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Research Article

The use of animal manure for improving chemical properties of degraded Ultisol, yield and secondary metabolic of *Zingiber montanum*

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Abstract

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Ultisols in Indonesia have the potential for agricultural development, but the soils have low pH and nutrient contents that hinder plant growth and yield. Using animal manure can be an alternative to improve soil productivity and crop yields. This study aimed to examine the effects of animal manure on the chemical properties of Ultisol, yield and secondary metabolic of *Zingiber montanum*. The treatments tested were combinations of types of manure (cow and chicken manure) and manure application levels, namely P0 (control), P1 (cow manure 20 t/ha), P2 (cow manure 40 t/ha), P3 (cow manure 60 t/ha), P4 (chicken manure 20 t/ha), P5 (chicken manure 40 t/ha), and P6 (chicken manure 60 t/ha). The results showed that the application of chicken manure of 60 t/ha increased N and P contents of the soil, and the application of cow manure of 60 t/ha increased soil cation exchange capacity. The application of cow manure of 60 t/ha gave the highest plant height, the number of leaves, and the number of at 18 weeks after planting, while the application of chicken manure dose of 60 t/ha produced the longest plant roots. The highest fresh and dry rhizome weight was observed for the 60 t/ha cow manure treatment. The highest secondary metabolic levels in each parameter were found in dry rhizomes (phenolic, flavonoid, and tannin) and fresh rhizomes (phenolic and flavonoid), with the highest tannin compound in the treatment of 40 t chicken manure/ha. The application of chicken manure at a dose of 60 t/ha resulted in a strong antioxidant yield in fresh and dry rhizomes.

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Introduction

Zingiber montanum Roxb. (WFO, 2021) that is commonly known as "Banada" in Bangladesh, "Pala" in Thailand, "Janghadrak" in India, and "Bangle" in Malaysia and Indonesia, is extensively planted in Thailand, Malaysia, and Indonesia (Hassani et al., 2019). This plant is commonly used in traditional medicines to treat constipation, dyspepsia, gastritis, stomach bloating and stomach ache. Various parts of *Z. montanum* are used in Thailand as a daily diet (Lim, 2016), while the rhizome is used as a vermifuge in Malaysia and applied for abscesses, colic, diarrhea, fever and intestinal disorders. In Northeast India, rhizome paste was reported to be used to treat dyspepsia and stomach bloating (Anusamy, 2013). In East Kalimantan, Indonesia, the productivity of this plant that is commonly cultivated in the area dominated by the Ultisol soil order, is still low due to the low fertility of the soil.

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