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## *SUMMARY AND CONCLUSIONS*

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## SUMMARY AND CONCLUSION

In recent years, attention of various researchers has been drawn towards the arid and semiarid regions, due to peculiar plant forms and the problems they pose; such as morphological, anatomical, ecophysiological and others adjustments. The above mentioned problems have been dealt with in various books and reviews, such as Levin (1973), Johnson (1978), Sen (1978), Mann (1977), Mann and Dhir (1984), Evenari (1982, 1985), Wickens et. al. (1985), Goodall and Perry (1978) etc.

The present area of investigation, the district of Kutch, falls under arid cum semi-arid regions of India. In the past, only phytogeographical, vegetational and floristic studies have been carried out, that too for specific localities only. In recent reports, few researchers have given details regarding the flora and its diversities indicating qualitative and quantitative differences present among them.

**Vegetation :**

The study area has been divided into five zones for recording details regarding vegetational types present therein and to give details regarding the variations. The different aspects of vegetation have been described for different zones in detail.

Forest vegetation, in true sense, was recorded at limited sites only. Thorny scrub forest is the commonest vegetation in the region, occurring on large areas; on hillocks, hill slopes, rocky and undulated plains and few ones on alluvial/sandy soils also. Such vegetation is recorded in all the five zones of the district. However, only the plant forms and the area covered, differ in each zone. The hillocks in north, west and central zones form a natural landscape and support good number of trees. In these zones, on hills and hill slopes, dry deciduous type plant species are also recorded from Kala Dungar in north, Dinodhar and parts of Mata na madh in west and Chaudava and Mota dhola in central zones. These represent the heighest stage of development in the region.

Aquatic vegetation as a whole does not differ markedly in different zones. While, marshy and sandy saline vegetation is observed in east, south and west zones showing dominance of Avicennia marina and Salvadora persica. Vegetation along the roadsides is by and large comparable in different zones

except occurrence of different spinuous and non-spinuous plant species. Agricultural crops, weeds and hedge flora varies in different zones due to difference in soil composition and availability of irrigation facilities. Such vegetation was recorded from south, west and central zones, more conspicuously than north and east zone.

The overall study of the vegetation clearly depicted the degraded nature of vegetation in north, west and central zones. At few places, on rocky habitats, it represent the last remnants of vegetation and if it remains as such, in due course of time, it may become barren land devoid of vegetation.

The study of vegetation revealed the presence of few plant species, which are not usually metwith in adjoining areas. Moreover, populations representing them are very much localised in distribution and have been observed at few selected sites only. The size of the population is also very small. These plant species can be classified into 4 groups:

**A: Locally abundant in several habitat but restricted in distribution**

Fagonia indica var. schweinfurthii, Senra incana

**B: Locally abundant in specific habitat but restricted in distribution**

Abutilon pannosum, Pavonia arabica, P. zeylanica, Senra incana, Tribulus rajasthanensis and Premna resinosa

C: Constantly sparce in several habitat, but restricted in distribution

Zygophyllum simplex, Helichrysum cutchicum, Launaea resedifolia, Monsonia seneglensis and Seddera latifolia.

D: Constantly sparce and restricted in specific habitat

Capparis cartilaginea, Pavonia grewioides, Indigofera argentea, Heliotropium bacciform, Ipomoea kotschyana, Schweinufurthia pterosperma, and Chascanum marrubifolium.

### Morphology

A scrutiny of different population of these plant species, depicted differences in gross morphological features. Most of the observed differences were quantitative in nature than qualitative ones. Capparis cartilaginea and Senra incana depicted differences in both vegetative and reproductive features. While, Fagonia indica var. Schweinfurthii and Launaea resedifolia showed variations in vegetative characters only. Populations of Abutilon pannosum, Pavonia arabica, Pavonia zeylanica, Helichrysum cutchicum showed only minor variations in vegetative characters.

### Micromorphology

Comparison of micromorphological data revealed certain

features, which showed distinctness in epidermal features such as shape, size, frequency of epidermal cells, trichomes, stomatal types, veinislets number and palisade ratio.

Majority of the genera showed the presence of elongated, isodiametric epidermal cells except in 3 taxa, viz. Capparis certilaginea, Zygophyllum simplex and Schweinfurthia pterosperma; which depicted the presence of more number of polygonal cells alongwith above mentioned type. Epidermal cells of minimum size (52 x 48  $\mu\text{m}$ ) was noticed in Pavonia arabica and of maximum size (104 x 62  $\mu\text{m}$ ) in Zygophyllum simplex. The heighest (416 per/ $\text{mm}^2$ ) and the lowest (168 per/ $\text{mm}^2$ ) cell frequencies were recorded in Indigofera argentea and Z. simplex and Schweinfurthia pterosperma depicted the presence of smooth anticlinal walls. While, all the rest, showed presence of sinuous anticlinal walls. Over and above, the above mentioned features a mention may be made of the cuticular striations metwith in C. cartilaginea and Schweinfurthia pterosperma. Presence of multicellular scale and occurrence of calcium oxalate crystals was recorded only in Z. simplex and Ipomoea kotschyana.

Eglandular unicellular trichomes of different types were of more common occurrence than the different types were of more common occurrence than the different types of glandular ones. In addition, amidst the presently investigated taxa, 9 plant species viz. Abutilon pannosum, Pavonia arabica,

Pavonia zeylanica, Senra incana, Tribulus rajasthanensis, Monsonia senegalensis, Indigofera argentea, Launaea resedifolia and Heliotropium bacciferum showed predominance of eglandular, multicellular, stelate type of trichomes. Some characteristic type of trichomes viz. eglandular unicellular, 'T' shaped; eglandular, unicellular hooked and eglandular unicellular conical (thick walled) trichomes were noticed in specific taxa viz. Seddera latifolia, Indigofera argentea and Chascanum marrubifolium respectively. The glandular types of trichomes alongwith others were recorded in 10 plant species, which includes, Abutilon pannosum, Pavonia arabica, P. zeylanica, Senra incana, Tribulus rajasthensis, Monsonia senegalensis, Indigofera argentea, Launaea resedifolia, Heliotropium bacciferum and Premna resinosa.

Among the 19 plant species studied, quite a few revealed the presence of anomocytic, anisocytic and paracytic types of stomata. Variations regarding the percentage distribution of different types were recorded in different species. However, majority of them revealed the dominance (70% and above) of anomocytic type as compared to others. Dominance of (70% and above) anisocytic stomata was noticed in Pavonia arabica, P. zeylanica, Abutilon pannosum, Senra incana, Launaea resedifolia and Heliotropium bacciferum. A special mention of Ipomoea kotschyana becomes necessary because of this plant species showed presence of paracytic (70%) and

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 dicytic (29%) type only.

A different stomatal types were uniformly distributed in most of the species except C. cartilaginea, Schweinfurthia pterosperma and Fagonia indica var. schweinfurthii; in which they were sunken or deeply sunken. Stomatal abnormalities such as degenerated stomatal cell, permanent stomatal initials, twin contiguous stomata and juxtaposed stomata were recorded from Senra incana, Zygophyllum simplex, Monsonia senegalensis and Pavonia grewioides.

A review of available literature, revealed that of the 19 species worked out presently, only 7 species were earlier studied for micromorphological features. The present study also helped to add additional information regarding trichome types, stomatal types and stomatal abnormalities in 7 species viz. Pavonia zeylanica, Senra incana, Zygophyllum simplex, Fagonia indica var. Schweinfurthii, Launaea resedifolia, Tribulus rajasthanensis and Premna resinosa.

### Cytology

In the present work populations of some selected plant species distributed in Capparidaceae, Malvaceae, Zygophyllaceae, Fabaceae, Asteraceae, Boraginaceae, and Verbenaceae families have been studied for n and 2n numbers, meiotic behaviour and karyomorphology.



Different workers in the past, based on their studies have reported different base numbers for the genera included in the present study. Of the different base numbers proposed, the present study supports  $x = 6$  for Tribulus;  $x = 7$  for Pavonia and Helichrysum;  $x = 8$  for Abutilon, Launaea and Indigofera;  $x = 9$  for Fagonia and Capparis;  $x = 12$  for Chascanum;  $x = 13$  for Heliotropium;  $x = 17$  for Senra and  $x = 19$  for Premna. Quite a few of the presently studied species viz. Capparis cartilaginea, Pavonia arabica, Pavonia grewoides, Abutilon pannosum, Helichrysum cutchicum, Heliotropium bacciferum, Chascanum marrubifolium and Premna resinosa had remained cytologically unexplored.

Quite a few of the taxa scrutinised for meiotic behaviour, revealed the presence of meiotic abnormalities such as occurrence of laggards, bridge formation, early separation of bivalents, non-synchronised movement of chromosomes, presence of micronuclei etc. The above referred abnormalities were recorded in more numbers of pollen mother cells of Capparis cartilaginea, Abutilon pannosum, Pavonia arabica, Pavonia zeylanica, Senra incana, Indigofera argentea, Helichrysum cutchicum, Chascanum marrubifolium and Premna resinosa. One of the noteworthy features noticed in 8 out of 14 plant species studied is the occurrence of persistent tapetal cells, which appear distinct by its size, shape, deep staining and presence of micronuclei. These tapetal

cells were also studied for their divisional stages. Occurrence of persistent tapetal cells in these taxa of arid and semi-arid stress conditions, support the proposed hypothesis (Nakashima and Hosokawa 1974), that persistent tapetal cells must be the primary cause for presence of only few fertile pollen mother cells. The same trend concerning the influence of abnormal tapetal cells and its behaviour is envisaged in the works of Gupta and Nanda (1973, 1974) and Horner & Rogers (1974), Panchaksharappa et al. (1985).

Out of 5 plant species, worked out presently, for the karyomorphological details, Pavonia zeylanica was earlier studied by Dasgupta (1976). Other 4 species viz. Senra incana, Abutilon pannosum, Launaea resedifolia and Capparis cartilaginea have been studied for the first time, for karyotypic details. All the taxa studied, by and large showed asymmetrical and graded nature of the karyotypes. The karyotypes of different species differ amongst themselves in having more or less number of different types of chromosomes. The longest chromosome pair was noticed in the somatic complement of Senra incana (7.02  $\mu$ m) and shortest chromosome pair in Capparis cartilaginea (1.98  $\mu$ m). In addition in Senra incana and Pavonia zeylanica presence of satellited chromosomes were recorded.

Persual of available literature revealed that, out of 14 species studied only 5 species viz. Senra incana, Pavonia

zeylanica, Tribulus rajasthanensis, Launaea resedifolia and Indigofera argentea were earlier studied from cytological view points.

#### Germination Behaviour

It can be concluded from the present studies that, the inability of seeds to germinate, except those of Capparis cartilaginea is due to i) Presence of thick seed coat and ii) Presence of inhibitors. The percentage germination of seeds was improved consequent to their scarification, presowing soaking and treatment with thiourea and plant hormones.

The observed meiotic abnormalities as reflected in low pollen fertility, occurrence of persistent tapetal cells, poor seed setting, coupled with unfavourable environmental conditions could be responsible for small populations of various taxa. The presence of xeromorphic nature of plants having unique characteristic macro and micromorphological features must be rendering tolerance mechanisms to the unfavourable conditions. A combination of the above mentioned factors may be responsible for restricted distribution and small population of various taxa under arid and semi-arid conditions of the study area.