

Anatomical adaptations of xerophytes

Xerophytes:

Plants which grow in dry habitats or xeric conditions are called xerophytes. Places where available water is not present adequate quantity are termed xeric habitats. They grow in deserts or in very dry places and for this purpose they have certain peculiar adaptations. The xerophytic plants have to guard against excessive evaporation of water; this they do by reducing evaporating surface. Plants form a long tap root which goes deep into the sub-soil in search of moisture. To retain the water absorbed by the roots; the leaves and stems of certain plants become very thick and fleshy (viz., *Aloe*, *Agave*). Water tissue develops in them for storing up water; this is further facilitated by the abundance of mucilage contained in them. Multiple epidermis sometimes evolves in the leaf (viz., *Nerium*). Modification of the stem into the phylloclade for storing water and food and at the same time performing functions of leaves is characteristic of many desert plants (viz. *Opuntia* and other cacti).

Anatomical Adaptations of Xerophytes

i. Epidermis and Thick Cuticle:

Heavy cuticularization and extreme cutinization of the epidermis and even of sub-epidermal cells are common in xerophytes. In extreme xerophytes the cuticle may be as thick as, thicker than, the diameter of the epidermal cell. In addition to the presence of thick cuticle, the walls of epidermal cells become cutinized and sometimes also those of underlying cell. Along with well-evolved cutinized layers the epidermal and subepidermal cells also become lignified. In some cases the covering of wax is formed on the epidermis (viz., *Calotropis*). The epidermal cells are usually radially elongated. In the leaves of *Nerium* and *Ficus*, the epidermis becomes multilayered.

In many xerophytes in addition to a cutinized epidermis, single to multi-layered hypodermis is also present. In most plants, the hypodermis of leaves is morphologically mesophyll and can be in the form of a sheet of fibrous tissue or a layer of sclereids. The hypodermis of the stems seems to be a part of the cortex. The hypodermis of stems and

leaves can be cutinized to lignified. In many plants, the mucilage, gums and tanning are commonly found in hypodermis.

Hairs:

In several xerophytic plants, especially those of alpine regions exposed to strong winds, a covering of matted epidermal hairs on the underside of the leaves prevent water loss. Hairs can also be abundant over the entire aerial part of the plant. The thick matting of hairs also prevents rapid evaporation through stomata. The xerophytes that contain abundant hairs, on their leaves and stems, are commonly called trichophyllous.

ii. Structure of Stomata:

The xerophytes can contain less stomata, either by reduction of leaf surface or of stomatal number per unit area. To reduce excessive transpiration usually the stomata that remain sunken in pits are formed. Such stomata are commonly called sunken stomata (e.g., *Hakea*, *Agave*, etc.). In certain cases the stomata are found in groups and they remain confined to depressions found on leaf surface (e.g. *Nerium*, *Banksia*, etc.).

iii. Sclerenchyma:

The xerophytes commonly have a large proportion of sclerenchyma in their leaf structure than is observed normally in mesophytes. The sclerenchyma is either found in groups or in continuous sheets.

iv. Rolling of Leaves:

The leaves of several xerophytic grasses roll tightly under dry conditions. In these grasses, the stomata are confined to the ventral surface of the leaf, so that when the leaf edges roll inward, the stomata are effectively shut away from the outside air. As the stomata are situated on the inner surface of the leaf, the air enclosed by the rolled leaf soon becomes saturated with water and the outward water diffusion stops.

In *Ammophila arenaria*, there is tight upward folding of the leaf and also the sheltered situated of the stomata in furrows, greatly reduce air movement over stomatal areas. Special motor cells (hinge) on the upper surface of the leaf are responsible for the inward rolling of leaves. In the xerophytic grasses, the motor cells are well evolved.

v. Reduced Leaf Surface:

In many xerophytes, reduction of the leaf surface partly checks water loss because the total exposed surface of the plant body is relatively small as compared with that of normal mesophytes (viz., *Casuarina*, *Asparagus*, etc.). In such xerophytes the leaves are either scale-like or very small in size. Generally they are not found in the mature plant, or they persist as small scales or bracts. The reduction of leaf surface is usually accompanied by well-evolved sclerenchyma, water storage tissue and sunken stomata. Xerophytes, with reduced leaves, are called micro-phyllous.

vi. Water Storage Tissue:

Many fleshy xerophytes contain water storage tissue and mucilaginous substance in them. In leaves such tissues are situated beneath the upper or the lower epidermis or upon both sides of the leaf and sometimes in the centre too. The storage cells are visually large and often thin-walled, as in *Begonia*. The storage tissue can actually serve as a source of reserve water during drought. The xerophytes, that possess fleshy leaves or stems, are called malacophyllous.

vii. Abundant Palisade Parenchyma:

In the stems of several xerophytes, the palisade tissue is present (viz., *Capparis decidua*). In the xerophytic leaves the palisade is abundant and completely arranged.

viii. Latex Tubes:

In many xerophytic stems and leaves the laticiferous canals are present (viz., *Calotropis*, *Euphorbia*, *Asclepias*, etc.). Because of viscosity latex the transpiration is reduced to some extent.

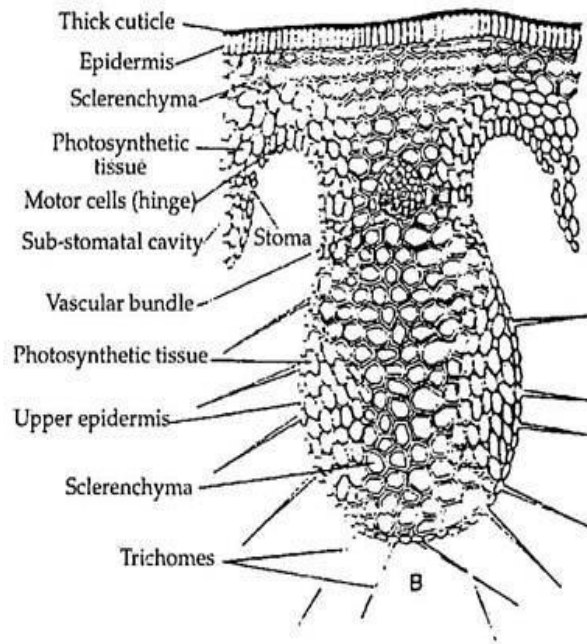


Fig. 15.4. Structure of xerophytic leaf. Part of T.S. of leaf a *Ammophila arenaria*, between two ridges (detailed).

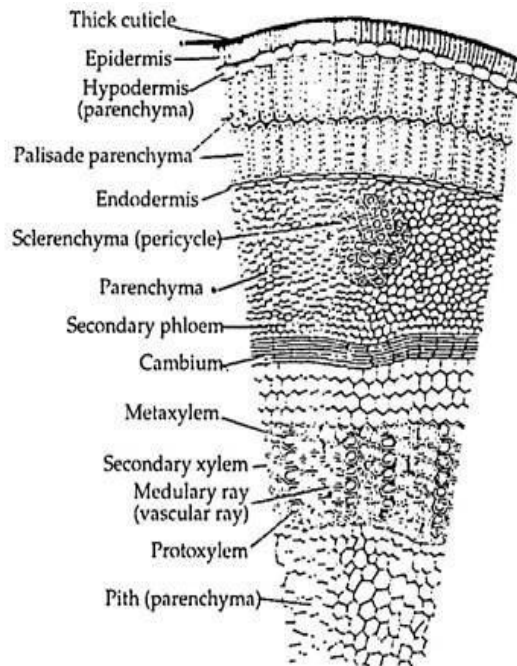


Fig. 15.6. Anatomy of xerophytic stem. T.S. of stem of *Capparis decidua* (dicot.)—detail of a sector.