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***Research Article***

# PALYNO-MORPHOMETRIC STUDIES IN SOME CASSIA L. SPECIES FROM MAHARASHTRA

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## ABSTRACT
Palyno- Morphometric studies in 8 species of *Cassia* from Maharashtra State were performed with the help of processes like principal component analysis, principal co-ordinate analysis, cluster analysis and scanning electron microscopy technique. It was observed that most of the pollen grains are trizonicolporate, prolate or subprolate evaluating the evolutionary closeness among the studied species in the sequence as - *Cassia auriculata- Cassia fistula- Cassia obtusifolia- Cassia alata- Cassia siamea- Cassia tora- Cassia uniflora.*

***Keywords:*** *Cassia, Cluster Analysis, Palyno-Morphometric, Principal Component Analysis, Principal Co-ordinate Analysis*

## INTRODUCTION
*Cassia* is one of the largest genera with maximum number of species which is represented by about 32 different species from Maharashtra State, out of these, 16 species are wild and 16 are exotic ones (Singh and Karthikeyan 2000). Members of the genus *Cassia* consists of annual or perennial herbs, shrubs and trees which have been differentiated on the basis of number of leaflets, fertile and sterile stamens in single flower and glands present on the leaves (Cooke 1902). Taxonomy of this group is puzzling because of the extreme morphological variability, overlapping morphological characters and great range of similarities as well as ambiguous boundaries between taxa (Kumar *et al.,* 2007, Soladoye *et al.,* 2010). Palynology play important role in plant systematics and has great application in tracing the history of plant groups (Arogundade and Adedeji 2009). Hyde and William (1945) first coined the term 'palynology' which relates to the study of pollen grains and spores (Aftab and Perveen 2006). Palynological studies have been carried in the genera *Polygonum* (Hedgeberg 1946), *Bauhinia* (Larsen 1975), *Ceratonia* (Ferguson 1980), *Arabidopsis* (Khan 2004), *Ocimum* spp. (Arogundade and Adedeji 2009), *Rumex* spp. (Yasmin *et al.,* 2010). Likewise different workers have studied different plant families such as Apocynaceae (Schill and Leuenberger 1972), Malvaceae (Christensen 1986), Sapotaceae (Harley 1991), Leguminosae- the Caesalpinioideae (Jumah 1991), Naucleeae (Kuanga *et al.,* 2008), Leguminosae (Perveen and Qaiser 1998; Masih *et al.,* 2005), Asteraceae (Zafar *et al.,* 2007). The pioneer palynological studies have been done by Erdtman (1952, 1960).
Morphometric studies have great importance and play significant role in distinct grouping or segregation of closely associated species. The processes like principal component analysis, principal co-ordinate analysis and cluster analysis produces hierarchical classification of entities based on similarity matrix, distance matrix and dendrogram. Such studies have earlier performed in the genus *Ficus* L. (Sonibare *et al.,* 2004), *Acalypha* L., *Senna* Mill., *Indigofera L.* (Soladoye *et al.,* 2008, 2010, 2010) and *Cassia* L., *Exacum* L., *Clerodendrum* L., *Caesalpinia* L. (Deshmukh *et al.,* 2011, 2012, 2012, 2013) by taking an account of the morphological quantitative characters only. In the present study an attempt has been made to evaluate the relationship in between the *Cassia* species on the basis of Palyno-Morphometric analysis.

## MATERIALS AND METHODS
The plant samples were collected from various localities of Maharashtra and identified with the help of standard literature (Cooke 1901, Singh and Karthikeyan 2000, Singh, 2001 and Yadav and Sardesai

2002). Pollen grains were collected and processed for the acetolysis method (as per Erdtamn 1952, 1960). After acetolysis the pollen grains were prepared for scanning microscopy. The SEM studies were done in the Department of Physics, Shivaji University, Kolhapur. Pollen dimensions were measured and different quantitative characters viz. equatorial diameter, polar diameter, P/E ratio and numbers of apertures processed for the principal component analysis (PCA), principal co-ordinate analysis and cluster analysis (Kovach 1999).

## RESULTS AND DISCUSSION

The results interpreted shows that most of the pollen grains are three zonicolporate, prolate or subprolate with three apertures at equatorial region. The polar dimension ranges from 28.33 µ to 43.21 µ while the equatorial dimension ranges from 23 µ to 37 µ. Palyno-Morphometric studies based on the PCA (similarity matrix) reveals close relationship between polar diameter and equatorial diameter while principal co-ordinate analysis (distance matrix) shows great similarities between *Cassia alata- Cassia obtusifolia- Cassia tora; Cassia auriculata- Cassia occidentalis and Cassia fistula- Cassia occidentalis- Cassia uniflora*. On the basis of cluster analysis (Dendrogram) the species relationship in sequence is *Cassia auriculata- Cassia fistula- Cassia obtusifolia- Cassia alata- Cassia siamea- Cassia tora- Cassia uniflora.*

**Table 1: Studied *Cassia* L. species with their habit**

| Sr. No. | Name of the species | Habit |
|---|---|---|
| 1 | *Cassia alata* L. | Shrub |
| 2 | *Cassia auriculata* L. | Shrub |
| 3 | *Cassia fistula* L. | Tree |
| 4 | *Cassia obtusifolia* L. | Herb |
| 5 | *Cassia occidentalis* L. | Shrub |
| 6 | *Cassia siamea* Lam. | Tree |
| 7 | *Cassia tora* L. | Herb |
| 8 | *Cassia uniflora* Mill. | Herb |

**Table 2: Palynological dimensions in the studied *Cassia* species**

| | *Cassia alata* L. | *Cassia auriculata* L. | *Cassia fistula* L. | *Cassia obtusifolia* L. | *Cassia occidentalis* L. | *Cassia siamea* Lam. | *Cassia tora* L. | *Cassia uniflora* Mill. |
|---|---|---|---|---|---|---|---|---|
| Polar Diameter (µ) | 31.25 | 36.36 | 35.83 | 34.28 | 36.92 | 43.21 | 28.33 | 34.61 |
| Equatorial Diameter (µ) | 24.7 | 30 | 33.63 | 24.6 | 32 | 33.33 | 23 | 37 |
| P/E Ratio (µ) | 1.26 | 1.212 | 1.065 | 1.39 | 1.15 | 1.29 | 1.23 | 0.9182 |
| Aperture Number | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Table 3: Data standardized for Principal Component Analysis, Principal Co-ordinate Analysis and Cluster Analysis**

| | *Cassia alata* L. | *Cassia auriculata* L. | *Cassia fistula* L. | *Cassia obtusifolia* L. | *Cassia occidentalis* L. | *Cassia siamea* Lam. | *Cassia tora* L. | *Cassia uniflora* Mill. |
|---|---|---|---|---|---|---|---|---|
| Polar Diameter (µ) | 1.509 | 1.572 | 1.566 | 1.548 | 1.579 | 1.646 | 1.467 | 1.552 |
| Equatorial Diameter (µ) | 1.410 | 1.491 | 1.539 | 1.408 | 1.519 | 1.536 | 1.380 | 1.580 |
| P/E Ratio (µ) | 0.354 | 0.345 | 0.315 | 0.378 | 0.332 | 0.360 | 0.348 | 0.283 |
| Aperture Number | 0.602 | 0.602 | 0.602 | 0.602 | 0.602 | 0.602 | 0.602 | 0.602 |

**Table 4: Principal Component Analysis**

| Similarity matrix | Polar Diameter | Equatorial Diameter | P/E Ratio | Aperture Number |
|---|---|---|---|---|
| Polar Diameter (µ) | 1.000 | | | |
| Equatorial Diameter (µ) | 0.705 | 1.000 | | |
| P/E Ratio (µ) | -0.005 | -0.713 | 1.000 | |
| Aperture Number | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 5: Principal Co-ordinate Analysis**

| Distance matrix | *Cassia alata* L. | *Cassia auriculata* L. | *Cassia fistula* L. | *Cassia obtusifolia* L. | *Cassia occidentalis* L. | *Cassia siamea* Lam. | *Cassia tora* L. | *Cassia uniflora* Mill. |
|---|---|---|---|---|---|---|---|---|
| *Cassia alata* L. | 0.000 | | | | | | | |
| *Cassia auriculata* L. | 0.104 | 0.000 | | | | | | |
| *Cassia fistula* L. | 0.147 | 0.057 | 0.000 | | | | | |
| *Cassia obtusifolia* L. | 0.046 | 0.093 | 0.147 | 0.000 | | | | |
| *Cassia occidentalis* L. | 0.131 | 0.031 | 0.030 | 0.124 | 0.000 | | | |
| *Cassia siamea* Lam | 0.186 | 0.087 | 0.091 | 0.162 | 0.074 | 0.000 | | |
| *Cassia tora* L. | 0.051 | 0.153 | 0.190 | 0.090 | 0.178 | 0.237 | 0.000 | |
| *Cassia uniflora* Mill. | 0.189 | 0.110 | 0.054 | 0.196 | 0.083 | 0.129 | 0.226 | 0.000 |

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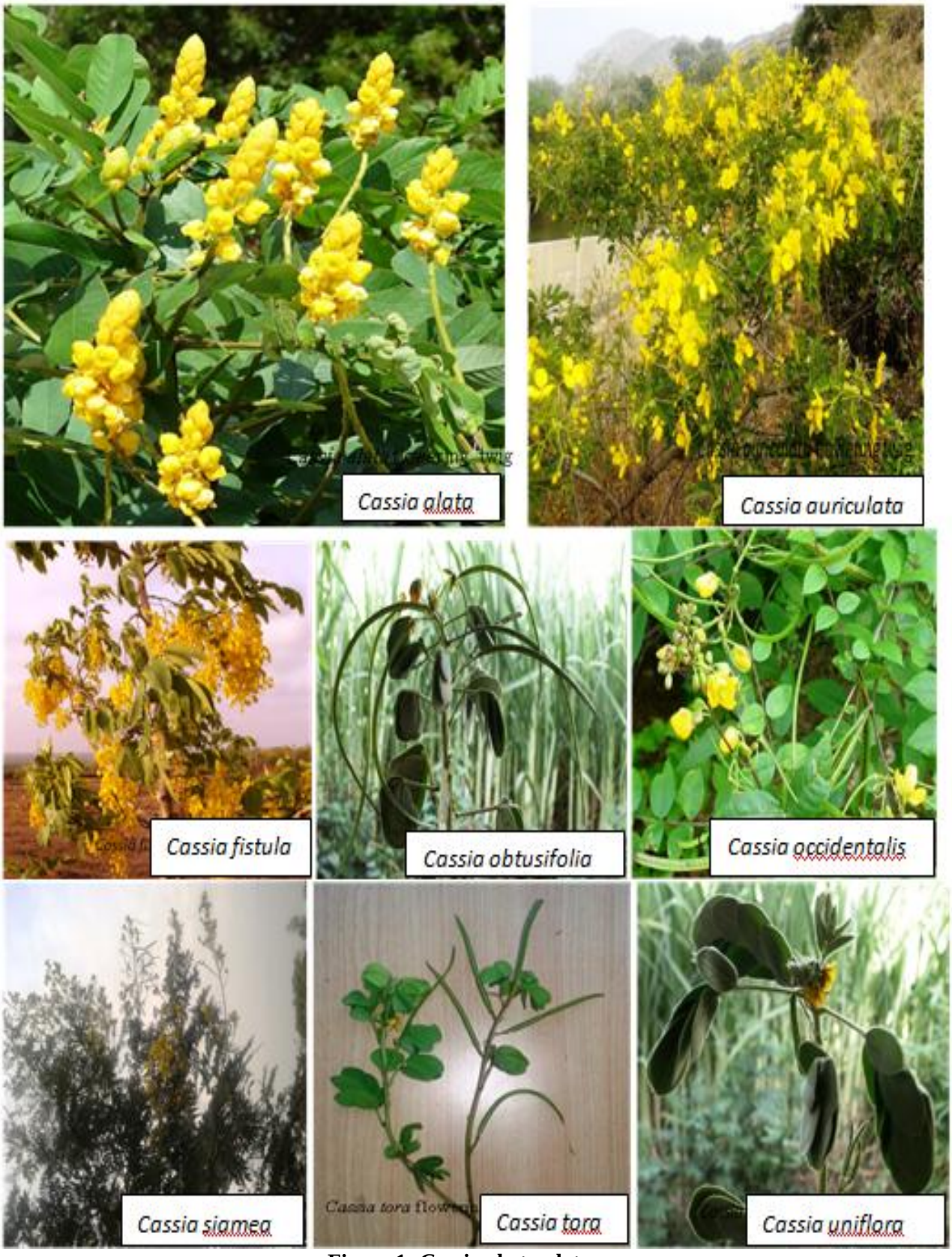
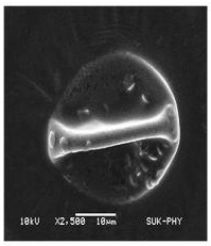
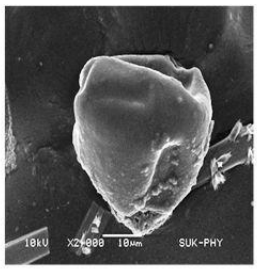


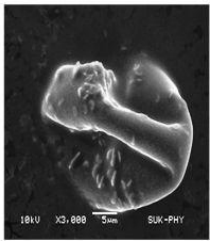

**Figure 1: *Cassia* photo plates**

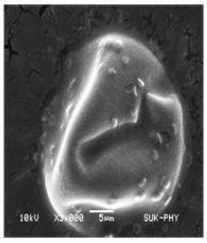
*Cassia alata*

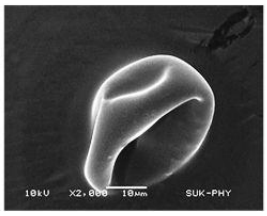


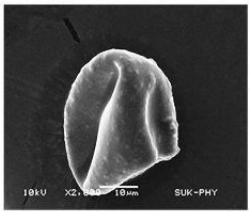
*Cassia auriculata*



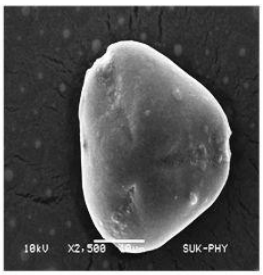




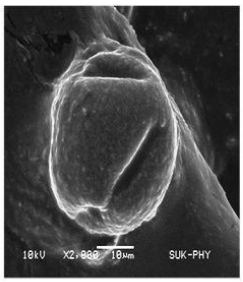


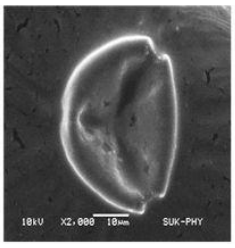


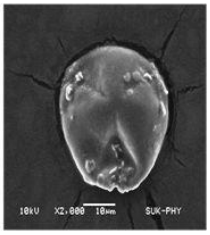
*Cassia fistula*

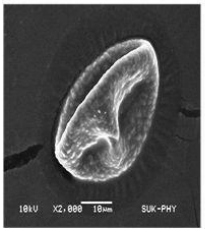


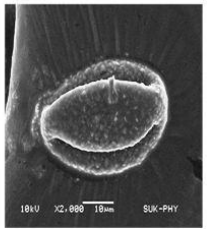
*Cassia obtusifolia*



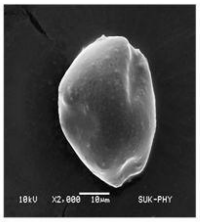




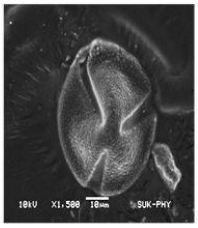


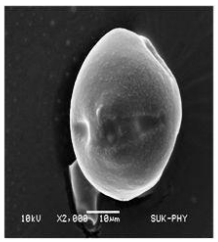


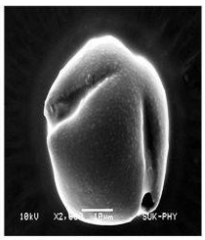
*Cassia occidentalis*



*Cassia siamea*







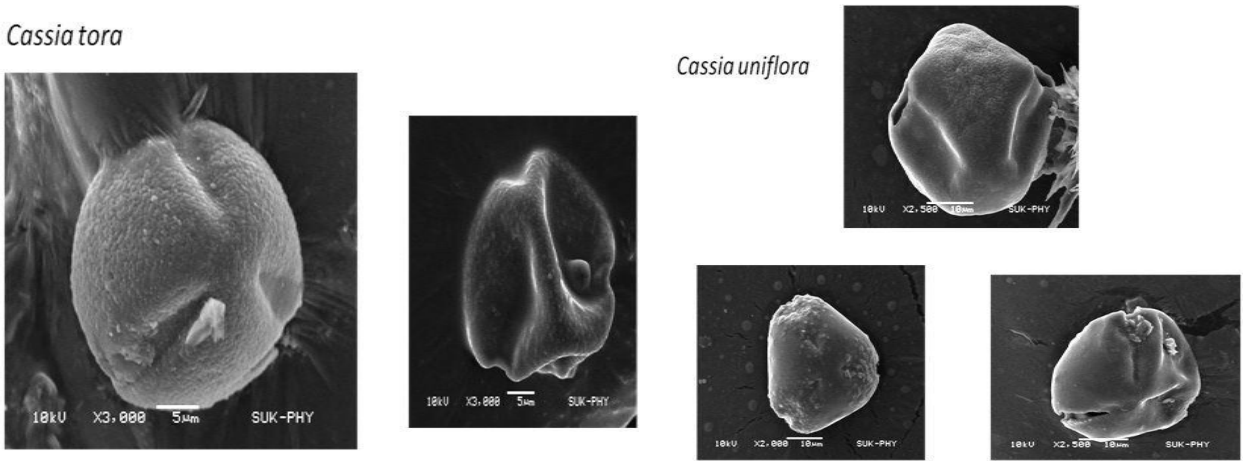



**Figure 2: SEM photo plates of pollen grains of *Cassia* species**

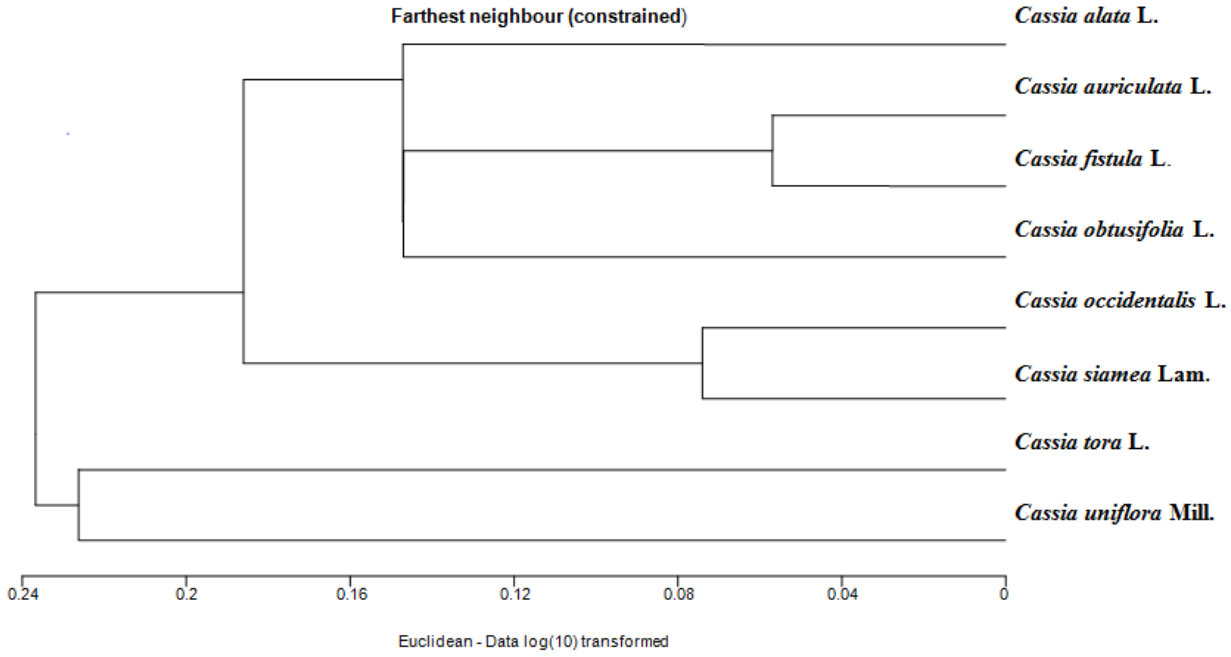



**Figure 3: Dendrogram based on the palynological characters in the studies *Cassia* species**

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