Local Organic Fertilizers for Food Security and Self Sufficiency

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Local Inputs

Composts

Tankage

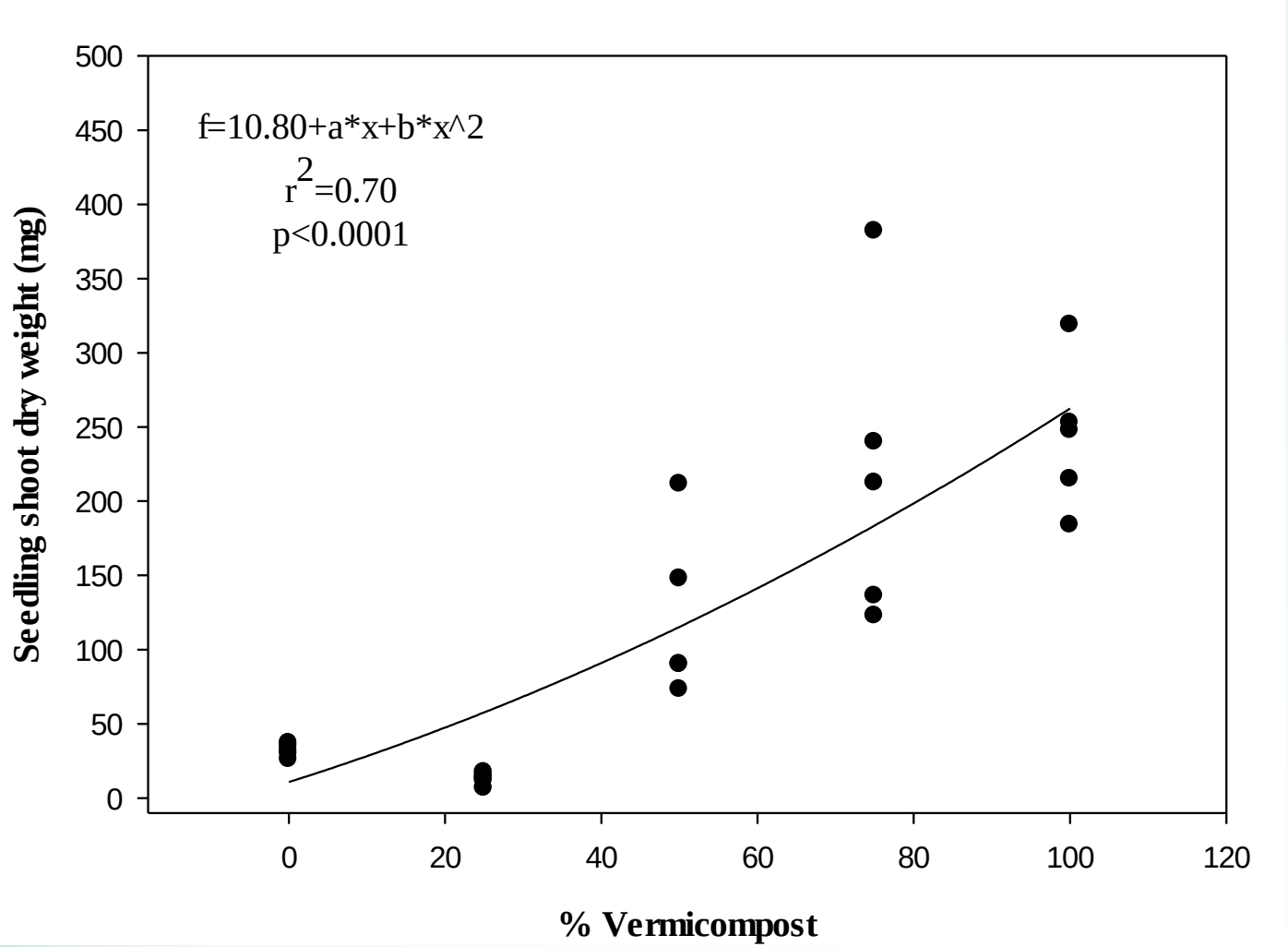
Biochar

Invasive algae

Seedlings media

Seedlings in 100% compost

Replacement of peat moss based media with local resources



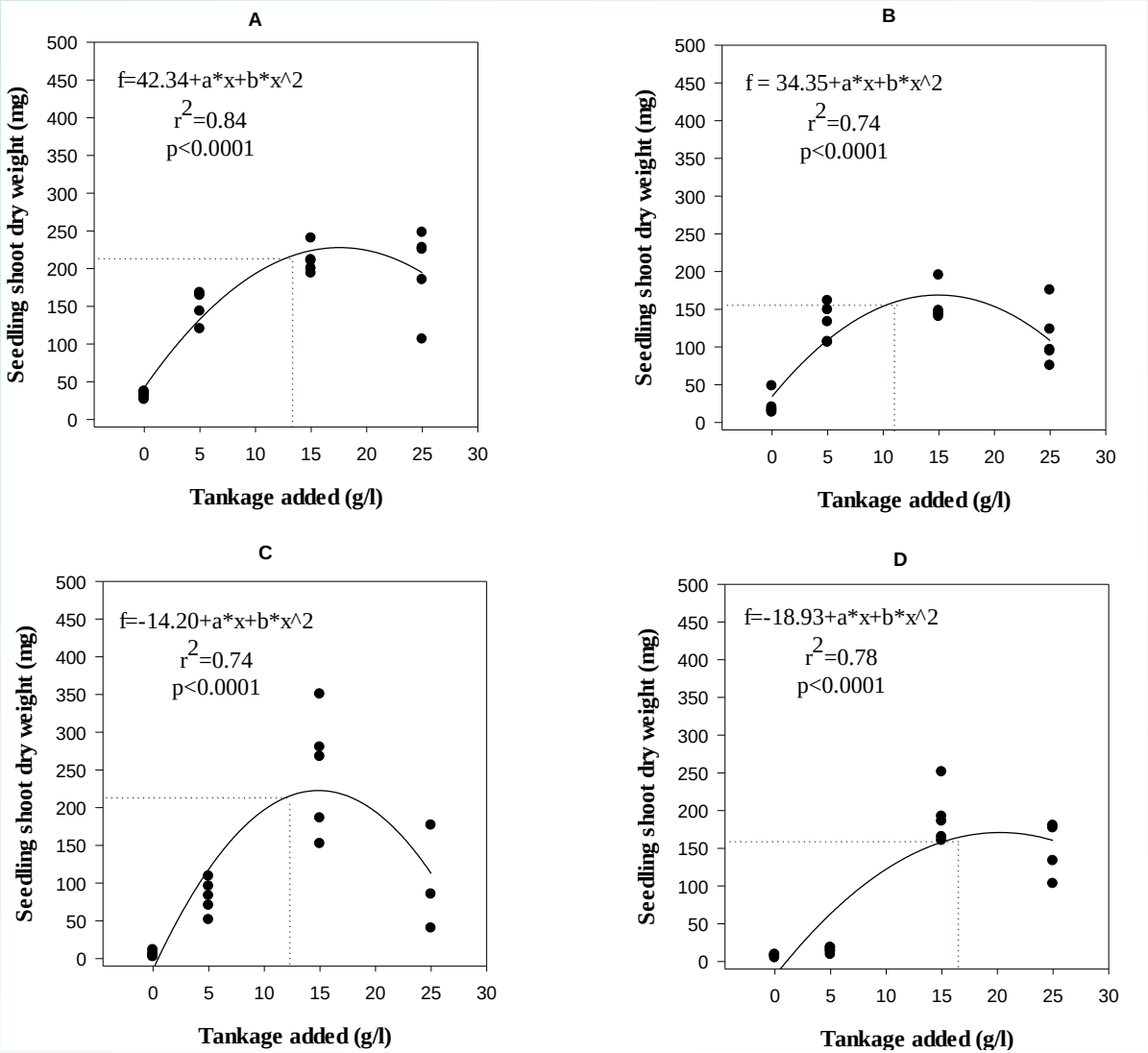
Regression analysis between vermicompost application rate and shoot dry weight of 6 week old eggplant seedlings grown in peat.

A: Peat

B: Peat amended with $CaCO_3$

C: Coconut coir

D: Thermophilic compost



Regression analysis between tankage application rate and shoot dry weight of 6 week old eggplant seedlings grown in (A) peat, (B) peat amended with $CaCO_3$ 0.7 g/l of medium, (C) coconut coir, and (D) thermophilic compost.

Invasive Algae

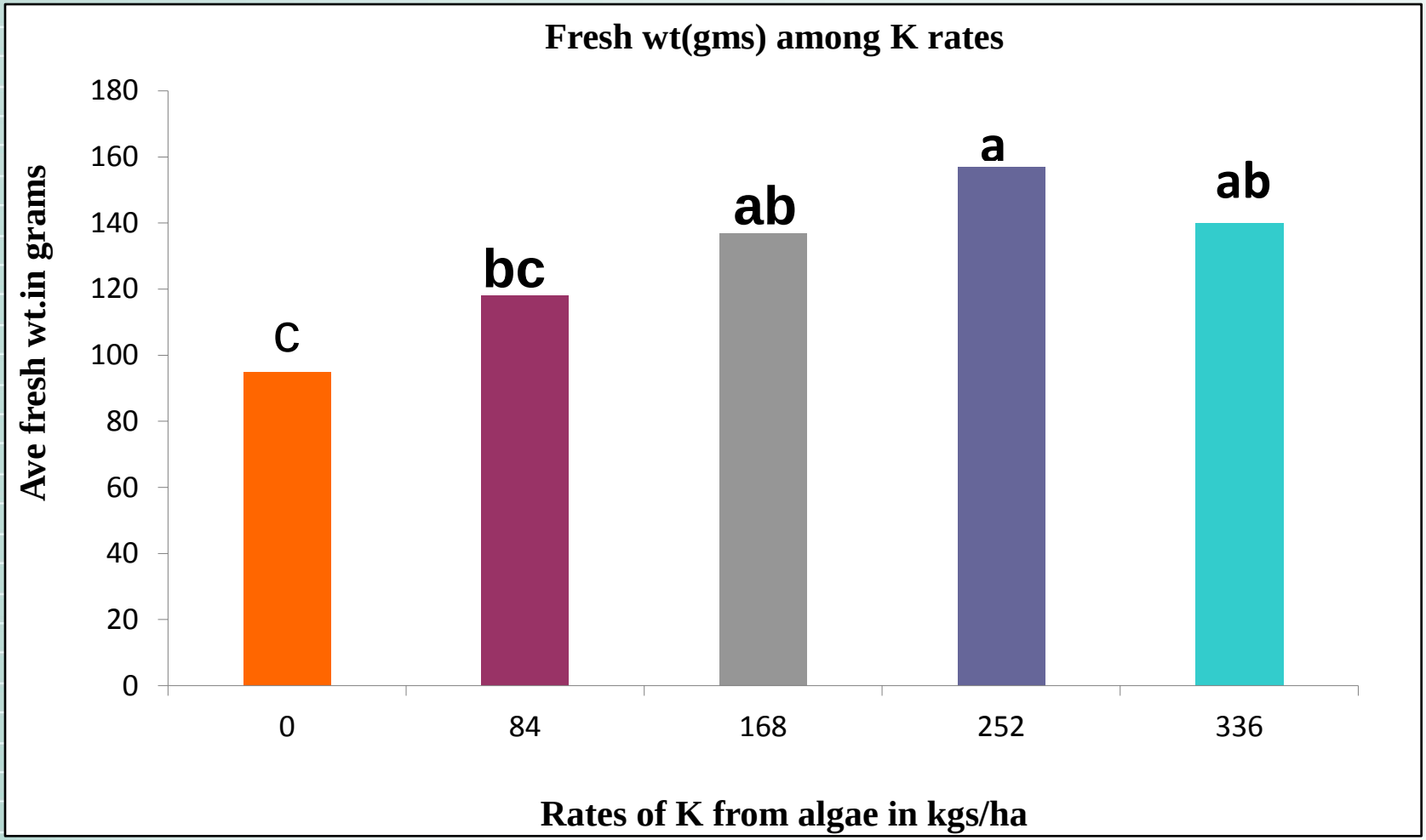
- Algae seaweeds & their extracts are known to improve crop production.
- Majority are plant growth stimulants, not directly as a source of nutrient.

Samples 1st bacth		%	
Description	N*	P	K
Kappaphycus	0.68	0.04	19.52
Eucheuma	1.01	0.06	18.38
Ogo	1.41	0.11	12.48
Samples 2nd batch		%	
Description	N*	P	K
Kappaphycus	0.62	0.06	24.85
Eucheuma	0.84	0.07	17.6
Ogo	1.33	0.1	13.9

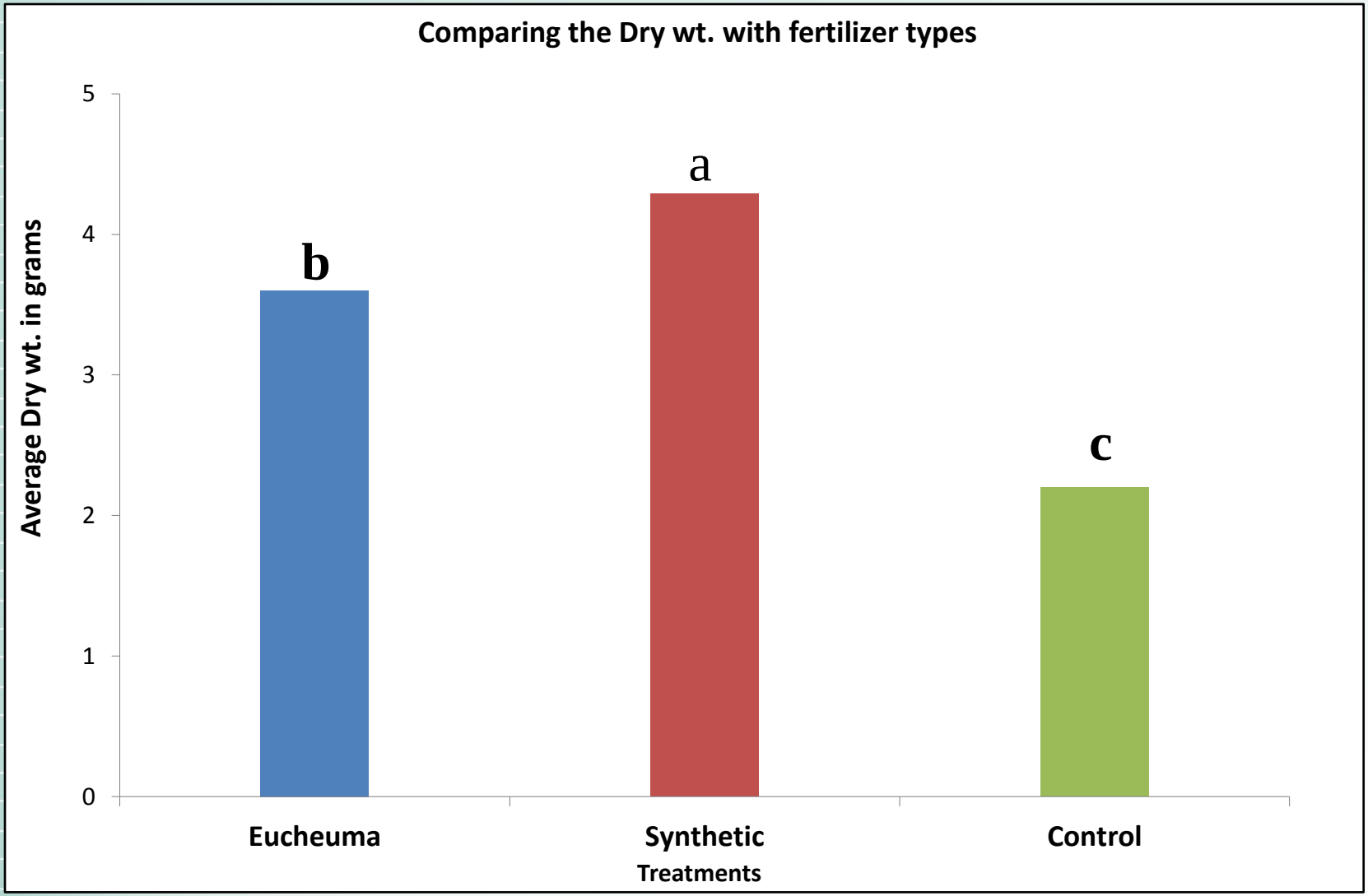
Source: http://www.hydroponics.eu/plagron-alga-bloom-1l~9487.html

The tissue samples were analyzed at the Agricultural Diagnostic Service Center of the University of Hawaii.

Pak Choi and Sweet Potato crops were used to evaluate the effect of K application from seaweed on plant growth and yield.



The bar diagrams comparing the average Fresh wt.(gms) among the 5 different rates of Algae (K in kgs/ha) provided through 3 invasive species of Algae from the 1st greenhouse trial. Means followed by the same letter are not significantly different ($P < 0.05$) using Duncan's multiple range test.



The bar diagram displaying the average Dry wt.(gms) of Pak choi plants grown with Eucheuma & synthetic fertilizers and control K from the 2nd GH trial. Means followed by the same letter are not significantly different ($P < 0.05$) using Duncan's multiple range test.

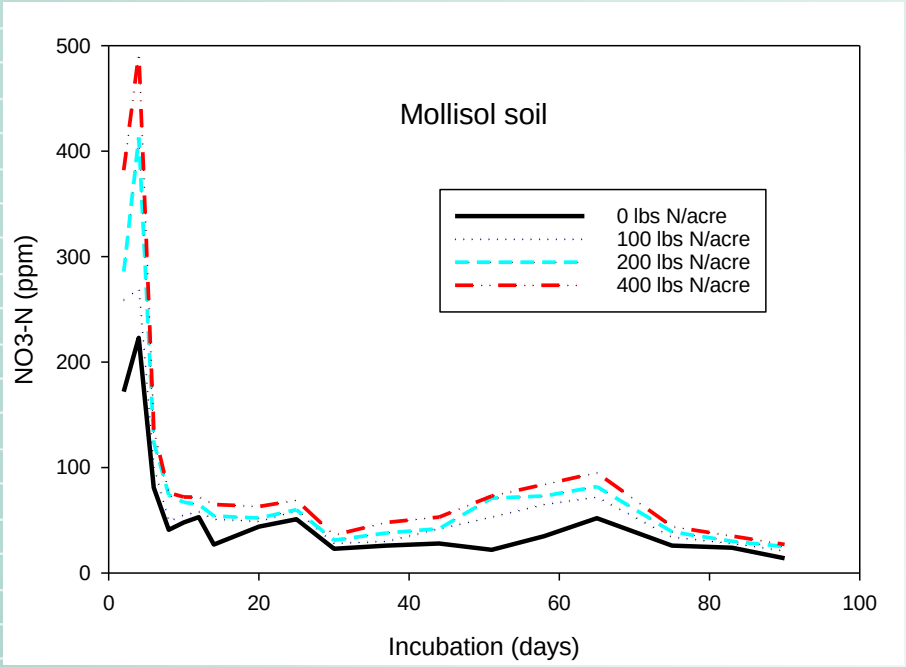
Tankage

Meat and Bone Meal by Products.

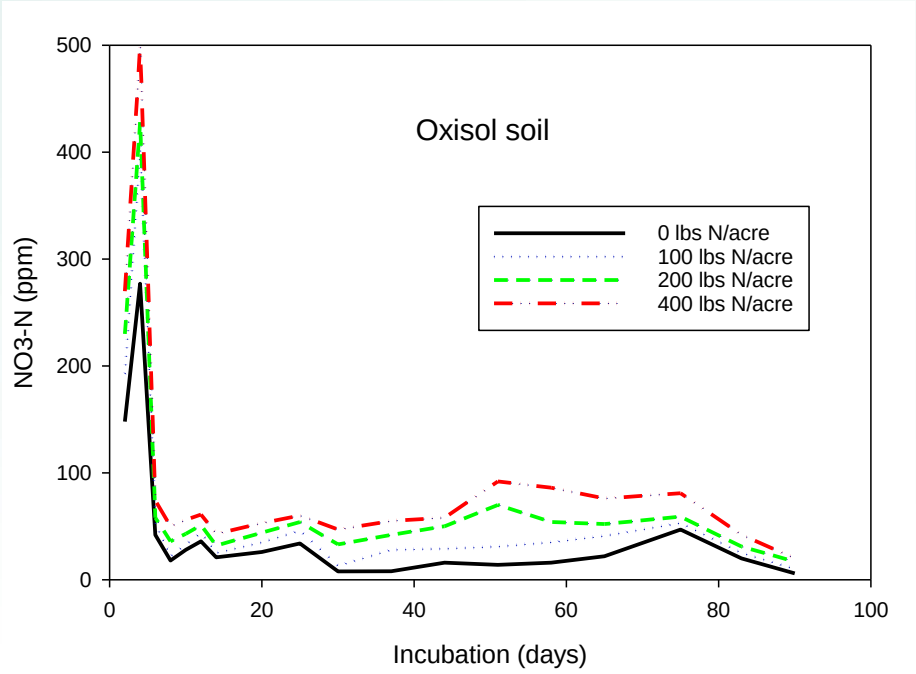
Produced Locally in Hawaii by Island Commodities. It contains:

Nitrogen = ~ 10%,
Phosphorus = ~2.5%,
C:N Ratio = 5:1

Nitrogen Release pattern from Tankage



Nitrate release from tankage applied at different application rates over 90 days under Waiamanalo (Mollisol) and Poamoho (Oxisol) soils.



Liquid fertilizer with high nitrogen from tankage

We tested different factors:
Time (0, 4, 8, 24, and 48 hours),
Temperature (75 and 95^{o}F),
Cover and open conditions,
Chemical and biological agents (Soil, Sugar, Baking Soda, and Vermicompost).

Meat and bone meal by products (Tankage). High nitrogen content (10%). Also good source of other nutrients.

Liquid Fertilizer from Tankage

Application Recipe:

-1.5 lbs of tankage into 10 gallon water.

-Add about 1 ounce vermicompost

-Air for 12-24 hours

-Strain and apply with drip irrigation (Fertigation).

Field Trials

- Poamoho Research Station on Oahu.
- Pak choi, lettuce, and daikon crops were used.
- Tankage and synthetic 30-10-10 were used.
- Randomized complete block design (RCBD) with 3 replicates (blocks).
- Liquid Fertilizers were applied through drip irrigation.

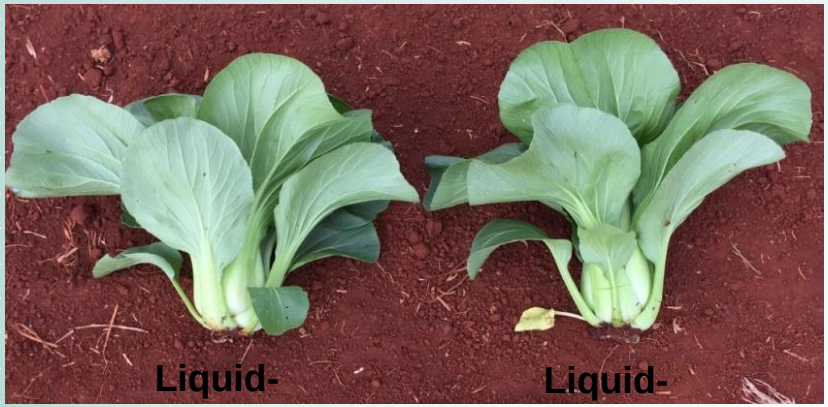
Measured: Relative chlorophyll content in leaf weekly using SPAD meter and fresh and dry weight after harvest.

Field Trial

Field trial setup at Poamoho Research Station on an Oxisol soil.

Fertigation from 20 gallon bucket.

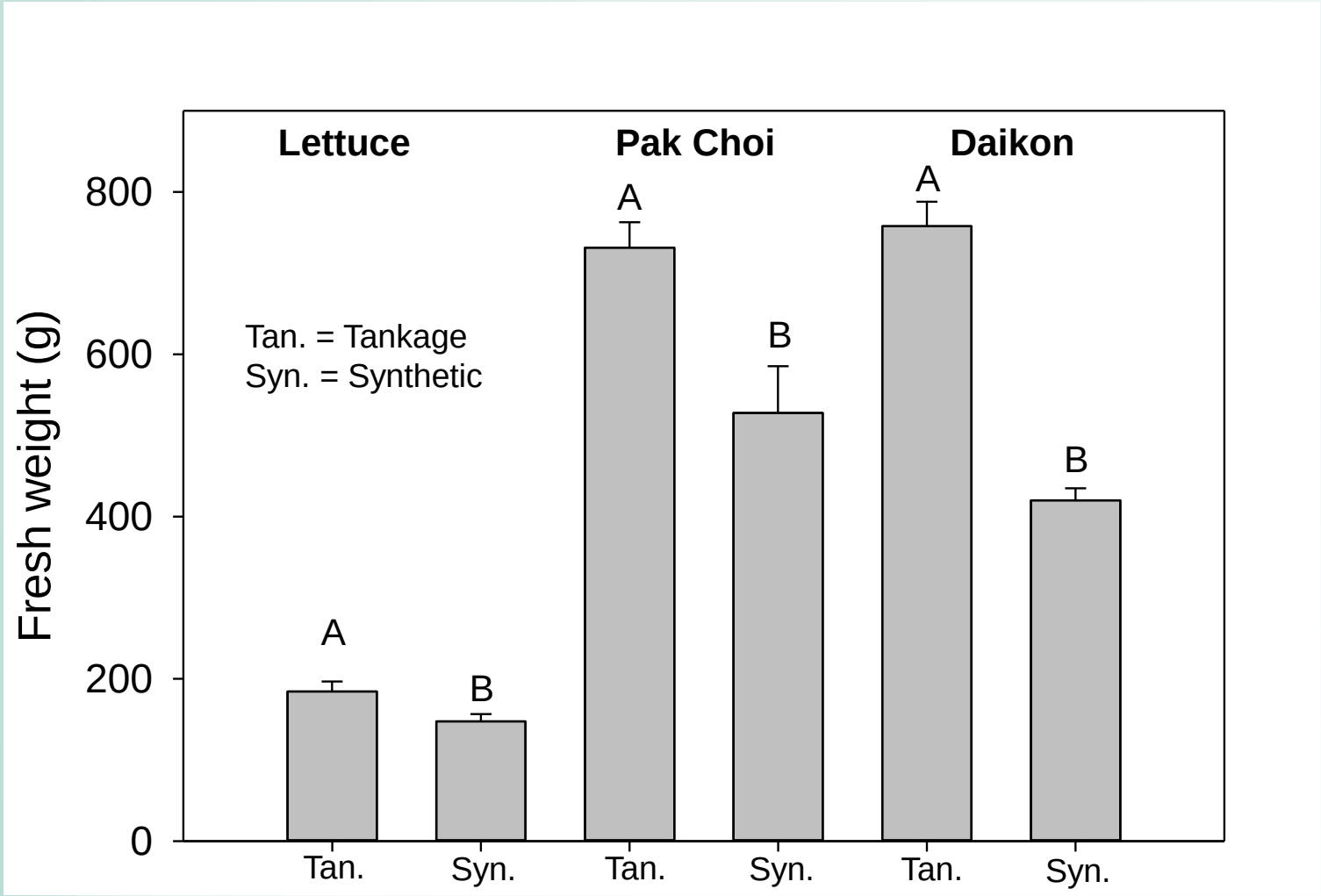
Results-Lettuce, Pak Choi, and Daikon



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

Daikon was harvested after 9 weeks of planting

Results-Fresh weight (g)



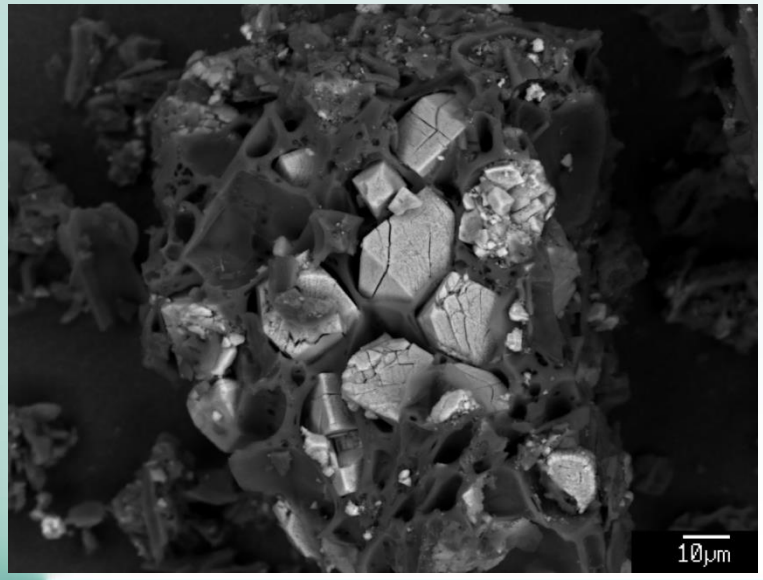
Fresh weight (gram) for lettuce, pak choi, and daikon under organic and synthetic liquid fertilizers application.

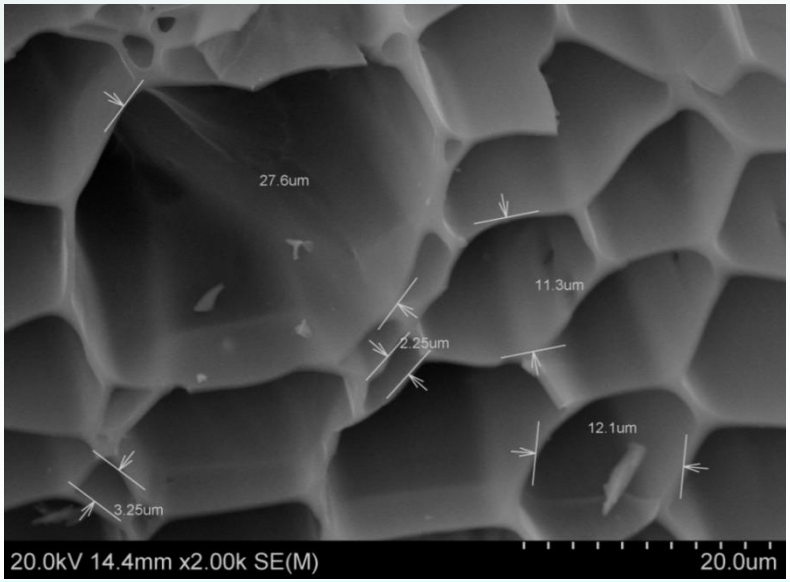
Biochar and Compost:

Biochars: organic materials (e.g., wood and manure) burned in the absence of or low oxygen.

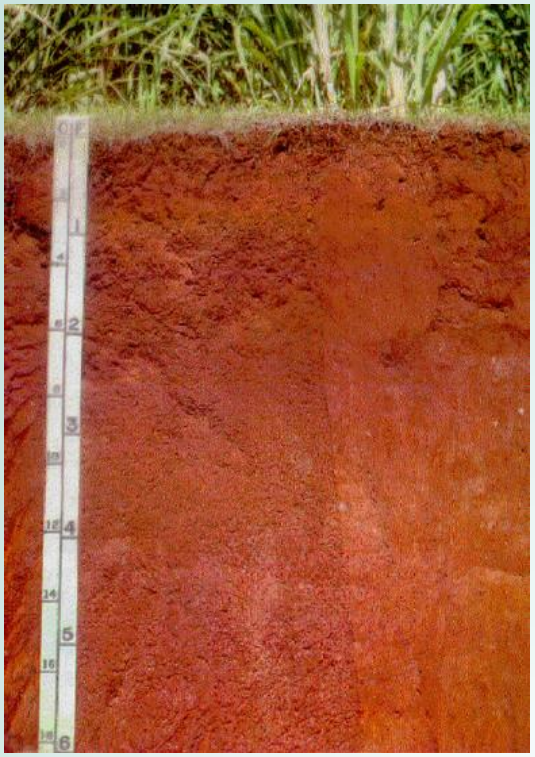
Properties vary with:

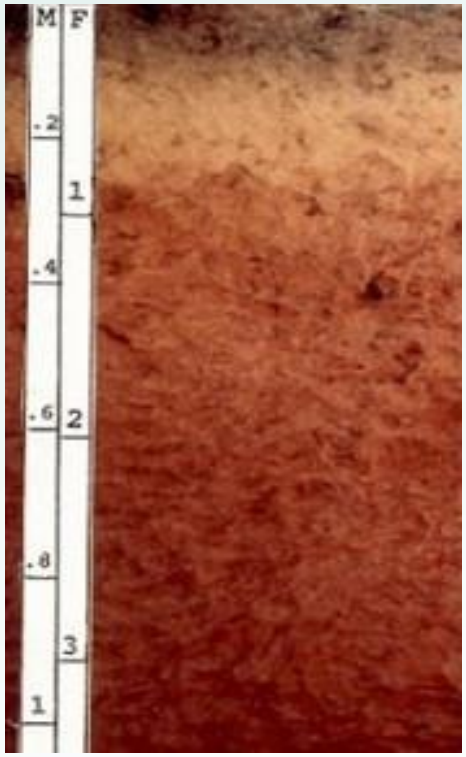
- Feedstock (e.g., manure vs. wood).
- Highest treatment temperature (e.g., 400 ^{o}C vs. 700 ^{o}C).





Highly weathered tropical soils: Mainly Oxisols and Ultisols





Oxisols: high content of Fe, Al, Mn oxides; low plant nutrients (Ca, Mg, K)

Ultisols: Low pH, potential Al toxicity and/or Ca deficiency

Hypothesis:

A combination of biochar and compost when applied to nutrient-poor soils would enhance soil fertility and plant growth more than when biochar or compost is applied separately.

Materials & Methods:

2 biochars at 0 and 2% application rates

- Lac tree (*Schleichera oleosa*) wood from Indonesia
- Scrapped mixed wood from Hilo, Hawaii.

Biochar	pH	EC	CEC	N	Al	P	K	Ca	Mg	Fe	Mn
	1:5 water	dS/m	$cmol_c/kg$	← total, % →							
Lac tree	9.2	1.93	18.0	0. 4	0.05	0.06	0.33	3.13	0.13	0.07	0.005
Hilo	9.5	2.42	14.7	0.5	0.97	0.09	0.47	1.60	0.22	1.22	0.015

2 composts at 0 and 2% application rates

* A locally made vermi-compost
* A commercial wood + manure based thermo-compost

Compost	pH	EC	CEC	N	Al	P	K	Ca	Mg	Fe	Mn
	1:10 water	dS/m	$cmol_c/kg$	←	----------	----------	total, %	----------	----------	----------	→
Thermo	8.3	3.23	44.5	1.90	0.99	0.17	0.04	2.39	0.36	0.83	0.02
Vermi	7.2	2.28	44.8	1.42	0.18	1.48	1.37	2.11	0.36	0.24	0.06

2 highly weathered tropical soils:

- Oxisol (Wahiawa series)
- Ultisol (Leilehua series)

Soil	pH	EC	ECEC	N	Al	P	K	Ca	Mg	Fe	Mn
	1:1 H_2O	dS/m	$cmol_c$/kg	%	$cmol_c$/kg	<--Mehlich-3 extractable, mg/kg->					
Oxisol	5.6	0.13	6.4	0.15	0.17	51.5	141	716	232	64	808
Ultisol	4.5	0.08	4.3	0.21	2.16	2.0	49	112	54	98	11

Experimental Design:

(Factorial: 2 biochars x 2 composts x 2 application rates, for each soil)

+ 2 additional lime treatments:

Test plant: Chinese cabbage (*Brassica rapa* cv. Bonzai)

Completely random arrangement, 3 replications per treatment; 2 consecutive plantings.

Results & Discussion:

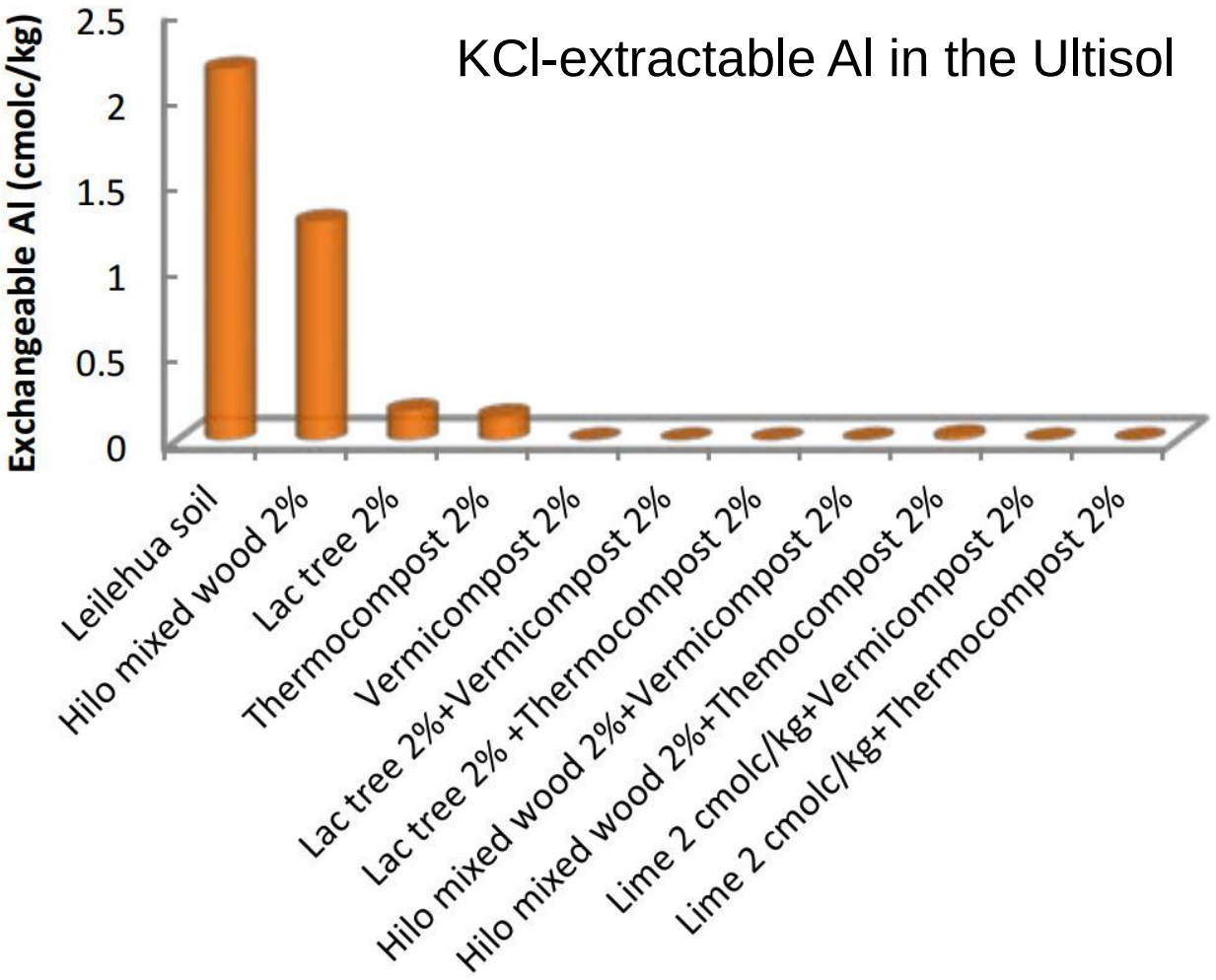
Biochar & Compost changed soil properties

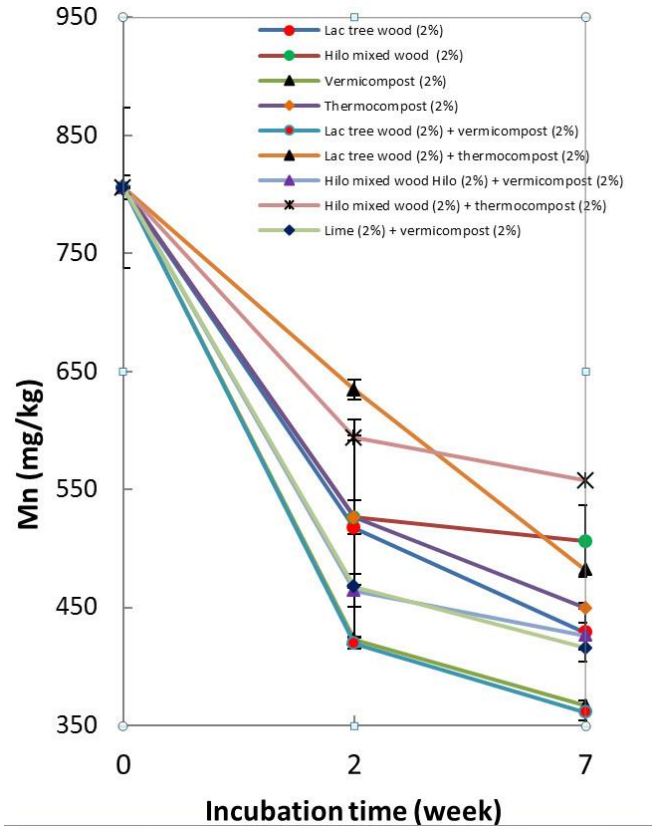
Soil pH (1:1 in water)

	Oxisol		Ultisol	
Treatment	2 weeks	**7 weeks**	2 weeks	**7 weeks**
Unamended ctrl	5.6		4.5	
Lac tree char	6.5	**6.6**	5.8	**5.8**
Hilo char	6.0	**6.0**	4.8	**4.8**
Vermi-compost	6.4	**6.9**	5.7	**6.3**
Thermo-	6.3	**6.5**	5.1	**5.5**
Lac tree+ vermi-	6.8	**7.2**	5.9	**6.5**
Lac tree+ thermo	6.7	**7.1**	5.8	**6.1**
Hilo + vermi-	6.9	**7.2**	5.8	**6.5**
Hilo + thermo-	6.3	**6.8**	5.4	**5.8**
Lime + vermi-	7.1	**7.3**	6.1	**6.6**
Lime + thermo-	6.8	**7.1**	5.6	**6.1**

Biochar & Compost changed soil properties

Exchangeable Al & Mehlich-3 extractable Mn

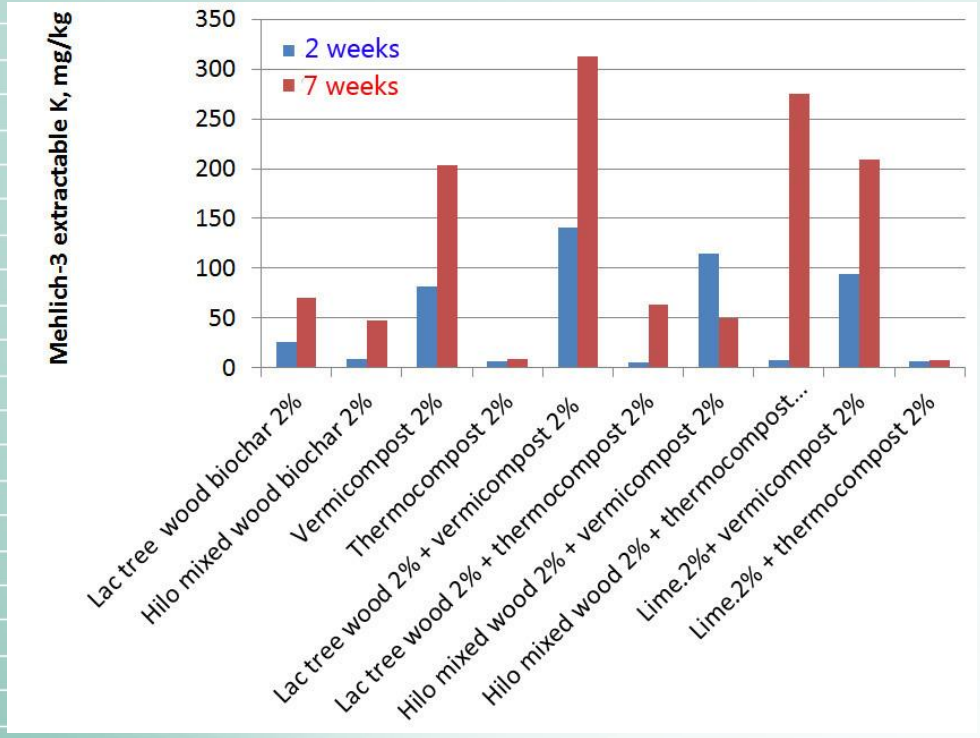


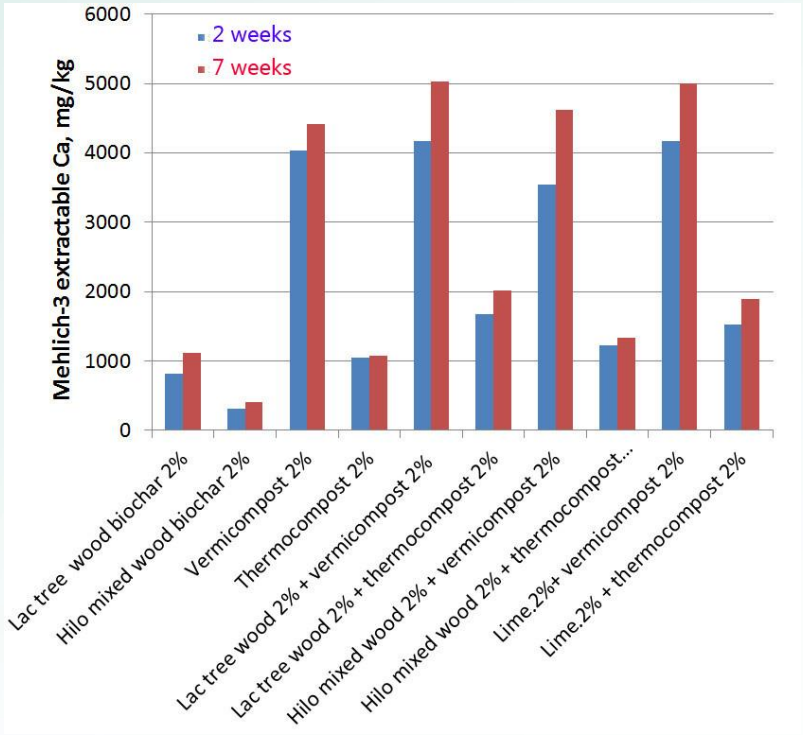


Mehlich-3 extractable Mn in the Oxisol as a result of biochar-compost treatments

Biochar & Compost changed soil properties

Mehlich-3 extractable K and Ca





Biochar & Compost Increased Chinese Cabbage Growth

Figure 1. Pak Choi (*Brassica rapa*) growth in Leilehua Ultisol after treated with biochars at 2% and composts at 2%. Lime 2 cmolc/kg + compost 2% as the control.

Quantitative Responses of Chinese Cabbage

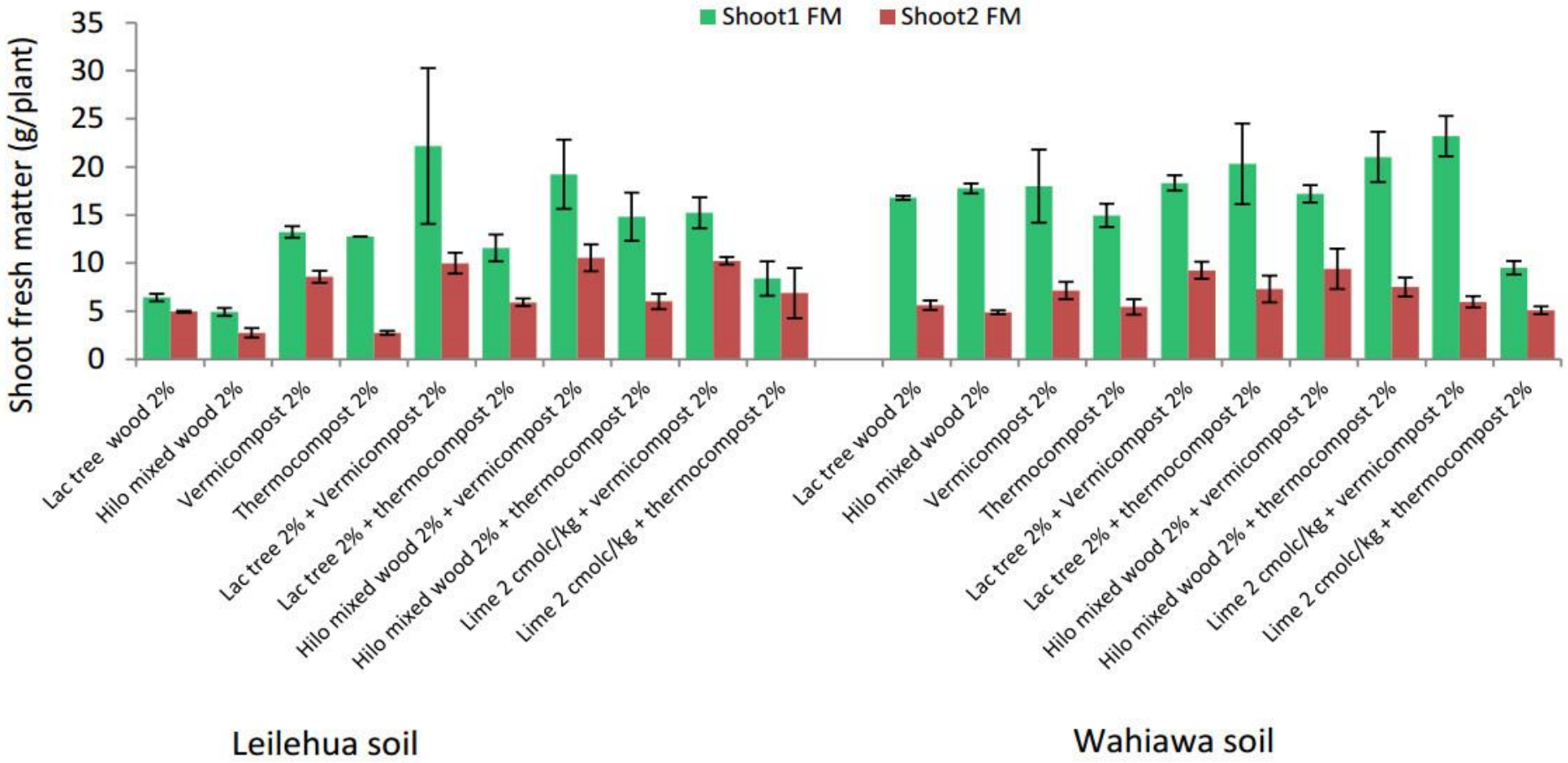
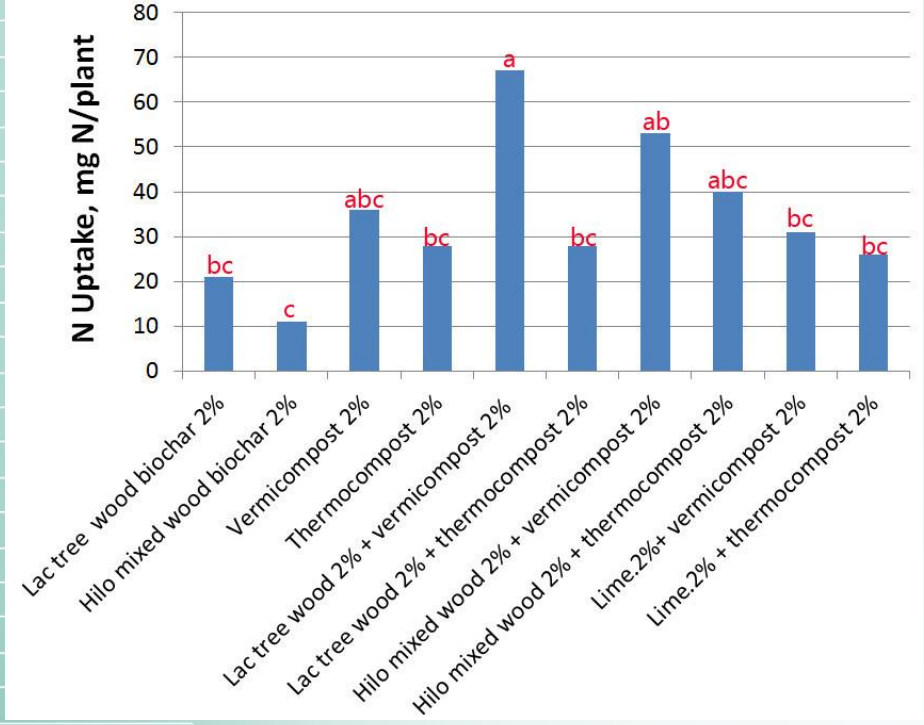
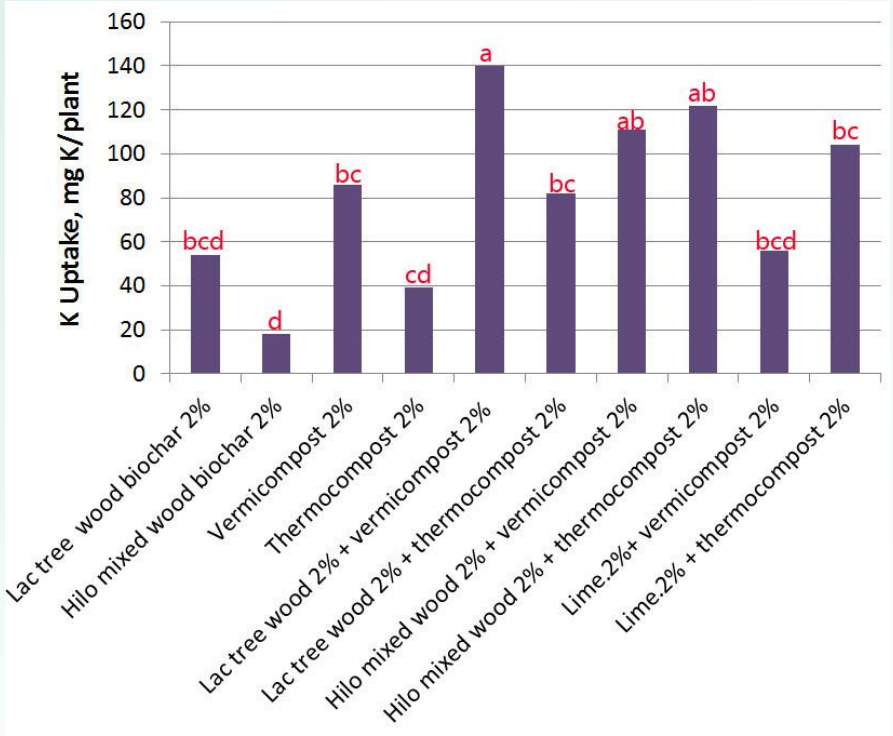


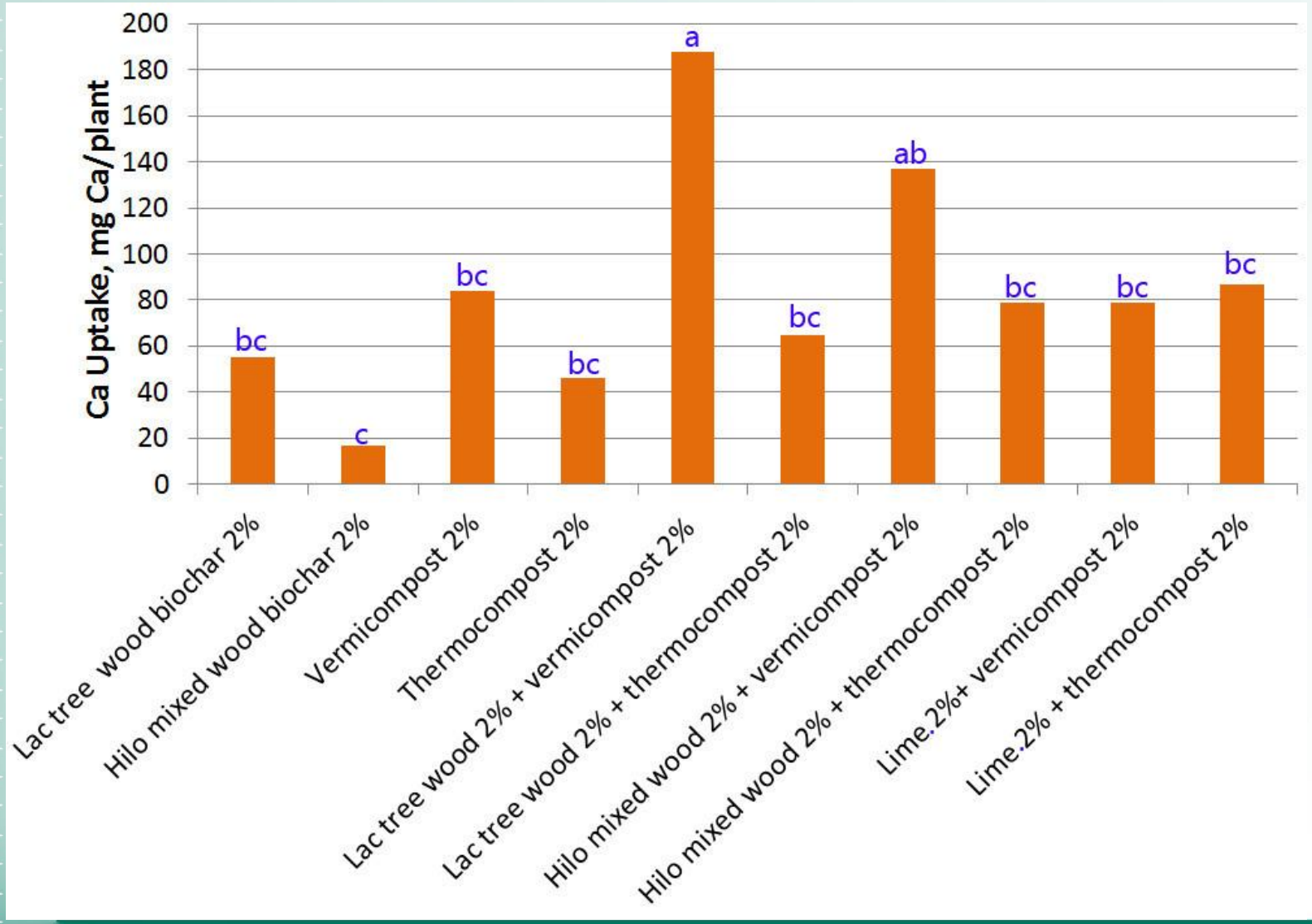
Figure 2. Chinese cabbage shoot fresh weight as affected by biochars and composts additions
FM= Fresh matter; 1 and 2: first and second plantings; Error bars: SE (n=3)

Nutrient Uptake of Chinese Cabbage:
Nitrogen and Potassium





Nutrient Uptake of Chinese Cabbage: Calcium



Conclusions:

- The use of biochar in combination with compost did indeed improved soil fertility and plant growth.

- Such biochar/compost combination was particularly beneficial to soils having problems with Al, Mn toxicity or Ca deficiency mainly because of high pH and Ca residual in such an amendment.

Acknowledgements

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Thanks for listening

Questions .....