Research Title:

Increasing Rice Yield in Demonstration Plots Using Bio-Soil: Somdetpittayakom School, Somdet District, Kalasin Province

Researchers:

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Level:
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Abstract

The objectives of this research were: 1) to **study the properties of planting soil mixed with bio-fertilizer**, and 2) to **compare rice yields** from soil mixed with bio-fertilizer The study was conducted at a **784-square-meter demonstration rice field** at Somdetpittayakom School, Somdet District, Kalasin Province. The research methodology followed the **GLOBE Protocol** to investigate soil color, texture, temperature, moisture, pH, and fertility, with data recorded in the Data Entry system

The results indicated that **soil mixed with coffee grounds and cow manure** was **dark brown and clumpy**, with a temperature of **33 degrees Celsius**, a **pH of 5**, and **high levels of N, P, and K** Regarding rice yield comparison, rice grown in soil mixed with coffee grounds and cow manure showed an **average height of 189 cm**, an **average leaf length of 96 cm**, and an **average circumference of 8 cm**. This group produced **larger stems and leaves** and achieved a **higher yield of 33 seeds per panicle**. The seeds were **larger and heavier**; specifically, a standard weight of **1 gram contained only 30 seeds**. In comparison, the seed counts per 1 gram for rice grown in soil mixed with coffee grounds, soil mixed with cow manure, and non-mixed soil were **34, 33, and 35 seeds**, respectively
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Keywords: Soil, Bio-fertilizer, Soil properties, Rice yield

Introduction

Soil is a vital resource for plants and all living organisms, serving as the primary source of water, air, and essential nutrients required for growth. High-quality soil generally consists of **45% inorganic matter, 5% organic matter, 25% water, and 25% air**. Currently, soil degradation is often caused by the shift from subsistence farming to commercial agriculture, as well as prolonged land use without proper quality

improvement. In Thailand, agricultural land accounts for approximately 131.59 million rai, or about 30% of the country's total area

Somdetpittayakom School, located in Kalasin Province, established a demonstration rice field using soil dredged from the **Wari Reservoir** in 2021

A previous study in the 2022 academic year found that soil mixed with **coffee grounds** contained higher levels of Nitrogen (N), Phosphorus (P), and Potassium (K) compared to non-mixed soil, with a pH range of 5.5–6.5, which is suitable for rice cultivation. However, the actual rice yield obtained was only **144 kilograms**, which is significantly lower than the expected yield of 200–250 kilograms for the given area

Therefore, the researchers are interested in studying **how to increase rice yields** in the demonstration plots by using **bio-fertilizer mixed soil** In this context, **bio-fertilizer** refers to the combination of **coffee grounds and cow manure**. The primary objectives are to investigate the properties of soil mixed with bio-fertilizers and to compare the resulting rice yields between mixed and non-mixed soil conditions

Research Question:

Are the rice yields the same amount in demonstration plots that use a mixture of bio-fertilizer and those that do not? If so, how?

Research Hypotheses

1. Rice grown in demonstration plots mixed with bio-fertilizer will yield higher results than rice grown in demonstration plots without bio-fertilizer.

2. Rice yields from demonstration plots using different types of bio-soil will vary in quantity.

Research Objectives:

1. To study the properties of planting soil mixed with biofertilizer.

2. To compare rice yield from planting soil mixed with biofertilizer and without biofertilizer.

Definition of Terms:

Biofertilizer is a fertilizer produced from coffee grounds and cow dung.

Materials and Research Methodology
1. Research Materials

The materials used for studying soil properties and rice cultivation include

1. Planting soil (4 plots)
2. Dried coffee grounds
. 3. Cow manure

.   4. RD6 sticky rice seeds

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        5. **Soil property analysis equipment**, such as soil thermometers (digital or needle), soil augers, pH meters/paper, and soil fertility test kits (for N, P, K)

        6. **Other tools:** Distilled water, hammers, measuring tapes, and data recording sheets

Research Methodology

        The research was divided into two main phases as follows:

Phase 1: Pre-planting Soil Analysis (Before Rice Cultivation)

        1. **Site Survey:** Conducted a survey of the study area at the Somdetpittayakhom School demonstration rice field

.   2. **Soil Preparation:** Prepared 4 sets of soil (90 square centimeters each) and allowed the soil to rest for 30 days

            ° **Set 1:** Control group (unmixed planting soil)

.   ° **Set 2:** Soil mixed with 1 kg of coffee grounds (dried for 7 days)

            ° **Set 3:** Soil mixed with 1 kg of cow manure (dried for 7 days)

.   ° **Set 4:** Soil mixed with 1 kg of both dried coffee grounds and cow manure (dried for 7 days)

        3. **Data Collection using GLOBE Protocol:**

         ° **Soil Color:** Observed soil samples in wet and dry states and compared them with a soil color chart

         ° **Soil Texture:** Moistened soil samples and molded them by hand to identify the texture class

         ° **Soil Temperature:** Measured at a depth of 5 cm using a thermometer after pre-drilling a 12 cm hole with a nail

         ° **Soil Moisture:** Collected samples at depths of 0-5 cm and 10 cm; samples were weighed before and after being dried in an oven at 95–105°C for 24 hours to calculate moisture content

         ° **Soil pH:** Mixed soil with distilled water at a **1:1 ratio**, stirred 5 times, and measured the pH of the clear liquid surface

         ° **Soil Fertility:** Used test kits to measure the levels of **Nitrate (N), Phosphorus (P), and Potassium (K)**

Phase 2: Rice Cultivation in Demonstration Plots

The cultivation period lasted from **June 1, 2025, to November 16, 2025**

        1. **Area Preparation:** Prepared a 784-square-meter field, plowed to remove weeds, and rested the land for one week

2. **Plot Division:** Divided the field into 4 sub-plots (196 square meters each)
:

      ° **Plot 1:** Control group (no bio-fertilizer)
      ° **Plot 2:** Mixed with 24 kg of coffee grounds
      ° **Plot 3:** Mixed with 24 kg of cow manure
      ° **Plot 4:** Mixed with 24 kg of both coffee grounds and cow manure

3. **Cultivation:** Plowed the organic mixtures into the soil on June 8, 2025, and transplanted the rice on August 4, 2025

4. **Monitoring and Analysis:** Recorded plant height, leaf count, and observed grain characteristics to analyze growth **every 15 days** until harvest

Research Results

      The research results are divided into two main parts:

Phase 1: Results of Planting Soil Properties Analysis The study compared four types of soil after a 30-day resting period:

      1. **Plot 1 (Control - Unmixed Soil):** The soil was **reddish-yellow** and **hard** to the touch It had a temperature of **36°C**, a **pH of 7.0**, and low levels of Nitrogen (N) and Phosphorus (P), with moderate Potassium (K)

      2. **Plot 2 (Mixed with Coffee Grounds):** The soil was **brown**, **coarse**, and could be molded into clumps It had a temperature of **34°C**, a **pH of 7.0**, and moderate levels of N, P, and K

      3. **Plot 3 (Mixed with Cow Manure):** The soil was **light brown, friable, and sandy** . It had a temperature of **36°C**, a **pH of 6.0**, and **high levels of Nitrogen and Potassium**, with moderate Phosphorus

      4. **Plot 4 (Mixed with Coffee Grounds and Cow Manure):** The soil was **dark brown** and **soft (clay-like)**, easily molded into spheres
. This plot recorded the lowest temperature at **33°C** and the **highest moisture content** (1.8–2.14 g/g). It also contained the **highest levels of N, P, and K** with a **pH of 5.0**

Phase 2: Comparison of Rice Yields. The comparison of rice grown in the four different soil conditions revealed the following

      • **Growth Performance:** Rice in **Plot 4 (Coffee Grounds + Cow Manure)** showed the best growth, with an **average height of 189 cm**, an **average leaf length of 96 cm**, and an **average stem circumference of 8 cm**

      • **Yield Quantity:** Plot 4 produced the highest yield with an average of **33 seeds per panicle**, compared to 23, 26, and 30 seeds in Plots 1, 2, and 3, respectively

      • **Grain Quality:** The seeds from Plot 4 were **larger and heavier**. When measuring a standard weight of **1 gram**, it contained only **30 seeds**, whereas Plots 1, 2, and 3 required 35, 34, and 33 seeds, respectively, to reach the same weight

Conclusion and Discussion

Conclusion

The research results from the demonstration plots at Somdetpittayakom School can be summarized as follows:

1. **Plot 1 (Control Group):** The soil was **reddish-yellow and hard** with a temperature of **36°C** and a **pH of 7.0** It had **low levels of Nitrogen (N) and Phosphorus (P),** and moderate Potassium (K)

. 2. **Plot 2 (Mixed with Coffee Grounds):** The soil turned **brown and coarse,** allowing it to be molded into clumps The temperature was **34°C** with a **pH of 7.0,** containing **moderate levels of N, P, and K**

3. **Plot 3 (Mixed with Cow Manure):** The soil was **light brown and friable (sandy)** with a temperature of **36°C** and a **pH of 6.0** It contained **fairly high levels of Nitrogen and Potassium**

4. **Plot 4 (Mixed with Coffee Grounds and Cow Manure):** This plot showed the best soil properties, being **dark brown and soft like clay,** with the lowest temperature of **33°C** and the **highest moisture content**   It contained **high levels of N, P, and K** with a **pH of 5.0**

. 5. **Rice Yield Comparison:** Rice in **Plot 4** achieved the highest growth and yield, with an **average height of 189 cm**, **33 seeds per panicle**, and the **heaviest seeds** (30 seeds per 1 gram) compared to the other plots

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Discussion

1. **Soil Physical Properties:** The addition of **coffee grounds** changed the soil color to **brown** and improved its texture to be **softer and clumpy** This is because coffee grounds have a naturally dark color from the roasting process and contain **high organic matter**, which directly enhances soil structure

2. **Nutrient Enhancement:** Soil mixed with bio-fertilizers (especially coffee grounds) showed **higher N, P, and K levels** . Scientific analysis indicates that coffee grounds are rich in minerals, particularly **Potassium (K),** which is essential for plant growth. Using coffee grounds is therefore a viable alternative for promoting crop development

3. **Plant Height:** Rice grown in soil mixed with **cow manure** showed a greater average height than unmixed soil. . This is attributed to the **high Nitrogen content** in cow manure, which specifically stimulates rapid increases in plant height, leaf length, and leaf width

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Acknowledgements

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