



Title : A Study of Soil Properties in Beach and Paddy Field Areas on the Growth and Sweetness of Koh Sukorn Watermelons, Pa Lian District, Trang Province, Thailand

Students: Miss Sukhwan Nuphuti, Miss Ninchaya Srisakote, and Miss Rasi Nuphuti

Grade Level: Upper Elementary School

Advisors: Miss Navaporn Tipsed

Special Advisors: Mrs. Sirikwan Nuphuti, and Mrs. Supattra Srisakote

Pornsirikul School, Thailand

30th January 2026

Abstract

This study aimed to investigate soil quality and its effects on the size and sweetness of watermelons. The research was conducted on Koh Sukorn Island, Trang Province, Thailand. Watermelon cultivation areas were divided into two distinct zones: the beach area (0-200 meters from the shoreline) and the paddy field area (300-500 meters from the shoreline). Soil samples were randomly collected from both areas and analyzed for quality parameters. The findings revealed significant differences in soil properties between the two zones. Specifically, soil moisture content, organic matter percentage, and phosphorus levels in the beach area were lower than those in the paddy field area. The pH value of paddy field soil was lower than that of beach soil. However, nitrogen and potassium levels showed no significant differences between the two areas. Soil texture analysis showed that the beach area consisted of Sandy Loam, while the paddy field area consisted of Silty Loam. Soil color in the beach area was Brown, whereas the paddy field area exhibited a darker Yellowish-Brown color. Watermelon size analysis revealed that fruits from the paddy field area were significantly larger and heavier than those from the beach area. Conversely, sweetness measurements showed that watermelons from the beach area had higher sugar content than those from the paddy field area. In conclusion, differences in soil properties directly affect both the size and sweetness of watermelons, demonstrating the critical relationship between soil characteristics and crop quality.

Keywords: Soil properties, Watermelon, Sweetness, Koh Sukorn

Research Questions:

1. Do soil properties in the beach area and paddy field area on Koh Sukorn Island differ? If so, how?
2. Do soil properties in the beach area and paddy field area on Koh Sukorn Island affect watermelon growth? If so, how?
3. Do soil properties in the beach area and paddy field area on Koh Sukorn Island affect watermelon sweetness? If so, how?

Hypothesis

1. Soil properties in the beach area and paddy field area are different.
2. Soil properties in the beach area and paddy field area affect watermelon growth differently.
3. Soil properties in the beach area and paddy field area affect watermelon sweetness differently.

Introduction

Watermelon (*Citrullus lanatus*) is an economically important crop that enjoys high popularity due to its sweet, refreshing taste and nutritional value. This is particularly true in the Koh Sukorn area of Trang Province, which features a unique coastal ecosystem. This distinctive environment produces exceptional quality watermelons that have been officially registered as a Geographical Indication (GI) product. The watermelon industry generates more than 27 million baht in annual income for the local community.

However, through agricultural ecosystem surveys on Koh Sukorn Island, we observed an interesting phenomenon in two main cultivation areas: the "beach area" and the "paddy field area." Watermelons from these two locations exhibited markedly different fruit sizes and sweetness levels. From an environmental science perspective, soil is a fundamental factor that affects nutrient absorption and sugar accumulation in plants. Therefore, we hypothesized that differences in soil properties between these areas are the main variables determining watermelon growth and quality.

Consequently, we recognized the importance of studying soil properties using GLOBE protocols, which represent international standards for environmental measurements. By analyzing and comparing soil properties in beach and paddy field areas and their effects on watermelon size and sweetness, we can help farmers manage soil resources more

accurately and precisely. This knowledge will lead to sustainable increases in crop value while maintaining the unique flavor standards that make Koh Sukorn watermelons special to the local community for generations to come.

Materials

1. Hand Refractometer (for measuring sweetness)
2. NPK soil test kit
3. Measuring tape
4. Soil drying oven and soil furnace
5. Soil sieve
6. Distilled water
7. Test tubes
8. Universal Indicator
9. Soil texture identification manual
10. Munsell Soil Color Chart

2. Methods

2.1 Study sites

This research was conducted on Koh Sukorn Island, Pa Lian District, Trang Province, Thailand, located at coordinates 7°09'87"N latitude and 99°58'13"E longitude. The study area was divided into two distinct zones, each measuring 100 meters by 50 meters:

Study Area A: Beach Area – Located 0 to 200 meters from the high tide shoreline

Study Area B: Paddy Field Area – Located 300 to 500 meters from the high tide shoreline, separated from the beach area by a road and irrigation canal.

Figure 1: Images showing Beach Area (A) and Paddy Field Area (B)



Beach Area (A)

Paddy Field Area (B)

2.2 Procedures and Data Collection

Soil Property Data Collection

Soil quality was measured following GLOBE protocols. Measurements included soil moisture content, pH, organic matter content, soil nutrients, soil texture, and soil color, as follows:

Step 1: Sampling points were established in two areas. Each study area was randomly divided into 5 sampling points.

Step 2: Soil samples were collected from within the designated study area measuring 100 x 50 meters. Soil was collected from the surface down to a depth of 10 centimeters. All soil from each point was thoroughly mixed before randomly collecting 600 grams per sample (total of 10 samples). Samples were placed in separate bags for analysis of soil properties including pH, soil nutrients (nitrogen, phosphorus, potassium), moisture content, organic matter content, soil texture, and soil color.

Soil pH Measurement: pH was measured using Universal Indicator solution.

Soil Nutrient Measurement: NPK levels were measured using standard soil test kits.

Soil Moisture Calculation: Remaining soil samples were weighed before drying. Samples were then dried in an oven at 105°C for 24 hours. After drying, samples were weighed again and moisture content was calculated.

Organic Matter Measurement: Moisture-free soil samples were further heated in a furnace at 450°C for 4 hours. Samples were then weighed to calculate the percentage of organic matter in the soil using the Loss on Ignition method.

Soil Texture Analysis: Soil was placed on hands, moistened with water spray, and kneaded following GLOBE protocol procedures to analyze soil texture.

Soil Color Analysis: Soil color was determined by comparing samples with the Munsell Color Chart.

Step 3: All data were uploaded to the GLOBE Data Entry system.

Watermelon Growth Study

Step 1: Sampling points were established by randomly dividing each study area into 5 sampling points.

Step 2: Measurements were taken for horizontal circumference (X), vertical circumference (Y), and watermelon weight in each study area.

Figure 2: Images showing measurement of horizontal circumference (X) and vertical circumference (Y)



measurement of horizontal circumference (X) measurement of vertical circumference (Y)

Watermelon Sweetness Measurement ($^{\circ}$ Brix)

Step 1: Sampling points were established by randomly dividing each study area into 5 sampling points.

Step 2: Watermelons were cut at the center position. Watermelon juice was then extracted to measure sweetness using a Hand Refractometer.

Step 3: Sweetness values were read in degrees Brix ($^{\circ}$ Brix). Measurements were repeated 3 times per fruit.

Figure 3: Image showing watermelon sweetness measurement



watermelon sweetness measurement

2.3 Data Analysis

- Soil quality and watermelon sweetness were analyzed using mean (\bar{x}) and standard deviation (S.D.)

- Mean calculation formula (\bar{x})

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{N}$$

- Standard deviation calculation formula (S.D.)

$$S. D. = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

Results

1. Soil Quality Study

The study of soil quality in the beach area and paddy field area revealed that beach soil had lower moisture content and organic matter compared to paddy field soil. The pH value of paddy field soil was lower than that of beach soil. Nitrogen and potassium levels did not differ significantly between the two areas, but phosphorus levels in beach soil were lower than in paddy field soil. Soil texture characteristics differed between the two areas. The beach area consisted of Sandy Loam, while the paddy field area consisted of Silty Loam. Soil color also differed: the beach area exhibited Brown soil, while the paddy field area displayed a darker Yellowish-Brown color, as shown in Tables 1-2 and the physical characteristics of soil from both areas shown in Figure 4.

Table 1: Soil Quality Data

Study Area	Soil Quality (%)		pH	Soil Nutrients		
	Moisture	Organic Matter		Nitrogen	Phosphorus	Potassium
Beach Soil	5.22 ± 0.59 ^a	3.12 ± 0.62 ^a	7	trace	trace	trace
Paddy Field Soil	10.35 ± 1.27 ^b	5.20 ± 0.56 ^b	6	trace	low	trace

Note: Different letters in the same column indicate statistically significant differences ($p \leq 0.05$)

Table 2: Soil Texture and Soil Color

Study Area	Soil Texture	Soil Color
Beach Area	Sandy Loam	Brown (10YR 4/3)
Paddy Field Area	Silty Loam	Yellowish Brown (10YR 4/6)

Figure 4: Physical characteristics of soil from both areas - Beach soil (left) and Paddy field soil (right)



Beach soil

Paddy field soil

2. Watermelon Size Study

The study of Koh Sukorn watermelon size revealed that the mean horizontal and vertical circumferences of watermelons from the paddy field area were greater than those from the beach area, as shown in Table 3.

Table 3: Watermelon Size Data

Study Area	Mean Watermelon Data		
	Horizontal Circumference (X) (cm)	Vertical Circumference (Y) (cm)	Fruit Weight (kg)
Beach Area	52.4 ± 2.1 ^a	58.2 ± 3.5 ^a	2.8 ± 2.4 ^a
Paddy Field Area	64.8 ± 3.2 ^b	70.5 ± 4.8 ^b	4.2 ± 0.6 ^b

Note: Different letters in the same column indicate statistically significant differences ($p \leq 0.05$)

4. Watermelon Sweetness Study

The study of watermelon sweetness levels revealed that sweetness from beach area watermelons was higher than that from paddy field area watermelons, as shown in Table 4.

Table 4: Watermelon Sweetness Data

Study Area	Sweetness (°Brix)
Beach Area	15.0 ^a
Paddy Field Area	12.6 ^b

Note: Different letters in the same column indicate statistically significant differences ($p \leq 0.05$)

Figure 5: Watermelon size comparison - Beach area watermelon (left) and Paddy field area watermelon (right)



Beach area watermelon Paddy field area watermelon

Discussion and Conclusions

Discussion

Soil quality, soil texture, and soil color differed significantly between the two study areas. The beach area, characterized by Sandy Loam texture, exhibited lower moisture content, organic matter percentage, and phosphorus levels compared to the paddy field area with its Silty Loam texture.

Soil quality also affected soil color. Beach soil, with its lower organic matter content, displayed a lighter color than paddy field soil. The pH value of paddy field soil was lower than that of beach soil, which correlates with the organic matter content. This lower pH results from the decomposition process of rice stubble and accumulated organic matter in the paddy field area, which releases organic acids during decomposition. This finding is consistent with the darker soil color resulting from higher organic matter content. Both areas showed similar nitrogen and potassium levels in the soil.

Watermelons in the paddy field area had significantly greater circumferences (X, Y) and fruit weight compared to the beach area. This difference is attributable to higher soil fertility, with organic matter content reaching 5.20 percent from the practice of plowing rice stubble back into the soil. This organic matter serves as a reservoir of essential nutrients for fruit tissue development.

Furthermore, the Silty Loam soil texture demonstrated superior water retention capacity—approximately twice that of beach soil (10.35 percent compared to 5.22 percent). This optimal moisture condition facilitated continuous and consistent cell expansion and nutrient transport processes, resulting in superior physical growth of watermelons in the paddy field area compared to beach area watermelons.

Sweetness levels differed significantly between the two study areas, with beach area watermelons exhibiting higher sweetness than paddy field watermelons. The higher sweetness in beach watermelons results from plant stress response. Sandy Loam soil texture has low water-holding capacity (5.22 percent), causing temporary water deficit conditions that trigger plants to accelerate sugar accumulation to maintain osmotic pressure within cells.

Additionally, although beach soil contains lower nutrient levels than paddy field soil, the fact that plants receive potassium (K) at similar levels in an environment with excellent and rapid drainage helps promote photosynthesis and sugar transport from leaves to fruits more efficiently than in paddy field areas with excessive moisture. Excessive moisture

typically causes sugar dilution in fruits (Dilution Effect), resulting in beach area watermelons having more concentrated and distinctive sweetness values (°Brix).

Conclusions

Based on the study of soil properties and their effects on size and sweetness of Koh Sukorn watermelons, we offer the following recommendations for improving crop production and advancing knowledge:

For Paddy Field Areas: Farmers should apply deficit irrigation techniques (Water Stress) for 10-14 days before harvest, combined with potassium fertilizer supplementation to stimulate sugar accumulation rather than fruit size expansion.

For Beach Areas: Farmers should improve soil structure by adding organic matter and using mulching materials to increase water and nutrient retention efficiency, which will increase fruit size while maintaining the distinctive sweetness characteristic.

These practices will enable Koh Sukorn watermelons to achieve both excellent size and superior sweetness, creating a consistently high-quality product that meets GI standards, benefits all farmers equally, and strengthens the community's economy through practical science applications

Acknowledgements

We would like to express our deep gratitude to Mrs. Sirikwan Nuphuti, and Mrs. Supattra Srisakote, special advisors from Princess Chulabhorn Science High School Trang, who provided invaluable guidance and recommendations throughout this research process.

We thank Mr. Thawatchai Khaimusik, President of the Koh Sukorn Watermelon Community Enterprise, for generously allowing us access to study sites and sharing his extensive knowledge about watermelon cultivation, care, harvesting, and marketing throughout Thailand.

We also thank Princess Chulabhorn Science High School Trang for providing facilities and equipment essential for conducting this research.

Citations

Department of Intellectual Property. (2025). *Koh Sukorn Watermelon* (สงข 68100248)

[Geographical Indication Registration] (in Thai). Ministry of Commerce, Thailand.

GLOBE Implementation Office. (n.d.). *Pedosphere (Soils) learning activities and protocols*.

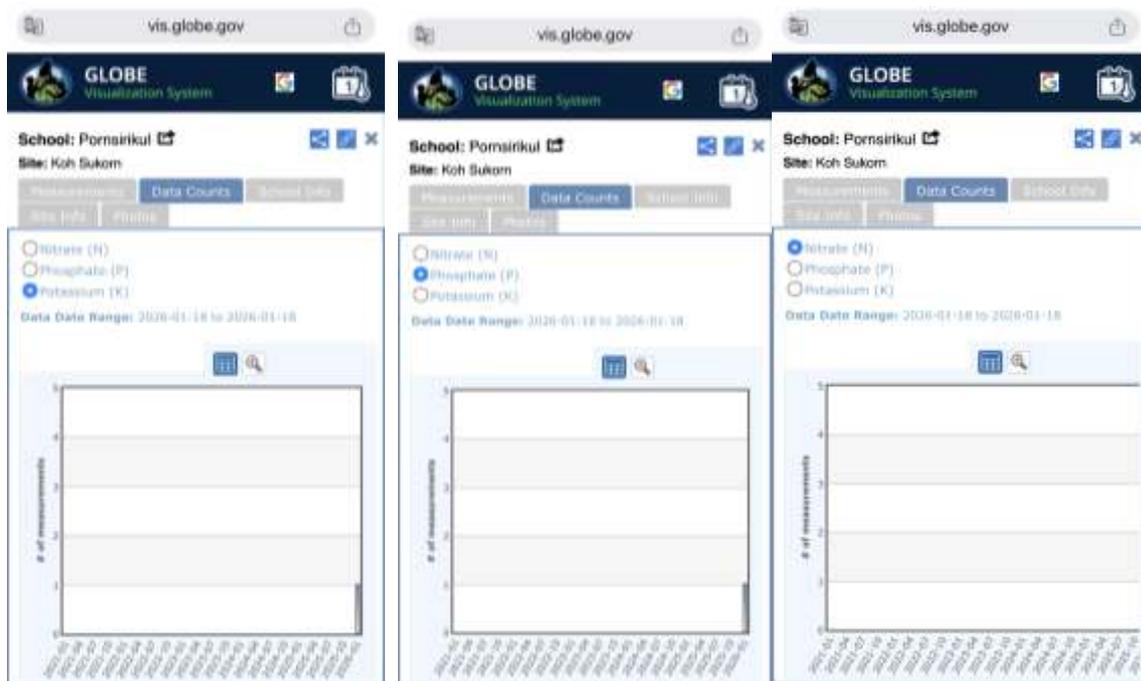
The GLOBE Program. Retrieved from <https://www.globe.gov/do-globe/for-teachers/learning-activities/pedosphere>

Khwunsakun, C., Phinrub, W., Khamcharoen, M., Wattanakul, W., Wongsanansin, T., & Kachenpukdee, N. (2026). Growing patterns affecting the growth and yield of watermelon (*Citrullus lanatus*) in a model community greenhouse. *Maejo Journal of Agricultural Production*, 8(1), 98-108.

Khwunsakun, C. (2023). Development of growing media for watermelon production in vertical outdoor pots. *Agriculture and Technology Journal*, 4(3), 1-10.

Watanabe, S. (2014). Fruit productivity of vertically trained watermelon [*Citrullus lanatus* (Thunb.) Matsum. et Nakai] plants. *Japan Agricultural Research Quarterly*, 48(2), 121-131.

GLOBE's databases



Option Badges

1. I am an Earth System Scientist

Reason for Selection: This research applies GLOBE Protocols to investigate the complex interactions between the Pedosphere (soil properties) and the Biosphere (plant physiology), exploring how these systems influence watermelon growth and quality.

Academic Description: This study demonstrates Earth System Interconnectedness by analyzing how soil physico-chemical characteristics in beach and paddy field areas (Pedosphere) directly govern biological processes (Biosphere). By examining soil moisture and nutrient content as key drivers of sugar accumulation, the research illustrates the dynamic linkage between Earth's spheres, providing a science-based explanation for agricultural phenomena within the local ecosystem.

Key Evidence:

Sphere Interconnectedness: Analysis of how Pedosphere conditions dictate Biosphere outcomes (crop sweetness and yield).

Protocol Application: Systematic integration of GLOBE soil and plant protocols to collect interrelated environmental datasets.

Systems Thinking: Evaluation of nutrient and water cycles within the local ecosystem to address agricultural challenges.

Data-Driven Insights: Utilizing Earth system data to correlate environmental variables with food production quality.

2. I am a Collaborator

Reason for Selection: This project leveraged **multilateral collaboration** between students, community enterprises, and experts. By synthesizing historical local wisdom with modern scientific analysis, the team developed sustainable solutions that address both environmental and socio-economic community needs.

Academic Description: The research was driven by a dynamic collaborative framework:

1. **Intra-team Synergy:** A structured team of three students and three advisors executed a specialized workflow, from **GLOBE Protocol** field surveys to laboratory analysis of soil properties and °**Brix** sweetness values.
2. **Knowledge Integration:** Close partnership with the **Koh Sukorn Watermelon Community Enterprise** and the inclusion of **previous university-level research** ensured academic continuity and a comprehensive understanding of long-term agricultural trends.
3. **Participatory Problem Solving:** Statistical findings were co-interpreted with local farmers, leading to "**practical innovations**" in soil management. This approach transformed classroom research into a catalyst for stabilizing local crop standards and boosting the community economy.

Key Evidence:

- **Multilateral Team Structure:** Clearly defined roles among 3 students and 3 advisors for comprehensive field and lab research.
- **Adherence to Global Standards:** Use of **GLOBE Protocols** to ensure data consistency and international reproducibility.
- **Integration of Local Wisdom:** Strategic partnership with local enterprises to incorporate historical and environmental insights.
- **Academic Continuity:** Comparative analysis with university-level data to bridge and extend scientific knowledge.
- **Participatory Interpretation:** A feedback loop with farmers to co-analyze results (e.g., °**Brix**) and co-create soil solutions.
- **Actionable Impact:** Science-based guidelines translated from collaborative findings into real-world agricultural improvements.

3. I Make an Impact

Reason for Selection: This project transcends theoretical study by transforming scientific findings into actionable solutions for Koh Sukorn's agricultural sector. It directly addresses community socio-economic challenges by enhancing crop quality and securing local livelihoods.

Academic Description: Serving as a model for Citizen Science, this study creates significant socio-economic impact by translating empirical data into Actionable Recommendations. By introducing targeted soil management and deficit irrigation techniques, the research helps maintain Geographical Indication (GI) standards. This stabilizes yield consistency, addresses income inequality, and strengthens a grassroots economy valued at 27 million THB annually, demonstrating the role of young scientists in fostering Sustainable Development.

Practical Recommendations:

Paddy Field Area: Implement deficit irrigation 10-14 days before harvest and apply potassium supplementation.

Beach Area: Incorporate organic matter and apply mulching to improve soil structure and moisture retention.

Key Evidence:

Actionable Solutions: Development of specific agricultural guidelines tailored to distinct local soil types (Beach vs. Paddy field).

Economic Strengthening: Supporting a 27-million-baht local industry by ensuring consistent product quality and marketability.

Preservation of Heritage: Safeguarding the GI certification of Koh Sukorn watermelons to preserve the community's unique agricultural identity.

Social Equity: Using science-based methods to reduce income gaps among farmers through stabilized crop standards.