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Shelterbelt Planting and Sheet Mulching for Nematode, Soil Health and Weed Management in a Taro Agroecosystem

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INTRODUCTION

- Sheet mulching (SM) is using multiple layers of recycled organic matter to enrich soil while suppressing weeds.
- Shelterbelt (SB) is trees interplanted between crop rows to add additional benefits to the agroecosystem.
- Pigeon pea is a drought-tolerant and fast-growing legume (Nitrogen fixer) often used as SB and its clippings can be easily chipped and add to sheet mulching.
- Integrating SB & SM would be a good resilient agriculture practice that recycle on-farm resources and mitigate external inputs.

Objectives were to evaluate the effects of SB and SM on 1) plant-parasitic nematodes, 2) soil health, 3) weeding time, and 4) taro growth.

MATERIALS & METHODS

Sheet Mulching

Mushroom Compost | Cardboard | Pigeon Pea Cuttings

Treatments (6 reps, 7.6 × 1.2 m^2/plot)
1) **SB-SM** = no shelterbelt + sheet mulch
2) **SB-SM-** = no shelterbelt + no sheet mulch
3) **SB+SM** = shelterbelt + sheet mulch
4) **SB+SM-** = shelterbelt + no sheet mulch

Protocols
- *Baermann Tray (Jenkins, 1964)*
- *Solvita Soil basal respiration*
- *SLAN (Solvita Labile Amino-N)*
- *Weeding time*
- *Salinity Test*

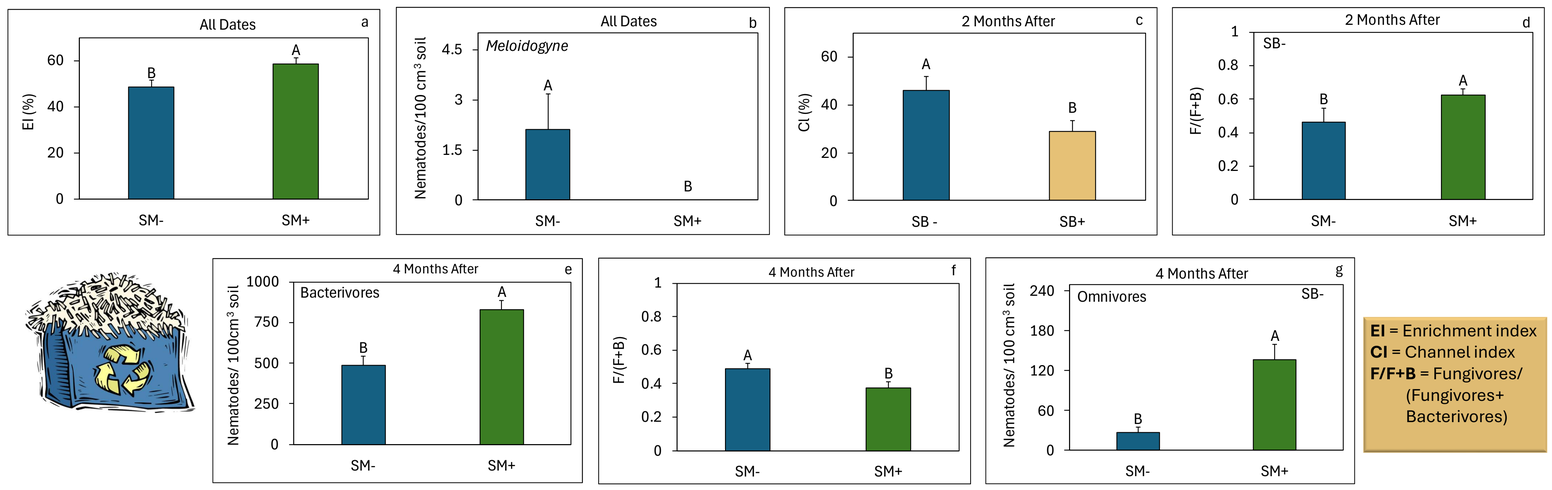
Shelterbelt - Pigeon Pea
- *Planted every 3 rows of taro*
- *Chop and drop (0, 1, and 2 months after)*
- *Shredded and drop (4 months after)*

Woodchipper (Power-King)

Pigeon Pea shredded mulch

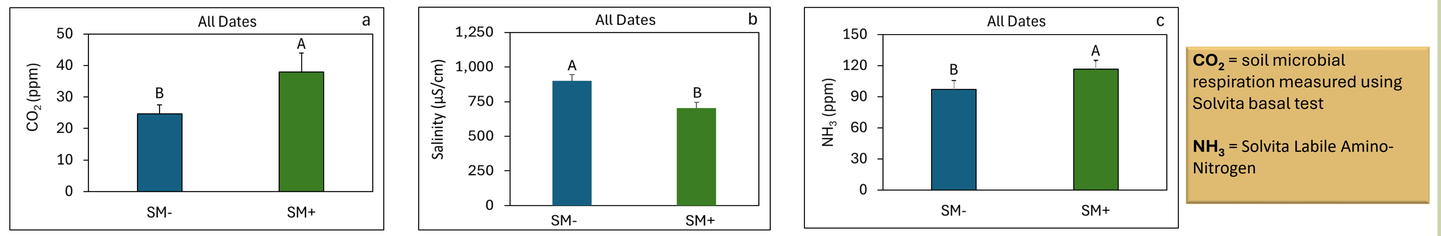
RESULTS

Fig. 1. Soil Health Properties (Nematodes as indicators)



EI = Enrichment index
CI = Channel index
F/F+B = Fungivores/ (Fungivores+ Bacterivores)

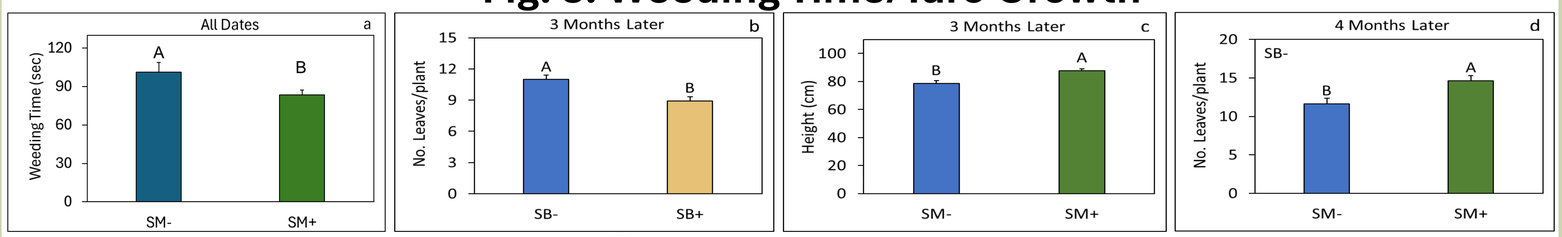
Fig. 2. Soil Health Properties (Microbial respiration and chemical properties)



CO_2 = soil microbial respiration measured using Solvita basal test

NH_3 = Solvita Labile Amino-Nitrogen

Fig. 3. Weeding Time/Taro Growth



Summary

- SM increased nematode enrichment index (EI), indicated soil nutrient enrichment and reduced root-knot (*Meloidogyne* spp.; RKN) nematode abundance ($P = 0.04$). Though RKN pressure was low over 4 months after planting (Fig. 1a, b).
- Effects on the other nematode community indices varies by dates.
- **At 2 months** after taro planting, SB reduced channel index (CI), indicating field plots next to SB (regardless of SM treatments) supported less fungal decomposition, while SM without SB increased F/(F+B) i.e., more fungal decomposition (Fig. 1c, d).
- **4 months** after treatment, SM significantly increased the abundance of bacterivorous nematodes and reduced F/(F+B) (regardless of SB planting), indicating that SM enhanced bacterial decomposition and enriched the soil with nutrients due to recycling of organic matter from pigeon pea mulch and mushroom compost (Fig. 1e, f). In addition, SM also increased omnivorous nematodes abundance by 5-fold in no SB plots (Fig. 1g).
- SM also significantly increased the soil microbial activity and amino nitrogen ($P \leq 0.05$), while significantly reducing the salinity of the soil (Fig. 2a, b, c).
- SM reduced weeding time by 17.4% compared to synthetic mulch (SM-) ($P \leq 0.05$), confirming that sheet mulching was effective in weed suppression (Fig. 3a).
- **At 3 months** after treatment, SB decreased 18.9% of the number of leaves compared to SB-, but SM increased the height of taro by 11.5% compared to SM- ($P \leq 0.05$; Fig. 3b, c).
- **At 4 months** after treatment, number of taro leaves in SB- was increased by SM by 25.8% ($P \leq 0.05$; Fig. 3d).

Conclusion

- (Objective 1) SM suppressed RKN numbers significantly 4 months after planting.
- (Objective 2) SM improved soil health as indicated by an increase in EI, abundance of bacterivores, soil microbial respiration, and labile amino-nitrogen, while reducing salinity over 4 months of the study. SM could also increase omnivorous nematodes if used in SB- plots.
- (Objective 3) SM also reduced weeding time slightly.
- (Objective 4) SB decreased number of taro leaves, whereas SM increased taro height and leaf numbers.
- Overall, SM provides better benefits than SB planting.

Future Work

- Continue monitoring until harvest.
- Evaluate longer term effects of SM on soil health (second trial).

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