Morphological and Anatomical Modifications of *Prosopisjuliflora*(SW.) DC. in Gombe State, Nigeria

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***Abstract*: - Studies were conducted on *Prosopisjuliflora*(SW.) DC. with the aim of investigating the Morphological and Anatomical modifications of(Leaf, Root and Stem).The Morphological study was carried out according to standard procedures. The Anatomical study was carried out by using Sharp razor blade and potato pith. Very thin sections of both the stem, leaf and roots were obtained and then stained with Saffranin and temporally mounted in 10% glycerine jelly before being observed under the microscope. Pictures of the slides were takensing digital camera,. The findings of the anatomy revealed the presence of thick cuticle, multi-layered palisade parenchyma, numerous large and small xylem vessels, tracheids, water bubbles inside the xylem vessels and cortex. The morphology of the leaf was found to be small in size and bipinnate, and the root had deep taproot and well developed lateral roots. It was concluded that, features such as small bipinnate leaves, multi-layered palisade parenchyma, thick cuticles, xylem element tracheid, spines, deep taproot and well developed lateral roots, were the feautres that contributed to the survival of *Prosopisjuliflora* in the Semi-Arid environment, of Gombe State,Nigeria. It was recommended that the plant could be used for wind breaks, erosion control and afforestation programmes in Northern Nigeria in order to conserve the environment and prevent desertification**

***Key Words:* MORPHOLOGICAL, ANATOMICAL, *Prosopisjuliflora*, GOMBE.**

I. INTRODUCTION

Gombe State like many other States of Northern Nigeria is situated in the South of the Sahara which falls in the Semi-Arid Zone. It is one of the drought zones lying within latitude 10° 18'E and longitude 11° 10'E (Ikusemoran *et al.,* 2016). The rainfall pattern +in this zone is characterised by its seasonal features and wide variability from month to month and year to year. For instance, the precipitation in Gombe varies as little as below 500mm to a maximum of nearly 1000mm. The duration of rainy season is short extending from June to September (Mohammed*,* 2011).

The weather is characterized with desiccation, high wind velocity which causes severe erosionwith scarcity of water and very scanty vegetation (Mohammed*,* 2011).Hence, the Semi-Arid Zone is one of the inhospitable areas of the world were plants are all subject to severe environmental problems which are many and varied. Dominant among these are great heat, intense radiation and aridity of the air (Abba, 2015). Inspite of these adverse environmental conditions certain plants, for example *Prosopisjuliflora, among* others have become adapted. This plant can withstand prolonged period of drought without exhibiting symptoms of water stress, hence they are known as drought resistance/tolerant plants or xerophytes.

II. MATERIALS AND METHODS

For the anatomical study, the plant materials collected was that of *Prosopisjuliflora* within Botanical garden of Gombe State University. The stem was cut and the tap and lateral root system was dug up, brought to the Botany Laboratory, Gombe State University. The sample was washed with water and then put into Formaldehyde Acetic Acid (F.A.A) solution to preserve the tissues "In situ" by the use of potato pith and sharp razor blade, very thin sections of both the stem and root were obtained and then stained with Saffranin and temporarily mounted in 10% glycerine jelly before being observed under the microscope.Pictures of the slides were snapped using a digital camera, as described by Cutler (1978). The general morphological description of the characters like habit, root, stem, seed pods, flowers and leaf was carried out according to the method of (Maydell, 1990).

III. RESULTS

Leaf Morphology

The results shows that the plant had Bipinnate leaves; pale-yellow flowers arranged in spikes; flattened fruits, non-dehiscent with hardened epicarp, pulpy sweet mesocarp, multi-seeded and curved. The leaves were compound with one or sometimes two pairs of rachis, each having 12 to 22 pairs of green foliates (Plates 1)

Plate 1. Leaf Morphology

Root Morphology

The root system includes a tap root that grows deeply downward in search of water tables with many lateral roots (Plate 2).

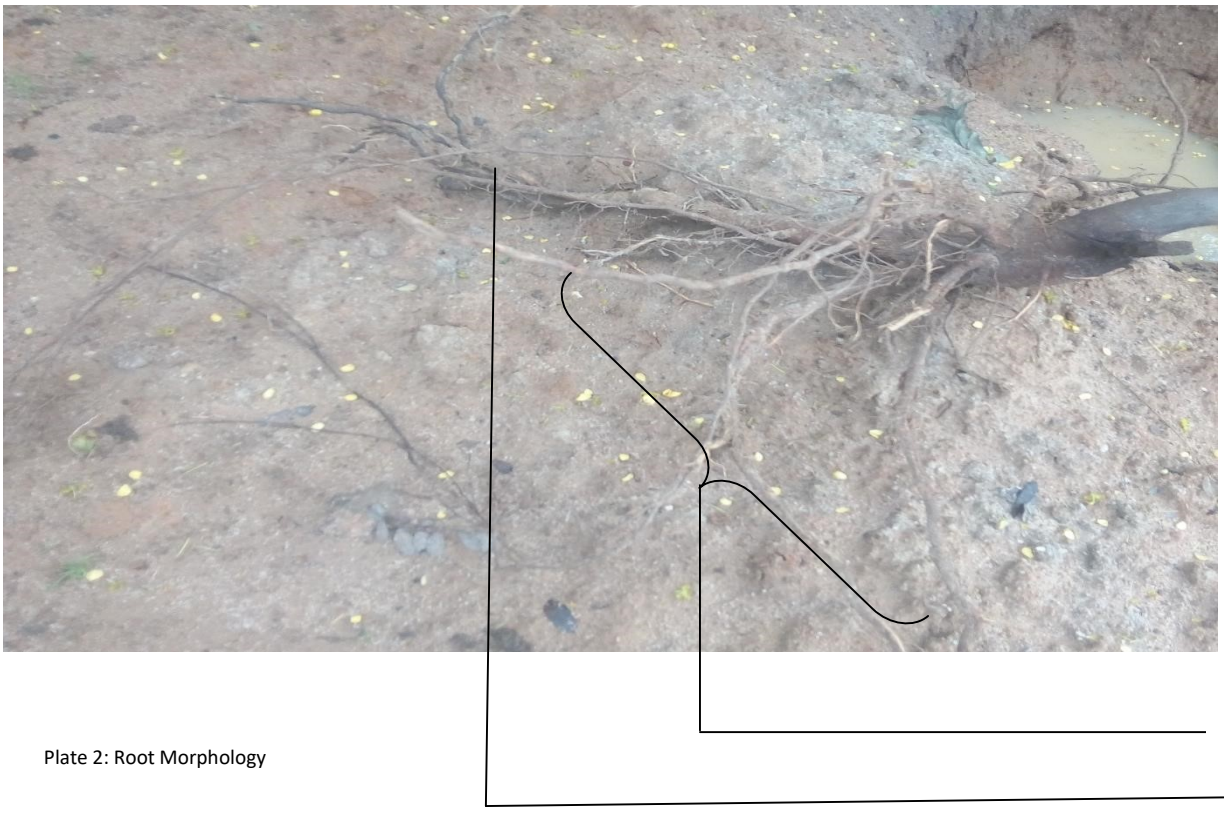

Plate 2: Root Morphology

Stem Morphology

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Plate 3: Stem Morphology

P. juliflora is a tree with, flexible branches with long, strong thorns. the stem is green-brown, sinuous and twisted stem, up to 6–9 m in height and 45 cm in diameter, with axial thorns situated on both sides of the nodes and branches, from 63 mm to 2.5 cm; bark somewhat rough and dull-red (Plate 3)

Anatomical studies revealed that the plant had certain anatomical features which helped them to adapt to the extreme environmental conditions of the semi- arid environment of Gombe State, Nigeria.

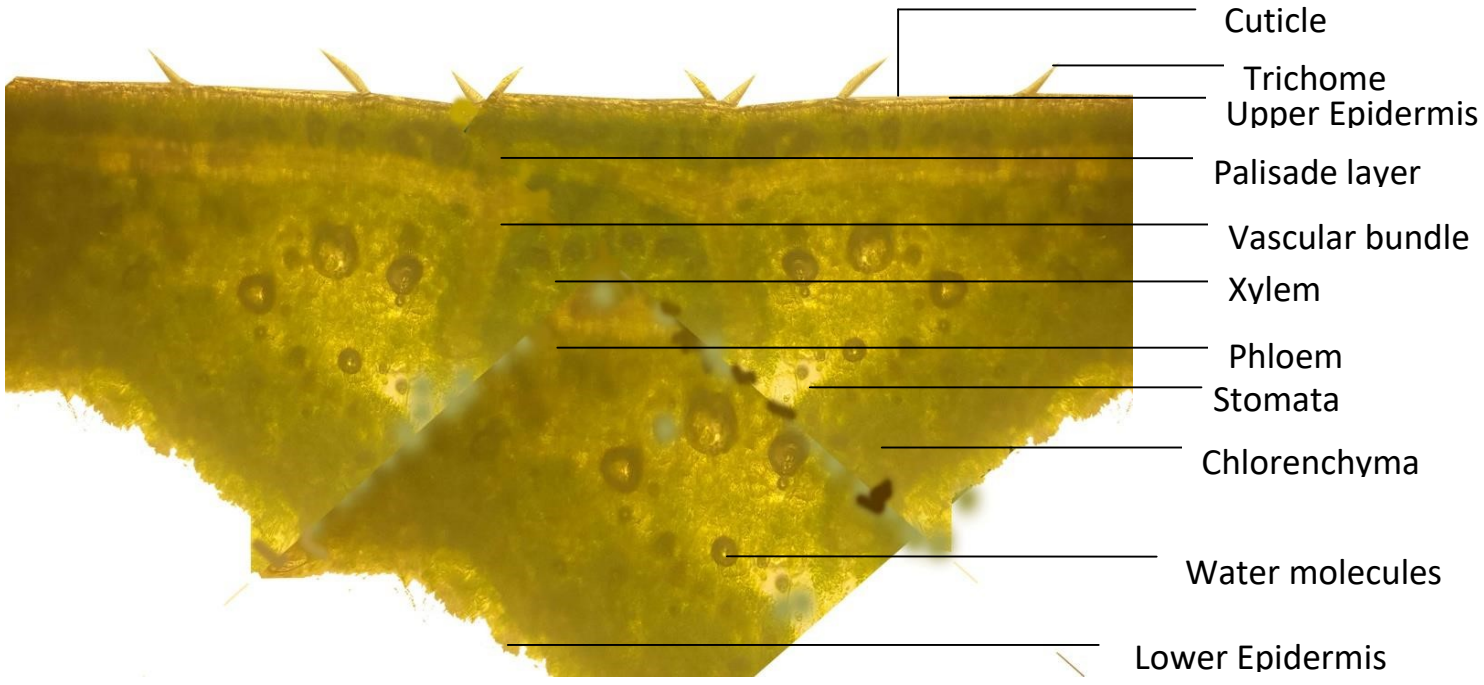

Plate 4 Leaf anatomy

Key:

ST	=	Stomata
LEP	=	Lower epidermal layer
UEP	=	Upper epidermal layer
PL	=	Palisade layer
T	=	Trichomes
WM	=	Water Molecules
XY	=	Xylem
PH	=	Phloem
MS	=	Mesophyll

The upper and lower epidermis was made of a single layer of rounded cells with a thick cuticle and straight walled epidermal cells. There was no difference between the cuticles of the upper epidermis with the lower epidermis. Stomata were present inside the mesophyll tissue. The mesophyll lies between the two epidermal layers and consisted of compactly arranged rounded cells. It was differentiated into the palisade parenchyma, consisting of two or three layers of elongated cylindrical cells, closely packed with intercellular spaces. The vascular bundles consisted of the xylem vessels and phloem tissue, Also, surrounding each vascular bundle was a compact layer of thin-walled paranchymatous cells. This layers is called border parenchyma or bundle sheath (Plate 4).

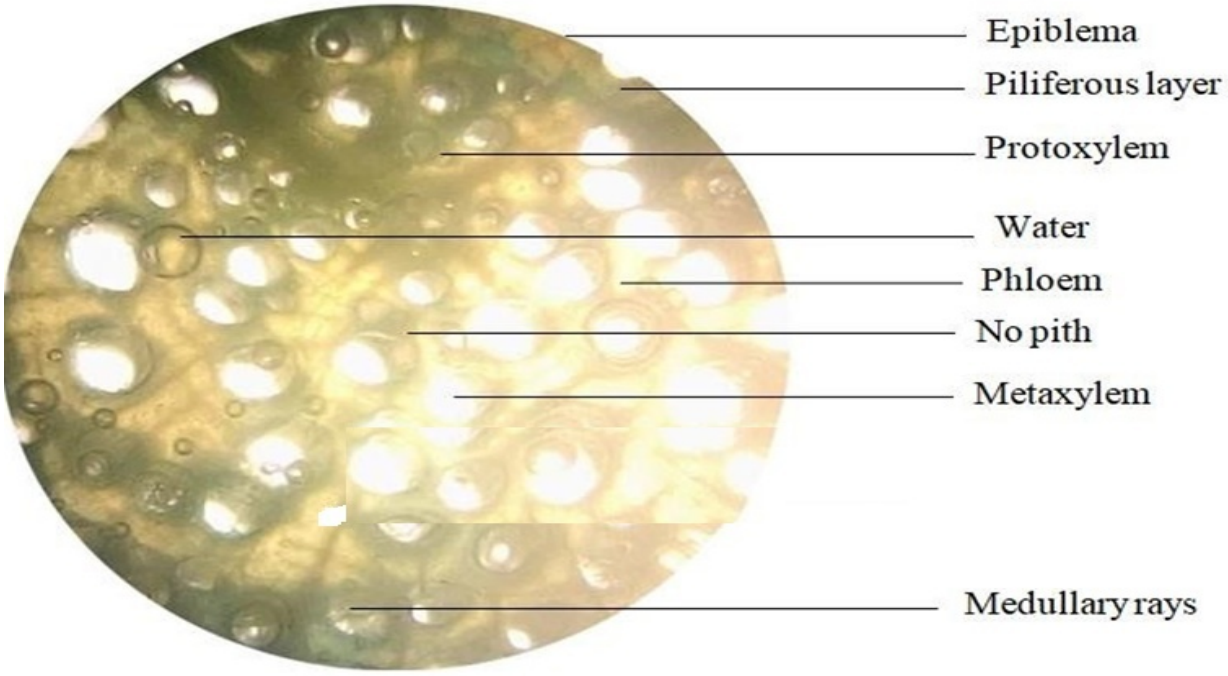

Plate 5. Root anatomy	
Key PL = Piliferous layer PR = Protoxylem PH = Phloem	
MD = Medullary rays	
MTW = Metaxylem with water	
CO = Cortex	
P = Pith	
W = Water	
EP = Epiblerma	

The epiblema was made up of a single outmost layer of thick-walled cells, covered by a thick cuticle. Beneath the epiblema was the cortex The innermost layer of the cortex have a layer of suberin, an impermeable material called casparian strips. The endodermal cell was cambium. There is no presence of pith. Water bubbles were found associated with the xylem vessels. The vascular bundles was made up of the xylem and phloem tissues. The xylem consisted of several large (metaxylem) and smaller (protoxylem) vessels scattered within the cortex. The phloem was found on the outermost part of the xylem. Paranchyma cells were scattered, occurring together with the xylem. There are presence of numerous medullary rays, (Plate 5).

Stem Anatomy

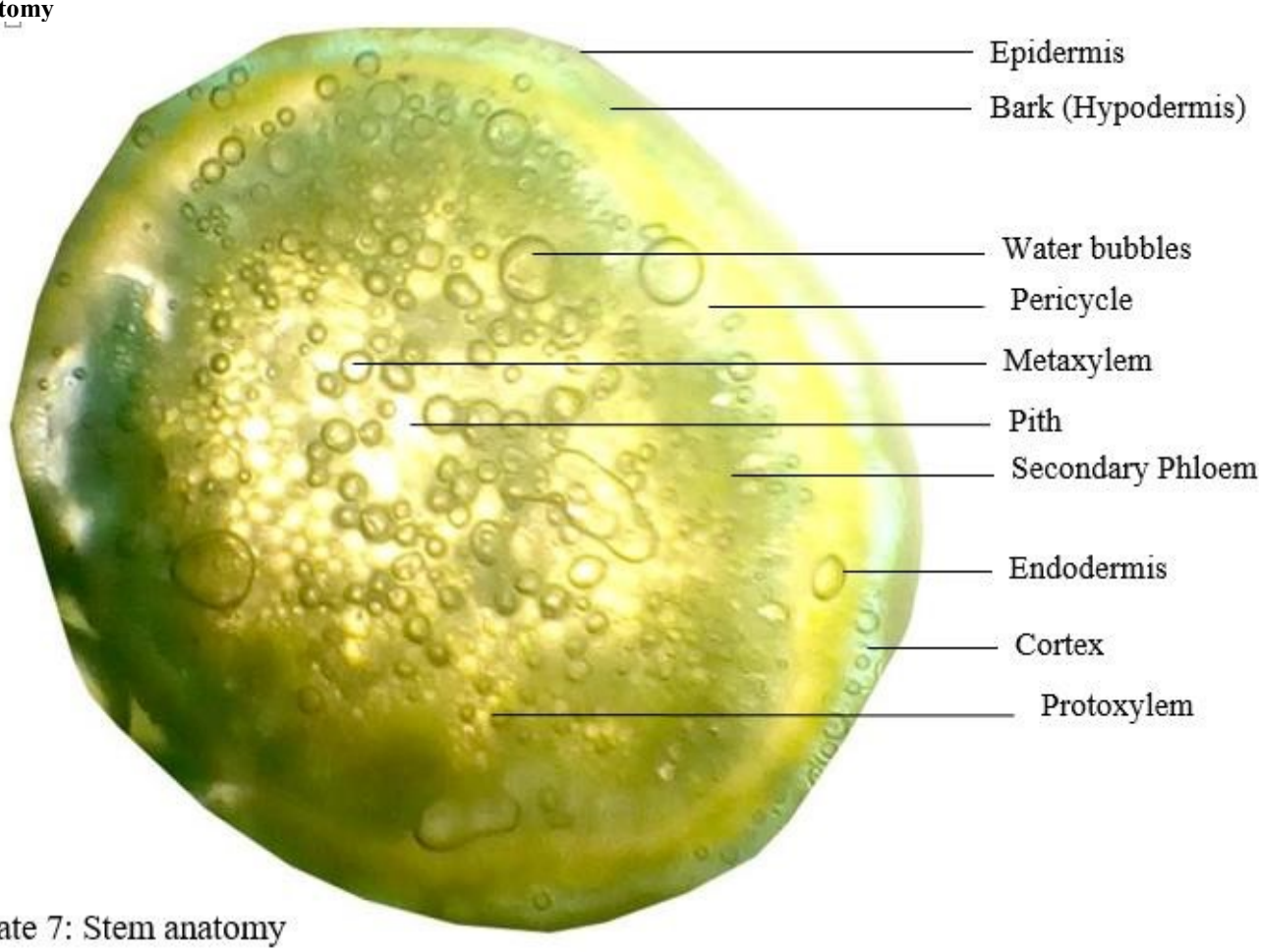

Plate 7: Stem anatomy

Key:

EP	=	Epidermis
CO	=	Cortex
PR	=	Pericycle
PI	=	Pith
SP	=	Secondary phloem
BA	=	Bark
EN	=	Endodermis
MX	=	Metaxylem

PR = Protoxylem

WB = Water bubbles

The epidermis formed the outermost layer of the stem and consists of a single row of cells with a thick cuticle extending over it. The cortex lied below the epidermis and was made up of compactly arranged round cells called the periderm, below this layer were tightly packed parenchyma cells. The endodermis formed the innermost of the cortex and the cambium was the region lying internal to the endodermis. The pith occupied the centre of the stem and was composed of compactly arranged parenchyma cells. The vascular bundle was composed of metaxylem and proto xylem vessels and phloem tissues. The xylem contains water bubbles while the phloem lied above it. Parenchyma cells were present alongside the xylem vessels (Plate 6).

IV. DISCUSSION

The morphology of the leaves of *Prosopisjuliflora* were found to be small in size and bipinnate. The reduction in the size of the leaves is often accompanied by reduction in cell size. Leaf size reduction tend to reduce the leaf area involved in transpiration hence minimized excessive loss of water. It also ensures that leaf surface is not overheated by intense solar radiation. The finding of this work confirms the earlier observation by (Cutler, 1978; Abba, 2015) who studied **xerophytic** plants and reported that the most obvious features of xerophytic leaf structures are low ratio of leaf surface area to leaf volume and a reduction in cell size leading to an increase in internal free surface area.

The morphology of the root of *Prosopisjuliflora,* have well developed lateral roots and taproot system. This feature is important in establishing perennial plant in the desert for high conductance of water from deep-water reservoirs and efficient absorption of water and nutrient in the top layers of soil during wet periods, as well as the extraction of stored moisture from deeper horizons during drought. This finding is in correlation with the works of Abba *et al*. (2015) in her study of some selected *Acacia* species, in Borno State, Nigeria.

The morphology of the stem of *Prosopisjuliflora* is scaly (Plate 3) and resulted when various Phellogens formed separate arcs to protect the auxiliary bud present. Similarly, the observation has been made on different trees in the Semi-arid region (Maydell, 1990).

The bark, which is an accumulation of death cells, may also act as barriers against pathogens, and other related injuries. It may also reduce the amount of heat reaching the deep living tissues, thus reducing evaporation. Spines or prickles were observed on the stem of *Prosopisjuliflora*

(Plate 3). These spines act as different mechanism against external invaders and behaviours. Spines or prinkles are common morphological adaptations of xerophytes. Similar observation has been made on different trees in Semi-arid region (Nakano, 2010). The morphological measurements revealed the presence of more lateral roots than tap roots (Plate 4).It is consistent with the works of Kiyotsugu *et al*., (2012)

The leaf, stem and root anatomy of the plant revealed the presence of multilayered palisade parenchyma, numerous large and small xylem vessels which could probably be the reasons for rapid absorption of water by the plant. Presence of water bubbles inside xylem vessels, thick cuticles, well developed periderm, cortex and vascular bundles (Plate 5-7). It is consistent with the works of (Hameeda *et al.* 2008; Abba *et al*. 2015)

V. CONCLUSION

It was concluded that the anatomical and morphological modifications such as small binnate leaves, multilayered palisade parenchyma, thick cuticles, xylem elements, trachieds, spines/prinkles, deep taproot and well developed lateral roots, have been identified as features that contributed to the survival or adaptation of *Prosopisjuliflora* in the Semi-arid environment and also the mechanism which enables the plant to inhibit its invasive behaviours; such as its extraordinary resistance to drought, precociousness, ability to thrive in highly saline or poorsoilsof Gombe State and Northern Nigeria.

Morphologically the presence of small leaves and well developed taproot with different lateral roots deeply down the ground in search of water and other nutrients and minerals element and it serve as remarkable evidence that make the plant to successfully adapt or survive in the Semiarid environment. In addition anatomically, the presence of numerous meta and prot xylem vessel, trichomes in the root and leaf of *P. Juliflora* respectively has an impact on the successful adaptation of the plant to Semi-arid environment of Gombe State, Nigeria.

CONFLICT OF INTEREST

The author have declared that, there is no conflict of interest exist.

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