

SEM STUDIES ON SPERMODERM OF SOME SPECIES OF *MEDICAGO* (PAPILIONOIDEAE-TRIFOLIEAE)

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ABSTRACT

Seeds of 9 species of *Medicago* have been investigated under light and scanning electron microscope to find out the systematic significance of spermoderm pattern. Under light microscope, the surface is smooth in all the species except *M. monantha* and *M. orbicularis* where it is tuberculate. Under scanning electron microscope, majority of species viz., *M. laciniata*, *M. lupulina*, *M. minima*, *M. orbicularis*, *M. polymorpha* var. *vulgaris* and *M. × varia* show tuberculate (papillose) pattern while *M. edgeworthii*, *M. monantha* and *M. sativa* show false reticulate, reticulate and rugulate patterns respectively. The nature of tubercles differs from species to species and thus spermoderm pattern can be used in the identification of plants at specific level.

INTRODUCTION

Medicago, a genus of Leguminosae-Papilionoideae under tribe Trifolieae consists of about 83 species (Small & Jomphe 1989) in the world and is distributed in temperate regions, mainly in Mediterranean, Europe, N. Africa, W.&C. Asia and S. Africa. In India this genus is represented by 10 species and one variety (Sanjappa 1991, Chaudhary 1993).

Earlier Trivedi and Bagchi (1982), Lersten and Gunn (1982), Solum and Lockerman (1991), Pandey (1991) have studied the spermoderm pattern of a few species of *Medicago*.

In the present work seeds of 9 species of *Medicago* were studied by using LM and SEM in connection with the revisionary study on this genus for Flora of India, to ascertain the taxonomic relationships among the species.

MATERIALS & METHODS

The seeds were obtained from herbarium specimens deposited at Central National Herbarium, Howrah (CAL). Voucher specimens of the taxa studied are listed in Table 1. Dry cleaned

matured seeds were mounted on metallic stubs with the help of double-stick "Scotch tape" and subsequently gold coating was done in a Technics Hummerz D.C. Sputter Coater. Scanning was done in Philips, SEM 500 scanning electron microscope at RSIC, Bose Institute, Calcutta. The mature seeds were investigated and photographed in face view. For each species several seeds of different populations were examined by using Olympus Stereo dissecting microscope and 1 or 2 seeds of each species were examined by SEM.

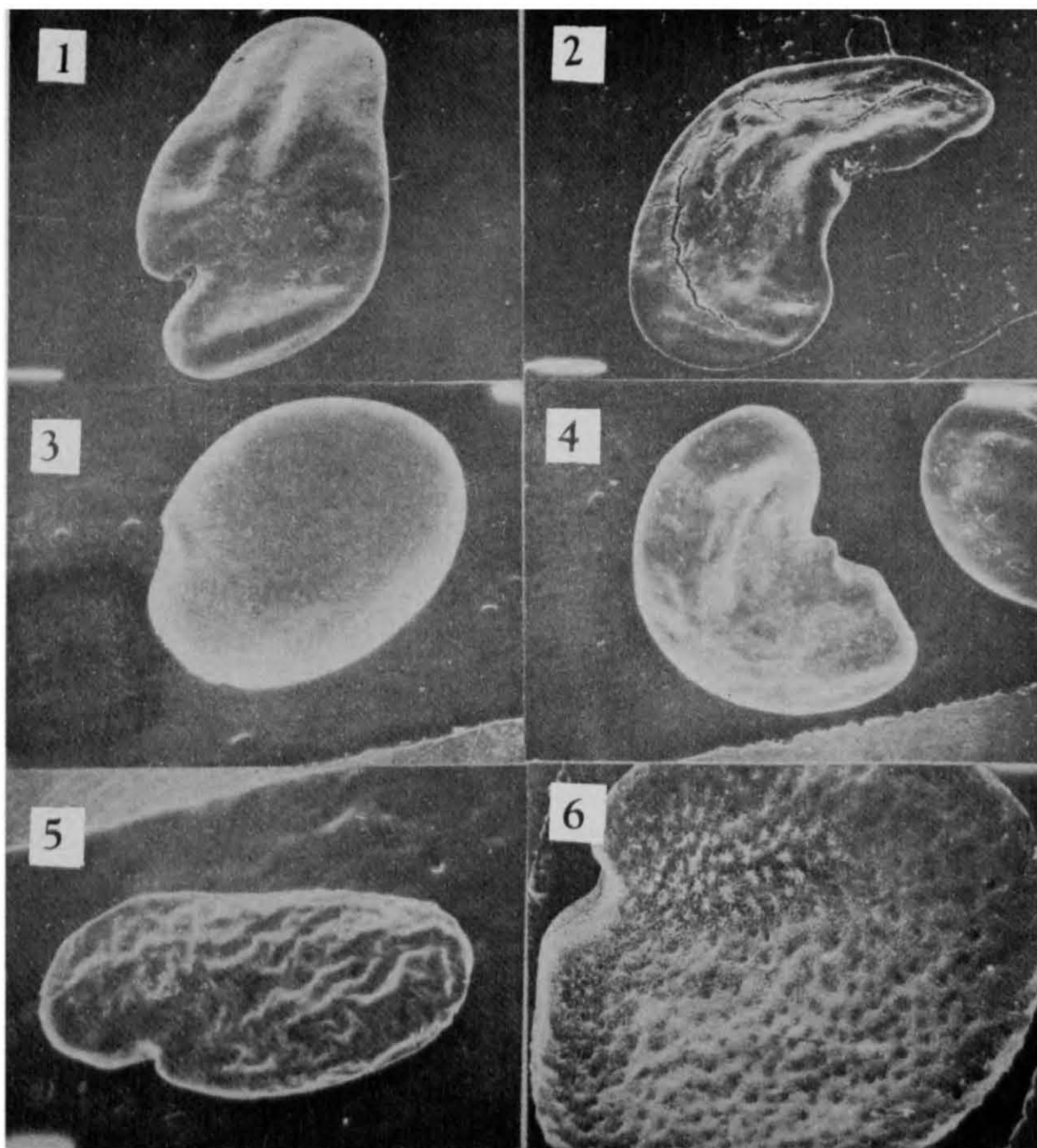
Terminology mainly follows Lersten (1981) and Stearn (1983).

Table -1: Voucher Information for the taxa studied here.
All collections are deposited in CAL.

Taxa	Collection data
<i>Medicago edgeworthii</i> Sirj.	Kashmir, July 1956, T.A. Rao 517.
<i>M. laciniata</i> (L.) Mill.	Punjab, Beas, 24 Mar. 1960. J.N. Vohra 11325.
<i>M. lupulina</i> L.	Uttar Pradesh, Dehra Dun, J.F. Duthie s.n.
<i>M. minima</i> (L.) Bartal.	Kashmir, 7 June. 1892. J.F. Duthie 10822
<i>M. monantha</i> (C.A. Meyer) Trautv.	Rajasthan, Bharatpur, 20 Aug. 1982. P.J. Parmar 8587.
<i>M. orbicularis</i> (L.) Bartal.	Distributed at Royal Garden, Kew, 1864. Herb. Falconer 416.

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Figs. 1-6 : *Medicago* species. SEM Photographs.

1. *M. edgeworthii* ($\times 50$) ; 2. *M. laciniata* ($\times 50$) ; 3. *M. lupulina* ($\times 50$) ; 4. *M. minima* ($\times 50$) ; 5. *M. monantha* ($\times 50$) ;
6. *M. orbicularis* ($\times 50$) .

Taxa	Collection data
<i>Medicago polymorpha</i> var. <i>vulgaris</i> (Benth.) Shinn.	Rajasthan, Ganganagar, 24 Feb. 1978. G.P. Roy 4084.
<i>M. sativa</i> L.	Herb. Ind. Or. Hook. f. & Thomson, Karnatak, s.d., Anon. 6.
<i>M. × varia</i>	Himachal Pradesh, Chamba, 15 Aug. 1899. Harsukh s.n.

OBSERVATIONS

Seeds characters such as size, shape colour and surface have been given in Table 2 by using light and scanning electron microscopes. Usually the seeds are turgid except *Medicago orbicularis* where they are flat. The testa surface is usually smooth (Fig. 1-9) at the lower magnification except *M. monantha* (Fig. 5) and *M. orbicularis* (Fig. 6) where they show tuberculate surfaces and reveals quite definite pattern when observed under higher magnification. Majority of species examined here show tuberculate pattern of spermoderm except *M. monantha* and *M. sativa* in which it is reticulate and rugulate respectively. But the nature of tubercules varies considerably among species with tuberculate spermoderm, and hence, the spermoderm pattern of each species is described separately as below :

Medicago edgeworthii : The spermoderm shows reticulate pattern superimposed by tubercules. The tubercules are not distinct and forming false reticulation (Fig. 10).

M. laciniata : The testa surface is tuberculate. The tubercules are compact and very distinct with acute to subobtuse tip. Sometimes thread like structure radiating from apex of tubercules and joining adjacent tubercules. The surface of tubercules is rugose (Fig. 11).

M. lupulina : The spermoderm pattern is tuberculate. The tubercules are compressed (less elevated), more or less rounded, loosely arranged in distinct rows and connected with each other by thread like structure and forming beaded structure. The surface of tubercules is smooth (Fig. 12).

M. minima : In this species the testa surface is tuberculate. The tubercules are closely spaced and their tips are obtuse, rounded or occasionally subobtuse. The surface of tubercules is smooth (Fig. 13).

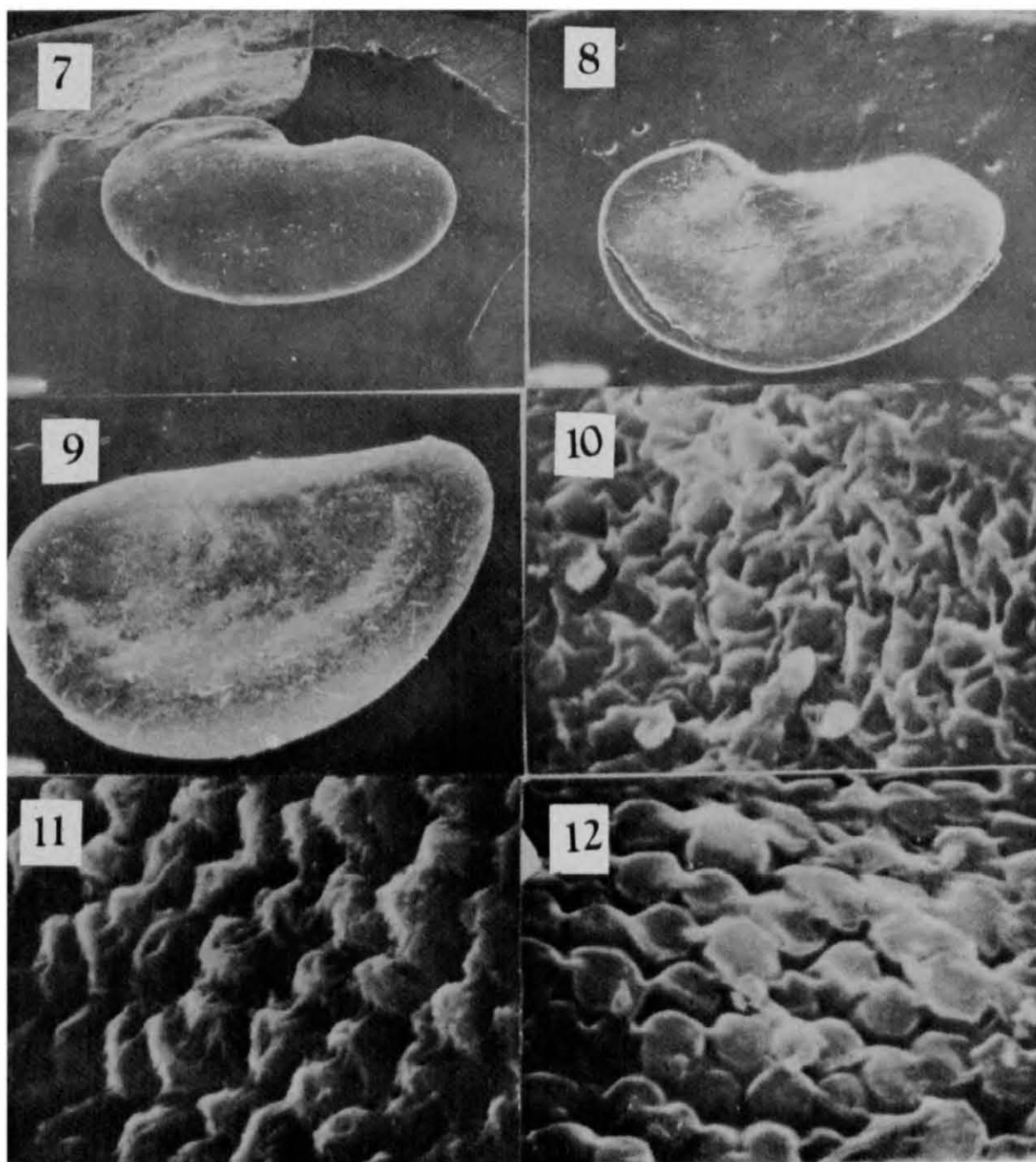
M. monantha : The spermoderm pattern in this species is prominently reticulate. The reticulations are irregular in shape and size with uniform thick walls. The walls are straight or undulate (Fig. 14).

M. orbicularis : The spermoderm pattern is tuberculate. The tubercules are less raised, loosely arranged with more or less rounded shape. Elongated process drawn out in all directions which join neighbouring tubercules (Fig. 15).

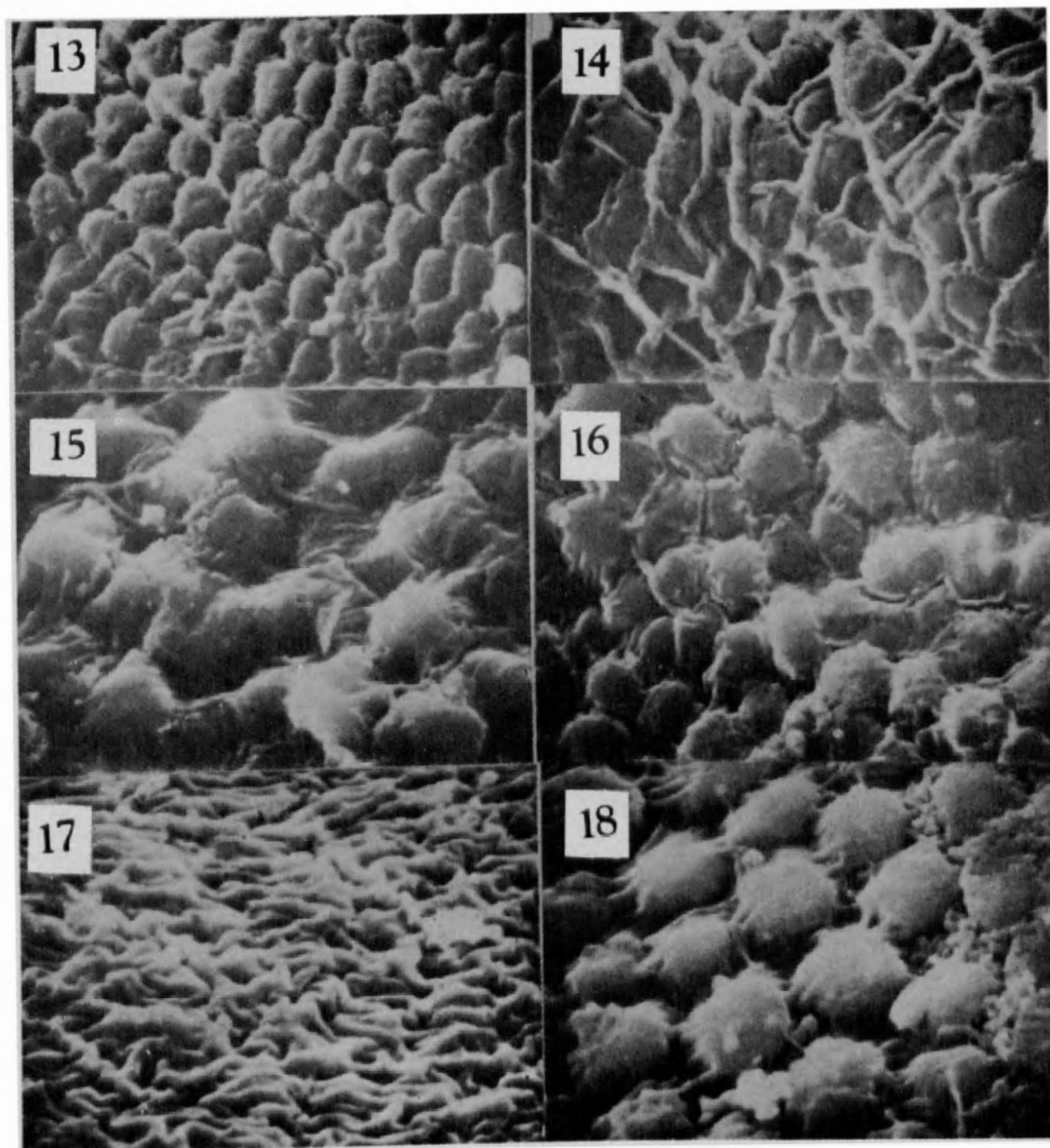
M. polymorpha var. *vulgaris* : The spermoderm shows tuberculate pattern. The tubercules are rounded, compressed (less raised) and closely spaced. Elongated processes extend in all direction from side of tubercules which generally join the neighbouring tubercules. The surface of tubercules is smooth (Fig. 16).

M. sativa : In this species the spermoderm shows rugulate pattern. The rugulae are quite prominent and are irregularly arranged (Fig. 17).

M. × varia : The testa surface shows tuberculate pattern. The tubercules are very distinct rounded and loosely arranged. Thread like structure, extend from side of tubercules in all directions which may or may not join the adjacent tubercules. The surface of tubercules is smooth (Fig. 18).



Figs. 7-12 : *Medicago* species SEM Photographs.
7. *M. polymorpha* var. *vulgaris* ($\times 50$); 8. *M. sativa* ($\times 50$); 9. *M. x varia* ($\times 50$); 10. *M. edgeworthii* ($\times 3200$);
11. *M. lachiniata* ($\times 3200$) ; 12. *M. lupulina* ($\times 3200$).



Figs. 13-18 : *Medicago* species. SEM Photographs.

13. *M. minima* (× 3200); 14. *M. monantha* (× 3200) ; 15. *M. orbicularis* (× 3200) ; 16. *M. polymorpha* var. *vulgaris* (× 3200); ,
17. *M. sativa* (× 3200); 18. *M. × varia* (× 3200).

Table -2 : Seed Characters in *Medicago* species

Taxa	Size	Shape	Colour	Surface	
				LM	SEM
<i>Medicago edgeworthii</i>	1.5 – 2.0 × 1 mm	Ovoid	Brown	Smooth	Reticulate super imposed by tuberculate
<i>M. laciniata</i>	2 × 1 mm	Reniform	Yellow to dark brown	Smooth	Tuberculate
<i>M. lupulina</i>	2 × 1 mm	Oblong or ovoid	Yellowish brown	Smooth	Tuberculate
<i>M. minima</i>	2 × 1 mm	Oblong or oblong-reniform	Brown	Smooth	Tuberculate
<i>M. monantha</i>	2.0 – 2.3 × 0.9 – 1.2 mm	Oblong or rhomboid	Brown	Faintly tuberculate or ribbed	Reticulate
<i>M. orbicularis</i>	2.5 – 3.0 × 2.2 – 2.5 mm	Deltoid or suborbicular	Brown	Tuberculate	Tuberculate
<i>M. polymorpha</i> var. <i>vulgaris</i>	2.5 × 0.5 mm	Elongate-reniform	Brown	Smooth	Tuberculate
<i>M. sativa</i>	3 × 2 mm	Oblong-reniform	Brown	Smooth	Rugulate
<i>M. × varia</i>	2.0 – 2.5 × 1.5 mm	Ovoid	Yellowish brown	Smooth	Tuberculate

DISCUSSION

The seeds of all species studied here show uniformity in their size and colour and they vary only in shape. At lower magnification the testa surface is smooth except *Medicago monantha* and *M. orbicularis* where it is tuberculate. At higher magnification in the present investigation the tuberculate pattern is predominant followed by false reticulate (*M. edgeworthii*), reticulate (*M. monantha*) and rugulate (*M. sativa*) pattern.

Lersten and Gunn (1982) observed only papillose (tuberculate) pattern in 5 species of *Medicago* (*M. cancellata*, *M. mesopotamica*, *M. pironae*, *M. platycarpa* and *M. sativa*). In *M. sativa* they recorded papillose pattern near hilum and non papillose pattern in mid-seed. Trivedi & Bagchi (1982) and Solum and Lockerman (1991) reported tuberculate and obscurely tuberculate pattern respectively in *M. sativa*. However, the present investigation shows rugulate pattern in *M. sativa* indicating that *M. sativa* is greatly variable in spermoderm pattern which varies from rugulate to papillose.

Pandey (1991) reported levigate (smooth) pattern in *M. orbicularis* while in the present study

we observed tuberculate pattern in low as well as in high magnification.

Medicago laciniata, *M. minima* and *M. polymorpha* var. *vulgaris* which are known to be closely related have a similar type of testa surface (tuberculate) with slight differences in tubercules.

M. lupulina is quite different from other *Medicago* species not only in morphological characters but also in its spermoderm pattern.

M. sativa and *M. × varia* (hybrid form of *M. falcata* and *M. sativa*) are very similar in their gross morphology and differ only in pod characters, have different type of seed surface which can be used as key character for their identification.

M. monantha and *M. edgeworthii* are usually placed in *Trigonella* based on pod characters. Recently small *et al.* (1987) placed these species in *Medicago* on the basis of floral characters (i.e. explosive tripping pollination mechanism) and these species have a distinct spermoderm pattern which differs from other *Medicago* species. Gupta (1991) reported multi-reticulate pattern in *Trigonella geminiflora* which is now a synonym of

M. monantha however, present studies show distinct reticulate pattern.

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