

SOIL FERTILITY QUALITY TEST THROUGH LIQUID ORGANIC FRUIT EXTRACTS OF *Solanum lycopersicum esculentum* Mill. AND EXTRACTS *Ananas comosus* (L.) Merr. ON RED-YELLOW PODZOLIC SOIL MEDIA

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Abstrak

Keywords:

Solanum Lycopersicum,
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Ultisol.

The application of liquid organic fertilizer derived from extracts of *Solanum lycopersicum esculentum* Mill. and *Ananas comosus* (L.) Merr. extracts can improve soil quality through its effects on the physical, chemical and biological properties of the soil. The application of liquid organic fertilizer derived from extracts of *Solanum lycopersicum esculentum* Mill. and *Ananas comosus* (L.) Merr. can improve soil structure and increase the availability of nutrients such as nitrogen, phosphorus and potassium required by plants and the soil. Regarding the role of soil microbes in soil biological properties, they help decompose soil organic matter, increase the availability of nutrients in the soil, and help maintain an ideal soil pH level in Red-Yellow Podzolic soil, commonly known as Ultisol. In this study, the application of liquid organic fertilizer was able to improve the quality of red-yellow Podzolic soil, which was initially nutrient-poor or deficient, to a state where nutrients were available and even abundant. The recommended application of this liquid organic fertilizer is capable of increasing the nutrient content of red-yellow Podzolic soil whilst maintaining soil fertility and health.

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INTRODUCTION

Red-yellow Podzolic soil, commonly known as Ultisol, is a soil type characterised by low nutrient content or a high degree of nutrient deficiency (Lubis, 2020 in Yosephine *et al.*, 2022).

The best and most ideal soil textures for growing plants are loamy-sandy, loamy-clay, and loamy soils; in this context, this will result in a soil pH level suitable for optimising soil conditions, with a pH of 5.0–6.0.

Red-yellow Podzolic soil, commonly known as Ultisol, is currently a major concern due to its low to very low nutrient levels, extremely low organic matter content and highly acidic soil (Fitriatin *et al.*, 2018; Noprizal, 2019 in Lubis, 2020)

Red-yellow podzolic soil is classified as marginal soil, characterised by very low productivity, extremely low nutrient levels due to intensive nutrient leaching, and a very low organic matter content. It is confirmed that the fertility potential of Red-Yellow Podzolic soil is very low (Damanik *et al.*, 2021 in Prasetyo & Suriadikarta, 2022).

Tomato fruit extract (*Solanum lycopersicum esculentum* Mill.) is a commodity of economic value, and this tomato fruit extract serves as a liquid fertilizer that benefits soil fertility and health. According to research by Neli *et al.* (2016), the application of liquid organic fertilizer derived from tomato extract (*Solanum lycopersicum esculentum* Mill.) at a rate of 3 ml per litre of water was able to add nutrients to Inceptisol soil. Meanwhile, according to Lubis *et al.* (2023), the application of liquid organic fertilizer derived from plants can increase nutrient levels that are deficient, thereby making nutrients available to the soil and plants.

Liquid organic fertilizer plays a vital role in agricultural cultivation. Fertilisation that is appropriate in terms of type, dosage and application method will yield the desired productivity. Essentially, Red-Yellow Podzolic soil is severely deficient in nutrients; as such, the application of inorganic fertilizer alone is insufficient to improve soil fertility, making the use of liquid organic fertilizer the most appropriate solution.

According to Anggraini *et al.* (2022), it is recognised that the application of liquid organic fertilizer holds potential and can be further developed in agriculture; consequently, the application of liquid organic fertilizer will help to improve nutrient-deficient soils.

The application of waste to pineapple (*Ananas comosus* (L.) Merr.) is an effective method for improving soil fertility and health, particularly in Yellow-Red Podzolic soils, which are generally acidic. Ultisol (Red-Yellow Podzolic) soil is nutrient-poor and has a low organic matter content; therefore, it is necessary to rehabilitate and conserve Ultisol soil through the application of liquid organic fertilizer derived from pineapple (*Ananas comosus* (L.) Merr.) The application of pineapple fruit or waste (*Ananas comosus* (L.) Merr.), processed into liquid organic fertilizer, compost or bokashi, will improve the physical, chemical and biological properties of the soil, generally resulting in a very significant improvement.

According to Lubis (2026), the application of liquid organic fertilizer can increase nutrient levels in Ultisol soil, particularly in Ultisol soil where no crops have previously been grown. Meanwhile, according to Ramadhani *et al.* (2020), the application of pineapple (*Ananas comosus* (L.) Merr.) peel is capable of increasing the microbial population in Ultisol soil, thereby increasing the nutrient content in the soil so that it is available to plants.

METHOD

This study was conducted at the Soil and Plant Laboratory, Darwan Ali University, Sampit, Indonesia. Soil samples were collected from the Red-Yellow Podzolic soil type in the Sampit area. The study was carried out from January 2026 to

March 2026.

In the case of liquid organic fertilizer, tomatoes (*Solanum lycopersicum esculentum* Mill.) are used, with the extract being derived from the fruit. Another type of liquid organic fertilizer is made from pineapples (*Ananas comosus* (L.) Merr.), with the extract being derived from the fruit.

In this study, a non-factorial completely randomised design (CRD) was employed, involving the application of liquid organic fertilizers derived from tomato fruit extract (*Solanum lycopersicum esculentum* Mill.) and pineapple fruit extract (*Ananas comosus* (L.) Merr.) to Red-Yellow Podzolic soil.

By way of comparison, we examined the initial soil analysis before the application of liquid organic fertilizer derived from tomato fruit extract (*Solanum lycopersicum esculentum* Mill.) and pineapple fruit extract (*Ananas comosus* (L.) Merr.), and after the application of this liquid organic fertilizer.

Observations of Red-Yellow Podzolic soil were carried out at the Soil Laboratory of the Indonesian Oil Palm Research Institute (IOPRI or PPKS) in Medan. Soil observations were conducted on two occasions: an initial soil observation and a final soil observation. The soil observations tested at the start and end included soil organic carbon content (C-Organic) (%), total soil nitrogen content (N-Total) (%), available soil phosphorus (P₂O₅-Available) (ppm P), soil potassium (K₂O-Potential Ex. HCl 25%) (me.100 g⁻¹), cation exchange capacity (CEC) (me.100 g⁻¹), and soil acidity (pH) at a H₂O ratio of 1:1.

RESULT AND DISCUSSION

The results of the study, which produced initial and final soil analyses of the Red-Yellow Podzolic soil, are as follows.

1. Initial Soil Analysis – Red-Yellow Podzolic Soil (Ultisol)

The results of the study in Table 1, which were obtained from initial soil observations in Red-Yellow Podzolic soil, are explained as follows:

Table 1. Initial Soil Analysis – Red-Yellow Podzolic Soil (Ultisol)

Texture	Methods of Analysis	Units	Results	Description
C-Organic	Spectrofotometry	%	1,77	l
N-Total	Kjedhal	%	0,25	l
P ₂ O ₅ -Available	Spectrofotometry	ppm P	4,87	l
K ₂ O-Potential Ex. HCl 25%	AAS	me.100 g ⁻¹	0,40	l
CEC	Volumetry	me.100 g ⁻¹	3,30	vl
pH H ₂ O	Electrometry	-----	4,10	Sour

Description : Criteria for Planting Media, h = High, l = Low, m = Medium, sl = Slightly Low, vl = Very Low, vh, Very High, nm = Not Measurable.

From the results of the initial soil analysis of the Red-Yellow Podzolic soil medium shown in Table 1, several soil texture analyses were identified. The analysis of organic carbon (C-Organic) content yielded a result of 1.77%, which is classified as low. Similarly, the analysis of total soil nitrogen content yielded a result of 0.25%. In

this context, it is known that soils with low nutrient status, such as low organic carbon content (C-Organic) and total soil nitrogen content (N-Total), fall into the nutrient-poor category.

Under such conditions, the soil structure becomes denser, water-holding capacity is low, microbial activity declines, and plants suffer from nutrient deficiency. This aligns with Lubis (2026) view that low total nitrogen (N-Total) levels and insufficient organic matter content lead to nutrient-deficient soil, resulting in reduced and slowed vegetative growth of plants.

The results of the analysis showed that the available phosphorus content in the soil (P₂O₅-Available) was classified as low, with a value of 4.87 ppm P, and the soil potassium content (K₂O-Potential Ex. HCl 25%) were also classified as low, with a value of 0.40 me.100 g⁻¹. Furthermore, the soil cation exchange capacity (CEC) was also classified as very low, with a value of 3.30 me.100 g⁻¹. In this context, the three nutrients—phosphorus (P), potassium (K) and cation exchange capacity (CEC)—which have decreased or are classified as low, clearly indicate that the soil is nutrient-poor or unable to supply essential nutrients, and that the soil is incapable of retaining these nutrients.

This is consistent with the view of Hamzah *et al.* (2024) that land capacity is a key factor in utilising its potential; similarly, in the case of nutrient-deficient soil, the soil will be unable to supply nutrients to plants as a growing medium, resulting in plant decline or death due to nutrient deficiency.

When measuring soil acidity (pH) using a 1:1 ratio, the soil was found to be acidic, with a pH of 4.10. This indicates that the Red-Yellow Podzolic soil is classified as less fertile. The high soil acidity in Red-Yellow Podzolic soil causes high levels of exchangeable aluminium (Al), making it toxic to plants and capable of inhibiting root growth.

This aligns with the view of Saragih & Tarigan (2025) that aluminium (Al) saturation is prevalent in Red-Yellow Podzolic soil, thereby preventing the cation exchange capacity from exchanging nutrient cations. Meanwhile, according to Yosephine *et al.* (2023), the absence of organic compost derived from plants in Ultisol soil can trigger plant toxicity due to the high aluminium content in Red-Yellow Podzolic soil.

In line with research by Ainun (2021), which states that soil biological activity is greatly influenced by moisture, aeration, the availability of organic matter, and soil acidity. If the soil is too acidic, nutrient availability will be insufficient for plant growth and biological activity in the soil will cease due to a lack of organic matter in the soil.

2. Final Soil Analysis – Red-Yellow Podzolic Soil (Ultisol)

The results of the study, which examined the final soil conditions following the application of liquid organic fertilizers derived from *Solanum lycopersicum esculentum* Mill. and *Ananas comosus* (L.) Merr. to Red-Yellow Podzolic soil, are presented in Table 2 as follows:

Table 2. Final Soil Analysis Results – Red-Yellow Podzolic Soil (Ultisol)

Texture	Methods of Analysis	Units	Results	Description
C-Organic	Spectrofotometry	%	6,82	h
N-Total	Kjedhal	%	0,81	h
P ₂ O ₅ -Available	Spectrofotometry	ppm P	23,88	h
K ₂ O-Potential Ex. HCl 25%	AAS	me.100 g ⁻¹	2,30	h
CEC	Volumetry	me.100 g ⁻¹	43,10	vh
pH H ₂ O	Electrometry	----	6,20	<i>Slightly Sour</i>

Description : Criteria for Planting Media, h = High, l = Low, m = Medium, sl = Slightly Low, vl = Very Low, vh, Very High, nm = Not Measurable.

The results in Table 2 indicate that the soil organic carbon (C-Organic) content is classified as high, with a value of 6.82%, and that the nutrient status of total soil nitrogen (N-Total) meets the high criterion, with a value of 0.81%. This indicates that the Red-Yellow Podzolic soil has achieved adequate soil fertility and is considered fertile, as high organic matter content improves soil structure and enhances microbial activity, whilst also providing sufficient essential nutrients for plants. Meanwhile, high total soil nitrogen (N-Total) content provides an adequate nitrogen supply for plant growth. This is consistent with the findings of Nopsagiarti *et al.* (2020), who noted that sufficient and available organic carbon in the soil improves soil physical structure, helps retain soil water, and increases soil cation exchange capacity (CEC). Consequently, Red-Yellow Podzolic soil is better able to retain nutrients for plants.

In the final soil analysis, it can be seen that the levels of available phosphorus (P) and potassium (K) in the soil indicate high nutrient status. The available phosphorus content was 23.88 ppm P, whilst the potassium content was 2.30 me.100 g⁻¹. This demonstrates that Red-Yellow Podzolic soil meets the criteria for fertile soil and supports plant and root development, as well as plant vigour and yield. This aligns with the findings of Yosephine *et al.* (2022); Lubis *et al.* (2023) in Lubis & Pakpahan (2026), which state that the availability of phosphorus and potassium in the soil, particularly at high levels, is one of the key indicators of soil fertility—including in Red-Yellow Podzolic soil—which can support root development, plant vigour and crop yield. However, if phosphorus and potassium levels are high but the soil is compacted and the soil pH is extreme, plant roots will still struggle to absorb nutrients from the soil.

Given the very high cation exchange capacity (CEC) of 43.10 me.100 g⁻¹ of soil, and a soil pH of 6.20—classified as slightly acidic—the Red-Yellow Podzolic soil can still be considered to have a level of fertility suitable for crops. It is stated that a high CEC is capable of retaining nutrients effectively and is not easily leached; conversely, if it is low, nutrients will not be available to plants. The suitable soil acidity (pH) range is from slightly acidic to neutral. According to Tampubolon *et al.* (2022) in Wati *et al.* (2025), suitable soil acidity promotes better plant growth and higher yields; however, if the soil pH does not meet the criteria, it will hinder the availability of macronutrients and may lead to the toxicity of micronutrients.

CONCLUSION

The conclusion of this study is that the nutrient content of Red-Yellow Podzolic soil is indeed very low; indeed, the nutrients are not available in the soil. However, following the application of liquid organic fertilizer derived from extracts of *Solanum lycopersicum esculentum* Mill. and *Ananas comosus* (L.) Merr., the Red-Yellow Podzolic soil experienced an increase in the availability of essential nutrients, making it highly suitable as a growing medium for plants.

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