Study the quality of soil in rice fields before planting

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Abstract

From the study of soil quality before rice planting, physical and chemical properties of the soil were assessed, which are important factors affecting the growth and yield of rice. The parameters used in the analysis included pH, soil temperature, soil salinity, soil moisture, and the amount of essential nutrients for plants. The study found that the average soil salinity was 0.18 mS/cm, which is less than <2 mS/cm, indicating that the soil in the study area has salinity levels that do not hinder the absorption of nutrients by rice. The pH value is 6.54, which falls within the suitable range (5.0-7.0) for rice cultivation, as it allows essential nutrients such as nitrogen, phosphorus, and potassium to dissolve and be absorbed by the plants efficiently. The soil temperature is at 30°C, which is suitable for the tillering stage and the photosynthesis process, allowing rice plants to efficiently accumulate energy and grow fully. The soil moisture content is in the range of 75%-100%, which is suitable for rice growth because rice is a water-intensive plant, especially during the tillering and grain-filling stages. Water is essential for nutrient transport and maintaining cell turgor pressure. Meanwhile, the soil fertility level is IDEAL. Indicates the sufficient amount of essential nutrients for rice growth, such as nitrogen (N), which aids in the development of stems and leaves; phosphorus (P), which promotes root growth and seed formation; and potassium (K), which enhances plant strength and disease resistance.

Acknowledgments

Research on the invasiveness of the quality of soil in rice fields before planting

The authors received funding support from the principal of Kalasin Pittayasan School, Dr. Jaruwan Rattanamalee, who provided assistance and support throughout the project. They also received help from teachers Chumphon Chareesan regarding the science laboratory, tools, and equipment, as well as guidance on various reference materials and websites used for research and problem-solving during the study.

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Chapter 1

Introduction

1.1 Background and Importance of the Project

Rice (Oryza sativa L.) is an important economic crop in Thailand, serving as a staple food for more than half of the world's population, especially in Asian countries. It is also one of Thailand's main agricultural export products, with Thailand being the second-largest rice exporter in the world after India. The growth and yield of rice depend on several factors, particularly the soil quality before cultivation. Therefore, studying soil quality before rice planting is essential to assess the physical, chemical, and biological conditions of the soil. This will help farmers improve the soil to be suitable for cultivation and increase productivity effectively. The study of soil quality in rice fields focuses on analyzing various components such as soil pH, organic matter content, the fertility of essential nutrients (nitrogen, phosphorus, and potassium), and soil structure. These factors affect the nutrient absorption of rice plants and the soil's water retention capacity. Examining soil quality before planting will help in planning soil improvement, fertilizer application, and water management appropriately. Therefore, the organizers are interested in studying the soil quality in rice fields before planting so that farmers can improve the soil to suit cultivation and increase productivity effectively.

1.2 Project Objectives

To study the quality of soil in rice fields before planting.

1.3 Hypothesis

The soil sample used for rice cultivation is of suitable quality for rice planting.

1.4 Expected benefits

Knowing the soil quality is suitable for rice cultivation supports strong growth and good yields. Soil testing before planting helps improve management efficiency for even better yields.

1.5 Scope of study

Location : (16.841751, 103.670569)

Duration : December 20, 2024

Chapter 2

Related Documents and Research

The author has studied information and research related to the study of soil quality suitable for rice growth to obtain soil of appropriate quality as follows.

2.1 Rice (*Oryza sativa* L.)

2.2 Soil quality

2.1 Rice (Oryza sativa L.)

Rice is a grain of immense importance to humanity, especially in Asian countries where it is the staple food for the majority of the population. In addition to being a primary source of energy providing carbohydrates, rice is also an integral part of the culture, traditions, and way of life of people in many regions. Rice production not only affects food security but also impacts the economy and the livelihoods of farmers Although many factors affect the growth of rice, soil is one component that plays a crucial role in cultivation. Fertile soil rich in minerals and with suitable conditions helps rice grow well and produce high-quality yields. However, other factors such as water, temperature, and maintenance also impact rice production.

2.2 Soil quality

2.2.1. The pH value of the soil

The pH level of the soil is an important factor that directly affects the growth of rice, as it influences the plant's ability to absorb nutrients and affects the activity of soil microorganisms involved in the nutrient release process. The appropriate soil pH for rice cultivation: Generally, rice can grow well in soil with a pH range of 5.5 - 7.0, which is conducive to the dissolution of nutrients in the soil in a form that plants can efficiently absorb. Highly acidic soil (pH below 5.5) causes essential nutrients such as nitrogen, phosphorus, and calcium to be less soluble, resulting in rice nutrient deficiency. Increase the solubility of certain heavy metals, such as aluminum (Al) and manganese (Mn), which can be toxic to rice roots and inhibit growth. Reduce the number of beneficial microorganisms in the soil, leading to decreased decomposition of organic matter and nutrient release. Highly alkaline soil (pH above 7.0). Phosphorus and micronutrients may precipitate into forms that rice cannot utilize, leading to nutrient deficiencies and affecting rice plant development. This may cause increased sodium accumulation in the soil, resulting in soil structure degradation, reduced water and nutrient absorption capacity of rice roots, and decreased nitrogen-fixing microorganisms in the soil, which are essential for rice growth.

2.2.2. The temperature of soil

Soil temperature is another important factor that directly affects the growth of rice, as it influences the physiological processes of the plant, such as seed germination, root growth, water and nutrient absorption, as well as the activity of soil microorganisms. The optimal soil temperature range for rice growth Seed germination: Rice can germinate well at soil temperatures between 25 - 35°C. Temperatures lower or higher than this range may reduce the germination rate and slow down seedling growth. The growth of rice plants: Rice grows well in soil temperatures of 20 - 30°C, which is the range where roots can efficiently absorb water and nutrients. The development of roots and water absorption: The optimal soil temperature for root growth in rice is between 22 - 28°C. If the temperature is lower than this, root growth may slow down, leading to water and nutrient deficiency in the rice plants. The impact of soil temperature on rice growth: Soil temperatures that are too low (below 15°C) slow down seed germination and reduce the germination rate, resulting in slow root growth. Causing the rice seeds to germinate slowly and reducing the germination rate, resulting in slow root growth. Water and nutrient absorption decrease, and the activity of soil microorganisms declines, resulting in slower decomposition of organic matter and nutrient release. Soil temperatures are too high (above 35°C). Causes reduced water absorption, leading to easy water deficiency in rice. This may result in root damage or faster deterioration, and reduces the activity of beneficial microorganisms. Causing a decrease in nutrient release, if the temperature is too high, it may cause the soil to dry out and harden, affecting the soil structure and the growth of rice roots.

2.2.3. The salinity of soil

Soil salinity is an important factor that affects rice growth because saline soil can make it harder for rice plants to absorb water and nutrients, resulting in slower growth and potentially reducing rice yields. The appropriate salinity level of the soil for rice cultivation The salinity of the soil can be measured by the electrical conductivity (EC) of the soil solution, with units in decisiemens per meter (dS/m). The impact on rice growth can be categorized as follows: soil with low salinity (EC < 2 dS/m) is suitable for rice cultivation. Rice can grow well in soil with low salinity (EC < 2 dS/m). Soil with moderate salinity (EC 2 - 4 dS/m) Rice may start to grow slightly less, but it can still adapt. Soil with high salinity (EC 4 - 8 dS/m) causes rice to grow more slowly and the leaves to turn yellow. Water absorption decreases, and it may reduce yields. Soil with severe salinity (EC > 8 dS/m) Rice may not be able to grow normally, showing stunted growth and very low yields. The impact of saline soil on rice growth: Reduced water absorption. Saline soil increases osmotic pressure, making it harder for rice roots to absorb water. This can lead to water deficiency in the plants, even when there is sufficient water in the soil. Toxicity from salt ions. In highly saline soils, there is often a high accumulation

of sodium (Na^+) and chloride (Cl^-), which can be toxic to rice roots, weakening the root system and affecting the photosynthesis process. Nutrient deficiency: Saline soil can disrupt the nutrient balance in the soil. For example, the accumulation of sodium can hinder the absorption of potassium (K^+) and calcium (Ca^{2+}), which are essential nutrients for rice growth. Changes in soil structure: Saline soil with high sodium content can deteriorate soil structure, making it compact and poorly draining, which affects the proper growth of rice roots.

2.2.4. The moisture levels of soil

Soil moisture is an important factor that directly affects the growth of rice, as rice is a plant that requires more water than other types of plants, especially during different stages of growth. Soil moisture affects the absorption of water and nutrients by rice roots, as well as the photosynthesis process and overall growth. The appropriate soil moisture content for rice cultivation can be measured by the level of water the soil can retain (Soil Moisture Content). The soil suitable for rice cultivation should have sufficient water for each growth stage as follows: Germination Stage - the soil moisture should be around 80-100% of the soil's water-holding capacity. The soil should be moist enough to stimulate seed germination and root development. If the soil is too dry, the rice seeds may not germinate or may take longer to germinate. Tillering Stage - the water level in the rice field should be about 5-10 centimeters to support the growth of rice plants and tillering. If the soil lacks water, the tillering rate will decrease, resulting in reduced yield. The Panicle Initiation Stage requires continuous high moisture to allow the rice to fully develop its grains. The water level in the rice field should be maintained at approximately 5 - 15 centimeters. Flowering and Grain Filling Stage should have consistently high soil moisture because this is the period when rice requires the most water. If there is a lack of water during this stage, it may cause the grains to be shriveled or reduce the number of grains per panicle. Harvesting Stage: In the period about 7-10 days before harvesting, the water level should be reduced to maintain soil moisture at approximately 60-70% of the soil's water-holding capacity. Water should be drained from the rice field to allow the soil to dry sufficiently, reducing seed moisture and making harvesting easier. The impact of soil moisture levels on rice growth: If the soil moisture is too low (water deficit), seed germination decreases or takes longer. Root growth and tillering decrease, rice leaves wilt, photosynthesis decreases, and it may result in lower yields. Soil moisture is too high (waterlogged for too long). If waterlogged for an extended period, more than 15 centimeters, it may cause roots to lack oxygen, resulting in slower rice growth and increased risk of root rot and fungal diseases.

2.2.5. Nutrient mineral content of the soil

The growth of rice depends on soil nutrients that play a crucial role in various plant processes. Soil with sufficient nitrogen stimulates tillering and makes rice leaves green and lush, allowing the rice to photosynthesize effectively. Phosphorus is an essential element that helps rice roots grow strong and also plays a role in the development of rice panicles and grains. Without phosphorus, rice grows slowly and has fewer grains per panicle. Meanwhile, potassium strengthens rice plants, making them resistant to diseases and changing environments. Without potassium, rice plants become weak and yield decreases. Sulfur is another necessary element for protein synthesis in rice. A lack of sulfur may cause young leaves to pale and grow slowly. Magnesium is important for the photosynthesis process as it is a component of chlorophyll. Without magnesium, rice may have spotted pale leaves and overall reduced development. Calcium helps strengthen cell walls and is necessary for the development of rice roots. A calcium deficiency may weaken rice plants and impair nutrient absorption. Micronutrients, such as zinc, are important for the development of leaves and stems. A zinc deficiency may cause rice leaves to pale and the plants to grow slower than normal. Iron plays a crucial role in chlorophyll production. A lack of iron may cause rice leaves to yellow and reduce photosynthesis efficiency. Copper is necessary for the production of various enzymes in the growth process. A copper deficiency may cause rice leaves to yellow and the plants to be stunted.

Chapter 3

Research methodology

Project on Invasive Study the quality of soil in rice fields before planting The study was conducted by the following methods:

Equipment Materials

1. **The sample soil**
2. **The Vernier LabQuest 2**
3. **The 4in1 Soil Survey Instrument**
4. **The EC Soil Meter model EC8801**
5. **The soil using the Rapitest Soil 4 in 1 Tester**
6. **The Rapitest Soil 4 in 1 tester**

Procedure

Part 1: Planning and Defining the Study Area

1.1.1. The target area for soil study is the farmers' rice fields.

Part 2: Soil Sampling

2.1. Select 10-15 random points throughout the rice field.

2.2. Combine soil from all points to create a composite sample.

Part 3 Soil Quality Analysis

3.1. Values to be analyzed

3.1.1. Soil pH value using the Vernier LabQuest 2

3.1.2. Soil temperature values using the 4in1 Soil Survey Instrument

3.1.3. Soil salinity value using the EC Soil Meter model EC8801

3.1.4. The moisture value of the soil using the Rapitest Soil 4 in 1 Tester

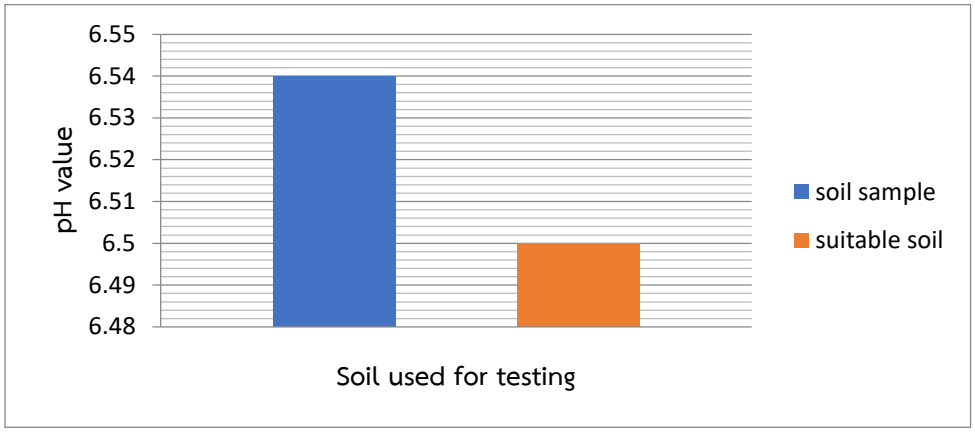
3.1.5. Soil nutrient values using the Rapitest Soil 4 in 1 tester

Chapter 4

Results

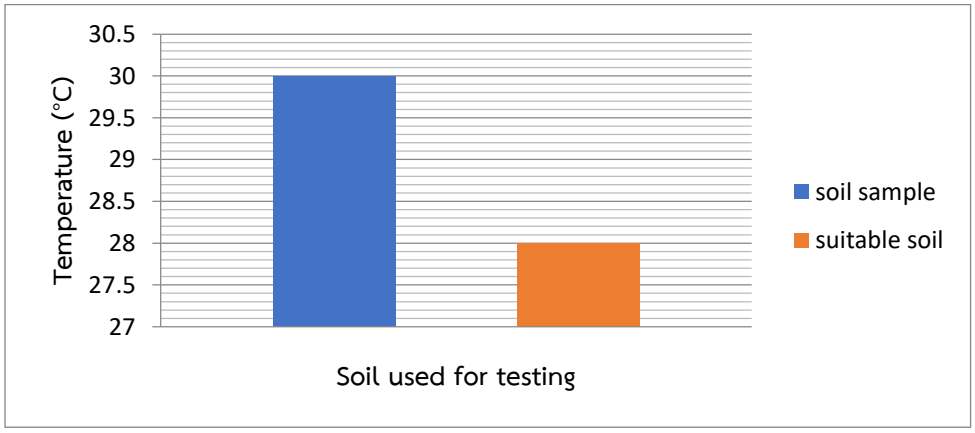
Project on Invasive Study the quality of soil in rice fields before planting The study conducted the study and obtained the following results:

Graph 1 shows the comparison of pH values in suitable soil and in the sample soil.



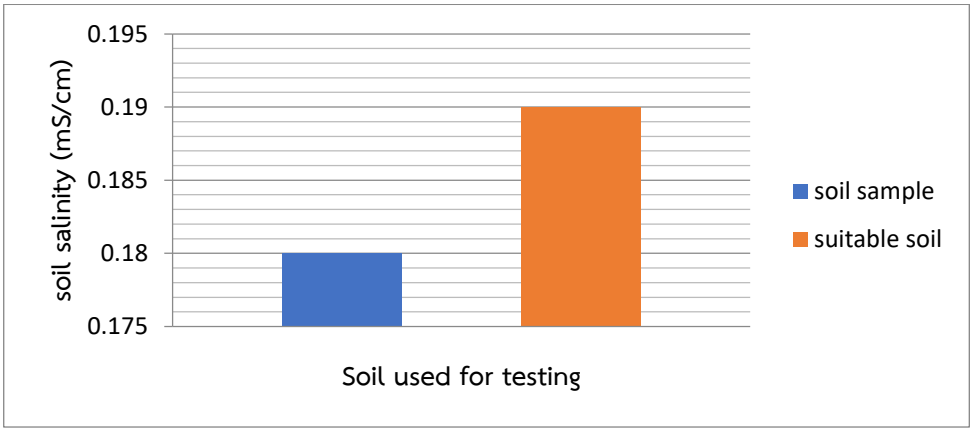
From Graph 1, which compares the pH values of soil suitable for rice cultivation and the sample soil, it can be concluded that suitable soil has a pH value of 5.0 - 7.0. The pH value of the studied sample soil is 6.54, indicating that the pH of the soil in this area is already suitable.

Graph 2 shows a comparison of the optimal soil temperature and the temperature in the sample soil.



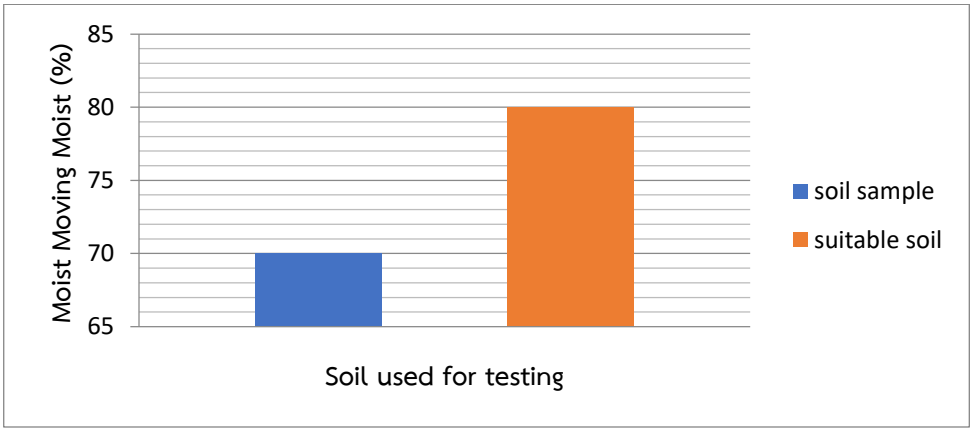
From Graph 2, the comparison of the suitable soil temperature for rice cultivation and the soil sample shows that the suitable soil temperature is between 25-32°C, especially during the tillering stage of rice. The soil sample has a temperature of 30°C. This means that the soil temperature in this area is already suitable, particularly during the tillering stage of rice.

Graph 3 shows a comparison of the appropriate soil salinity values and those in the sample soil.



From Graph 3, the results compare the salinity levels of soil suitable for rice cultivation and the sample soil. The conclusion is that suitable soil has a salinity of less than 2 mS/cm, while the sample soil has a salinity of 0.18 mS/cm. This means that the salinity of the soil in this area is already at an appropriate level.

Graph 4 shows a comparison of the optimal soil moisture content and the soil sample.



From Graph 4, the results compare the soil moisture levels suitable for rice cultivation and in the soil samples. The conclusion is that suitable soil will have a moisture level of 70-100%, while the soil samples have a moisture level of 75-100%. This means that the soil moisture in this area is already at an appropriate level.

Table 1 shows the nutrient richness essential for rice growth.

Soil used for testing	FERTILITY Value
soil sample	IDEAL
suitable soil	IDEAL

From Table 1, the comparison of nutrient values in soil suitable for rice cultivation and in the sample soil shows that the suitable soil has an IDEAL FERTILITY value, indicating the completeness of soil nutrients in that area. The sample soil also has an IDEAL FERTILITY value, meaning the nutrient values in this area are already appropriate.

Chapter 5

Summary Results and Recommendations

Project on Invasive Study the quality of soil in rice fields before planting The researcher conducted the study and summarized and discussed the results of the implementation as follows:

5.1 Summary of the operations

From the study of soil quality before rice planting, it was found that the pH, soil temperature, salinity, moisture, and nutrient levels in the soil were close to the standard values suitable for rice cultivation. These are important factors that directly affect plant growth. When the physical and chemical properties of the soil are within the appropriate range, rice plants can efficiently absorb nutrients from the soil, resulting in healthy growth and high-quality yields. Therefore, checking soil quality before planting is an important guideline that helps farmers plan soil management appropriately, which will enhance cultivation efficiency and promote rice production with the highest quality yield. Soil quality assessment also aids in deciding on suitable soil maintenance methods, as well as selecting fertilizers or soil amendments that can effectively and sustainably promote rice plant growth in the long term.

5.2 Discussion

From the analysis of soil quality before rice planting, it was found that the soil salinity value is 0.18 mS/cm, which is below the 2 mS/cm threshold that does not affect plant growth. Therefore, the area has a soil salinity level suitable for rice cultivation without impacting the root system and nutrient absorption. The measurement of soil pH showed values ranging from 5.0 to 7.0, which is suitable for rice cultivation, with an average of 6.54. This pH level facilitates the dissolution of nutrients in the soil, allowing rice to absorb nutrients efficiently, resulting in optimal growth. The measurement of soil temperature found that it was at 30 degrees Celsius, which is suitable for the growth process of rice, especially during the tillering stage. This temperature level helps stimulate photosynthesis and the biochemical processes of the plant efficiently. The soil moisture content measured was in the range of 75%-100%, which is considered appropriate since rice is a plant that requires a high amount of water. This level of moisture helps rice plants continuously absorb water and nutrients, facilitating smooth growth, reducing plant stress, and strengthening the structure of the rice plants. The analysis of soil nutrients shows a FERTILITY value of IDEAL, indicating that the soil is rich in essential nutrients for rice growth, such as nitrogen, phosphorus, and potassium, in appropriate amounts. This allows the rice to efficiently use these nutrients to produce leaves, stems, and grains. If the soil quality is found to be unsuitable, it can

be improved with organic or manure fertilizers to enhance the soil's ability to retain water and nutrients. The use of green manure to help improve soil structure and increase nitrogen, and the control of soil pH by using lime if the soil is too acidic. Or use soil amendments to maintain pH balance and manage the water system to keep soil moisture at an appropriate level for rice growth.

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