COOPERATIVE EXTENSION
UNIVERSITY OF HAWAI'I AT MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

Reducing Fertilizer Requirements through Sunn Hemp Cover Cropping

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BACKGROUND

Fig. 1. Turtle with tumors (credit: Chris Stankis)

Although essential for crop production, fertilizers are often applied in excess for "insurance" purposes. After decades of this practice, some agricultural soils show 6x and 20x higher than recommended levels of nitrogen and phosphorus, respectively (personal data). Leaching or runoff of this nutrient-loaded soil with heavy rains can result in environmental and wildlife harm (e.g. algal blooms, turtles with tumors; Van Houtan et al. 2014) and wasted costs.

Fig. 2. Sunn Hemp Cover Crop

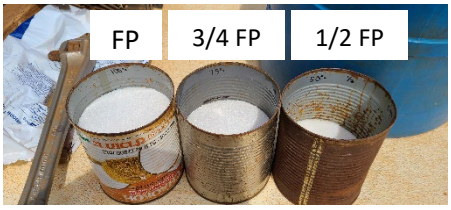
Cover crops serve many agroecological benefits, such as increasing soil health, combating soil diseases, shading out weed species, and attracting beneficial insects and pollinators (Snapp et al. 2005). Cover crops also can provide plant nutrients, particularly nitrogen where cover crops like sunn hemp are 2.5% nitrogen. The objective of this project was to evaluate a farmer's sunn hemp cover crop practice in reducing their synthetic fertilizer inputs while meeting plant needs.

METHODS

Plot Design

Two trials were installed at a cooperating farm in July 2020 and May 2021. The treatments consisted of the following:

a. **FP**= Farmer practice (FP) of 110 lbs nitrogen/acre as ammonium sulfate
b. **3/4 FP**= 75% FP
c. **1/2 FP + SH**= 50% FP + sunn hemp
d. **0N + SH**= sunn hemp + no fertilizer.



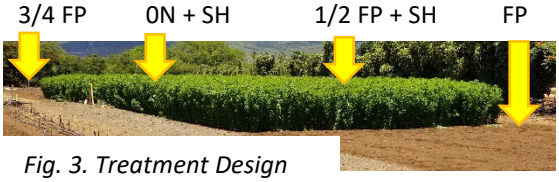


Fig. 3. Treatment Design

Yellow sunn hemp was direct seeded at 80 lbs/acre and incorporated after 1.5 months, when flowers first appeared. Fertilizer was added once per week for the three weeks crops were in the field. At harvest, 12 sq.ft. areas were harvested in triplicate per treatment. Other trial details are in the table below.

TRIAL INFO	2020 TRIAL	2021 TRIAL
Soil Series	Ewa Series (Mollisols)	
Crop	Pak Choi (v. Joi Choi)	Pak Choi (v. Mei Qing)
Sunn Hemp Incorporated	July 31, 2020	May 18, 2021
Transplant Date (Days After Incorporate)	August 21, 2020 (21 days)	May 20, 2021 (2 days)
Harvest Date (DAI)	September 11, 2020 (42 days)	June 8, 2021 (21 days)

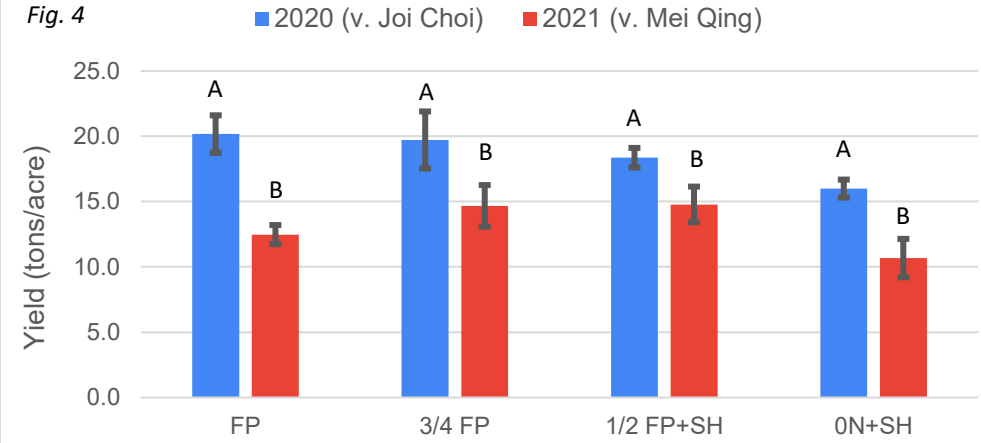
Cover Crop Calculator, Soil Nitrogen

The nitrogen supplied from the sunn hemp cover crop was calculated using the calculator developed by Wang et al. (2017). Prior to incorporation, fresh sunn hemp biomass was collected in triplicate from 2ft x 2ft areas and oven dried at 60°C for 4 days to determine dry matter % and fresh weight. Sunn hemp nitrogen of 2.59% was utilized from previous measurements. Information was entered into the tool to calculate Actual Plant Available Nitrogen (lbs/acre) after 28 days and 70 days from incorporation, with 21 days and 42 days being interpolated from linear regression. For the 2020 trial, soil nitrate was also measured weekly during the crop growth cycle using EMD Millipore Soil Nitrate test strips and RQFlex 20 reflectometer.

RESULTS

Crop Yield; Sunn Hemp and Plant Available Nitrogen Levels

Fig. 4



*No significant statistical differences found among treatments (One-Way Anova, Tukey comparison)

- **Sunn hemp treatments with reduced fertilizer rates yielded similar amounts of pak choi as higher fertilizer rates (Fig. 4).**
- For the 21 days that transplants were in the field, incorporated sunn hemp supplied approximately 50-70 lbs of nitrogen (Fig. 5).
- Sunn hemp with 50% reduced fertilizer contributed similar nitrogen amounts as the 100% farmer practice (Table 2).
- Soil nitrate tests indicated nitrate levels for all treatments except for the 0N+SH were adequate for cabbages (Fig. 6), with nitrate levels between 25-50 mg/kg soil being the critical range (Loo 2018).

Fig. 5

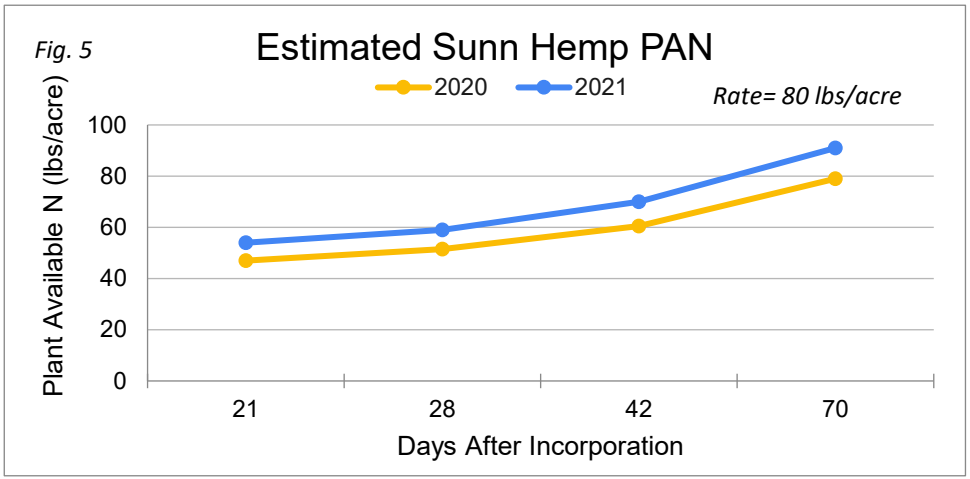


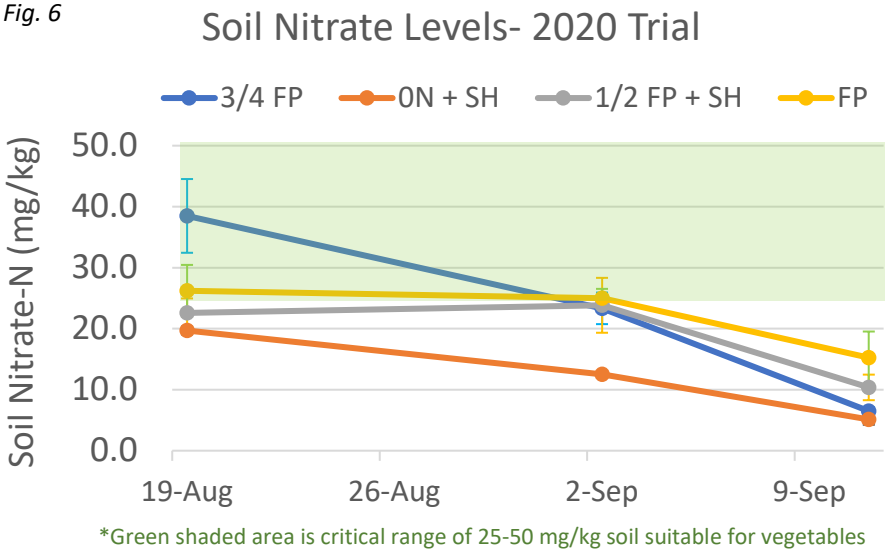
Table 2. Nitrogen Supplied from Sunn Hemp and Fertilizer

	SH No Fert	SH 50% FP	75% FP	100% FP
N- Fertilizer		56 lbs	90 lbs	112 lbs
N- Sunn Hemp (2020)	61 lbs	61 lbs		
Total lbs N/acre (2020)	**61 lbs**	**117 lbs**	**90 lbs**	**112 lbs**
N- Fertilizer		56 lbs	90 lbs	112 lbs
N- Sunn Hemp (2021)	54 lbs	54 lbs		
Total lbs N/acre (2021)	**54 lbs**	**110 lbs**	**90 lbs**	**112 lbs**

DISCUSSION

Our multiple trials demonstrated the possibility of cover crops like sunn hemp to reduce fertilizer requirements without negatively impacting yields. Sunn hemp additions provided substantial quantities of nitrogen where fertilizer could be reduced by half or completely. Although the 0N + SH treatment was not significantly different from the other treatments, the mean yield was lower than others, so reduced fertilizer rates rather than no fertilizer might be best to ensure productivity.

Fig. 6



Economics, Costs

For this trial, sunn hemp cover cropping saved $131 per acre in ammonium sulfate fertilizer for the half FP and $262 per acre for no fertilizer treatments. However, growing cover crops includes production costs that should be considered such as seed, labor, and irrigation. For this trial and farm practice, the irrigation amount and cost were substantial, with high amounts of water being used throughout the sunn hemp growth. As sunn hemp is a moderately drought tolerant cover crop, future research may identify lower irrigation amounts and more efficient schedules that are cost effective. Also, sunn hemp does offer other agronomic benefits such as improving soil health and managing soilborne pathogens (e.g., root knot nematodes) that may add to fertilizer savings benefits.

Trial Costs

Fertilizer 100% FP: 536 lbs ammonium sulfate per acre per crop x $0.49/lbs= $262.54
Seed: 80 lbs seed per acre x $0.50 per pound= $40
Labor (seed): 0.25 hours x 5 workers x $20 per hour= $25
Labor (till): 0.5 hours x 1 worker x $20 per hour= $10
Irrigation: 1200 gal per acre x 10 minutes x 40 days x $0.002 per gallon= $960

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