ISSN 0376-5561
Geophytology 45(1): 31-40
May 2015

Pollen diversity in medicinal shrubs of Adilabad District, Telangana, India

R. Prabhakar and H. Ramakrishna*

Department of Botany, University College of Science, Osmania University, Saifabad, Hyderabad-500004, India
E-mail: prabhakar.rathna@gmail.com; hrkpaleobot@gmail.com*
*Corresponding author

Manuscript received: 04 July 2014
Accepted for publication: 22 December 2014

ABSTRACT

Prabhakar R. & Ramakrishna H. 2015. Pollen diversity in medicinal shrubs of Adilabad District, Telangana, India. Geophytology 45(1): 31-40.

The present paper deals with pollen diversity in thirty-nine medicinal shrubs from forest and irrigated localities of Adilabad district, Telangana. These shrubs, belonging to Acanthaceae, Annonaceae, Apocynaceae, Asclepiadaceae, Asteraceae, Caesalpiniaceae, Cactaceae, Caricaceae, Celastraceae, Euphorbiaceae, Fabaceae, Liliaceae, Lythraceae, Malvaceae, Mimosaceae, Nyctaginaceae, Nyctanthaceae, Pedaliaceae, Rubiaceae, Solanaceae, Tiliaceae and Verbenaceae, are used by the inhabitant tribes for medicinal purposes to cure various ailments. The pollen of these shrubs have diversity in apertural pattern, viz. inaperturate, monosulcate, dizonocolporate, tricolpate, trizonocolpate, tricolporate, trizonocolporate, parasyncolpate, pantocolpate, polyporate and pollinia, and other morphological characters.

Key-words: Pollen diversity, ethnomedicinal shrubs, Adilabad district, Telangana, India.

INTRODUCTION

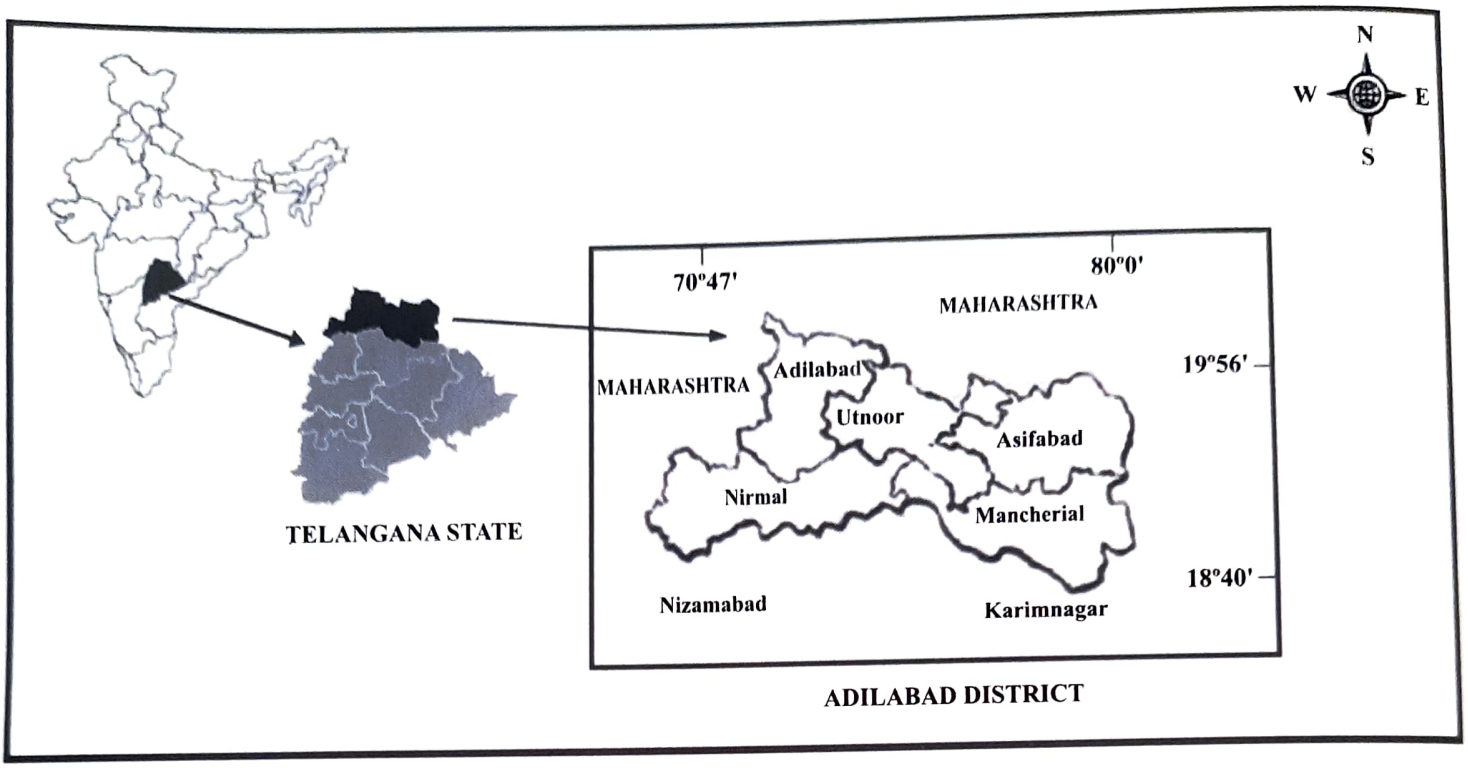
Adilabad District (Lat. 18°40'N to 19°56'N, Long. 77°47'E to 80°0'E) of Telangana occupies both irrigated and forested areas (Text-figure 1). It has dry deciduous forest with diversity in flora, containing herbs, shrubs and trees of medicinal importance which are used to cure various ailments by inhabitant tribes of Adilabad District. In the present study, diversity in pollen characters are recorded in the ethnomedicinal shrubs.

MATERIAL AND METHODS

The polleniferous material from shrubs of ethnomedicinal importance was collected from Adilabad, Asifabad, Mancherial, Nirmal and Utnoor revenue divisions of Adilabad district in Telangana State. Ethnomedicinal data was recorded by interacting with inhabitant tribes in summer, rainy and winter seasons during 2011-2013. The material was processed by using acetolysis technique (Erdtman 1960) and pollen slides were prepared. These pollen slides were studied under trinocular research microscope and pollen morphological characters were recorded. The ethnomedicinal uses of these shrubs were confirmed from the inhabitant tribes and local people of the studied localities.

OBSERVATION

Pollen of thirty-nine medicinal shrubs, belonging to families Acanthaceae, Annonaceae, Apocynaceae, Asclepiadaceae, Asteraceae, Caesalpiniaceae, Cactaceae, Caricaceae, Celastraceae, Euphorbiaceae, Fabaceae, Liliaceae, Lythraceae, Malvaceae, Mimosaceae, Nyctaginaceae, Nyctanthaceae, Pedaliaceae, Rubiaceae, Solanaceae, Tiliaceae and



Text- figure 1. Map showing location of study area.

Verbenaceae, were studied and diversity in their morphological characters was observed. These shrubs are used by local tribes as medicinal plants to cure various ailments (Table 1).

DESCRIPTION OF POLLEN

Family: Acanthaceae

Adhatoda zeylanica Medic. in Hist & Comm

Plate 1, figure 1

Description: Pollen prolate, polar view (P.V.) 49.5 µm, equatorial view (E.V.) 30 µm, dizonocolporate. Colpi linear, 25.5 µm long, 0.75 µm wide at equator, sides tapering, tips acute, ora lalongate. Exine 4 µm thick, sexine as thick as nexine, columella distinct 1 µm long, reticulate sculpture.

Barleria prionitis L.

Plate 1, figure 2

Description: Pollen spheroidal, amb 90 µm in diameter, P.V. 66 µm, E.V. 60 µm, trizonocolporate. Colpi narrowly elliptic, 49 µm long, 28 µm wide, sides tapering, tips acute, ora lolongate. Exine 13 µm thick, sexine thicker than nexine, lumina irregularly polygonal to variously shaped, columella distinct, reticulate sculpture.

Family: Annonaceae

Annona squamosa L.

Plate 1, figure 3

Description: Pollen in monads, dyads or tetrads, prolate, monads prolate spheroidal, inaperturate. Exine

→

Plate 1

All figures magnified x500

1. *Adhatoda zeylanica*. 2. *Barleria prionitis*. 3. *Annona squamosa*. 4. *Nerium oleander*. 5. *Rauwolfia serpentina*.6. *Calotropis gigantea*. 7. *Holostemma adakodien*. 8. *Artemesia vulgaris*. 9. *Notonia grandiflora*. 10. *Cassia alata*. 11. *Cassia auriculata*. 12. *Caesalpinia pulcherrima*. 13. *Opuntia stricta*. 14. *Carica papaya*. 15. *Celastrus paniculata*. 16. *Maytenus emarginatus*. 17. *Jatropha gossypifolia*. 18. *Jatropha multifida*. 19. *Manihot esculanta*. 20. *Ricinus communis*. 21. *Cajanus cajan*. 22. *Indigofera tinctoria*. 23. *Tephrosia purpurea*. 24. *Asparagus racemosus*. 25. *Lawsonia inermis*. 26. *Woodfordia fruticosa*. 27. *Abutilon indicum*. 28. *Gossypium herbaceum*. 29. *Hibiscus rosasinensis*. 30. *Mimosa pudica*. 31. *Bougainvillea spectabilis*. 32. *Mirabilis jalapa*. 33. *Nyctanthes arbortristis*. 34. *Martynia annua*. 35. *Ixora coccinea*. 36. *Solanum melongena*. 37. *Withania somnifera*. 38. *Grewia hirsuta*. 39. *Vitex negundo*.

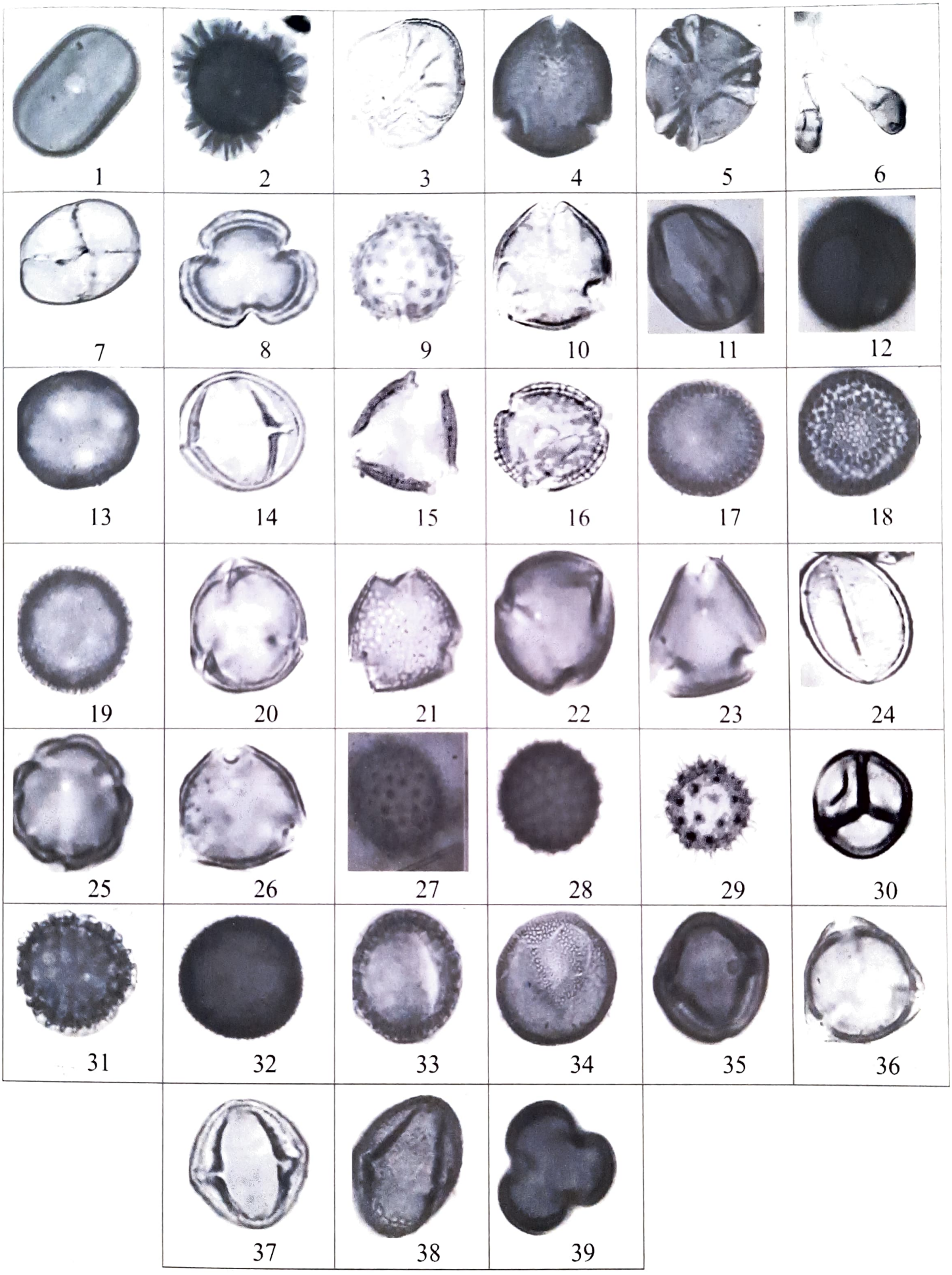

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

Plate 1

3.5 µm thick, sexine thicker than nexine, foveolate-striate sculpture.

Family: Apocynaceae

***Nerium oleander* L.**

Plate 1, figure 4

Description: Pollen in monad, subprolate, amb 45 µm in diameter, tricolporate. Exine 3 µm thick, sexine as thick as nexine, granulate sculpture.

***Rauwolfia serpentina* (L.) Benth. ex Kurz.**

Plate 1, figure 5

Description: Pollen grains spheroidal, amb 63 µm in diameter, obtuse, convex, parasyncolpate. Exine 3 µm thick, sexine as thick as nexine, perforate sculpture.

Family: Asclepiadaceae

***Calotropis gigantea* (L.) R. Br.**

Plate 1, figure 6

Description: Pollen grains usually pollinia, united in tetrads, 31.5 µm in diameter. Tetrads tetrahedral, rhomboidal and linear. Exine very thin, obscure sculpture.

***Holostemma adakodien* Schult.**

Plate 1, figure 7

Description: Pollen grains usually pollinia, united in tetrads, 29.5 µm in diameter. Tetrads tetrahedral, rhomboidal and linear. Exine very thin, obscure sculpture.

Family: Asteraceae

***Artemesia vulgaris* L.**

Plate 1, figure 8

Description: Pollen grains prolate spheroidal, amb 24 µm in diameter. P.V. 22.5 µm, E.V. 21 µm, trizonocolporate. Colpi narrowly elliptic, 18 µm long, 3 µm wide, sides tapering, tips acute, ora faint, mesocolpia 17.5 µm long. Exine 3 µm thick, sexine thicker than nexine, scabrate sculpture.

***Notonia grandiflora* DC.**

Plate 1, figure 9

Description: Pollen grains oblate spheroidal, amb 30 µm in diameter, trizonocolporate. Colpi narrowly elliptic, 15 µm long, 3.5 µm wide, sides tapering, tips acute, ora lalongate. Exine 6 µm thick, sexine thicker than nexine, echinate sculpture, spines 2.5 µm long, 1.5 µm at the base.

Family: Caesalpiniaceae

***Cassia alata* L.**

Plate 1, figure 10

Description: Pollen grains prolate spheroidal, amb 30 µm in diameter, triangular, obtuse, convex, P.V. 25.5 µm, E.V. 24 µm, tricolporate. Colpi narrowly elliptic, 22 µm long, 2 µm wide, sides tapering, tips acute, ora narrowly oblong. Exine 1.5 µm thick, sexine thicker than nexine, psilate sculpture.

***Cassia auriculata* L.**

Plate 1, figure 11

Description: Pollen grains prolate, amb 27 µm in diameter, P.V. 37.5 µm, E.V. 25.5 µm, trizonocolporate. Colpi narrowly elliptic, 30 µm long, 2.5 µm wide, sides tapering, tips acute, ora not very distinct. Exine 1.5 µm thick, sexine as thick as nexine, reticulate sculpture.

***Caesalpinia pulcherrima* (L.) Sw.**

Plate 1, figure 12

Description: Pollen grains spheroidal, amb 52.5 µm in diameter, trizonocolporate. Colpi narrowly elliptic, 32 µm long, 12 µm wide, sides tapering, tips acute, ora circular. Exine 3 µm thick, sexine as thick as nexine, reticulate sculpture.

Family: Cactaceae

***Opuntia stricta* (Haw.) Haw.**

Plate 1, figure 13

Description: Pollen grains suboblate, amb 84 µm in diameter, rounded, pantoporate. Pori circular to oblate, 14 µm in diameter, margin thin, 17.5 µm in wide, interpolar distance 16 µm. Exine 6 µm thick, sexine thicker than nexine, foveolate sculpture.

Family: Caricaceae

***Carica papaya* L.**

Plate 1, figure 14

Description: Pollen grains spheroidal, amb 30 µm in diameter, rounded, P.V. 30 µm, E.V. 29.5 µm, tricolporate. Colpi 19 µm in diameter, ora lalongate, tapering ends. Exine 1.5 µm thick, sexine as thick as nexine, reticulate sculpture.

Family: Celastraceae

Celastrus paniculata Willd.

Plate 1, figure 15

Description: Pollen grains in monads, monads prolate, amb 14 µm in diameter, triangular, trizonocolporate. Colpi narrowly elliptic, 18.5 µm long, sides tapering towards the poles, tips acute, ora oblong to circular, mesocolpia 14.5 µm long. Exine 2.5 µm thick, sexine thicker than nexine, columella distinct, 0.5 µm long, reticulate sculpture, lumina variously polygonal.

Maytenus emarginatus (Willd.) Ding Hou.

Plate 1, figure 16

Description: Pollen grains subprolate, amb 18 µm in diameter, triangular, P.V. 18 µm, E.V. 15 µm, tricolporate. Colpi narrowly elliptic, 13.5 µm long, 2 µm wide, sides tapering, tips acute, ora lalongate. Exine 1.5 µm thick, sexine thinner than nexine, columellae distinct, reticulate sculpture.

Table 1. List of plants used for various diseases.

S. No.	Name of the taxa	Part of plants used	Diseases
1	*Adhatoda zeylanica*	Leaves, flower	Asthma, chicken pox, cough, gonorrhoea
2	*Barleria prionitis*	Stem, root, leaves	Asthma, boils, body swellings, skin diseases, eye infection
3	*Annona squamosa*	Stem, root	Dandruff, worm killing
4	*Nerium oleander*	Flower, leaves	Asthma, tuberculosis, whooping cough
5	*Rauwolfia serpentina*	Root	Blood pressure, dog bite, fever, joint pains, rheumatic pains, scorpion sting, snake bite
6	*Calotropis gigantea*	Leaves, latex, root	Arthritis, cuts, wounds, purgative, stomach ache
7	*Holostemma adakodien*	Root	Gonorrhoea
8	*Artemesia vulgaris*	Leaves	Indigestion
9	*Notonia grandiflora*	Stems	Pimples
10	*Cassia alata*	Leaves, flower	Ringworm, purgative
11	*Cassia auriculata*	Leaves, seed	Anthelmentic, bone fracture, diabetes, eye infection, worm killing
12	*Caesalpinia pulcherrima*	Stem ,leaf, flower	Purgative, fever
13	*Opuntia stricta*	Stem, fruit	Asthma, contraceptive, whooping cough
14	*Carica papaya*	Latex, leaves	Abortion
15	*Celastrus paniculata*	Leaves, root	Body pains, cancer, fever, leucorrhoea, memory power
16	*Maytenus emarginatus*	Leaves, stem	Body swelling, lice killing, rheumatic pain, sores, ulcers
17	*Jatropha gossypifolia*	Leaves, root, seed	Blood purification, body swellings, skin disease, eczema, inflammation, leprosy, snake bite, ulcers
18	*Jatropha multifida*	Seed	Purgative
19	*Manihot esculanta*	Tuberous root	Dyspepsia, vomiting, toothache, constipation
20	*Ricinus communis*	Root, leaves, seed	Fever, headache, purgative, sun stroke
21	*Cajanus cajan*	Seed, leaves	Diarrhoea, dysentery, stomach ache
22	*Indigofera tinctoria*	Leaves, root	Bronchitis, burns, dog bite, obesity
23	*Tephrosia purpurea*	Leaves, root	Arthritis, headache, fever, rheumatic pain, scorpion sting, cooling effect
24	*Asparagus racemosus*	Root, cladode, leaves	Dyspepsia, sun stroke, rheumatic pain, galactogogue, nervous weakness
25	*Lawsonia inermis*	Leaves, stem	Alopecia, burns, dandruff, headache, psoriasis
26	*Woodfordia fruticosa*	Leaves, flower	Diarrhoea, rheumatic pain,
27	*Abutilon indicum*	Stem bark, root, leaves	Diuretic, dysentery, toothache
28	*Gossypium herbaceum*	Root	Snake bite
29	*Hibiscus rosasinensis*	Leaves	Alopecia
30	*Mimosa pudica*	Leaves, root	Diarrhoea, dysuria, fever, filariasis, malaria
31	*Bougainvillea spectabilis*	Leaves	Diabetes
32	*Mirabilis jalapa*	Root	Blisters, boils, chest pain
33	*Nyctanthes arbortristis*	Leaves, seed	Blood purification
34	*Martynia annua*	Root	Bronchitis, diuretic, pneumonia
35	*Ixora coccinea*	Root	Diarrhoea, dysentery, ulcers
36	*Solanum melongena*	Leaves	Earache
37	*Withania somnifera*	Tuber, root	Nervous weakness, blood disorders
38	*Grewia hirsuta*	Leaves, root	Blood secretion from the nose
39	*Vitex negundo*	Leaves	Arthritis, asthma, bruises, headache, sprains

Family: Euphorbiaceae

***Jatropha gassypifolia* L.**

Plate 1, figure 17

Description: Pollen grains spheroidal, amb 34 µm in diameter, circular. P.V. 51 µm, E.V. 50.5 µm, inaperturate. Exine 4.5 µm thick, columellae distinct, 1 µm long, gemmate sculpture, gemmae 4.5 µm high, capita 1.5 µm in diameter.

***Jatropha multifida* L.**

Plate 1, figure 18

Description: Pollen grains spheroidal, amb 57 µm in diameter, circular, inaperturate. Exine 6 µm thick, gemmate sculpture, gemmae 4 µm high, capita 1.5 µm in diameter.

***Manihot esculenta* Crantz. Inst.**

Plate 1, figure 19

Description: Pollen grains spheroidal, amb 126 µm in diameter, rounded, inaperturate. Exine 4.5 µm thick, sexine thicker than nexine, gemmate sculpture, gemmae 4 µm high, capita 1.5 µm in diameter.

***Ricinus communis* L.**

Plate 1, figure 20

Description: Pollen grains prolate spheroidal, amb 24 µm in diameter, triangular. P.V.24 µm, E.V.23 µm, tricolporate. Colpi narrowly elliptic, 21 µm in diameter long, 1 µm wide, sides tapering, tips acute, ora lalongate. Exine 1.5 µm thick, sexine thinner than nexine, faintly reticulate sculpture.

Family: Fabaceae

***Cajanus cajan* (L.) Millsp.**

Plate 1, figure 21

Description: Pollen grains oblate spheroidal, amb 37.5 µm in diameter, triangular. P.V. 36 µm, E.V. 39 µm, tricolporate. Colpi narrowly elliptic, 14.5 µm long, 2.5 µm wide, sides tapering, tips acute, ora circular. Exine 3.1 µm thick, sexine thinner than nexine, lumina hexa- to pentagonal, reticulate sculpture.

***Indigofera tinctoria* L.**

Plate 1, figure 22

Description: Pollen grains subprolate, P.V. 24 µm, E.V. 19.5 µm, tricolporate. Colpi narrowly elliptic, 16.5 µm long, 2.5 µm wide, sides tapering, tips obtuse, ora indistinct. Exine 2 µm thick, sexine as thick as nexine, reticulate sculpture.

***Tephrosia purpurea* (L.) pers.**

Plate 1, figure 23

Description: Pollen grains prolate spheroidal, amb 31.5 µm in diameter, triangular, P.V. 31.5 µm, E.V. 28.5 µm, tricolpate. Colpi broad, 18 µm long, 5 µm wide, sides tapering, tips acute, ora indistinct. Exine 3 µm thick, sexine thicker than nexine, microreticulate sculpture.

Family: Liliaceae

***Asparagus racemosus* Willd.**

Plate 1, figure 24

Description: Pollen grains prolate, amb 19.5 µm in diameter, rounded, P.V. 28.5 µm, E.V. 15 µm, monosulcate. Sulcus 21 µm long, 1.5 µm wide, sides tapering, tips obtuse. Exine 3 µm thick, sexine as thick as nexine, microreticulate sculpture.

Family: Lythraceae

***Lawsonia inermis* L.**

Plate 1, figure 25

Description: Pollen grains subprolate, amb 16.5 µm in diameter, rounded, P.V. 16.5 µm, E.V. 13.5 µm, trizonocolporate. Colpi narrowly elliptic, 10.5 µm long, 1.5 µm wide, sides tapering, tips acute. Exine 3 µm thick, sexine as thick as nexine, columellae not distinct, microreticulate sculpture.

***Woodfordia fruticosa* (L.) Kurz.**

Plate 1, figure 26

Description: Pollen grains subprolate, amb 18 µm in diameter, rounded, P.V. 18 µm, E.V. 15 µm, tricolporate. Colpi narrowly elliptic, 13.5 µm long, 1.5 µm wide, sides tapering, tips acute, ora elliptic to oblate. Exine 3 µm thick, sexine thicker than nexine, microreticulate sculpture.

Family: Malvaceae

***Abutilon indium* (L.) sweet.**

Plate 1, figure 27

Description: Pollen grains spheroidal, amb 58-70 µm in diameter, rounded, tricolporate. Colpi faint,

sides tapering, tips acute, ora circular. Exine 2-8 µm thick, sexine thicker than nexine, echinate sculpture, spines supratectal, short with swollen bases, slightly elevated, tips acute, interspinal region densely granular.

***Gossypium herbaceum* L.**

Plate 1, figure 28

Description: Pollen grains spheroidal, amb 43.2 µm in diameter, rounded, pantoporate. Pori circular, 1.5 µm in diameter, spines 4.5 µm long, tips sharp, base 1.5 µm in diameter. Exine 3 µm thick, sexine as thick as nexine, columellae distinct, reticulate sculpture.

***Hibiscus rosasinensis* L.**

Plate 1, figure 29

Description: Pollen grains spheroidal, amb 84 µm in diameter, rounded, pantoporate. Pori circular, 3.5 µm in diameter, interpolar distance 15 µm in diameter. Exine 4 µm thick, sexine as thick as nexine, echinate sculpture , echinae 15 µm long, echinae base 6 µm, sides slowly tapering, tips obtuse, 3 µm in diameter at tips.

Family: Mimosaceae

***Mimosa pudica* L.**

Plate 1, figure 30

Description: Pollen grains spheroidal, amb 9 µm in diameter, rounded, pantoporate.

Exine 0.75 µm thick, sexine as thick as nexine, psilate sculpture.

Family: Nyctaginaceae

***Bougainvillea spectabilis* Willd.**

Plate 1, figure 31

Description: Pollen grains oblate-spheroidal, amb 24 µm in diameter, rounded, tricolpate. Colpi elliptic, 11 µm long, 2.5 µm wide, sides tapering, tips acute. Exine 2.5 µm thick, sexine as thick as nexine, reticulate sculpture.

***Mirabilis jalapa* L.**

Plate 1, figure 32

Description: Pollen grains oblate-spheroidal, amb 54 µm in diameter, rounded, pantoporate. Pori circular, 4.5 µm in diameter, interpolar distance 30 µm in diameter.

Exine 5 µm thick, sexine as thick as nexine, surface spinulose, reticulate sculpture.

Family: Nyctanthaceae

***Nyctanthes arbortristis* L.**

Plate 1, figure 33

Description: Pollen grains prolate to subprolate, amb 72 µm in diameter, rounded, P.V. 45 µm, E.V. 40.5 µm, tricolpate. Colpi linear, streak like, tips acute, margins incrassate. Exine 6-7 µm thick, sexine as thick as nexine, subtectate, retipilate sculpture, piloid processes of two types (narrow and broad), lumina polygonal with free bacules, muri simplipilate.

Family: Pedaliaceae

***Martynia annua* L.**

Plate 1, figure 34

Description: Pollen grains spheroidal, amb 60 µm in diameter, rounded, pantocolpate. Colpi arranged in penta- to hexagonal pattern, narrowly elliptic, 27 µm long, 1 µm wide. Exine 3 µm thick, sexine thicker than nexine, columellae 1.75 µm long, foot layer 0.5 µm thick, reticulate sculpture.

Family: Rubiaceae

***Ixora coccinea* L.**

Plate 1, figure 35

Description: Pollen grains subprolate, amb 22.5 µm in diameter, circular, P.V. 22.5 µm, E.V. 19.5 µm tricolporate. Colpi broadly, elliptic, 18 µm long, 1.5 µm wide, tips obtuse, ora oblong. Exine 1.5 µm thick, sexine as thick as nexine, columellae distinct, reticulate sculpture.

Family: Solanaceae

***Solanum melongena* L.**

Plate 1, figure 36

Description: Pollen grains prolate spheroidal, amb 22.5 µm in diameter, circular, P.V. 22.5 µm, E.V. 24.5 µm tricolporate. Colpi linear, 14.5 µm long, 1.5 µm wide, tips acute, sides tapering, ora prominently lalongate. Exine 1.5 µm thick, sexine as thick as nexine, psilate sculpture.

***Withania somnifera* (L.) Dunal in DC.**

Plate 1, figure 37

Description: Pollen grains prolate spheroidal, P.V. 19.5 µm, E.V. 18 µm trizonocolporate. Colpi narrowly elliptic, 20 µm long, 1.5 µm wide, tips acute, sides tapering, ora concave. Exine 1.5 µm thick, sexine as thick as nexine, psilate sculpture.

Family: Tiliaceae

***Grewia hirsuta* Vahl.**

Plate 1, figure 38

Description: Pollen grains prolate, P.V. 46.5 µm, E.V. 31.5 µm, tricolporate. Colpi linear, 36 µm long, 1.5 µm wide, tips acute, sides tapering, ora oblong. Exine 3 µm thick, sexine as thick as nexine, columellae distinct, lumina polygonal, faintly reticulate sculpture.

Family: Verbenaceae

***Vitex negundo* L.**

Plate 1, figure 39

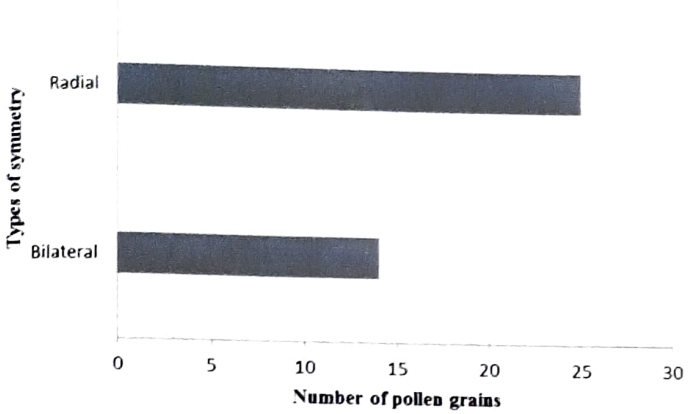
Description: Pollen grains prolate, amb 22.5 µm in diameter. P.V. 22.5 µm, E.V. 11.5 µm, trizonocolpate. Colpi elliptic, 10 µm long, 1.5 µm wide, tips acute, sides tapering, ora oblong. Exine 0.5 µm thick, sexine as thick as nexine, microreticulate sculpture.

DISCUSSION

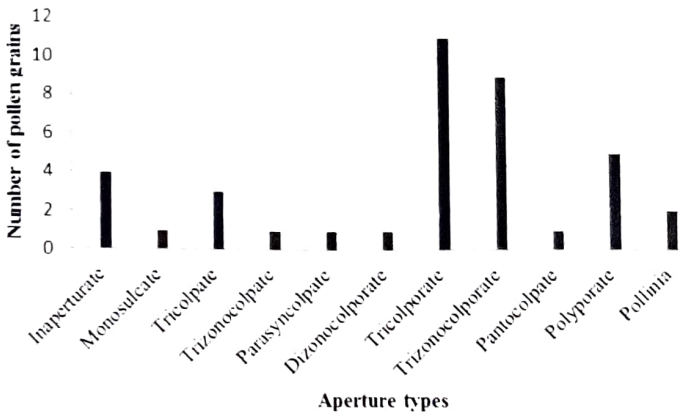
The ethnomedicinal shrubs, useful to cure various ailments, show diversity in pollen morphological

Table 2. Morphological characters of the shrubs pollen taxa

S. No.	Taxa name	Family	Symmetry	Shape	Polarity	Aperture	Sculpture
1	*Adhatoda zeylanica*	Acanthaceae	Bilateral	Prolate	Isopolar	Dizonocolporate	Reticulate
2	*Barleria prionitis*	Acanthaceae	Radial	Prolate spheroidal	Heteropolar	Trizonocolporate	Reticulate
3	*Annona squamosa*	Annonaceae	Bilateral	Prolate	Isopolar	Inaperturate	Foveolate-striate
4	*Nerium oleander*	Apocynaceae	Bilateral	Subprolate	Heteropolar	Tricolporate	Granular
5	*Rauwolfia serpentina*	Apocynaceae	Radial	Spheroidal	Isopolar	Parasyncolpate	Perforate
6	*Calotropis gigantea*	Asclepiadaceae	Radial	Oblate spheroidal	Isopolar	Pollinia	Obscure
7	*Holostemma adakodien*	Asclepiadaceae	Radial	Oblate spheroidal	Isopolar	Pollinia	Obscure
8	*Artemesia vulgaris*	Asteraceae	Radial	Prolate spheroidal	Isopolar	Trizonocolporate	Scabrate
9	*Notonia grandiflora*	Asteraceae	Radial	Oblate spheroidal	Isopolar	Trizonocolporate	Echinate
10	*Cassia alata*	Caesalpiniaceae	Radial	Prolate spheroidal	Isopolar	Tricolporate	Psilate
11	*Cassia auriculata*	Caesalpiniaceae	Bilateral	Prolate	Heteropolar	Trizonocolporate	Reticulate
12	*Caesalpinia pulcherrima*	Caesalpiniaceae	Radial	Spheroidal	Isopolar	Trizonocolporate	Reticulate
13	*Opuntia stricta*	Cactaceae	Radial	Suboblate	Isopolar	Pantoporate	Foveolate
14	*Carica papaya*	Caricaceae	Radial	Spheroidal	Isopolar	Tricolporate	Reticulate
15	*Celastrus paniculata*	Celastraceae	Bilateral	Prolate	Isopolar	Trizonocolporate	Reticulate
16	*Maytenus emarginatus*	Celastraceae	Bilateral	Subprolate	Isopolar	Tricolporate	Reticulate
17	*Jatropha gossypifolia*	Euphorbiaceae	Radial	Spheroidal	Isopolar	Inaperturate	Gemmate
18	*Jatropha multifida*	Euphorbiaceae	Radial	Spheroidal	Isopolar	Inaperturate	Gemmate
19	*Manihot esculanta*	Euphorbiaceae	Radial	Spheroidal	Isopolar	Inaperturate	Gemmate
20	*Ricinus communis*	Euphorbiaceae	Radial	Prolate spheroidal	Isopolar	Tricolporate	Faintly reticulate
21	*Cajanus cajan*	Fabaceae	Radial	Oblate spheroidal	Isopolar	Tricolporate	Reticulate
22	*Indigofera tinctoria*	Fabaceae	Bilateral	Subprolate	Isopolar	Trizonocolporate	Psilate
23	*Tephrosia purpurea*	Fabaceae	Radial	Prolate spheroidal	Isopolar	Tricolpate	Microreticulate
24	*Asparagus racemosus*	Liliaceae	Bilateral	Prolate	Isopolar	Monosulcate	Microreticulate
25	*Lawsonia inermis*	Lythraceae	Bilateral	Subprolate	Isopolar	Trizonocolporate	Microreticulate
26	*Woodfordia fruticosa*	Lythraceae	Bilateral	Subprolate	Isopolar	Tricolporate	Reticulate
27	*Abutilon indicum*	Malvaceae	Radial	Spheroidal	Isopolar	Tricolporate	Granular
28	*Gossypium herbaceum*	Malvaceae	Radial	Spheroidal	Isopolar	Pantoporate	Reticulate
29	*Hibiscus rosasinensis*	Malvaceae	Radial	Spheroidal	Isopolar	Pantoporate	Echinate
30	*Mimosa pudica*	Mimosaceae	Radial	Spheroidal	Isopolar	Tetrapantoporate	Psilate
31	*Bougainvillea spectabilis*	Nyctaginaceae	Radial	Oblate spheroidal	Isopolar	Tricolpate	Reticulate
32	*Mirabilis jalapa*	Nyctaginaceae	Radial	Oblate spheroidal	Isopolar	Pantoporate	Reticulate
33	*Nyctanthes arbortristis*	Nyctanthaceae	Bilateral	Subprolate	Isopolar	Tricolpate	Retipilate
34	*Martynia annua*	Pedaliaceae	Radial	Spheroidal	Isopolar	Pantocolpate	Reticulate
35	*Ixora coccinea*	Rubiaceae	Bilateral	Subprolate	Isopolar	Tricolporate	Reticulate
36	*Solanum melongena*	Solanaceae	Radial	Prolate spheroidal	Isopolar	Tricolporate	Psilate
37	*Withania somnifera*	Solanaceae	Radial	Prolate spheroidal	Isopolar	Trizonocolporate	Psilate
38	*Grewia hirsuta*	Tiliaceae	Bilateral	Prolate	Heteropolar	Tricolporate	Faintly reticulate
39	*Vitex negundo*	Verbenaceae	Bilateral	Prolate	Heteropolar	Trizonocolpate	Microreticulate



Text-figure 2. Diversity in symmetry.



Text-figure 3. Diversity in aperture types.

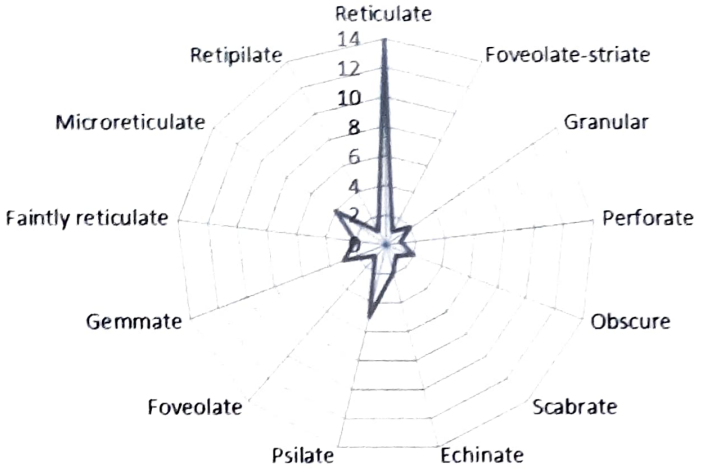
characters. In these taxa, there is diversity in symmetry, shape, polarity, aperture and sculpture.

Symmetry: The pollen of *Adhatoda zeylanica, Anona squamosa, Nerium oleander, Cassia auriculata, Celastrus paniculata, Maytenus emarginatus, Indigofera tinctoria, Asparagus racemosus, Lawsonia inermis, Woodfordia fruticosa, Nyctanthes arbortristis, Ixora coccinea, Grewia hirsuta* and *Vitex negundo* exhibit bilateral symmetry whereas the remaining ones show radial symmetry. Hence the species having radially symmetric pollen are more in percentage than those having bilateral symmetry (Text-figure 2).

Shape: The pollen show diversity in their shapes, as given below: **Prolate:** *Adhatoda zeylanica, Annona squamosa, Cassia auriculata, Celastrus paniculata, Asparagus racemosus, Grewia hirsuta* and *Vitex negundo*; **Prolate spheroidal:** *Barleria prionitis, Artemesia vulgaris, Cassia alata, Ricinus communis, Tephrosia purpuria, Solanum melongena* and *Withania somnifera*; **Subprolate:** *Nerium oleander, Maytenus emarginatus, Indigofera tinctoria, Lawsonia inermis, Woodfordia fruticosa, Nyctanthes arbortristis* and *Ixora coccinea*; **Spheroidal:** *Rauwolfia serpentina, Caesalpinia pulcherrima, Carica papaya, Jatropha gassypifolia, Jatropha multifida, Manihot esculenta, Abutilon indicum, Gossypium herbaceum, Hibiscus rosasinensis, Mimosa pudica* and *Martynia annua*; **Oblate spheroidal:** *Calotropis gigantea, Holostemma adakodien, Notonia grandiflora, Cajanus cajan, Bougainvillea spectabilis* and *Mirabilis jalapa*; and **Suboblate:** *Opuntia stricta.*

Polarity: Pollen of *Barleria prionitis, Nerium oleander, Cassia auriculata, Grewia hirsuta* and *Vitex negundo* are heteropolar whereas pollen of all other taxa are isopolar.

Aperture: The pollen grains exhibit diversity in aperture morphology, e.g. inaperturate, monosulcate, dizonocolporate, tricolpate, trizonocolpate, tricolporate, trizonocolporate, parasyncolpate, pantocolpate, polyporate and pollinia, as given below: **Inaperturate**: *Annona squamosa, Jatropha gassypifolia, Jatropha multifida* and *Manihot esculenta*; **Monosulcate:** *Asparagus racemosus*; **Dizonocolporate**: *Adhatoda zeylanica*; **Tricolpate:** *Bougainvillea spectabilis, Nyctanthes arbortristis* and *Tephrosia purpuria*; **Trizonocolpate:** *Vitex negundo*; **Tricolporate:** *Nerium oleander, Cassia alata, Carica papaya, Maytenus emarginatus, Ricinus communis, Cajanus cajan, Woodfordia fruticosa, Abutilon indicum, Ixora coccinea, Solanum melongena* and *Grewia hirsuta*; **Trizonocolporate**: *Barleria prionitis, Artemesia vulgaris, Notonia grandiflora, Cassia auriculata, Celastrus paniculata, Indigofera tinctoria, Lawsonia inermis, Caesalpinia pulcherrima* and *Withania somnifera*; **Parasyncolpate:** *Rauwolfia serpentina*; **Pantocolpate**: *Martynia annua*; **Polyporate:** *Opuntia stricta, Mimosa pudica, Gossypium herbaceum, Hibiscus rosasinensis* and *Mirabilis jalapa*; and **Pollinia:** *Calotropis gigantea* and *Holostemma adakodien*. It is therefore clear that plant taxa having pollen with tricolporate aperture are



Text-figure 4. Diversity in exine sculpture.

dominant (Text-figure 3).

Exine sculpture: The pollen grains exhibit variations in exine sculpture, e.g. reticulate, foveolate-striate, perforate, granulate, obscure, scabrate, echinate, psilate, foveolate, gemmate, faintly reticulate, microreticulate and retipilate, as given below: **Reticulate:** *Adhatoda zeylanica, Barleria prionitis, Cassia auriculata, Carica papaya, Celastrus paniculata, Maytenus emarginatus, Cajanus cajan, Woodfordia fruticosa, Gossypium herbaceum, Bougainvillea spectabilis, Mirabilis jalapa, Martynia annua* and *Ixora coccinea*; **Foveolate-striate:** *Annona squamosa*; **Perforate:** *Rauwolfia serpentina*; **Granulate:** *Nerium oleander* and *Abutilon indicum*; **Obscure**: *Calotropis gigantea* and *Holostemma adakodien*; **Scabrate:** *Artemesia vulgaris*; **Echinate:** *Notonia grandiflora* and *Hibiscus rosasinensis*; **Psilate:** *Cassia alata, Indigofera tinctoria, Mimosa pudica, Solanum melongena* and *Withania somnifera*; **Foveolate:** *Opuntia stricta*; **Gemmate:** *Jatropha gassypifolia, Jatropha multifida* and *Manihot esculenta*; **Faintly reticulate:** *Ricinus communis* and *Grewia hirsuta*; **Microreticulate:** *Tephrosia purpuria, Asparagus racemosus, Lawsonia inermis* and *Vitex negundo*; and **Retipilate:** *Nyctanthes arbortristis* (Table 2). It is therefore evident that plant taxa having pollen with reticulate exine sculpture are dominant (Text-figure 4).

Some of these medicinal shrubs, viz. *Ricinus communis, Cajanus cajan* and *Abutilon indicum*, are significant for honey production. Pollen of these plants were earlier recorded from summer and winter honey samples of Adilabad district (Swathi & Ramakrishna 2012, 2013, Ramakrishna & Swathi 2013).

ACKNOWLEDGEMENTS

The authors are thankful to Professor C. G. K. Ramanujam for his kind cooperation and guidance in the preparation of this paper; to local tribes for their help in collection of pollen material; and to the Principal, University College of Science, Osmania University, Saifabad, Hyderabad for providing laboratory facilities. Special thanks are due to the University Grants Commission for financial assistance by granting Rajiv Gandhi National Fellowship.

REFERENCES

Erdtman G. 1960. The acetolysis method. A revised description. Sevens. Bot. Tidskr. 54: 561-564.

Ramakrishna H. & Swathi S. 2013. Pollen diversity in some *Apis florea* honeys from Adilabad District, Andhra Pradesh, India. Geophytology 42(1): 11-20.

Swathi S. & Ramakrishna H. 2012. Nectar source for summer honeys of Adilabad district in Andhra Pradesh. J. Swamy Bot. Club 29: 19-30.

Swathi S. & Ramakrishna H. 2013. Pollen analysis of winter honeys from the dry deciduous forest of Adilabad district, Andhra Pradesh, India. Adv. Plant Sci. 26(2): 447-455.