A Study of Substance Properties Affecting the Yield of Peanut Variety Thai Nan 9 in Ban Fah Huan, Khaw Wang Sub-district, Khaw Wang District, Yasothon Province, Thailand

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A Research Project Using Authentic GLOBE Protocols

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Abstract

This study investigated the effects of soil properties on the yield of Tainan peanuts in Ban Fah Huan, Khaw Wang District, Yasothon Province. Samples were collected from 10 plots and measured for temperature (°C), pH, soil moisture (%), organic matter, available phosphorus, available potassium, soil structure, cohesion, texture, and color. The results showed that the optimal yield per rai was achieved at site 10, with an average temperature of 22.70°C at 5 cm and 21.67$^{°C}$ at 10 cm depth, an average pH of 5.8, and an average soil moisture of 7.53%. The organic matter content in the soil (6) is between 0.26 -2.12. The available phosphorus (P) content is between 0-25 mg/kg (mg kg^{-1}). The available potassium content is between 59-130 mg kg (mg kg^{-1}). The soil structure is lumpy, very compact, and the texture is sandy loam. The soil colors found are SYR2/4, 25YR5/10, 75YR2/4, 75YR3/8, 75YRS/6.

Keywords: Soil properties, temperature, pH, humidity, organic matter, phosphorus, potassium

Introduction

After rice farming, the primary occupation of farmers in Khaw Wang District, they cultivate peanuts as an additional income-generating crop. In Khaw Wang District, the Tainan 9 variety of peanut is popular due to its unique characteristics: smooth skin, thin shell, firm flesh, and sweet, nutty flavor, making it suitable for roasting. However, the main challenges in peanut production in Khaw Wang District, Yasothon Province, are low yield and quality. This is attributed to a lack of knowledge and technology among farmers regarding soil preparation, proper fertilizer management, pests, and diseases. Therefore, this study analyzed the impact of soil quality on peanut yield, with farmer participation in the analysis.

To inform farmers in the area about the soil quality suitable for growing Tainan peanuts, the results of this study can be used to help farmers learn about soil preparation, thereby increasing yields, reducing production costs, and ultimately increasing farmers' income. This could also encourage farmers in Yasothon province to consider growing Tainan peanuts as a new alternative crop.

Research question

Does soil where Tainan peanuts are grown have different soil properties? If so, how?

Research hypothesis

Areas where Tainan 9 peanut variety is grown have different raw material properties.

Research materials and methods

Materials and equipment

1. Thermometer (C)
2. Soil pH test kit.
3. Simple moisture-measuring oven, MEMMERT brand, model...
4. OHAUS brand weighing scale: Model CENT-O-GRAM balance 331g Capacity
5. Beaker
6. Portable Analysis Kit (SOM PK Test Kit)
7. Pedoshere (Soil) Protocol includes soil color, soil temperature, and soil structure.
8. Munsell soil color chart. Munsell codes are Hue Value and Croma.

Research Methodology

1) Research Procedures

1. Selection of the Study Plot The study plot was designated as a field used for growing mung beans (Vigna radiata) with a total area of 10 plots.

2. Soil Sampling

Method of Investigation

Soil samples were collected from each soil layer by selecting appropriate sampling locations within the study area. A total of three samples were collected to verify data accuracy, and one composite sample was prepared for each plot under study.

Soil samples were placed in bags or other suitable containers and properly sealed. Each sample was labeled with the plot number, the name of the researcher, and the depth from the soil surface to the top and bottom of the soil layer. The samples were then transported back from the field and spread on plastic sheets or paper to air-dry before further analysis.

3. Study of Soil Structure (SOIL STRUCTURE)

Soil structure refers to the shape and arrangement of soil aggregates, which are influenced by both physical and chemical properties of the soil. The basic unit of soil structure is called a ped. Soil may exhibit a structured or structureless condition.

Method of Investigation

Soil samples were collected using standard methods for studying soil characteristics. Observations were recorded on undisturbed soil samples, including soil profile conditions. Soil was gently broken apart by hand and examined in detail. The soil structure was identified according to standard classification types. Characteristics such as structure type and shape were recorded in soil survey data sheets.

4. Determination of Soil Moisture (SOIL MOISTURE)

Soil samples were collected at a depth of 10 centimeters from each plot, with three samples per plot. Soil moisture content was analyzed by weighing the soil samples before drying, then drying them in an oven at a temperature of 95–105°C for 24 hours. After drying, the samples were weighed again, and soil moisture content was calculated using the following formula:

$$\text{Soil moisture (\%)} = \left(\frac{\text{Weight of moist soil-Weight of dry}}{\text{Weight of dry soi}} \right) \times 100$$

5. Soil Color Measurement (Soid Color)

Measurement Procedure

Soil aggregates from each soil layer were taken for observation and recorded in the data recording sheet, noting whether the soil was dry or moist. If the soil was dry, it was slightly moistened with water from a prepared bottle. The soil aggregate was then divided into two parts. The observer stood with sunlight shining over the shoulder onto both the soil color chart and the soil sample being measured. The soil color value was then recorded in the data recording sheet.

6. Soil Temperature Measurement (soil temperature)

Temperature at a Depth of 5 Centimeters

A metal rod was inserted into the soil to a depth of approximately 15 centimeters. A thermometer was placed inside a plastic tube 12 centimeters in length for measuring soil temperature at a depth of 5 centimeters, then inserted into the prepared soil hole. After waiting for 2 minutes, the soil temperature was read for the first time and both the temperature value and time were recorded in the data recording sheet. The soil temperature was read two more times, allowing 1 minute between each reading.

If the three readings differed by no more than 1 degree Celsius, the values were considered acceptable. However, if the difference among the three readings exceeded 1 degree Celsius, the outlying value was discarded and soil temperature readings were repeated every 1 minute until the difference between readings was within 1 degree Celsius.

Temperature at a Depth of 10 Centimeters

Soil temperature at a depth of 10 centimeters was measured using the same procedure as for the 5-centimeter depth, except that a plastic tube 7 centimeters in length was used instead of a 12-centimeter tube. All other steps were conducted as described above.

7. Soil Texture Measurement (SOIL TEXTURE)

Soil texture is formed from a mixture of three different sizes of soil particles in varying proportions. Soil particles can be divided into three types:

Sand is the largest particle and gives the soil a rough, coarse texture. Size 2 -0.05 mm (USDA) (Size 2.00 -0.02 mm ISSS)

Fine sand is made of medium-sized particles and has a soft, smooth, or "powdery" feel to the touch. Size ranges from 0.05 to 0.002 mm (USDA) (0.02 - 0.002 mm ISSS).

Clay is the smallest particle size and feels "sticky" and firm, making it difficult to squeeze. Size <0.002 mm (USDA) (Size <0.002 mm ISSS).

8. Analyze the soil's acidity or alkalinity (pH) using a pH test kit. Soil Acidity and Variations (pH test kit))

9.Analyze the organic matter content, phosphorus content, and other parameters of the soil.Potassium can be measured using the Portable Analysis Kit (SOM PK Test Kit)

6. Record the test results and analyze, compare, and summarize the findings.

2) Statistics used in the experiment.

Percentage and average values

RESEARCH RESULTS

A study of soil properties in areas where Tainan peanuts are grown in the study area of Ban Fah Huan, Khaw Wang Subdistrict, Khaw Wang District, Yasothon Province, yielded the following results:

Soil properties observed included variations in temperature, pH, soil moisture, organic matter, phosphorus, and potassium. Specifically, pH ranged from 4.70 to 5.80, temperature ranged from 21.33 ℃ to 24.00 ℃, soil moisture ranged from 301% to 10.51% (average 7.53%), and soil organic matter (SOM) was around 0.26%.
2.12% Available phosphorus (P) values are between 12-18 mg kg^{-1}) and available potassium (10) values are between 20 - 130 (mg/kg^{-1}) in all 10 study sites (Table 1).
Soil structure is granular, flattened, soil texture is loamy clay. Raw colors found include 5YR3/2, 5YR4/2, 7.5YR5/6 (Table 2)

Table 1. Average soil properties for Tainan peanut cultivation.

Properties of soil	Area where Tainan9 peanut variety is grown (plot number).										average
	plot 1	plot 2	plot 3	plot 4	plot 5	plot 6	plot 7	plot 8	plot 9	plot 10	
Depth 5 cm. Temperature (°C)	23.33	22.67	21.33	23.00	22.67	22.33	20.33	24.00	24.00	23.33	22.70
Depth 10 centimeters, Temperature (°C)	23.00	21.00	21.00	22.00	22.33	20.00	21.67	23.00	23.00	22.33	21.67
pH values (acidity-difference)	4.93	4.83	4.70	4.80	4.80	5.17	5.20	5.30	4.93	5.80	5.05
Soil moisture (%)	8.25	5.95	9.04	3.09	10.51	5.84	6.51	4.22	6.83	5.02	7.53
Organic matter in soil (%)	2.12	2.12	2.12	1.50	2.12	1.04	1.50	0.26	2.12	2.12	-
Phosphorus (P) (mg/kg^{-1})	18	18	18	18	25	0	0	18	18	12	-
Potassium (K) (mg/kg^{-1})	59+++	78+++	59+++	59+++	78+++	78+++	59+++	78+++	78+++	130	-

Soil quality was found to be cohesive with a dense structure. The soil texture consisted of sandy loam and silty clay loam. Soil colors observed included 5YR2/4, 25YR5/10, 75YR2/4, 75YR3/8, and 75YR5/6, as shown in Table 2.

Table 2. Soil quality under cultivation of Tainan9 peanut variety, study area, layer 1, depth 5 cm

Quality of the soil	**Area where Tainan9 peanut variety is grown (plot number).**									
	plot 1	plot 2	plot 3	plot 4	plot 5	plot 6	plot 7	plot 8	plot 9	plot 10
SOIL STRUCTURE	lump	lump	lump	lump	lump	lump	lump	lump	lump	lump
seizing	Very tight	Very tight	Very tight	Very tight	Very tight	Very tight	Very tight	Very tight	Very tight	Very tight
SOIL TEXTURE	SLC	SLC	SLC	SLC	SLC	SLC	SiCL	SLC	SLC	SLC
Soil Color	75YR3/8	75YR3/8	5YR2/4	5YR2/4	75YR2/4	5YR2/4	25YR5/10	75YR2/4	75YR2/4	75YR5/6

Summary and Discussion of Research Results

From the study results of soil properties in the 10 study sites, it was found that the study site with the most suitable temperature, pH, soil moisture, and organic matter was site 10, which had an average temperature of 22.70°C at a soil depth of 5 cm and an average temperature of 21.67°C at a soil depth of 10 cm. The average soil pH was 5.8, and the average soil moisture was 7.53%. This site yielded the highest production per rai. The percentage of organic matter in the soil ranged from 0.26 to 2.12. The amount of available phosphorus (P) ranged from 0 to 25 mg/kg (mg kg^{-1}). The amount of available potassium ranged from 59 to 130 mg/kg (mg kg^{-1}). The soil structure was agglomerated, very compact, and the soil texture was sandy loam. Soil colors found include 5YR2/4, 25YR5/10, 75YR2/4, 75YR3/8, and 75YR5/6, consistent with the research by Parichat et al. (2014) which studied soil properties. Peanuts are grown throughout Thailand, preferably in loamy, sandy loam, or clay loam soils with moderate fertility, good drainage, and aeration, with a pH between 5.5-6.5. However, differences in temperature, pH, and soil moisture affect the yield per acre. Considering the soil properties, it can be seen that even small differences in soil properties can significantly alter the yield.

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