First report of stem borer (*Xylotrechus smei*) occurrence on red sanders plantations of Tamil Nadu and Gujarat

Abstract

This communication presents the first documented case of the stem borer *Xylotrechus smei* (Cerambycidae: Coleoptera) infesting red sanders in Tamil Nadu and Gujarat, India. The pest was detected in red sanders plantations located in Dharmapuri and Tenkasi districts of Tamil Nadu, as well as in Surat, Navsari, and Tapi districts of Gujarat, India, during August 2023. In both regions, young red sanders trees aged between 2 to 16 years were affected, with incidence levels varying from 2.24% to 10.86% in the affected plantations. Signs of infestation include the presence of galleries, bore holes in cut stems, complete drying, and mortality of the trees. Initially, larvae feed on the bark, and as they mature, they tunnel through the cambium and wood, impeding nutrient flow and leading to tree mortality. The larvae's deep tunneling within the wood makes them difficult to eradicate with pesticides. Adult beetles typically emerge in peak numbers during April to May and November to December, coinciding with their mating period and selection of host plants for egg-laying. This report aims to outline the damage caused by the stem borer in red sanders and document ongoing monitoring efforts to support interim management strategies.

Key words: Stem borer, *Xylotrechus smei*, red sanders, First record, Tamil Nadu, Gujarat, Interim management

Introduction

Pterocarpus santalinus L. F., commonly referred to as red sanders, is a tree species native to the southern regions of the Eastern Ghats, India. Renowned for its vibrant blood-red heartwood, the demand for this wood in the global market is rapidly increasing, akin to the demand for gold. Its wood finds applications in crafting high-value furniture, musical instruments, and various industries utilize santalins extracted from the wood in textiles, food, and pharmaceuticals. Additionally, the heartwood is esteemed for its medicinal properties, often employed in treating coughs, digestive issues, and fluid retention (Bulle et al., 2016).

Recent assessments by the International Union for Conservation of Nature and Natural Resources have escalated the species' status to 'Endangered,' up from its previous classification of 'Near Threatened.' Red sanders is listed in Appendix 1 of CITES, imposing restrictions on the

international trade of its wood and wood products sourced from natural habitats. Naturally distributed across 3.98 lakh hectares of dispersed forests, there is a growing trend of cultivating this species on farmland (Arunkumar and Joshi, 2014). However, extensive cultivation efforts by both the State Forest Department and farmers have led to an increase in the occurrence and spread of insect pests in nurseries and plantations. The specific insect-pest complex targeting red sanders in nurseries, plantations, and natural forests remains unidentified.

Material and Methods

To assess insect pests affecting red sanders, a field survey was carried out in the Dharmapuri and Tenkasi Districts of Tamil Nadu, as well as in the Surat, Navsari, and Tapi Districts of Gujarat. To facilitate a comparative analysis, experiments were conducted in both natural populations and plantations within Tamil Nadu. Plantations aged between 2 and 30 years were chosen across all locations. Diameter at breast height (DBH) was measured for each sampled tree, and the mean annual increment (DBH/year) was calculated for each stand. The number of bore holes created by stem borers and their height from the ground level were recorded for each sample tree. Additionally, felled red sanders trees were inspected to identify the attacking insects and ascertain their developmental stages.

Results and Discussion

In August 2023, a survey was conducted across various districts of Tamil Nadu and Gujarat. Plantations in Dharmapuri and Madurai districts of Tamil Nadu, as well as Surat and Navsari districts in Gujarat, were notably affected by stem borer infestation, resulting in a mortality rate of 10.86% in plantations aged between 2 to 16 years. Affected trees exhibited characteristic signs such as galleries, bore holes in cut stems, complete drying, and mortality, as depicted in Figure 1. This marks the first documented instance of stem borer infestation in red sanders plantations in Tamil Nadu and Gujarat, India. Further investigations into the pest's biology could aid in the development of targeted management strategies. Effective control of such insect pests holds the potential for significant economic benefits.

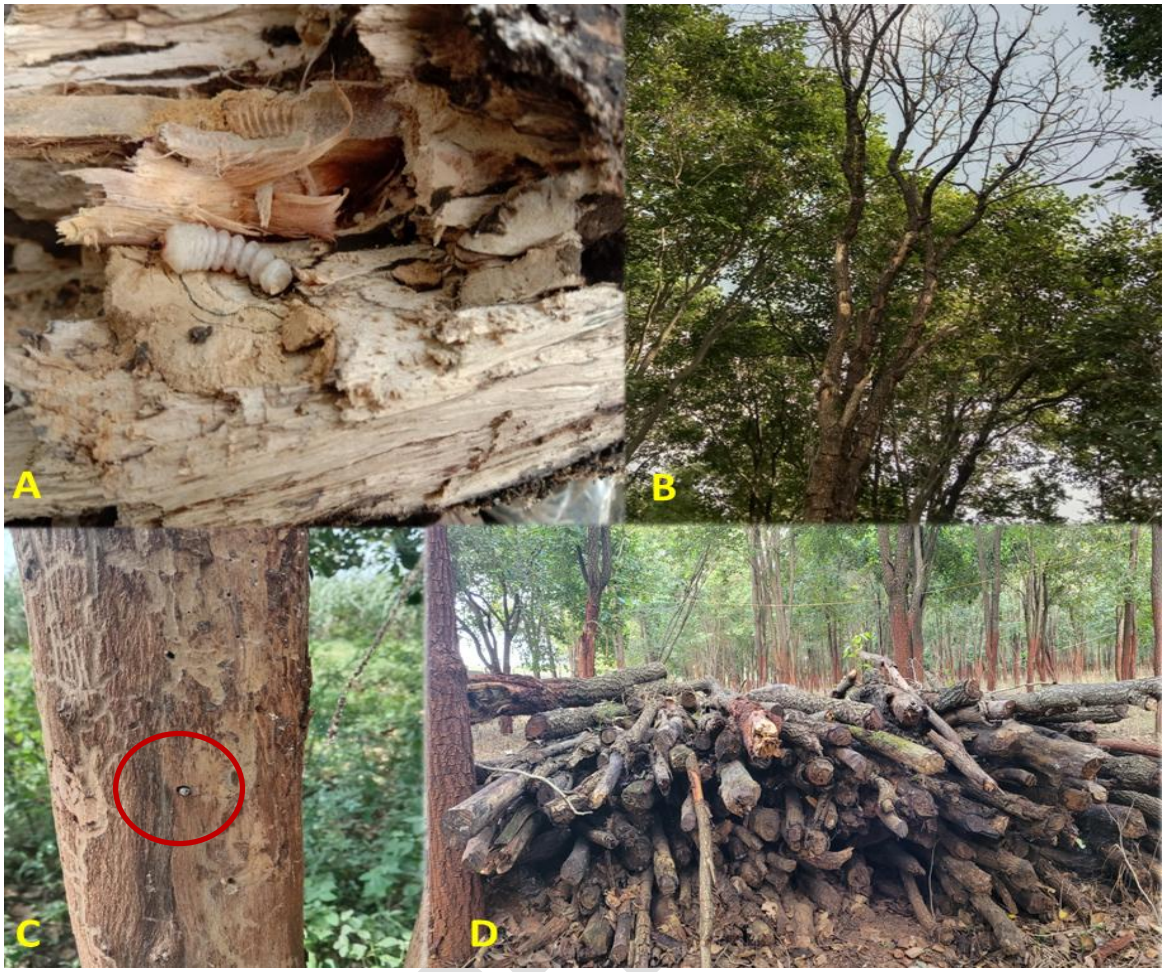

Fig. 1. Stem borer damage in red sanders: (a) Grub visible in the tunnel (b) Tree mortality (c) Adult emergence/exit holes from infected tree (d) Heap of infested dead trees in plantations

Habit: Females only lay eggs when bark is present; debarked, sawn, and seasoned timber are not susceptible to attack. A female can lay a maximum of 190 eggs, with the highest number typically laid within a 24-hour period ranging from 24 to 60 eggs. The longest recorded oviposition period is 6 days, typically occurring in April. Eggs are typically laid in crevices and covered depressions on the surface of bark, often in large clusters. These eggs typically hatch within 4 to 5 days during April, as documented by Beeson in 1941.

Larva: The larvae of *Xylotrechus smei* are white and robust, with a dark head and strong mandibles. They excavate tunnels of regular nature on the inner aspect of the bark and outer aspect of the sapwood, gradually progressing inward where they create deeper tunnels densely packed with wood dust. These tunnels form a crowded chamber as they remain

intercalated. The rate of larval development varies, with the shortest larval period observed under certain conditions being 52 days in April and May. According to Gardner (1927), the larval head capsule is sub-rectangular, slightly wider behind, and not strongly transverse. The antennae are prominent, with the second joint distinctly longer than the third. Leg structures are hardly visible with a hand lens, but under a microscope, legs are seen to consist of two very short circular joints with minute apical spines. The first-stage larva possesses biforous spiracles.

X. smei infests newly felled trees within a month of felling and can also attack trees several months after felling. It targets grilled trees and the crowns of dying or stag-headed trees. Logs stored in sunlight are more susceptible to attack, although the preference is not strongly marked. Larval tunnels, excavated on the surfaces of sapwood and inner bark, are flattened oval in section and tightly packed with bark and wood dust; in heavily infested areas, the tunnels interlace closely. In timbers with strongly differentiated heartwood, the borings are confined to the sapwood. However, in homogeneous wood, tunnels may extend to the center of the log and trend irregularly or concentrically with the zones of growth. The beetle escapes through the prepupal tunnel and creates a circular exit hole in the bark (Beeson, 1941).

Pupa: The pupa measures approximately 17 mm in length, with a rounded head featuring short cheeks that are abruptly hooked at their apex and carinate along the cutter side. The base of the cheeks is pubescent, while the labrum is longitudinally striated with short recumbent setae. The clypeus is transversally striated and pubescent at the sides. The forehead exhibits a V-shaped carina, the tip of which reaches the lower margin of the eyes and extends beyond the level of the antennal supports, forming an oval-elongate flat tubercle that reaches the hind margin of the head. The joints of the palpi are subquadrate, with rounded ends. The antennae are short, with the 10th joint reaching the front knees.

The pronotum is rounded and very feebly constricted at the base, appearing smooth with two small clusters of 7-8 sparse short conical spinules on each side—one at the base and another slightly behind the middle of the lateral margin, visible from the ventral side. The mesonotum and metanotum are fairly punctate. The pupal chamber, formed at a shallow depth in the sapwood, measures approximately 15-20 cm in length and is continuous with the larval tunnel. However, such chambers are not formed in the heartwood according to Vitali (2004).

Adult: The beetle typically ranges from 10 to 18 mm in length, displaying a brown coloration with a greyish or yellowish pubescence on the head and prothorax, often forming bands or spots on the elytra. The coloration of these markings can vary, ranging from nearly entirely yellow to grey. Elytra patterns also vary, ranging from an apical and basal band with two lateral spots to configurations including an apical and basal band connected to post-median and antemedian bands, along with a humeral spot. Additionally, the prothorax may exhibit a reddish hue (Beeson, 1941). According to Stebbing (1914), the beetle measures 11 to 17 mm in length and 3 to 5 mm in breadth. It features a brown coloration from above, with a grayish or yellowish pubescence covering most of the head and prothorax, often forming bands and spots on the elytra. The underside of the body is marked with spots or bands of whitish pubescence.

Life cycle: The emergence of *X. smei* typically initiates at the end of March from overwintered broods, reaching its peak during May-June, and continuing until the end of November. Eggs laid during April-May give rise to short-cycle and long-cycle generations. The former takes between 2 to 7 months to complete, with emergence occurring between the beginning of July and the end of November. In contrast, the latter hibernates to emerge in the second year. Eggs laid at the beginning of July or later in the year do not complete a full generation within the same year. Instead, the immature beetle or larva enters a resting stage during the cold weather, with adults emerging in the second year between April and November. The shortest life-cycle observed among overwintering broods is about 6 months, while the longest may extend from 6 to 16 months (Sidharthan et al., 2023).

Other host plants:

The plant species mentioned, according to Beeson (1941), are*: Adina cordifolia, Aegle marmelos, Anogeissus latifolia, Bauhinia retusa, Bombax malabaricum, Cassia fistula, Dalbergia latifolia, Dalbergia sissoo, Ficus religiosa, Gmelia arborea, Grewia tiliaefolia, Holoptelia integrifolia, Mallotus philippinensis, Mangifera indica, Morus indica, Shorea robusta, Tectona grandis, Terminalia tomentosa, and Vitis latifolia.*

Extent of Damage/Status:

A survey conducted in August 2023 in the Dharmapuri, Madurai, and Tenkasi districts of Tamil Nadu revealed an outbreak of stem borer infestation in red sanders plantations aged between 2 to 16 years, resulting in damage ranging from approximately

7.10% to 9.42%. Affected trees exhibited characteristic signs such as galleries, bore holes in cut stems, complete drying, and mortality.

During the second fortnight of August, a survey was conducted to assess stem borer infestation in red sanders plantations located in the Navsari, Surat, and Tapi districts of Gujarat. Severe outbreaks of stem borer were observed in plantations cultivated by farmers, with exit holes accompanied by wood frass observed in infected trees. The highest stem borer infestation rate (10.85%) was recorded in a 15-year-old plantation in Dhamdod village, Surat. Further details regarding the survey and documentation of stem borer incidence in red sanders plantations are provided in Table 1.

Table 1 Localities surveyed for *Xylotrechus smei* in Tamil Nadu and Gujarat, India and extent of damage on red sander plantations

Locality	GPS coordinates	Area surveyed (in acres)	Number of trees infested	Number of Larvae/grub per tree
Harur, Dharmapuri District, Tamil Nadu	12.04696^0N 78.48327^0E	5.00	39	4
Puliyankudi, Tenkasi District, Tamil Nadu	9.17589^0N 77.39552^0E	20.00	78	2
Dhamdod village, Surat District, Gujarat	21.50182^0N 73.00123^0E	18.75	83	7
Tapi, Gujarat	21.2789^0N 73.6065^0E	2.00	35	5
Sunthwad Village, Navsari District, Gujarat	20.49530^0N 73.05439^0E	0.25	4	3

Farmers are grappling with a severe stem borer infestation in their plantations, prompting some tree growers to resort to shifting cultivation due to the pest invasion. Stem borers pose a significant threat to red sanders cultivation as they cause tree mortality and diminish timber quality. This pest is a key factor contributing to the decline of this tree species and requires effective management strategies. Currently, farmers are resorting to traditional methods such as smearing red mud onto the bark of red sanders at a height of 150 cm from the base. However, these measures have not brought the pest incidence under control or within tolerable levels. Since specific management measures are lacking, only prophylactic methods are recommended for controlling stem borers in red sanders plantations at present.

Interim management:

Sanitation measures should be implemented in red sanders plantations, with affected parts being pruned and either buried or burnt before the flight periods of the stem borers commence, typically in April-May and October-December. Additionally, after two years, temporary shade species should be planted to mitigate direct sunlight exposure to the stems. Employ common techniques such as hand-picking larvae and destroying them. Cross-vane pheromone traps are primarily utilized to attract beetles during peak flight periods, aiding in effective pest control at low densities and facilitating field monitoring. Botanical methods, such as stem swabbing with Neem oil at a concentration of 5 ml per liter of water during November and April, can deter egg-laying. Furthermore, the application of white muscardine fungus *Beauveria bassiana* at a concentration of 2.5% to bore holes can also be effective in pest management efforts.

Conclusion

The current study documents the infestation of red sanders by *X. smei* for the first time in Tamil Nadu and Gujarat, India. Given the significance of red sanders and the severity of the impact of *X. smei* on these trees, there is a pressing need for control measures to be implemented for the effective management of this pest. Such measures are crucial from both economic and conservation perspectives, emphasizing the importance of addressing this issue promptly and comprehensively.

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