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Preliminary Trial 2025: Durability, Feasibility of Biodegradable Mulch

Joshua Silva and Amjad Ahmad
Department of Tropical Plant and Soil Sciences

BACKGROUND

Polyethylene plastic mulch is used in agriculture to help manage weeds and soil moisture, but it requires additional labor to remove once the crop cycle is finished and is another source of plastic waste. A potential alternative addressing these plastic waste and labor issues is biodegradable mulch (BDM). BDM are made from biologically-based polymers that are derived from natural sources (ex. thermoplastic starch), synthesis (ex. polylactic acid), or microorganisms (ex. polyhydroxyalkanoates). As its name suggests, BDM is meant to be tilled into the soil after use, with microorganisms degrading BDM under favorable moisture levels and temperatures (Miles 2023).

Currently, the research for BDM is primarily in temperate regions. A preliminary trial was conducted on Oahu to evaluate the durability and efficacy of a commercially-available biodegradable mulch, given Hawaii's tropical climate.

Fig. 1. Biodegradable Mulch (Bio360)

METHODS

The treatments for this trial included 1) BDM (Bio 360 black/white; Dubois Agrinovation, Saint-Remi, Quebec, Canada) and 2) Non-biodegradable, polyethylene black plastic mulch (PE). The trial was established at a farm in Waianae, Oahu, with the crop being kalo/taro (*Colocasia esculenta, var. Moi*). Crop rows (3ft x 50 ft) were amendedper farmer practice with mushroom substrate blocks, horse manure, and Sustane fertilizer (N-P-K 8-2-4); and drip irrigation lines installed prior to covering with treatment mulches. Mulch edges were also covered with wood chips. Treatment rows were repeated in triplicates (Fig. 2). Treatment installation occurred on December 20, 2024, and data collection occurred at 3 months (March 2025) and 5 months (May 2025). Mulch deterioration was assessed on a 0-3 scale over a 3ft x 3ft area, with 0=no deterioration, 1= 1-25% deterioration and slight soil exposure, and 3= greater than 50% deterioration and excessive soil exposure (Appendix 1). Three measurements were taken and averaged per replicate. Data were analyzed in JMP Pro statistical software.

Fig. 2. Field Trial- Biodegradable Mulch Rows

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RESULTS& DISCUSSION

Durability:

The lifespan of BDM in a commercial kalo field was approximately 5 months. At the 3-month stage, the BDM sheet showed initial signs of deterioration, with an average deterioration level of 1.2 (1-25%). However, by the 5-month stage, BDM average deterioration level was at 1.9, with BDM being very brittle to the touch and completely tearing with any slight pull or applied force. This higher deterioration rate of BDM was statistically higher than conventional PE plastic, which had average deterioration levels of 0.2 and 0.4 at the 3- and 5-month stages, respectively (Fig.3). Also to note, the weather conditions during January-April 2025 at the site was an average rainfall of 2.3 inches and average temperature of 74.4°F (McLean 2025; Hawaii Climate Data Portal). Deterioration rates may increase with higher rainfall and temperatures. However, despite its faster deterioration, BDM was still suitable for weed control in this kalo production system, with kalo at the 3-month stage providing adequate shade to complement the BDM and weeds being minimal in both treatments even as the kalo approached its ~7 months harvest window.

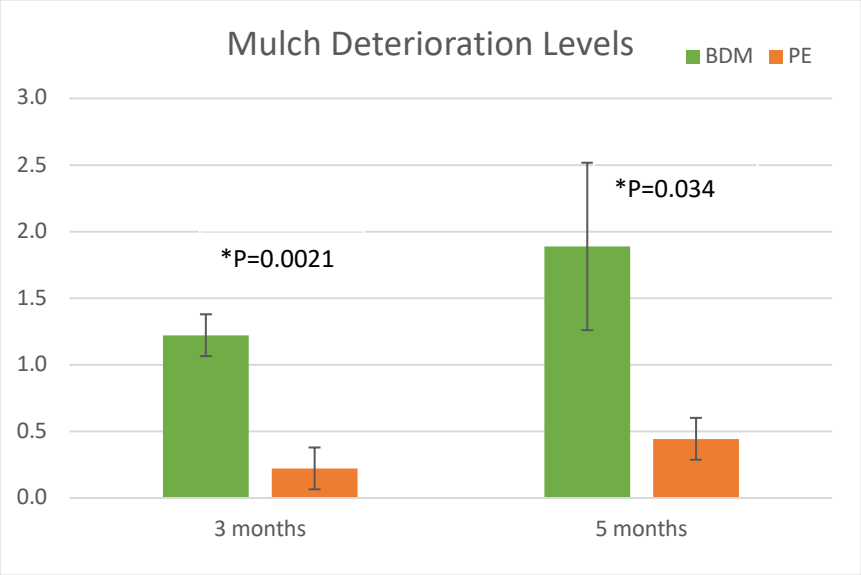

Fig. 3. Mulch deterioration levels for BDM and Polyethylene Black Plastic (PE) at 3 months and 5 months after installation. *Indicates statistically significant at P<0.05.

Economic Feasibility:

In addition to durability, the economic feasibility of BDM compared to PE was analyzed. The following costs and metrics were considered from Velandia 2019 and Miles 2023, with adjustments for the costs of BDM and PE in Hawaii (Table 1).

Table 1. Estimated Costs, Metrics, Comparisons for BDM, PE, and Woven Weed Mat Use

Thickness of PE mulch: 1.0 mil	Number of mulch rolls per acre: 2
(woven: $96, 4ftx300ft) (PE: $214, 4ftx4000ft) (BDM: $715,4ftx4000ft)	Cost PE mulch/acre: 2 x $214/roll = $428/acre Woven/acre: 26 x $96/roll= $2,496/acre
Thickness of BDM: 0.6 mil	Cost BDM/acre: 2 x $715/roll = $1,430/acre
Mulch roll size: 4 ft x 4,000 ft	Labor Cost: $20/hour
Bed spacing: 6 ft	Disposal cost: $85/ton (based on cost in Connecticut)
Removal and disposal: 17.25 hours/acre	Drip tape removal: 1.5 hours/acre

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Biodegradable Mulch (BDM) vs Polyethylene Plastic Mulch (PE)	
Additional Cost (AC): $1,002.00 • BDM- PE	**Additional Income (AI): $0**
Reduced Income (RI): $0	**Reduced Costs(RC): $326.05** • Labor savings: **$315** • Disposal savings: **$ 11.05**
A. Total AC and RI: $1,002	**B. Total AI and RC: $326.05**
Net Change in Profit (B-A): $-675.95	

BDM vs Woven Weed Mat	
Additional Cost (AC): $-1,066 • BDM – Woven	**Additional Income (AI): $0**
Reduced Income (RI): $0	**Reduced Costs(RC): $326.05** • Labor savings: **$315** • Disposal savings: **$ 11.05**
A. Total AC and RI: $-1,066	**B. Total AI and RC: $326.05**
Net Change in Profit (B-A): $1,392.05	

Comparing BDM and PE, simply the cheaper cost per roll of PE outweighs any labor savings received from being able to till BDM into the soil. Currently the BDM used in this trial costs $400 per roll, but the shipping cost is $315 per roll. If shipping and material costs can be reduced in the future, then the feasibility of BDM might be possible compared to PE. The only scenario where BDM was economically feasible was its use in situations where woven weed mat, which the square footage per roll is less, is used then discarded at the end of the crop cycle. However, if the woven weed mat is reused or used on a longer term crop exceeding 5-7 months, then woven weed mat appears to still be more feasible.

FUTURE WORK

The purpose of BDM is very attractive for weed management and labor savings in commercial agriculture, but currently the cost of BDM greatly limits its feasibility. As this technology advances further, perhaps costs may reduce to profitable levels. Additionally, if growers would like to adopt this practice, it is worth trialing in that specific climate first to evaluate if BDM deterioration is faster or slower there.

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APPENDIX 1

Deterioration Rating Scales

1= 1-25% det.

2= 26-50% det.

3= > 50% det.

0= no deterioration

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