

## FOLIAR EPIDERMAL STUDIES IN INDIAN *JASMINUM*

NIRMALA UPADHYAY, B. S. TRIVEDI

AND

C. L. VERMA

*Botany Department, Lucknow University, Lucknow*

### ABSTRACT

The paper reports epidermal structures including their appendages in thirty three species of *Jasminum*. Various types of stomata including the abnormalities have been reported. Trichomes which are the characteristic of this genus have been observed in all the investigated species. Cuticular striations and other important feature are also discussed in detail. Giant stomata and domatia are recorded for the first time in this genus. Species of *Jasminum* can be identified on the basis of epidermal features.

### KEY WORDS

Stomata, trichomes, domatia, cuticular striations.

### INTRODUCTION

Epidermal structures including their appendages have been described in a few species of *Jasminum* Linn. Six species of this genus viz. *J. officinale*, *J. angustifolium*, *J. auriculatum*, *J. flexile*, *J. humile* and *J. sambac* have been studied for ontogeny of stomata and trichomes (Inamdar 1967a, 1967b, 1968 ; Inamdar, Chauhan & Patel, 1970), while *J. dispersum*, *J. arborescens*, *J. malabaricum*, *J. grandiflorum* and *J. mesnyi* have been described for their cuticular characters (Srivastava, 1975, 1979). Controversial genus *Nyctanthes arbor-tristis* Linn. has been discussed for its epidermal structures by many workers (Inamdar, 1967b, 1968 ; Trivedi & Upadhyay, 1978).

The genus *Jasminum* has about 300 species which are distributed in Southern Asia, Africa, Australia and tropical America. Main centres of distribution of this genus

are in India and in China (Kobuski, 1932). About forty species are known from India which are under cultivation in the botanical gardens in various part of the country.

There is no detailed systematic description of the epidermal structures of this genus, therefore, it is thought to study them in detail. The paper reports the epidermal structures of 33 Indian species of *Jasminum* (Oleaceae).

### MATERIAL AND METHODS

The material for the present investigation was collected from the botanical gardens and also procured as herbarium specimens from different parts of the country. Materials were largely obtained through the courtesy of Dr. S. L. Kapoor, Asstt. Director, National Botanical Research Institute, Lucknow, which were brought by his associates collected from different parts of India, during their tour for the revision of the family Oleaceae. In the present study, peels of middle portion of different leaves of a single species collected from the different localities were taken.

Cuticles were obtained from the leaves by

usual maceration method. They were stained with aqueous safranin or Sudan IV and mounted in pure glycerine. The numerical data of the epidermal characters was based on the average of twenty random counts. The terminology used here is the same as suggested by Dilcher (1974).

#### OBSERVATION

##### 1. *Jasminum adenophyllum* Wall. (Text fig. 8)

Leaves hypostomatic; upper epidermal cells penta to hexagonal, smooth walled; lower epidermal cells polygonal or irregular with slightly sinuate walls; stomata anomocytic occasionally paracytic; trichome peltate, few, 2 to 5-celled; striations confined to stomatal complex.

##### 2. *J. amplexicaule* Buch.-Ham. (Text fig. 35)

Leaves hypostomatic, epidermal cells, penta-hexagonal with straight walls and thick; lower epidermal cells, narrow with slightly sinuate walls; stomata anomocytic; trichomes frequent, unicellular, uniseriate, glandular and peltate.

##### 3. *J. anastomosans* Wall.

Leaves hypostomatic; epidermal cells penta to polygonal, smooth and thick-walled; stomata crowded, anomocytic rarely paracytic; trichomes glandular, sparsely distributed.

##### 4. *J. angustifolium* Vahl (Text figs. 7, 16, 39; Pl. 3, fig. 4; Pl. 4, fig. 6)

Leaves hypostomatic; epidermal cells polygonal smooth-walled; stomata medium size, anomocytic rarely paracytic; peltate trichomes present, sparsely distributed; striations few seen arising from the guard cells of the stomata.

##### 5. *J. arborescens* Roxb. (Text fig. 28; Pl. 1, fig. 2)

Leaves chiefly hypostomatic but a few stomata near the larger veins on the upper sur-

face; epidermal cells variously shaped, penta-hexa or polygonal with straight walls, stomata anomocytic, small; trichomes, short or long, unicellular, multicellular peltate; striations all over the epidermal cells and also arising from the hair bases and guard cells.

##### 6. *J. auriculatum* Vahl (Text figs. 10, 14, 31, 41; Pl. 1, fig. 3)

Leaves hypostomatic; epidermal cells penta to hexagonal, smooth and thick-walled; stomata small, rounded in shape, anomocytic, rarely paracytic; trichomes on both the surfaces, glandular and non-glandular; striations all over the epidermal cells on the upper surface, confined to trichome bases on the lower surface; giant stomata common, two to three times larger than the normal ones.

##### 7. *J. azoricum* Linn. (Text figs. 25-26, 30)

Leaves hypostomatic, epidermal cells penta to various shapes, smooth-walled, cells elongated thick-walled on veins; stomata anomocytic sometimes anisocytic; trichomes absent.

##### 8. *J. calophyllum* Wall.

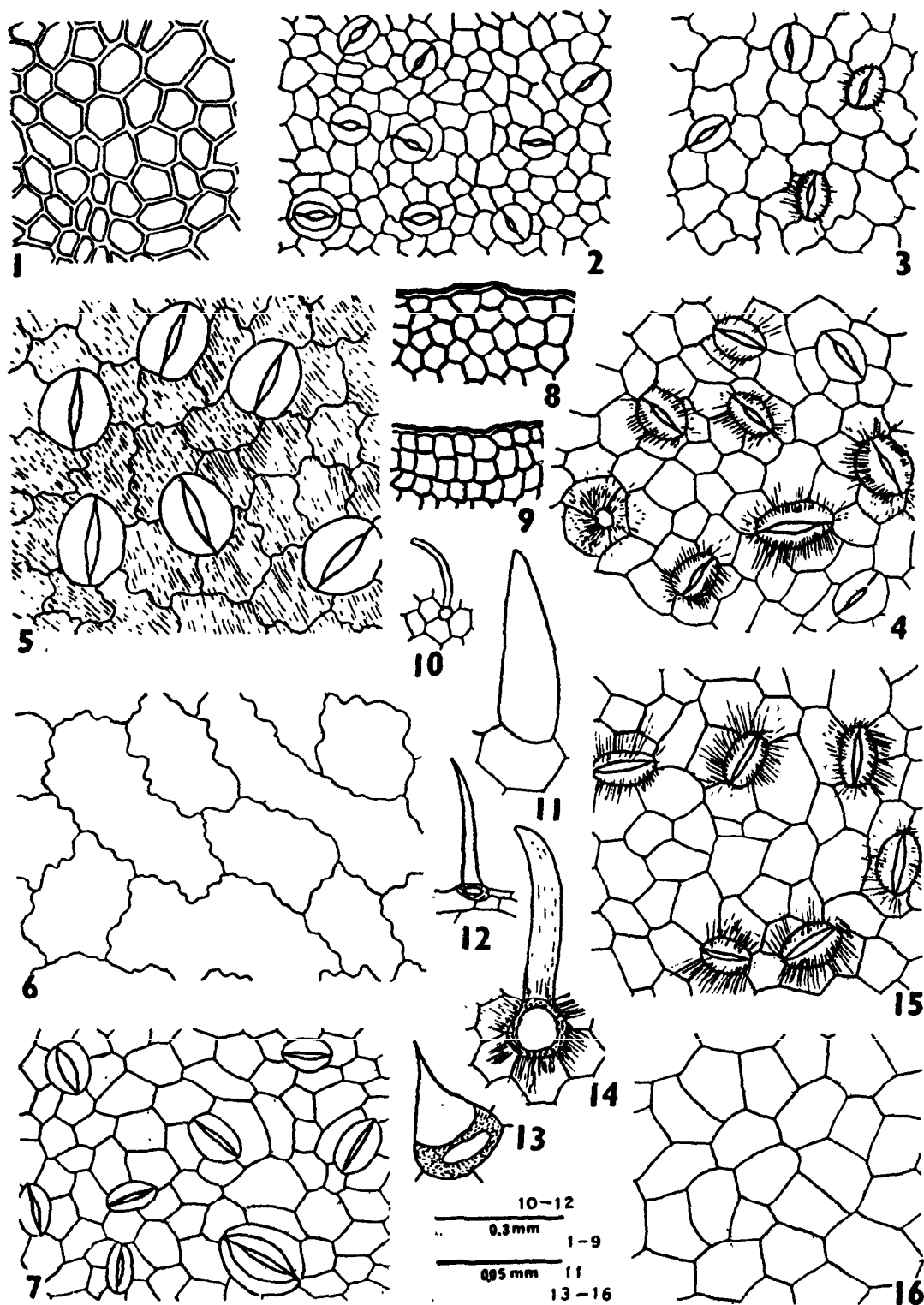
Leaves hypostomatic predominantly but in few are present on the upper surface near the margin and larger veins; epidermal cells, penta, hexa or polygonal with slightly sinuate walls; stomata paracytic and anomocytic; trichomes sparsely distributed, glandular.

##### 9. *J. caudatum* Wall. (Pl. 4, fig. 8)

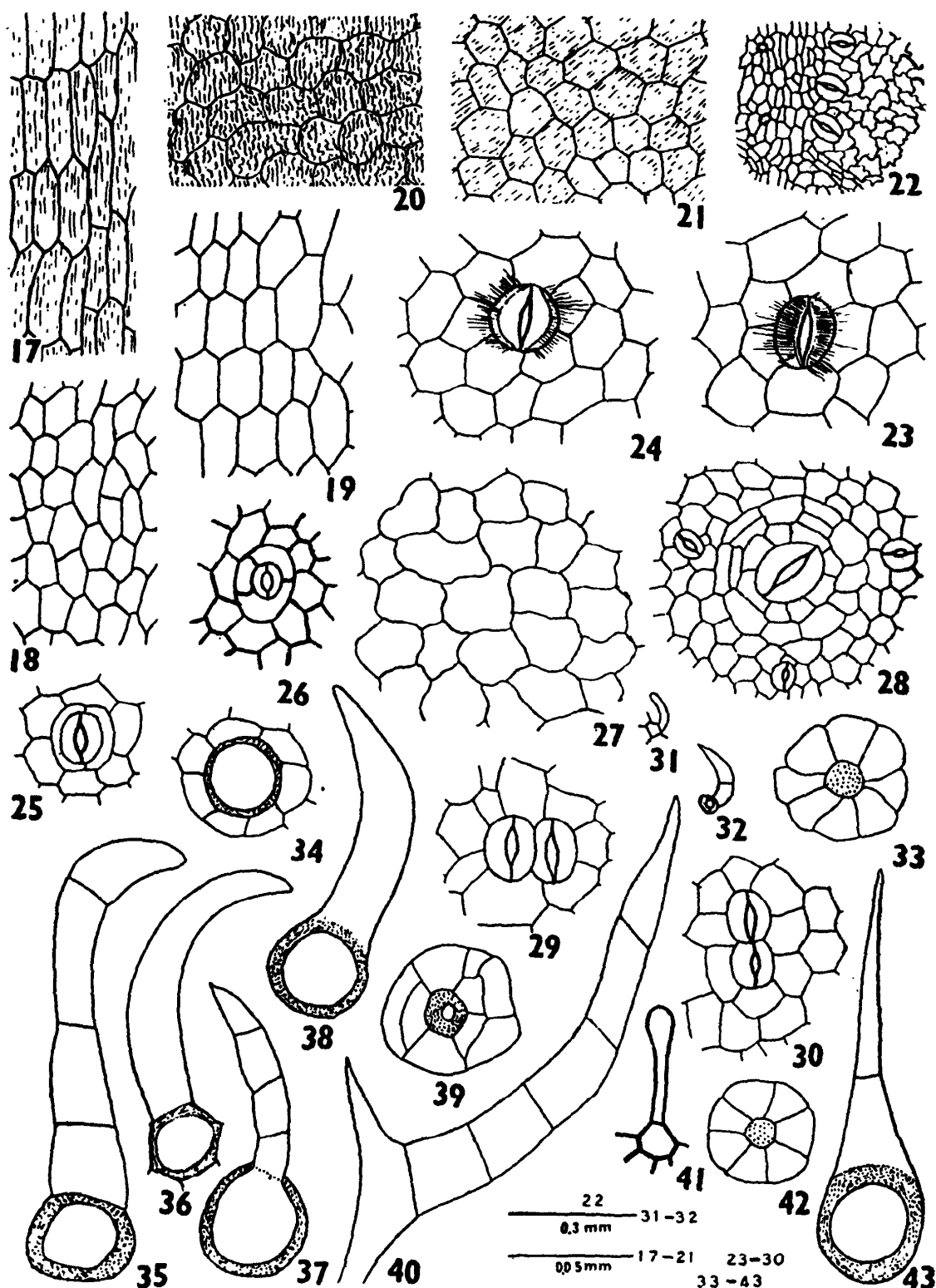
Leaves hypostomatic; epidermal cells penta to hexagonal, smooth-walled; stomata anomocytic rarely paracytic; trichomes long, glandular confined to larger veins.

##### 10. *J. coarctatum* Roxb. (Text figs. 13, 36)

Leaves hypostomatic; epidermal cells, penta-polygonal with thin and straight walls; stomata anomocytic; trichomes unicellular, uniseriate, short or long; trichome bases large, oval.



Figs. 1-16 : 1. Epidermal cells of *F. cordifolium* enlarged to show smooth walls. 2. Lower foliar surface of *F. cordifolium* showing distribution of stomata. 3. Lower epidermis of *F. mesnyi* showing striations arising from the stomata. 4. Lower epidermal surface of *F. trichotomum* showing distribution of stomata and striations. 5. Epidermal cells and stomata of *F. rigidum*. Epidermal cells showing striations. 6. Upper sinuate epidermal cells of *F. rigidum*. 7. Epidermal cells and stomata of *F. angustifolium*. 8. Marginal thick-walled hexagonal cells of *F. adenophyllum*. 9. Marginal thick-walled squarish cells of *F. glandulosum*. 10-14. Different types of unicellular trichomes (10. *F. auriculatum*, 11. *F. rigidum*, 12. *F. sambac*, 13. *F. coarctatum*, 14. *F. auriculatum* showing striations). 15. Upper epidermal layer of *F. trichotomum* showing stomata and striations. 16. Upper epidermal cells of *F. angustifolium*.



Figs. 17-43 : 17-21. Different types of epidermal cells. (17. Cells of veinal region of *J. wengeri* showing striations, 18. Penta or hexagonal veinal cells of *J. lanceolaria*, 19. Elongated, rectangular veinal cells of *J. pubescens*, 20. Irregular epidermal cells of *J. grandiflorum* showing striations, 21. Pentagonal upper epidermal cells of *J. grandiflorum* showing striations). 22. Irregular epidermal cells and stomata of *J. rigidum*. 23. Striation arising from the inner face of the guard cells of *J. humile*. 24. Stomata showing striations arising from the outer face of guard cells of *J. grandiflorum*. 25. Paracytic stomata of *J. azoricum*. 26. Anisocytic stomata of *J. azoricum*. 27. Irregular, sinuate epidermal cells of *J. mesnyi*. 28. Giant and normal stomata of *J. arborescens*. 29. Contiguous stomata of *J. sessiliflorum*. 30. Contiguous stomata of *J. azoricum*. 31-43: Different types of trichomes. (31. Small, unicellular trichome of *J. auriculatum*, 32. Two celled, uniseriate trichome of *J. sambac*, 33. Peltate trichome of *J. malabaricum*, 34. Large trichome base of *J. multiflorum*, 35. Uniseriate trichome of *J. amplexicaule*, 36. Long, unicellular trichome of *J. coarctatum*, 37. Small, uniseriate trichome of *J. multiflorum*, 38. Long, unicellular trichome of *J. multiflorum*, 39. Peltate trichome of *J. angustifolium*, 40. Long, uniseriate trichome of *J. multiflorum*, 41. Glandular trichome of *J. auriculatum*, 42. Peltate trichome of *J. trichotomum*, 43. Long, two celled trichome of *J. multiflorum*).

**11. *J. cordifolium* Wall.** (Text figs. 1-2)

Leaves amphistomatic, epidermal cells, penta-hexagonal with straight walls; stomata medium size, anomocytic and paracytic, giant stomata common, twice of the normal one, contiguous stomata seen at places; trichomes peltate, 4 to 6 celled; striations few, round the trichomes.

**12. *J. dispernum* Wall.**

Leaves hypostomatic; epidermal cells polygonal, smooth-walled; stomata small, irregular, anomocytic; trichomes confined to upper surface, peltate 2 to 7 celled with short stalk.

**13. *J. flexile* Vahl**

Leaves hypostomatic; epidermal cells penta to polygonal, smooth-walled, or elongated in various directions; stomata, small, irregular, anomocytic and paracytic; trichomes long, uniseriate, 2 to 5 celled; peltate trichomes 5 to 7 celled; striations frequent all over the surface.

**14. *J. glandulosum* Wall.** (Text fig. 9)

Leaves hypostomatic; epidermal cells penta to polygonal, smooth-walled; stomata crowded, anomocytic; trichomes few short, unicellular or 2 celled on the larger veins.

**15. *J. grandiflorum* Linn.** (Text figs. 20-21, 23)

Leaves amphistomatic; epidermal cells penta to polygonal, smooth-walled; lower epidermal cells irregular, sinuous walled; stomata irregular, anomocytic occasionally paracytic; trichomes short, conical spine like, bases round and broad; striations prominent on both the surfaces, arising from the guard cells and trichome bases and also all over the epidermal cells.

**16. *J. humile* Linn.** (Text fig. 24)

Leaves hypostomatic, epidermal cells penta to polygonal, smooth-walled; stomata irregular, anomocytic and paracytic; trichomes

peltate 2 to 10-celled; striations arising from the stomatal complex.

**17. *J. lanceolaria* Roxb.** (Text fig. 18)

Leaves hypostomatic; epidermal cells penta to hexagonal, smooth-walled; stomata anomocytic and paracytic, small, 2 to 4 cells apart; trichomes peltate 5 to 7-celled; contiguous stomata common; one guard cell stomata also frequent.

**18. *J. laurifolium* Roxb.** (Pl. 3, fig. 3)

Leaves hypostomatic; epidermal cells penta to polygonal, smooth-walled; stomata mostly anomocytic but paracytic also common, rounded, small, frequency quite high; unicellular small trichomes on larger veins.

**19. *J. malabaricum* Wight** (Text fig. 33, Pl. 1, fig. 1)

Leaves hypostomatic; epidermal cells variously shaped, penta, hexa, polygonal with straight walls; stomata large, paracytic and anomocytic; trichomes on both the surfaces, peltate and glandular; striations frequent arising from subsidiary cells and also over the epidermal cells.

**20. *J. mesnyi* Hance** (Text figs. 3, 27)

Leaves hypostomatic; epidermal cells irregular, sinuous walls; stomata large, anomocytic, frequency low; glandular trichomes seen at places; striations all over the surface of the epidermal cells.

**21. *J. multiflorum* (Burm. f.) Andrews** (Text figs. 34, 37-38, 40, 43; Pl. 2, fig. 6; Pl. 4, fig. 5)

Leaves hypostomatic; epidermal cells penta to hexagonal, smooth-walled; stomata large size anomocytic or sometimes paracytic; contiguous stomata frequent, mostly two stomata laterally fused; trichomes on both the surfaces, long, uniseriate, trichome bases thick, round or oval; giant stomata present on the smaller veins.

**22. *J. officinale* Linn.**

Leaves hypostomatic; epidermal cells penta or hexagonal, smooth walled; stomata irregular, anomocytic and paracytic; trichomes simple, uniseriate and peltate glandular on both the surfaces; striations round the trichome bases and subsidiary cells; contiguous stomata common.

**23. *J. pubescens* Willd. (Text fig. 19)**

Leaves hypostomatic; epidermal cells penta to polygonal, smooth walled, elongated slightly thick-walled on the larger veins; stomata, small, rounded, irregular, anomocytic; trichomes, 2-3-celled, uniseriate, long, frequent on the veins; peltate trichomes 2 to 6-celled, contiguous stomata frequent.

**24. *J. rigidum* Zenker (Text figs. 5-6, 11, 22; Pl. 2, fig. 8)**

Leaves although amphistomatic but stomatal number is few as well as confined along the larger veins of upper surface; epidermal cells highly irregular with sinous walls; stomata medium size, anomocytic, on the upper surface common around the veins; trichomes small, uniseriate; cuticular striations all over the epidermal cells.

**25. *J. ritchiei* Clarke (Pl. 2, fig. 5)**

Leaves hypostomatic; epidermal cells penta to hexagonal or of various shapes, smooth walled; stomata medium size, anomocytic, frequency low; trichomes unicellular; domatia common and confined to upper surface; cuticular striations frequent on the upper surface.

**26. *J. rottlerianum* Wall.**

Leaves hypostomatic; epidermal cells polygonal, smooth-walled; stomata medium sized, anomocytic; trichomes long, uniseriate, 2 to 6-celled; peltate 2 to 5-celled; striations arising from the trichome bases and stomatal complex; single guard cell stomata common.

**27. *J. roxburghianum* Wall.**

Leaves hypostomatic; epidermal cells penta-polygonal, smooth-walled, lower epidermal cells slightly sinuate walled; stomata anomocytic rarely paracytic; trichomes long or short pointed, 2 to 5-celled; peltate trichomes rare, 5 to 8-celled, contiguous stomata common.

**28. *J. sambac* Aiton (Text figs. 12, 32)**

Leaves amphistomatic; epidermal cells penta to hexagonal, smooth-walled, elongated thickened cells on the veins; stomata anomocytic rarely paracytic, present round the veins on the upper surface; trichomes long, pointed, trichome bases oval or rounded.

**29. *J. scandens* Vahl**

Leaves hypostomatic; epidermal cells penta to hexagonal, smooth and thick-walled; stomata crowded, anomocytic rarely paracytic, guard cells thickened; glandular trichomes present; round the larger veins few stomata seen on the upper surface.

**30. *J. sessiliflorum* Vahl (Text fig. 29; Pl. 3, fig. 1)**

Leaves hypostomatic; epidermal cells penta to hexagonal, smooth walled, cells usually smaller, lower epidermal cells comparatively thin-walled than the upper ones; stomata medium size, anomocytic rarely anisocytic, frequency low; stomata also occur on the upper surface near the veins; giant stomata common; trichomes sparsely distributed, peltate or unicellular, medium size.

**31. *J. subglandulosum* Kurz (Pl. 2, fig. 7)**

Leaves hypostomatic, epidermal cells, penta-polygonal with thick and straight walls; stomata mostly anomocytic and paracytic, contiguous stomata common; trichomes glandular; domatia present.

**32. *J. trichotomum* Heyne ex Roth. (Text figs. 4, 15, 42; Pl. 3, fig. 2, Pl. 4, fig. 7)**

Leaves amphistomatic; epidermal cells penta to hexagonal, smooth and thick-walled; stomata on both the surfaces, frequency slightly high on the lower surface, anomocytic, guard cells slightly thickened; trichomes common, peltate; cuticular striations all over the surface of the epidermal cells and also arising from the guard cells; domatia common on both the surfaces.

**33. *J. wengeri* C.E.C. Fischer (Text fig. 17)**

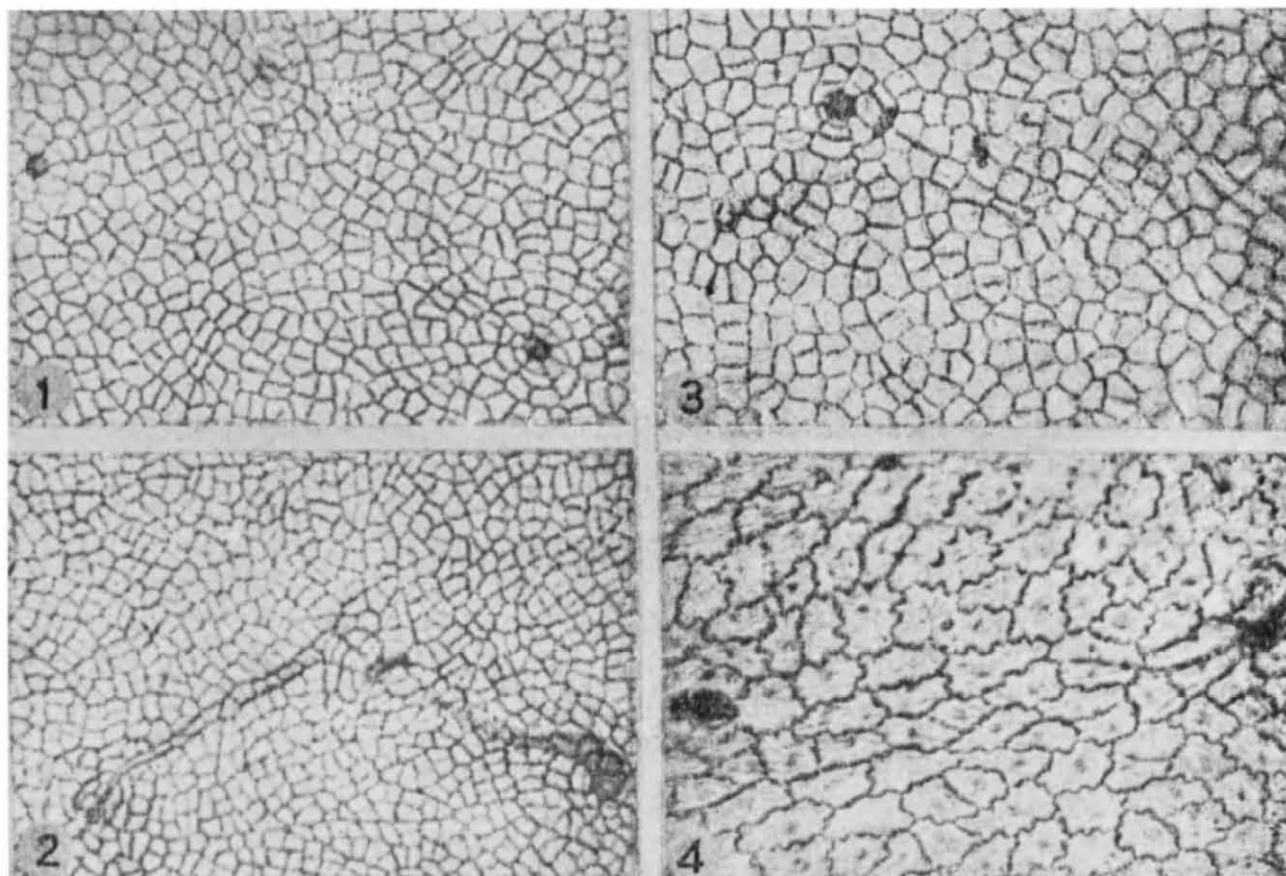
Leaves hypostomatic; epidermal cells penta to polygonal, smooth-walled; stomata small, crowded, anomocytic and paracytic; trichomes unicellular, unistriate, 2-5-celled, short and long; peltate trichomes 4 to 6-celled; striations all over the surface.

#### DISCUSSION

The family Oleaceae consists of 29 genera and over 600 species of which the chief genus is *Jasminum*, with about 300 species of which 40 occur in India.

Leaves in the investigated species are hypostomatic. Only four species viz., *J. trichotomum*, *J. sambac*, *J. grandiflorum* and *J. cordifolium* are amphistomatic, frequency of stomata in these species is higher on the lower foliar surface. *J. calophyllum*, *J. arborescens* and *J. rigidum* have the stomata on the upper surface as well but they are confined along the larger veins.

The genus is characterised by the presence of anomocytic stomata (Metcalf & Chalk, 1950). Inamdar (1967a, 1968) and Srivastava

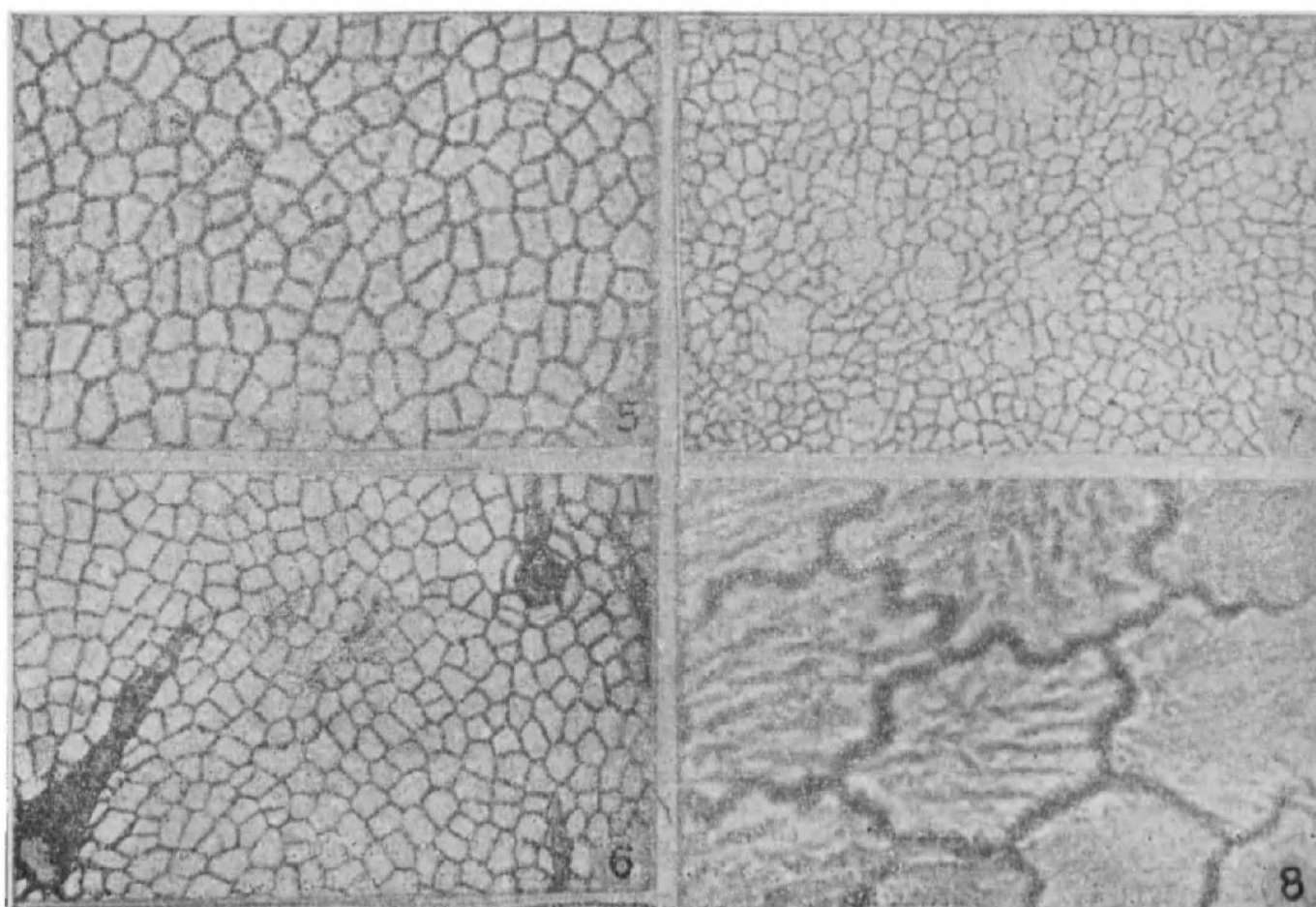


Pl. 1, figs. 1-4 : 1. Upper epidermal surface of *J. malabaricum* showing peltate trichomes  $\times 300$ . 2. Upper epidermal surface of *J. arborescens* showing long, unicellular trichome  $\times 300$ . 3. Upper epidermal cells of *J. auriculatum* showing striations and peltate trichome  $\times 300$ . 4. Irregular upper epidermal cells of *J. rigidum*  $\times 300$ .



(1975) reported paracytic stomata in a few species of this genus. The present study with large number of species reveals that paracytic stomata are of common occurrence along with anomocytic ones. Frequency of the paracytic stomata is definitely low. In *J. azoricum*, anisocytic type of stomata have been recorded. Stomatal abnormalities like single guard cell, aborted stomata and contiguous stomata have been described in some species of *Jasminum* (Inamdar 1967a, 1968). We have observed these abnormalities in many species (*J. cordifolium*, *J. subglandulosum*, *J. multiflorum*, *J. roxburghianum*, *J. officinale*, *J. pubescens*, *J. lanceolaria* and *J. rotterianum*). Giant stomata which are three to four times larger than the nor-

mal ones, are recorded in *J. cordifolium*, *J. multiflorum* and *J. auriculatum*. Stomata are compactly arranged, small to medium sized and 2 to 3 cells apart, therefore, the stomatal frequency is usually high in this genus. Earlier, Srivastava (1975) reported highest stomatal frequency of 82 per mm<sup>2</sup> in *J. grandiflorum* and lowest 23 per mm<sup>2</sup> in *J. pubescens*. With this frequency it appears that the stomata are counted as seen under the microscopic field. Stomatal frequency in the investigated species has been counted in different parts of the leaf and it has been found that it is highest (720 per mm<sup>2</sup>) in *J. laurifolium* and lowest (148 per mm<sup>2</sup>) in *J. subglandulosum*. Stomatal index is also highest and lowest in *J. laurifolium* and *J.*



Pl. 2, figs. 5-8 : 5. Upper epidermal cells of *J. ritchiei* × 300. 6. Upper epidermal surface of *J. multiflorum* showing uniseriate trichomes × 300. 7. Upper foliar surface of *J. subglandulosum* showing stomata near veins × 300. 8. Upper epidermal cells of *J. rigidum* enlarged to show the striations × 1200.

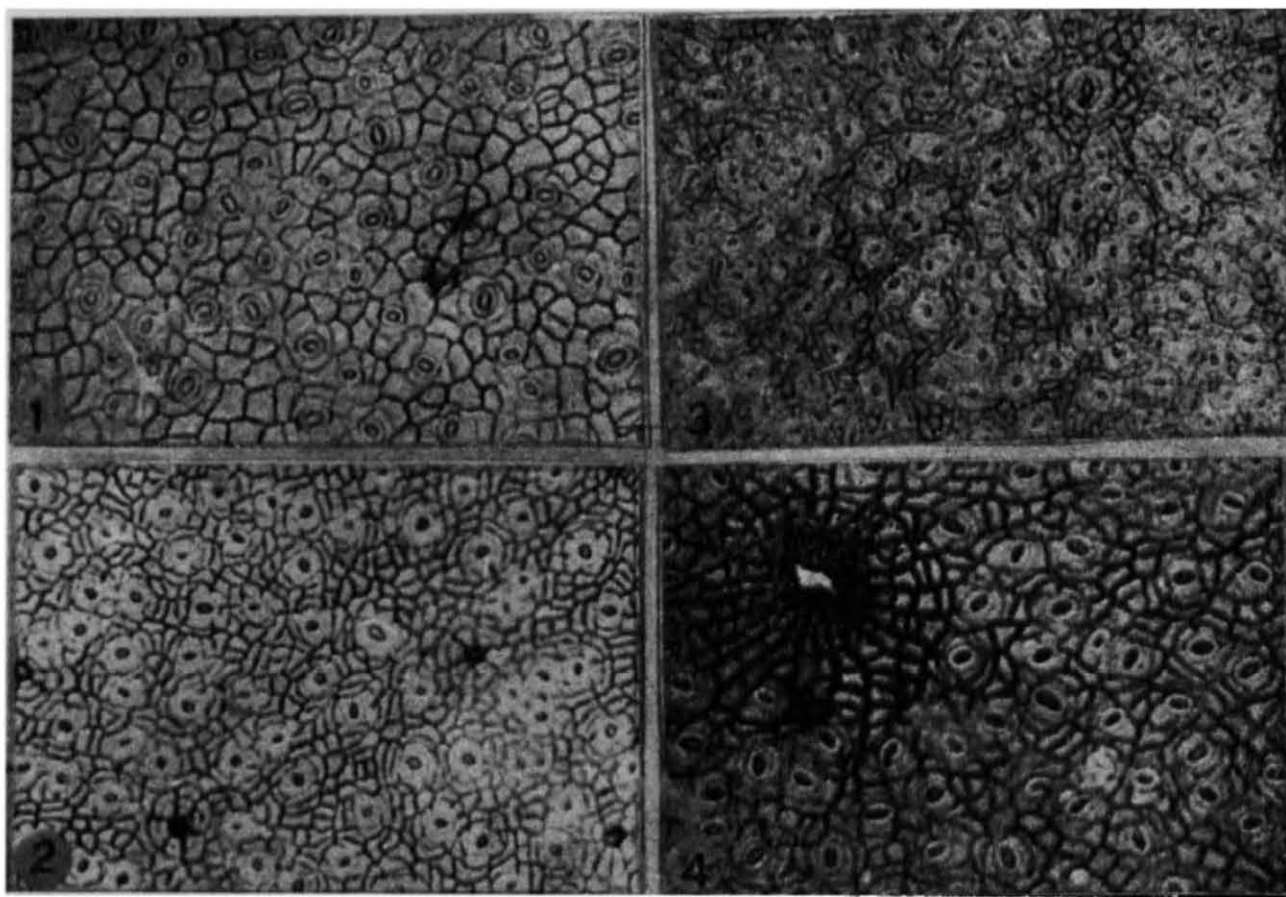


*subglandulosum* respectively. Size of the stomata is highly variable but usually ranges from  $16 \times 20 \mu\text{m}$  to  $20 \times 30 \mu\text{m}$ ; largest stomata recorded in *J. scandens* ( $33 \times 33$ – $37 \times 34 \mu\text{m}$ ) and smallest in *J. arborescens* ( $10 \times 7 \mu\text{m}$ ).

Epidermal cells and nature of their walls are characteristic in this genus. Majority of the investigated species show striaght cell-walls but some species have sinuous walls. Cells are highly sinuous in *J. rigidum* and *J. mesnyi*, slightly sinuate in *J. calophyllum* and only the lower epidermal cells are sinuate in *J. amplexicaule*, *J. roxburghianum*, *J. grandiflorum*, *J. adenophyllum* and *J. angustifolium*. Somewhat thick-walled epidermal cells have been observed in *J. sub-*

*glandulosum*, *J. trichotomum*, *J. scandens*, *J. auriculatum*, *J. anastomosans* and *J. amplexicaule* (only on upper foliar surface). Marginal cells are either short or elongated and usually thick-walled.

Characteristic trichomes which are of various types have been recorded in all the investigated species except *J. azoricum* where they are absent. Three main types of trichomes viz. unicellular, simple uniseriate and peltate have been described by Solereder (1908) in Oleaceae. Inamdar (1967b) reported twelve types of trichomes and their ontogeny in four species of *Jasminum* and placed into two groups: eglandular and glandular. Distribution of trichomes are also important in this genus, they are almost equal on both



Pl. 3, figs. 1-4 1. Lower foliar surface of *J. sessiliflorum* showing distribution of stomata  $\times 300$  2. Lower epidermis of *J. trichotomum* showing stomata and trichomes  $\times 300$ . 3. Crowded stomata on the lower epidermis of *J. laurifolium*  $\times 300$ . 4. Lower foliar surface of *J. angustifolium* showing domatis  $\times 300$ .

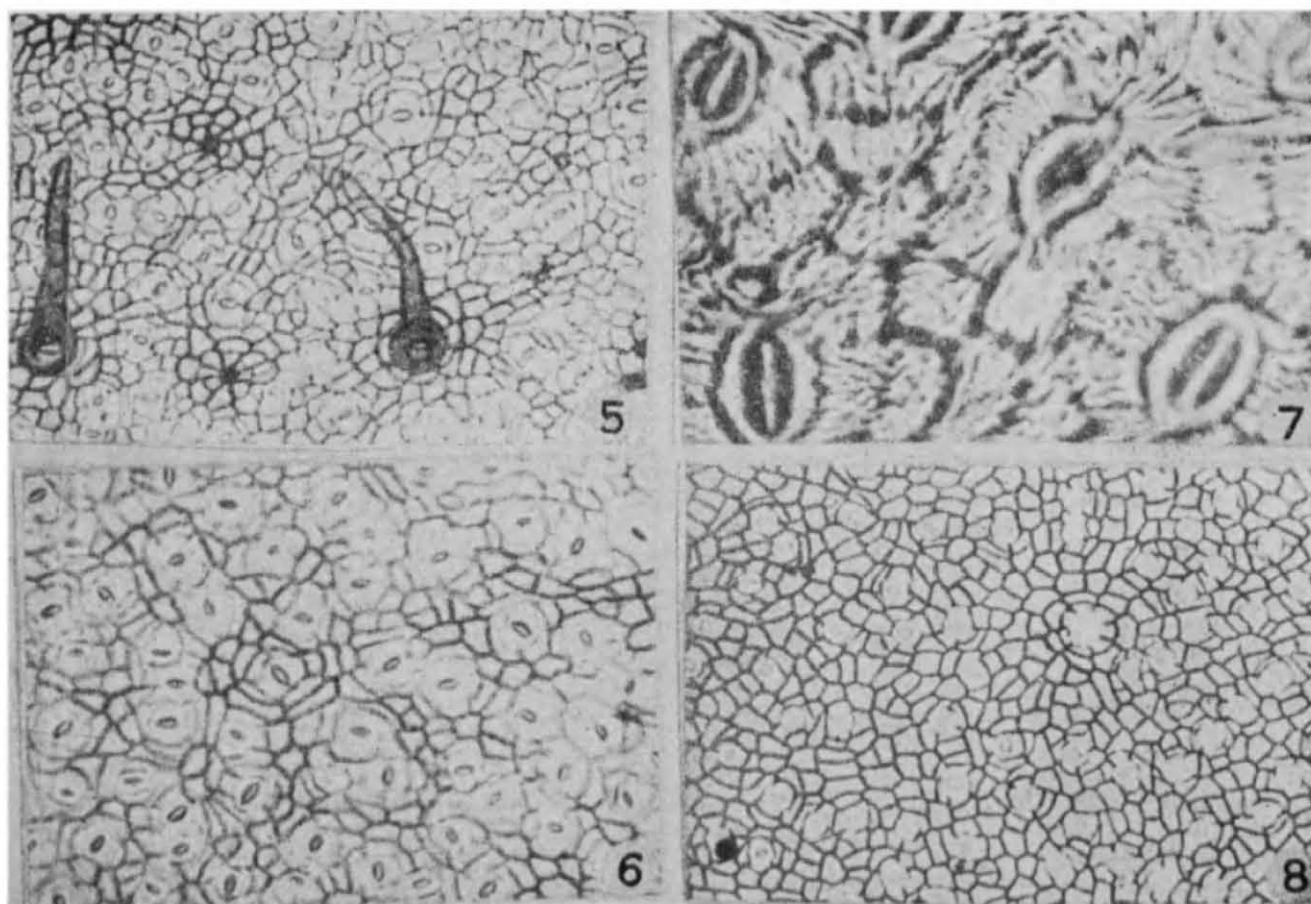
the surfaces or more on the lower surface or confined to veins on the upper surface or more prominent along the larger veins (Table 1). Size and shape of the trichome bases are also variable in this taxon. They are either small circular pore-like or round or hexagonal, thickened or thin-walled basal celled with large pores.

Cuticular striations are common and significant in this genus. They are distributed all over the foliar surfaces in *J. malabarium*, *J. arborescens*, *J. rigidum*, *J. trichotomum*, *J. mesnyi*, *J. auriculatum*, *J. grandiflorum*, *J. flexile* and *J. wengeri* and frequent only on the upper surface in *J. ritchieri*. Striations arising from the trichome bases, subsidiary cells or outer face of the

guard cells are recorded in *J. cordifolium*, *J. angustifolium*, *J. rottlerianum*, *J. humile*, *J. officinale* and *J. adenophyllum*. Striate are either straight or undulated. Striations arising from the stomatal complex are either compactly or sparsely arranged and also in four distinct groups or all round the subsidiary cells.

Domatia have been recorded in some species of this genus viz. *J. ritchieri*, *J. subglandulosum* and *J. trichotomum*.

Various types of stomata viz. anomocytic, paracytic and diacytic have been reported in the genus *Nyctanthes arborescens* belonging to this family by Trivedi and Upadhyay (1978). Inamdar (1967b) described various types of trichomes and their ontogeny in the



Pl. 4, figs. 5-8 : 5. Stomata, peltate and uniseriate trichomes of *J. multiflorum*  $\times 300$ . 6. Lower epidermal surface of *J. angustifolium* showing distribution of stomata  $\times 300$ . 7. Lower epidermis of *J. trichotomum* enlarged to show the striations  $\times 1200$ . 8. Lower epidermis of *J. caudatum* showing stomata  $\times 300$ .

Table

Name of species	Epidermal cells		Distribtuion		Type	Stomata size in $\mu$ m
			Upper	Lower		
1. <i>J. cordifolium</i>	St.	10×13—13×15	P	P	Pa & An	19×13—21×15
2. <i>J. malabaricum</i>	St.	16×13—19×15	A	P	Pa & An	32×28
3. <i>J. calophyllum</i>	Slightly sin.	10×10—13×12	A	P	Pa & An	16×13—19×14
4. <i>J. subglandulosum</i>	St. & Th.	26×16—29×19	A	P	An & Pa	33×26—36×28
5. <i>J. amplexicaule</i>	St. & Th.	16×12—17×13	A	P	An	20×20—23×20
6. <i>J. arborescens</i>	Lw. slightly sin St.	7×10—11×12	A	P	An	10×7—13×10
7. <i>J. coarctatum</i>	St.	13×10—16×12	A	P	An	16×14—19×13
8. <i>J. ritchiei</i>	St.	23×20—26×21	A	P	An	20×16—24×18
9. <i>J. laurifolium</i>	St.	13×10—16×12	A	P	An & Pa (rare)	16×13
10. <i>J. sessiliflorum</i>	St.	10×10—15×12	A	P	An & Pa (rare)	16×14—19×15
11. <i>J. multiflorum</i>	St.	14×10—17×11	A	P	An & Pa (rare)	14×10—17×12
12. <i>J. rigidum</i>	sin	38×26	A	P	An	33×26
13. <i>J. azoricum</i>	St.	16×16—20×17	A	P	An & Anis.	16×13—20×14
14. <i>J. trichotomum</i>	St. & Th.	16×13—18×14	P	P	An	26×20—29×22
15. <i>J. angustifolium</i>	St.	15×13—19×15	A	P	An & Pa (rare)	23×16—26×20
16. <i>J. mesnyi</i>	Lw. slightly sin sin	14×12—18×13	A	P	An	36×30
17. <i>J. sambac</i>	St.	23×23—26×23	P	P	An & Pa (rare)	33×26—36×26
18. <i>J. scandens</i>	St. & Th.	14×10—16×12	A	P	An & Pa (rare)	33×33—37×34
19. <i>J. auriculatum</i>	St. & Th.	26×20	A	P	An & Pa (rare)	14×10—18×16
20. <i>J. caudatum</i>	St.	26×14	A	P	An & Pa (rare)	16×14
21. <i>J. anastomosans</i>	St. & Th.	14×10—20×10	A	P	An & Pa	20×14
22. <i>J. rotlierianum</i>	St.	16×14—18×12	A	P	An	15×10
23. <i>J. roxburghianum</i>	St.	20×14	A	P	An & Pa (rare)	16×12—18×14
24. <i>J. disperman</i>	Lw. slightly sin St.	22×13	A	P	An	17×13
25. <i>J. humile</i>	St.	22×20	A	P	An & Pa	20×12
26. <i>J. officinale</i>	St.	18×15	A	P	An & Pa	22×13
27. <i>J. grandiflorum</i>	St.	16×15	P	P	An & Pa (rare)	21×19
28. <i>J. pubescens</i>	Lw. sin walled St.	25×17	A	P	An	20×16
29. <i>J. flexile</i>	St.	20×18	A	P	An & Pa	18×14
30. <i>J. adenophyllum</i>	St.	15×17	A	P	An & Pa (rare)	17×15
31. <i>J. glandulosum</i>	Lw. sin walled St.	21×16	A	P	An	22×18
32. <i>J. lanceolaria</i>	St.	23×18	A	P	An & Pa	14×10
33. <i>J. wengeri</i>	St.	16×12	A	P	An & Pa	17×15

A. Absent ; An.-Anomocytic ; Anis.-Anisocytic ; P-Present ; Pa.-Paracytic ; Sin.-Sinuate walls ; St.-Straight walls ;

I

<i>Stomatal frequency in mm<sup>2</sup></i>	<i>Stomatal index</i>	<i>Trichomes</i>	<i>Striations</i>	<i>Remarks</i>
530	25	Peltate, 4 to 6-celled	Few round the trichomes	Giant & contiguous stomata common
290	22	Peltate, 3 to 7-celled	Frequent, all over the surface	—
352	19	Sparsely distributed, uniseriate	A	Stomata on upper surface near the large veins
148	14	Peltate, glandular	A	Domatia & contiguous stomata common
394	30	Unicellular, uniseriate, peltate glandular	A	—
580	28	Short unicellular, uniseriate 3-5-celled, Peltate 3 to 7-celled	All over the epidermal cells	—
262	20	Long or short unicellular, uniseriate 2 to 6-celled	A	Trichome bases large
163	16	Unicellular short	Frequent on upper surface	Domatia common
720	40	Unicellular small on the larger veins	A	—
340	29	Few peltate and unicellular	A	Few stomata on the upper surface near the large veins
260	27	Long, uniseriate, 2 to 5-celled, both the surfaces	A	Giant & contiguous stomata common
244	20	Small, unicellular, uniseriate	All over epidermal cells	—
370	22	A	A	—
236	18	Peltate 2 to 6-celled	All over the epidermal cells	Domatia common
446	30	Peltate, few 2 to 5-celled	Few arising from the stomatal complex	—
232	23	Glandular trichomes at places	All over the epidermal cells	—
175	27	Long, unicellular, pointed, uniseriate	A	—
248	20	Glandular, on larger veins & on the upper surface	A	—
336	22	Glandular & non-glandular on both the surfaces	All over the surface	Giant stomata
392	25	Glandular, long confined to veins	A	—
318	24	Glandular, sparsely distributed	A	—
220	28	Long uniseriate 2-5 celled, Peltate 2 to 6 celled	Few round the trichome bases	Single guard cell stomata
322	23	Long or short, uniseriate 2 to 5 celled, Peltate 5 to 8-celled	A	—
207	21	Confined to upper surface, Peltate 2 to 7-celled	A	—
235	26	Peltate 2 to 10-celled	Few arising from stomatal complex	—
180	17	Simple uniseriate, Peltate glandular	Few round the trichome bases	Contiguous stomata
160	19	Simple, short, conical spine like	All over the surface	—
210	27	Uniseriate 2-3-celled, Peltate 2-6 celled	A	Contiguous stomata
170	16	Long uniseriate 2-5, Peltate 5-7-celled	All over the surface	—
190	20	Peltate 2-5-celled	Confined to stomatal complex	—
320	23	Unicellular 2-celled, on large veins	A	—
295	21	Peltate 5-7-celled	A	Contiguous & one guard cell stomata
410	24	Uniseriate 2-5-celled short or long Peltate 4 to 6-celled	All over the surface	—

Th.-Thick-walls.

family Oleaceae including the genus *Nyctanthes*.

Present study reveals that the investigated species of *Jasminum* upto some extent can be identified using the epidermal characters. Detailed epidermal features and numerical data of all the investigated species are given in Table.1

#### ACKNOWLEDGEMENTS

Authors are thankful to Dr. S. L. Kapoor, Asstt. Director, National Botanical Research Institute, Lucknow for providing the material. One of us (N. Upadhyay) is thankful to CSIR for financial support.

#### REFERENCES

- DILCHER, D. L. Approaches to the identification of angiosperm leaf remains. *Bot. Rev.* 40(1) : 1-157. 1974.
- INAMDAR, J. A. Stomatal ontogeny in *Jasminum officinale* L. *Curr. Sci.* 36 : 443-444. 1967a.
- Studies on the trichomes of some Oleaceae. Structure and ontogeny. *Proc. Indian Acad. Sci.* 66 : 164-177. 1967b.
- Ontogeny of stomata in some Oleaceae *Proc. Indian Acad. Sci.* 67 : 157-164. 1968.
- , A. J. CHAUHAN AND R. C. PATEL. Morphological studies in *Jasminum officinale*. *Vidya J. Gujarat Univ.* 13(2) : 106-113. 1970.
- KOBUSKI, J. Synopsis of the Chinese species of *Jasminum*. *J. Arn. Arb.* 13 : 145-179. 1932.
- METCALFE, C. R. AND L. CHALK. *Anatomy of Dicotyledons* (Clarendon Press, Oxford). 2 : 893-900. 1950.
- SOLEREDER, H. *Systematic Anatomy of Dicotyledons* (Clarendon Press, Oxford). 2 : 521-526. 1908.
- SRIVASTAVA, K. Epidermal studies in some species of *Jasminum*. *Proc. Indian Acad. Sci.* 81 B(3) : 111-117. 1975.
- Epidermal studies in some members of Oleaceae. *Curr. Sci.* 48 (2) : 79-80. 1979.
- TRIVEDI, B. S. AND N. UPADHYAY. Epidermal structures and ontogeny of stomata of *Nyctanthes arbor-tristis* L. *Geophytology* 8(1) : 22-31. 1978.