COVER CROPS FOR SOIL AND PEST MANAGEMENT

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USDA

NRCS

OUTLINE

- Benefits of cover cropping
- Cover crop calculator
  - Factors affecting plant available N% (PAN%)
- Sustainable approaches for pest management
  - Insect pests
  - Nematodes
  - Weeds

BENEFITS OF COVER CROPPING

1. Reduce fertilizer costs
2. Add organic matter
3. Improve yields by enhancing soil health
4. Reduce the need for herbicides and other pesticides (nematicide)
5. Prevent soil erosion
6. Conserve soil moisture
7. Protect water quality
8. Help safeguard personal health
9. Some cover crops offer harvest possibilities as forage, grazing or seed in multiple crop enterprises.

Benefits of cover cropping:

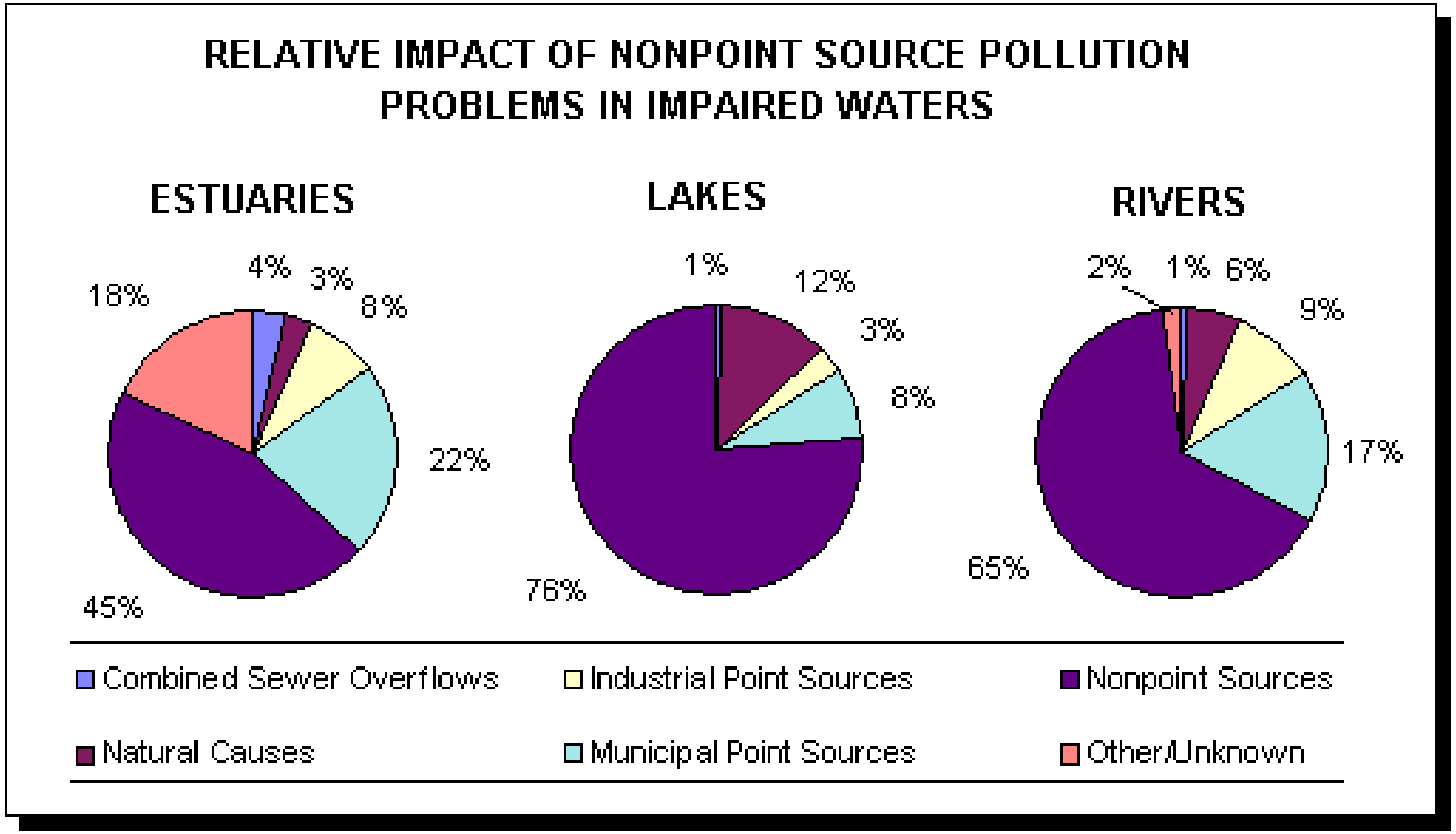
Soil Health

unlock the SECRETS IN THE SOIL

Water Health?

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

NON-POINT SOURCE POLLUTION



US Forest Service (NA-PR-07-91)

Nonpoint source pollutants, such as sediments, nutrients, pesticides, herbicides, fertilizers, animal wastes and other substances that enter our water supply as components of runoff and ground water, have increased in relative significance and accounts for > 50% of the pollution in U.S. waters.

EUTROPHICATION

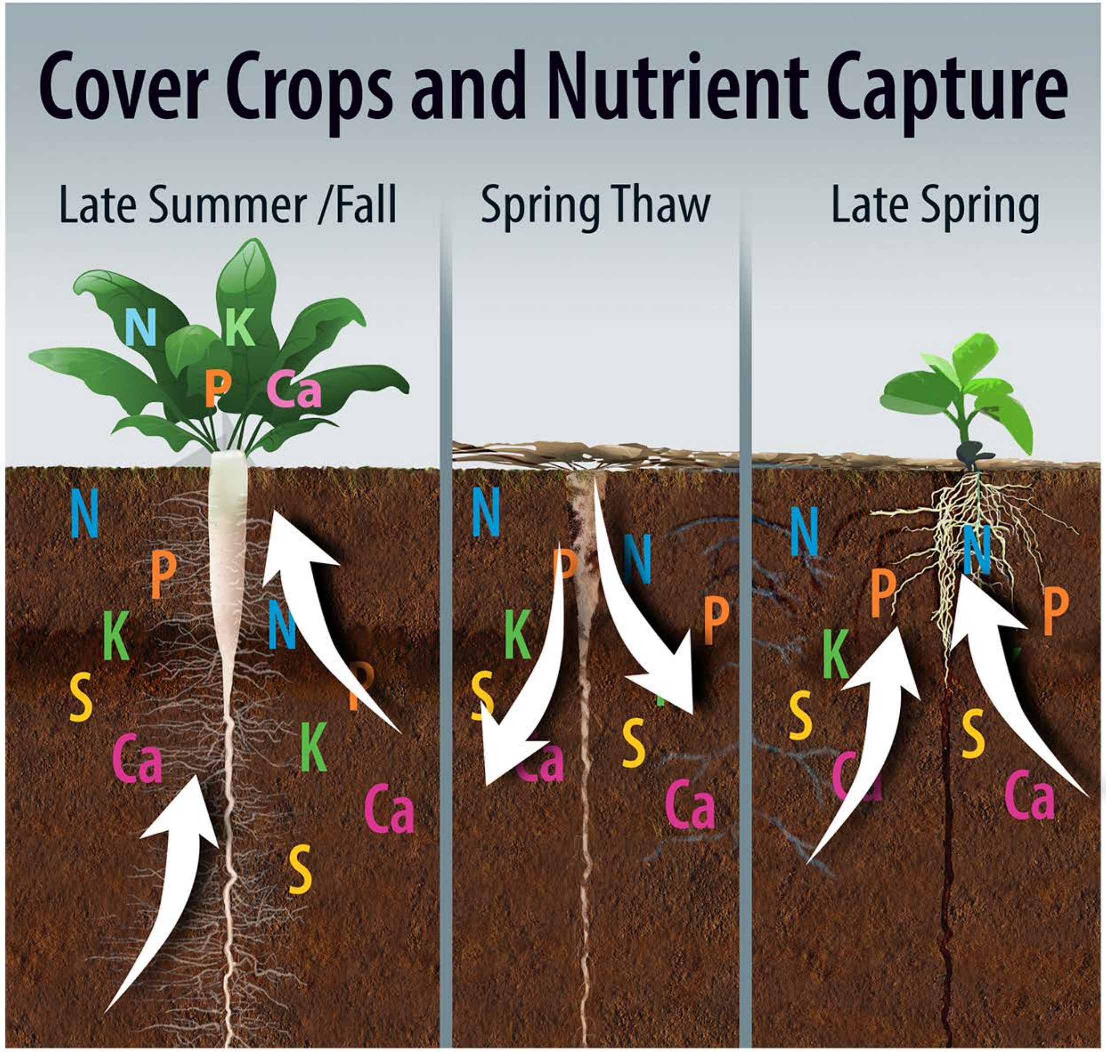
Excess Nitrogen and Phosphorous Spur Algal Growth, Deplete Oxygen and Kill Fish.

Algae bloom

Many species, including fish, are sensitive to low oxygen levels and die as a result.

1. CUT FERTILIZER COSTS

1. Contributing N to cash crops
   - 30-60% of N that the legume produced can be available for the subsequent cash crop
   - But plant N available rates varies by cover crop and soil condition --- Cover crop calculator
   - Examples: sunn hemp, cowpea, lablab, yellow sweet clover, white clover, hairy vetch
2. Scavenging and mining soil nutrients
   - Fibrous-rooted cereal grains or grasses – scavenging excess N left in soil after a cash crop, reduce nutrient leach



Cover crops can increase the amount of nutrients available for the next crop by taking up nutrients that remain in the soil and holding them in plant tissue until they are released the next spring, when they can be used by the following crops. *Courtesy: Cover Crop Solutions*

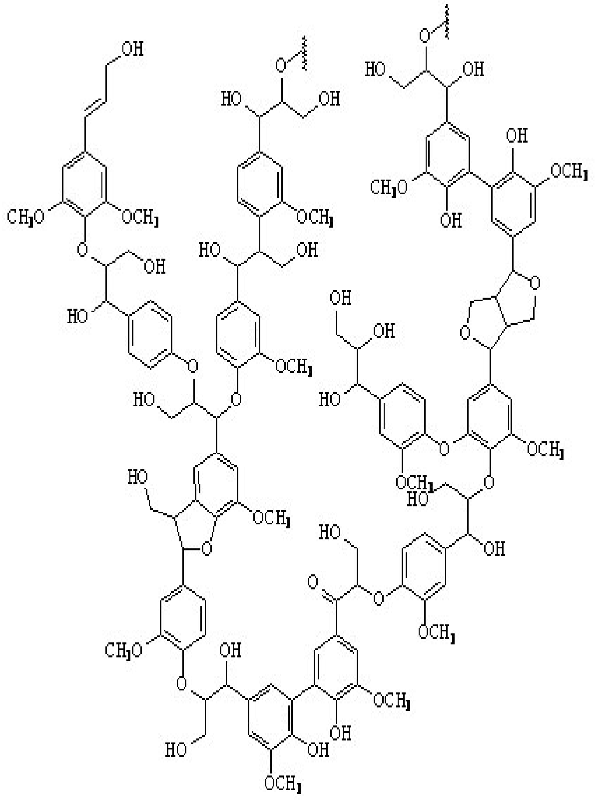
1. NUTRIENT SCAVENGING

- **Need to plant early:** Rye can took up 70 lb **N**/A when planted soon after termination of last crop.
- Deep-rooted cover crops (such as oil radish) draw **Ca and K** that leach down the soil profile to upper soil surface.
- Although P doesn't leach, it is not readily available for plant to uptake. Cover crops such as buckwheat and lupins, secrete acids into soil that put P into a more soluble form for plant to uptake.
- Cover crops could also enhance plant P uptake by hosting mycorrhizae fungi.

Oil radish

Lupin

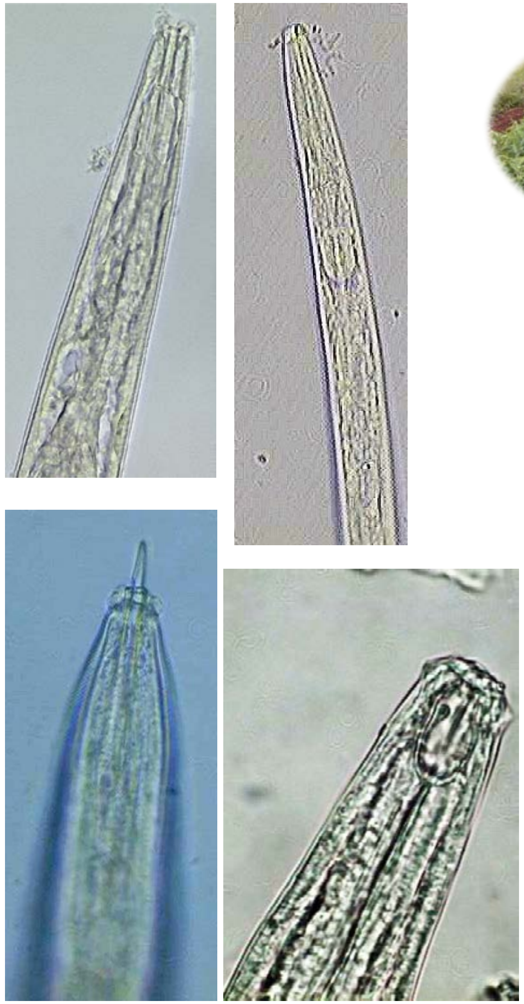
2. ADDING SOIL ORGANIC MATTER

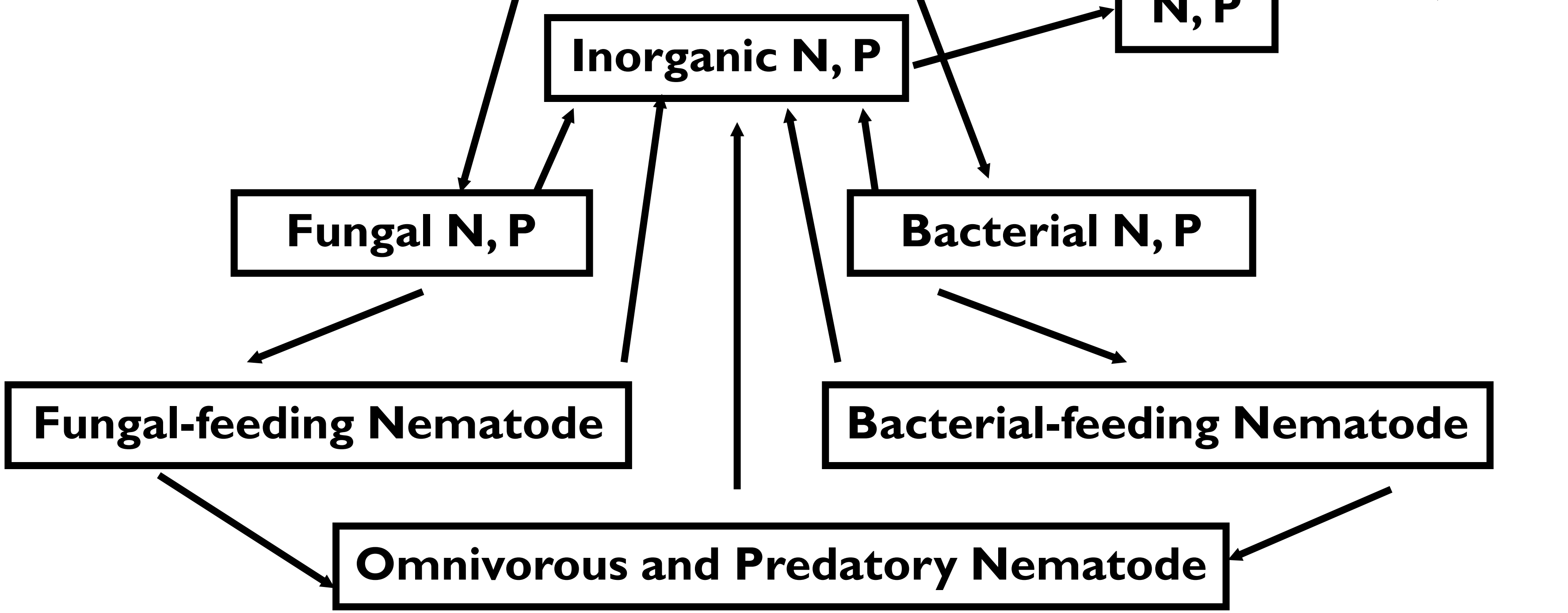


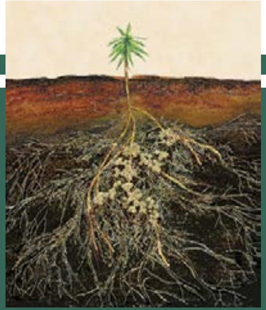
- Soil organic matter contributes to improve soil structure, increase infiltration and water holding capacity, increase cation exchange capacity (help soil to store nutrients).
- Two portions of soil organic matter:
  - Active fraction -- rich in simple sugars, proteins, fresh residues, microbial cells (responsible for the release of most N, P, K from organic matter)
  - Stable fraction – rich in celluloses and lignins, tougher to break down, contribute to humus (responsible for real soil organic matter, dark content, water holding capacity, cation exchange capacity or CEC)

3. IMPROVE SOIL NUTRIENT CYCLING

Cover crops enhance microbial activities involve in soil nutrient cycling

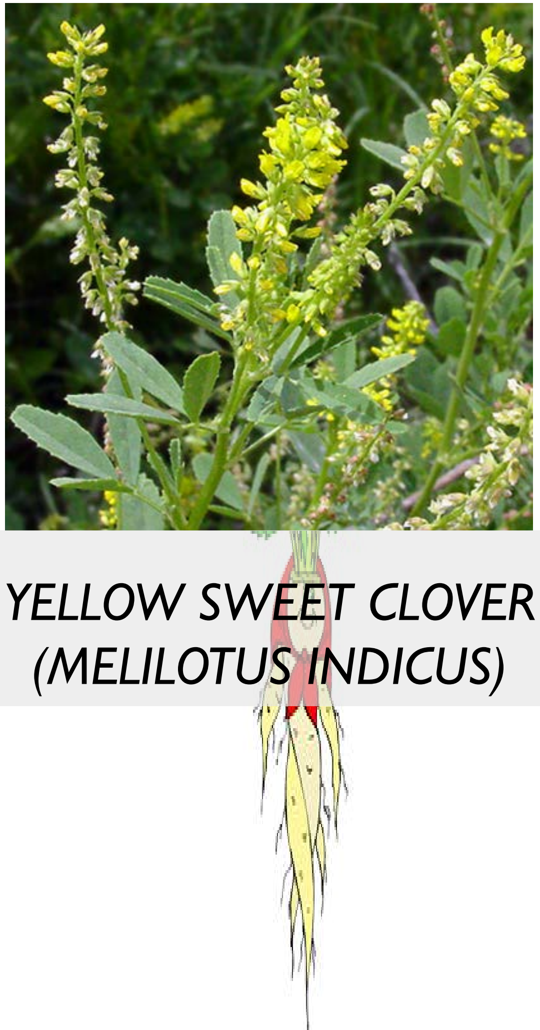






3. IMPROVE SOIL STRUCTURE

- Leguminous cover crops enhance bacteria in the soil. **Bacteria** produced polysaccharides that 'glue' soil particle together.
- Grasses have a 'fibrous' root system that help aggregate the soil between roots.
- Most plant roots develop mutualistic relationships with mycorrhizae fungi that produce **glomalin**, which glues together organic matter, plant cells, bacteria and other fungi.
- Cover crops with deep roots **(sorghum-sudangrass, rapeseed, yellow sweetclover)** also break up compacted soil.
- Cover crops (ryegrass) help dry out wet soils.
- Leading soil-building crops (e.g. rye)



YELLOW SWEET CLOVER (MELILOTUS INDICUS)

HOW TO SELECT COVER CROPS TO FIT YOUR NEEDS? (EFFECTS ON ORGANIC MATTER)

Crimson clover
Trifolium incarnatum

Oat
Avena sativa

White clover
Trifolium repens

- **Annual legumes:** Produce plant materials that are succulent and rich in proteins and sugars – leave little long-term organic matter.

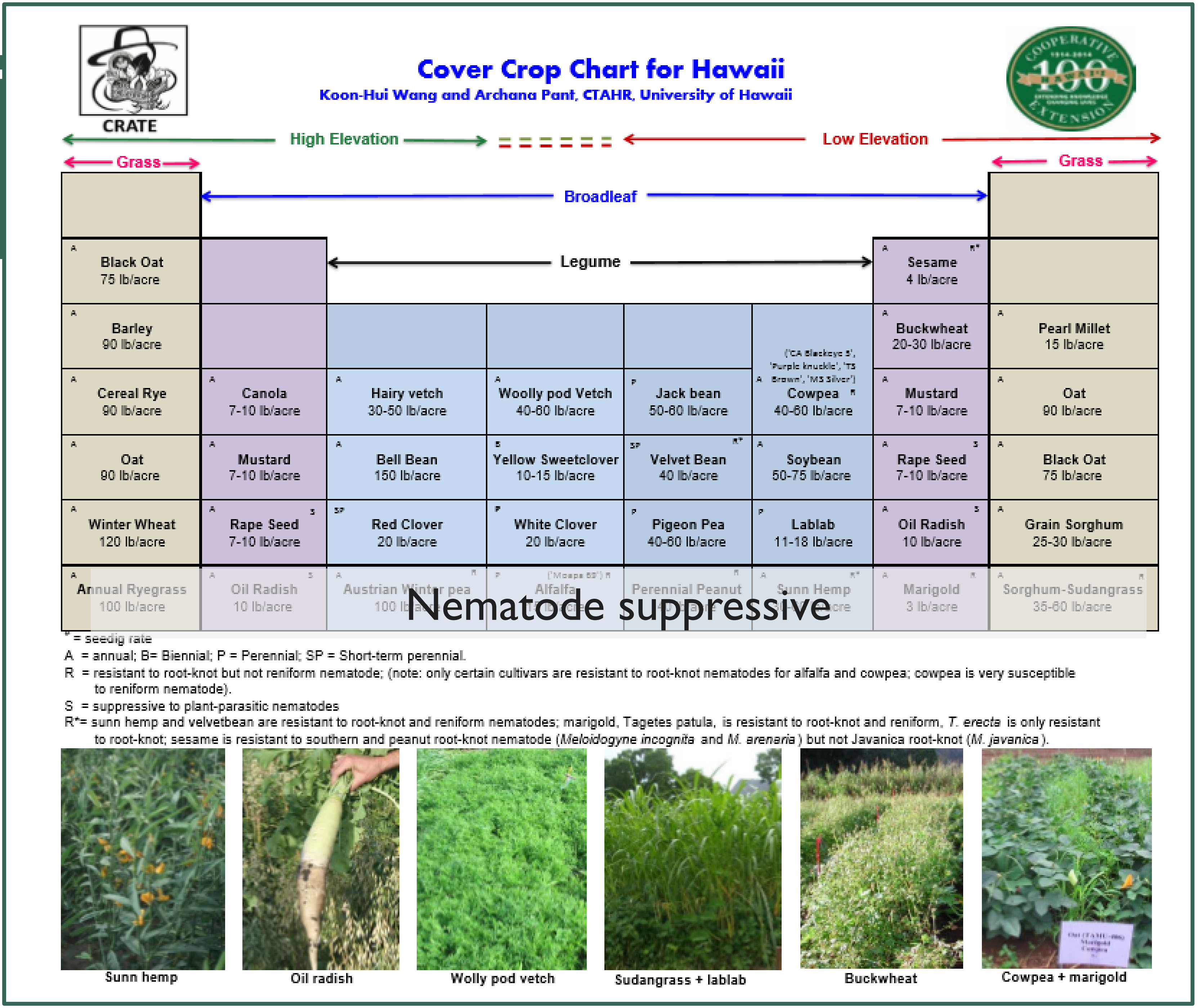
- **Grain and grasses, non-legumes:** Produce plant materials that are woodier or more fibrous – promote more stable organic matter (humus), increase soil structure, CEC, but might tie up nutrients temporarily.

- **Perennial legumes** such as perennial peanut, white clover or sunn hemp (if let sunn hemp grown for months) may fall in both categories – leaves will break down quickly, but stems and root systems can contribute to humus accumulation.

Selecting Cover Crops

http://www.ctahr.hawaii.edu/WangKH/Downloads/CCChart-Hawaii-KHWang.pdf

- Benefits of cover crop for soil fertility management
- Cover crop calculator
  - ✓ Factors affecting plant-available N% (PAN%)



PLANT AVAILABLE NITROGEN (PAN)

- Although cover crops can fix or accumulate nitrogen (N) in plant tissues, not all the N in the tissue will be released into a plant available form.

At 28 days after cover crop incorporation
At 70 days after cover crop incorporation

$[NO_3^-]$

$[NO_3^-]$

$$\text{Plant Available Nitrogen (PAN \%)} = \frac{[\text{Soil nitrate with cover crop (mg/kg)} - \text{soil nitrate without cover crop}]}{\text{Total N added by cover crop (mg/kg)}} \times 100$$

% N in tissue × cover crop biomass = Total N

Actual PAN = cover crop dry biomass × % N × PAN%

Amount of N fertilizer input that farmers can cut back

FACTORS AFFECTING PAN% FROM COVER CROP

- climate conditions, season
- soil types
- cover crop species
- biomass, plant age, % N in tissue
- time after cover crop termination
- farming practice (till vs no-till)
- microbial activities in your soil

Based on studies in Kansas, Vigil and Kissel (1991) found strong correlation between PAN released % with % N in tissues

$$PAN\ (\%) = -53.44 + 16.98\ (\%\ N\ in\ tissue \times 10)^{1/2}$$

However, Hawaii has many micro-climates and soil types. Thus, different PAN prediction models need to be developed for different regions in Hawaii……………

PAN FROM COVER CROPS IN POAMOHO, OAHU (WINTER)

Cover Cropping Practice				Cover Crop Tissue			28 Days		70 Days	
Season/tillage	Cover Crop	Fresh Weight (lb/ft^2)	Dry Content (%)	Dry Weight (lb/Acre)	Tissue N (%)	Total N(lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN(lb/A)
Winter/Till	Sunn hemp	1.2	23.10%	12074.83	1.66	200.44	55.24	110.72	67.82	135.94
Winter/Till	Cowpea (Blackeye #5)	1.04	13.70%	6206.43	2.87	178.12	63.74	113.54	75.17	133.90
Winter/Till	Lablab	0.78	14.89%	5059.15	2.75	139.13	62.72	87.26	75.22	104.65
Winter/Till	Pigeon pea	0.55	20.47%	4904.20	3.47	170.18	66.14	112.55	81.69	139.02
Winter/Till	Woolypod vetch	0.55	9.21%	2206.53	4.43	97.75	70.52	68.93	84.19	82.30

- % Tissue N varied among cover crop species.
- Some cover crop released PAN more efficiently than others (70.5% vs 55.2%).
- Actual PAN can be strongly influenced by cover crop biomass.

http://www.ctahr.hawaii.edu/WangKH/cover-crop.html

PAN FROM COVER CROPS IN POAMOHO, OAHU (SUMMER)

Cover Cropping Practice				Cover Crop Tissue			28 Days		70 Days	
Season/tillage	Cover Crop	Fresh Weight (lb/ft^2)	Dry Content (%)	Dry Weight (lb/Acre)	Tissue N (%)	Total N(lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN(lb/A)
Winter/No-till	Sunn hemp	1.07	24.62%	11475.19	2	229.50	56.85	130.47	66.72	153.12
Winter/No-till	Cowpea (Blackeye #5)	1.47	14.20%	9092.71	2	181.85	56.6	102.93	65.42	118.97
Summer										
Summer/No-till	Sunn hemp	0.72	21.34%	6692.91	2.72	182.05	60.54 ✓	110.21	75.14 ✓	136.79
Summer/No-till	Cowpea	1.54	14.24%	9552.53	2.83	270.34	67.57 ✓	182.67	74.43 ✓	201.21
Summer/No-till	Lablab	0.34	13.31%	1971.26	3.13	61.70	78.05	48.16	81.91	50.54
Summer/No-till	Sudex	0.96	16.02%	6699.18	1.33	89.10	43.48	38.74	54.95	48.96
Summer/No-till	Oat (TAM406)	0.51	14.72%	3270.14	1.84	60.17	46.25	27.83	62.55	37.64
Summer/No-till	Oil Radish	0.55	6.40%	1533.31	2.49 ✓	38.18	70.8 ✓	27.03	77 ✓	29.40

- PAN released % was higher in summer than winter.
- Grassy cover crops had lower % N and slower PAN released % compared to legumes, but that in oil radish was equivalent or higher than legumes, thus a good nutrient scavenging crop.

PAN FROM COVER CROPS IN LALAMILO, HAWAII

Cover Cropping Practice				Cover Crop Tissue			28 Days		70 Days	
Season/tillage	Cover Crop	Fresh Weight (lb/ft^2)	Dry Content (%)	Dry Weight (lb/Acre)	Tissue N (%)	Total N(lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN(lb/A)
Winter/Till	Bell bean	0.78	10.60%	3601.54	4.2	151.26	64.03	96.85	69.95	105.81
Winter/Till	Austrian Winter Pea	0.6	11.70%	3057.91	4.9	149.84	63.34	94.91	67.72	101.47
Winter/Till	Annual ryegrass	0.36	13.42%	2104.47	4.72	99.33	54.76	54.39	60.58	60.17
Winter/Till	Woolypod vetch	0.45	11.20%	2195.42	5.32	116.80	58.46 ✓	68.28	66.57	77.75
Winter/Till	Oat (Cayuse)	1.15	17.20%	8616.17	2.34	201.62	42.55	85.79	53.28	107.42

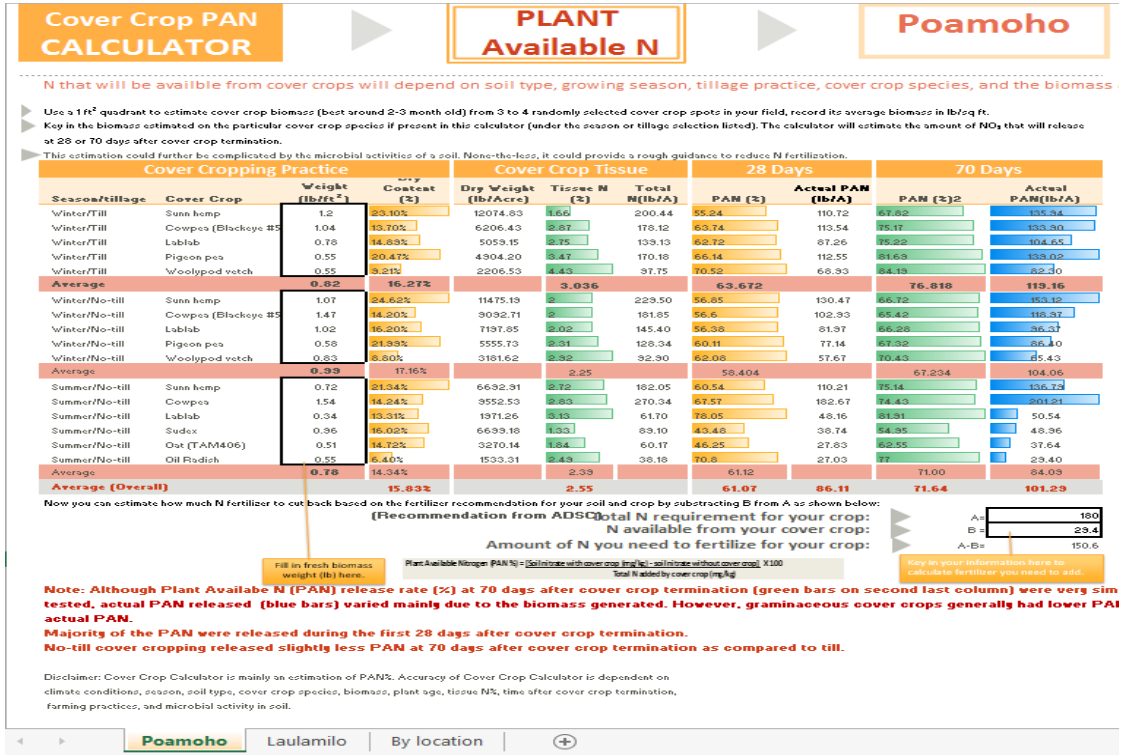
- PAN released % could change from location to location.
- Although N % in these cover crops were higher than the tropical legumes tested earlier, the actual PAN released were lower.
- Farmers could calculate amount of N fertilizer needed to full-fill the crop requirement.

Total N requirement for your crop:	A =	180
(Recommended by ADSC)		
N available from your cover crop:	B =	105
Amount of N you need to fertilize for your crop:	A-B =	75

How to use Cover Crop Calculator?

http://www.ctahr.hawaii.edu/WangKH/cover-crop.html

Tissue N%



Cover Crop PAN CALCULATOR ▶ PLANT Available N ▶ Poamoho

N that will be availble from cover crops will depend on soil type, growing season, tillage practice, cover crop species, and the biomass

- Use a 1 ft² quadrant to estimate cover crop biomass (best around 2-3 month old) from 3 to 4 randomly selected cover crop spots in your field, record its average biomass in lb/sq ft.
- Key in the biomass estimated on the particular cover crop species if present in this calculator (under the season or tillage selection listed). The calculator will estimate the amount of NO_3 that will release at 28 or 70 days after cover crop termination.
- This estimation could further be complicated by the microbial activities of a soil. None-the-less, it could provide a rough guidance to reduce N fertilization.

Cover Cropping Practice				Cover Crop Tissue			28 Days		70 Days	
Season/tillage	Cover Crop	Weight (lb/ft²)	Dry Content (%)	Dry Weight (lb/Acre)	Tissue N (%)	Total N(lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN(lb/A)
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Winter/Till	Pigeon pea	0.55	20.47%	4904.20	3.47	170.18	66.14	112.55	81.69	139.02
Winter/Till	Woolypod vetch	0.55	9.21%	2206.53	4.43	97.75	70.52	68.93	84.19	82.30
Average		0.82	16.27%		3.036		63.672		76.818	119.16
Winter/No-till	Sunn hemp	1.07	24.62%	11475.19	2	229.50	56.85	130.47	66.72	153.12
Winter/No-till	Cowpea (Blackeye #5	1.47	14.20%	9092.71	2	181.85	56.6	102.93	65.42	118.97
Winter/No-till	Lablab	1.02	16.20%	7197.85	2.02	145.40	56.38	81.97	66.28	96.37
Winter/No-till	Pigeon pea	0.58	21.99%	5555.73	2.31	128.34	60.11	77.14	67.32	86.40
Winter/No-till	Woolypod vetch	0.83	8.80%	3181.62	2.92	92.90	62.08	57.67	70.43	65.43
Average		0.99	17.16%		2.25		58.404		67.234	104.06
Summer/No-till	Sunn hemp	0.72	21.34%	6692.91	2.72	182.05	60.54	110.21	75.14	136.73
Summer/No-till	Cowpea	1.54	14.24%	9552.53	2.83	270.34	67.57	182.67	74.43	201.21
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Summer/No-till	Oil Radish	0.55	6.40%	1533.31	2.49	38.18	70.8	27.03	77	29.40
Average		0.78	14.34%		2.39		61.12		71.00	84.09
Average (Overall)			15.83%		2.55		61.07	86.11	71.64	101.29

Now you can estimate how much N fertilizer to cut back based on the fertilizer recommendation for your soil and crop by substracting B from A as shown below:

(Recommendation from ADSC) Total N requirement for your crop: A= 180

N available from your cover crop: B = 29.4

Amount of N you need to fertilize for your crop: A-B= 150.6

Fill in fresh biomass weight (lb) here.

Plant Available Nitrogen (PAN %) = [Soil nitrate with cover crop (mg/kg) - soil nitrate without cover crop] / Total N added by cover crop (mg/kg) X 100

Key in your information here to calculate fertilizer you need to add.

Note: Although Plant Availabe N (PAN) release rate (%) at 70 days after cover crop termination (green bars on second last column) were very sim tested, actual PAN released (blue bars) varied mainly due to the biomass generated. However, graminaceous cover crops generally had lower PAI actual PAN.

Majority of the PAN were released during the first 28 days after cover crop termination.

No-till cover cropping released slightly less PAN at 70 days after cover crop termination as compared to till.

Disclaimer: Cover Crop Calculator is mainly an estimation of PAN%. Accuracy of Cover Crop Calculator is dependent on climate conditions, season, soil type, cover crop species, biomass, plant age, tissue N%, time after cover crop termination, farming practices, and microbial activity in soil.

Poamoho | Laulamilo | By location

1. **Estimate cover crop dry biomass (lbs/acre)**
2. **Send tissue to analyze for tissue N content (%)**
3. **Find a location in Cover Crop Calculator similar to your area, calculate actual PAN at 4 or 10 weeks after cover crop termination.**

Amount of N fertilizer input that farmers can cut back = Actual PAN = % N × cover crop dry biomass × PAN%

Cover Crop PAN CALCULATOR

PLANT Available N

By location

- In the event that you grow a cover crop mix, you can send a sample of your cover crop tissue at crop termination to Agriculture Diagnostic Service Center (ADSC) to assay for **tissue N (%)**, and estimate the **dry weight** of your cover crop biomass in lb/acre.
Estimate **dry weight** by collecting fresh cover crop biomass in lb/ft^2, dry tissue in sun, and weigh.
- Estimate plant available Nitrogen (PAN) from your cover crop mix by using PAN-N regression lines generated for your location.

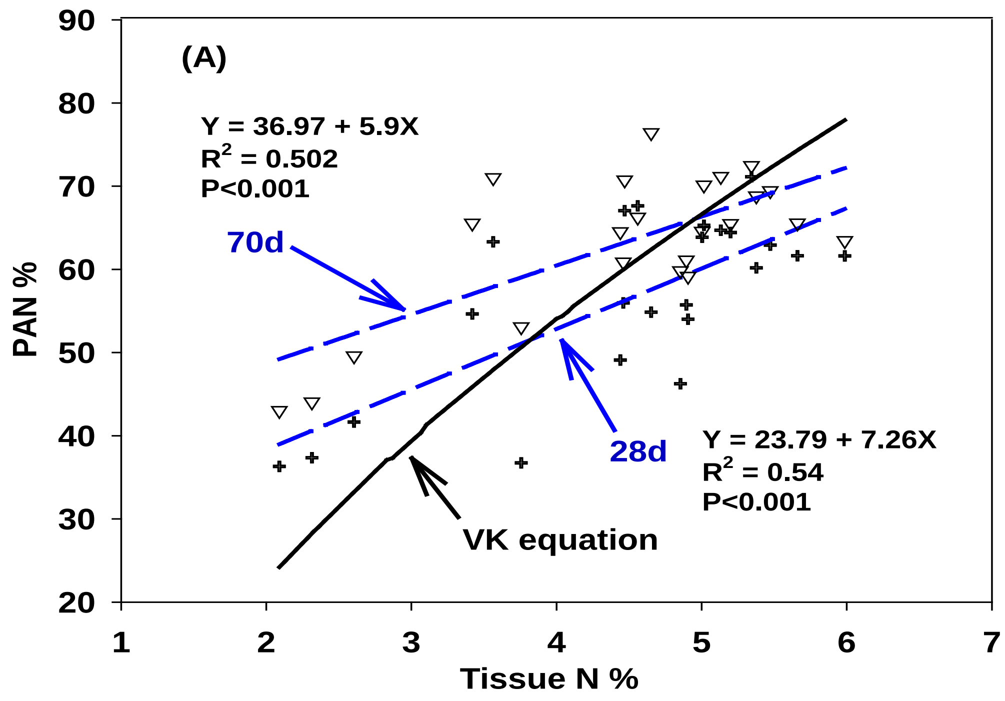
Key in

	Cover Crop Tissue				28 Days		70 Days	
Location	Dry Weight (lb/ft^2)	Dry Weight (lb/Acre)	Tissue N (%)	Total N(lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN(lb/A)
Poamoho	0.15	6534	2	131	55.4	72	66.7	87.16356
Waimea	0.15	6534	2	131	38.31	50	48.77	63.732636
Kula	0.15	6534	2	131	39.342	51	54.518	71.2441224
Hoolehua	0.15	6534	2	131	30.179	39	39.912	52.1570016

Actual PAN = Cover crop biomass (dry weight in lb/acre) × Tissue N% × PAN%

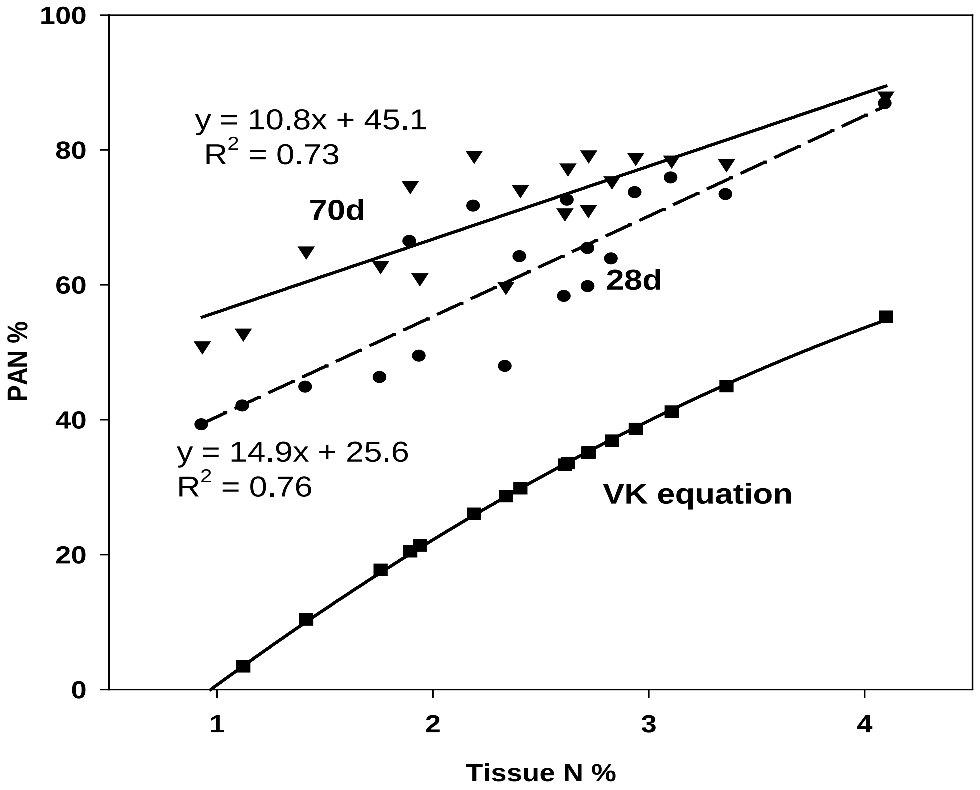
PAN% PREDICTION CURVES IN HI

PAN% Prediction Curve at Waiamea

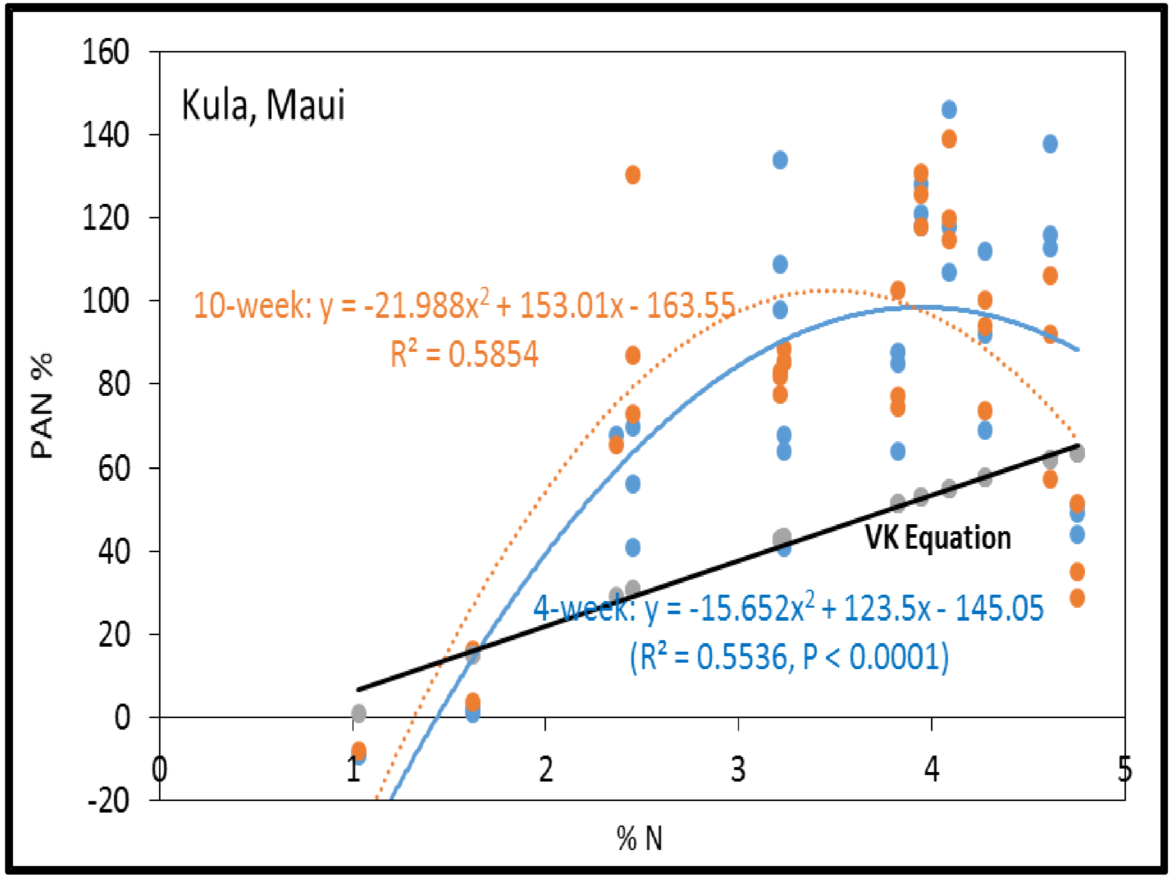


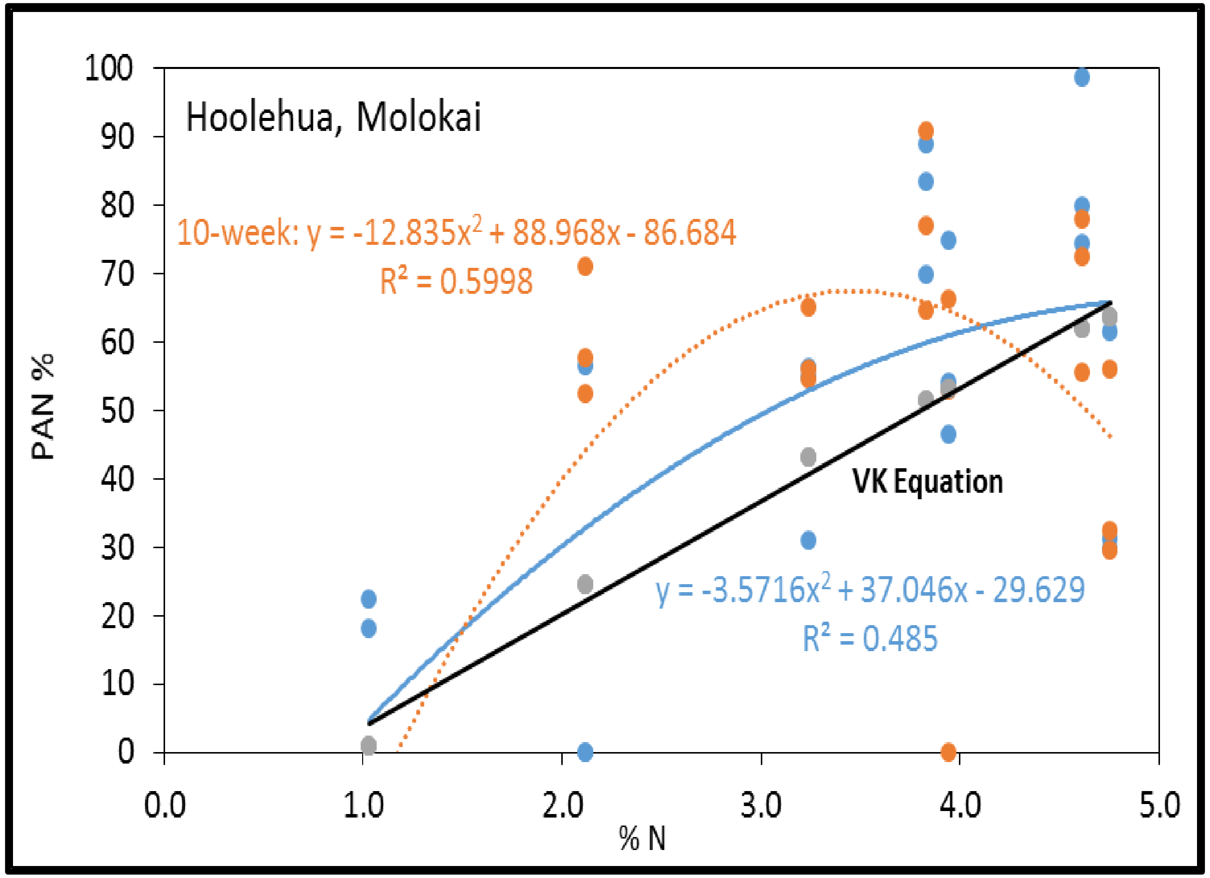
PAN% prediction curve based on %N in cover crop tissues (any cover crop mix will work) generated from Waiamea and Poamoho are very different from that predicted by VK equation.

PAN% Prediction Curve at Poamoho



PAN% PREDICTION CURVES IN HI





- In general, PAN% of tissues with %N between 2-4% are higher in Hawaii than that using VK prediction.
- But PAN% of tissues with %N higher than 4% might result in reduction of PAN% in HI possibly due to N immobilization.

FARMER'S SAMPLES

	Dry wt (tons/A)	Tissue N (%)	28 day PAN (%)	28 day Actual PAN (lb/A)	40 day PAN (%)	40 day Actual PAN (lb/A)
Hirayama	1.94	4.05	61.73	95.08	68.77	106.03
Bonk	1.38	4.77	62.92	90.53	71.42	93.64
Robbs	2.64	2.64	62.22	89.60	-	-

	Cover crops mix
Hirayama	Vetch, red clover, spring pea, oats
Bonk	Oil radish, vetch
Robbs	Cayuse oat, bell beans, purple vetch, Austrian winter peas

Majority of the PAN was released during the first 28 days after cover crop termination, thus **additional fertilizer should be added there after.**

CONCLUSION

- ✓ Although PAN release rates at 70 days after cover crop termination were similar among all legumes and oil radish tested, actual PAN released varied mainly due to the biomass generated. **Thus, it is a good practice for farmers to estimate cover crop biomass accumulated prior to termination of cover crop**.
- ✓ Graminaceous cover crops generally had lower PAN%, resulted in lower actual PAN regardless of the biomass generated. None-the-less, graminaceous cover crops are good nutrient scavenging crops, and soil C builders.
- ✓ Majority of the PAN was released during the first 28 days after cover crop termination, thus **additional fertilizer should be added there after.**

BENEFITS OF COVER CROPS FOR PEST MANAGEMENT

BENEFITS OF COVER CROPPING

1. Reduce fertilizer costs
2. Add organic matter
3. Improve yields by enhancing soil health
4. Reduce the need for herbicides and other pesticides (insecticide, nematicide)
5. Prevent soil erosion
6. Conserve soil moisture
7. Protect water quality
8. Help safeguard personal health
9. Some cover crops offer harvest possibilities as forage, grazing or seed in multiple crop enterprises.

4-1. REDUCE THE NEED FOR HERBICIDES

Cover crops can effectively suppress weeds by:

- Producing allelopathic compounds that provide natural herbicidal effects (e.g. sudangrass, rye)
- Smothering / outcompetes weeds for water and nutrients (e.g. buckwheat, yellow sweet clover, woollypod vetch)
- Shading weeds (e.g. sunn hemp)

Squash grown in a plot mulched with sudangrass residues.

Ex. Fall planted brassica cover crops coupled with mechanical cultivation help potato growers with a long growing season maintain marketable yield and reduce herbicide applications by 25% (Stark, 1995).

Buckwheat smothered weeds between zucchini rows

C.R.R. Hooks

COVER CROP AS INSECTARY PLANTS

INSECTARY PLANTS

Plants that attract insects, either produce flowers with pollen and nectar for beneficial insects, or lure insect pests away from the cash crop.

Lady beetles on Aweoweo

Hoverflies on buckwheat and cilantro

Sunn hemp flowers attracts Lycaenidae butterflies that drawn *Trichogramma* wasps to lay eggs on the Lepidopteran eggs.

Uhaloa attracts wasps and bees

BORDER COVER CROPS ALSO SERVE AS FOOD SOURCE FOR POLLINATORS

Amaranth

Yellow Crown Beard

Sweat bee

Carpenter bee

Leaf cutter
+ Sweat bee

Green bee

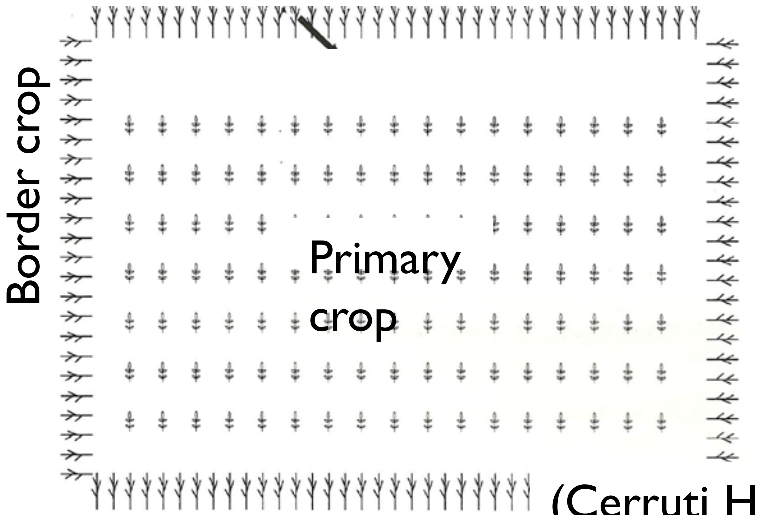
Leaf cutter
bee

Leaf cutter+honey bee

Pollinators visiting sunn hemp flowers

HOW TO USE COVER CROPS AS INSECTARY PLANTS?

1. As border crop



(Cerruti Hooks)

2. As intercrop

Buckwheat and zucchini

Sunn hemp and corn

(Roshan Manandhar)

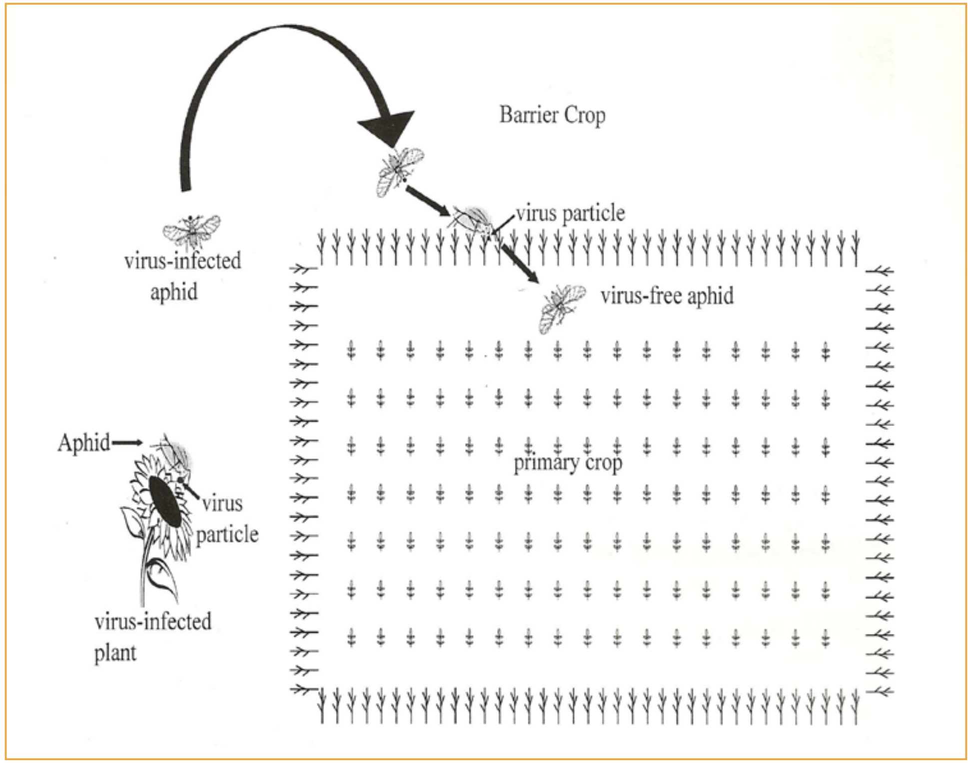
3. Insectary plant corridors (Nicholls, Parrella, and Altieri, 2000)

HOW TO USE COVER CROPS AS INSECTARY PLANTS?

3. As organic mulch (no-till)

Cowpea and buckwheat as insectary borders, and sunn hemp organic mulch harbor natural enemies or parasites against insect pests (thrips, leaf miners) and fungal disease (purple blotch).

4. As trap crop / virus sink theory



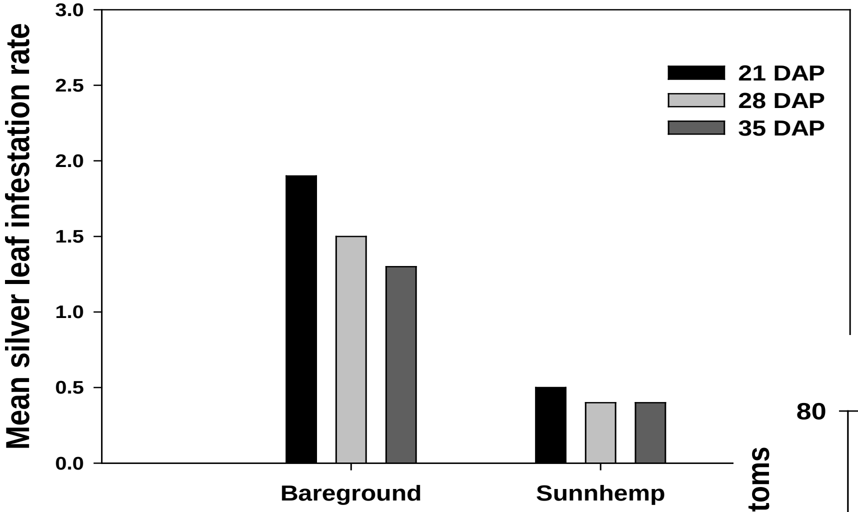
HOW TO USE COVER CROPS AS INSECTARY PLANTS?

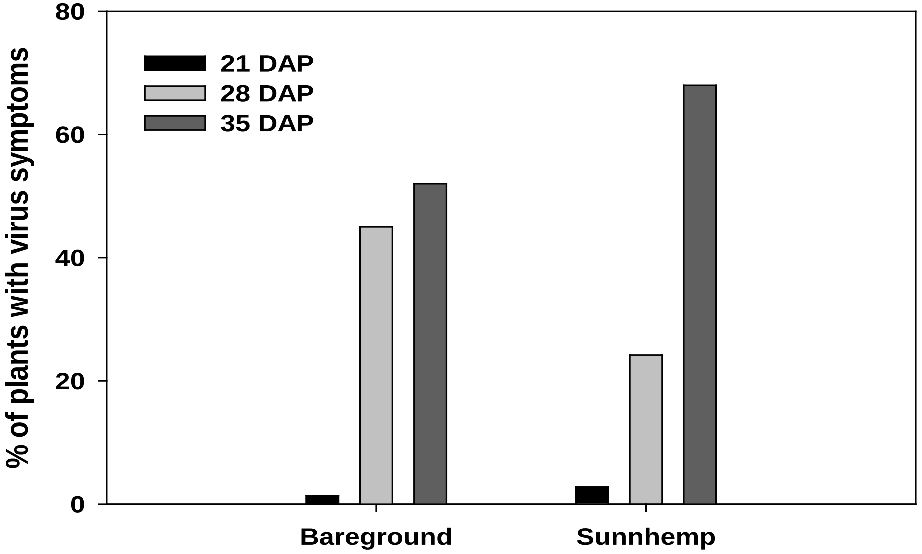
5. Cover crop in strip-till system: as living mulch and surface mulch

SUNN HEMP SERVES AS TRAP CROP FOR WHITEFLIES, THUS REDUCING SILVERLEAF SYMPTOMATIC ZUCCHINI

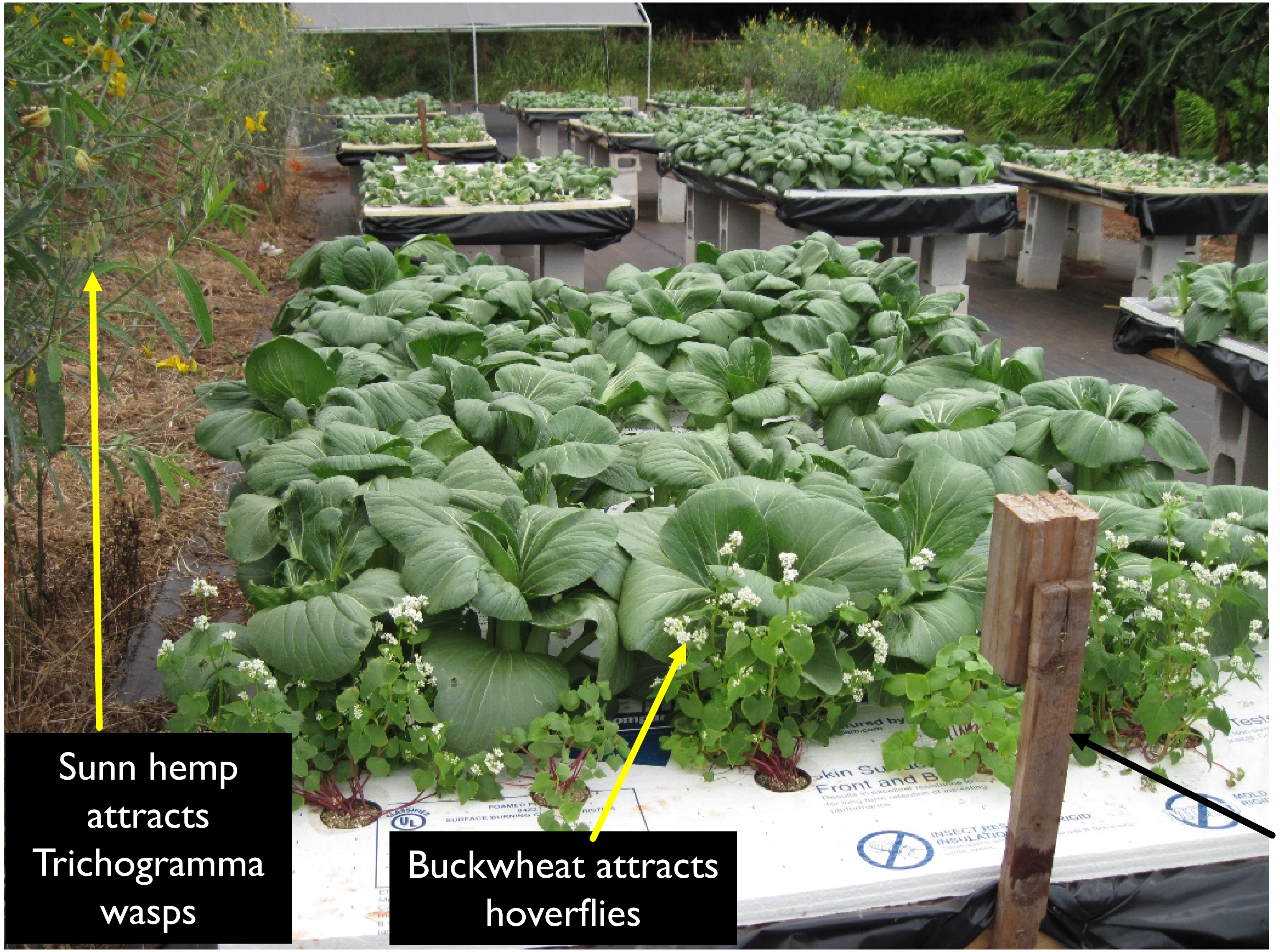
Zucchini intercropped with sunn hemp.

Zucchini in bare ground showing silver leaf symptom





Insectary Planting System for Hydroponic Production



Wasp nesting block attracts keyhole wasps

WASP NESTING BLOCK

Pollinators

Leaf cutter bee

Hylaeus bee

Untreated wood

Predators

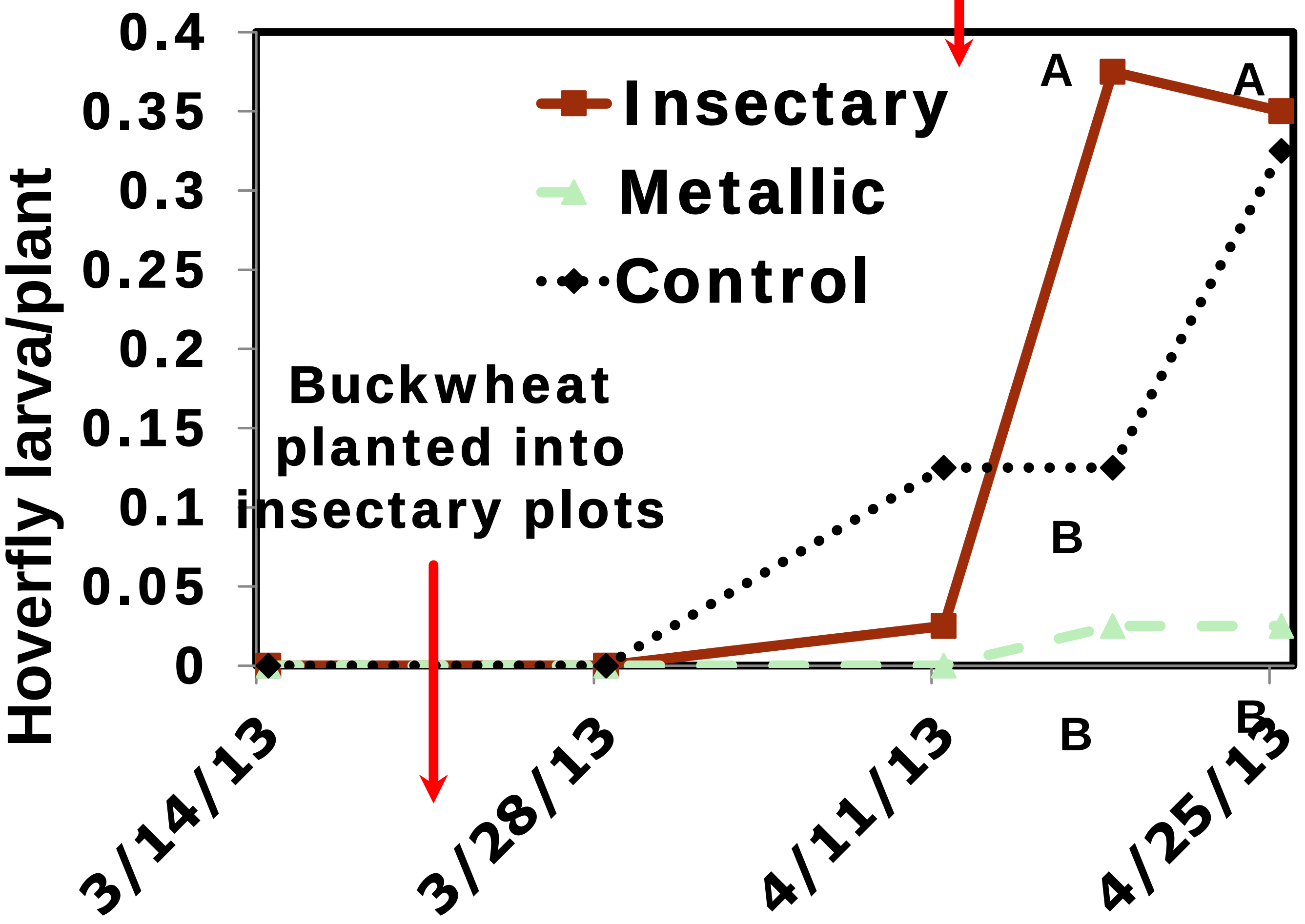
Key-hole Wasp

http://bugguide.net/node/view/241212

Aphid-collecting Wasp

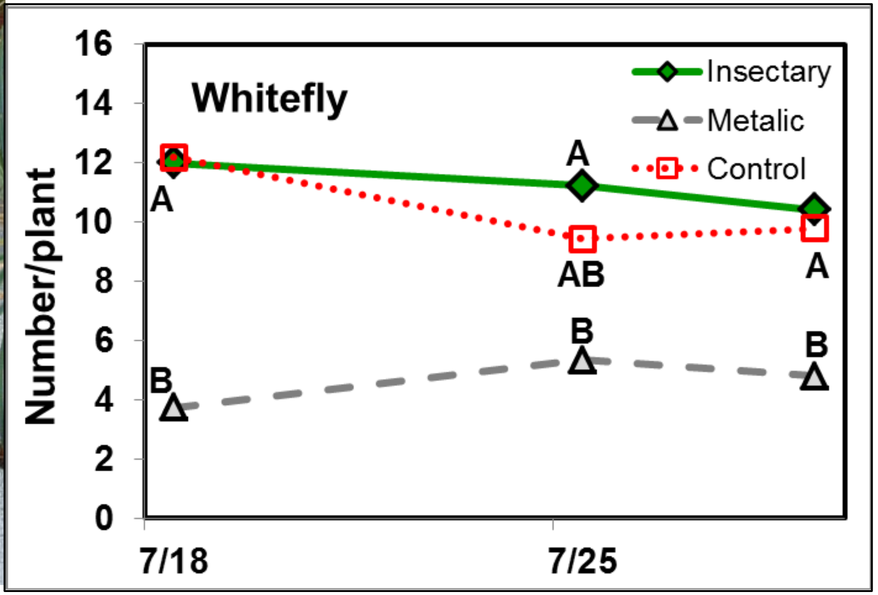
HOVERFLIES

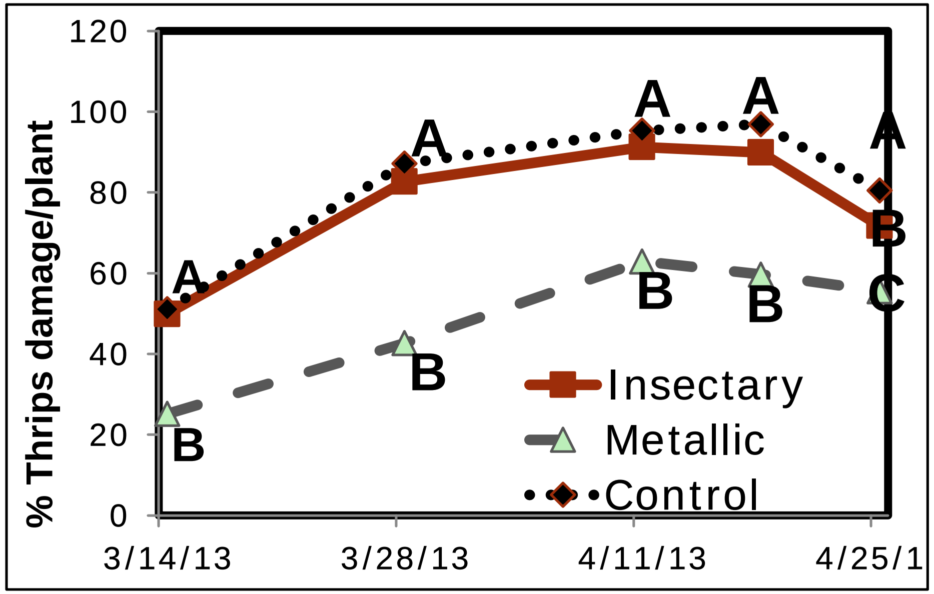
Buckwheat just started flowering



Hoverfly larva eating aphid

Reflective board reduce whiteflies and thrips damage





Main insect pests on brassica

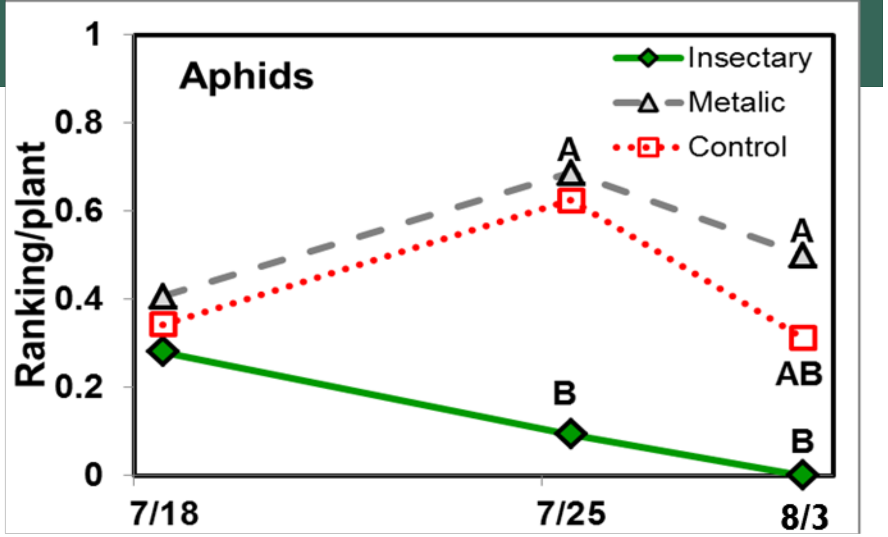

Diamondback moth (DBM) larva

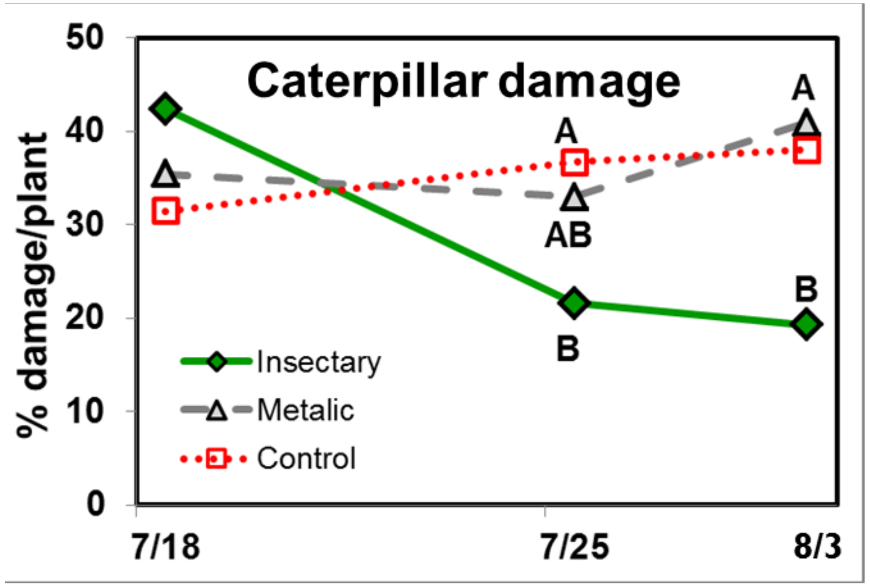

Imported cabbage web worm larva


Imported cabbage worm larva


Aphids

Insectary setting suppressed aphids and caterpillar damage





BENEFICIAL INSECTS

Trichogramma wasp

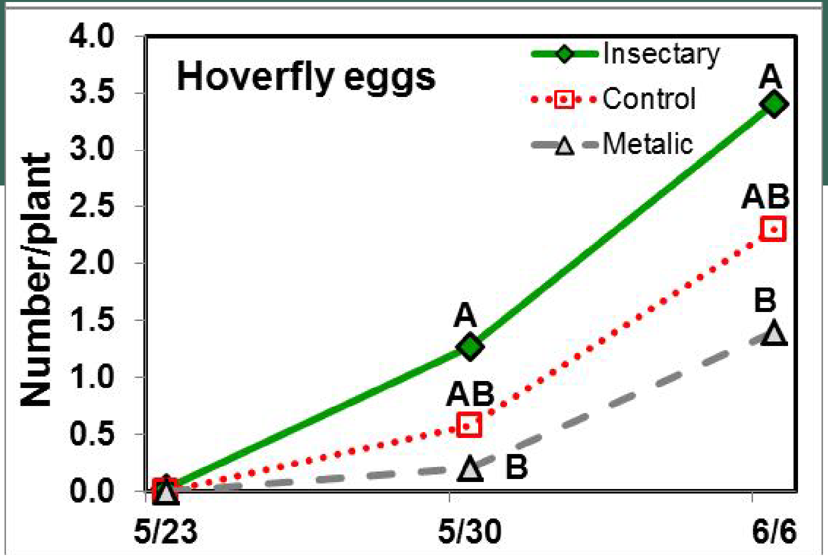
Parasitized aphids

Hoverfly larvae eating an aphid

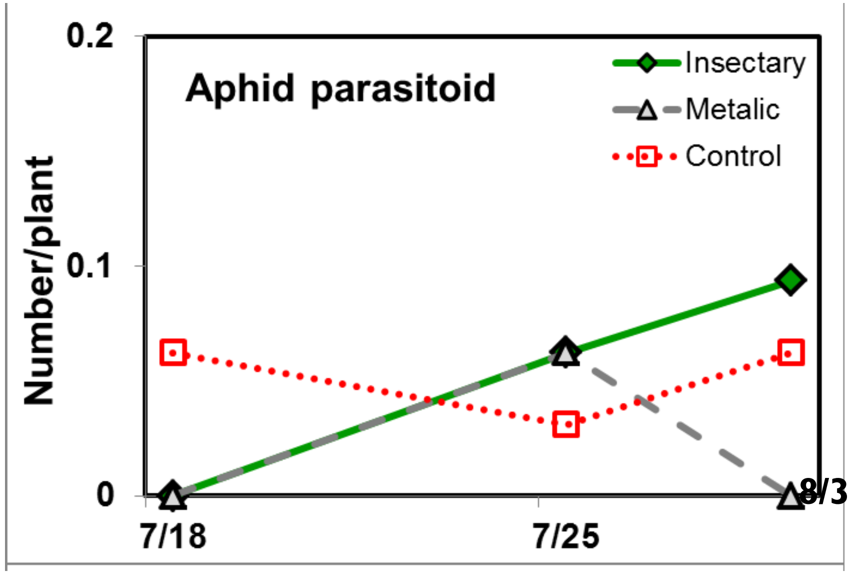
Evidence of the DBM parasitoid wasp

Hoverfly eggs among aphids

Trial I



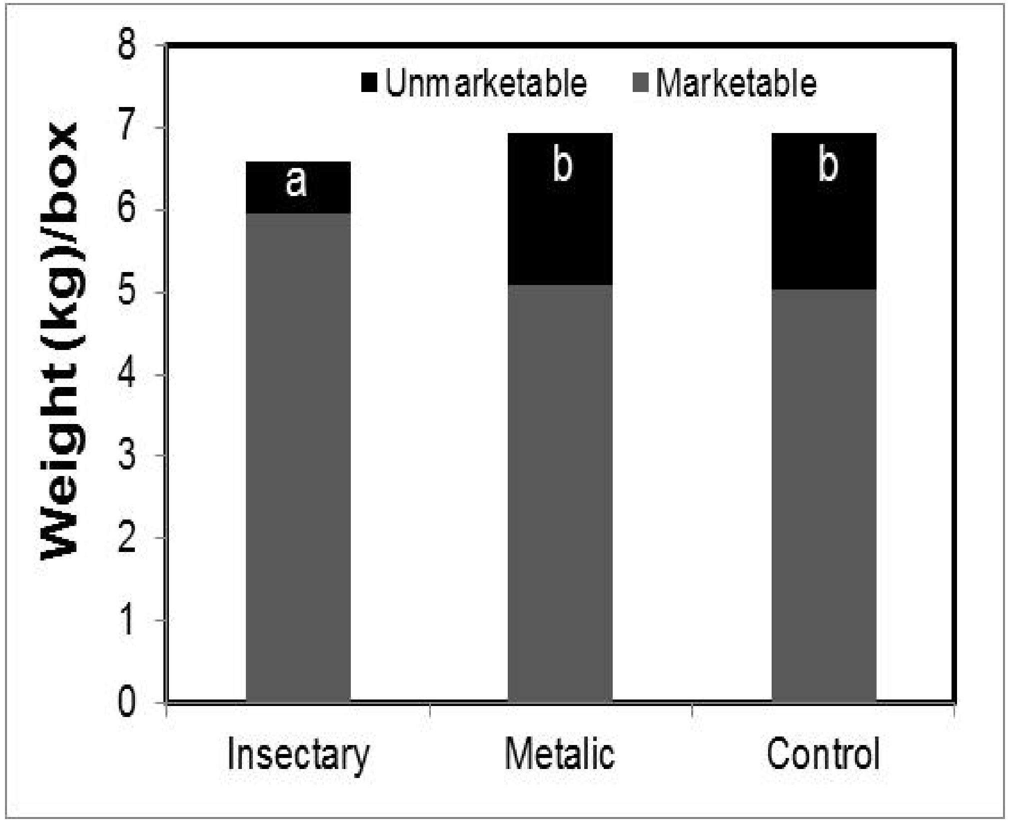
Trial II



SUMMARY

Insectary box:

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



BENEFITS OF COVER CROPPING

1. Reduce fertilizer costs
2. Add organic matter
3. Improve yields by enhancing soil health
4. Reduce the need for herbicides and other pesticides (insecticide, nematicide)
5. Prevent soil erosion
6. Conserve soil moisture
7. Protect water quality
8. Help safeguard personal health
9. Some cover crops offer harvest possibilities as forage, grazing or seed in multiple crop enterprises.

5. PREVENT SOIL EROSION

- Topsoil is the most fertile portion of a field that contain the highest % of organic matter and nutrients. Thus, it is wise to protect soil from erosion.

White clover as ground cover between zucchini rows.

Planting field border with vetiver grass with deep root system is perfect for soil erosion prevention.

5. PREVENT SOIL EROSION

- Select quick-growing cover crops could protect soil against wind and rain erosion.
- Grain cover is better than legumes for erosion control because legumes decompose quickly.
- Shoots of cover crops protect soil from the impact of rain-drops.
- Long-term use of cover crops, increase soil organic matter, improve soil structure, thus increases water infiltration and reduces runoff.

6. CONSERVE SOIL MOISTURE

- Organic surface mulch provided by cover crops (especially grassy cover in conservation till system) increase water infiltration and reduces evaporation.

7 years no-till (NT), black oat cover crop plus *Crotalaria spectabilis* as additional organic mulch

Conventional tillage, bare ground (BG)

Solarization (SOL)

6. CONSERVE SOIL MOISTURE

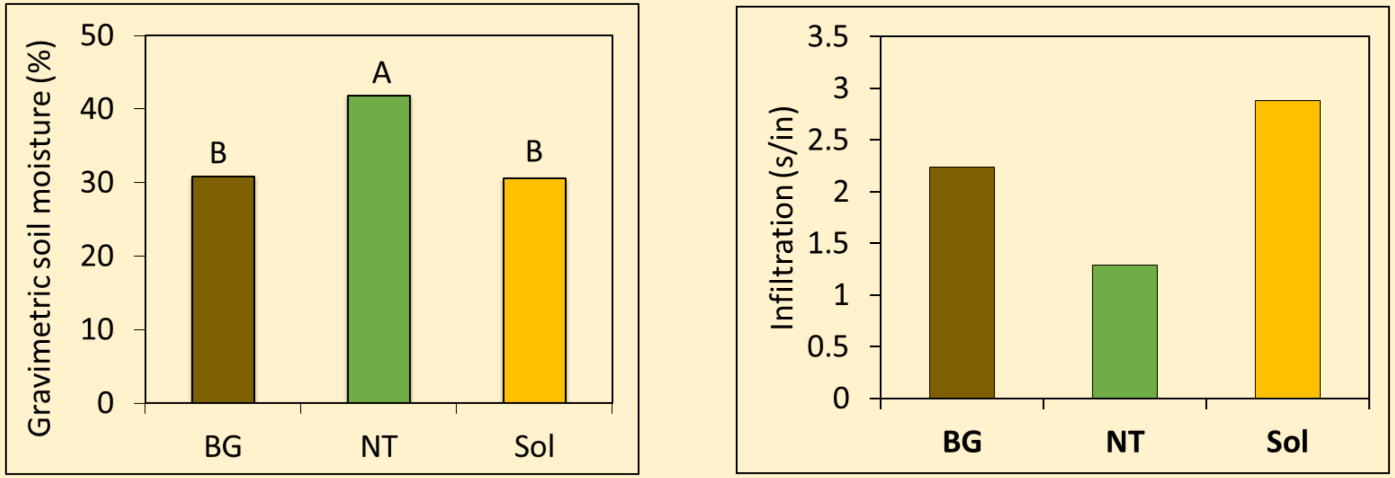
Simulation rainfall

More water infiltrates through the NT column

No water infiltrates in BG

NT = No-till, BG = Bare Ground, Sol = Solarization

Enhancing Plant available water



No-till conserved soil moisture, improved water infiltration and percolation and soil aggregation

- Soil water holding capacity was higher in NT.
- Water infiltrated through NT soil faster than that in BG and Sol.

OUTLINE



- Benefits of cover cropping
- Cover crop calculator
  - Factors affecting plant available N% (PAN%)
- Sustainable approaches for pest management
  - Insect pests
  - Nematodes
  - Weeds

ALTERNATIVE NON-CHEMICAL BASED PEST MANAGEMENT

Banker plant, High Tunnel Screenhouse, Hot water treatment, etc

MACARANGA TANARIUS *as Natural Banker Plant for minute pirate bug*

Orius spp.
Minute pirate bug

Female flowers

Male flowers

Dr. Robert Hollingsworth, USDA ARS, Hilo introduced Macaranga male flowers (minute pirate bug) into orchid nurseries to control thrips.

Insect Exclusion Screenhouse: Pumpkin / Cucumber

17 mesh-insect exclusion screenhouse

Hand pollinate pumpkin

Pickle worms on cucumber

Fruitflies/melon flies damage

Parthenocarpic cucumber

Minimal damage from pickle worm or fruit flies

But plants die prematurely from root-knot nematode infection that cause the plant to wilt.

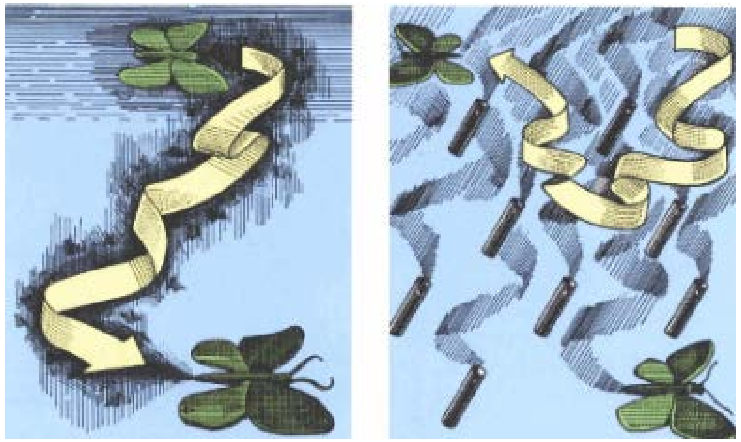
Luring and Trapping

Rose Beetle Light Trap

https://vimeo.com/166306170

Fruit flies methyl eugenol/cue-lure traps

Pin worm
Nomate

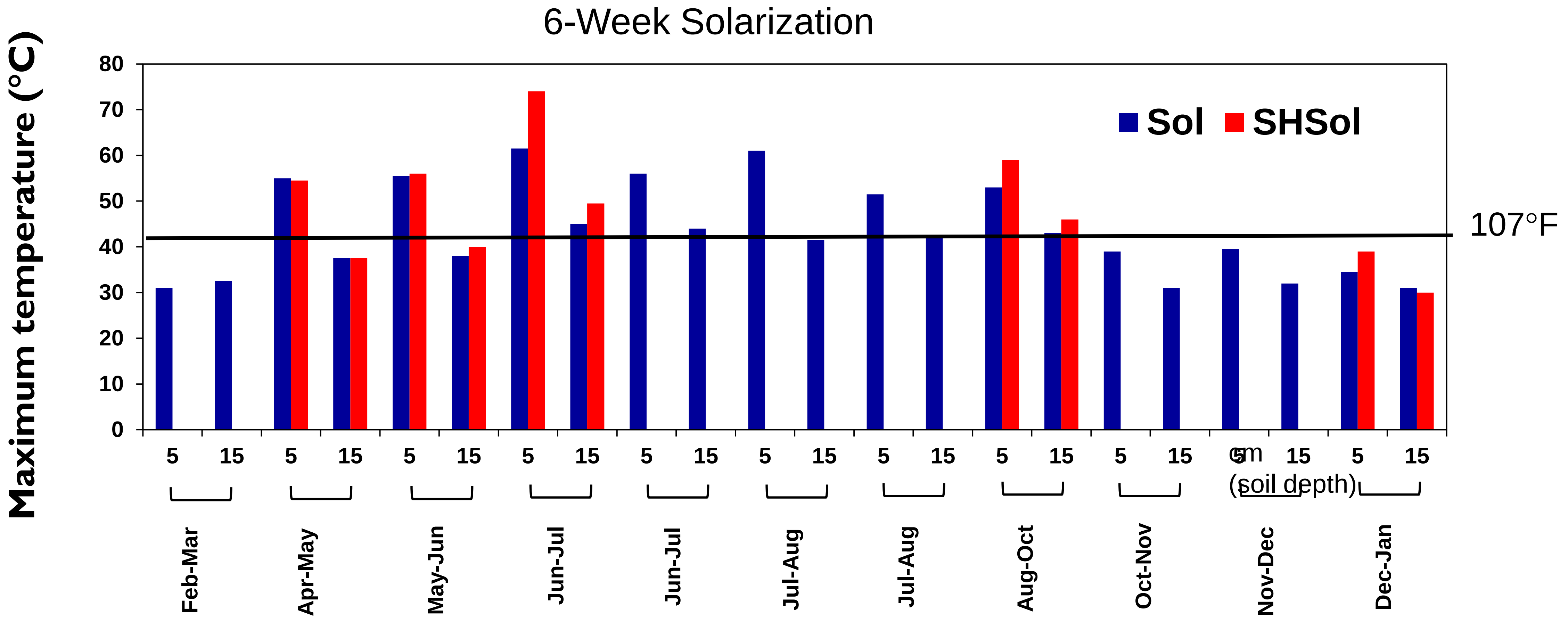


WEED MANAGEMENT

Solarization for weed management

- Soil solarization involves covering the soil with transparent mulch (25-μm-thick, uv-stabilized, low-density polyethylene mulch) for 6 weeks so that it reaches temperatures detrimental to soilborne pests and pathogens.

SOLARIZATION TEMPERATURE SCHEME IN HAWAII



(Wang 2011)

Solarization for Weed Management

Solarization reduces weed seed bank effectively.

If solarization mulch is not available, flush the planting beds with water over 2-3 weeks, then kill the weeds with weed flamer when weeds are young also significantly reduce weed seed bank.

Turn-the-page Technique for No-till Nematodes and Weed Management

Turn-the-page Technique for No-till Nematodes and Weed Management

Trap crops were terminated, lightly tilled into soil, tarp with solarization mulch or just weed mat. Let glucosinolate convert into isothiocinate for biofumigation.

Weed mat was used again to help suppress more weeds, and break down oil radish residues.

Turn-the-page Technique for No-till Nematodes and Weed Management

TTP method does not suppress weed seed bank, but works well for transplanting crops that have higher weed tolerance level. Post plant weeding is needed but manageable.

Chicken Tractor in Hawaii

Grazing cages by

Glenn Fukumoto

Kona

- Suitable for wide row spacing orchard system.
- Chicken likes to dig out nutsedge tubers.

ALTERNATIVELY……..
(HEAVY MULCHING)

Three Sisters Cropping System

Any question?

Summary

HOW TO SELECT COVER CROP THAT FIT YOUR NEEDS?

Needs	Cover crop suitable for Hawaii climate
N source	
Add Org matter	
Drought tolerant	
Acid soil	
Salt tolerant	

Summary

HOW TO SELECT COVER CROP THAT FIT YOUR NEEDS?

Needs	Cover crop suitable for Hawaii climate
Weed suppressive	[redacted]
Weed suppressive	[redacted]
Nematode suppressive	[redacted]
Deep root	[redacted]
Nutrient scavenging	[redacted]

ACKNOWLEDGEMENT

- Shelby Ching, Shova Mishra, Philip Waisen, Josiah Marquez, Donna Meyer, Gareth Nagai, Archana Pant.
- Marla Fergerstrom, Susan Migita, Pam Shingaki and Farm Crews from Mealani, Poamoho, and Kula Experiment Stations and Randy Hamasaki, Maria Derval Diaz, Brian Bush

- http://www.ctahr.hawaii.edu/WangKH/cover-crop.html
- http://www.ctahr.hawaii.edu/WangKH/Downloads/P-High-elevation-covercrops.pdf
- https://youtu.be/cBP52egYG9s
- https://vimeo.com/166306088

This project is supported in part by NRCS CIG grant (project number 69-3A75-14-231) and in part by NIFA CRATE program (project number 2013-04774).