GEOGRAPHIC LEAF CUTICULAR AND MORPHOLOGICAL VARIATIONS IN *SALVIA LYRATA* L. [CANCER-WEED] AND THEIR POSSIBLE RELATIONSHIP TO SALINITY

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ABSTRACT

Two populations of *Salvia lyrata* L. (cancer-weed) were studied in the Gulf coast areas of Mississippi, U.S.A. to determine the possible relationship between the cuticular and morphological features and the varying degrees of salinity in the area. Plant height, leaf size, inflorescence number and floral productivity, stomatal frequency, and epidermal wall undulations were reduced while trichome frequency increased in the highly saline habitat. The subsidiary cell complex remained unaffected by varying degrees of salinity of the habitat.

INTRODUCTION

SALINITY and its effects on plant morphology have been studied by various investigators but comparative studies on plant taxa concerning the cuticular, anatomical, and morphological adaptations are lacking. Some of the early studies describing the relationships of plants to salinity were initiated by Schrader and few workers[1-3]. Recent contributions to the understanding of plant-salinity relationships have been made by Unger and few workers[4-7].

Plant cuticular features such as stomatal frequency, stomatal index, trichome frequency and type, stomatal size, and subsidiary cell complex have been used in the understanding of ecological, taxonomic, and environmental pollution relationships. Salisbury[8] conducted pioneer studies on the relevance of stomatal frequency in the ecology of woodland flora. Recent studies[9,10] indicate the application of certain cuticular features in phylogeny and taxonomy. Relationships between cuticular features and environmental pollution have been demonstrated in several studies[11-13]. However, there is a paucity of literature on the quantitative and qualitative aspects of plant cuticle as affected by salinity.

The present study was conducted, therefore, to determine the adaptations or modifications found in the cuticular and morphological features of a commonly found herbaceous plant taxon. The study analyzed two populations of cancer-weed (*Salvia lyrata*), growing in two sites in the Gulf coast area in Ocean Springs, Mississippi, characterized by saline macrohabitat complex.

MATERIALS AND METHODS

Two populations comprising 20 plants of cancer-weed were collected at random from two different sites. Population A was from the marine, Gulf coast areas in Ocean Springs, Mississippi, and was characterized by saline habitats and frequent mist from salt sprays. Plants were selected at random from this area for recording the gross morphological and cuticular features. Population B was collected from the less saline microhabitat of the inland terrestrial area—a site more than 40 km north of the Gulf coast area in the interior. The plants collected for population B were growing along an abandoned field compared to the microhabitat of population A, characterized by marine, swampy, and wet conditions. It seems reasonable to assume that the two populations were growing in the same general macroclimate—thus reducing the overall variations in cuticular and morphological features caused by microhabitat factors such as soil moisture, temperature and light.

Gross morphological features such as plant height, leaf length, leaf width, number of inflorescences, and floral production of the plants were recorded in the field and the data were subjected to computer analysis.

Five leaves were selected from each population for leaf cuticular slides. The leaves were washed with mild detergent and distilled water, air-dried and a few drops of Duco-cement were applied on their upper and lower surfaces to form a thin layer of film over the leaf surfaces. Upon drying, the films showing the cuticular impressions of the leaves were removed[14]. A small portion from their central area was used to make study slides. Leaf cuticular data such as stomatal frequency and size, trichome frequency and type, epidermal wall undulations, and subsidiary cell complex were recorded by selecting at random 25 fields ($n = 25$) from each microscope slide.

RESULTS AND DISCUSSION

It is obvious from the statistical analysis of the data that cancer-weed plants growing in the marine, coastal area of population A were smaller (34.7 cm) than the plants of less saline, inland population B (49.3 cm). Plant leaves of population A were smaller than those of population B. Leaf length was 12.2 cm in population A and 21.1 cm in population B, while leaf width was 4.6 cm in population A and 7.1 cm in population B. The number of flowers produced averaged 5 in population A and 6 in population B, suggesting that salinity of the coastal environment around Gulf coast had a detrimental effect on flower production. Population A had about 7 inflorescences per plant while the number was much higher (13 per plant) in the less saline conditions surrounding population B. It seems clear that salinity reduced leaf size and plant height in cancer-weed.

Stomatal frequency values of both the upper and lower leaf surfaces were also low in the plants of the saline, coastal area population A. Stomatal frequency was 12.2 on the lower leaf surface of population A while population B had a stomatal frequency of 14.9, suggesting that salinity reduced stomatal frequency.

Stomatal size was somewhat larger in population A than in population B. Stomatal size ranged from 7.96 μm to 10.96 μm in population A while in population B the range was 7.61 μm to 10.24 μm.

It seems obvious from the above results that a reduced number of slightly enlarged stomata were the characteristics of plant population of saline environment while the reverse was true for plants growing in the relatively less saline habitat of population B.

Epidermal cell wall undulations were fewer in plant population A. The number of undulations per cell was 4.3 in population A and 9.3 in population B. Similar results have been reported in other taxa when plants were growing under water stress[15].

Coastal population A of cancer-weed had more trichomes ($\bar{x} = 6623/cm^2$) on the lower surfaces of leaves than in population B ($\bar{x} = 3123/cm^2$). All trichomes were unicellular and the leaves of population A had a grayish appearance because of the presence of large number of trichomes. It would seem that a higher trichome frequency in the cancer-weed plants growing in the exposed coastal habitats of population A must be an adaptation in salinity and a defense mechanism against salt spray and also against excessive loss of water by lowering plant surface temperature.

Subsidiary cell complex consisting of 2 cells remained fairly constant in both populations—suggesting its usefulness in cancer-weed taxonomy.

The results of this study seem to indicate morphological and cuticular adaptations exhibited by cancer-weed growing in saline habitats and responsible for its survival in that environmental complex. It is suggested that these adaptations may have ecotypic and evolutionary significance for plants growing in saline environments of coastal area.

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