INTERCROPS FOR TURMERIC PRODUCTION

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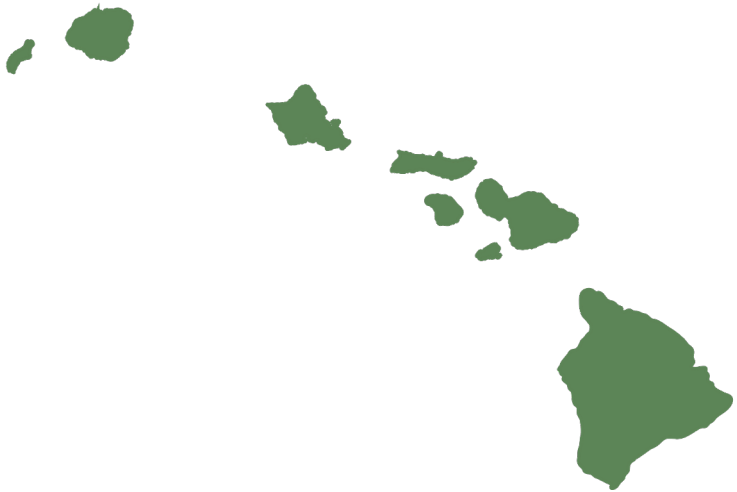
Hawai‘i’s Food System: Challenges

- **Agricultural Sector**
  - Limited production space
  - High input (e.g. fertilizer) costs
  - Restrictions on fertilizer and pesticide use (organic production)
- **Solution**
  - System where producers can maximize production and minimize costs in small production spaces



Turmeric Production in Hawai‘i

- Industry value growing
  - $1.2 million in 2018
- Increasing demand (esp. exportation)
- Roma variety outperforms
  - Yield
  - Curcuminoid content

Project Objectives

- Farmer-led, participatory agricultural research project
- To develop an organic turmeric production system in which yields are enhanced in small areas
- Comparing mixed-species intercrops by looking at:
    - Biomass production (as mulch)
    - Weed suppression
    - Indicators of soil health

Cover Crops

- **Benefits**
  - Erosion
  - Soil structure and fertility
  - Compaction
  - Weed, disease, pest suppression
  - “Green Manure”
- **“Three Sisters”**
  - Grass + legume + broadleaf
  - Diverse benefits

Project: Cover Crop Species

- **Grasses**
  - Piper Sudangrass
  - White Wonder Foxtail Millet
- **Legumes**
  - Red Ripper Cowpea
  - (Indian & Tropic Sun) Sunn hemp
- **Broadleaves**
  - Black Oil Sunflower
  - Early Flowering Chia
  - Smart Radish







Treatment Composition

Trials 1 & 2

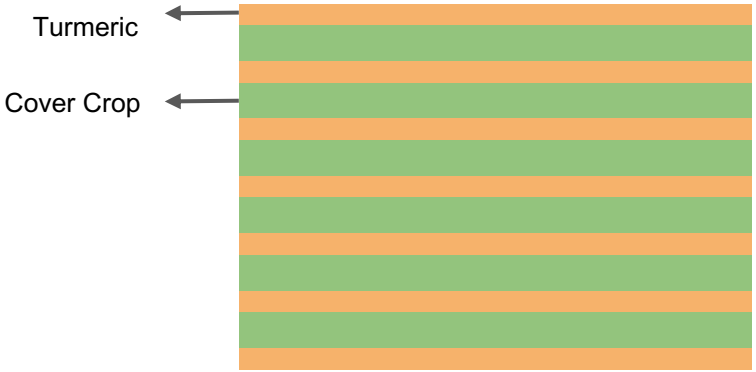
TABLE 1. Cover crop treatment species composition.

TRT	Grass	Legume	Broadleaf
T1	Piper sudangrass	Sunn hemp	Smart radish
T2	White wonder foxtail millet	Red ripper cowpea	Early flowering chia
T3	Piper sudangrass	Sunn hemp	Early flowering chia
T4	Piper sudangrass	Red ripper cowpea	Black oil sunflower
T5	White wonder foxtail millet	Sunn hemp	Smart radish
Control*	N/A	N/A	N/A

*Plastic weed mat used as control treatment.

Project Methods

- **Experimental Design**
  - 2 turmeric growing seasons (9-10 months each)
  - 2 cover crop cycles (~70 days) in each turmeric season
  - Intercropped
  - Rotation after turmeric season
- **Data Collection**
  - Biomass production (quantity, C:N ratio)
  - % cover (weed suppression)
  - Nematode community structure
  - CO_2 respiration

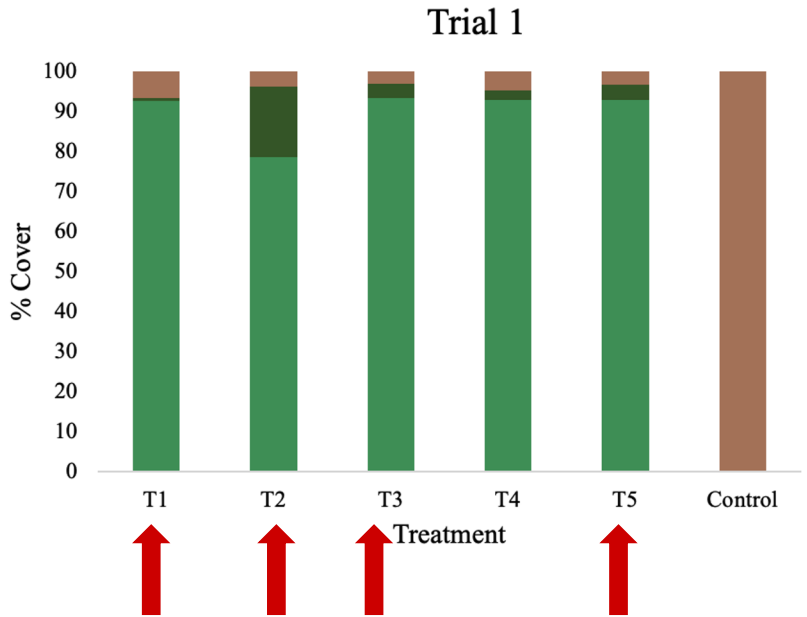


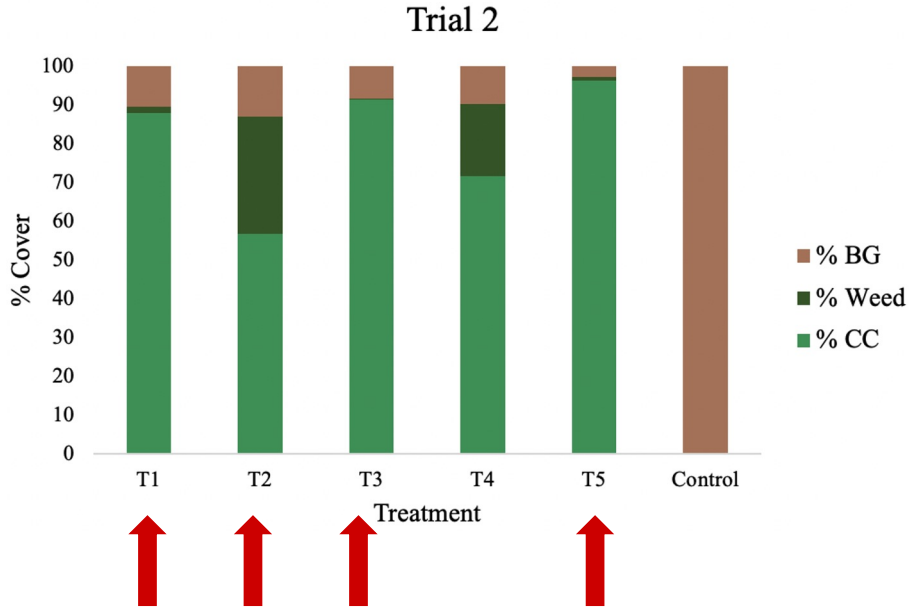
1 Rep x 3 = 18
cover crop alleys

Background: Cover Crop Alleys

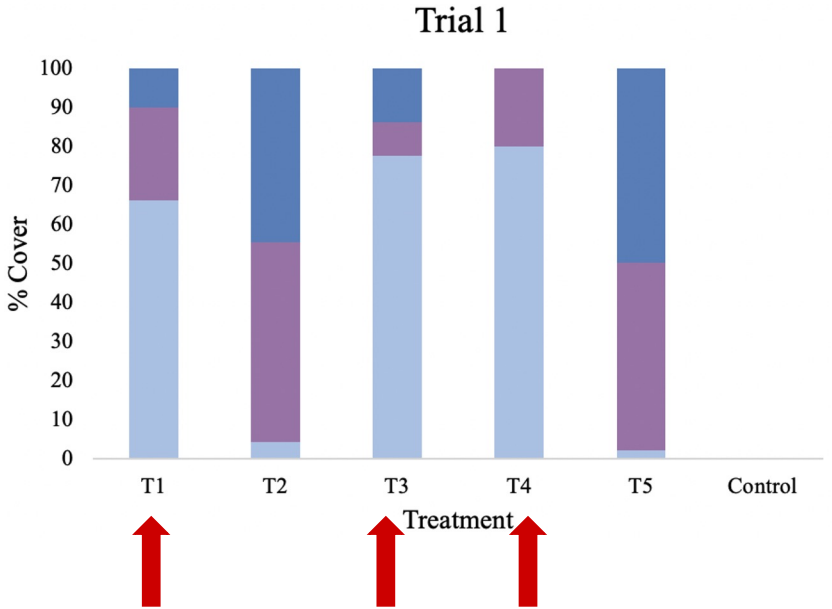
Trial 1 (Fall 2021)

Results: Mean % Cover Crop (CC), Weed, & Bare Ground (BG) at 7 Weeks of Growth

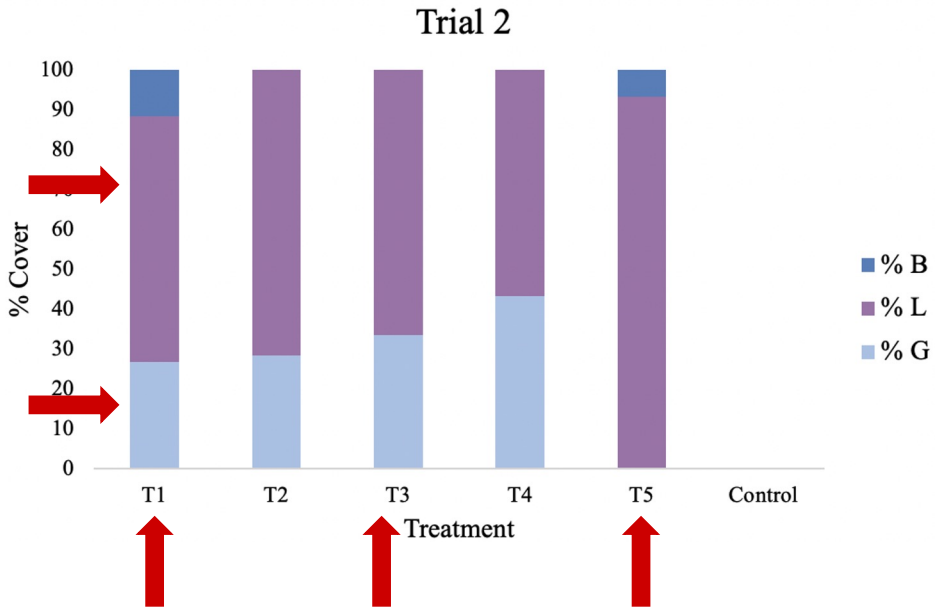




Results: Mean % Grass (G), Legume (L), & Broadleaf (B) at 7 Weeks of Growth



Grass = Sudangrass



Legume = Sunn Hemp

Results: Total C, Total N, and C:N ratio

Trial 1.

TRT	C (kg/ha)	N (kg/ha)	C:N
T1	2233.51 AB	113.02 AB	19.85:1 ABC
T2	1504.79 BC	81.81 B	18.21:1 BC
T3	3893.31 A	153.92 A	24.07:1 AB
T4	3044.03 AB	121.63 AB	25.39:1 A
T5	2082.82 B	147.47 A	14.52:1 C
Control	0.00 C	0.00 C	0.00 D

Trial 2.

TRT	C (kg/ha)	N (kg/ha)	C:N
T1	2055.91 A	150.69 A	13.79:1 B
T2	2201.22 A	94.72 A	23.57:1 A
T3	2450.94 A	134.55 A	18.24:1 AB
T4	2488.62 A	116.25 A	22.90:1 A
T5	2215.21 A	128.09 A	17.40:1 AB
Control	0.00 B	0.00 B	0.00 C

T1 & T5: Sunn hemp + radish

CO_2 Respiration & Nematodes

- CO_2 respiration: No significant differences

- Nematodes: In progress

Trials 1 & 2: Conclusions

- Sudangrass outperformed millet (Trial 1)
- Radish outperformed chia & sunflower
- Supported benefit of mixed-species
- Legume species can fill in gaps (sunn hemp)
- Ideal C:N ratio
    - Mixtures with sunn hemp + radish

Goals Moving Forward

- **Management challenges**
  - Germination issues
    - Irrigation
    - Drilling depth
    - Seed sourcing
- **Seed supplier changes**
  - Trial 2
    - Sunflower (Green Cover Seed -> Johnny Seed)
    - Cowpea (Green Cover Seed -> Koolau)
    - Sunn hemp (Green Cover Seed -> Koolau Seed)

Future Analysis

- **Further analysis**
  - Seasonal variations (temperature data)
  - Soil carbon

Acknowledgements