A Study on the Effects of Cultivating Three Bromeliad Species

Wichienmatu School

GLOBEPROGRAM

Abstract

Abstract
This study on the properties of bromeliad plants in relation to soil conditions and water retention was conducted to investigate the role of bromeliads in soil improvement and moisture conservation. The objectives of the study were: to examine soil properties by measuring soil moisture, pH, NPK content, and soil structure in soils planted with bromeliad species Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva;to study the water retention capacity of the bromeliad species Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva; and to investigate the relative humidity of the air in areas where Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva were cultivated. The experiment was conducted by preparing soil under identical conditions. Bromeliad plants were then cultivated in pots with controlled water supply and environmental conditions as similar as possible. Changes in physical characteristics and moisture levels were observed, along with the recording of water storage in different parts of the bromeliad plants. The results showed that Aechmea blanchetiana exhibited the highest average soil moisture content at 93.3%.
The average soil pH was 7.0, while the average nitrogen (N), phosphorus (P), and potassium (K) contents were 36.3 mg/kg, 34 mg/kg, and 71.3 mg/kg, respectively. These values were higher than those observed in soils planted with Neoregelia cruenta and Aechmea malva, respectively. The water retention capacity of Aechmea blanchetiana also had the highest average value of 93.3%, exceeding that of Neoregelia cruenta and Aechmea malva. Bromeliad plants were found to play an important role in water retention within small-scale ecosystems by helping to maintain soil moisture and improve soil conditions suitable for the growth of other plant species. Furthermore, the findings provide useful reference data supporting the use of bromeliads as ornamental plants with ecological benefits. Beyond their aesthetic value, bromeliads contribute significantly to water conservation and the maintenance of environmental balance in cultivated areas.

Research Question

1. To examine soil properties by measuring soil moisture content, pH, NPK levels in soil planted and soil structure with Aechmeablanchetiana, Neoregelia cruenta, and Aechmea malva.
2. To investigate and compare the water retention capacity of theBromeliad species Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva.
3.To examine the relative humidity of the air in areas where Aechmeablanchetiana, Neoregelia cruenta, and Aechmea malva are planted.

Introduction

Climate change and water resource management have become major global challenges nowadays, as water is a fundamental factor sustaining human life, plants, and animals. Soil, as an essential natural resource, functions as a reservoir for water and nutrients necessary for the growth and survival of living organisms. Many regions currently face water scarcity caused by arid climatic conditions, seasonal variations, and unsustainable water resource utilization. These issues highlight the urgent need for effective strategies to cope with water shortages. One approach that has gained increasing attention is the cultivation of plant species that can help reduce water scarcity and enhance water retention in the environment. Bromeliad, commonly known as bromeliads, possess distinctive characteristics. Their overlapping leaf bases form a central tank capable of collecting and storing rainwater and dew. This stored water not only enables the plants to survive under limited water conditions but can also infiltrate the soil, increasing soil moisture and relative humidity in the surrounding environment. These processes may influence soil pH levels, nutrient content NPK and ambient relative humidity.Therefore, this project aims to investigate the role of different ornamental pineapple species in influencing soil properties
by comparing soil moisture content, pH, and NPK values, as well as water retention capacity and relative humidity in areas planted with Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva. This study seeks to enhance the understanding of water retention mechanisms in these plants and to evaluate their potential contributions to soil and water conservation. The findings may provide useful insights for future applications in natural resource management and sustainable agriculture.

Research Objectives

1. To examine soil properties by measuring soil moisture content, pH, NPK levels in soil planted and soil structure with Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva.
2. To investigate and compare the water retention capacity of the Bromeliad species Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva.
3.To examine the relative humidity of the air in areas where Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva are planted.

Research Questions

1. How do soil moisture content, pH, NPK levels and soil structure differ in areas planted with Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva?
2.How does the water retention capacity differ among Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva?
3.What are the characteristics of relative humidity in areas planted with the Bromeliad?

Research Methods

Research Hypotheses

1. The soil in areas planted with Aechmea blanchetiana is expected to exhibit higher moisture content, pH values, and NPK levels than soils planted with Neoregelia cruenta and Aechmea malva, while the soil
structure is expected to be similar across all three varieties.
2.Areas planted with Aechmea blanchetiana will demonstrate a higher water retention capacity than those planted with Neoregelia cruenta and Aechmea malva.
3.The relative humidity of the air in areas planted with ornamental pineapple plants will be high.

Materials

Bromeliad: Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva,Tile sheets for planting hole separation,Loamy soil,Watering can,Shovel / hoe,Soil moisture meter,NPK soil meter,Wet–dry hygrometer,Universal pH indicator paper,Equipment for collecting soil samples,Soil sample chart

Research Procedures

Part 1: Soil Moisture
Soil moisture and pH were measured using a soil meter. The probe was inserted to approximately three-quarters of the soil depth. The appropriate mode was selected for moisture or pH measurement, and the probe was cleaned before and after each use.
Part 2: Laboratory Soil pH Analysis
Air-dried and sieved soil samples were mixed with distilled water at a 1:1 ratio. The suspension was repeatedly stirred and allowed to settle until a clear supernatant formed. Soil pH was determined using universal indicator paper or a calibrated pH pen.
Part 3: Measurement of Soil NPK Nutrients
Soil nitrate nitrogen, phosphorus, and potassium contents were analyzed by using a soil test kit. Nutrient concentrations were determined by comparing color or turbidity changes of the soil extract with standard reference charts.
Part 4: Measurement of Water Retention Capacity
Three bromeliad species (Aechmea blanchetiana, Neoregelia cruenta, and Aechmea malva) were cultivated for three months. A known volume of water was poured into the leaf axils until overflow occurred, and water retention capacity was calculated from the difference between the initial and remaining volumes.
Part 5: Measurement of Relative Humidity
Relative humidity was measured using a wet- and dry-bulb hygrometer by comparing temperature differences with a standard reference table.
Part 6: Soil Structure Observation
Undisturbed soil samples were collected and observed in the field. Soil structure characteristics were recorded once at each study point.

Carrying Out Investigations

Table shows the geographic coordinates of bromeliad.

area	Geographic Coordinates	
	Latitude(N)	Longtitude(E)
Bromeliad.	7.504139	99.628528



GLOBE Badges

I AM A DATA SCIENTIST
The report includes in-depth analysis of data downloaded from the GLOBE database as well as the research team's own data sources if new data was collected. Participants discuss limitations of these data; make inferences about past, present or future events, or use data to answer questions or solve problems in the represented system.
I AM A COLLABORATOR
All research team members are listed including collaborators from other organizations, along with clearly defined roles, how these roles support one another and descriptions of each researcher's contribution. If the researchers collaborated with others outside of their organization, describe how the collaboration improved the research.
I MAKE AN IMPACT
The project clearly describes how a local issue led to the research questions or makes connections between local and global impacts. The research team clearly describes or shows how the research contributed to a positive impact on their community through making recommendations and taking action based on findings.

Results

Data Analysis and Research Conclusions

Results of soil moisture, pH, NPK levels in soil planted and soil structure measurements while growing bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, and Aechmea Malva.

Study of water retention capacity, soil moisture after watering, and relative humidity of bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, and Aechmea Malva.

Table 1. Results of soil moisture, pH, NPK levels in soil planted and soil structure measurements while growing bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, and Aechmea Malva.

Species	Date	Water quantity: 63.6 cm³/m²	Soil moisture after watering(%)	Relative Humidity(%)
Aechmea Blanchetiana	18/11/68	700	90	92
	2/12/68	655	90	85
	17/12/68	725	100	92
Average		693.3±35.4	93.3±5.8	89.6±4
Neoregelia cruenta	18/11/68	550	80	85
	2/12/68	800	90	78
	17/12/68	530	90	92
Average		526.6±150.4	86.6±5.8	87.3±7
Aechmea Malav	18/11/68	450	80	85
	2/12/68	480	70	71
	17/12/68	425	80	85
Average		451.6±27.54	76.6±5.8	80.3±8.08

Table 2. Study of water retention capacity, soil moisture after watering, and relative humidity of bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, and Aechmea Malv

Species	Date	Moisture (%)	pH	Minerals in the soil (mg/kg)			soil structure
				N	P	K	
Aechmea Blanchetiana	18/11/68	93.3±10.0	7±0.58	36.3±24	34±16.5	71.3±56.6	mold
	2/12/68	96.6±5.8	7.3±0.6	23±7.6	13.3±5.9	45.3±13.2	
	17/12/68	101.6±2.9	6.7±0.8	31±6.3	38.3±11	52±17.4	
Average		93.3±5.8	7 ± 0	36.3±24	34±16.5	71.3±56.6	
Neoregelia cruenta	18/11/68	90±5.8	6±0.58	18.3±8.6	17.7±9.1	34±5.2	mold
	2/12/68	96.6±5.8	7±1	15.3±11.6	14.6±8.1	50.3±57.1	
	17/12/68	100±0	5.8±0.3	9.6±5.5	15.7±6.1	28±20.7	
Average		90±0	6±1	18.3±8.6	17.7±9.1	34±5.2	
Aechmea Malav	18/11/68	80±8.7	5.7±0	18.3±14.1	3.67±3.1	8.67±2.9	mold
	2/12/68	83.3±15.3	7.6±0.3	8.3±7.6	7.6±4.2	21±10	
	17/12/68	100±0	6.5±0.5	9.3±6.1	5.3±4.9	22.7±10.7	
Average		80±8.7	5.7±0.6	18.3±14.1	3.6±3.1	8.7±2.9	

According to Table 1, the results indicate that the three ornamental pineapple varieties influenced soil properties, with moisture content ranging between 80 and 93.3%, pH values between 5.7 and 6.0, nitrogen (N)levels from 18.3 to 36.3 mg/kg, phosphorus (P) levels from 3.6 to 34 mg/kg, and potassium (K) levels from 8.7 to 71.3 mg/kg. Overall, Aechmea blanchetiana demonstrated the most optimal performance among the tested varieties

According to Table 2, the results indicate that the three ornamental pineapple varieties influenced water absorption, with absorption capacities ranging from 451 to 693 cm^3/m^3 and soil moisture content between 76.6 and 93.3%. Overall, Aechmea blanchetiana demonstrated the greatest ability to absorb water among the tested varieties

Chart 1 : The bar chart shows the measurements of soil moisture, pH, and NPK values while growing the bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, and Aechmea Malva.

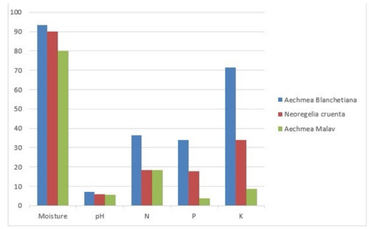
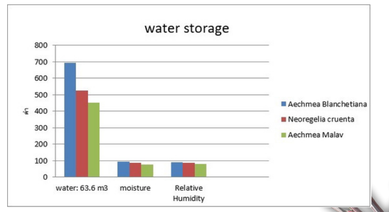


Chart 2 :The bar chart shows a study of the water retention capacity, soil moisture after watering, and relative humidity in the air of the bromeliad species Aechmea Blanchetiana, Neoregelia cruenta, Aechmea Malva.



Conclusions and Discussion

The results of the study revealed that all three bromeliad species increased soil moisture levels at every sampling period. The soil type, pH, and NPK values showed no significant differences among the treatments. However, soils planted with Aechmea blanchetiana exhibited higher average soil moisture, pH, and NPK values than those planted with Neoregelia cruenta and Aechmea malva. The soil structure was found to be similar across all three bromeliad species. The water retention test demonstrated differences in water-holding capacity among the three bromeliad species. Aechmea blanchetiana showed a greater ability to retain water compared to Neoregelia cruenta and Aechmea malva. Therefore, Aechmea blanchetiana exhibited superior water retention capacity, which was consistent with the observed increase in soil moisture. The relative humidity of the air in the cultivation area showed no noticeable changes during the experiment. Additionally, the soil used in this study remained suitable for the cultivation of other plant species.

Bibiliography

- Waitayangkura, P. (2016). Natural innovative water retention: Bromeliads. Retrieved August 17, 2025, from https://www.kroobannok.com/m/mview.php?id=79949
- The Institute for the Promotion of Teaching Science and Technology (IPST). (2025). The GLOBE Program (Temporary Office). Retrieved August 17, 2025, from https://globefamily.ipst.ac.th/globe-protocols/biosphere
- Treephetprapa, S., Pian, T., & Komkla, K. (2016). Natural innovative water retention mimicry: Bromeliad (Aechmea aculeatosepala). Retrieved August 17, 2025, from https://mgronline.com/science/detail/9590000087440#google_vignette
- Trang Land Development Department. (2025). Retrieved May 7, 2025, from https://orgweb.ldd.go.th/trg
- ChatGPT Translate. Retrieved January 26,2026 ,from https://chatgpt.com/th-TH/