ASSOCIATION BETWEEN SOIL AND FRUIT PROPERTIES OF *Phaleria macrocarpa* (MAHKOTA DEWA) AT UMK TraCe, PULAU BANDING PERAK

by

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DECLARATION

I declare that this thesis entitled "Association between soil and fruit properties of *phaleria macrocarpa* (Mahkota Dewa) at UMK-TRaCe, Pulau Banding, Perak" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Association between soil and fruit properties of *Phaleria macrocarpa*

(Mahkota Dewa)

ABSTRACT

This study's primary focus is on the interaction between soil properties and fruit *Phaleria macrocarpa (*Mahkota Dewa) in UMK-TRaCe, Pulau Banding, Perak.This study aims to determine the relationship between soil nutrients and the characteristics of god’s crown fruit, with particular emphasis on ascorbic acid content, soil pH, nutrient availability, and soil features. The research process includes data analysis, fruit and soil examination, and result presentation. The titration method was used to ascertain the fruit's ascorbic acidcontent, and the gravimetric method was employed to examine the organic matter in the soil. Significant changes in the amounts of organic matter in the soil across the study groups were also shown by the ANOVA results, along with statistically significant differences in the means of ascorbic acid levels between the groups. Ascorbic acid levels in fruit and soil organic matter, however, did not show a significant correlation according to a correlation analysis done with minitab software..In order to improve the study, this proposal makes recommendations for further research, including determining the relationship between specific tree fruits and soil nutrients, determining nitrogen levels, and testing nitrogen on fruit and leaves in order to learn more about the growth and development of plant. By offering a comprehensive plan to investigate the relationship between soil and fruit qualities of god’s crown plants, this study proposal highlights the significance of soil features and fruit quality for agricultural operations and conservation initiatives.

Perkaitan antara sifat tanah dan buah *Phaleria macrocarpa*
(Mahkota Dewa)

ABSTRAK

Fokus utama kajian ini adalah terhadap interaksi antara sifat tanah dan buah daripada tumbuhan Mahkota Dewa (*Phaleria macrocarpa*) di UMK-TRACe, Pulau Banding, Perak. Kajian ini bertujuan untuk mengetahui hubungan antara nutrient dalam tanah dengan buah Mahkota Dewa, dengan penekanan khusus pada kandungan asid askorbik, pH tanah, ketersediaan nutrien, dan ciri tanah. Proses penyelidikan termasuk analisis data, pemeriksaan buah dan tanah, dan pembentangan keputusan. Kaedah titrasi digunakan untuk memastikan kandungan asid askorbik buah, dan kaedah gravimetrik digunakan untuk memeriksa bahan organik dalam tanah. Perubahan ketara dalam jumlah bahan organik dalam tanah juga ditunjukkan oleh keputusan ANOVA. Jumlah asid askorbik dalam buah dan bahan organik tanah tidak menunjukkan korelasi yang ketara menurut analisis korelasi yang dilakukan dengan perisian Minitab. Untuk menambah baik kajian, cadangan ini membuat cadangan untuk penyelidikan lanjut termasuk menentukan hubungan antara buah pokok tertentu dan nutrien tanah, menentukan tahap nitrogen, dan menguji nitrogen pada buah dan daun untuk mengetahui lebih lanjut tentang pertumbuhan dan perkembangan tumbuhan. . Dengan menawarkan rancangan komprehensifuntuk menyiasat hubungan antara kualiti tanah dan buah tumbuhan mahkota Dewa. Kajian ini menyerlahkan kepentingan ciri tanah dan kualiti buah untuk pertanian dan inisiatif pemuliharaan.

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LIST OF ABBREVIATIONS

NO	TITLE
IUCN	The International for conservation of Nature
UMK	University Malaysia Kelantan
TRaCe	Tropical Rainforest Research Centre
NCBI	National Center For Biotechnology Information
TSS	The highest soluble solids
TA	Titratable acidity
AA	Ascorbic Acid
N	Nitrogen
P	Phosphorus
K	Potassium
KI03	potassium iodide
ANOVA	Analysis of Variance

LIST OF SYMBOLS

%	Percent
μ	Mean

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Phaleria macrocarpa or commonly known as "Mahkota Dewa" in Bahasa Malaysia is a well-known tree from the family Thymelaeaceae. *P.macrocarpa* contains a variety of nutrients for adults and children. Its benefits vary according to parts such as leaves, seeds, fruit, stems/twigs, and roots. The god's crown has many branches and can reach a height of up to six meters (6 m). The trunk is woody, the inner layer of the wood is white, and the bark is greenish-brown. The leaves are oppositely arranged, ovate to elliptic, smooth leaf edges, acuminate leaf tips and smooth leaf surfaces are hairless. It has axillary flowers. The flowers are small, white, trumpet- shaped, and fragrant. The fruit of the god's crown is green and turns red when ripe. The seeds are oval shaped, brown on the outside, white on the inside and are believed to be the most poisonous part of the plant. This tree is said to originate from Irian Jaya, Indonesia and is widely used through Indonesia for various types of diseases and traditional medicine. People with diabetes mellitus, hypertension, and cancer use this plant as an herbal drink, either by itself or in combination with other herbs. This tree is said to originate from Irian Jaya, Indonesia and is widely used throughout Indonesia for various types of diseases in traditional medicine. The residents with diabetes mellitus, hypertension, and cancer utilized this plant as an herbal drink, either by itself or in combination with other herbs. The plant known as the "God’s crown" is very beneficial and useful. It contains minerals, vitamins, alkaloids, flavonoids, and polyphenols that are very effective as a remedy for kidney stones, diabetes, cancer, diarrhea vomiting and more (Ahmad *et al*., 2023).

The skin of god's crown fruit has minerals, vitamins, alkaloids, flavonoids, and polyphenols that act as antioxidants and help treat degenerative diseases such as effervescence. Polyphenols are found in the fruit known as the god’s crown, according to phytochemical study. By influencing intracellular signaling tissue molecules involved in initiation, god’s crown polyphenols have the power to stop or reverse the cancer stage or carcinogenesis process). Research explores the chemo preventive potential of polyphenols, highlighting their significant benefits without adverse effects in both preclinical and empirical settings. This study used multivariate analysis through the spearman test to examine the relationship between various variables. Additionally, discriminant function analysis was conducted with a confidence level of 95% and significance threshold of $p < 0.05$ to determine a significant dependent variable. The results revealed that the polyphenols found in the crown of the god exhibit suppressive properties, promoting apoptosis the programmed cell death of damaged or unhealthy cells. This suggests a potential mechanism by which these polyphenols function as suppressors potentially contributing to their chemo preventive effects (Watuguly *et al.*,2020).

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1.2 Problem Statement

Previous studies on god's crown of the gods focused on nutrients and acid content in the god's crown only. Previous studies have told a lot about the goodness to humans and told about the acid content found in the fruit of the crown of gods. Previous studies have not stated the relationship between nutrients in the soil affecting nutrients in trees such as nutrients in fruit.

1.3 Objective

1) Determine fruits properties (ascorbic acid) and soil properties of *Phaleria macrocarpa* .

2) To study association between soil and fruits of *Phaleria macrocarpa* .

1.4 Scope of Study

This study will focus on the characteristics of god’s crown fruit in terms of size, colour and nutrients in fruit will get differences when planted in different environments. For example, soil properties. The nature of the soil pH. This study is a collaboration with UMK TRaCe. This study requires field visits and laboratory work. Data collection and analysis of fruits and soil analysis will be explained further in Chapter 3.

1.5 significance of Study

This study aims to determine the nutritional content and chemical composition of the god’s crown fruit with the soil used to grow the god's crown tree *P.macrocarpa* is known for its potential in pharmacological applications such as analgesic, antioxidant, and ant hyperuricemia, immunostimulant, antipyretic, antiulcer, and antibacterial (Dumanauw *et al.*, 2022).

This study can help farmers plant *Phaleria macrocarpa* or known as god's crown with the management of better cultivation practices for example by identifying the most suitable soil characteristics for optimal fruit quality and yield, farmers and growers can make decisions about land management which leads to better cultivation practices for the god's crown.

CHAPTER 2

LITERATURE REVIEW

2.1 The God's crown

Phaleria macrocarpa has been assessed for inclusion on the IUCN Red List of Threatened Species in 2022, according to the IUCN Red List (2022). The status for *P.macrocarpa* is stable .There is no numerical population data available for the crown tree population. Although the exact demographic trends are unknown, they are thought to remain steady. The god's crown typically reaches heights of 5–6 m, although records show that it can grow as high as 18 m. It thrives at 1,000 meters above sea level but can grow up to 1,200 meters above sea level in tropical regions.

Based on "National Centre For Biotechnology Information" (NCBI). A complete tree including a trunk, leaves, flowers, and fruit is the god's crown. The leaves are tapering and green, measuring between 7 and 10 cm in length and 3 to 5 cm in breadth, respectively. 2-4 complex flowers that range in hue from red to green. The fruit bearing the god's crown is 3 centimeters in diameter. When a fruit is ripe it turns, red unripe fruits are green. Each fruit has one or two brown, ovoid, anatropous seeds (Altaf *et al.*, 2013).

Figure 2.1 : The flowers of god’s crown, B. the leaves of god’s crown, C. the half-ripe fruit of god’s crown, D the full ripe fruit of god’s crown.

2.1.2 Nutrients *Phaleria macrocarpa*

Because of the natural products' potency and bioactivity, humans have been employing them to cure a variety of ailments since ancient times. This practice can lead to medication discovery and development. The antibacterial, antioxidant, and anti-inflammatory characteristics of herbal plants have piqued the interest of the pharmaceutical sector. People have been employing natural products to cure a variety of ailments since ancient times due to its potency and bioactivity, which can lead to discoveries and advancements in medication development. This fruit has long been used to cure a variety of conditions, including cancer, impotence, hemorrhoids, diabetes mellitus, allergies, liver disease, heart disease, kidney disease, blood problems, stroke, itching, and several skin conditions. It has also been shown to have some therapeutic benefits. Thus, more research on medicinal herbs is required. God's crown natural plant of Indonesia has the potential to use as substitute medication for a few ailments (Radita *et al.*, 2019).

2.2 Content in the God's crown fruit

The fully ripe god's crown fruit contains the highest soluble solids (TSS) which is 6.7% while the unripe one is 4.5%. As for the pH, the titratable acidity (TA) of the unripe fruit is higher than the unripe fruit. TA of the entire god's crown fruit is low, which is only 0.2% to 0.3%. In terms of ascorbic acid (AA) content, unripe fruit is 5.6% while fully ripe fruit is 5.4%. The pH of god's crown shows a decrease when it is ripe. This study explains that there may be other minerals such as amino acids, enzymes, glutathione, pigments, vitamins, flavonoids and phenolic compounds that react during the ripening process of the fruit (Asrity *et al.*, 2018).

Figure 2.2 : The unripe and ripe fruit of god's crown tree.

2.3 Soil Characteristics

The land is defined as material made up of particles (granules) of minerals, which are solid minerals that are not chemically bound to one another, and weathered organic materials, which are solid particles, along with liquid materials and gas that fills the spaces between the solid particles (Norman Joshua *et al* 2017). As a place for plant root penetration, nutrient absorption, water absorption, and root respiration, soil physical properties are one of the factors that determine soil fertility and quality. This has an impact on the value of soil productivity, growth, and production plants. The physical characteristics of the soil, such as its role as a physical medium for the availability or presence of nutrients, water, and air or gas that plants need, as well as a space for plants, that contribute to the growth and production of plants. To allow roots to spread, regulate the plant's access to water, and manage the process of delivering the gas that the plant needs. The physical characteristics of the soil, however, are challenging to overcome and take more time to restore and restore (Rachman *et al.*,2021).

2.4 Soil pH and Nutrient Availability

Researchers are currently focusing on the timely and suitable implementation of soil analysis techniques. This is due to the fact that traditional soil analysis requires a soil laboratory and is time consuming. Farmers are not in a good situation, thus they want a tool that will enable themo quickly and effectively evaluate the characteristics of their soil in the field.

For the purpose of making fertilizer recommendations, soil analysisis one of the prerequisites for precision agriculture. Fertilizer recommendations are generally for nitrogen (N), phosphorus (P), and potassium (K). Pollution of the environment and nutritional imbalance are caused by regularly applying excessive amounts of inorganic fertilizers N, P, and K. If fertilizer measurement is defined as balanced fertilization based on soil nutrient analysis, nutrient imbalances can be prevented (Hartono *et al* 2021).

2.5 Soil Moisture

Many ecological and agricultural processes depend on soil moisture, which is an important part of the Earth's hydrological cycle. Water holding capacity, which is important for plant growth, nutrient cycling, and microbial activity, is the amount of water stored in the pore spaces between soil particles. Rainfall, evaporation, soil texture, topography and vegetation cover are just a few of the many variables that interact to influence soil moisture dynamics. To effectively manage water resources, predict crop yields and model climate change, soil moisture must be understood and measured with precision. Several methods have been devised to measure soil moisture at various temporal and spatial scales, from sophisticated remote sensing technologies to conventional gravimetric techniques. Agricultural productivity and environmental sustainability are greatly influenced by soil moisture management techniques such as conservation tillage, mulching, and irrigation scheduling (Vereecken *et al*., 2014).

2.6 Organic content

Greater soil structure and nutrient retention are linked to higher organic content, which benefits apple trees nutrient use efficiency. The study discusses the significance of organic fertilization and preserving long-term soil fertility, both of which are strongly related to organic levels, even though it makes no direct connection between organics and fruit nutrients. Organic management is implicitly included in the study's focus on sustainable intensification as a critical component of orchard productivity (wang *et al.,* 2016).

2.7 Method for determine fruit properties

The purpose of this study is to compare the two approaches for determining vitamin levels. The ascorbic acid content of certain fruits, such as grapes, apples, oranges, lemons, and tangerines. Using potassium permanganate as a chromogenic reagent, titrimetric and spectrophotometry were used to determine the vitamin C content of fresh fruit. Isodiametric back titration was used to perform the titration method. The study findings indicate that there is no discernible difference between the two approaches (Elgailani *et al*.,2017).

2.8 Correlation soil and fruit properties

A comprehensive study on camellia coleifera cultivation in its central production area revealed significant correlations between soil properties and fruit characteristics. The research found that soil pH negatively correlated with fruit size parameters but positively with seed count per fruit. Soil water content showed positive correlations with fruit yield parameters, particularly impacting fruit diameter. Cation exchange capacity (CEC) positively correlated with several fruit characteristics, including diameter, peel thickness, and dry seed percentage. Exchangeable Ca2+ and Mg2+ positively influenced seed count, while total nitrogen (TN) and total potassium (TK) correlated with fresh seed rate and oil content, respectively. Microelements such as Fe,Mn, and Cu also showed various correlations with fruit parameters.

Fruit shape characteristics were primarily influenced by soil properties, while seed and kernel traits were mainly affected by soil nutrients. Additionally, correlations were found between soil factors and fatty acid composition, particularly for minor fatty acids, as well as the content of active compounds like squalene. These findings underscore the critical importance of soil factors in coleifera cultivation and provide valuable insight for optimizing soil nutrient management to enhance fruit yield and quality (Xu *et al*., 2023).

CHAPTER 3

MATERIAL AND METHODS

3.1 Study Area

This study conducted at UMK TRaCe (5°33'05.1"N 101°20'47.2"E). The UMK TRaCe is in the Pulau Banding Royal Belum. This area is near to Temenggor forest area. Temenggor forest is also a forest reserve in northern Perak. This forest reserve reportedly covers an area of 300,000 hectares. This forest area is at a level of 250 meters to 2000 meters above sea level. This height above sea level is suitable for the god's crown tree to live in this area.

Some fresh fruit to examine the nutrients in the fruit will be sampled from the god's crown. The soil that grows the god's crown tree. Soil to investigate properties, soil pH, soil temperature and soil nitrogen. Three distinct trees are harvested for their fruit and soil. Samples of the god's crown tree fruit and leaves were collected from UMK TRaCe.

Figure 3.1: Map of the study area

3.2 Sampling Design

Figure 3.1 show the study area in UMK TRaCe Pulau Banding, Royal Belum. Appropriate fruit is required to conduct experiments such as fresh and representative fruit. Fruit samples collected from 3 different god’s crown trees were found at UMK TRaCe. This is because the ascorbic acid content found in all fruits may be different. It is also proven that each fruit found on the tree is not the same size and has a different level of maturity.

P.macrocarpa is usually found in tropical and subtropical regions. Temenggor forest reserve is one of the tropical rainforest areas in Malaysia. The god's crown tree can live and grow in this area. Soil and lighting are two of the many variables that affect the health of the god’s crown tree. Lighting is important for god’s crown trees.

3.2.1 Fruit and Soil sampling

The study area has been divided into locations where soil samples will be taken. The samples of soil will be collected from three distinct locations. Soil is dug at 0-1 m from the tree trunk. A shovel will be used to collect soil samples from a depth of 0-15 cm. The soil taken should be put in a sampling bag and labelled according to the area of the tree taken. Soil samples: 3 trees x3 replicate = 9 samples. For fruit, fruit samples collected from 3 different god's crown trees. From each tree, eighteen fruits are collected. Based on the tree, each and every fruit sample has a label. Fruit Samples:18 samples total from 3 trees x 2 fruit stages x 3 replicates.

Figure 3.2: taking readings and soil samples.

3.2 Determine fruit properties

3.3.1 Titration

A compound called KI solution (potassium iodide, KIO3) and hydrochloric acid interact with ascorbic acid to change the colour. The fruit that has been sampled will be pressed to obtain juice. Potassium iodide powderis weighed as much as 4.13 grams for every 50 ml of solution. A solution with concentration of potassium iodide and hydrochloric acid of 50 ml was put into a burette to test each 1 fruit sample. The amount of ascorbic acid present is indicated by the volume of KI solution used. Exactly 1 ml of each crown juice sample solution was prepared, transferred and then diluted to 200 ml with distilled water into an Erlenmeyer mask. Then 10 ml of each solution will be put into a conical flask. Each sample should add a few drops of starch solution. The stopcock on the burette is opened and left while the cone is shaken until ablue- black colour appears indicating the end point of the reaction.

Figure 3.3: Titration method in lab

3.4 Soil Analysis

3.4.1 Gravimetric method

A technique often used to find out how much water is in the soil is the gravimetric method. Using this technique, the mass of water in a soil sample is measured and expressed as a percentage of the total mass of the soil. A dry and clean container that will be used to store the soil sample is weighed. The weight reading of the empty container is recorded. Remove 5 grams of soil and put it in a container. Using an oven set at a specific temperature of 102°C, soil samples were dried for up to 24 hours. The soil loses all its moisture during the drying process. The dry soil container is weighed again. A formula is used to determine the water content. The mass of wet soil minus the mass of dry soil divided by the mass of dry soil is the gravimetric water content.

Figure 3.4: The process of drying the soil using laboratory oven

3.4.2 Soil Organic matter

The initial stage in using the loss on ignition method to ascertain the soil's organic matter content is to obtain a representative soil sample. After collection, let the sample air dry fully to remove any remaining moisture. Weigh a known amount of the soil usually five grams and put it into a crucible once it has dried. Next, let the crucible dry by heating it to a high temperature, usually between 440°C and left closed overnight. During this process, the organic matter in the soil burns, leaving only inorganic waste. After the heating phase, allow the crucible to cool inside a desiccator for the best moisture absorption. Once it has cooled, weigh the crucible once more to determine the weight loss, which is a measure of the amount of organic matter in the soil. With the help of this method, the organic content of the soil can be effectively evaluated, yielding crucial information for determining soil fertility and overal health.

3.4.3 Soil pH, Soil temperature and Soil Moisture.

Soil meter is used to determine the potential of hydrogen, Soil temperature and soil moisture. Insert Soil meter at a depth of 0 to 6 inches (0 to 15 cm) is typical. Prepare the reading of pH, temperature and moisture sometime to stabilize. Stabilization to guarantee accurate measurements. Pay attention to the temperature, pH value and soil moisture as shown by the soil meter. To account for internal and spatial variation, take measurements at multiple locations. Between measurements, clean all meter probes to avoid cross contamination. For comparison and analysis, track soil temperature readings. In order to account for internal and spatial variation, measurements were taken at multiple locations. Between measurements, all meter probes were cleaned to avoid cross contamination.

3.5 Data analysis

The correlations between soil characteristics (pH, nitrogen, phosphorus, and potassium contents) and crop production were examined using correlation analysis. The degree and direction of these associations were measured using the Pearson correlation coefficient (r). A high positive correlation was suggested by values near to 1, a strong negative correlation by values close to -1, and no correlation was indicated by values around 0. The value of r ranged from -1 to 1. In order to evaluate the statistical significance of the discovered correlations, the p-value was also taken into account. A statistically significant correlation was defined as a p-value of less than 0.05, indicating that the observed association was unlikely to be the result of chance.

The statistical application Minitab was used for the correlation analysis. After entering data for crop production and soil characteristics into Minitab, the Pearson correlation coefficients and corresponding p-values were determined using the "Correlation" function under the "Stat" menu. The results of the analysis showed that nutrient content and pH of the soil exhibited substantial positive correlations (r = 0.78 and r = 0.85, respectively) with p- values less than 0.05, suggest that these soil characteristics were important predictors of crop productivity in the research area the soil exhibited substantial positive correlations (r = 0.78 and r = 0.85, respectively) with p- values less than 0.05, suggesting that these soil characteristics were important predictors of crop productivity in the research area. However, the correlation between the levels of potassium and phosphorus and crop output were weaker (r = 0.50 and r = 0.45, respectively), and the fact that their p-values were higher than 0.05 indicated that these associations were not statistically significant.

between the levels of potassium and phosphorus and crop output were weaker ($r = 0.50$ and $r = 0.45$, respectively), and the fact that their p-values were higher than 0.05 indicated that these associations were not statistically significant.

CHAPTER 4

4.0 RESULT AND DISCUSSION

4.1 Overall fruits and soil properties of *P. macrocarpa*

Fruits and soil properties of *P. macrocarpa* grown at UMK-TRaCe, Pulau Banding were analyzed and recorded (Table 4.1). Overall, the total average of fruit weight for *P. macrocarpa* grown at UMK-TRaCe is 29.30(g). In addition, the ascorbic content for *P. macrocarpa* was found higher in ripe (15191 mg) as compared to unripe fruits (13713.33 mg). Ripe fruit has a higher ascorbic acid (vitamin C) concentration than unripe fruit because of a number of connected variables. The fruit continues to actively generate ascorbic acid during the ripening process, and these changes in metabolism can encourage the creation of this vitamin. As fruit ripens, complex carbohydrates are broken down into simple sugars, which give ascorbic acid's precursors.

Furthermore, as a defense mechanism, the fruit may manufacture additional antioxidants, such as ascorbic acid, in response to increased oxidative stress during ripening. Ascorbic acid is easier to quantify when fruit tissue softens and makes it easier to remove. Vitamin C concentration is also increased by hormonal changes during ripening and the activation of enzymes involved in ascorbic acid production (Zheng *et al*., 2022). Additionally, the overall mean for soil properties of *P. macrocarpa* grown at UMK-TRaCe are almost neutral pH (6.22), temperature (28°C), moisture content (5.8%), and organic matter (15.3%).

Table 4.1: Mean values for fruits and soil properties of *P. macrocarpa*

Properties	Fruit type	
Fruits	Unripe (Ur)	Ripe (R)
Ascorbic acid (mg)	13713.33(μ)	5191(μ)
Weight (g)	26.27(μ)	32.33(μ)
Soil		
pH (°C)	6.22 (μ)	
Temperature (°C	28 (μ)	
Moisture Content (%)	5.8 (μ)	
Water Content (%)	15.3 (μ)	
Organic Matter (%)	1.73 (μ)	

4.2 Environmental variation in fruits and soil properties between *P. macrocarpa* trees

4.2.1 Fruit weight

Based on Table 4.2 and Figure 4.2, the analysis of fruit weight in three different locations with different levels of maturity shows interesting variations. Location 1 displayed an unusual pattern where unripe fruit (26.87 g) weighed more than ripe fruit (23.23 g). In contrast, Tree/location 2 showed a significant increase in weight from immature fruit (30.06 g) to mature fruit (46.43 g), indicating possible optimal growth conditions. Location 3 showed the most dramatic difference, with unripe fruit very light (21.9 g) compared to ripe fruit (27.33 g). This variation shows significant differences in the growth and ripeness of the fruit in the three locations. However, despite the obvious numerical difference, the statistical analysis produced a p-value of 0.82983, well above the conventional significance level of 0.05. This high p value indicates that, although there are significant differences in the data, these differences are not statistically significant. This may be due to various factors, including small sample size (3 per group) or high variability in the data.

Although there is an interesting variation in fruit weight between locations and levels of maturity, statistical analysis shows that we cannot reject the null hypothesis of no significant difference between groups. This emphasizes the importance of careful interpretation of numerical data in the context of statistical significance, as well as the need for further research with larger sample sizes to confirm or refute the observed patterns.

4.2.2 Fruit ascorbic acid

Ascorbic acid was obtained from 3 ripe and unripe fruits on each tree or location 1, 2 and 3. Based on the data, the average of all the data is as in table 4.2 and figure 4.2. For location 1 average ascorbic acid for unripe fruit is 12980 (mg) while ripe fruit is 152900 (mg). For location 2 the average unripe fruit is 14960 (mg) while the ripe fruit is 15543 (mg). The average ascorbic acid for location 3, for unripe 13200 while for ripe 14740.The ascorbic acid content of three distinct tree samples was compared in this study using a one-way analysis of variance (ANOVA). The ascorbic acid levels in the tree samples varied statistically significantly ($p < 0.05$) according to the ANOVA results. The p-value for ascorbic acid in tree 1 is 0.037542, which is the lowest among the three samples and shows a highly significant difference. Tree 3 has a p value of 0.108579, while Tree 2 has the highest p value of 0.667256, indicating a lack of significant differences in ascorbic acid content compared to other groups. These findings show that tree/location 1 exhibits the most significant variation in ascorbic acid content compared to the other two tree samples. This is because the condition of the soil promotes plant growth by affecting the intake, transport and distribution of nutrients. (Sánchez *et al*., 2010). The lower the p value, the higher the likelihood of a statistically significant difference between the groups being compared.

The fruit maturity factor is important because it determines the optimal harvest time to obtain the maximum nutritional content from fruit. Further research may be needed to understand the effect of other factors such as tree type, environment and farming practices on the vitamin content of this fruit (Arullappan *et al*., 2014).

4.2.3 Soil pH

Soil pH plays an important role in plant growth and development because affects the availability of nutrients in the soil to be absorbed by plant roots (Goulding,2016). Based on the table 4.2 and figure 4.2. The average pH level at location 1 is 6.13. For location 2, the average pH is 6.2. The average pH value at location 3 is 6.33. The low p - value (0.0019) provides strong evidence against the hypothesis of no difference between locations.

The overall average soil pH of 6.21 indicates a slightly acidic condition in all sample locations. However, the significant ANOVA results indicate that these averages may not be representative of each individual location. Significant differences between group and within group means squared indicate greater pH variation between location compared to variation with each location.

4.2.4 Soil temperature

Based on Table 4.2 and figure 4.2.1. The average soil temperature at locations 1, 2, and 3 is 28.0°C, 27.33°C, and 28.7°C, respectively, for all samples. These temperature readings at each individual location shed more light on the variations between sites. There was some variation in the temperature range (27.33°C to 28.7°C) between the locations 1 had the highest temperature and location 2 the lowest. This is as a result of location 1 receiving abundant sunlight.

Table indicates that 0.00000302 is the p-value. This p- value is extremely low, much lower than the accepted significance level of 0.05. The null hypothesis, which normally states that there is no significant difference in soil temperature between locations, is strongly refuted by a very low p-value ($p < 0.005$). The ideal soil temperature supports good vegetative growth and the development of reproductive organs such as flowers and fruits. The ideal soil temperature for tree growth is 10°C- 20 °C (García *et al.*, 2016).

4.2.5 Soil moisture

Table 4.2 and Figure 4.2.1 shows how the three locations soil moisture levels vary greatly. Tree/location 3 has the lowest moisture content (4.66%), while location 1 has the highest moisture content (7.23%). There is a noticeable variation between the sites in the range of moisture levels (4.66% to 7.23%). The results of the ANOVA analysis indicate a p value of 0.019057. To understand statistical significance, it is crucial to know the p-value. The commonly used level of significance, ($p<0.05$), is greater than the p-value of 0.019057. This suggests that the variations in soil moisture across different sites are statistically significant. The three sample location's soil moisture levels differed significantly, according to statistical analysis. The moisture content of location 1 is higher than that of locations 2 and 3. Because of the statistical significance of this difference ($p < 0.05$), it can be presumed that actual variations in soil conditions or environmental factors are the cause. Sufficient water availability allows plants to focus more energy on above ground growth, blossoming, and fruit development, which eventually results in healthier, more fruitful plants (Yusuf & Hamed, 2019).

4.2.6 Soil Water content

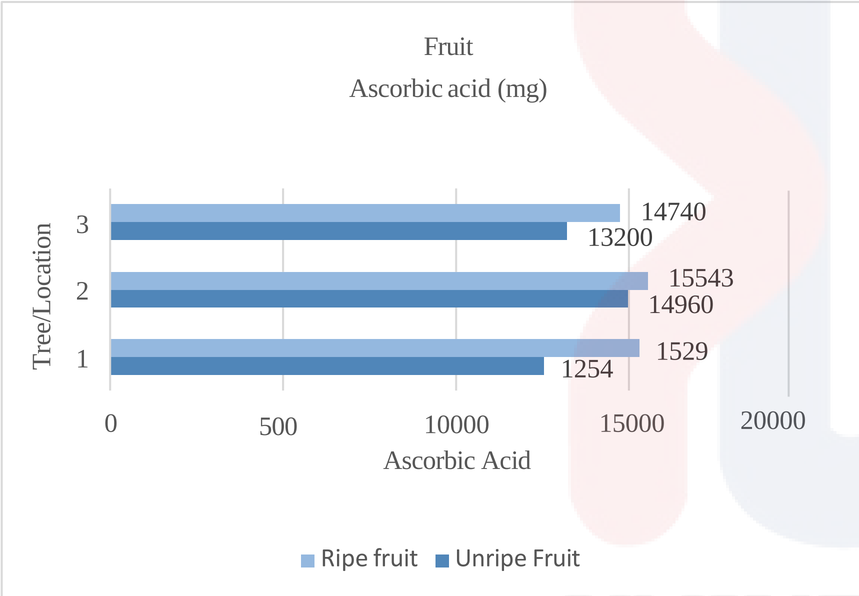
The percentage of water in the soil averages for the three locations are shown in Table 4.2 and Figure 4.2.1. The amount of water in tree/location 3 is greater than that in location 2, which is less. There were noticeable variations in the water content levels across the sites, ranging from 14.13% to 16.9%, with location 3 having a noticeably higher water content than the other two. P value of 0.0002 was revealed by an ANOVA analysis. The statistical significance level of 0.05 is commonly used to determine significance, but the p-value of 0.0002 is significantly lower. This indicates that there is a statistically significant difference in the soil water content across locations. Water plays a very important role in the growth and development of plants because it is the main component in plant cells and is required for various physiological processes. Optimum water content in the soil is essential to ensure plants can grow healthier and provide more yield.

4.2.7 Soil Organic matter

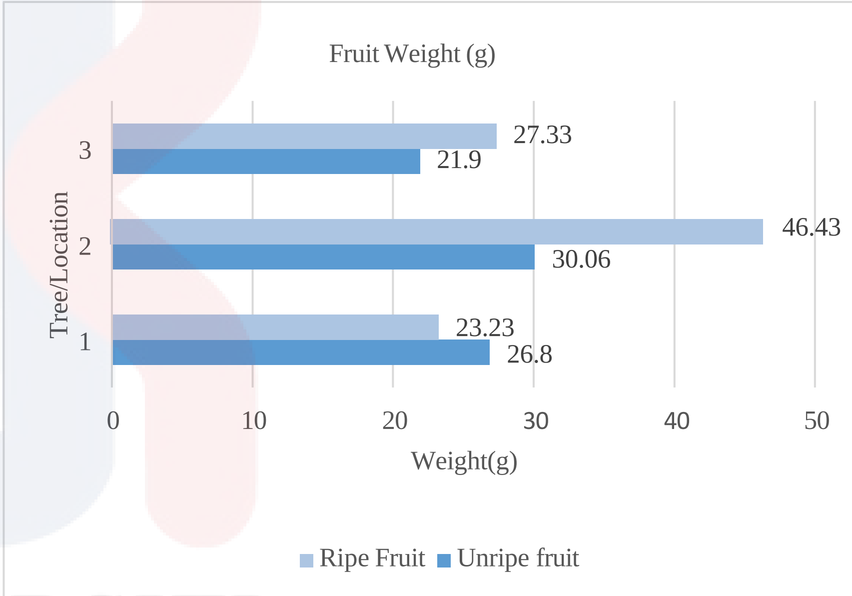
Table 4.2 and Figure 4.2.1 shows that there were significant differences in the soil organic matter content between the three locations analyzed. Tree/location 1 had a content of 1.33%, which is low and below optimal standards for agricultural land. Tree/Location 2 had 0.66%, which shows very low conditions and may indicate serious problems with soil fertility and structure; and tree/location 3 had 3.33%, which is within the range considered good for agricultural land and shows better fertility and structure than the other two locations. Despite the obvious numerical differences, statistical analysis via ANOVA yields a p-value of 0.82983, which is significantly higher than the general significance level of 0.05, indicating that the differences in organic matter content between the locations are not statistically significant. The small sample size (3 per group) may have an impact on this because it may reduce the ability to identify meaningful differences. Nevertheless, practical variations in organic matter content should still be taken into account in soil management strategies even though they are not statistically significant. It might be necessary to intervene at tree/location 1 and 2 to increase the amount of organic matter, perhaps by adding compost or using conservation farming techniques. An indepth knowledge of these variations in soil organic matter content may be possible through larger sample sizes, additional data on the physical attributes, and land management techniques at each location.

Table 4.2 Fruits and soil properties of *P. macrocarpa* trees.

Properties	**Location 1**		**Location 2**		**Location 3**	
	Unripe (Ur)	Ripe (R)	Unripe (Ur)	Ripe (R)	Unripe (Ur)	Ripe (R)
Fruits						
Weight	26.87(µ)	23.23(µ)	30.06(µ)	46.43(µ)	21.9(µ)	27.33(µ)
Ascorbic acid (mg)	12980 (µ)	15290 (µ)	14960(µ)	15543(µ)	13200(µ)	14740(µ)
Soil						
pH	6.13(µ)		6.2(µ)		6.33(µ)	
Temperature (°C)	28.7(µ)		27.33(µ)		28(µ)	
Moisture content (%)	7.23(µ)		5.33(µ)		4.66(µ)	
Water content (%)	14.76(µ)		14.13(µ)		16.9(µ)	
Organic matter (%)	1.33(µ)		0.66(µ)		3.33(µ)	
Habitat description	• Get enough sunlight • Moist soil with lots of dry leaves		• Not receive direct sunlight • Moist soil with lots of dry leaves		• Not receive direct sunlight • Dry soil with gravel	



A) Mean of fruit ascorbic acid (mg)



B) Mean of fruit weight (g)

Figure 4.2 "The Mean of Fruits properties of *P. macrocarpa* trees

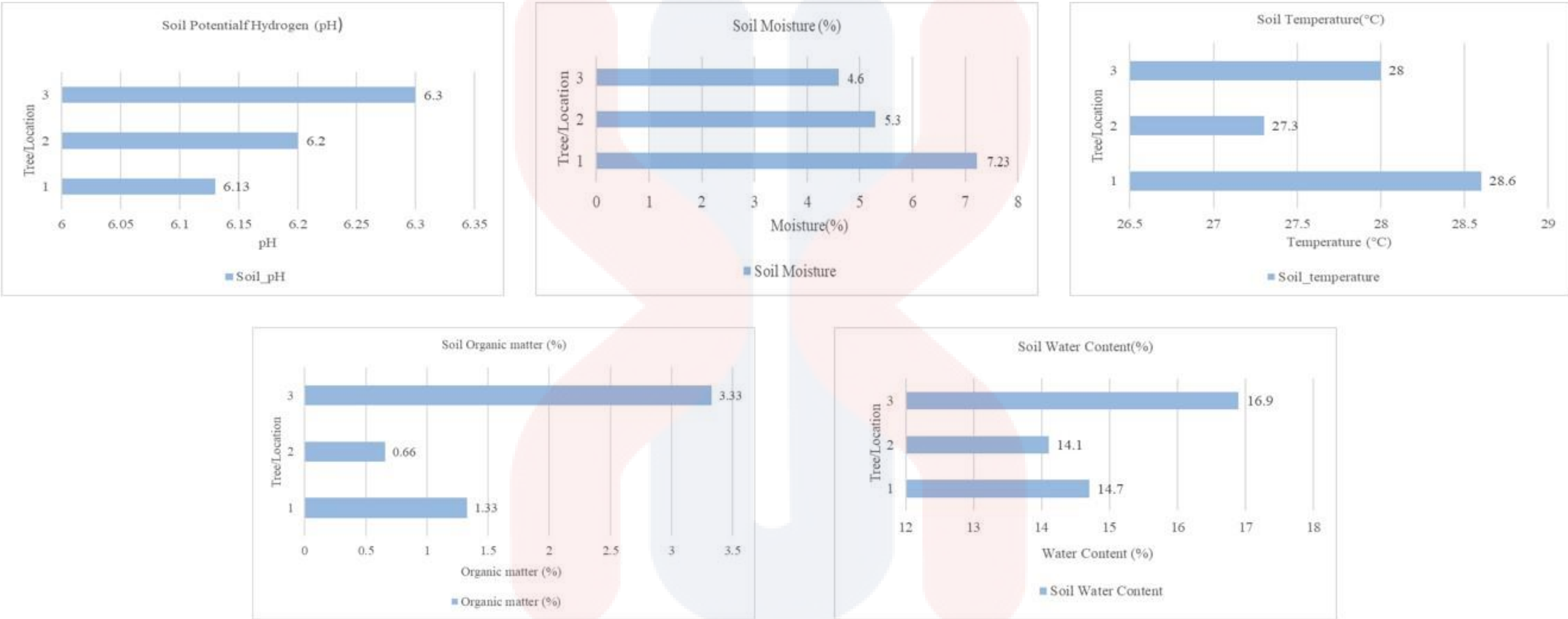


Figure 4.2.1 The Mean of soil properties of *P. macrocarpa* trees

4.2 DATA ANALYSIS

4.3.1 Correlation between fruit and soil properties

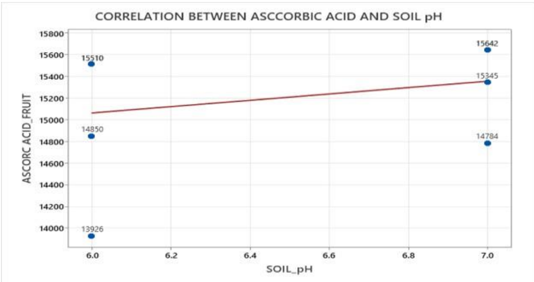
Based on Table 4.3 and Figure 4.3, there is a weak positive correlation between ascorbic acid content and soil pH which shows a correlation value of 0.269. However, the P value is well above the normal significance threshold of 0.05 which is 0.484 indicating that this relationship is not statistically significant. Plants may have adapted well to various soil pH conditions without affecting the ascorbic acid content significantly. In addition, a very weak positive correlation exists between ascorbic acid and soil temperature which shows a correlation value of 0.153 but again a high P value of 0.694 and shows that this relationship is not statistically significant. It is likely that the god's crown tree comes from a habitat in the wild forest and that situation has made the god's crown tree a hardy tree that is suitable for living in unstable soil temperatures.

The correlation between ascorbic acid and soil moisture is almost unrelated, showing 0.005. The very high p value of 0.989 confirms the lack of a significant relationship. Soil moisture can affect the activity of microorganisms in the soil that contribute to nutrient availability, but this effect may be more indirect to ascorbic acid. The correlation between ascorbic acid and soil water content shows a very weak positive correlation which shows a correlation value of 0.018, but a high p value of 0.964 shows no statistical significance. The correlation between soil organic and ascorbic acid shows a weak negative correlation value, which is -0.068 but again, the high p value which is 0.862 shows that this relationship is not statistically significant.

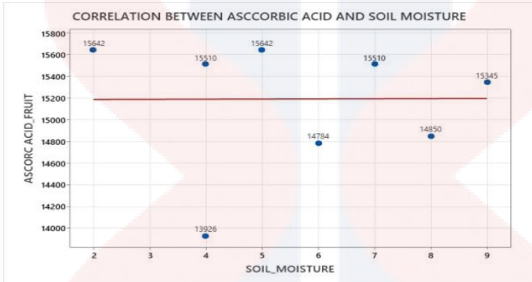
Table 4.3: The correlation between ascorbic acid in fruit with soil properties

Correlations

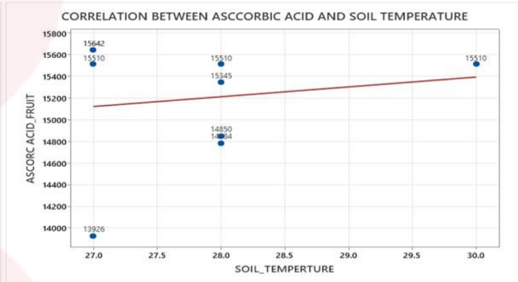
	Ascorbic acid fruit	Soil pH	Soil temperature	Soil moisture	Soil water content
Soil pH	0.269				
Soil temperature	0.153	-0.271			
Soil moisture	0.005	-0.119	0.611		
Soil water content	0.018	-0.105	0.186	-0.269	
Soil organic matter	-0.068	-0.402	-0.442	-0.480	0.198



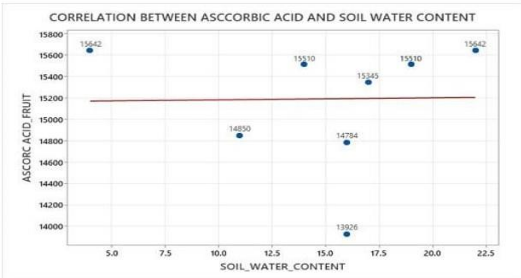
A) Correlation ascorbic acid with soil pH



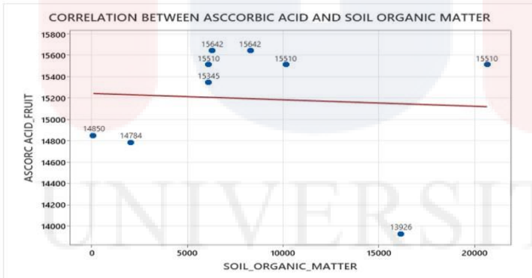
B) Correlation ascorbic acid with soil moisture



C) Correlation ascorbic acid with soil temperature



D) Correlation ascorbic acid with soil water content



E) Correlation ascorbic acid with soil organic matter

Figure 4.3 : The correlation between ascorbic acid in fruit with soil properties

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

The significance of comprehending the connection between soil nutrients and crown fruit production and quality is emphasized by this study. It highlights the significance of the research, which has implications for improved cultivation techniques as well as possible advantages for *Phaleria macrocarpa* conservation and cultivation. The proposal also outlines the goals, parameters, and anticipated outcomes of the study, highlighting the significance of figuring out the characteristics of the fruit soil, and the interaction between god's crown fruit and soil.

The literature review offers a thorough summary of the god's crown plant, emphasizing its pharmacological uses, medicinal qualities, and istinctive botanical features. It could be helpful for this investigation. It also covers the significance of pH, nutrient availability, and soil characteristics for plant growth and productivity. This study highlights significant of these elements in comprehending the connection between soil and fruit qualities by looking into techniques for evaluating fruit qualities and soil analysis.

The study provides a thorough data analysis that includes the ascorbic acid content of the fruit's crown and the organic matter in the soil, as well as the connection between the two. The findings revealed no correlation between the ascorbic acid content of the various tree samples and the statistically significant variations in the amount of soil organic matter among the groups under investigation

5.2 Recommendations

Comprehensive investigations are needed to evaluate the relationship between soil nutrients and specific tree fruits to further strengthen this thesis. One of the properties in the soil that needs to be tested is nitrogen through the kjeldah method. This is because nitrogen is an important component in the formation of proteins and nucleic acids such as DNA and RNA. These proteins and nucleic acids play an important role in the growth and development of plant cells. Nitrogen is an important component in the formation of chlorophyll, the green pigment that allows plants to carry out photosynthesis. A lack of nitrogen will cause the leaves to turn pale or yellow. Nitrogen is also important for the formation of flowers, fruits, and seeds. However, an excess of nitrogen can cause the formation of too many flowers and fruits but of poor quality. To further strengthen this relationship, it is also necessary to make a nitrogen teston the fruit and leaves. Nitrogen is the main component in chlorophyll molecules, the green pigment that allows plants to carry out photosynthesis. Nitrogen deficiency causes leaves to turn pale or yellow (Havlin *et al.*, 2014).

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APPENDIX A

Appendix A.1: Example of data sheet to record fruit and soil properties

		FRUIT					SOIL		
DATE	TREE (1,2,3)	FRUIT (Ripe/Unripe	FRUIT WEIGHT (g	ASSORBIC ACID (mmol)	SOIL PH	TEMPREATURE 0 °C	SOIL MOISTURE	ORGANIC MATTER	WATER CONTENT
	1	ripe							
	1	ripe							
	1	ripe							
	1	unripe							
	1	unripe							
	1	unripe							
	2	ripe							
	2	ripe							
	2	ripe							
	2	unripe							
	2	unripe							
	2	unripe							
	3	ripe							
	3	ripe							
	3	ripe							
	3	unripe							
	3	unripe							
	3	unripe							

APPENDIX A

Appendix A.2: Raw of data sheet to record fruit and soil properties

TREE	ASCORBIC	RIPE/UNRIPE	SOIL_pH	SOIL_TEMPERATURE	SOIL_MOISTURE	SOIL_WATER CONTENT	SOIL_ORGANIC MATTER
1	13530	R	6	28	8	11	98
1	11550	R	6	30	7	19	6122
1	13860	R	6	28	7	14	10154
1	14850	UR	7	27	2	22	6301
1	14817	UR	7	27	5	4	8299
1	15213	UR	7	28	9	17	6101
2	12045	R	6	27	4	19	20668
2	13662	R	6	27	4	16	16173
2	13893	R	7	28	6	16	2063
2	13530	UR					
2	11550	UR					
2	13860	UR					
3	14850	R					
3	14817	R					
3	15213	R					
3	12045	UR					
3	13662	UR					
3	13893	UR					

APPENDIX B

Appendix B.1: Raw data for correlation between r fruit and soil properties

Correlations

	ASCORC ACID_UNRIPE	ACORBIC_ACID_RIPE	SOIL_pH	SOIL_TEMPERTURE	SOIL_MOISTURE
ACORBIC_ACID_RIPE	0.021				
SOIL_pH	0.269	0.749			
SOIL_TEMPERTURE	0.153	-0.503	-0.271		
SOIL_MOISTURE	0.005	-0.004	-0.119	0.611	
SOIL_WATER_CONTENT	0.018	-0.301	-0.105	0.186	-0.269
SOIL_ORGANIC_MATTER	-0.068	-0.329	-0.402	-0.442	-0.480

	SOIL_WATER_CONTENT
ACORBIC_ACID_RIPE	
SOIL_pH	
SOIL_TEMPERTURE	
SOIL_MOISTURE	
SOIL_WATER_CONTENT	
SOIL_ORGANIC_MATTER	0.198

Pairwise Pearson Correlations

Sample 1	Sample 2	N	Correlation	95% CI for ρ	P-Value
ACORBIC_ACID_RIPE	ASCORC ACID_UNRIPE	9	0.021	(-0.652, 0.676)	0.957
SOIL_pH	ASCORC ACID_UNRIPE	9	0.269	(-0.481, 0.792)	0.484
SOIL_TEMPERTURE	ASCORC ACID_UNRIPE	9	0.153	(-0.569, 0.742)	0.694
SOIL_MOISTURE	ASCORC ACID_UNRIPE	9	0.005	(-0.661, 0.667)	0.989
SOIL_WATER_CONTENT	ASCORC ACID_UNRIPE	9	0.018	(-0.654, 0.674)	0.964
SOIL_ORGANIC_MATTER	ASCORC ACID_UNRIPE	9	-0.068	(-0.700, 0.624)	0.862
SOIL_pH	ACORBIC_ACID_RIPE	9	0.749	(0.170, 0.944)	0.020
SOIL_TEMPERTURE	ACORBIC_ACID_RIPE	9	-0.503	(-0.875, 0.242)	0.168
SOIL_MOISTURE	ACORBIC_ACID_RIPE	9	-0.004	(-0.667, 0.662)	0.991
SOIL_WATER_CONTENT	ACORBIC_ACID_RIPE	9	-0.301	(-0.804, 0.454)	0.432
SOIL_ORGANIC_MATTER	ACORBIC_ACID_RIPE	9	-0.329	(-0.815, 0.429)	0.387
SOIL_TEMPERTURE	SOIL_pH	9	-0.271	(-0.793, 0.479)	0.480
SOIL_MOISTURE	SOIL_pH	9	-0.119	(-0.726, 0.592)	0.761
SOIL_WATER_CONTENT	SOIL_pH	9	-0.105	(-0.719, 0.601)	0.789
SOIL_ORGANIC_MATTER	SOIL_pH	9	-0.402	(-0.841, 0.358)	0.284
SOIL_MOISTURE	SOIL_TEMPERTURE	9	0.611	(-0.090, 0.907)	0.081
SOIL_WATER_CONTENT	SOIL_TEMPERTURE	9	0.186	(-0.545, 0.757)	0.631
SOIL_ORGANIC_MATTER	SOIL_TEMPERTURE	9	-0.442	(-0.855, 0.315)	0.234
SOIL_WATER_CONTENT	SOIL_MOISTURE	9	-0.269	(-0.792, 0.481)	0.484
SOIL_ORGANIC_MATTER	SOIL_MOISTURE	9	-0.480	(-0.868, 0.270)	0.191
SOIL_ORGANIC_MATTER	SOIL_WATER_CONTENT	9	0.198	(-0.537, 0.762)	0.609