CENTER FOR RURAL AGRICULTURAL TRAINING & ENTREPRENEURSHIP (CRATE) UPDATE

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How to make organic farming more profitable and sustainable?

CRATE OBJECTIVES

Building on Soil Health

Reduce, reuse, recycle but with Food Safety

Sustainable Agriculture

Outreach to local farmers, train new farmers, undergraduate, and 4-H students

Develop non-chemical based IPM
EFFICIENT USE OF ON-FARM RESOURCES

- Cover crops for soil health improvement
  - Does mix cover cropping resulted in better soil health than single cover cropping?
- Introducing beneficial soil organisms to agricultural soil
  - Can introducing beneficial soil organisms reduce fertilizer use?

Ray Archuleta: The road to Soil Health-Farming in the 21th century
A FARMER’S FAVORITE COCKTAIL MAY NOT BE WHAT YOU THINK.

INNOVATIVE FARMERS ARE BREATHING NEW LIFE INTO THEIR SOIL BY SEEDING A “COCKTAIL MIX” OF 6-12 PLANTS TO GET DIVERSITY ABOVE-GROUND, WHICH CREATES MUCH-NEEDED DIVERSITY BELOW THE GROUND. THROUGH THAT DIVERSITY, FARMERS ARE MIMICKING THE SOIL-BUILDING AND MICROBIAL-FRIENDLY CONDITIONS OF THE DIVERSE NATIVE PRAIRIES.

WANT MORE SOIL SECRETS?

CHECK OUT WWW.NRCS.USDA.GOV
Winter Cover Crop Trial at Laulamilo Experiment Station, Waimea, HI
Nematodes as Indicators of Soil Health

Bacterivore  Fungivore  Herbivore  Omnivore  Predator

EI = Enrichment index
CI = Channel index
SI = Structure index

Till in organic matters
Reduce tillage
Cover cropping improved soil health compared to Control.

AWP enriched the soil, BB provided a more balance bacteria/fungal decomposition channels, adding AR to V provided a more balance decomposition pathways. Soil builder (7 mix) only performed averagely in Waimea.
WINTER COVER CROPS FOR HIGH ELEVATION (WAIA MEA, BIG ISLAND)

- Bell bean (*Vicia faba*)
- Hairy vetch (*Vicia villosa*)
- Annual rye (*Lolium multiflorum*) - cannot compete with weeds
- Austrian winterpea (*Pisum sativum subsp. Arvense*)
- Annual rye + hairy vetch
CAN INTRODUCTION OF BENEFICIAL SOIL ORGANISMS REDUCE FERTILIZER USE?

- **Sumagrow** contains various plant-growth promoting rhizobacteria: *Bacillus subtilis, Pseudomonas putida, Rhizobium leguminosarum, Trichoderma virens, T. harzianum, Asobacter vinelandii* + Humic acid.

- Mykos liquid, Mykos Gold: *Rhizophagus irregularis* (formal *Glomus irregularis*).

- **Indigenous microorganisms (IMO):** Deliberate cultivation of indigenous microorganism collected from natural area (e.g. forest) close to farmland, to restore nutrient cycling organisms into human disturbed agroecosystem. This practice is in conjunction with minimal tillage, mulching with organic surface mulch, and foliar spray with nutrient input extracted from excess farm produce.
INTRODUCING
SOIL
MICROORGANISMS

Results were partly complicated by bird damage.

1. Std = standard fertilizer (200 lb N/acre)
2. No = no fertilizer
3. IMO = Indigenous microorganisms + foliar spray (no additional fertilizer)
4. Suma50 = Sumagrow + 50% of the Std
5. Mykos50 = Mykos liquid + 50% of the Std
6. Suma25 = Sumagrow + 25% of the Std
7. Mykos25 = Mykos liquid + 25% of the Std
CAN INTRODUCTION OF BENEFICIAL SOIL ORGANISMS REDUCE FERTILIZER USE?

- Introduction of commercial rhizobacteria (Sumagrow) and mycorrhizae (Mykos) could reduced 50% of fertilizer use.

- Introduction of farm prepared IMO produced corn growth similar to the standard fertilizer practice.

- Experiment in progress to measure soil health……

For more information on how IMO4 compost affect soil health, please visit: http://www.ctahr.hawaii.edu/WangKH/KNF.html
CRA E OBJECTIVES

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WHY A NEED ON NON-CHEMICAL BASED IPM?

Disadvantages of pesticides (OMRI or not) and monoculture:

- Environmental hazard (bees, aquatic invertebrates)
- Low biodiversity
- Pesticide treadmill
- NOP Sunset list

Several organic insecticides such as sulfur, horticultural oil, insecticidal soap, and even insect pheromone and sticky traps for insect management are on the National Organic Program (NOP) Sunset list due on 27 Jun, 2017.

(http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5096045)
Develop non-chemical based pest management strategies

- Attracting natural enemies of arthropod pests through the planting of insectary borders
- Induce host plant resistance through vermicompost tea drenching
- Recycle spent oyster mushroom compost for nematode management (Shelby Ching’s Booth)
- Soil solarization for weed management
INSECTARY PLANTS

- Plants that attract insects, either by producing abundant flowers with pollen and nectar for beneficial insects, or by luring insect pests away from the cash crop.

Hoverflies on buckwheat

Hoverflies on cilantro

Sunn hemp flowers attract Lycaenidae butterflies that draw Trichogramma wasps to lay eggs on the Lepidopteran eggs.
WASP NESTING BLOCK

Pollinators
- Leaf cutter bee
- Hylaeus bee

Predators
- Key-hole Wasp
- Aphid-collecting Wasp

Untreated wood
INTEGRATING INSECTARY PLANTS WITH WASPS NESTING BLOCK

- Sunn hemp border
- Diamond back moth (DBM) larvae
- Hoverfly larva eating aphid

This insectary setting reduced aphids and DBM, and resulted in significant pak choi yield than the control treatment.

**SUMMARY**

Insectary box:
- yielded similar to other treatments despite losing one row of crop for buckwheat plants.
- had less unmarketable pak choi than the other treatments.

Jane Tavares, 2013
Sunn hemp (SH) for 9 weeks, no till with flail mower

Integrating Insectary border with no-till sunn hemp cover cropping

Cowpea & buckwheat border

No-till SH mulch
Case Study 3: Terrestrial Green Onion

2) Solarization (Sol)

Till & Solarized for 11 weeks (1 µm thick, UV protected clear plastic)

3) SH + Solarization (SHSol)

Solarization for 1 month + SH grown for 7 wks
No-till with flail mower

Green onion planted into cut solarization mulch
INSECTARY SETTINGS REDUCE THRIPS DAMAGE AND INCREASE CROP YIELD

SH = Sunn hemp no-till+insectary border
Sol = Soil solarization
SHSol = Sunn hemp tilled + solarization
BG = Bare ground

= insecticide treatment in the BG

Green onion yield
INDUCE HOST PLANT RESISTANCE THROUGH VERMICOMPOST TEA DRENCHING

ISR = Induced plant systemic immunity against broad spectrum of pests and pathogens by beneficial soil-borne microorganisms.

Rhizobacteria
Uncured and 1-month cured VCT suppressed root penetration of *M. incognita* (*P* < 0.05) compared to the NVC control on tomato.

**NVC:** No vermicompost

**6-MVC:** VCT from 6 month cured vermicompost

**1-MVC:** VCT from 1 month cured vermicompost

**UC:** VCT from uncured vermicompost

(Shova Mishra, 2014)
VERMICOMPOST TEA TREATMENT INDUCE TEA RESISTANCE TO SPIDER MITE DAMAGE

% Leaves damaged by mite

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Tea damaged by spider mites

N = 7
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OUT-DOOR CRATE CLASS ROOMS
FACILITATE CTAHR COOPERATIVE EXTENSION SERVICE TO HOST MANY OUTREACH ACTIVITIES

Average 4 community visits to Poamoho Station per month (July – Aug 2014)
OUT-DOOR CRATE CLASS ROOMS ENHANCE CTAHR UNDERGRADUATE TEACHING PROGRAM
CRATE CLASS ROOMS ALSO TARGET ON TRAINING NEW FARMERS IN HAWAII

GoFarm Hawaii AgXposure
HOW TO DO ORGANIC FARMING PROFITABLY?

Clyde S. Tamaru

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