

Comparison of Some Morphological, Anatomical and Pollen Characteristics of Some Plants of the Palm Family (*Aracaceae*)

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I. Abstract

This research presents a comparative study of two plant genera belonging to the family Araceae: *Spathiphyllum* with its two cultivated varieties (*S. wallisi* – *Pearl Cupido* and *S. wallisi* – *Regel*), in addition to the genus *Anthurium* represented by the species *A. scherzerianum*. These plants are of particular importance as they have been recently introduced to Iraq, making taxonomic and anatomical studies of them locally limited.

The morphological study revealed clear variation among the studied species in terms of plant height, length of the flowering stem, leaf dimensions, and the shape of the spathe, which provides these plants with their ornamental value. The variety *S. wallisi* (Regel) surpassed the other species in most vegetative and floral dimensions, and was distinguished by morphological differences in both leaves and spathe.

The anatomical study showed considerable similarities among the three species. Transverse sections of the petiole and flowering stem were characterized by a regular epidermis covered with a thick cuticle, and a cortex differentiated into two regions: an outer hypodermis containing few collenchyma tissues with chloroplasts, and an inner cortex composed of two to three layers of parenchyma cells. The vascular bundles of the collateral type contained 2–3 xylem vessels surrounded by a sheath of sclerenchyma. The peduncle differed by having an increased number of inner cortex layers (3–6 layers).

The pollen study revealed that all species possess medium-sized pollen grains of the subprolate type, with clear variation in the thickness of the exine. *S. wallisi* (Regel) recorded the highest exine thickness compared to the other species.

Keywords : *plant anatomy, morphological traits, pollen grains.*

II. Introduction

The family Araceae, commonly known as the palm family, is one of the oldest and most diverse groups of plants in the world. It is a major component of ecosystems and agriculture, with a significant impact on human and animal life. Members of this family are widely distributed across tropical and subtropical climates, though certain species can also be found in desert and temperate regions, reflecting their remarkable adaptability to diverse environments.

Palm family plants are distinguished by their unusual morphology: most species possess tall stems and large pinnate or palmate leaves. Many are perennial and can live for decades or even centuries. Their fruits—such as dates, coconuts, and oil palm—are among their most notable features, serving as essential food sources for humans and animals and supporting a wide range of agricultural and industrial uses.



Economically and commercially, Arecaceae species are of great importance. For example, the date palm (*Phoenix dactylifera*) is a staple crop in many Arab and Middle Eastern countries and is central to traditional cuisine. Similarly, palm oil (derived from *Elaeis guineensis*) is one of the most widely used oils in the global food industry, valued for its role in cooking, processed foods, and cosmetics.

Beyond their economic value, palms are ecologically significant. They provide habitats for wildlife, help prevent soil erosion, and improve air quality by absorbing carbon dioxide. Their ability to thrive in harsh conditions such as deserts and arid regions underscores their vital role in environmental sustainability.

The palm family (Arecaceae) faces numerous challenges that hinder its cultivation and productivity. Chief among these is the impact of climate change, including rising temperatures and increased soil salinity, both of which negatively affect plant growth and yield. Environmental threats such as pests and diseases also pose risks, leading to crop deterioration.

Furthermore, palm cultivation requires large amounts of water, placing considerable pressure on water resources, especially in arid regions. Sustainable agricultural practices are needed to enhance productivity, yet many farmers lack sufficient knowledge of these methods.

Arecaceae plants play a crucial role in the global economy, environment, and biodiversity, making their study highly significant. They provide substantial supplies of food and oils—such as dates and palm oil—to millions of people worldwide, particularly in tropical and subtropical regions. By improving cultivation methods through scientific study, food security can be strengthened in countries that rely heavily on these crops.

This study aims to present a comparative analysis of two plant taxa within the palm family (Arecaceae) that are believed to have been recently introduced to Iraq. Local taxonomic and anatomical studies of these plants are lacking. The focus is on *Spathiphyllum* and *Anthurium*.

The palm family (sometimes referred to as Aracaceae in older sources) is characterized by either rhizomatous or tree-like stems, typically bearing large, sheathing, folded leaves and fleshy fruits, often drupes. Seeds generally lack starch. These features—such as folded leaves and drupaceous fruits—are considered unusual within the family (Thomas, 2021).

1. Concept of the Palm Family

The palm family is a group of monocotyledonous flowering plants belonging to the order *Arcales*. It comprises approximately 2,600 species distributed across 185 genera, occurring mainly in tropical regions worldwide, with greatest diversity in Asia and South America. Members may be climbers, trees, shrubs, or stemless plants. Their fruits, such as dates and coconuts, are used as food, while their wood is employed in furniture and construction (e.g., sago palm). Many species are also cultivated as ornamentals.

Higaki (1976) described palms as low-growing plants with cordate leaves and heart-shaped flowers. He noted two developmental phases: a juvenile stage, characterized by vegetative buds in the axils of leaves, and a reproductive stage, marked by floral buds in leaf axils opposite vegetative buds. His study included morphological and anatomical observations of the species.

Another definition describes Arecaceae as a family of flowering plants that includes palms and shrubs, typically with one or more stems and large pinnate leaves, occurring in tropical and subtropical regions (Alaida, 2023).

Raj et al. (2022) emphasized the family's ecological and agricultural importance, noting that its fruits and oils are widely used in food industries and commercial enterprises.



2. Geographical Distribution

The family *Arecaceae*, commonly referred to as the palm family, is widely distributed across tropical and subtropical climates worldwide. Its species occupy a broad range of geographic locations and demonstrate remarkable adaptability to changing environmental conditions.

Palms are a defining feature of tropical rainforests, particularly in Southeast Asia, where high humidity and stable temperatures prevail. Malaysia, Indonesia, and the Philippines host a rich diversity of palm species, benefiting from abundant rainfall and dense canopy cover that provide ideal conditions for rapid palm growth. In these habitats, coconut palms and oil palms are among the most economically significant species (Bacon et al., 2016).

They are also widespread in tropical and humid regions of Africa, notably within rainforest ecosystems in Nigeria and the Congo. Oil palm, for instance, is a well-known species whose oil is extensively used in food and cosmetic industries. In these regions, palms adapt to high humidity and warm temperatures, while also playing a vital role in soil conservation and erosion control (de Lima et al., 2022).

In Central and South America, palms are abundant, especially in the Amazon rainforest. They thrive in lowland areas with heavy rainfall and consistently high temperatures. These species serve multiple purposes, including food, construction materials, and traditional medicine. In Brazil and Colombia, palms are a crucial source of income for indigenous communities, who rely on their fruits and fibers for survival (Eiserhardt et al., 2011).

Coconut palms primarily grow on tropical islands in the Pacific and Indian Oceans. They have evolved to flourish in coastal environments with high humidity. They are cultivated for oil, fiber, and coconut water in regions such as Hawaii, as well as along the coasts of the Philippines and Indonesia (Abdo, 2017).

Although palms are typically associated with humid climates, some species have adapted to arid and desert conditions. For example, date palms thrive in North Africa and the Gulf states, showing exceptional tolerance to extreme heat and drought by relying on deep root systems to access groundwater (Pintaud et al., 2011).

In subtropical regions such as the southern United States, palms are cultivated for agricultural and ornamental purposes, benefiting from warm conditions and fertile soils.

From the above, it is evident that the palm family (*Arecaceae*) inhabits a wide variety of geographic regions, ranging from humid tropical rainforests to arid deserts and mountainous areas. This adaptability, combined with their ecological and economic importance, makes *Arecaceae* one of the most significant plant families worldwide.

3. Morphological Characteristics

The palm family (*Arecaceae*) is distinguished by a set of morphological traits that enable its members to adapt to diverse environments, from hot deserts to dense tropical forests. These features have facilitated their wide distribution and ecological success, while also underpinning their economic and environmental importance. The main characteristics can be summarized as follows

- **Stems and Roots:** Palms typically possess thick fibrous roots extending from the base of the stem into the soil. In some species, adventitious roots grow above the ground, enhancing plant stability and nutrient absorption. Stems are generally cylindrical and upright, though certain species exhibit short or creeping stems. Tall species, such as coconut palms, can reach impressive heights, giving them a distinctive presence in their environment (Edelman & Richards, 2019).
- **Leaves:** Palm leaves are arranged spirally around the stem, creating a distinctive and organized appearance. They are usually very large and divided into leaflets, which may be arranged in either pinnate (feather-like) or palmate (fan-shaped) patterns. Pinnate leaves resemble bird feathers, with leaflets aligned along both sides of a central vein, producing an elegant form. Palmate leaves, on the other hand, radiate from the base to form circular or semicircular shapes, resembling a hand fan. These large leaves provide extensive surface area for respiration and light absorption, aiding adaptation to diverse environments (Greenwood & Conran, 2024).



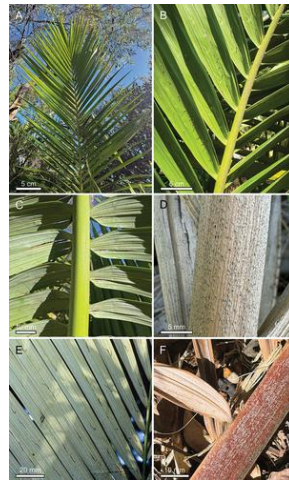


Figure (1): Diversity of Leaf Forms in the Palm Family

Flowers: Palm flowers typically appear in large clusters, which may be pendulous or erect depending on the species. Although the individual flowers are relatively small compared to the overall size of the plant, they are borne in dense inflorescences that compensate for their size. Structurally, palm flowers are composed of three sepals and three petals.

Importantly, the flowers are often **unisexual**, meaning that a plant may produce only male or only female flowers. This characteristic necessitates the cultivation of multiple plants in close proximity to ensure successful pollination. Consequently, palms rely heavily on wind and animals for pollen transfer (Allen, 2015).

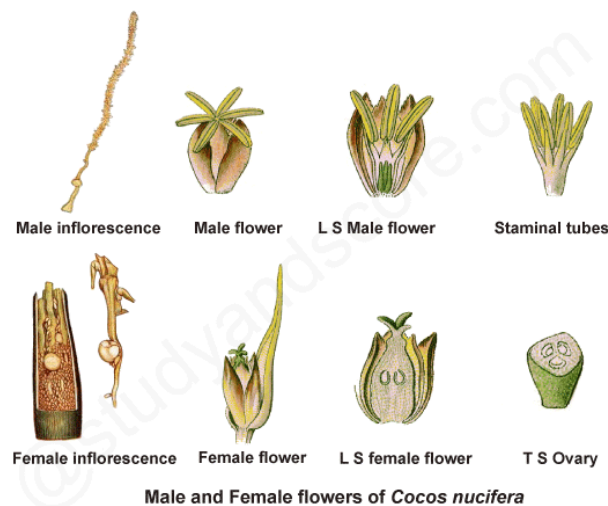


Figure (2): Diversity of Flowers in the Palm Family

Fruits :

Fruits of the palm family (Arecaceae) are among the most distinctive features of these plants, contributing significantly to their wide distribution. Most palm fruits are fleshy, meaning they possess a nutrient-rich outer layer that protects the seeds—examples include coconuts and dates. These fruits not only benefit the plant by attracting animals that aid in seed dispersal, but they also serve as an important food source for humans.

Typically, the fruit contains a single large seed at its center, or in some species, several smaller seeds. Certain palms, such as the coconut, are uniquely adapted for dispersal by water; their fruits can float across oceans, enabling them to reach distant islands and coastal regions where they germinate and thrive (Souza et al., 2020).



Figure (1) Fruit diversity in the palm family

Fourth: Economic Importance

The palm family (Arecaceae) is a plant family of great economic importance as it includes many species that play vital roles in the agricultural and industrial economy in many countries of the world. The following is a full explanation of the economic importance of this family: (Antary, et al., 2015)

1. **Food Sources**

Food sources are represented by their fruits and the oils extracted from them, as they are used in several ways, which are as follows:

1. **Palm fruits:** Dates, especially palm or coconut fruits, are a staple food in many cultures as they contain natural carbohydrates, which provide quick energy. They are also rich in fiber, which promotes digestive health, vitamin B6, and minerals including potassium and magnesium. Dates are used as a natural sweetener in a variety of recipes, including many classic desserts.
2. **Vegetable oils:** *Palm* oil is one of the most widely produced and widely used oils in the world. It is used in a wide range of applications, including frying, baking, pastries, and processed meals. Its high saturated fat content allows it to withstand high temperatures. It is also used in cosmetics and household goods.
3. **Raw materials for industries:** The wood of some types of palm family, such as the palm tree and coconut, is used in the furniture industry due to its strength and durability. Wood has an attractive appearance and is considered a more sustainable option than other types of wood. It is also used in traditional construction where the trees provide a strong and lightweight structure, and palm leaves are used in the manufacture of baskets and household items such as plates and mats. These products are popular in local markets, as they are considered a traditional craft that generates money for families.
4. **Environmental Importance:** Planting them contributes significantly to protecting the environment, as it reduces erosion and keeps the soil from erosion, thus preserving its fertility. Trees also help absorb carbon, which helps in the fight against climate change. Palm family trees also produce natural shade, which benefits other crops while lowering ambient temperatures. This shade promotes crop growth and increases yields.
5. **Tourism:** The palm family orchards are one of the famous tourist places where tourists can enjoy the beauty of the terrain.
6. **Job Opportunities:** Helps create jobs in rural communities. Individuals work in many stages of agriculture, from farming to harvesting and processing. This helps stimulate local economic growth and raise living standards..



Fifth: Types of the palm family

There are about 2600 species in several regions, and in our current study, we will focus on two types, which are:

1- Anthurium scherzerianum :

The genus (*Anthurium*) *Antherium* is a tropical perennial plant from the palm family (Aracaceae) native to the Hawaiian Islands of monocotyledons and its name is derived from two Greek words, (Anthos) which means flower and (Oura) which means tail and this name is due to the shape of the cylindrical bulb that resembles a tail or pen and this genus includes 500 species, all of which originated in the tropics, and one of the most important types is the species (*Anthurium*) Its flowers are found in a simple orange inflorescence surrounded by a large colored spathe, and the plants are monosex, and the dwelling is from the inflorescence, that is, the feminine and male flowers are separate and on the same inflorescence, the male flowers are located in the upper part and the female flowers are located in the lower part of the inflorescence, and there may be sterile flowers between them, and its flowers are commercially desirable because of their beauty and long duration of stay after harvest, as well as the beauty of its leaves. It reproduces either sexually by seeds or vegetatively by division in order to preserve the cultivated variety. The plant produces flowers all year round with one flower from the armpit of each leaf, and the production of flowers depends on the change in environmental conditions, and that most of the flowers are produced in the summer season

In a phenotypic and physiological study on the flower formation of the plant (*Anthurium andraeanum*), it was found that the plant passes through two stages, the stage of modernity and the stage of reproduction, and that phenotypic differences appear during the two stages, especially at the base of the neck or petiole , the newly formed leaves have a short sheath with the presence of a vegetative bud, while the leaves formed in the process of propagation are without a sheath with the presence of a propagating bud at the base of the leaf petiole at the axis. With the presence of an atrium to protect the floral bud (Christensen, 1971).

Croat, 1983 described the genus *Anthurium* as a tropical genus that includes more than 700 species belonging to the Pothoideae subfamily, and it is one of the genera that is universally widespread and tropical, except for some of them that are widespread in temperate regions, and stated that the most important taxonomic traits used in the classification of this genus are leaf sweating, canopy shape color and inflorescence.

Nvtjayaprada and Sudarshane (2017) stated that there is a wide variation in the shape and dimensions of the canape of the anthurium plant in southern Sri Lanka, and the study included measurements of the length and width of the canape, the inflorescence, the height of the plant, the measurement of the angle of the canape, the angle between the two lobes of the leaf, and the number of suckers, and it was stated that all the traits are derived except for the color of the canape.

Confirm (Henny 1999 ; Kamemoto and Kuehnle 1996) Crossbreeding between species increases the reproductive capacity of the plant, Noted ((Teixeira , *et.al* , 2015 He pointed out that the anthurium plant is a valuable plant all over the world for the beauty of its light, and stated that it is successfully propagated by tissue culture to maintain the cellular stability of the species, and explained in the article the conditions, details and requirements for the purpose of matc cultivation, genetic transformation, internal inguinal and seed production techniques



1. Spathiphyllum

White sails, spath flower, or peace lilies are native to Colombia and are a very common indoor houseplant, discovered in the late nineteenth century.

The genus *Spathy* is one of the 40 genera belonging to the palm family (*Aracaceae*), and this genus belongs to the tropical region of South America and the Asian part, and some of them are known as peace lilies, and its name is derived from the Greek words (*spath*), which means cover, and (*phylon*), which means leaf.

It is used as an ornamental plant and to purify the air, as it has been found to reduce nitrogen oxide (20%) (Metcalf *et al.* , 1960).

Berca and Fagares (2010) conducted an anatomical study of the roots and leaves and stated that the tissues of the transverse roots have a primitive structure, while the blade shows a layer of homogeneous mesophilic tissue, the vascular bundle of the mesophaeus is well developed and the vascular support of the bulb carrier consists of multiple vascular bundles immersed in the basal tissue.

Vanstechman *et al.*, 2009 explained the phenomenon of multi-genotypes of the spaghetti plant and the induction of the condition of (tetraploids), where it was confirmed that the case of polymorphism has a significant effect on the phenotypic and anatomical traits of both stomata area, thickness, length and width of the leaf, as well as the dimensions of the light and the canopy.

The research aims to shed light on some of the palm family plants introduced to Iraq and determine their identity based on the sources and taxonomic keys, and compare them phenomenally and anatomically, as well as compare their pollen grains microscopically.

Schedule (1) Scientific classification of spaghetti plant *Spathiphyllum*)

Kingdom:	Plantae
Clade:	Tracheophytes
Clade :	Angiosperms
Clade :	Monocots
Order :	Alismatales
Family:	Araceae
Subfamily:	Monsteroideae
Tribe:	Spathiphyllae
Genus:	<i>Spathiphyllum</i> Schott

Schedule (2) Scientific classification of anthurium plant *Anthurium*)

Kingdom:	Plantae
Clade:	Tracheophytes
Clade :	Angiosperms
Clade :	Monocots
Order :	Alismatales
Family:	Araceae
Subfamily:	Pothoideae
Tribe:	Anthurieae
Genus:	<i>Anthurium</i> Schott



Chapter Two

III. Materials and working methods

Plant samples were collected from the local markets of Mosul and kept in a warm and sunny place, and measurements were taken for vegetative and floral retribution in the flowering stage using a ruler, and for the purpose of diagnosis and classification of species and genera, the taxonomic keys of the genus and species (Wunderlin et al, 2024) were used.

As for the anatomical study, the temporary slides were prepared using a sharp blade and several cross-sections were made for the plant parts (leaf petal: flower stem: leaf blade: light) until thin sections were obtained for the purpose of examination, after dyeing them with diluted safranin dye, and examining them using a bin-lens composite microscope at different magnification power (4x,10x,40x).

Pollen was collected from mature flowering matuk, different agricultural varieties with different flowers and the number of corolla leaves, and the soft pollen was prepared for light microscopy based on the method of (*et al.*, 1974, Radford), by preserving the mutuk with FAA solution (formalin + acetic acid + ethyl alcohol). and dye the samples and put them on a clean glass slide. Add one or two drops of the cleansing dye to the glass slide. Open the slide and remove its covers, with light methods with a needle to disperse the pollen and get a clear image, then cover the slide with a slide cover and leave it for a short period of tie at room temperature so that the lid sticks. The examination included the identification of the general shape of the pollen grain and the shape of the decoration on its outer surface, as well as taking measurements of the thickness of the outer wall, as well as taking measurements of the thickness of the outer wall (exine) and the diameter of the pollen grain in the polar and non-tropical theorists of (20-30) pollen grains, and then calculating their values, noting that the measurements were made using the ocular micrometer as well as The pollen was photographed with a digital camera.



IV. Results and discussion

The results of the collection of samples resulted in the collection of two genera belonging to the palm family, the first is called (Peace Sail or White Sails) with two species, namely *Spathiphyllum wallisi* (Regel: *Spathiphyllum wallisi* (PearlCupido) and the other genus called the Flamenco flower with one species, which is *Anthurium scherzerianum*, and each of the studied species showed different phenotypic and anatomical differences as shown in Tables (3, 4, 5) and Figures (4, 5, 6)

It appears from Figure (4) that the height of the plants under study varied between (58 cm) for *S. wallisi* Regel and (25.5) for *S. wallisi* (PearlCupido), and the species *Anthurium scherzerianum* showed an average height (30 cm) and the variation of the shape of the leaf blade and the top and base of the leaf in the studied plants, where both *S. wallisi* Regel and *S. wallisi* (PearlCupido) were similar in terms of the shape of the oval leaf blade. The tip of the pointed leaf differed in the shape of the base of the leaf, where the pointed and cardiac shape varied, while the type *A. scherzerianum* showed the shape of the cardiac leaf blade a rounded top and a cardiac base. As for the leaf edge characteristic was smooth in both species (*S. wallisi* (PearlCupido) and *A. scherzerianum*) the species *Spathiphyllum wallisi* Regel showed a zigzag leaf edge, while the dimensions of the leaf blade and the length of the leaf petiole differed significantly between the three plants, where the species *S. wallisi* (PearlCupido) showed the smallest leaves in terms of the length and width of the leaf blade and its petiole, while the type *S. wallisi* (Regel) The largest leaf among the studied plants was shown in Table (3) Figure 4 and this is consistent with (Parsons *et al.*, 1998) which stated that the *S. wallisii* plant is the plant.

White-tailed, cannabis flower or moonflower is a tropical herbaceous perennial. It was discovered in the 19th century as a wild plant in central America and has become a common indoor plant. The stem grows directly from the soil and has large and dark green leaves up to 20 cm long and 7 cm wide and has a distinctive middle vein from which feathery branches protrude and has typical flowers with a flowering inflorescence called (spadix) and is surrounded by a large canopy called pal bal al-qinwa (spath) and sometimes the plant produces two canals one of which is small. It is creamy in color, ivory when small, and is generally white with green veins away from the edge and turns green with age and the canopy is oval with a tapered edge. The leaves are dark green and glossy oval in shape with a length of (10-20 cm) and width, the flower neck is long and the leaves are symmetrically and gracefully arched.



Table (3): Vegetative Morphological Traits of the Three Studied Genera of the Palm Family (Arecaceae)

Leaf Margin	Avg. Petiole Length (cm)	Avg. Leaf Blade Width (cm)	Avg. Leaf Blade Length (cm)	Leaf Base Shape	Leaf Apex Shape	Leaf Shape	Avg. Plant Height (cm)	Plant Species
Serrated	14	11	30	Rounded	Pointed	Oval with pointed tip	58	<i>Spathiphyllum wallisi</i> (Regel)
Smooth, flat	4	4.5	11	Cordate	Pointed	Oval	25.5	<i>Spathiphyllum wallisi</i> (Pearl Cupido)
Wavy, smooth, flat	19	10	20	Cordate	Acuminate	Inverted cordate	30	<i>Anthurium scherzerianum</i>

Figure 2) The external appearance of the three plants under study



Figure (3) External appearance of the leaves of the three plants under study

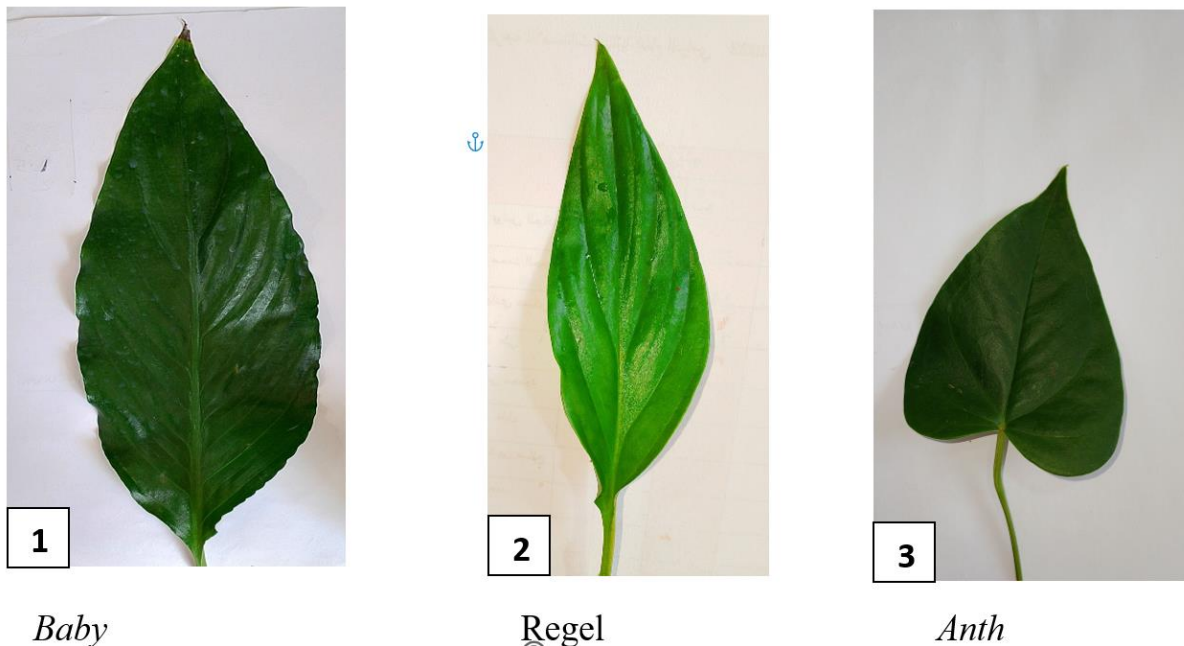


Table (4): Floral and Spathe Characteristics of the Studied Species (*Areaceae*)

Plant Species	Spathe Color	Avg. Spathe Length (cm)	Avg. Spathe Width (cm)	Avg. Inflorescence Length (cm)
Spathiphyllum wallisi (Regel)	Ivory–Cream	25	10	15
Spathiphyllum wallisi (Pearl Cupido)	White with green margin	24	4	3
Anthurium scherzerianum	Red with green venation	7	13	2.5



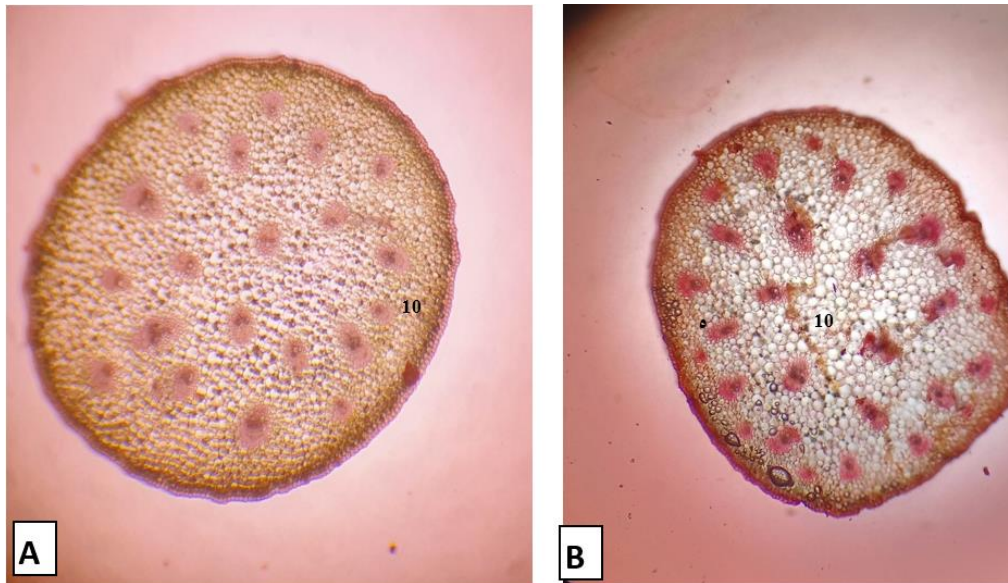
Anatomical Study of the Three Species

The transverse section of the petiole appeared circular and regular in both *Spathiphyllum* varieties, whereas in *Anthurium* the petiole cross-section was polygonal (Figure 7). All were surrounded by a regular epidermis covered with a thick cuticle. The cortex differentiated into two regions: outer region (hypodermis): contained few collenchyma tissues with chloroplasts and inner region: composed of two to three layers of parenchyma cells.

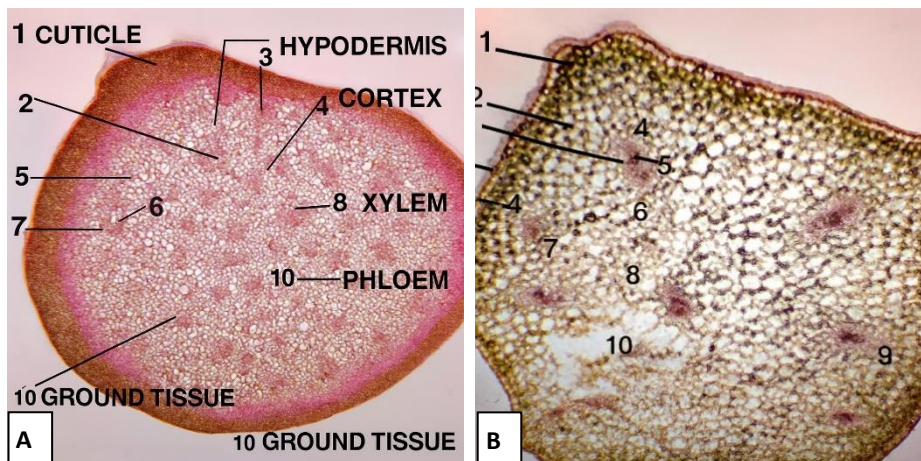
The stele of the petiole consisted of several collateral vascular bundles embedded in the ground tissue. Each bundle contained 2–3 xylem vessels, a few xylem parenchyma cells, and limited phloem elements, all surrounded by a sclerenchyma sheath.

The peduncle showed similar features to the petiole but differed in having 3–6 layers of inner cortical parenchyma. Sclerenchyma tissues formed a continuous layer around the pericycle (Figure 7). The stele of the peduncle contained more than nine collateral vascular bundles embedded in the ground tissue, arranged in a typical pattern. Each bundle included three xylem vessels and a few phloem elements, but lacked a distinct bundle sheath. Some intercellular air spaces were also observed.

Mechanical support was generally weak, represented by collenchyma tissues in the midrib of the leaf blade and in the petiole, while in the peduncle it was provided by sclerenchyma tissues of the pericycle. The number of vascular bundles varied between species: in *Spathiphyllum wallisi*, the petiole contained 19 vascular bundles (A), while the stem contained 23 vascular bundles (B), as illustrated in Figure 7.



It was found that the preparation of vascular bundles in the stem and leaf section of *Anthurium scherzerianum* : (A) 25 vascular bundles and (B) 9 vascular bundles) as shown in Figure (7)



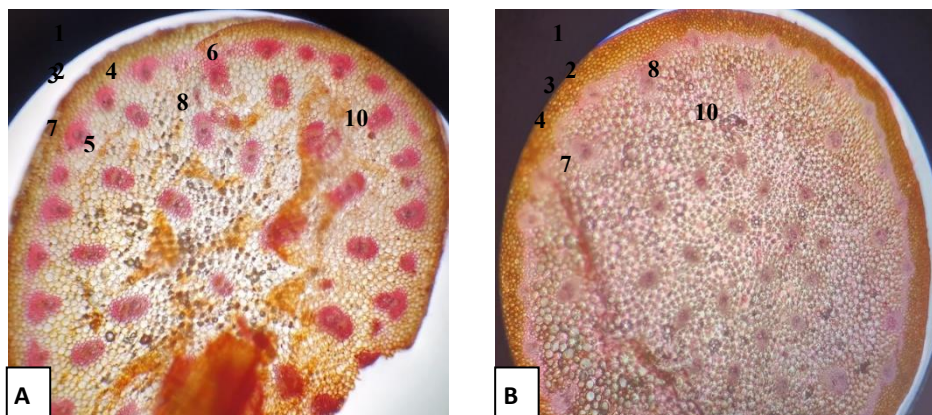
Anthurium scherzeria

num

The preparation of vascular bundles in the stem and leaf section of *Spathiphyllum wallisi* : A) 40 vascular bundle and ; B) 25 vascular bundle) was found as shown in Figure (7)



Figure (4) Transverse sections of the flower stem and leaf petioles of the three plants under study (magnification power x 10).



Spathiphyllum Wallisi

We note from the transverse sections of the flower stem and leaf petioles that the cells of the base fence contain needle crystals (Raphidis) Figure (8) consisting of calcium oxalate, as the sap of the plant contains these substances that make it toxic if animals feed on it, and also its contact with the skin and mucous membranes can lead to swelling and burning in the mouth, tongue and lips, vomiting, drooling, and difficulty swallowing (Prychid and Pudall, 1999)

Figure (5) Shapes of needle crystals in the three plants under study (magnification force x 40)

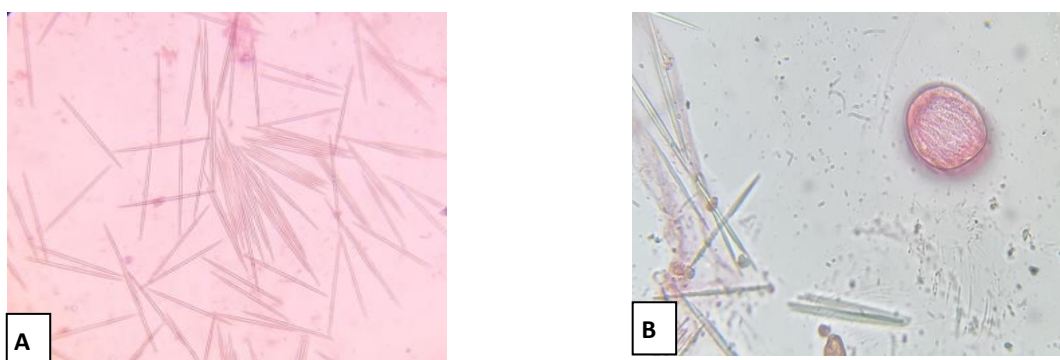
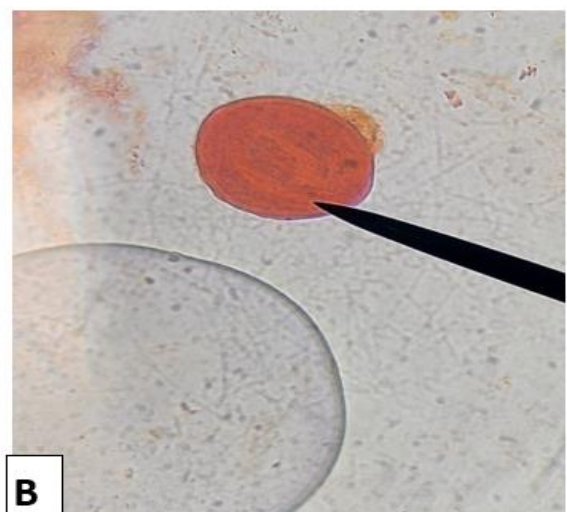
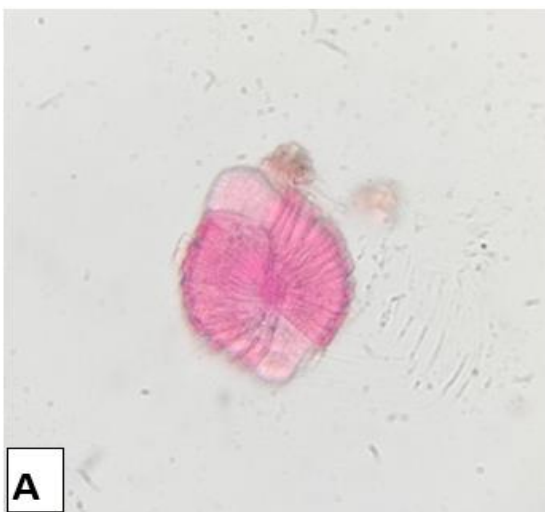
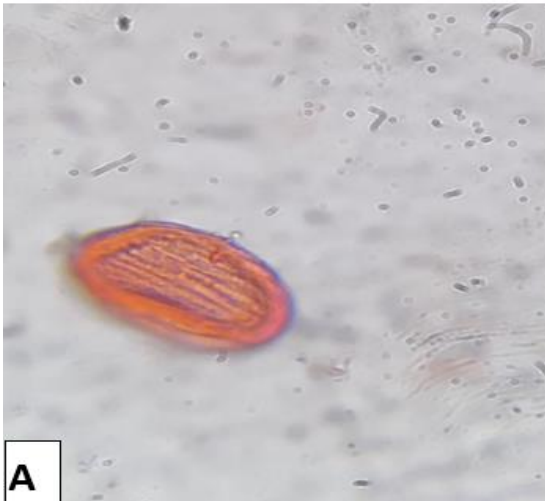
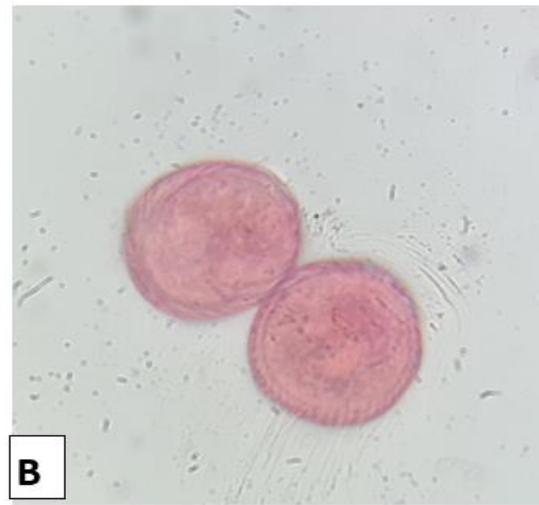


Table (5) Quantitative and qualitative characteristics of pollen for the three genera under study of the palm family Aracaceae

Grain Size	Avg. Outer Wall Thickness (µm)	Grain Shape	E/P Ratio	Avg. Equatorial View (µm)	Avg. Polar View (µm)	Species
Medium	3.044	Subprolate	1.165	34.17	39.84	<i>Spathiphyllum wallisi</i> (Regel)
Medium	1.991	Subprolate	1.295	32.47	42.075	<i>Spathiphyllum wallisi</i> (Pearl Cupido)
Small	2.21	Subprolate	1.128	22.1	24.93	<i>Anthurium scherzerianum</i>





Polar Appearance B.

Equatoria A .

Figure (9): Shapes of pollen grains in both polar and equatorial views of the three studied plants belonging to the family *Aracaceae* (magnification $\times 1000$).

From Table (5) and Figure (9), it is observed that the pollen grains of the studied plants are all of medium size, based on the average diameters in both polar and equatorial views, and compared with the values reported by Hesse et al. (2009). The size of pollen grains is influenced by their moisture content and the preparation method used. In this study, the pollen grains were measured in their fresh, non-dried state to provide the most accurate readings.

It was found that they have a subprolate shape, based on the E/P ratio. The average thickness of the outer wall (exine) varied among the three species: *Spathiphyllum wallisi* (Regel) showed the thickest exine (3.044 μm). *Spathiphyllum wallisi* (Pearl Cupido) had the thinnest exine among the studied species (1.991 μm). The pollen wall consists of two main layers: The outer layer (exine), itself composed of two sublayers: the outer sexine and the inner nexine and the inner layer (entine).

V. Conclusion

In summary, plants of the *Aracaceae* family play an important role in many aspects of life, including economy, environment, and society. This research highlighted their importance as a food and industrial resource, as well as their ecological function in improving ecosystems. We also discussed the challenges facing their production and sustainability, such as climate change and water scarcity, and emphasized the importance of ongoing research to find effective solutions.

The sustainability of palm cultivation and the development of new techniques to increase production represent both a challenge and an opportunity, as they can contribute to strengthening food security and biodiversity worldwide. It is crucial to enhance cooperation between academics, farmers, and policymakers to adopt more sustainable agricultural practices and ensure the preservation of this valuable resource for future generations.

The study reached several findings:

1. The three plants differed significantly in external appearance and dimensions of vegetative and floral parts.
2. Anatomically, the three plants showed clear similarities.
3. The pollen study revealed similarities in some traits and differences in others.
4. Further chemical and physiological studies on these plant species are recommended.



VI. References

- Abdo, M. E. (2017). A floristic study of Halmahera, Indonesia focusing on palms (Arecaceae) and their seed dispersal.
- Al Antary, T. M., Al-Khawaldeh, M. M., & Ateyyat, M. A. (2015). Economic importance of date palm *Phoenix dactylifera* L.(Liliopsida: Arecales: Arecaceae) pests in Jordan Valley. *Brazilian Journal of Biological Sciences*, 2(3), 101-109.
- Alaida, M. F. (2023). Taxonomic Studies on Arecaceae in Al-Madinah Al-Munawarah Region in Saudi Arabia (Doctoral dissertation, KING ABDULAZIZ UNIVERSITY).
- Allen, S. E. (2015). Fossil palm flowers from the Eocene of the Rocky Mountain region with affinities to *Phoenix* L.(Arecaceae: Coryphoideae). *International Journal of Plant Sciences*, 176(6), 586-596.
- Bacon, C. D., Look, S. L., Gutiérrez-Pinto, N., Antonelli, A., Tan, H. T., Kumar, P. P., ... & Baker, W. J. (2016). Species limits, geographical distribution and genetic diversity in *Johannesteijsmannia* (Arecaceae). *Botanical Journal of the Linnean Society*, 182(2), 318-347.
- Berca, R. And Fagares, M. 2010 . Anatomical aspects of the ornamental plant *Spathyphyllum wallisii* Regel . *Studii si Cercetari . Biologie .* 18 : 13-17 .
- Christensen, O.V. 1971 . Morphological studies on the growth and flower formation of *Anthurium scherzerianum* Schott and *Anthurium andreanum* Lind (Morfologiske undersøgelser af vækst og blomsterdannelse hos *Anthurium scherzerianum* Schott og *Anthurium andreanum* Lind). *Statens Forsøgsvirksomhed i Plantekultur* 996. beretning Statens Væksthusforsøg, Virum (V. Aa. Hallig) 793 – 798 .
- Croat, T.B. 1983 A Revision of the Genus *Anthurium* (Araceae) of Mexico and Central America. Part I: Mexico and Middle America Author(s): Thomas B. Croat Source: *Annals of the Missouri Botanical Garden*, Vol. 70, No. 2 (1983), pp. 211-416 Published by: Missouri Botanical Garden Press Stable URL: <http://www.jstor.org/stable/2399049> Accessed: 09-05-2015 01:34 UTC)
- de Lima, T. M., Portela, R. D. C. Q., Mendes, E. T. B., & Oda, G. A. (2022). Species distribution modeling allied with land-use reveal priority sites and species for palm (Arecaceae) conservation in Rio de Janeiro, Brazil. *Frontiers in Forests and Global Change*, 5, 928446.
- de Souza, F. G., de Araújo, F. F., de Paulo Farias, D., Zanotto, A. W., Neri-Numa, I. A., & Pastore, G. M. (2020). Brazilian fruits of Arecaceae family: An overview of some representatives with promising food, therapeutic and industrial applications. *Food Research International*, 138, 109690.
- Edelman, S. M., & Richards, J. H. (2019). Review of vegetative branching in the palms (Arecaceae). *The Botanical Review*, 85, 40-77.
- Eiserhardt, W. L., Svenning, J. C., Kissling, W. D., & Balslev, H. (2011). Geographical ecology of the palms (Arecaceae): determinants of diversity and distributions across spatial scales. *Annals of Botany*, 108(8), 1391-1416.
- Greenwood, D. R., & Conran, J. G. (2024). A fossil pinnate palm leaf (Arecaceae, subfam. Arecoideae) from Island Lagoon, in the arid zone of South Australia. *Historical Biology*, 1-13.



- Henny RJ, Poole RT and Conover CA 1988. Southern Blush anthurium. HortScience 23: 922-923
Henny RJ and Norman DJ 1999. Red Hot anthurium. Hort Science 34(1): 153-154. Iwata RY, Tang CS and Kamemoto H 1985. Concentration of anthocyanins affecting spathe color in anthuriums. J. Amer. Soc. Hort. Sci. 110: 383-385 Kamemoto H and Kuehnle AR 1996. Breeding anthuriums in Hawaii. University of Hawaii Press, Honolulu, Hawaii. p. 168.
- Hesse , M. Halbritter , H. ,Weber ,M., Buncher , R., Frosch- Radivo , A., Ulrech ,S.,Zetter ,S. 2009 .Pollen Terminology ,An Illustrated Handbook .
<https://www.springer.com/gp/book/9783211999356#reviews>
- Higaki , T . 1976. Anatomical Study of The Anthurium PlantL , Anthurium andreaeanum , L., AND A Color Breakdown DisorderI of ITS FlowerL . A Dissertation Submitted to Michigan State University in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY Department of Horticulture 1976 U.S.A.
- Nvtjayaprada and Geekiyanage , 2017 . Short communication Analysis of Morphological Variation of Anturium From Southern Srilanka . Bangladesh J. Bot. 46(2): 799-804 .
- Pintaud, J. C., Ludeña, B., Aberlenc-Bertossi, F., Zehdi, S., Gros-Balthazard, M., Ivorra, S., ... & Bouguedoura, N. (2011, November). Biogeography of the date palm (*Phoenix dactylifera* L., Arecaceae): insights on the origin and on the structure of modern diversity. In I International Symposium on Date Palm 994 (pp. 19-38).
- Prychid,C.J. and Rudall,P.J. 1999. Calcium Oxalate Crystals in Monocotyledons: A Review of their Structure and Systematics. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5584367/>
- Raj, S. P., Solomon, P. R., Thangaraj, B., Raj, S. P., Solomon, P. R., & Thangaraj, B. (2022). Arecaceae. Biodiesel from Flowering Plants, 37-75.
- Teixeira da ,J. S., ,A.Silvaa , A . Dobranszki ,J ., Winartoc , B. Zeng ,S. 2015 . Anthurium in vitro: A review . journal homepage: Scientia Horticulturae 186 (2015) 266–298 .
www.elsevier.com/locate/scihorti.
- Thomas , J.,E.2021. Web World Portal | Wqeb World Tunnel . PlantSystematic.org.
- Vanstechman , I.,Vansteenkiste , H., Eeckhaut , T., Vanhuylenbroek ,J. and VanLabeke , M.,C. 2009 . Morphological and anatomical characterastion of chemically induced polyploids in *Spathyphyllum wallasii* .Acta. Hortic. 836 , 79-84 . DOI : 10.17660/ActaHortic.2009.836.10 . [https ;// doi : 10.17660/ActaHortic.2009.836.10](https://doi.org/10.17660/ActaHortic.2009.836.10) .
- Wunderlin , R.P. Hansen , B.,F., Franck,A.,R. And Essig,F.B. 2024. Atlas of Florida Plants. [Landry , S.M. and Campbell , K.N (application development) , USF Water Institute .] Institute for Systematic Botany , University of South Florida , Tampa . (<http://florida.plantatlas.usf.edu/>)

