

## Modified Kranz anatomy in *Salsola* leaves (Chenopodiaceae)

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Unique anatomical features of succulent *Salsola* leaves have been studied employing electron microscopy. Modified Kranz anatomy and distinct cellular differentiation were discovered in mesophyll cells. Two different types of chlorenchyma mesophyll tissue were recognized underneath the epidermis. The outer chlorenchymatous layer (CHO) was consisted of elongated palisade cells that were loosely arranged with relatively small peripherally aligned chloroplasts. The inner chlorenchymatous layer (CHI) was a monolayer of somewhat isodiametric cells that closely packed without spaces and contained numerous large chloroplasts in a centripetal arrangement. Features of chloroplasts also differed by the cell types. Chloroplasts in the CHO contained grana and no starch grains were observed. In contrast those of the CHI were agranal and had several starch grains that caused irregularities in chloroplast shape. Thick cell walls were observed between the CHO and CHI and clusters of well-developed plasmodesmata were highly common on these walls. The center of the leaf was comprised of several layers of a parenchymatous water storage cells embedding peripherally the small vascular bundles just beneath the inner chlorenchymatous layer in most cases. No bundle sheath formation was detected. The chloroplasts of the water storage tissue contained few scattered chloroplasts that were much smaller than those of the CHI, yet resembled rather those of the CHO by

having grana but no starch grains. It seems thin-walled cells of the CHO apparently play the role of mesophyll cells and cells of the CHI play the role of bundle sheath cells in a typical Kranz structured plants.

*Key Words:* Modified Kranz anatomy, *Salsola* species, two chlorenchymatous layers, Ultrastructure

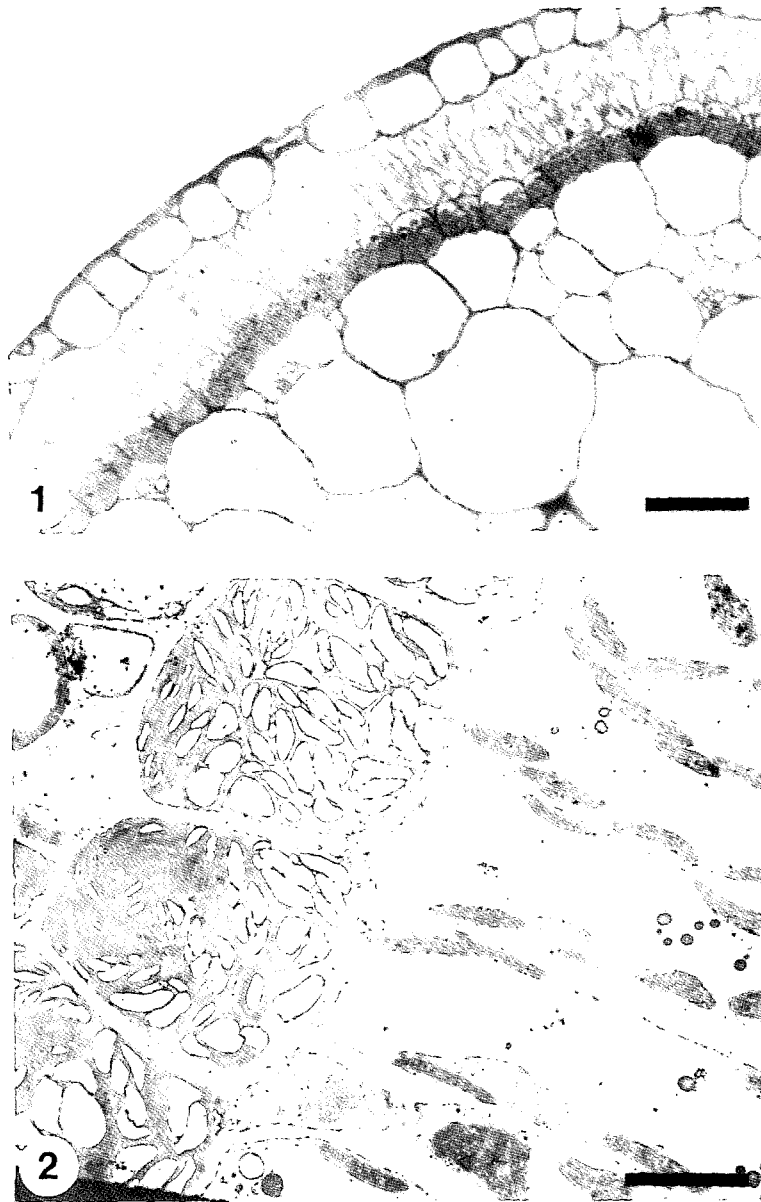


Figure 1. Cross section of *Salsola komarovi* leaf showing two chlorenchymatous layers. Scale bar = 40  $\mu$ m.

Figure 2. Ultrastructural feature of inner and outer chlorenchyma layers exhibiting considerable structural differentiation. Scale bar = 10  $\mu$ m.