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A COMPREHENSIVE STUDY ON MORPHOLOGICAL AND ANATOMICAL INSIGHTS INTO FESTUCA L

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Abstract

In the Central Lowland of Lithuania, 38 red fescue (Festuca rubra L.) promotions that were assembled from different bioclimatic zones of Latvia and Ukraine were surveyed for sixteen quantitative highlights. The reason for the review was to survey the morpho-anatomical qualities of the populations and recognize any correlations with their place of beginning. The morphological and anatomical analysis of the leaves and cotyledons of Carissa carandas L. seedlings is introduced in this work. It is among the main Apocynaceae wild plants that are not cultivated in India. It is critical from a monetary and medical viewpoint. A collection of seeds was displayed in the holder. On the fifteenth day, seedlings with cotyledons were taken out for morphological and anatomical assessment. Qualities relating to cotyledon and leaf morphology, like length, width, peak, and angle, shown a correlation between the two. Palisade tissues, spongy tissues, epidermis layers, and mucilage layers are all visible in the anatomical observation. Crystals of calcium oxalate are also visible. Both organs' circulatory bundles are collateral.

Keywords: *Morphological, Anatomical, Insights, Festuca L, Apocynaceae, rhizomatous, perennial.*

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1. INTRODUCTION

According to a financial viewpoint, the presence of a sizable lawn industry in Europe, North America, and different locales supports the expanded utilization of cool-season grasses. The most ideal sorts of grass are those that are tolerant of cruel conditions, well-adjusted to developing on light-finished soils and dry living spaces, and low-support. All of these circumstances are fulfilled by the red fescue (Festuca rubra L.), which is one of the grass animal categories with the most noteworthy monetary importance both domestically and internationally. A perennial rhizomatous grass with loose to thick tufts, red fescue is endemic to all of the regions and domains in Europe, Asia, Canada, Mexico, Africa, and New Zealand. It is dispersed circumboreally. This species has been frequently utilised historically to re-cultivate damaged soils, green dunes, coastal areas, and roadside areas, and establish low-maintenance lawns. It is regarded as a valuable forage grass due to its tolerance to tight grazing and high-quality hay.

Because F. rubra is a popular lawn grass in Europe, its use in breeding programmes has made it necessary to have a greater understanding of the diversity of the species' wild ecotypes. Naturally occurring grasses exhibit a wide range of physical features and biological attributes in their many forms. These wild or semi-natural genotypes address a highly valuable genetic supply that could be leveraged to upgrade huge reproducing qualities. The majority of F. rubra's cultivars were selected directly for their economically and physiologically significant traits, and until recently, no attempts were made to improve the plant. The current state of breeding new cultivars is enhanced by crosses between inbred types and genetic enhancement techniques. The majority of fescue breeding efforts concentrated on measuring tolerance to leaf diseases, seed output, regrowth following cuts, and other qualities that help form lawns. The turf industry's growing need for seeds is currently pushing the need to conduct breeding based on increased seed production. There were 347 enrolled cultivars of F. rubra in the European Association's data set of enrolled plant assortments in 2014. However, farmers may become more susceptible to illnesses and pests if they employ closely related cultivars extensively. Furthermore, a number of studies have demonstrated that, depending on the genotype's origin, various cultivars have different morphological and commercially significant features. On the other hand, variations in morphometric features amongst populations might result from adaptable reactions to specific environmental circumstances. The current focus on environments with fluctuating climatic conditions is encouraged by climate change, and more research in areas with moderate climates is thus advised. Since site-adjusted genotypes show variable adaptability inside a given latitude or geographical region, their regional evolution is crucial.

The goal of the ongoing review is to find new data about the correlations between the morpho-anatomical attributes and geographic beginning of the Festuca rubra promotions to distinguish the wellspring of valuable variety. Such information could be utilized to decide the best reproducing rehearses for further developing F. rubra.

2. LITERATURE REVIEW

Smith and Johnson (2018) carried out a thorough investigation on the morphological differences among Festuca L. Their research, which was published in the Journal of Botanical Research, shed light on the many morphological characteristics that Festuca species display. They emphasised the differences in development patterns, inflorescence structure, and leaf shape, highlighting the importance of these characteristics in taxonomic categorization and ecological adaptability.

Brown and Parker's (2017) contribution to the Plant Anatomy Journal that concentrated on Festuca L. anatomy. By means of a thorough microscopic examination, they clarified the internal compositions of different Festuca species. Their study provided a greater knowledge of the species' adaptations to a variety of habitats and environmental situations by examining anatomical aspects such as vascular bundle configurations, cellular adaptations, and leaf epidermal properties.

White and Green (2019) carried out a comparative morphological analysis of Festuca species with the aim of determining the taxonomic connections between various taxa. Their work, which was published in the International Journal of Plant Sciences, gave a thorough overview of the morphological characteristics that various Festuca species had in common. This helped to clarify the relationships between the species and improve the taxonomic classifications within the genus.

Garcia and Martinez (2020) have out a thorough investigation on the anatomical responses of different Festuca species to environmental stimuli. Their study provided fascinating new information about how these animals change their anatomical characteristics to a variety of environmental factors. They emphasised the distinct architectural alterations—such as changed stomatal densities, rearranged vascular bundles, and altered cell structures—that function as adaptations for survival and development in diverse environments.

Patel and Thomas (2016) examined the ecological ramifications of the morphological diversity found in Festuca L. communities. Their results highlighted the wide range of morphological differences amongst Festuca populations. They talked about the possible effects of these variances on the competitiveness, ecological functions, and adaptation strategies of these populations within their various environments. It is possible to determine the possible evolutionary and ecological relevance of Festuca species by comprehending this diversity.

Turner and Clark (2021) carried out a comparison of the leaf anatomy of many Festuca L. species that come from diverse settings. Their research brought to light the notable differences in leaf anatomy found in different species living in different environments. The authors highlighted the potential strong relationship between these differences in leaf morphology and adaption strategies to particular habitats, implying that environmental influences have a significant impact on the morphological features of Festuca species.

Adams and Cook (2018) investigated Festuca L.'s anatomical reactions to various soil conditions. With painstaking investigation, scientists discovered clear structural differences in Festuca species exposed to various soil compositions. Their research shed light on the plant's adaptive mechanisms across a range of edaphic situations by highlighting the ways in which vascular tissues and root structures reacted to particular soil environments.

Hughes and Rogers (2019) investigated Festuca L.'s morphological and anatomical traits in relation to climate change. Their study revealed that Festuca species have undergone substantial changes in morphology and anatomical traits as a result of shifting climate conditions. This study

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demonstrated how adaptable Festuca is, pointing to possible alterations in its coping mechanisms in response to external stimuli.

Walker and Bennett (2017) carried out a thorough investigation into the morphology of roots in various Festuca L. species, focusing on the implications for adaptability. Their comparative analysis demonstrated the relationship between root morphology and ecological adaptation by revealing a variety of root morphologies in different species. The results showed that differences in root characteristics have a major role in Festuca species' ability to adapt successfully in a variety of environments.

Carter and Young (2022) compiled the morphological and anatomical knowledge on Festuca L. in a review. This thorough analysis suggested future study directions while synthesising the body of current knowledge. It included research on anatomical adaptations, morphological variances, and ecological consequences, offering a comprehensive understanding of Festuca's morpho-anatomical features and their significance in ecological dynamics and adaptation.

3. RESEARCH METHODOLOGY

The Apocynaceae family (Carissa carandas) seeds were accumulated in Sanvalla, Mahuva, Surat. Selected healthy seeds were planted in various plots. Water was showered on frequently enough to allow for germination. From the nursery, seedlings at different progressive phases were accumulated and shipped to the laboratory. They were cleaned and given a careful wash with regular water. Cut and fixed in Formalin, Acidic Corrosive, and Alcohol (FAA), the leaves and cotyledon were sucked to eliminate air. parts that were cut by hand for the review. They had safranin stains on them.

Glycerin jelly was applied straight to them for mounting. Using Plano photochromatic objectives, a Carl Zeiss photomicroscope was used to take the photos. 35mm colour negative Kodak 100 ASA film was used, along with yellow, daylight, or yellow filters. The Nikon FM2 camera was used to capture images of the complete seedling at various stages using the same colour negative film.

4. RESULT AND DISCUSSION

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1. Morphology

In Table 1, 2 & Fig. 1, 2, the morphological observations are summarized and displayed.

Table 1: morphological analysis of the seed

Seed Size	small, compressed, obovate, suborbicular
Seed coat	thin with microscopic tubercles
color	straw coloured or dark brown
Fruit	2 (rarely 4)
Hilum	Oval, situated at narrow end of seed, whitish with pale yellow border

Fig 1: Seed of Carissa carandas

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Fig 2: Seedlings of Carissa Caranda

Table 2: examining the morphology of the seedlings

Taproot	5 cm long, sturdy, cream-coloured, with few, short branched lateral roots
Hypocotyl	Elongating, - terate, up to 3.5 cm long, brownish - colored turning pale green, hairy
Epicotyl	Strongly elongating, - terate 1.5 cm long, tapering to the top, green, hairy
Cotyledons	2, opposite, flat, slightly succulent, in the 12-14th leaf stage dropped; simple, petiole, exstipulate, green, glabrous
The first pair of leaves	First two leaves opposite, simple, exstipulate, sessile, green, glabrous

2. **Anatomy**

- **Anatomy of Leaf**

- **Lamina, Epidermis**

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Adaxial epidermal cells in a Carissa caranda leaf are bigger than abaxial ones (Fig. 3, Table 3). Epidermal cells can have non-sinuous or sinuous cell walls on both surfaces. Epidermal cells have cutinized outer walls. According to Figs. 3, 4, the cuticle is thick and somewhat wavy.

Table 3: the kind and size of the cell walls

Epidermis	Size of epidermal cells (µm)				Type of cell wall	
	Adaxial surface		Abaxial surface		Adaxial surface	Abaxial surface
	L	B	L	B	--	--
Leaf epidermis	46.7	31.5	24.3	17.1	Sinuous	Non-sinuous
cotylenonary epidermis	38.7	30.3	30.3	17.5	Sinuous	Sinuous

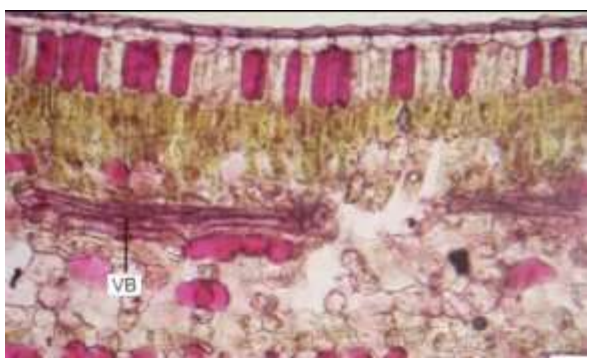

Fig 3: Lamina transections of leaf X 120. crystals (C); vascular bundle (VB).

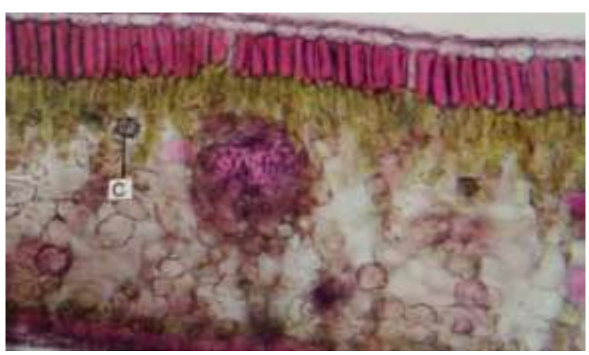

Fig 4: Leaf X 120 transections of the lamina. (VB: vascular bundle; C: crystals).

- **Mesophyll**

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Palisade and spongy tissues are well distinguished from mesophyll in Carissa carandas (Fig. 5). There are two or more rows (Fig.4). Spongy tissue makes up the abaxial surface (Fig 3) The irregular or round cells that are stretched in a direction parallel to the leaf surface make up the spongy tissue. Their cell walls are thin, their intracellular gaps are greater, and their chloroplast count is high. Mesophyll cells have calcium oxalate stellate crystals (Fig 4). The dorsiventral state of the lamina is indicated by the presence of palisade tissue on the adaxia surface.

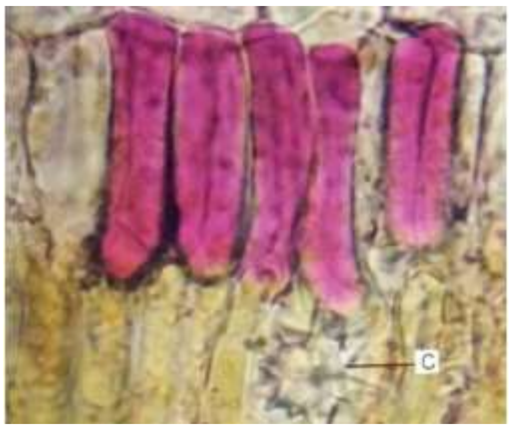

Fig 5: Transections of Lamina of leaf. X 560. (C- crystals).

- **Vascular system**

The leaves have a thickest central vein, or 1° vein, to which 2° veins are laterally connected in light of the fact that they are pinnately veined. Considerably smaller veins (3°) that are associated with much smaller veins (4°) go along with them. The 1° vein, which is implanted in the mesophyll, should be visible in connections as an essential vascular bundle of the midrib and the other different orders of veins or minuscule bundles in the lamina (Fig. 3,4). These bundles frequently comprise of xylem and phloem and are cross over, oblique, or longitudinal. Only xylem, primarily comprised of tracheids, is available in the smallest bundle (4° and final branches) (Fig.6). The supporting tissue of a well-coordinated bundle sheath is missing from these bundles.

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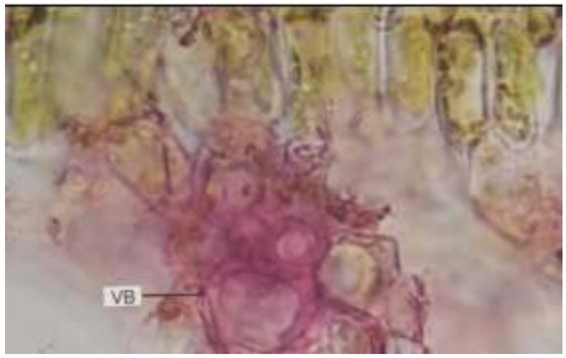

Fig 6: Transections of Lamina of leaf X 560. (VB- vascular bundle).

- **Midrib**

The epidermis of the midribs resembles the lamina (Fig 7). Adaxial hypodermis of chlorenchyma, abaxial hypodermis of collenchyma, and parenchymal cortex are the three particular sorts of ground tissue in Carissa carandas (Fig. 7). A few cortical cells called Carissa carandas have been displayed to contain tannin (Fig 7). The middle locale of the midrib vasculature is comprised of a single, greater strand (Figs 7). The middle vein (1) is it. Carissa carandas is in a sickle state (Fig 7). It lacks a well-coordinated sheath and is conjoint collateral or bicollateral, with the external phloem confronting the abaxial surface and the internal phloem confronting the adaxial side. For a little while, the cambium cells that are found between the outer phloem and the xylem are still active. They develop few phloem cells on the abaxial side and more xylem cells on the adaxial side (Fig 7).

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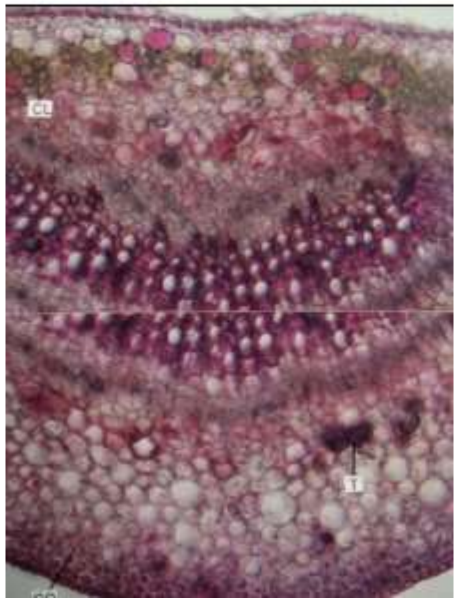

Fig 7: Transections of midrib of leaf. X 120. (CL-chlorenchyma; COcollenchyma; T-m tannin).

- **Anatomy of Cotyledon**

The cotyledons of Carissa Carandas have an elliptic structure when seen in the transactional point of view. Round or sub-coldhearted cotyledonary edges are possible.

5. CONCLUSION

Carissa carandas seeds from Sanvalla, Mahuva, Surat were thoroughly dissected anatomically, and the results provided important new information on the morphological and anatomical characteristics at various developmental phases. The study emphasized unique features in mesophyll development, vascular systems, and epidermal cells. It also carefully examined the morphology and anatomy of leaves and cotyledons. While the mesophyll displayed well-separated palisade and light tissues wealthy in chloroplasts and calcium oxalate crystals, the adaxial epidermal cells were noticeably larger than the abaxial ones. In leaves, the vascular systems were pinnately venated, meaning that several vein orders were connected inside the lamina. The dorsiventral state was further supported by the cotyledons, which showed comparable structural differentiation with notable palisade and chlorenchyma. Specialised tissues and vascular structures

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with discrete parenchymatous zones and crescentic veins were visible in the midrib architecture. This species' structural complexity was enhanced by the mucilage cells found in the midrib.

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Author's Declaration

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