Abstract

Research Title: A Study and Comparison of Soil Quality in Rice Cultivation at Seedling, Heading, and Golden Heading Stages in Na Muen Si Subdistrict, Na Yong District, Trang Province.

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Abstract

This study comparing soil quality during rice cultivation at the seedling, heading, and heading stages in Na Mueang Si Subdistrict, Na Yong District, Trang Province, aimed to: **1)** study soil quality during the seedling, heading, and heading stages, and **2)** compare soil quality during the seedling, heading, and heading stages. The objective was to understand the soil conditions that directly affect rice growth and yield. Analysis of key variables revealed that the physical environment of the soil was suitable for cultivation, with a stable pH of 6.0-7.0, which is an optimal level for nutrient release. Furthermore, the soil had the ability to retain temperature at 26-28°C, even with external temperature fluctuations reaching 32.1°C during the heading stage. A comparison of nutrient levels at each stage showed that in the seedling stage... The soil had sufficient initial nutrients for growth. However, during the heading stage, nitrogen (N) levels increased significantly, reaching a maximum of 66.7°C, supporting panicle and flower formation. Finally, during the golden heading stage, the levels decreased. Phosphorus (P) and potassium (K) levels peaked at 106.7 and 30.0°C, respectively, consistent with the rice plant's need for nutrient translocation to accumulate nutrients for increased grain weight and quality. In summary, soil quality showed positive changes, with increases in major nutrients correlated with growth stages, effectively meeting the rice plant's needs at each developmental stage**.**

Keywords: 1. Soil Quality 2. pH 3**.** Soil Moisture 4**.** NPK (Major Nutrients in Soil)

Introduction

Rice production is a vital economic foundation and way of life for the people in Na Muen Si Subdistrict, Na Yong District, Trang Province. However, successful cultivation depends primarily on soil quality, especially pH and the amount of essential nutrients, which must be suitable and sufficient for the rice plant's needs at each stage of growth. The main reason for this study is that current soil conditions in different rice paddies may vary in degradation or fertility depending on farmers' management practices and fertilizer use. Furthermore, rice plants have different nutrient requirements at different stages of growth. Studying only one period is insufficient to reflect the true potential of the soil. Therefore, the researchers recognized the importance of "studying and comparing soil quality" at three key stages: seedling stage, heading stage, and golden heading stage, to understand the detailed physical and chemical changes in the soil. The data obtained will be extremely beneficial in helping farmers plan fertilizer application according to the rice's needs at each stage, reduce redundant production costs, and improve agricultural management in Na Muen Si Subdistrict for greater accuracy and sustainability.

Objectives of the research

1. Soil quality study for rice cultivation in seedling stage, ear emergence stage, and yellow ear stage

2. Comparison of soil quality in planting rice in the seedling stage, ear stage, and yellow stage

Scope of study

This research studies and compares soil nutrients at different stages of rice cultivation in rice paddies in Na Muen Si Subdistrict, Na Yong District, Trang Province. The study commenced on December 23, 2025, and covers three key growth stages of rice: seedling, heading, and golden panicle stage.

Research questions

Does the soil quality differ during the seedling, heading, and golden heading stages of rice cultivation?

Research hypothesis

Soil quality varies during the seedling, heading, and golden heading stages of rice cultivation.

Materials, equipment, and measurement methods for research.

1. pH meter using a device called a universal indicator.
2. Soil nutrient meter using a soil test kit.
3. Soil temperature meter.
4. Digital thermometer.
5. Digital hygrometer.

Main inspection methods

1.)GLOBE Measurement Method,

2.)Pedosphere (Soil) Measurement Principle,

3.)Atmosphere Measurement Principle

Defining the study points.

The study site was established in rice fields in Na Muen Si Subdistrict, Na Yong District, Trang Province. The soil quality for rice cultivation was studied at three stages: seedling, heading, and golden heading. Geographic coordinates: Latitude (N) 7.582759, Longitude (E) 99.67388.

Research methodology

1. Research Preparation Phase

1) Identify the research question; choose a topic for study.

2) Research and gather knowledge and theories related to the research.

3) Define the research objectives.

4) Determine sampling points within the study area.

. Operational Procedures and Data Collection:

1.) Measuring soil temperature in experimental plots.

2.) Measuring pH.

3.) Measuring nitrogen, phosphorus, and potassium (NPK) nutrient levels.

4.) Measuring relative humidity.

5.) Measuring air temperature.

Soil Temperature Measurement:

Use a glass bulb thermometer to measure soil temperature at depths of 5 and 10 centimeters. Take measurements at the same time each day to control for variables.

Soil pH Testing

1) Weigh 20 grams of dry, sieved soil and pour it into a beaker.

2) Add 20 or 100 milliliters of distilled water to achieve a soil:water ratio of 1:1.

3) Stir the soil with a glass rod for 30 seconds, then let it sit for 3 minutes. Repeat this 5 times.

4) After stirring 5 times, let the soil in the beaker settle, revealing clear water on top.

5) Dip a pH test strip or calibrated pH test pen into the clear water, avoiding contact with the soil below. Wait for the reading to stabilize, then read the pH value.

Soil Fertility Assessment

1) Weigh 20 grams of dry, sieved soil and pour it into a beaker.

2) Add 20 or 100 milliliters of distilled water to achieve a soil:water ratio of 1:1.

3) Stir the soil with a glass rod for 30 seconds, then let it rest for 3 minutes. Repeat this process 5 times.

4) After stirring 5 times, let the soil in the beaker settle. You will see clear water on top. The temperature in the soil at a distance of 5 and 10 centimeters should be measured.

Relative humidity of the air:

Use a digital hygrometer to read the relative humidity directly from the meter.

Air temperature:

Use a digital thermometer to read the temperature directly from the meter.

Part 2: Sampling

Soil Sampling

1.) Define the sampling area at Na Muen Si Subdistrict, Na Yong District, Trang Province, and select soil sampling points within the study plot to adequately cover the experimental area. Collect soil samples from the topsoil layer at the specified depth using clean and appropriate tools.

2.) Mix the soil samples from each point together to obtain a homogeneous sample representing the study area.

3.) Place the soil sample in a clean, dry container and clearly label it with the location, date, and sampling details.

4.) Send the collected soil samples to the laboratory for analysis of soil properties, including pH and the amount of important plant nutrients such as nitrogen, phosphorus, and potassium.

Analysis and Conclusion of Research Findings:

A comparative study of soil quality in rice paddies at three stages of growth—seedling, flowering, and heading—revealed that soil quality changes with each stage of rice growth. During the seedling stage, the soil has relatively high nutrient levels, suitable for the initial growth of the rice plant. In the flowering stage, soil nutrients begin to decrease as the rice

plants use them to develop stems and flowers. In the heading stage, the soil has the lowest nutrient levels because they are used to form rice grains. This results in a progressive decline in soil quality with each stage of rice growth.

Research Results

Table 1: Geographic Coordinates

Nature trail	Geographic coordinates	
	Latitude (N)	Longitude (E)
Na Muen Si/นาหมื่นศรี,Na Yong/ นาโยง,Trang/ตรัง	7.582759	99.67388

From Table 1, the geographical coordinates were used to study the rice paddy area in Na Muen Si Subdistrict, Na Yong District, Trang Province. Geographical coordinates Latitude (N) 7.582759, Longitude (E) 99.67388

Table 2 Soil temperature values in the study area.

Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage	27	28.5	28	27.8
2. Heading stage	30	29	30	29.7
3. Golden yellow ear-shaped heading stage.	29.5	30	29.8	29.8

Table 2 shows the soil quality parameters at the study area. Soil temperature tended to increase slightly with the growth stage of rice. The lowest soil temperature, averaging 27.8°C, was recorded during the seedling stage and increased until it stabilized during the heading and flowering stages, averaging approximately 29.7 - 29.8°C.

Table 3 shows the pH values in the soil of the studied area.

Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage	6	6	6	6
2. Heading stage	7	7	7	7

3. Golden yellow ear-shaped heading stage.	6	6	6	6

Table 3 shows the soil pH values in the studied area. The average pH during the seedling and heading stages was 6 (slightly acidic), while during the heading stage it was 7 (neutral), indicating the soil's optimal nutrient absorption.

Table 4 Nitrogen (N) values in the soil of the studied area.

Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage	10mg/L	50mg/L	20mg/L	32.3mg/L
2. Heading stage	50mg/L	100mg/L	50mg/L	66.7mg/L
3. Golden yellow ear-shaped heading stage.	50mg/L	50mg/L	50mg/L	50mg/L

Table 4 shows the nutrient values in the soil of the studied area.
The highest N content in plants was found during the heading stage (average 66.7 mg/L), and the lowest was found during the seedling stage (average 32.3 mg/L).

Table 5 P (phosphate) values in the soil of the studied area.

Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage	120mg/L	80mg/L	80mg/L	93.3mg/L
2. Heading stage	80mg/L	80mg/L	80mg/L	80mg/L
3. Golden yellow ear-shaped heading stage.	120mg/L	100mg/L	100mg/L	106.7mg/L

Table 5 shows the P (phosphate) values in the soil of the studied area. The highest P levels in plants were found during the heading stage (average 106.7 mg/L), which are used for rice grain formation.

Table 6 Potassium (K) values, plant nutrients in the studied area.

Measurement distance	1st time	2nd time	3rd time	average

1. Seedling stage	0mg/	20mg/L	20mg/L	13.3mg/L
2. Heading stage	20mg/LL	20mg/L	20mg/L	20mg/L
3. Golden yellow ear-shaped heading stage.	20mg/L	50mg/L	20mg/L	30mg/L

From Table 6 The K value of nutrients in the soil in the studied area showed that the K value in plants tended to increase with growth, with the highest value in the budding stage (average 30 mg/L).

Table 7 shows the relative humidity values in the air of the studied area.

Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage(°C)	32.5	32.1	31.7	29.5
2. Heading stage(°C)	29.8	29.5	29.3	32.1
3. Golden yellow ear-shaped heading stage. (°C)	28.4	28.2	28.1	28.2

Table 7 shows the relative humidity values in the studied area. It was found that the relative humidity values throughout the study were similar at all stages, with the highest average value during the seedling stage (66.7%) and the lowest during the heading stage (64.6%).

Table 8 shows the air temperature values in the studied area.

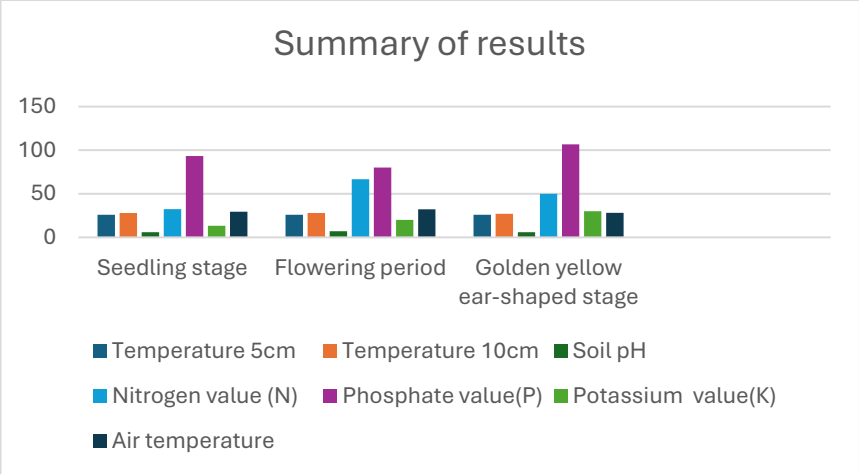
Measurement distance	1st time	2nd time	3rd time	average
1. Seedling stage(°C)	32.5	32.1	31.	29.5
2. Heading stage(°C)	29.8	29.5	29.3	32.1
3. Golden yellow ear-shaped heading stage.(°C)	28.4	28.2	28.1	28.2

Table 8 shows the air temperatures in the studied area. It was found that the air temperature tended to decrease continuously as the rice grew. The average air temperature was highest during the seedling stage at 32.1 degrees Celsius and dropped to its lowest point during the heading stage at 28.2 degrees Celsius.

Table 9: Soil Quality Comparison Table

Translators studied	Average($\bar{x}$)						
	soil temperature 5 cm. (℃)	soil temperature 15 cm. (℃)	pH	N	P	K	air temperatre (℃)
Seedling stage	26	28	6	32.3	93.3	13.3	29.5
Heading stage	26	28	7	66.7	80	20	32.1
3. Golden yellow ear-shaped heading stage.	26	27	6	50	106.7	30	28.2

Table 9 The soil quality was suitable for rice growth at all stages, with a pH of 6–7 that supports efficient nutrient availability. Nitrogen increased during the heading stage to support flowering, while phosphorus and potassium peaked at the golden heading stage for grain filling. Soil temperature ranged from 26–28 ℃.



Discuss the research findings

Seedling Stage

During the seedling stage, the soil temperature was found to be 27.8°C, which is within the optimal range for germination and root development of rice plants. The soil pH was 6, indicating slightly acidic soil conditions conducive to nutrient absorption. Nitrogen, phosphorus, and potassium values were 32.3, 93.3, and 13.3 mg/L, respectively, reflecting sufficient phosphorus for root development at this stage, but with relatively low potassium levels. Soil moisture content was 3.9, and relative humidity was 66.7%, while the air temperature was 32.1°C,

Heading Stage

During the heading stage, the soil temperature increased to 29.7°C, and the soil pH increased to pH 7, which is neutral. This affected changes in nutrient dissolution and absorption, especially nitrogen, which increased to a maximum of 66.7 mg/L, consistent with the increased nitrogen demand during panicle formation. Phosphorus and potassium levels were 80 and 20 mg/L, respectively. Soil moisture content was 4, and relative humidity decreased slightly to 64.6 percent, while air temperature dropped to 29.5 degrees Celsius.

Golden Heading Stage

During the golden heading stage, the soil temperature was 29.8 degrees Celsius, and the soil pH decreased to 6, which is within the optimal range for nutrient absorption for starch accumulation in rice grains. Nitrogen, phosphorus, and potassium levels were 50, 106.7, and 30 mg/L, respectively, with phosphorus and potassium being the highest at this stage. This reflects the role of these nutrients in developing grain quality and panicle completeness. Soil moisture content increased to 4.8, and relative humidity was 65.7 percent, while air temperature decreased to 28.2 degrees Celsius,

The objectives of this study were 1) to investigate soil quality at the seedling, heading, and golden heading stages of rice cultivation, and 2) to with an optimal pH of 6.0-7.0, which positively affected nutrient dissolution. The soil also maintained a stable temperature of 26-28°C, relative to fluctuating ambient temperatures. A comparison of nutrient levels across the three stages showed changes consistent with the physiology of the rice plant. Nitrogen (N) levels increased to a maximum at the heading stage (66.7) for panicle development, while phosphorus (P) and potassium (K) levels accumulated continuously until reaching peaks at the golden heading stage (106.7 and 30.0, respectively), a crucial mechanism for sugar translocation to increase grain weight. In summary, soil quality at each stage shows progressively improving nutrient levels as the rice plants mature, providing optimal support for growth and yield.

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I AM A PROBLEM SOLVER

This project demonstrates how the research team used environmental investigations to address problems related to soil quality in rice paddies across three growth stages: the seedling stage, the flowering stage, and the ripening (golden grain) stage. By measuring soil quality parameters such as soil temperature, soil moisture, pH, and nutrient levels at each stage, the researchers identified changes and potential challenges affecting rice growth. of Earth system science, the team analyzed the results to better understand soil–water interactions and their impacts on rice cultivation, allowing them to propose possible solutions for improving soil management and supporting sustainable rice production.

I MAKE AN IMPACT

This project clearly explains how local issues related to soil quality in rice paddies led to the research questions and connects these local concerns to broader environmental and global agricultural challenges. The research team shows how the findings from measuring soil quality across three rice growth stages contributed to a positive impact on the community by providing practical recommendations for soil and water management. Based on the results, actions and guidance were shared to support more sustainable rice farming practices, improve crop productivity, and promote long-term environmental sustainability.

I AM A DATA SCIENTIST

This report presents an in-depth analysis of data related to rice quality assessment, utilizing data downloaded from the GLOBE database together with data collected by the research team from rice fields. The study covers measurements of environmental and soil quality parameters, including soil temperature at depths of 5 and 10 centimeters under both flooded and dry soil conditions, soil pH, primary soil nutrients (nitrogen, phosphorus, and potassium), relative humidity, and air temperature.Data collection was conducted across three rice growth stages: the seedling stage, the flowering stage, and the ripening (golden grain) stage. The researchers analyzed the relationships between environmental factors and rice quality.