Compare the physical and chemical characteristics of the soil before planting and after plowing, covering the sunn hemp

Miss.Thanphichaya Seesuk , Miss.Prichaya Kaeophang ,Miss.Pitchapa Ponsri
Wichienmatu School

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Abstract

The findings revealed that the soil quality before planting sunn hemp had an average nitrogen content of 0.27 mg/L, an average phosphorus content of 0.20 mg/L, and an average potassium content of 1.07 mg/L. The average pH was 5.87, the average salinity was 55.40 ppm, and the organic matter content was ≥3.5, which is considered a high level. After sunn hemp reached the flowering stage and was incorporated into the soil over 1–2 months, the soil quality improved compared to soil without sunn hemp cultivation. The nitrogen content ranged from 1.40 to 3.13 mg/L, phosphorus ranged from 1.73 to 3.93 mg/L, and potassium ranged from 5.80 to 12.60 mg/L. The pH level increased to a range of 6.93 to 7.03, salinity ranged from 147.80 to 166.93 ppm, and the organic matter content remained ≥3.5. Further analysis of the soil 1–2 months after incorporation showed even higher soil quality. The nitrogen content ranged from 4.20 to 5.93 mg/L, phosphorus from 4.67 to 6.53 mg/L, and potassium from 15.47 to 18.07 mg/L. The pH level further increased to 7.23–7.28, while salinity ranged from 101.27 to 191.27 ppm. The organic matter content remained consistently ≥3.5, indicating a high level.

Keywords: Sunn hemp, physical properties, chemical properties, decomposition, soil testing, average value

Research Question

1.What are the differences, if any, in the physical and chemical properties of soil before sunn hemp cultivation and after cultivation while the plants still have leaves and after the leaves have completely fallen in the rubber plantation area, Village No. 8, BanNa Subdistrict, Palian District, Trang Province?
2. Different time periods for plowing and covering the Sunn hemp during its flowering stage and after the flowers have completely fallen off influence Are there distinctions in the physical and chemical properties of soil? If so, how?

Introduction

Rubber is an economically significant crop for the country's economy. It serves as a raw material in the production of various goods,supporting industries ranging from manufacturing to general consumer products. Rubber is a crop that thrives under specific environmental conditions, with soil structure being one of the key limitations to its successful cultivation, particularly in Thailand (Office of Agricultural Economics, 2006). Inappropriate soil structure can lead to various challenges in rubber cultivation, including soil degradation, nutrient imbalance, and low organic matter content. Consequently, it is crucial to identify optimal soil improvement methods that enhance soil fertility and promote sustainable rubber growth (Arshad et al., 1979).One approach involves planting green manure crops such as mung beans, soybeans, cowpeas, sesbania, and chili peppers. These fast-growing legumes not only contribute to soil fertility but also serve as a source of organic matter. Among these, sunn hemp (Crotalaria juncea) is a particularly effective green manure crop, capable of reaching a height of 180–300 cm. Sunn hemp enhances soil fertility by fixing atmospheric nitrogen through its root nodules, which store nitrogen in nodular bacteria. This nitrogen is gradually released into the soil five to six weeks after incorporation, helping to balance soil nutrients.The primary benefit of sunn hemp is that it grows quickly, can be easily incorporated into the soil, and effectively increases soil nitrogen levels. This process helps maintain soil balance, preserve soil structure, and improve fertility.

This study aims to investigate the physical and chemical properties of soil before and after the incorporation of sunn hemp. It will analyze soil characteristics, including organic matter content, soil pH, cation exchange capacity, macronutrient levels (N, P, K), organic matter content, and soil structural properties in a rubber plantation in Village 8, Ban Na Subdistrict, Palian District, Trang Province.



Research Methods

1.)Preparation Stage
1.Define the research topic: The study focuses on the physical and chemical characteristics of soil after rubber plantation clearance in a 30 × 30 square meterarea with in Rubber plantation Village, Village No. 8, Ban Na Subdistrict, Palian District, Trang Province
2.Conduct a literature review and explore relevant academic sources to gather fundamental knowledge on soil characteristics, soil properties, and the effects of land-use changes.
3.Review and select research methods based on GLOBE soil assessment protocolsto ensure standardized data collection.
4.Develop a soil sampling strategy for the selected study area by defining latitude, longitude, and specific sampling locations to ensure accuracy.
2.)Procedure
1.Convene a meeting to collaboratively plan the research activities within the research group.
2. Investigate the research domain.
3. Gather soil samples to assess soil temperature, moisture, and mineral composition. (N P K) Assesses soil pH, salinity, organic matter content, structure, texture, color, and adhesion.

Zone	Geographic Coordinates	
	Latitude (N)	Longitude (E)
Rubber plantation, Village No. 8, Ban Na Subdistrict, Palian District, Trang Province	7.282270	99.707856

:GLOBE Measurement Methods

Soil Measurement Methodology (Pedosphere Soil)
Vegetation Cover Measurement Methodology (Biosphere)

The study was conducted in the vicinity of Suan Yang Phra Village, Village No. 8, BanNa Subdistrict, Palian District, Trang Province.
•Soil samples were collected systematically from three different site categories: areas where rubber plantations had been recently cleared, areas with a longer elapsed time since clearance, and areas where rubber trees had been completely removed.
•Each sampling site covered 30 × 30 square meters, with a total of 7 sampling points, each covering 10 square meters.

Materials and equipment

1. Thermometer
2. Moisture meter
3. NPK meter
4. Organic matter meter
5. pH test paper
6. Soil color comparison chart
7. Soil structure comparison sheet
8. Field soil texture examination manual
9. Soil auger
10. Soil compaction test kit
11. Dropper
12. Glass funnel
13. Soil structure sample sheet
14. Beaker
15. Chemical spatula
16. Stirring rod
17. Distilled water
18. Filter paper
19. Sample container
20. Notebook
21. pH meter
22. Salinity meter
23. Soil sieve
24. Standard soil tray

GLOBE Badges

1. I AM A DATA SCIENTIST.
This project applies a scientific approach consisting of five key steps: observation, problem identification, hypothesis formulation, experimentation, data collection, and data analysis. The collected data were processed using Microsoft Excel to calculate averages and standard deviations (S.D.). Data analysis was performed based on recorded values to ensure accuracy and reliability, allowing for meaningful comparisons and conclusions. The results were then interpreted to confirm or refute the original hypotheses. Finally, the findings were compiled and presented in a structured format, ensuring clarity and systematic documentation for future study references.
2. I AM A COLLABORATOR
One of the most crucial aspects of this project is teamwork. The project's success heavily relied on collaboration, as no single individual could complete it alone. Each team member contributed their knowledge, ideas, and effort, fostering mutual support throughout all project stages—from brainstorming and planning to conducting experiments, processing data, and drawing conclusions.This project required continuous teamwork, where each member had clearly defined roles and responsibilities. Collaboration ensured accuracy, efficiency, and timely completion of tasks. Moreover, it enhanced teamwork skills, which are essential for future research and professional endeavors. This experience also highlighted the importance of cooperation among peers, guidance from teachers, and support from the school. As a result, the project was successfully executed with valuable lessons learned along the way.
3. I MAKE AN IMPACT
This project aimed to improve soil quality within a rubber plantation in Village 8, Ban Na Subdistrict, Palian District, Trang Province. The study was linked to the research project "A Comparative Study of Soil Physical and Chemical Properties Before and After Incorporating Sunn Hemp in a Rubber Plantation in Village 8, Ban Na Subdistrict, Palian District, Trang Province." The research findings provided significant scientific insights, demonstrating that incorporating sunn hemp into the soil for 1–2 months enhanced soil quality and altered soil structure. This serves as a potential approach for future soil improvement to support agricultural productivity.

Results

Analyzing Data

Data Analysis and Conclusion
1. Data Analysis
•The data obtained from each measurement are analyzed to identify trends and relationships among the measured parameters (e.g., temperature, pH, moisture, salinity, NPK levels, organic matter).
•Statistical tools such as mean and standard deviation (S.D.) are used to evaluate the variability of each parameter across different sampling points and conditions.
2.Graphical Representation
•Graphs are created to compare average values of the measured parameters, highlighting differences under various conditions or time intervals.
3.Conclusion
•The results of this study are summarized to provide insights into how different factors (e.g., land-use changes, timing of sampling) influence the physical and chemical properties of the soil.
•Recommendations may be proposed for further research or soil management practices, based on the observed outcomes.

Sampling stage	measured value							
	average humidity (%)	average temperatur (c)	average N value	average P value	averageK value	average pH	average salinity (ppm)	organic matter level(%)
1.Soil before planting	3.73 ±0.98	35.70 ±1.10	0.27 ±0.44	0.20 ±0.40	1.07 ±1.24	5.87 ±0.34	55.40 ±19.44	>=3.5 0
2.Soil when it has flowers	6.03 ±0.29	29.41 ±0.90	0.47 ±0.62	0.47 ±0.62	2.47 ±1.86	7.53 ±0.19	46.27 ±17.49	>=3.5 0
3.Soil when flowers fall	6.97 ±0.99	27.99 ±0.73	0.60 ±0.61	2.40 ±2.33	4.53 ±2.39	7.27 ±0.93	55.40 ±19.44	>=3.5 0
4.Soil plowing and covering 1 month after flowering	8.84 ±1.21	28.29 ±1.35	1.40 ±0.69	1.73 ±1.06	5.80 ±2.99	6.93 ±0.17	166.93 ±55.14	>=3.5 0
5.Soil plowing and covering 1 month after the flowers	7.09 ±1.42	28.83 ±0.75	4.20 ±3.56	4.67 ±4.03	15.47 ±12.18	7.28 ±0.28	191.27 ±109.02	>=3.5 0
2 months after flowering								
7.Soil plowing and covering 2 months after the flowers fall	2.34 ±1.60	29.27 ±0.99	5.93 ±4.22	6.53 ±4.53	18.07 ±14.01	7.25 ±0.25	101.27 ±45.42	>=3.5 0

Table : presents the average soil values across different measurement intervals, highlighting variations in moisture, temperature, nutrient content (NPK), pH, salinity, and organic matter.
• Soil Moisture: The highest level (8.84%) was in soil plowed under after one month, while the lowest (2.34%) was after two months. The greatest variability (S.D. ±2.43) was in soil plowed under after two months, whereas the lowest (S.D. ±0.29) was at the bud formation stage.
• Soil Temperature: The highest (35.7°C) was before planting, and the lowest (27.99°C) was in the post-flowering stage. Variability was highest (S.D. ±1.35) in soil plowed under after one month and lowest (S.D. ±0.73) in the post-flowering stage.
• Nutrient Content (NPK): The highest levels were in soil plowed under after two months, while the lowest were before planting. Variability was highest in the post-flowering stage.
• pH: The highest pH (7.53) was at the bud formation stage, while the lowest (5.87) was before planting. Variability was highest (S.D. ±0.17) in soil plowed under after one month.
• Salinity: The highest salinity (191.27 ppm) was in soil plowed under after one month, and the lowest (46.27 ppm) was at the bud formation stage, with the highest variability in the post-flowering stage.
• Organic Matter: Consistently ≥3.5% across all periods, with no observed variability (S.D. = 0).

These findings indicate significant variations in soil properties across different growth and plowing stages.

Based on these findings, it can be concluded that incorporating sunn hemp into the soil enhances all measured soil parameters and improves soil structure. This suggests that sunn hemp incorporation is an effective approach for soil improvement to support future agricultural activities.

Discussion

Interpreting Data

1. Methods of Sunn Hemp Incorporation:
Two types of incorporation methods were analyzed, revealing that the soil reached a state of equilibrium with a slightly alkaline pH ranging from 6.93 to 7.25 and an organic matter content of ≥3.5%. The nitrogen content in the soil was measured within the range of 1.40–5.93 mg/kg, while available phosphorus and potassium were found between 1.73–6.53 mg/kg and 5.80–18.07 mg/kg, respectively. This aligns with findings by Allison (1954, cited in Sangthong, 2011), which suggest that when sunn hemp is incorporated into the soil, the decomposition process leads to a significant increase in organic matter and nutrient availability. Additionally, the decomposition and nutrient release process continues at a slower rate over time. Research by Euskirchen et al. (2013) further supports this, indicating that plant residues improve soil phosphorus retention. When sunn hemp is incorporated, the released nutrients enhance the root system's efficiency in absorbing nutrients, demonstrating that extended decomposition periods positively affect soil fertility.
2. Soil Quality in Relation to Physical and Chemical Properties:
A comparative analysis between soil before planting and post-incorporation (both after flowering and after pod setting) revealed improvements in soil quality across both conditions. However, the most significant enhancement occurred after pod setting, as the concentrations of nitrogen (N), phosphorus (P), and potassium (K) increased significantly. Moreover, as the incorporation period extended from one month to two months, nutrient levels further improved.

Conclusions

The soil quality before planting Sunn hemp had an average nitrogen value of 0.27 mg/L, an average value of 0.20 mg/L, an average potassium value of 1.07 mg/L, an acidity-alkalinity value (average pH value) of 5.87, an average salinity value of 55.40 ppm, and an organic matter value of ≥ 3.5, which is at a high level. After plowing under Sunn hemp for 1 month, the soil when it was in flower had an average nitrogen value of 1.40 mg/L, an average phosphorus value of 1.73 mg/L, an average potassium value of 5.80 mg/L, an acidity-alkalinity value (average pH value) of The average (6.93) salinity was 166.93 ppm and the organic matter content was ≥ 3.5. The soil at the time of flower fall had an average nitrogen value of 4.20 mg/L and an average phosphorus value of 4.67 mg/L, average potassium 15.47 mg/L, acidity-alkalinity (average pH) is 7.28), average salinity 191.27ppm and the amount of organic matter is ≥ 3.5, which is at a high level.

When the sunn hemp was plowed and buried for 2 months, the soil with flowers had an average nitrogen value of 3.13 mg/L. Average phosphorus 3.93 mg/L, average potassium 12.60mg/L,(average pH value is 7.03) The average salinity is 147.80 ppm and the amount of organic matter is ≥ 3.5. The soil at the time when the flowers fell has an average nitrogen value of 5.93mg/L, an average phosphorus of 6.53mg/L, an average potassium of 18.07 mg/L, an average pH value of 7.25) The average salinity is 101.27ppm and the amount of organic matter is ≥ 3.5 is at a high level. From the study, it can be concluded that plowing and burying Sunn hemp after the flowers have all fallen off at an appropriate time can increase soil fertility more effectively because the mineral content in the soil is higher. Therefore, it is a good way to improve soil quality for future cultivation.

Bibliography

:Somphop Daya. Research report on the effects of selected microbial strains on productivity and nutrient content of rice grown in clay soil. [Online]. Retrieved on September 15, 2024, from https://kuojs.lib.ku.ac.th/index.php/tjsf/article/download/4395/2057/13366
:Nithirat Inthiam, Pholrasong Sangsawang, and Sineesuk Kroosurang. Research report on the promotion of organic farming to improve soil quality in rice cultivation in agricultural areas of Trat Province. [Online]. Retrieved on September 15, 2024, from https://www.stou.ac.th/thai/grad_stdy/Masters/
:Professor Dr. Phonrak Tithaporn, Lecturer in Soil Science, Faculty of Agricultural Technology. (2011). Research report on soil amendments and their effectiveness in increasing soil organic matter for sustainable agriculture. University of Agricultural Technology. [Online]. Retrieved on September 14, 2024, from https://cdn.fbsbx.com/v/t/59.2708-21/
:Associate Professor Dr. Wichaiyut Suksaman, Assistant Professor Dr. Phitsanu Nilsawatwattanakun. (2015). Research report on the benefits of soil organic matter in agriculture. Suranaree University of Technology. [Online]. Retrieved on September 15, 2024, from http://sutir.sut.ac.th:8080/jspui/bitstream/123456789/5795/1/Fulltext.pdf
:Jaksuchon Kree, Jiraphat Suphaya. Research report on soil testing for agricultural implementation and productivity of rice plants grown in clay soil. Ubon Ratchathani University. [Online]. Retrieved on September 15, 2024, from https://kjna.ubru.ac.th/fj_files/document/J1603781512.pdf