A study of Arachis pintoi density affecting soil quality

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Abstract

This study investigated the effects of Arachis pintoi density on soil quality at Wat Khuan Si Nuan School, Trang Province, by comparing planted areas with nearby unplanted sites. Physical and chemical properties were analyzed from December 5, 2025, to January 10, 2026. Findings showed that high-density A. pintoi areas had an average soil temperature of 27.94°C, moisture of 6.05, pH of 5.50, and salinity of 45.51 ppm, with N-P-K levels at 7.62, 8.57, and 20.18 mg/kg, respectively. Low-density areas recorded 27.85°C, 4.41 moisture, 5.50 pH, 22.32 ppm salinity, and N-P-K at 2.53, 3.44, and 7.63 mg/kg. Unplanted areas showed 28.53°C, 2.13 moisture, 5.50 pH, 10.94 ppm salinity, and N-P-K at 2.06, 1.75, and 3.76 mg/kg. Comparison revealed that high-density A. pintoi significantly increased soil moisture and primary macronutrients (N, P, K). This confirms A. pintoi improves soil fertility, supporting its use as a cover crop for sustainable soil management and restoration in agricultural and degraded lands.

Research Questions

How does the density of Arachis pintoi affect soil pH, moisture levels, and fertility (N, P, K)?

Hypothesis

High Arachis pintoi density results in higher soil moisture and fertility (N, P, K) compared to low-density areas and areas without Arachis pintoi.

Introduction

Soil is a vital natural resource for the existence of plants and diverse living organisms. Its fertility varies based on several physical, chemical, and biological factors, such as organic matter content, moisture, pH levels, and primary nutrients including Nitrogen (N), Phosphorus (P), and Potassium (K), all of which directly affect plant growth. Plants play a crucial role in improving and maintaining soil quality, particularly those in the legume family (Leguminosae), which possess the unique ability to fix atmospheric nitrogen into root nodules through biological processes, thereby enriching the surrounding soil. Additionally, their spreading root systems improve soil structure and reduce surface erosion, a major issue in agricultural areas. Arachis pintoi (Pinto Peanut), a leguminous cover crop, has gained widespread interest due to its outstanding nitrogen-fixing capabilities and robust root system. It also provides ground cover that prevents moisture loss and protects against topsoil erosion from wind and rain, as noted in the Amarillo Pinto Peanut cultivation manual by the Forage Crop Research and Development Group, Bureau of Animal Nutrition Development, Department of Livestock Development. Studying the properties of this species is essential for developing soil restoration and conservation strategies. Therefore, this project aims to investigate the effects of Arachis pintoi density on soil quality by comparing planted and unplanted areas at Wat Khuan Si Nuan School, Moo 5, Na Khao Sia Subdistrict, Na Yong District, Trang Province. The study focuses on analyzing moisture, pH levels, and macronutrients (N, P, K) to concretely understand the role of Arachis pintoi in soil quality improvement.

Research Methods

The research preparation process consists of four main steps: identifying the research topic, selecting the study area, reviewing and gathering relevant information and theories, and defining the study objectives. The planning and execution phase involved studying the effect of Arachis pintoi density on soil quality over a two-month period. Soil samples were collected using a random sampling method once a month for two months, with 4 replicates per area for each of the 2 collection sessions. The soil quality parameters tested included temperature, moisture content, pH level, salinity, and macronutrient fertility (N, P, K).In this experiment, the temperature, moisture content, pH, salinity, and nutrient levels (N, P, K) were compared across three areas: high density, low density, and a nearby unplanted area, to systematically evaluate how Arachis pintoi density affects soil quality. Materials and equipment : Small Shovel,Containers for soil samples,Name labels and pens for detailing samples,Base Acidity Measurement Kit,Soil moisture meter ,Soil fertility meter,Beaker ,Glass stick,Digital Scales and Distilled water.The soil analysis procedures are as follows:

1.Density Measurement
The measurement of Arachis pintoi density was conducted by selecting the study areas and then randomly placing 50 x 50centimeter quadrats. The number of Arachis pintoi plants within each quadrat was counted and recorded in a data form for further analysis.

2.Soil salinity
measured by weighing 20 grams of sieved dry soil and mixing it with 100 milliliters of distilled water to achieve a 1:5 ratio. The mixture was stirred with a glass rod for 30 seconds at a time, repeating the process 5 times. The solution was then left until the soil settled, after which a salinity meter was used to measure and record the results.

3.Soil moisture
measurement was conducted by designating study points, then inserting a moisture meter approximately 10 centimeters deep into the soil. The readings were then taken and recorded.

4. Soil Temperature
Soil temperature was measured using a soil thermometer inserted directly into the soil at a depth of approximately 5-10 centimeters (general plant depth), and left in place for 2-5 minutes before recording the reading.

5.Soil pH
measurement was conducted by weighing 20 grams of sieved dry soil into a beaker and adding distilled water at a 1:1 soil-to-water ratio. The mixture was stirred with a glass rod for 30 seconds and left to rest for 3 minutes, repeating this process 5 times. The solution was then left until the soil settled, after which a pH indicator strip was dipped into the clear supernatant liquid to read and record the results

6.Soil fertility
measurement (N, P, K) was conducted by weighing 20 grams of sieved dry soil into a beaker and adding 100 milliliters of distilled water, stirring until well mixed. An NPK meter was then immersed into the solution to read and record the results.

GLOBE PROTOCOLS ----> Pedosphere (Soil)

DATA COLLECTION SCHEDULE

No.	Soil Sampling Period	
	Day/Month/Year	Period
1	5 December 2025	10.00-12.00
2	10 January 2026	10.00-12.00

STUDY SITE

Table 1 : Geographical Coordinates

Soil Sampling Locations	Geographical coordinates	
	Latitude(N)	Longitude(E)
At Wat Khuan Si Nuan School, Moo 5, Na Khao Sai Sub-district, Na Yong District, Trang Province	7.5281204	99.7369568

GLOBE Badges

I AM A COLLABORATOR
We worked together with active participation, assigning roles based on each member's expertise. From planning and data collection to analysis and brainstorming, our process was built on clear communication and mutual respect. This strong synergy allowed us to streamline our workflow and efficiently meet all project goals.

I AM A DATA SCIENTIST
Field research was carried out to systematically collect and analyze data regarding the impact of Arachis pintoi density on soil moisture and NPK fertility. The operational process adhered to standard data management practices, ensuring that every step from collection to analysis produced accurate and reliable results. These insights served as the basis for the project's conclusion and future research enhancements.

I MAKE AN IMPACT
Our research explored how the density of Arachis pintoi affects soil quality in terms of moisture and NPK fertility . The results show that denser plant growth leads to higher moisture retention and increased nutrient availability. These insights serve as a valuable resource for local farmers, demonstrating how Arachis pintoi functions as a nitrogen-fixing legume that boosts soil fertility. Additionally, it acts as a natural mulch, protecting the soil surface and preventing dehydration, ultimately leading to more sustainable land management.

Expected Outcomes

This study is expected to enhance our understanding of the relationship between Brazilian Arachis density and soil quality, particularly regarding moisture retention and primary macronutrients (N, P, K). The findings will highlight the role of Brazilian Arachis as an effective cover crop that improves soil properties and mitigates soil degradation. Ultimately, this research can serve as a guideline for sustainable soil management practices at both school and community levels.

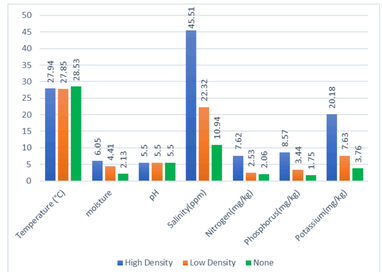
Results

Table 2: Average values from both trials across each area based on Arachis pintoi density.

Parameter	Density of *Arachis pintoi*					
	High1 (100%)	High2 (100%)	Low1 (50%)	Low2 (50%)	None1 (0%)	None2 (0%)
Temperature	29	26.88	29.06	26.63	30.06	27
moisture	5.8	6.3	4.75	4.07	2.19	2.07
pH	5	6	5	6	5	6
Salinity(ppm)	50.13	40.88	25.63	19	11.3	10.88
Nitrogen(mg/kg)	8.36	6.88	2.75	2.3	2.75	1.38
Phosphorus(mg/kg)	9.38	7.75	4.63	2.25	2.25	1.25
Potassium(mg/kg)	20.86	19.5	8.75	6.5	4.13	3.38

Table 2 illustrates that the high-density area had an average soil moisture of 5.8–6.3, with average N, P, and K levels of 6.88–8.36 mg/kg, 7.75–9.38 mg/kg, and 19.5–20.86 mg/kg, respectively. These values were higher than those of the low-density area, which had an average moisture of 4.07–4.75, N of 2.3–2.75 mg/kg, P of 2.25–4.63 mg/kg, and K of 6.5–8.75 mg/kg. The nearby area without Arachis pintoi recorded the lowest values, with average soil moisture of 2.07–2.19, N of 1.38–2.75 mg/kg, P of 1.25–2.25 mg/kg, and K of 3.38–4.13 mg/kg. Meanwhile, average soil pH, salinity, and temperature were similar across all three study areas. Furthermore, both soil moisture and fertility levels in the second trial showed a decrease compared to the first trial.

Graph 1 shows a comparison of the average results of experiments in different areas.



In the high-density area, the average soil moisture was 6.05, with average N, P, and K levels of 7.62 mg/kg, 8.57 mg/kg, and 20.18 mg/kg, respectively. These values were higher than those of the low-density area, which had an average soil moisture of 4.41, N of 2.53 mg/kg, P of 3.44 mg/kg, and K of 7.63 mg/kg. The nearby area without Arachis pintoi recorded the lowest values, with an average soil moisture of 2.13, N of 2.06 mg/kg, P of 1.75 mg/kg, and K of 3.76 mg/kg. Meanwhile, the average pH levels, salinity, and temperature were similar across all three study areas.

Discussion

The research results indicate that areas with high Arachis pintoi density possess high soil moisture because the plant's canopy covers the soil surface, reducing moisture loss and maintaining a soil environment conducive to moisture accumulation. Furthermore, Arachis pintoi plays a significant role in increasing soil fertility, particularly nitrogen levels through the nitrogen fixation process, resulting in higher primary macronutrients (N, P, and K). This is consistent with ecological principles stating that leguminous plants can improve soil quality, making the soil more suitable for plant growth.

Conclusions

The study results found that the area with high Arachis pintoi density had an average soil moisture of 6.05, which was higher than the low-density area and the nearby area without Arachis pintoi. Additionally, this area exhibited high soil fertility, with average nitrogen (N) of 7.62 mg/kg, phosphorus (P) of 8.57 mg/kg, and potassium (K) of 20.18 mg/kg, which were clearly higher than the other areas.

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