

Protocol for the management of the gall wasp:

1. ICAR-NBAIR obtained the parasitoids from Israel in two consignments, in 2008 November and 2010 February and quarantined/multiplied for host-specificity and safety tests.
2. The parasitoid *Q. mendeli* was brought in pupal stage within the galls of eucalyptus and emergence was monitored.
3. Pure cultures of the emerged parasitoids were collected and second generation parasitoids were raised using eucalyptus plant galls of the age of 35-40 days.
4. The plant debris was incinerated after the emergence of parasitoids.
5. The parasitoids were released in limited area initially for further multiplication in the eucalyptus nurseries of respective IPMA member mills/Institutions.
6. The indigenous parasitoid, *Megastigmus viggiani* was also multiplied and supplied to eucalyptus plantation growers for field release on spotting the incidence of gall wasp.



Megastigmus viggiani



Quadrastichus mendeli

Conservation: *Quadrastichus mendeli*, which was initially multiplied at the NBAIR was given to IPMA member mills/institutions for further multiplication in eucalyptus nurseries. Since, the indigenous parasitoid, *M. viggiani* was also found to be effective against eucalyptus gall wasp, the growers were advised to look for the same and conserve the same *in situ*.

Since natural enemies were found to control the eucalyptus gall wasp effectively, growers were advised not to apply chemical pesticides and conserve the parasitoids, thus preventing outbreaks.

Outcome

Quadrastichus mendeli was released in eucalyptus orchards and nurseries across India with the help of IPMA and their associate mills. The parasitoid dispersed within one year span to different parts of the country where eucalyptus was grown, i.e. in 80 lakh hectares. The infestation by gall wasp after one year was assessed and found that there was a drastic reduction in gall wasp population in field. From the second year of release, the gall insect became below pest status level in most of the states. Currently the pest is kept under check by the parasitoid. Thus, the introduction of the parasitoid from Israel has helped significantly in reducing the gall wasp infestation in India. An estimated 8,000 ha damage of eucalyptus gall wasp was checked within the first couple of years of release of the parasitoid, thus saving the paper industry.



Gall wasp infested plant



Healthy plant

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Biocontrol Rescues the Paper Industry: Management of Eucalyptus Gall Wasp, *Leptocybe invasa*



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Biocontrol Rescues the Paper Industry: Management of Eucalyptus Gall Wasp, *Leptocybe invasa*

Eucalyptus is an important pulpwood species widely used in the paper and pulp industries. The gall wasp, *Leptocybe invasa* (blue gum chalcid), which migrated from Australia and spread throughout the world, gained entry into India in 2001 and damaged eucalyptus plantations in large areas in south India. It was first reported in Villupuram district of Tamil Nadu, from where spread to the neighboring states of Kerala, Karnataka and Andhra Pradesh and to the other eucalyptus-growing areas of the country.

Leptocybe invasa produces galls on leaf mid-ribs, petioles and shoot tips, which slowly damage the shoots leading to stunted growth. Heavy galling prevents further growth of the infested shoots thus causing heavy loss to wood production. Many nurseries produce eucalyptus seedlings on a large scale and supply to growers for raising plantations. The nursery stock was severely affected by this gall wasp and as a result planting rate had come down gradually. The outbreak of this gall wasp threatened the productivity of the eucalyptus plantations (146 t/ha) and had become a constraint to the expansion of plantations throughout India. There were no effective management strategies to reduce the impact of this pest.



Leptocybe invasa male



Leptocybe invasa female

Importation of natural enemies of the pest for biological control

Two wasp parasitoids, *Quadrastichus mendeli* and *Selitrichodes kryseri* confirmed to effectively parasitise *Leptocybe invasa*, were brought to Israel from Australia, the native range and were successfully used to manage the gall wasp in Israel. The same were introduced into India from Israel for the management of the pest by adhering to the quarantine formalities.

The Indian Paper Manufacturers Association (IPMA) took the initiative for the classical biological control of the gall wasp. ICAR-NBAIR (then Project Directorate of Biological Control or PDBC) being a nodal agency for importation, took active steps in obtaining import permits from the Directorate of Plant Protection, Quarantine and Storage in 2008 and the two important biocontrol agents, *Quadrastichus mendeli* and *Selitrichodes kryseri* were brought to India for management of the gall wasp and evaluated for their host specificity and efficacy.



Suitable stage of galls for oviposition by *Quadrastichus mendeli*

Host specificity and safety testing

The biology of wasps, *Q. mendeli* and *S. kryseri* was studied to standardise the rearing protocols at NBAIR. The parasitoids were mass multiplied and evaluated for their host specificity using a wide range of hosts and were found to be safe to tested plants and insects. *Quadrastichus mendeli* was found to be more effective in controlling the gall wasp and hence the same was mass produced for field releases in eucalyptus plantations.

Safety to selected non-target organisms

Safety of the parasitoids to the following non-target beneficial organisms, viz. *Micromus igorotus*, *Chrysoperla zastrowi sillemi*, *Brumoides* sp., *Cryptolaemus montrouzieri*, *Goniozus nephantidis*, *Trichogramma chilonis*, *T. japonicum*, *Bombyx mori*, *Apis cerana indica*, *Scymnus coccivora* and *Spalgis epius* was also confirmed.



Collection and maintenance of adult *Leptocybe invasa*

