other closely in characters like: cortex differentiated into three zones, outer cortex-consists of thickened parenchyma cells, middle cortex comprises a number of large air chambers, inner cortex with round, regular parenchyma cells with air spaces. The stele is polyarch with exarch protoxylem. Pith is thick-walled and lateral roots originate from pericycle. The rootlets also resemble the rootlets of *Eichhornia* in the presence of 1–2 xylem tracheids and undifferentiated cortex with air spaces. The axis consists of cortex and central zones separated by parenchymatous region with crowded vascular bundles which are irregular, collateral and closed. Each bundle has 2–5 xylem tracheids and thickened surrounding cells. Ground tissue of both the zones has fairly regular air spaces. Obviously, all these characters show closest similarity with the axis of extant *Eichhornia*.

Thus it has been surmised that the fossil roots, rootlets and axes undoubtedly belong to the corresponding organs of *E. crassipes*. The occurrence of fossil *Eichhornia* in the Deccan Intertrappean beds throws light on the distribution and origin of the genus.

20 July 1985; Revised 16 September 1985

1. Chitaley, S. D., *Palaeobotanist*, 1968, **17**, 224.
2. Chitaley, S. D., *J. Indian Bot. Soc.*, 1968, **47**, 7.
3. Chitaley, S. D., Sheikh, M. T. and Rao, A. R., *Palaeobotanist*, 1970, **18**, 151.
4. Trivedi, B. S. and Ambwani, K., *Palaeontographica*, 1971, **133**, 135.
5. Trivedi, B. S., Verma, C. L. and Ambwani, K., *Curr. Sci.*, 1970, **39**, 241.
6. Trivedi, B. S., Verma, C. L. and Bajpai, S. K., *Geophytology*, 1982, **12**, 135.
7. Verma, C. L., *Curr. Sci.*, 1974, **43**, 289.
8. Arber, A., *Water plants, a study of the aquatic angiosperms*. Cambridge Univ. Press, London, 1920.
9. Metcalfe, C. R. and Chalk, L., *Anatomy of dicotyledons*. **1 & 2**, Oxford 1950.
10. Penfound, W. T. and Earle, T. T., *Ecol. Mongr.*, 1948, **18**, 447.
11. Sculthorpe, C. D., *The biology of aquatic vascular plants*, Edward Arnold, London, 1957.

MADURASIA OBSCURELLA JACOBY—A NEW VECTOR OF SOUTHERN BEAN MOSAIC VIRUS

D. R. R. REDDY and ANUPAM VARMA
Division of Mycology and Plant Pathology,
Indian Agricultural Research Institute,
New Delhi 110012, India.

IN 1982, a green mosaic disease of cowpea caused by southern bean mosaic virus (SBMV) was observed under Delhi conditions[1]. The diseased plants develop chlorotic patches on young and old leaves and the leaves were greener than healthy plants. A somewhat similar disease caused by three unusual strains of SBMV was earlier reported from Gorakhpur[2]. SBMV is known to be transmitted by phytophagous beetles, *Ceratoma trifurcata* in USA[3] and *Ootheca mutabils* in Nigeria[4]. Although the virus spreads in nature, no information was available about its natural vector in India. During the present investigations a vector of the virus was identified which is different from the known vectors and the results are reported here.

Galerucid beetle, *Madurasia obscurella* Jacoby (figure 1), the most common phytophagous beetle, causes serious damage to cowpea, mung bean, soybean and other legumes during *kharif* season in northern India. The beetles feed on plants during the dusk and early morning hours on leaves making small holes and during the day time they hide in soil crevices. Most serious damage is caused to the young plants. Feeding behaviour of these beetles is ideally suited for

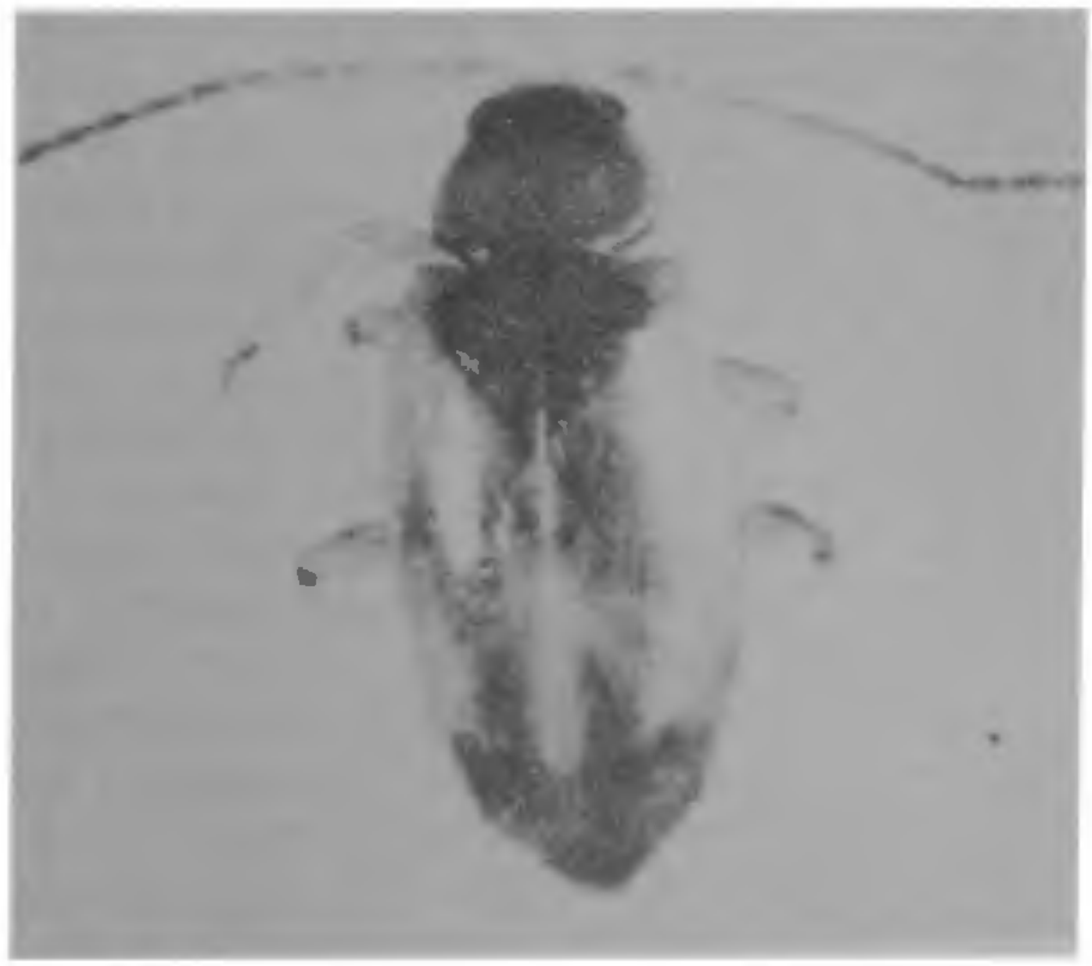

Figure 1. An adult *Madurasia obscurella*.

Table 1. *Transmission of SBMV by M. obscurella*

No. of beetles per plant	Acquisition access period (hr)	Transmission access period (hr)	No. of plants tested	% Plants infected	Time taken in developing symptoms (days)
2	120	16	4	25.0	10
2	48	16	4	25.0	10
3	120	16	7	42.8	11
5	24	16	20	40.0	12
5	24	24	12	25.0	10
7	24	24	17	29.4	12

transmission of viruses; therefore these were tested for the transmission of the present isolate of SBMV.

Individual beetles were fed on SBMV infected leaves of cowpea cv V-513 in a plastic petridish (11 cm dia). The leaves were kept turgid by inserting their petiole in moistened cotton swabs. Equal number of beetles were allowed to feed similarly on healthy detached leaves. The beetles were given acquisition access period ranging from 24–120 hr. The required number of beetles were then transferred, using an aspirator, to plastic cages/glass chimneys covering healthy test plants and allowed transmission access feeds of 16 or 24 hr. Two to seven beetles per test plant were tested for their efficacy in the transmission of SBMV. After the required transmission access the feed beetles were individually removed from the test plants. The test plants were observed for six weeks for symptoms. All the plants, irrespective of development of symptoms, were tested serologically for confirming infection.

M. obscurella transmitted SBMV efficiently from cowpea to cowpea. The percentage success in transmission varied from 25–43% in different tests (table 1). No difference was found in the efficiency of transmission by the beetles given an acquisition access period of 48 or 120 hr. Similarly the number of beetles used for transmission per plant also did not have much influence on transmission of the virus. For example using two beetles per plant 25% transmission was obtained, whereas increasing the number of beetles to seven per plant increased the per cent transmission marginally to 29.4% (table 1). All the plants infected through the beetles developed typical symptoms in 10–12 days (figure 2). In serological tests the virus was detected only in plants developing the symptoms. No infection was obtained in tests with beetles given the acquisition feed on healthy detached leaves.

M. obscurella is a new vector of SBMV and is the only vector known for this virus so far in India. Transmission of SBMV by *M. obscurella* adds another dimension to the importance of this pest, as it not only causes damage by direct feeding but also efficiently transmits SBMV which also reduces yields.

Figure 2. Symptoms of SBMV on a leaf of cowpea cv. 513 twelve days after the plant was inoculated.

The authors thank the Director and Dean of the I.A.R.I., New Delhi for providing a fellowship to DRRR.

2 September, 1985

1. Varma, A. and Reddy, D. R. R., *Indian Phytopathol.*, 1984, **37**, 409.
2. Singh, R. and Singh, R., *Portu. Acta Biol. A.*, 1974, **13**, 87.

3. Walters, H. J. and Henry, D. B., *Phytopathology*, 1970, **60,** 177.
4. Allen, D. J., Anno-nyako, F. O., Ochieng, R. S. and Ratinam, M., *Tropical Agriculture*, 1981, **58,** 171.

LABORATORY COLONISATION OF *MANSONIA* MOSQUITOES

P. S. SASIKUMAR, CHERIYAN THOMAS and R. S. PRASAD
Department of Zoology, University of Kerala, Kariyavattom, Trivandrum 695 581, India.

MEDICAL importance of *Mansonia* mosquitoes stems from the fact that they are vectors of Brugian filariasis in Kerala State. Laboratory rearing of *Mansonia* has been reported by Gillett[1], Jayawickreme and Niles[2] and Laurence *et al*[3]. However, owing to the nonavailability of "paper leaves" used by Laurence *et al*[4] it became necessary to search for suitable materials for larval attachment and newer techniques had to be devised for laboratory rearing of *Ma. annulifera* and *Ma. uniformis*.

In the present study two different methods were used for the rearing of *Mansonia* mosquitoes in the laboratory. In the first, adults collected from the field were released in small cages of 18″ × 18″ × 22″. A small bowl containing water and *Pistia stratiotes* or thermocol (an expanded polystyrene, commonly used as packing material) were kept in the cage for oviposition. Eggs were removed from the bowl and kept in wide-mouthed plastic containers (2000 ml capacity) with dechlorinated tap water. In order to prevent overcrowding only 2 egg clusters were kept in one container. *Pistia* plants were provided for larval attachment and these were replaced by fresh ones as and when they decayed. The emerged adults were released back in the cage. In the second method, a specially fabricated 'twin cage' was used for an uninterrupted breeding of these mosquitoes. This consisted of 2 cages, one of which had a dimension of 5′ × 4′ × 3′ and the other was a fish tank (size 18″ × 18″ × 10′) to which a rectangular metal frame was fixed and covered with plastic net. Both cages were connected together by a sleeve made of plastic net for easy movements of mosquitoes between the cages. After layering the bottom with sand, the fish tank was half filled with dechlorinated tap water. One of the advantages of this type of a cage set-up, consists of the study of the movement of mosquitoes between the breeding water source and the host. In this set-up a light beam across the passage, between the 2 cages with a photoelectric cell would 'measure' the periodic movement of mosquitoes between the breeding water source and the host as well as movements for swarming behaviour. Such a fabrication is being attempted. *Eichhornia speciosa*, *P. stratiotes*, *Cynotis axillaris*, *Commelina nudiflora*, *Ipomoea aquatica* and *Limnophila heterophylla* were tried separately for larval attachment. When *P. stratiotes* were not provided, evenly cut pieces of thermocol were allowed to float over the surface of water to facilitate oviposition.

In both methods, albino rabbit was used as host. Cotton-wool pad soaked in sugar solution was provided in the cages. To maintain high humidity, a requirement for the adult mosquitoes as indicated by Laurence *et al*[3] the cages were placed over metal trays full of water and the sides of the cages were covered with damp lint. The larval diet consisted of a finely powdered mixture made with known proportions of dog biscuit (ca. 10 g), faecal pellets of rat (ca. 10 g), B-vitamins (ca. 0.5 to 0.8 g) and dried bovine liver (ca. 2.5 g) in 1000 ml of water. The pH of the culture medium was occasionally checked.

In addition to the above mentioned aquatic plants, alternative materials like thermocol, pith from *Aeschynomene aspera* and Cassava plants and commercially available cork were also tried for larval attachment. Petri culture method was used to study the growth, moulting and nutrient requirements of the larvae. For this, thermocol cut in circular shape, whose central portion had the form of a cup, was fitted tightly to a petri dish of size 50 × 70 mm. Dechlorinated tap water and larval food were poured into the depression up to the brim. The petri dish was covered after releasing the larvae and observations were made using a stereo-dissection microscope.

One of the most important problems associated with the laboratory rearing of *Mansonia* mosquitoes is the heavy mortality of the pre-imago stages, possibly resulting from either nutritional inadequacies or the decay of aquatic plants used in the culture. This has been indicated by Laurence *et al*[3]. Though the larval diet supplemented with dried and powdered liver raised the nutritive value, as judged from the larval survival, the mortality remained high. Methods to improve diets are now being tried.

Among aquatic plants for larval attachment, *P. stratiotes*, and *E. speciosa* are best preferred. However, these are not promising in the laboratory cultures as they decay very fast in the absence of sun light. This