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**ABSTRACT**

Weeds are equally important as other plant species. Being an integral part of our ecosystem, they along with crops serve as food source in adverse kind of environments. Weeds develop different kinds of adaptations for their survival in different stressed conditions. Epidermal appendages and stomata serve as first line of defence against natural stresses. Present study was conducted to investigate the diversity of stomatal features of weeds collected randomly from Sargodha district. From the weeds collected 10 distinct weed species with diverse kinds of stomatal structure and shapes were selected. Weeds have different stomatal anatomy as some have paracytic and diacytic type of stomata while others have compound type of stomatal anatomy as well. Morpho-anatomical data showed that weeds in region Sargodha tend to have low stomatal density while higher stomatal length and width.

**Keywords:** Stomata, Diversity, Anomocytic, Paracytic, Diacytic

## 1. INTRODUCTION

Weeds are defined as a plant out of place or growing where it is not wanted, flourishing in habitats disturbed by humans, possessing competitive behaviour, and capable of mass movement from one area to another. Human values related to disturbed and agricultural habitats, appearance, utility and biological traits dominate how we define a plant as weedy **(**Dekker, 2011) . Since the leaf epidermal studies are considered important in phylogeny and taxonomy. Attention of plant taxonomists has been attracted toward the leaf epidermal anatomical studies to resolve the taxonomic problem and stomata are considered as a protection against extreme weather conditions. Region Sargodha is saline, and in saline region Paracytic and anomocytic type of stomata are more frequently found (Das & Ghose, 1993).

There are some reasons why we have great interest in stomata. Principal reason is that stomata are involved in the control of two of the most important plant processes, namely photosynthesis and transpiration (Mansfield et al., 1990). Stomata control 95 percent or more of the carbon dioxide and water vapour exchange between the leaf and the atmosphere (Bunce, 2004). They therefore control rates of photosynthesis and transpiration by plants and since photosynthesis is a major factor in determining rates of dry matter accumulation.

## 2. MATERIALS AND METHODS

To unravel the stomatal anatomy of weeds, fresh weed specimens were collected from the region under study. After careful identification and classification of leaf parts major taxonomical characteristics such as family name was pinpointed. After that free hand peeling and nail paint methods was done to observe the leaf epidermis.

Stained slides were prepared meticulously. To prepare stained slides of section of specimen, leaf was treated with varied concentrations of the ethanol solution in a 10-15 minutes time interval, the concentrations of ethanol solution treatment are as follow in time series manner: 30% , 60%, 50%. Afterwards in each leaf section 70% alcohol and 1 drop of safranin was added after a 10 minute interval. To remove the dye color, we washed our specimens with 90% and 100% alcohol solution for the leaf part of each sample under observation to conduct the anatomical section study by observing the epidermal appendages using high resolution microscope.

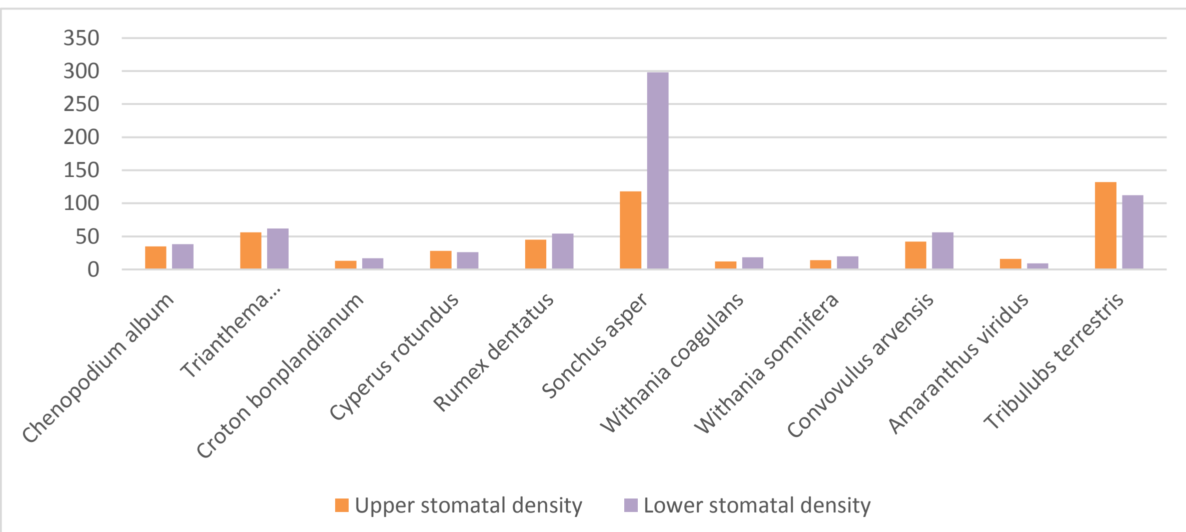
## 3. RESULTS AND DISCUSSION

Weeds are important part of flora have varying taxonomical and anatomical features. In the current study out of 11, two plants belong to family Solanaceae. Weeds of Solanaceae family have been characterized as media for

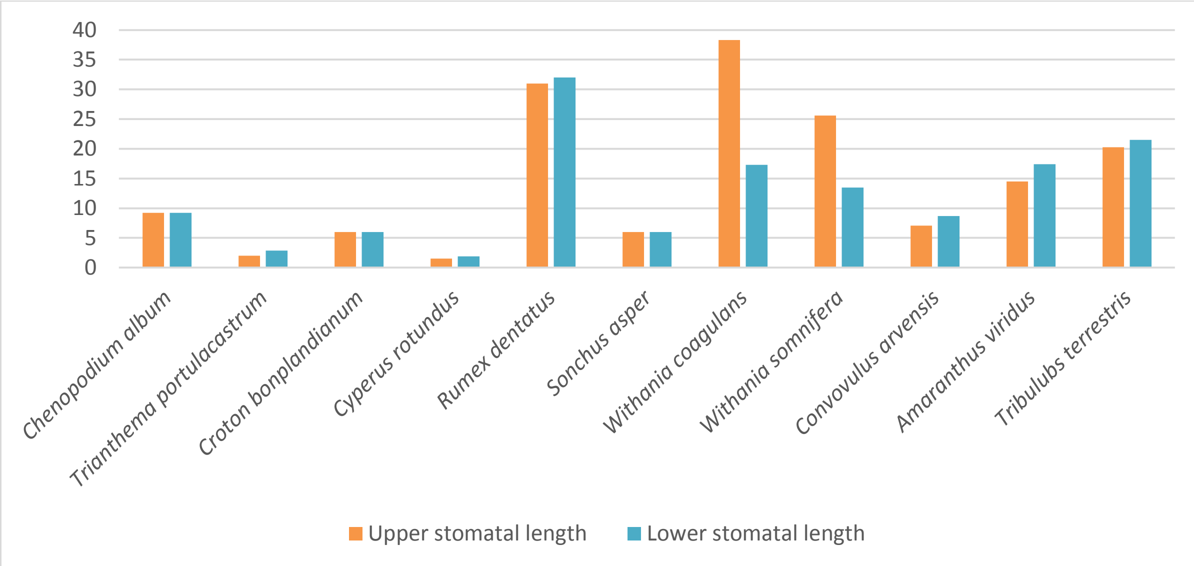
Cucumber mosaic virus infection in Southern Illinois (Hobbs et al., 2000) and other 1 each from other families namely: Chenopodiaceae, Aizoaceae or Ficoidaceae, Euphorbiaceae, Cyperaceae, polygonacea, Asteraceae, Convolvulaceae, Amaranthaceae, and Zygophyllaceae. Various types of stomata observed. On the basis of presence of stomata on the leaf surface we found two distinct types of leaves were under examination namely: epistomatic leaves (i.e. stomata occurring on the types of leaves adaxial surface only) and hypostomatic leaves (i.e. stomata occurring on the abaxial surface only (Li et al., 2007; Metcalfe & Chalk, 1950**)**. After careful observation 6 distinct types of stomata mainly Paracytic, anomocytic, anisocytic, actinocytic, diacytic and staurocytic, while in some weeds mixed stomatal type i.e., combination of two types was observed. Table 1 depicts the stomatal type. Paracytic, staurocytic and anomocytic types of stomata are mostly observed in the weeds under examination. In the paracytic type guard cells are accompanied by two subsidiary cells, the longitudinal axis of which is parallel to that of the guard cells and aperture. The stomata types can be signalled out as being the most significant in relation to the taxonomic separation of taxa. Anomocytic stomata are those in which the guard cells are not surrounded with any subsidiary cell indicating that presence of subsidiary cells varies from weed to weed. Thus it can be deduced from the data that paracytic, staurocytic and anomocytic stomatal type in weeds is more prominent in region Sargodha.

Stomatal density is one common measure of plant response to rising atmospheric carbon dioxide concentrations (Royer, 2001). Based on the density of stomata, *Sonchus asper* has Anomocytic stomata having highest density on upper and lower surfaces. But all other weeds under study have density upper stomatal upper and lower density up to 50 $mm^2$. Considering density in association to stomatal type, and leaves reflect significant differences in the weeds under study. A higher value of stomatal density directly correlates to higher rate of photosynthetic activity of particular plant and water conductance in plant (Schletz, 2008). However environmental factors also effect density of stomata. In the current study the weeds taken as sample generally do not exhibit high upper and lower stomatal density. As soil of Sargodha region is saline, thus lower density indicating low water conductance.

The stomatal size is parameter that is directly influences stomatal density. In the current study we found *Sonchus asper* having higher density has smallest stomatal length both upper and lower indicating that it has large number of stomata and their size is small. The data for stomatal length is in complete coherence with that of stomatal density. In our study, all the weeds except *Sonchus asper* have low stomata density but have significantly high length of stomata as compare to the density. Thus higher stomatal length is associated to reduced stomatal size (Drake et al., 2013).

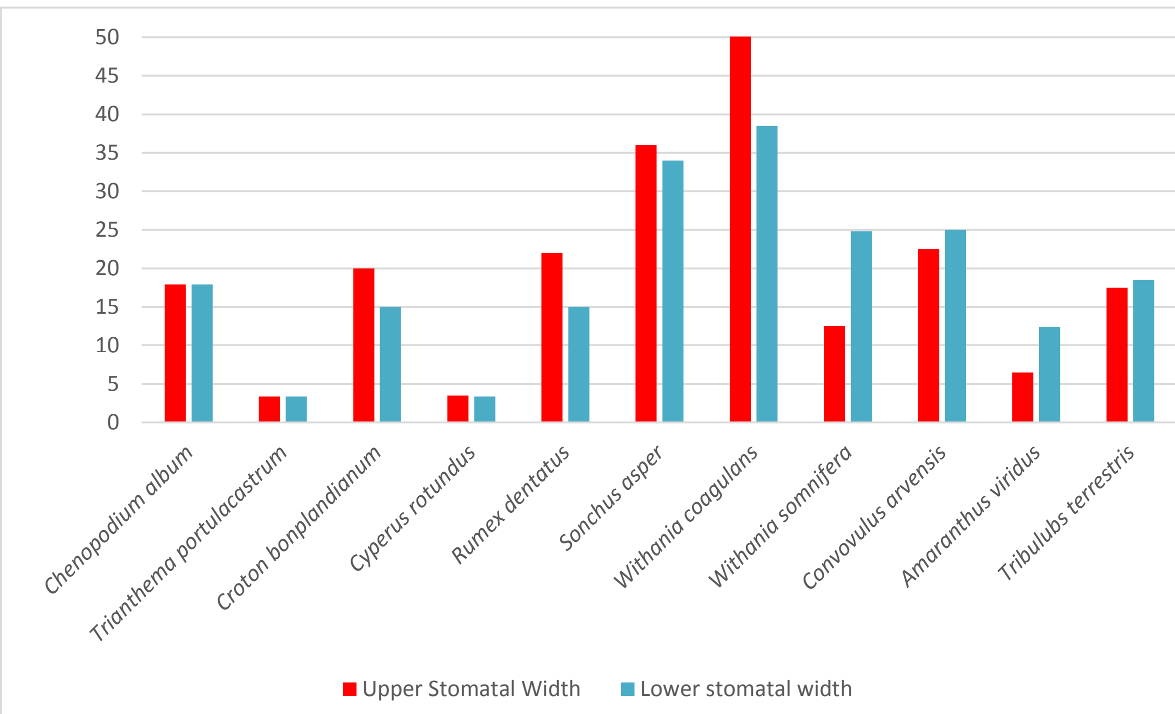



**Graph 1.** Stomatal density on upper and lower surface of selected weed species



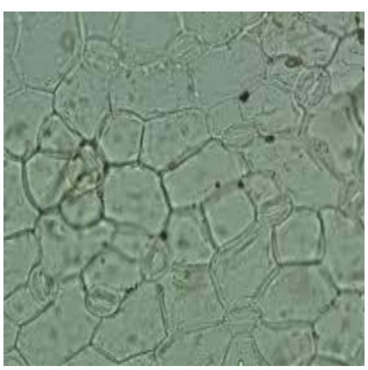
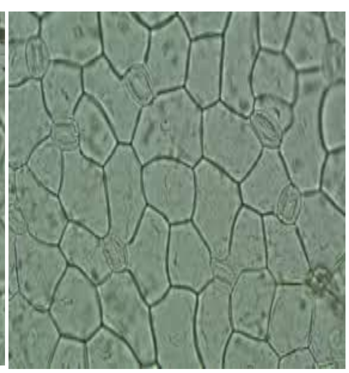

**Graph 2.** Stomatal length on upper and lower surface of selected weed species.

In previous studies stomatal width and stomatal length are found to be positively correlated with each other while both have negative correlation with stomatal density (Padoan et al., 2013). Our data shows an exception for *Sonchus asper*.




**Graph 3.** Stomatal width on upper and lower surface of selected weed species.

| | | *Stomatal Width in micrometer* | | *Stomatal lengths in micrometer* | | *Stomatal Density in mm2* | |
|---|---|---|---|---|---|---|---|
| *Specie Name* | Stomata Type | Upper | Lower | Upper | Lower | Upper | Lower |
| *Chenopodium album* | Staurocytic | 17.9 | 17.9 | 9.2 | 9.2 | 35 | 38 |
| *Trianthema portulacastrum* | Anomocytic & Aniosocytic | 3.38 | 3.38 | 1.99 | 2.89 | 56 | 62 |
| *Croton bonplandianum* | Paracytic | 20 | 15 | 6 | 6 | 13 | 17 |
| *Cyperus rotundus* | Paracytic | 3.5 | 3.35 | 1.51 | 1.9 | 28 | 26 |
| *Rumex dentatus* | Paracytic | 22 | 15 | 31 | 32 | 45 | 54 |
| *Sonchus asper* | Anomocytic | 36 | 34 | 6 | 6 | 118 | 298 |
| *Withania coagulans* | Anomotetracytic & Paracytic | 56.1 | 38.5 | 38.3 | 17.3 | 12 | 18.5 |
| *Withania somnifera* | Anomotetracytic & Anisocytic | 12.5 | 24.8 | 25.6 | 13.5 | 14 | 20 |
| *Convovulus arvensis* | Anomocytic | 22.5 | 25 | 7.09 | 8.7 | 42 | 56 |
| *Amaranthus viridus* | Staurocytic | 6.5 | 12.41 | 14.5 | 17.4 | 16 | 9 |
| *Tribulubs terrestris* | Actinocytic | 17.5 | 18.5 | 20.25 | 21.5 | 132 | 112 |

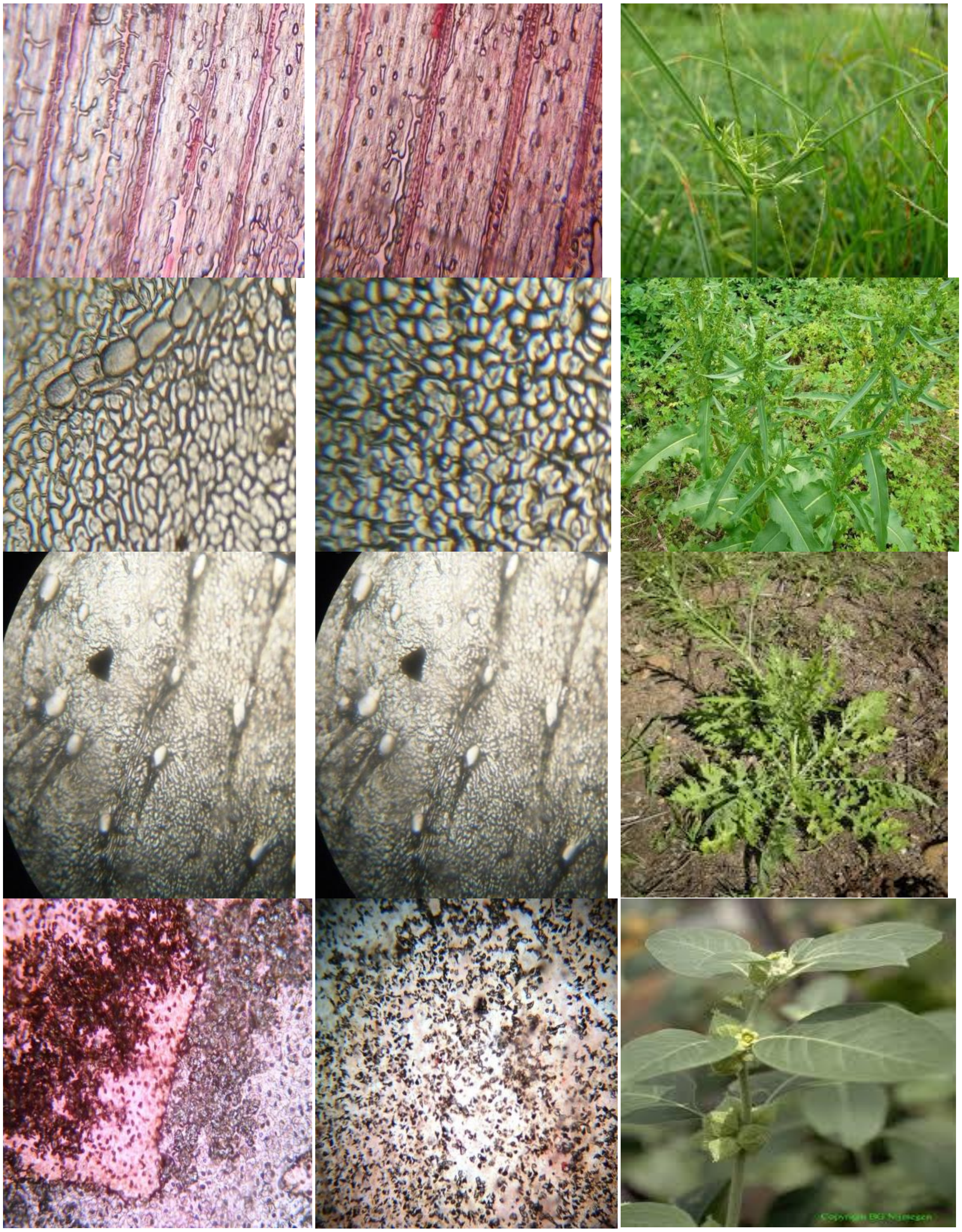



**Figure 1.** Comparative morpho-anatomical characteristics of (a) *Tribulus terrestris,* (b) *Chenopodium album*, (c) *Triantherma portulacastrum*, (d) *Croton bonplandianum*, (e) *Sonchus asper*, (f) *Cyperus rotundus*, (g) *Rumex dandatus*, (h) *Parthenium hysterophorus* and (i) *Withania coagulans*

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