PLANT ADAPTATIONS TO HOT & DRY CONDITIONS (Xeric Adaptations)

NOTE: Much of the material below comes from presentations of Mary Irish at a series of 4th Saturday August events in Phil Hardberger Park, supplemented by information from Floyd Waller's Grass Walks, and the general literature on plants.

PLANTS ADAPT TO HEAT & DROUGHT (REDUCED SOIL MOISTURE) BY ESCAPING, EVADING, OR ENDURING THESE CONDITIONS. SOME OF THE SPECIFIC ADAPTATIONS PLANTS USE ARE:

Succulence: Xeric adapted plants have special cells which hold water for photosynthesis when soil moisture is low or nonexistent. The cells of xeric adapted plants can lose up to 95% of their water content while for regular, thin-leaved plants water loss of 30% is usually fatal. All succulents, and many xeric adapted plants, have mucilaginous interior tissues (specialized cells) which store water. Cacti store water in their stems as do most succulent euphorbias. Others, like aloes and Haworthias, store water in their leaves, and a few store water in their roots as either tubers or other swollen membranes.

Reduced(absent) leaf area: By reducing the number of leaves, or breaking the leaf area into tiny parts, the leaf surface area is decreased so the plants lose less water. Leaves are reduced to spines (cacti) or very fine leaflets (legumes). In other cases, for example, Red Buckeye, Retama, Mesquite, and Creosote Bush, drop leave during the summer in response to drought.

Along with the reduction in leaves the main site of photosynthesis is moved to the stems (chloroplasts in the stems). Prickly Pear pads, which are actually stems. are an example of this adaptation.

Stomata, the sites where water vapor during transpiration is released, become fewer, are positioned in sunken pits below the surface, or are located on the leaf underside. Some grasses with broad leaves like Indian Grass have cells on the adaxial leaf surface which cause the leaves to fold in response to drought protecting the stomata. Many grass genera found in arid conditions like *Aristida*, *Sporobolus*, and *Muhlenbergia* have very narrow leaves which are not only folded but also longitudinally in-rolled (involute) enclosing the stomata more completely. This condition is often accompanied by very dense basal growth which further contributes to a micro-climate which conserves moisture.

Crassulacean acid metabolism (CAM metabolism) works as the plant gets its CO_2 at night and stores-malic acid to use during the day. This allows photosynthesis to take place so water loss during the day, when it is hottest, is minimized by having the stomata closed.

Growth tends toward compact, often spherical or cylindrical forms, which reduce surface area per unit volume saving water. Plants often have a ribbed structure enabling rapid increase in plant volume and decreasing surface area. A ribbed surface minimizes exposure to the sun and directs water directly to the roots. Another adaptation is a rosette arrangement of the leaves, which in agaves, yucca, and aloes, also directs water to the roots. Some authors suggest the pads of Prickly Pear orient E/W to escape the direct rays of the sun.

Waxy, hairy, spiny outer surfaces trap air to insulate the plant from heat and cold. In the case of Artemisia, the hair shades the plant. The hair and spines can also scatter light reducing the sun's effect. Waxy impervious covering holds water, for instance in our Live Oak leaves. Downward pointing spines can direct water from fog and dew to the plant roots.

Roots near the surface absorb water quickly and can regenerate quickly after a rain.

Restricting germination to optimal times, as in the case of bluebonnets, allows plants to germinate and bloom in the cool part of the year. Many xeric species have a short six to eight-week life cycle delaying germination to optimal conditions, while others, such as rain lilies bloom after a rain.