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Effects of Coconut-Pulp-Based Compost Rates on Growth And Fresh Biomass of Batik Amaranth (*Amaranthus tricolor* L.)**Diane Deibij Pioh^{1*}, Melisa Pascawati Todingan¹, Rafli Irland Kawulusan²**¹Agrotechnology Study Program, Sam Ratulangi University, Manado, Indonesia²Soil Science Study Program, Sam Ratulangi University, Manado, Indonesia*Corresponding author:
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Abstract. Coconut-processing residues can be recycled into compost, but their agronomic response depends on compost formulation, maturity, application rate, and the fertility of the base growing medium. This study evaluated a coconut-pulp-based compost on the growth and fresh biomass of Batik amaranth (*Amaranthus tricolor* L.) in Kauditan 1 Village, North Minahasa, Indonesia. A completely randomized design consisted of six compost rates with four replications: P0 = 0, P1 = 150, P2 = 200, P3 = 250, P4 = 300, and P5 = 350 g plant⁻¹. The base medium of all treatments contained soil, chicken manure, and burnt rice husk; therefore, P0 was a control without additional coconut-pulp-based compost rather than an unfertilized control. The compost itself was prepared from 10 kg coconut pulp, 3 kg rice husk, 3 kg rice bran, 5 kg chicken manure, brown sugar solution, and EM4 for approximately three weeks. Plant height and leaf number were recorded weekly for three observations, and fresh whole-plant and root weights were measured at harvest. ANOVA showed no treatment effect on plant height in weeks 1 and 2 or on leaf number at any observation. Plant height differed in week 3 ($F_{5,18} = 5.09$, $p = 0.004$), with P0 showing the highest mean (86.0 cm). Fresh whole-plant weight also differed ($F_{5,18} = 3.99$, $p = 0.013$); P0 (159.75 g) was significantly greater than all compost-amended treatments according to Fisher's LSD at 5%. Fresh root weight was not affected ($p = 0.349$). Thus, increasing the tested compost rate did not improve Batik amaranth growth or fresh biomass under the nutrient-containing base medium. Compost maturity and chemical composition were not measured and should be verified before agronomic recommendations are made.

Keywords: *Amaranthus tricolor*; coconut residue; compost maturity; organic amendment; plant biomass.

INTRODUCTION

Vegetable amaranths are fast-growing leafy crops valued for short production cycles, nutritional density, and adaptability to tropical cultivation. *Amaranthus* species provide important minerals, vitamins, proteins, and bioactive compounds, and *A. tricolor* is widely cultivated as a leafy vegetable in Asia and other tropical regions (Uusiku *et al.*, 2010; Achigan-Dako *et al.*, 2014). Because marketable yield is closely linked to rapid vegetative biomass accumulation, nutrient

availability during the short cropping cycle is particularly important.

Organic amendments are widely promoted for recycling agricultural residues while improving soil organic matter, nutrient supply, water retention, and biological activity. However, crop responses are not uniformly positive. Amendment quality, rate, degree of stabilization, base-soil fertility, crop nutrient demand, and the proportion of readily mineralizable carbon can determine whether an organic input increases, has no effect on, or temporarily suppresses plant growth (Edmeades,

2003; Diacono & Montemurro, 2010; Wortman et al., 2017).

Compost maturity is especially important in short-cycle vegetable production. Immature or insufficiently stabilized compost can contain readily degradable carbon, ammonium, organic acids, or soluble salts and may stimulate microbial nitrogen immobilization or phytotoxic responses after application. No single indicator is sufficient to define maturity; combinations of C/N ratio, respiration, temperature, humification, electrical conductivity, ammonium/nitrate relationships, and plant bioassays are commonly recommended (Goyal et al., 2005; Tiquia, 2005; Aslam et al., 2008; Bernal et al., 2009; Wichuk & McCartney, 2010).

Coconut-processing residues are promising organic feedstocks but differ substantially in physical and chemical characteristics. Research on coconut husk and coir pith demonstrates that composting can reduce C/N ratio, improve nutrient recovery, and convert lignocellulosic residues into useful soil amendments, particularly when combined with nutrient-rich animal manures or other co-substrates (Ghosh et al., 2007; Swarnam et al., 2016). These findings support recycling coconut residues, but they do not imply that every coconut-based compost formulation will provide the same agronomic response.

Amaranth has responded positively to mature compost in nutrient-limited soils. Maize-stover compost increased growth, shoot yield, and nutrient uptake of amaranth in field experiments, while compost also improved fresh shoot yield of *Amaranthus cruentus* grown on low-fertility soil (Akanbi & Togun, 2002; Dada et al., 2017). Such responses depend on the fertility context: when the base medium already contains nutrient-rich organic materials, additional compost may provide little short-term benefit or may create nutrient or decomposition-related interactions.

The present study evaluated six rates of a coconut-pulp-based composite compost on plant height, leaf number, fresh whole-plant weight, and fresh root weight of Batik amaranth. The study specifically tested whether increasing compost addition improved plant performance in a base medium already containing chicken manure and burnt rice husk.

MATERIAL AND METHODS

Study Site and Experimental Period

The experiment was conducted in a greenhouse in Kauditan 1 Village, Kauditan District, North Minahasa Regency, North Sulawesi, Indonesia, from April to November 2026.

Plant Material and Base Growing Medium

Batik amaranth (*Amaranthus tricolor* L.) seedlings were raised for approximately 14-21 days before transplanting to 35 × 35 cm polybags. The base medium used in every treatment consisted of soil mixed with chicken manure and burnt rice husk. The original record does not provide the mass or volume ratio of these three components. Consequently, P0 represents the base medium without additional coconut-pulp-based compost and should not be interpreted as a nutrient-free or organic-input-free control.

Preparation of Coconut-Pulp-Based Compost

The experimental compost was a composite material rather than coconut pulp alone. The recorded formulation contained 10 kg coconut pulp, 3 kg rice husk, 3 kg rice bran, and 5 kg chicken manure. A brown-sugar solution was prepared from 1 kg brown sugar in 3 L water, and an EM4 solution was prepared from 5 mL EM4 in 1 L water. The solid materials were mixed, transferred to a



closed container, combined with the two solutions, and mixed thoroughly.

The container was checked every three days. When the internal temperature reached approximately 40 °C, the material was opened and remixed before being closed again. Composting continued for approximately three weeks before field application. The study did not report final compost temperature, C/N ratio, pH, electrical conductivity, respiration, ammonium/nitrate concentration, germination index, or other maturity indicators. Therefore, compost maturity

cannot be confirmed from the available data.

Experimental Design and Treatments

A one-factor completely randomized design was used with six compost rates and four replications, resulting in 24 experimental units. The source design indicates one polybag-grown plant per unit; each polybag was treated as the experimental and analytical unit. The detailed randomization procedure was not retained.

Table 1. Experimental treatments

Treatment	Compost dose (g plant ⁻¹)	Description
P0	0	Base medium without additional coconut-pulp-based compost
P1	150	Base medium + compost
P2	200	Base medium + compost
P3	250	Base medium + compost
P4	300	Base medium + compost
P5	350	Base medium + compost

Note: The compost was the composite coconut-pulp-based material described above.

Crop Management and Measurements

Seedlings were transplanted into the assigned polybags and maintained under greenhouse conditions with routine watering. Plant height and leaf number were measured at three weekly observations after planting. The source file contained duplicated week labels in the leaf-count section; the three datasets were standardized chronologically as weeks 1, 2, and 3 to match the stated three-observation schedule. At harvest, fresh whole-plant weight and fresh root weight were measured in grams.

Statistical Analysis

Each response was analyzed by one-way ANOVA with compost rate as the fixed factor and four replicate plants per treatment. Exact *p* values were recalculated from the replicate values

reported in the source tables. When ANOVA was significant at $\alpha = 0.05$, Fisher's Least Significant Difference (LSD; BNT) test was calculated at the 5% level, consistent with the analytical procedure stated in the original method. Data are reported as mean $\pm$ standard deviation (SD).

RESULTS AND DISCUSSION

Plant Height

Compost rate did not significantly affect plant height in week 1 ($F_{5,18} = 2.64$, $p = 0.059$) or week 2 ($F_{5,18} = 1.44$, $p = 0.258$). In week 3, however, the treatment effect was significant ($F_{5,18} = 5.09$, $p = 0.004$). P0 had the highest mean height (86.00 cm). Fisher's LSD (6.22 cm) showed that P0 was higher than P1, P2, P4, and P5, but not significantly different from P3.



Table 2. Plant height of Batik amaranth during three weekly observations

Treatment	Week 1 (cm)	Week 2 (cm)	Week 3 (cm)
P0	25.12 ± 2.10	52.97 ± 2.17	86.00 ± 2.83 a
P1	23.38 ± 1.39	50.53 ± 3.63	78.75 ± 4.35 b
P2	22.55 ± 2.34	43.42 ± 15.92	75.50 ± 1.29 bd
P3	23.62 ± 1.80	51.55 ± 4.34	81.25 ± 5.85 ab
P4	19.55 ± 3.86	44.20 ± 3.83	72.25 ± 2.53 d
P5	20.30 ± 3.30	42.53 ± 7.41	79.00 ± 6.00 b
F(5,18)	2.64	1.44	5.09
p	0.059	0.258	0.004

Note: Values are mean ± SD (n = 4). Week-3 means sharing at least one letter are not significantly different by Fisher's LSD at $\alpha = 0.05$.

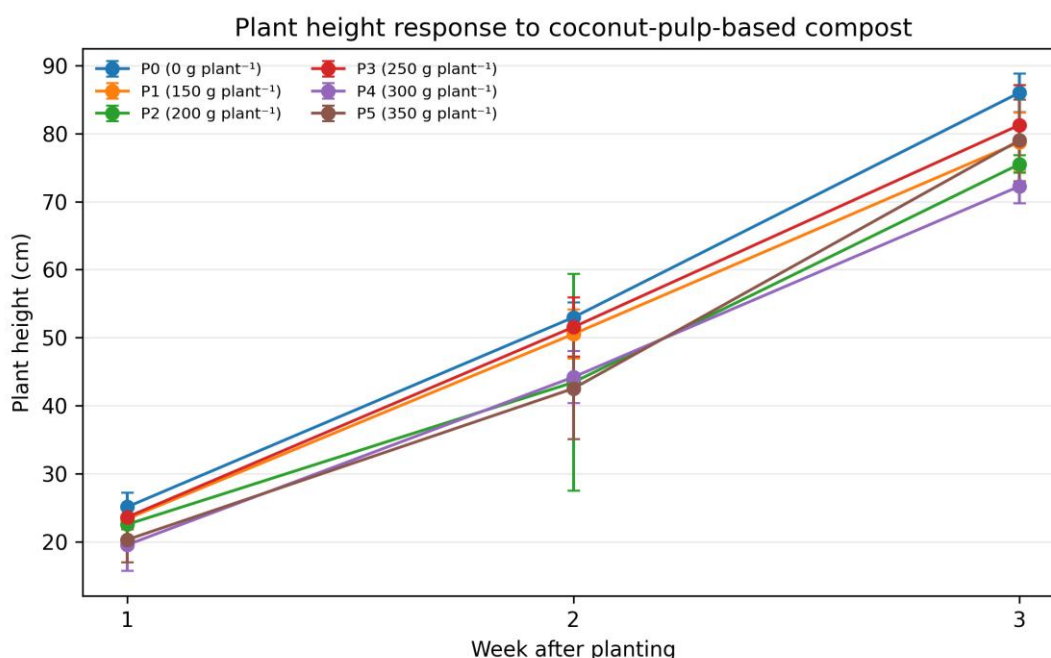


Figure 1. Plant height across three weekly observations. Error bars represent standard deviations. The treatment effect was significant only at week 3.

Leaf Number

Leaf number did not differ significantly among compost rates at any observation: week 1, $F_{5,18} = 1.74$, $p = 0.177$; week 2, $F_{5,18} = 1.70$, $p = 0.185$; and week 3, $F_{5,18} = 0.55$, $p = 0.737$. Therefore, numerical differences among treatment means do not provide evidence of a compost-rate effect on leaf production.

Table 3. Leaf number during three weekly observations

Treatment	Week 1	Week 2	Week 3
P0	9.25 ± 2.06	35.75 ± 8.26	97.50 ± 17.25
P1	9.75 ± 1.89	40.25 ± 7.54	88.75 ± 10.37
P2	8.00 ± 1.83	35.25 ± 6.02	87.00 ± 17.63



Treatment	Week 1	Week 2	Week 3
P3	9.50 ± 1.29	39.50 ± 5.51	93.25 ± 17.46
P4	7.25 ± 1.71	28.50 ± 6.81	81.75 ± 10.24
P5	6.75 ± 2.50	30.25 ± 9.00	88.50 ± 12.23
F(5,18)	1.74	1.70	0.55
p	0.177	0.185	0.737

Note: Values are mean ± SD (n = 4). No observation showed a significant treatment effect at $\alpha = 0.05$.

Fresh Biomass at Harvest

Fresh whole-plant weight differed significantly among treatments ($F_{5,18} = 3.99$, $p = 0.013$). P0 produced the highest mean fresh plant weight (159.75 g). Fisher's LSD (31.82 g) indicated that P0 was significantly greater than each compost-amended treatment, whereas P1-P5 were not significantly different from one another. Fresh root weight did not differ among treatments ($F_{5,18} = 1.20$, $p =$

0.349), although P1 had the highest numerical root weight (59.25 g).

Table 4. Fresh whole-plant and root weight at harvest

Treatment	Fresh whole-plant weight (g)	Fresh root weight (g)
P0	159.75 ± 22.74 a	54.25 ± 15.73
P1	118.25 ± 22.25 b	59.25 ± 29.62
P2	111.75 ± 11.64 b	37.50 ± 9.04
P3	119.50 ± 32.71 b	51.75 ± 9.32
P4	96.25 ± 2.06 b	45.00 ± 22.18
P5	111.50 ± 23.04 b	34.00 ± 13.09
F(5,18)	3.99	1.20
p	0.013	0.349

Note: Values are mean ± SD (n = 4). Different letters within fresh whole-plant weight indicate significant differences by Fisher's LSD at $\alpha = 0.05$.

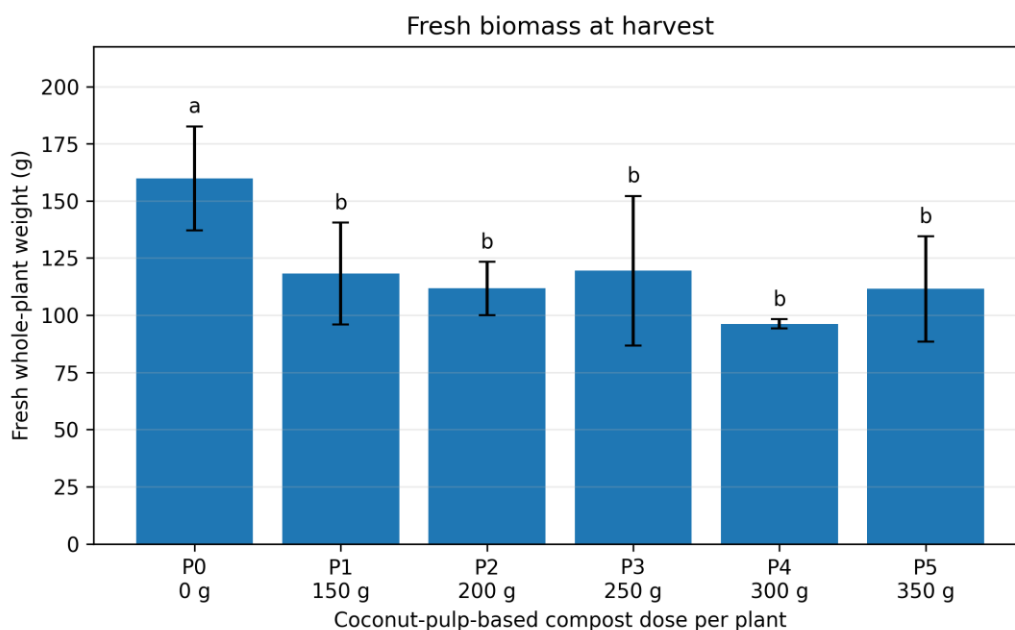


Figure 2. Fresh whole-plant biomass at harvest. Error bars represent standard deviations. Different letters indicate Fisher's LSD groups at $\alpha = 0.05$.

CONCLUSION

The conclusion must directly address the research objectives based on the findings discussed in the previous section. It should be written as a comprehensive paragraph, avoiding bullet points or numbered lists. Do not replicate the abstract or merely restate the results. Authors are encouraged to provide brief recommendations for future research at the end of the paragraph.

ACKNOWLEDGEMENT

Coconut-pulp-based compost rate affected selected Batik amaranth responses but did not improve growth or fresh biomass across the tested dose range. Plant height was not affected in weeks 1 and 2 but differed in week 3 ($p = 0.004$), when the control without additional coconut-pulp-based compost had the highest mean height (86.0 cm). Leaf number was not affected at any observation. Fresh whole-plant weight differed among treatments ($p = 0.013$), and P0 produced 159.75 g, significantly greater than all compost-amended treatments, whereas fresh root weight did not differ ($p = 0.349$). Because all treatments already contained chicken manure and burnt rice husk in the base medium, the result should not be interpreted as evidence that organic fertilization is ineffective. Instead, the additional coconut-pulp-based compost provided no short-term advantage under the tested base-medium conditions. The maturity and chemical quality of the approximately three-week compost were not measured; future recommendations should therefore be based on characterized compost, standardized growing-media proportions, and nutrient and maturity analyses

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