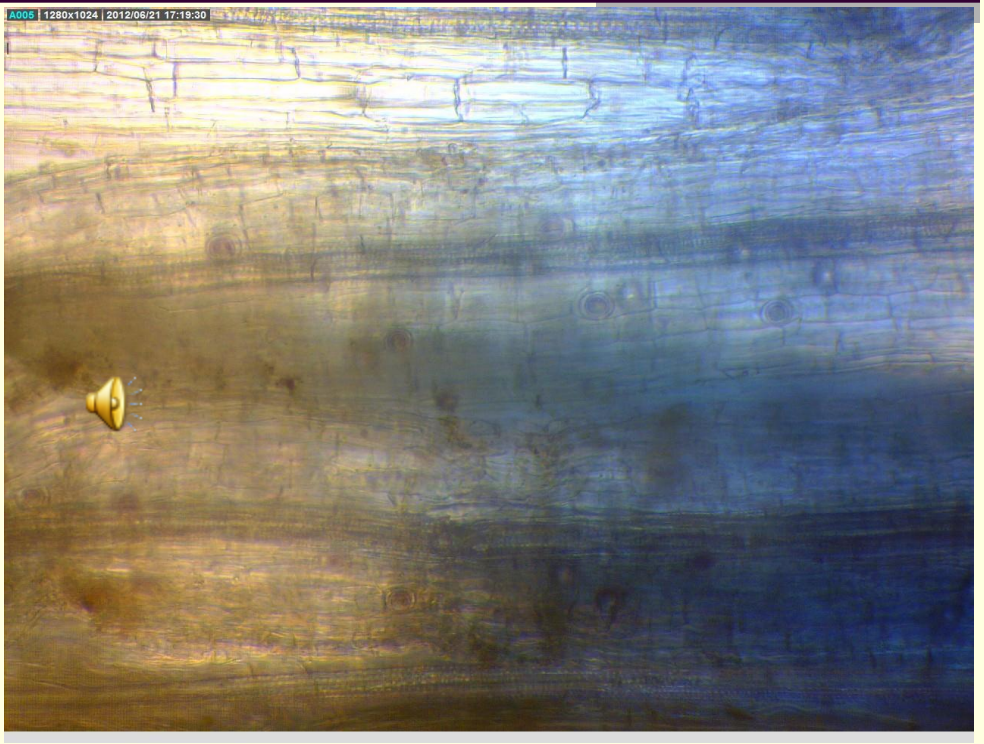
Mycorrhizae



- Enhance water and nutrient uptake efficiency
- Reduce fertility and irrigation requirements
- Increase drought resistance
- Increased pathogen resistance
- Enhancing plant health and vigor
- Enhanced seedling growth
- Enhanced plant transplant establishment

Farm #1

Mycorrhizal Fungi found colonizing soybean roots



Arbuscular and vesicular structures of mycorrhizae on soybean roots were counted, but no difference between KNF and CONV plots. More intense sampling might be needed,

Cost Evaluation in Farm #1

	Input/ft^2	Labor/ft^2	Total/ft^2
	----------	Cost ($/sq ft)	----------
CONV	$ 0.073	$ 0.094	$ 0.167
KNF (Optional input)	$ 0.044	$ 0.21	$ 0.26
KNF (without optional input)	$ 0.04	$ 0.132	$ 0.17

Farm #2 (kabocha squash)

At the end of a kabocha crop

KNF

Conv

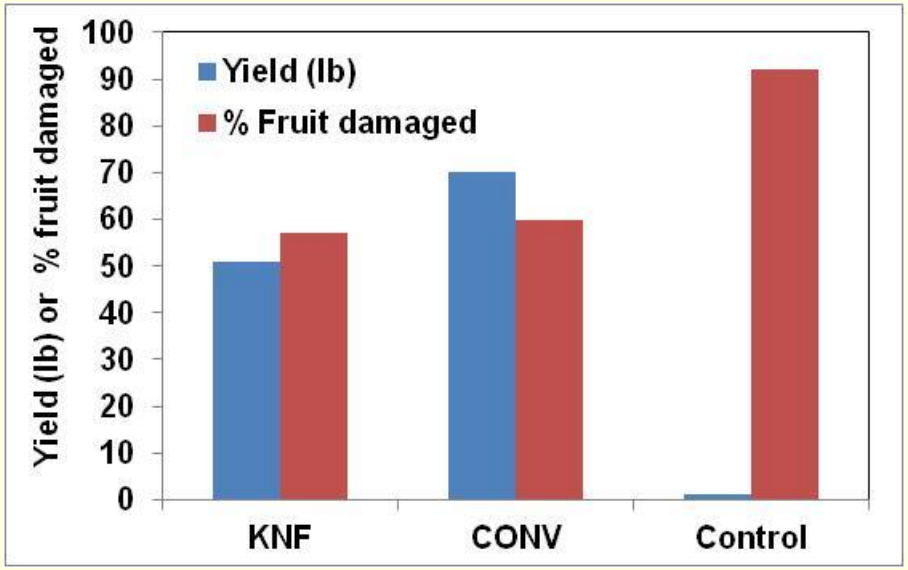
Untreated Control
(no herbicide)

Farm #2: Heavy infestation of powdery mildew and pickle worm

KNF did not protect the plants from powdery mildew and pickle worm.

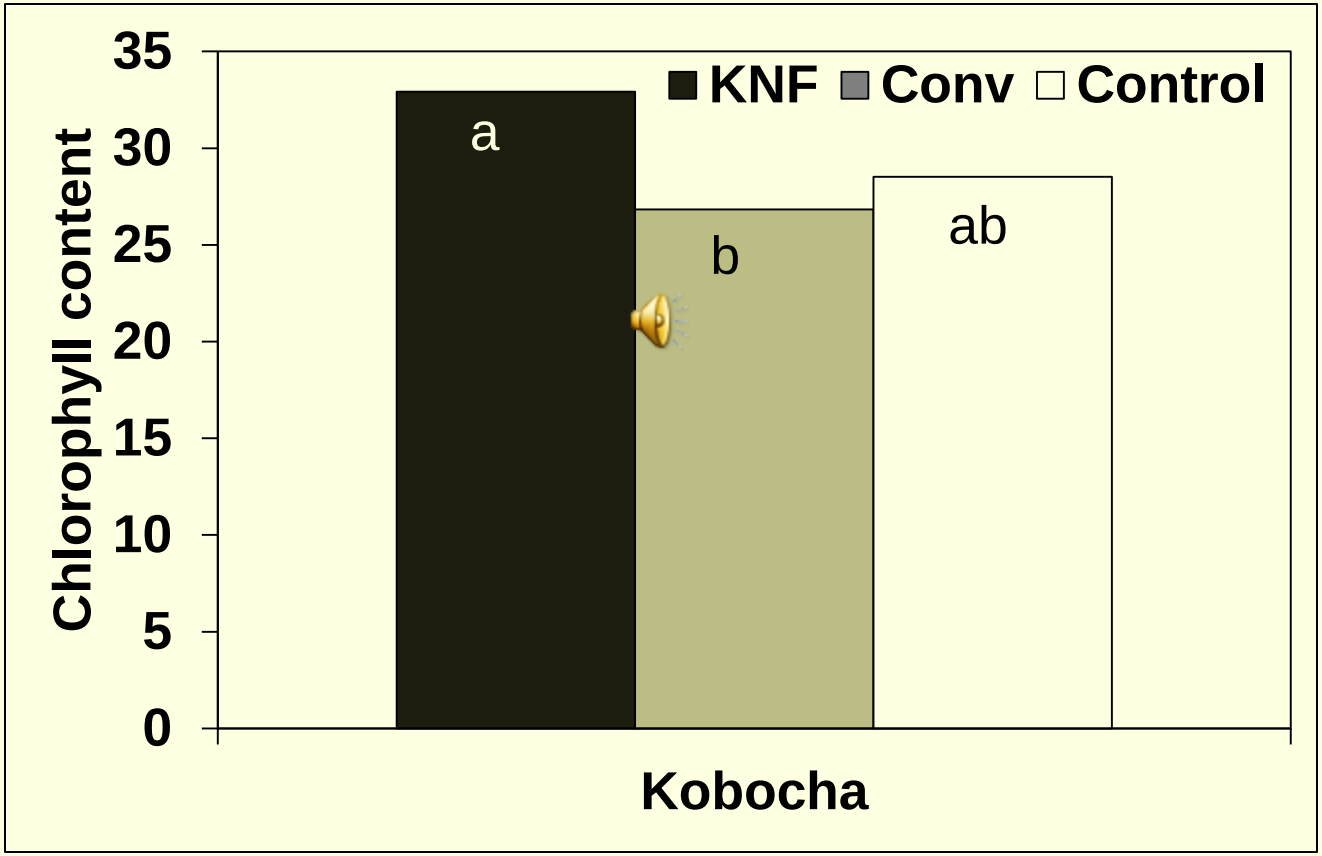
Farm #2

Results (Kabocha Yield)



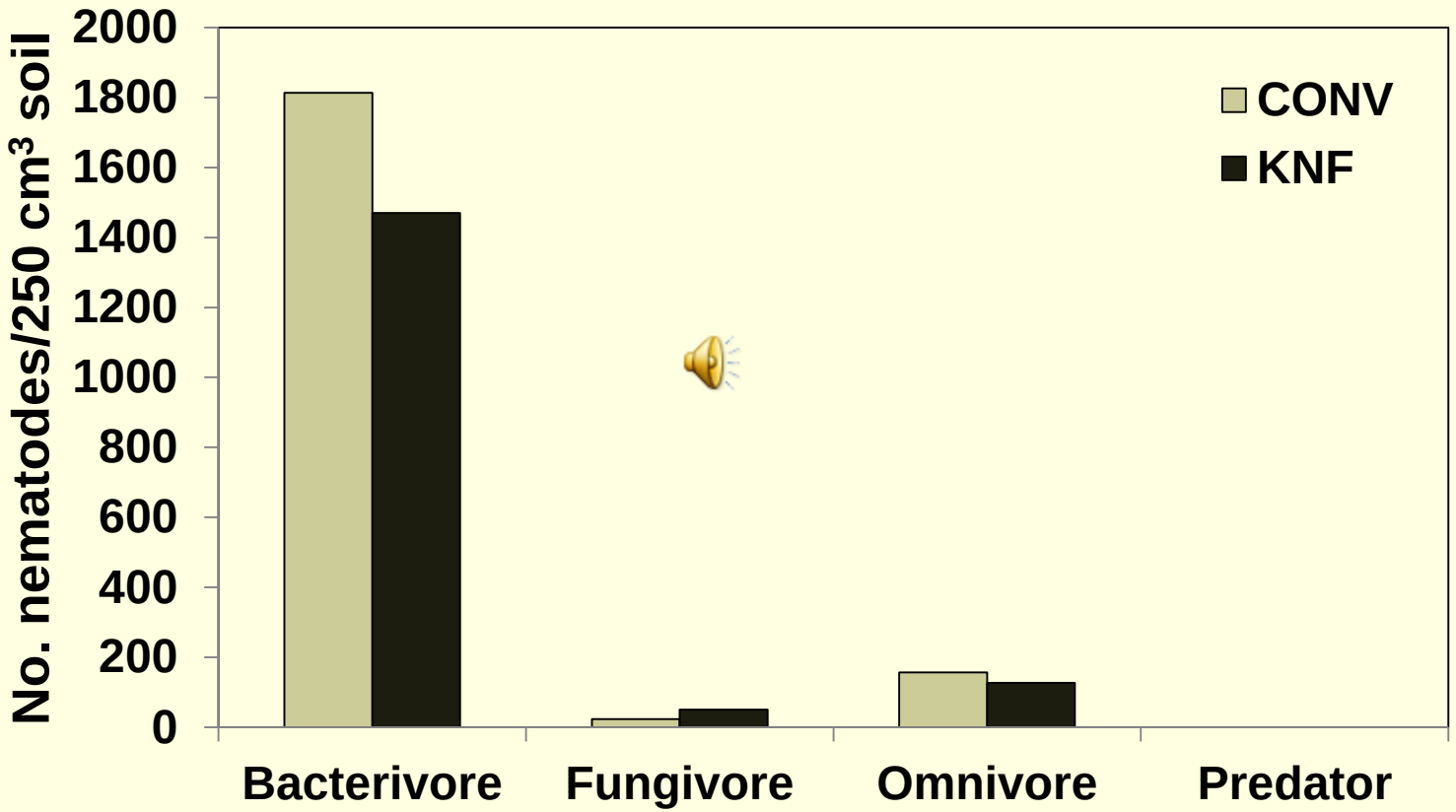
Farm #2

Plants in KNF are greener



Farm #2

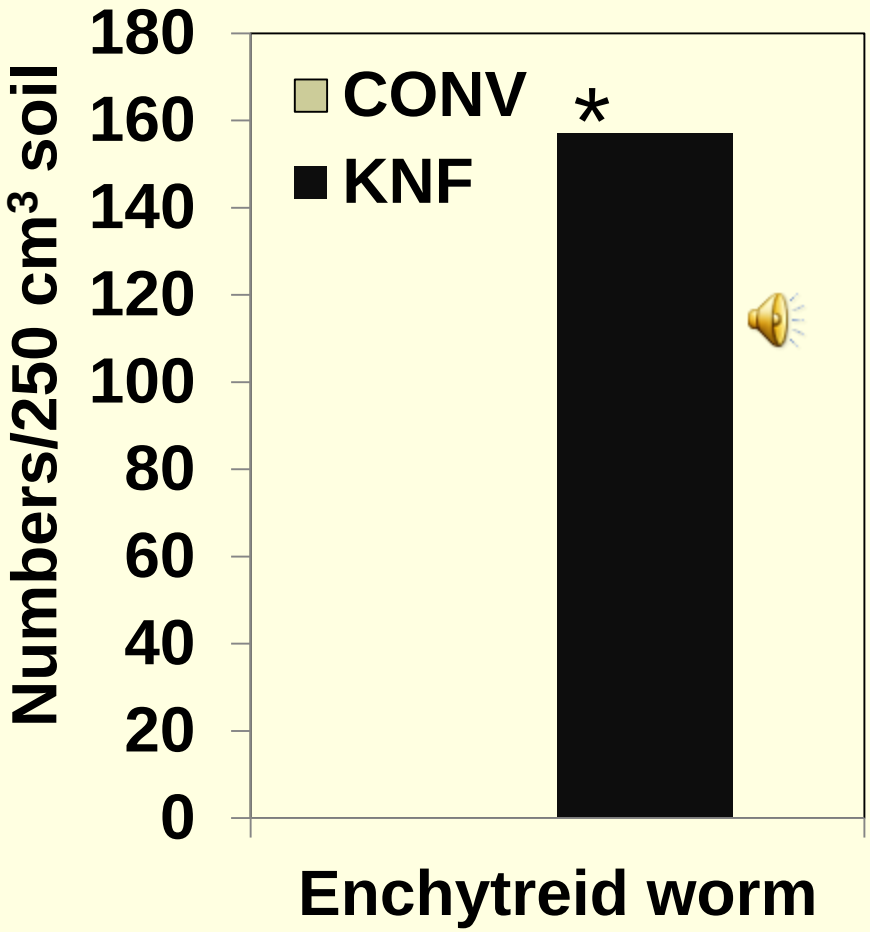
Results (Soil Health)



- KNF did not improve soil health condition in Farm #2.
- Possibly due to interference from pests infestation.

Farm #2

Results (Soil tilth)



KNF did increased enchytreid worm that could contribute to better soil tilth in Farm #2.

Farm #2 (kabocha squash)

At the end of a kabocha crop

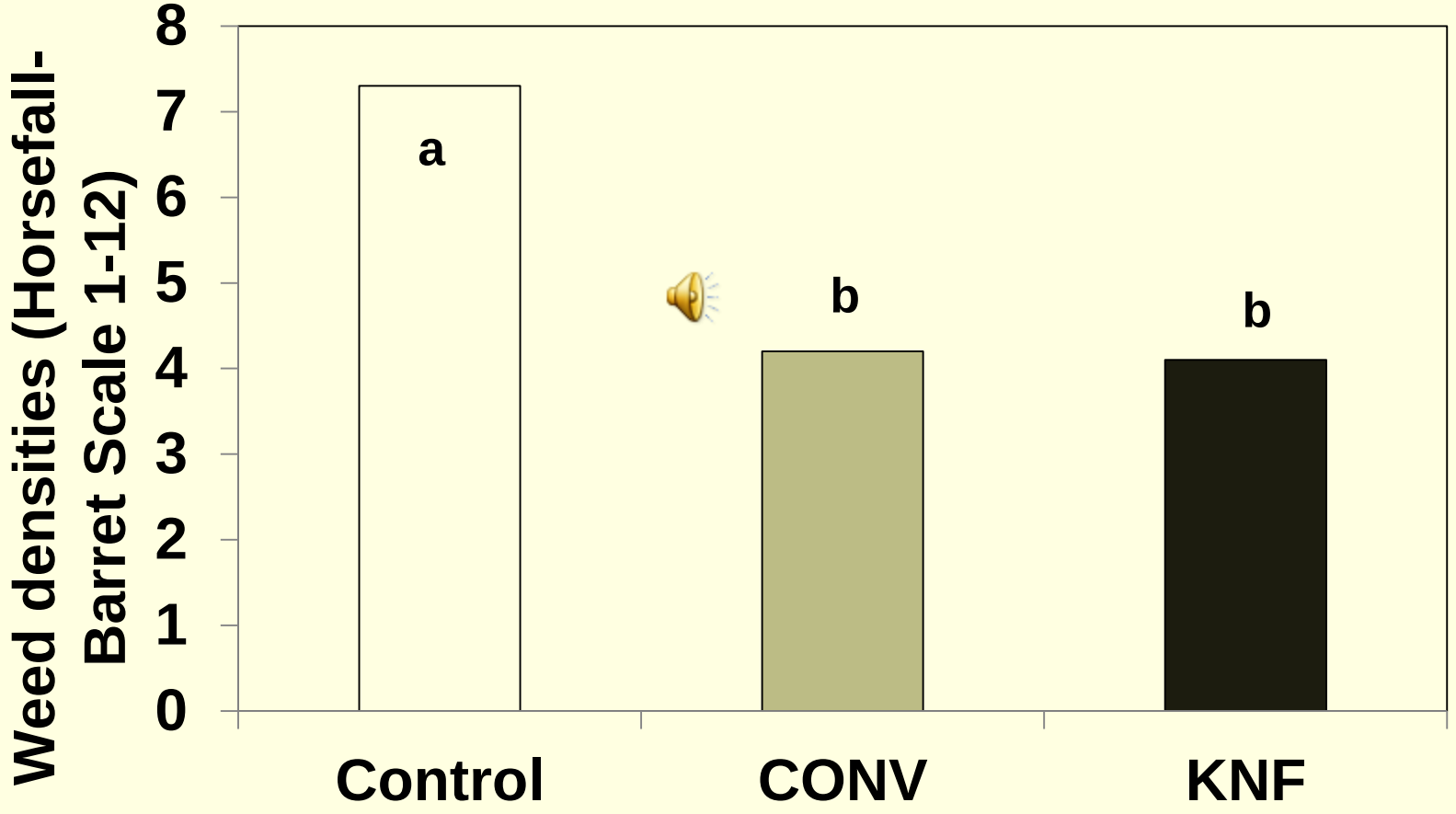
KNF

Conv

Untreated Control
(no herbicide)

Farm #2

Result (Weed Pressure)



Horsefall-Barret Scale 1= 0%, 12 = 100% weed coverage

Cost Evaluation at Farm #2

	Total yield (kg)	Year 1 input ($/2000 ft^2)	Estimate Year 2 input ($/2000 ft^2)
KNF	23.15	2,155	400
CONV	31.78	2,320	600
Untreated	0.57	1,510	200

- Farmer #2: The conventional row required 90 gallons more water than the NF row over the course of the growing season.

Farm #3

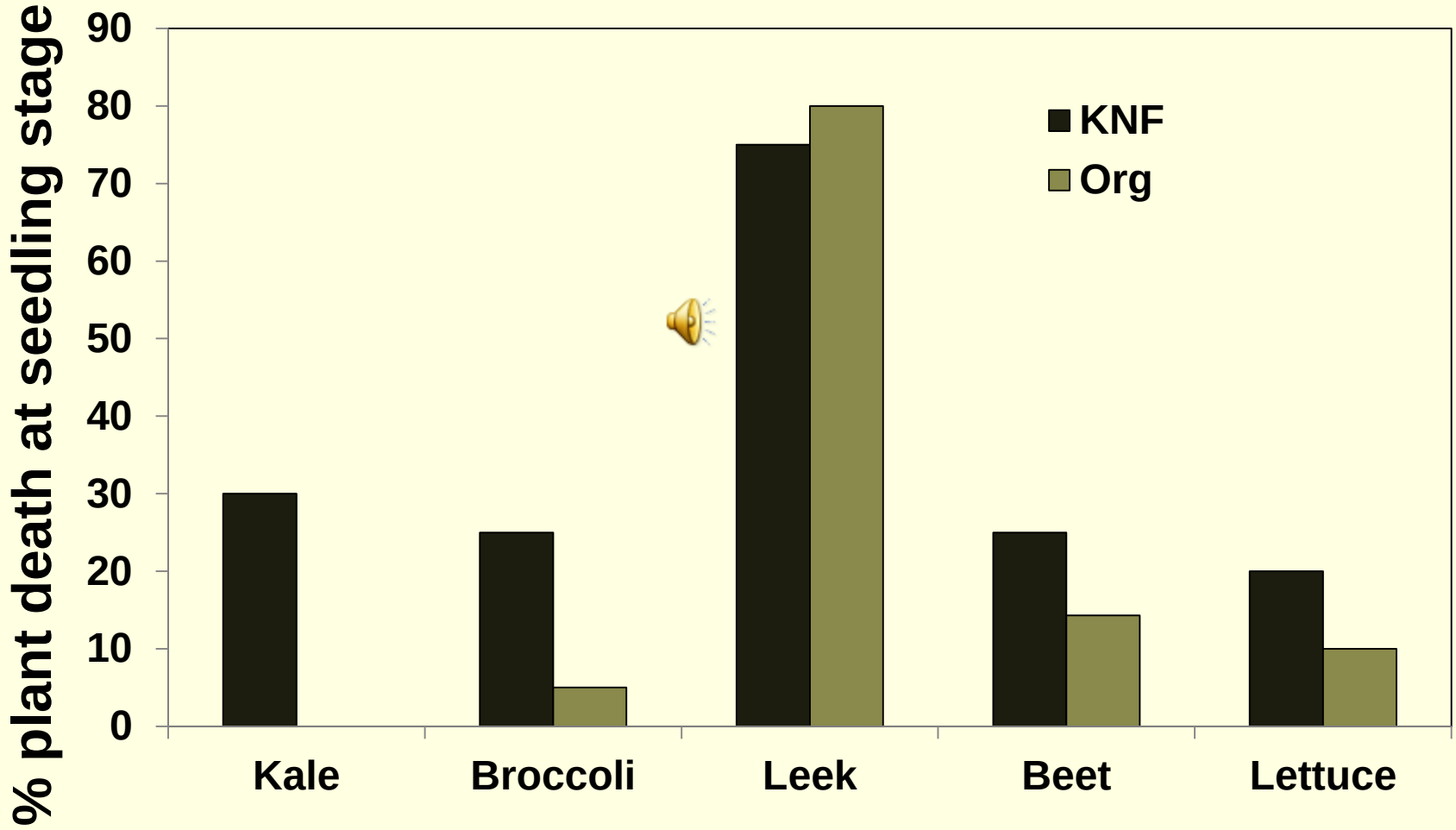
Korean Natural Farming vs Permaculture

Permaculture ORG

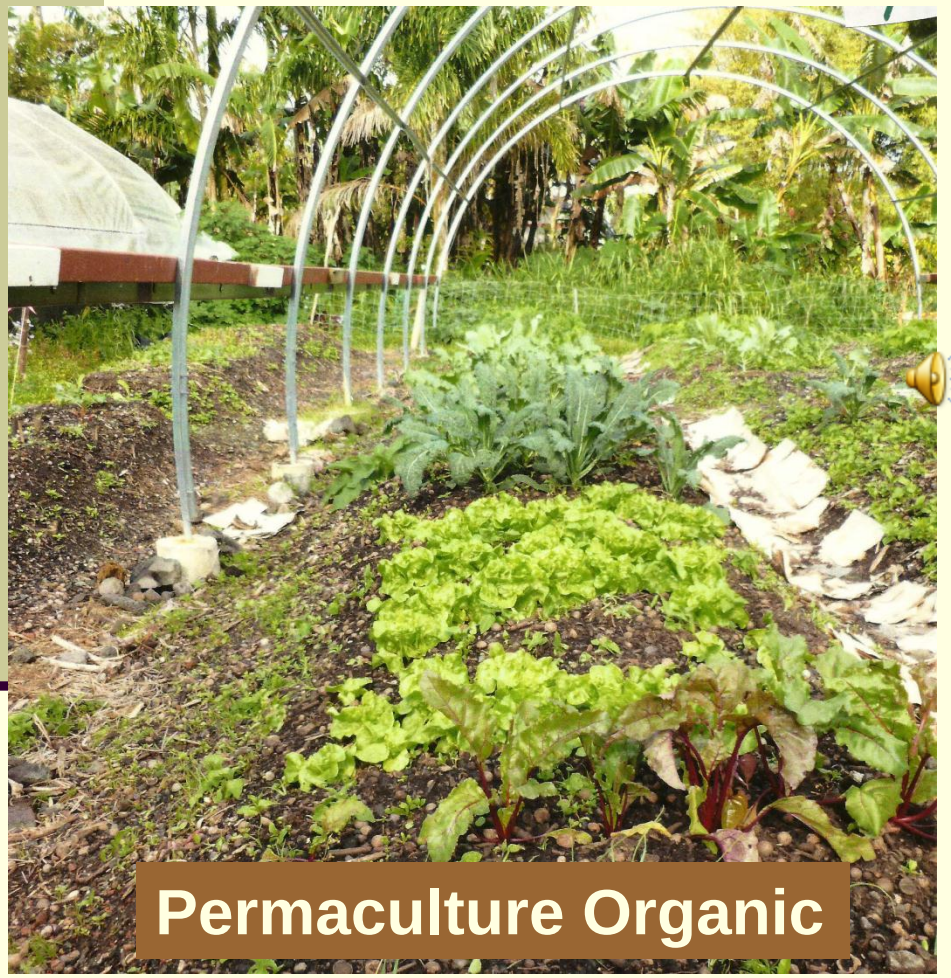
KNF

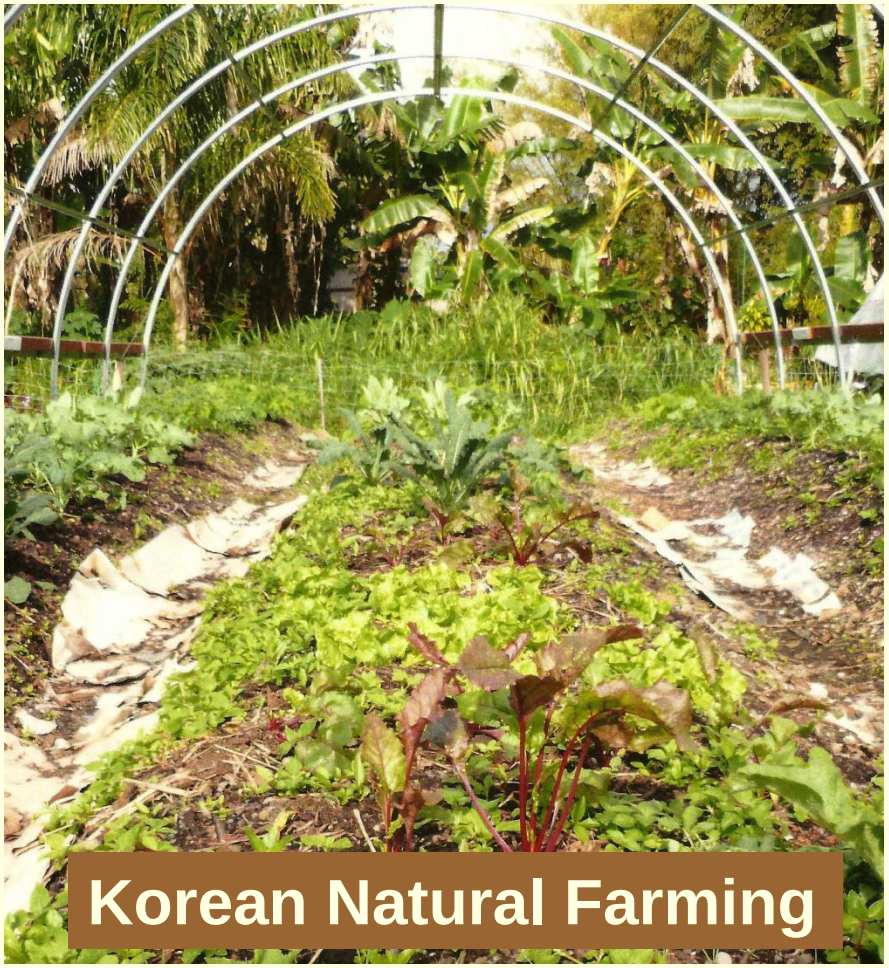
Permaculture = Organic farming + agroforestry +
sustainable agriculture + agroecology

Seedling die back



Korean Natural Farming vs Permaculture





2.18.2012

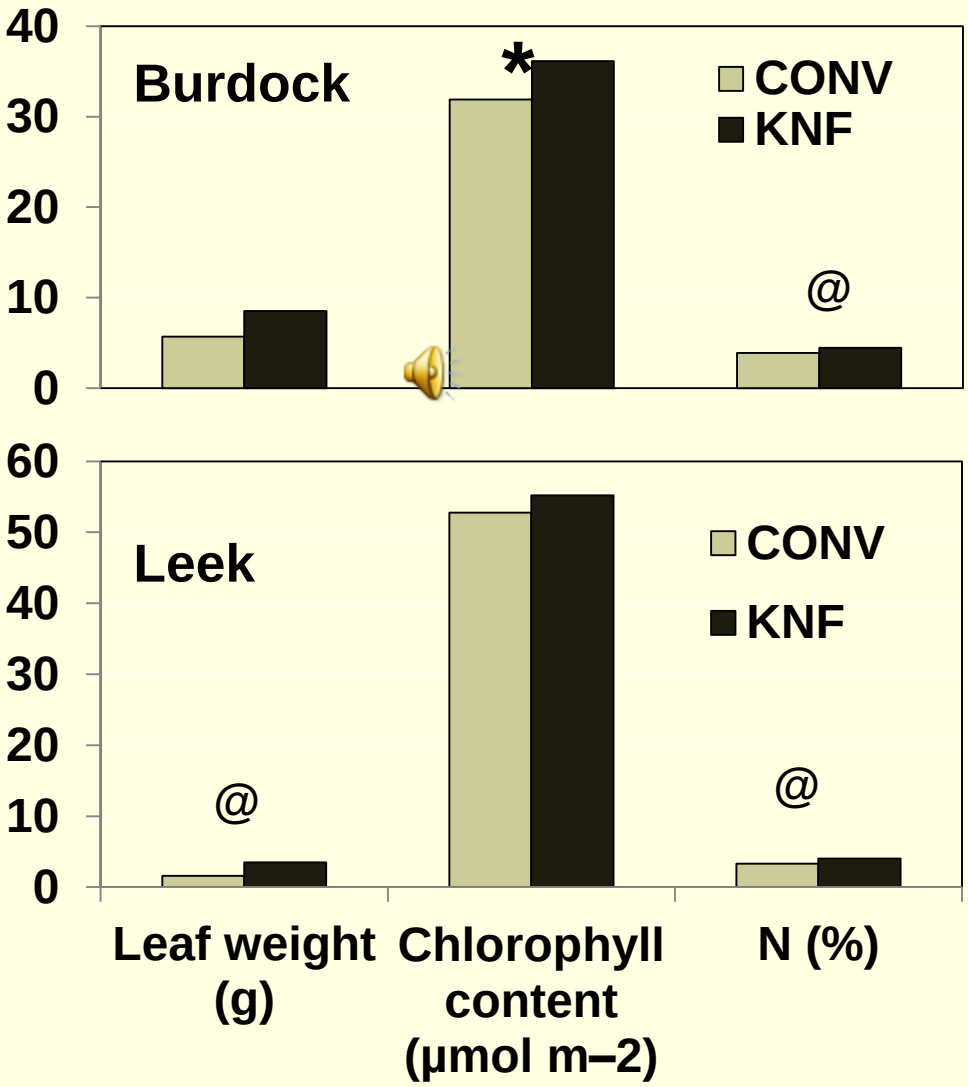
Adjusted KNF to IMO5

Permaculture Organic

Korean Natural Farming

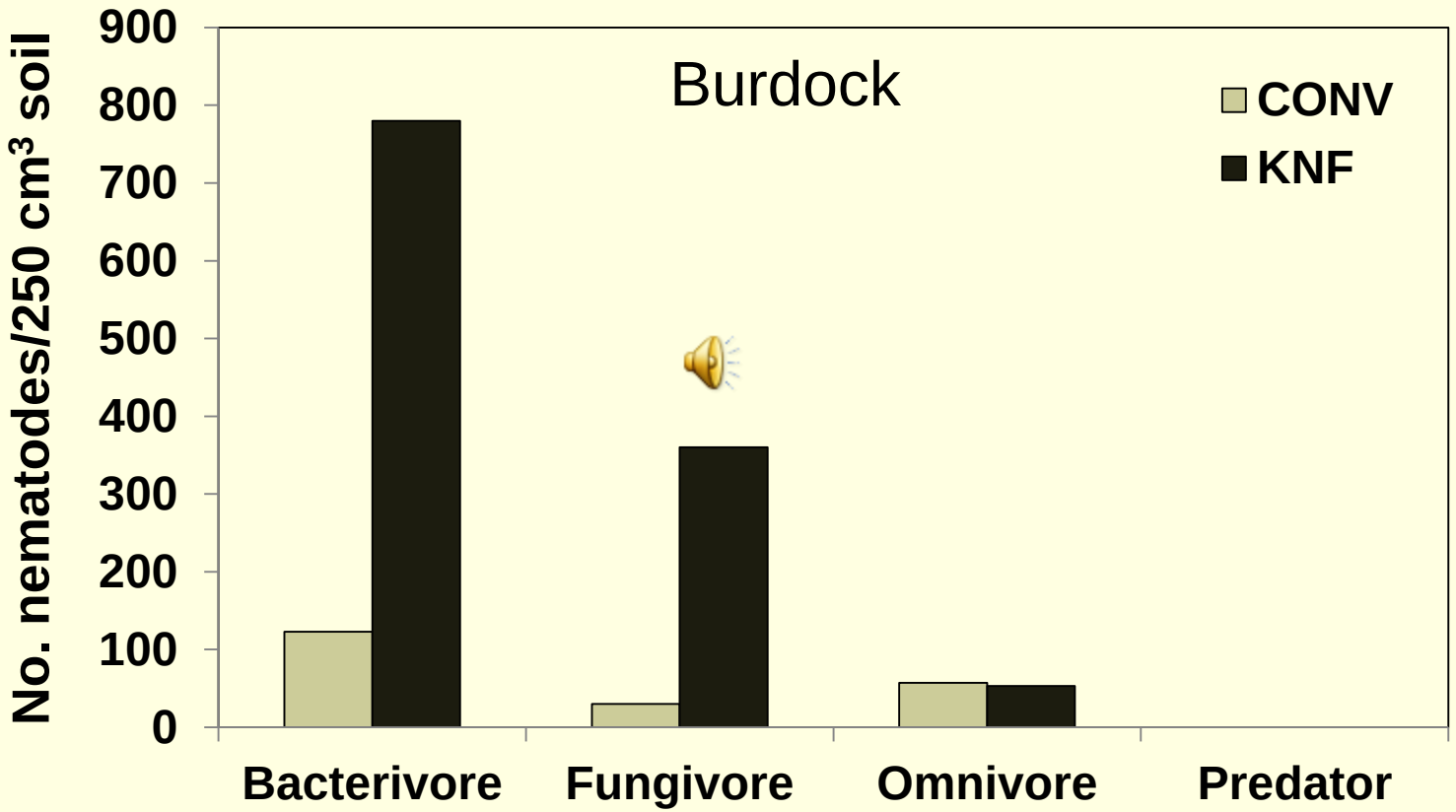
Farm #3 (Burdock and Leek)

Results (Plant Health)



Farm #3

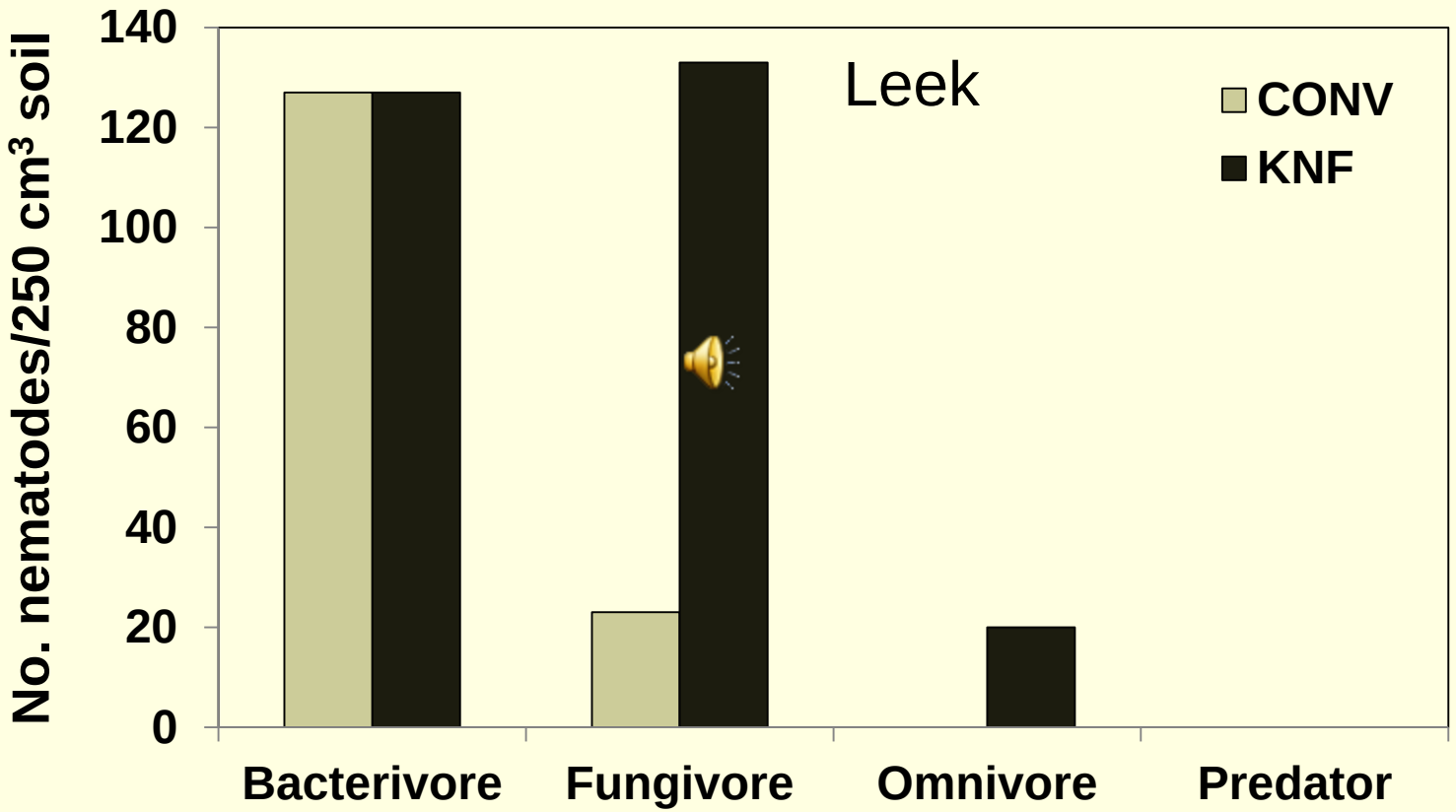
Results (Soil Health)



- KNF tended to increase fungal and bacterial decomposition, but did not increase more structured organisms in the soil food web.

Farm #3

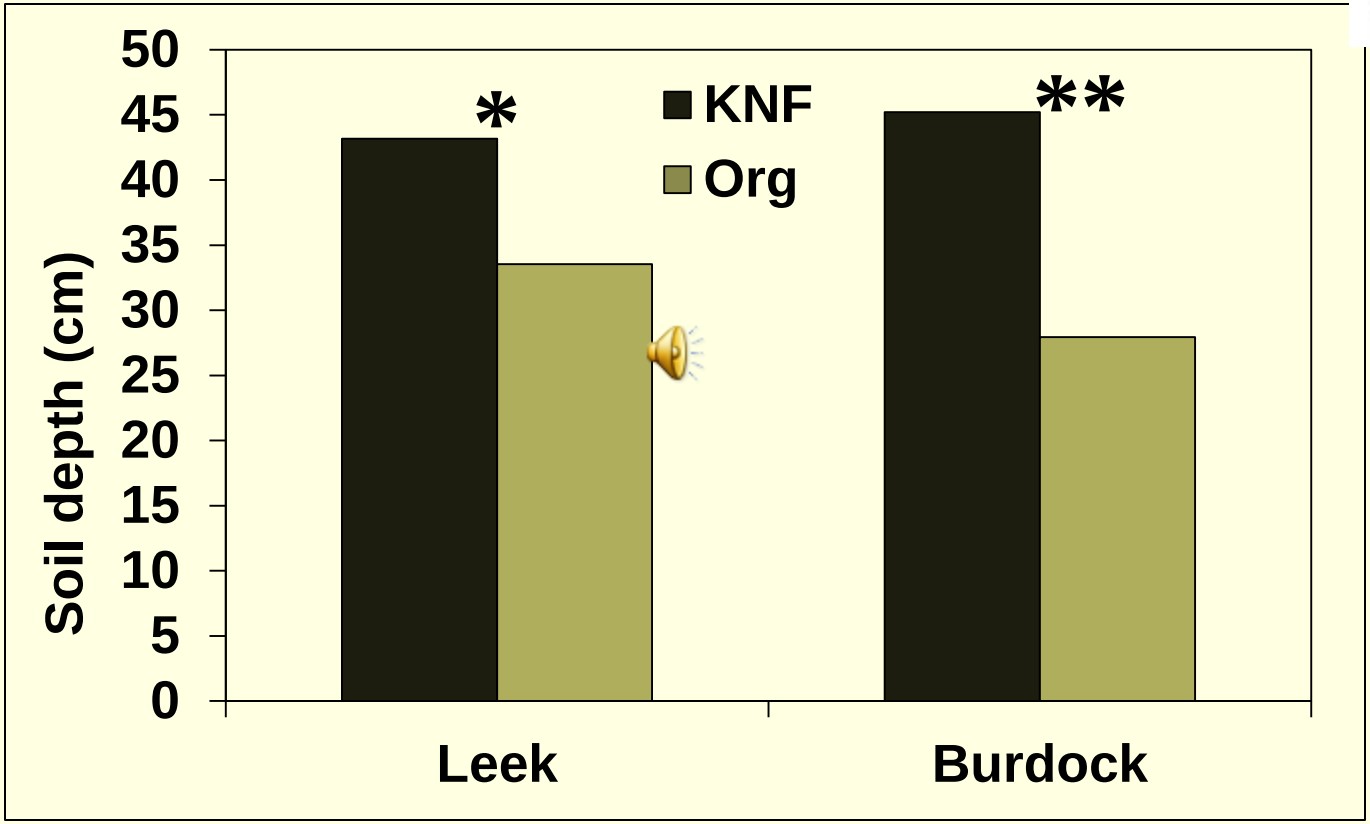
Results (Soil Health)



- KNF tended to increase fungal decomposition and slightly increased the structure of the soil food web.

Farm #3

Results (Soil tilth)



Summary

- Results of KNF on plant and soil health varied, but it consistently increased soil tilth and suppressed weeds.
- It improved plant health when not challenged by pests and diseases.
- Areas with high rainfall might need to build shelters for KNF.
- IMO4 did not improve soil health condition in long-term permaculture site, but incorporating animal manure to prepare IMO5 improved plant health conditions in this site.
- More data on mycorrhizae colonization is needed. Properties of KNF in increasing soil tilth could be attributed to earthworm, enchytreid worm and mycorrhizal fungi.
- KNF required less irrigation.
- Integration of sunn hemp cover cropping with KNF showed promising results.

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Appendix I (KNF inputs)

- FPJ = 1:3 brown sugar : Portulaca (~7 days)
- LAB = 1: 10 rice water : milk in 2/3 full jar (~2 days)
- FAA = 1:1 fish waste (head, skin, bones, guts): brown sugar (w/w) in big cooler to 2/3 full for 10 days to 3 months
- WCAP = 1: 10 charcoal bone: brown rice vinegar in 2/3 full jar (1 wk)
- WCA = 1: 10 vinegar: peel & low heat cook eggshell (1 wk)
- OHN = 1/3 full of (2 jars angelica root, 1 jar licorice root, 1 jar cinnamon bark) + 1/3 beer+1/3 air space; 2 days later add brown sugar to 2/3 full; leave for 7 days, add vodka to the top of container, seal, collect 1/3 liquid from each jar every two weeks, refill with vodka, repeat 5 times.

SOS Solution (Soil Treatment Solution)

Ingredient	rate	ml/5 gal
Liquedifies IMO4	1: 500	40
BRV	1: 500	40
FPJ	1: 500	40
LAB	1:1000	20
FAA	1:1000	20
OHN	1:1000	20
WCAP	1:1000	20
MA	1:1000	20
SW	1:30	600

SES Solution
(Seed Treatment Solution)

Ingredient	rate	ml/gal
FPJ	1: 500	8
BRV	1: 500	8
OHN	1: 500	4
NMA	1:1000	4

Foliar Spray

Type II Solution

	Rate	ml/gal
BRV	1:500	8
FPJ	1:500	8
OHN	1:1000	4
FAA	1:1000	4
MA	1:1000	4

Type III Solution

	Rate	ml/gal
BRV	1:500	8
FPJ	1:500	8
OHN	1:1000	4
WCA	1:1000	4
SW	1:30	600