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SHORT COMMUNICATION

RAPID SURVEY OF DAMAGE DUE TO GALL WASP INFESTATION IN A COPPICED *EUCALYPTUS CAMALDULENSIS* PLANTATION IN MARAGAMUWA, NAULA IN THE MATALE DISTRICT OF SRI LANKA

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ABSTRACT

According to several sources, *Eucalyptus* plantations in Sri Lanka are currently under threat due to an attack by a gall wasp. Our observations made at a coppiced *Eucalyptus camaldulensis* plantation at Maragamuwa, Naula in the Matale District revealed a heavy infestation of galls in coppiced shoots. Close examination of 40 trees in a block revealed low damage in 62.5% of the coppiced trees and heavy damage in 10% of the trees. The wasps that emerged from field collected galls were identified as *Leptocybe invasa* Fisher & La Salle (Hymenoptera: Eulophidae). Only female wasps emerged from the field collected galls and no parasitoids were recorded. This preliminary study highlights the severity of damage caused by *L. invasa* and the need to identify appropriate measures to manage this invasive gall wasp of *Eucalyptus* plantations in the country.

Keywords: *Leptocybe invasa*, coppiced shoots, conservation site

INTRODUCTION

Eucalyptus was introduced to Sri Lanka as a plantation crop in the latter part of the 18th century from Australia. Currently it is contributing to 20% of the major reforestation plantings that provide timber and fuel wood (Bandaratillake, 1993). Furthermore, *Eucalyptus* plantations play a dominant role in soil conservation, watershed management and provide wood and wood fiber products. Currently there are plantations of about 10 species of *Eucalyptus* distributed in three agro-climatic regions of the country; in the Dry and Intermediate zones and in the Up country and Low country Wet zone. Among them, *Eucalyptus camaldulensis* is the most widespread species planted in an area of >15,500 ha (Bandaratillake, 1993). It is one of the best known *Eucalyptus* species outside Australia. Economically it is the most important hardwood species of the dry lowland areas in the entire Mediterranean and Middle East regions (FAO, 1979).

Eucalyptus plantations and nurseries throughout the tropical and subtropical countries of the world are currently under threat by the gall forming invasive wasp, *Leptocybe invasa* (Hymenoptera: Eulophidae), commonly referred to as the blue gum chalcid (Mendel, *et al*, 2004; FAO, 2007). In 2000, this gall wasp was recorded from the Mediterranean region where it caused severe injury to young foliage of red river gum, *Eucalyptus camaldulensis*, by inducing galls mainly on rapidly growing shoots. Seedlings in nurseries, saplings in plantations and coppiced shoots in plantations are known to be more susceptible to *L. invasa* attack (Mendel, *et al.*, 2004). The wasp lays eggs in the petiole and midrib of leaves and stems of young shoots that leads to gall formation. Gall formation by *L. invasa* damages growing shoot tips and leaves of *Eucalypts*, resulting in quicker abscission of leaves and drying up of shoots. Heavy galling prevents further growth of the infested shoots. Its rapid population growth and spread in countries into which *Eucalyptus* has been introduced is attributed to the thelotokous parthenogenetic reproduction and multivoltine development of *L invasa* and the absence of natural enemies (Mendel *et al.*, 2004). *L invasa* is not considered a pest in Australia suggesting that the natural enemies in its native country

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keep the population level of the pest below observable level. Studies conducted in India recorded few species of naturally occurring parasitoids (natural enemies) of *L. invasa*. Of them, *Megastigmus* sp. (Torymidae) was recorded as the most abundant parasitoid of *L. invasa* in India (Kulkarni *et al.*, 2010).

In the plantation in Maragamuwa and Handuwa in the Naula area of the Matale District, where the study was conducted, 320 ha of land had been planted with *E. camaldulensis* in the late 1970's and had been coppiced in 2006/2007 to allow for natural forest recovery (Reed *et al*., 2009). A rapid preliminary survey was carried out in a section of this plantation to assess the severity of damage and to identify the gall forming insect.

MATERIALS AND METHODS

Survey site

The rapid survey was conducted in a 4 ha block of the harvested *E. camaldulensis* plantation with coppiced shoots in Maragamuwa, Matale District. The site was visited on 29th October, 2010. The surveyed block had a thick undergrowth of herbs and shrubs and the terrain was sloppy, therefore, access was not easy (Plate 1).

Assessment of the severity of damage

The 4 ha block had nearly 3500 coppiced trees of *E. camaldulensis*. Within a selected area in the block, 40 accessible coppiced trees were selected for the survey. The trees were located along a sloppy terrain ranging in elevation from 250-270 m. Access to each coppiced tree was made by clearing the undergrowth. The severity of damage in the coppiced growth of the selected trees due to gall formation was assessed modifying the criteria given by Thu *et al*, (2009) indicated below:

Percentage leaves infected	Damage level
Healthy trees, no damage	Nil
< 25% leaves and twigs of crown infected	Low
25-75% leaves and twigs of crown infected	Medium
>75% leaves and twigs of crown infected	High

Plate 1. Survey site in the 4 ha harvested *Eucalyptus camaldulensis* plantation at Maragamuwa, Naula.

Collection of gall forming insects from infested shoots of *E. camaldulensis*

Randomly selected *ca*. 15 small branches with mature galls were excised and brought to the Entomology Laboratory at the University of Peradeniya. The cut ends of branches were dipped in water and the branches were covered with ventilated polythene bags. Insects that emerged over a period of 25 days (by which time the braches had dried up) were collected and preserved in 70% alcohol. Wasps were identified using the descriptions given by Mendel *et al.* (2004) and Protasov *et al*. (2008).

RESULTS AND DISCUSSION

Of the coppiced *E. camaldulensis* trees examined, majority (62.5%) had a low infestation, with only 10% of the trees having a heavy infestation (Table 1). Galls of different stages (Plate 2) were present in 90% of the examined *E. camaldulensis* coppiced trees.

Table 1. Level of damage in coppiced trees of *E. camaldulensis* due to the gall wasp attack (n=40).

% Severity of damage	No. of trees damaged (%)	Damage level
0	4 (10.0)	Nil
1-25	25 (62.5)	Low
26-75	7 (17.5)	Medium
76-100	4 (10.0)	High

Plate 2. Severely damaged shoots of *E. camaldulensis* at the Maragamuwa plantation, showing galls of different stages formed by the gall wasp.

Casual sweeping of galled shoots of *E. camaldulensis* using a standard insect net, yielded a large number of gall wasps indicating a high population in the plantations at Maragamuwa. Close observation of mature leaves in older trees of *E. camaldulensis* indicated the presence of infrequent galls on leaf veins. From the infested *E. camaldulensis* branches held in the laboratory, a total of 76 wasps emerged (Plates 3 and 4), over a period of

25 days. These were identified as *Leptocybe invasa* Fisher & La Salle, 2004 (Plate 5). On close examination, all the wasps that emerged were found to be females. According to studies conducted in Israel (Mendel *et al.,* 2004) males were not found among thousands of *L. invasa* wasps that emerged from galls in *E. camaldulensis* and few other *Eucalyptus* species. However, Protasov *et al*. (2008) and Kavitha Kumari *et al*., 2010 had encountered males of *L. invasa* in India.

No other insect species emerged from galls of the coppiced shoots held in the laboratory, indicating the absence of natural enemies of *L. invasa* in the field collected sample. This may be due to the small number of shoots held in the laboratory or the low prevalence or absence of natural enemies at the site. In India, Gupta and Poorani (2009) reported five species of parasitoids from *L. invisa* namely, *Aprostocetus gala* Walker and *Aprostocetus* sp. (Eulophidae), *Megastigmus* sp. (Torymidae), *Parallelaptera* sp. (Mymaridae) and *Telenomus* sp. (Scelionidae). Of these, *Megastigmus* sp. was the most abundant. Native *Megastigmus* species are known to parasitize *L. invasa* in Italy, Turkey and Israel (Viggiani *et al*., 2000; Protasov *et al*., 2008).

According to personal information of Dr. N.D. R. Weerawardane (Forest Research Centre, Kumbalpola, Sri Lanka), damage due to gall formation in *Eucalyptus* has been seen over several years. Recent observation by scientists at the Tea Research Institute, Sri Lanka has indicated gall wasp infestations in *E. grandis*, *E. robusta* and *E. microcorys* as well. In the world, 13 species of *Eucalyptus* (*E. botryoides, E. bridgesiana, E. camaldulensis, E. deanei, E. globulus, E. gunii, E. grandis, E. saligna, E. maidenii, E. nitens, E. robusta, E. tereticornis* and *E. viminalis)* have been identified as susceptible to *L. invasa* (Thu *et al*, 2009; Mendel. *et al*., 2004; FAO–Health and Biosecurity working papers, Kenya, 2007). Of them, only five *Eucalyptus* species are present in Sri Lanka. Based on the extent and distribution of *Eucalyptus* plantations in the country, 97% of the plantations could be under threat by *L. invasa*. *Eucalyptu camaldulensis* represents 55% of the *Eucalyptus* plantations in the country that are largely confined to the Dry and Intermediate zones. According to Mendel *et al.* (2004), the gall wasp prefers warmer climates. In Israel, oviposition by adult wasps and all development stages of the wasp were observed during warmer climates. Their development was slow and suppressed during winter seasons. In Sri Lanka, warmer climates prevailing throughout the year in Dry and Intermediate zones may provide optimum conditions for the gall wasp development in its most preferred host, *E. camaldulensis*. *Eucalyptus camaldulensis* is known to be one of the most susceptible hosts of *L. invasa* (Krishnakumar and Jacob, 2010; Thu, *et al.*, 2009; Branco *et al.,* 2005 and Mendel *et al.,* 2004).

Plate 3. Leaf and petiole galls formed by *L. invasa* in *E. camaldulensis.*

Plate 4. Developing larva of *L. invasa* inside a gall (cut open).

Plate 5. *L. invasa* female on a leaf of *E. camaldulensis.*

This study highlights the threat to *Eucalyptus* plantations in general due to *L. invasa* and particularly to *E. camaldulensis.* Research in wider spatial and temporal scales to determine the impact of the gall wasp on *Eucalyptus* plantations in Sri Lanka and management strategies including biological control need to be addressed urgently.

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