



POPULAR ARTICLE

Integrated management of defoliators in red sanders (*Pterocarpus santalinus* L.f.) with special reference to botanical antifeedants

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Intricacies of the subject

Red sanders (*Pterocarpus santalinus* L.f.) is an economically and ecologically important forest tree species endemic to southern India. The species is affected by several insect pests, among which defoliators are of considerable importance. Defoliating insects cause damage by feeding on leaf tissues, resulting in reduced photosynthetic area, loss of foliage and adverse effects on plant growth and establishment. Repeated or severe defoliation may weaken young plants and increase their susceptibility to other biotic and abiotic stresses. The present study evaluated the antifeedant potential of Chloroxylon swietenia extracts at four concentrations, namely 0.25%, 0.50%, 0.75% and 1.00%, against the red sanders defoliator under laboratory conditions. Feeding parameters, including average weight of leaf feed consumed, leaf feed uneaten and fecal pellets excreted, were recorded and compared with an untreated control and standard checks of Neem-based formulation (Nimbecidine 0.5%) and Profenophos (0.05%). The results indicated a concentration-dependent reduction in feeding activity of the defoliator. Higher concentrations of *C.*

swietenia, particularly 1.0%, showed greater feeding deterrence compared with lower concentrations. Among the treatments, Profenophos (0.05%) and Neem-based formulation (0.5%) recorded comparatively lower leaf consumption, while *C. swietenia* at 1.0% concentration showed promising antifeedant activity. The findings indicate the potential of *C. swietenia* as a promising botanical resource for incorporation into integrated pest management programmes. Effective management of red sanders defoliators should combine regular monitoring, maintenance of plant vigour, mechanical removal of larvae and heavily infested foliage, conservation of natural enemies and scientifically validated botanical interventions. Further studies on pest identification, active compounds, formulation development and field-level efficacy are required for developing sustainable and environmentally friendly management strategies against red sanders defoliators.

Introduction

Red sanders (*Pterocarpus santalinus* L.f.) is a valuable and slow-growing forest tree species



indigenous to southern India. The species is highly valued for its characteristic heartwood and possesses considerable economic, ecological and conservation importance. Since red sanders requires several years to attain maturity, insect damage during different stages of growth can significantly affect plantation establishment, tree vigour and overall productivity. Among the insect pests associated with red sanders, defoliators are important because they directly damage the foliage by feeding on leaf tissues. Defoliating larvae consume the leaf lamina, resulting in irregular holes, partial feeding, skeletonization or, under severe infestation, extensive loss of foliage. Such damage reduces the effective photosynthetic surface of the plant and may adversely affect plant growth and development. Repeated or severe defoliation can lead to reduced photosynthetic activity, poor biomass accumulation and weakening of young plants. Young plantations may be particularly vulnerable, as extensive foliage loss can affect their establishment and growth. Continuous or repeated infestation may also increase the susceptibility of plants to other biotic and abiotic stresses. Management of defoliators has traditionally relied on chemical insecticides. However, excessive dependence on synthetic insecticides may result in environmental contamination, adverse effects on beneficial organisms and the possible development of insecticide resistance. Therefore, there is increasing interest in eco-friendly and sustainable approaches for the management of defoliating insect pests. Plant-derived compounds possess diverse biological properties, including antifeedant, repellent, insecticidal and growth-inhibitory activities against insect pests. *Chloroxylon swietenia*, an important forest tree containing several bioactive secondary metabolites, has attracted attention for its potential use in insect-pest management. Botanical extracts can interfere

with insect feeding behaviour and may reduce damage to host plants. The present article therefore focuses on the integrated management of defoliators associated with red sanders (*Pterocarpus santalinus* L.f.), with special reference to the evaluation of *Chloroxylon swietenia* extracts as potential botanical antifeedants. The study emphasizes the importance of integrating cultural, mechanical, biological and botanical approaches for developing environmentally sustainable management strategies against red sanders defoliators.

Symptoms of defoliator infestation

Early detection of defoliator infestation is essential for preventing severe foliage damage and maintaining the health and growth of red sanders. Infested plants commonly exhibit partial or complete feeding of the leaf lamina, resulting in irregular holes, notches, or skeletonization of leaves. Larvae may be observed feeding on leaves, tender shoots, and branches, while fecal pellets (frass) may accumulate on the foliage and beneath the tree canopy. Severe infestation results in progressive reduction of leaf area and thinning of the canopy. Heavily damaged leaves and tender shoots may dry, and repeated defoliation can reduce photosynthetic activity, leading to poor growth and weakening of young plants. Regular inspection of plantations and natural stands is therefore important for early detection and timely management of defoliator infestation.

Collection and preparation of plant material and methodology adapted

Leaves and bark of *Chloroxylon swietenia* were collected from the field, shade-dried and powdered. The plant material was processed for preparation of extracts. Different concentrations of the extract, namely 0.25%, 0.50%, 0.75% and 1.00%, were prepared for



laboratory bioassay. A neem-based formulation (Nimbecidine 0.5%) and Profenophos (0.05%) were maintained as standard checks, while untreated leaves served as the control.

Test insect

Larvae of the red sander defoliator were collected from infested plants in the field and maintained under laboratory conditions. Uniformly aged and similarly sized larvae were selected for feeding bioassays.

Feeding bioassay

Fresh red sanders leaves were treated separately with different concentrations of *C. swietenia* extracts. Treated leaves were allowed to air-dry before being offered to the larvae. Observations were recorded on: average weight of leaf feed eaten (g), average weight of leaf feed uneaten (g), average weight of fecal pellets excreted (g). The experiment included untreated control and standard check treatments. Appropriate replication and statistical analysis were followed to determine treatment differences.

Deep analysis and discussions

The feeding response of the red sander defoliator varied among different concentrations of Chloroxylon swietenia extracts, standard checks and untreated control. A progressive reduction in leaf consumption was observed with increasing concentration of the plant extract, indicating a concentration-dependent antifeedant effect. Lower concentrations, particularly 0.25% and 0.50%, showed relatively less feeding deterrence. However, the higher concentrations of 0.75% and 1.0% resulted in greater reduction in feeding activity. The observed reduction in feeding may be associated with the presence of bioactive secondary metabolites that interfere with

insect feeding behaviour and gustatory responses. Plant-derived compounds such as phenolics, terpenoids and other secondary metabolites are known to influence insect feeding and digestion. Among the standard treatments, Profenophos (0.05%) recorded the lowest leaf consumption, followed by the neem-based formulation. The reduced feeding observed in neem-treated leaves may be associated with the well-documented antifeedant properties of neem-derived compounds. The amount of uneaten leaf material generally increased with increasing concentrations of *C. swietenia* extract. This further indicated the feeding-deterrent effect of the botanical treatment. Variations were also observed in fecal pellet excretion among treatments. Such differences may reflect changes in feeding intensity, digestion and nutrient utilization by larvae exposed to plant-derived bioactive compounds. Overall, the results suggest that *C. swietenia* extracts possess promising antifeedant activity against the red sander defoliator, particularly at higher concentrations. However, laboratory results should be validated through replicated field experiments before recommending large-scale application.

Integrated management of red sanders defoliator

Management of the red sanders defoliator associated with *Pterocarpus santalinus* L.f. should follow an integrated pest management (IPM) approach. The strategy should emphasize regular monitoring, maintenance of plant health, conservation of natural enemies and the use of eco-friendly management practices, including botanical antifeedants.

Cultural management

Maintaining healthy red sanders plants is an important preventive strategy against defoliator damage. Appropriate plantation



management practices should be adopted to improve plant vigour and reduce stress. Maintaining plantation hygiene, proper spacing, suitable site management and adequate nutrition can contribute to healthy plant growth. Severely defoliated or damaged plant parts should be regularly examined. Excessive plant stress caused by drought, poor soil conditions or other adverse environmental factors should be minimized. Healthy plants may recover more effectively from defoliation than stressed or weakened plants.

Mechanical management

Regular inspection of red sanders plantations is essential for the early detection of defoliator infestation. Larvae, egg masses and severely damaged leaves may be manually removed where infestation is localized and the plantation area is manageable. Heavily infested leaves and shoots may be removed, wherever practical, to reduce the pest population and prevent further feeding damage. Collected larvae and infested plant material should be safely destroyed or disposed of appropriately. Mechanical management is particularly useful during the early stages of infestation and in young plantations.

Monitoring and surveillance

Regular monitoring is one of the most important components of red sanders defoliator management. Plantations should be inspected periodically for the presence of larvae, egg masses, feeding damage, irregular holes or skeletonization of leaves and accumulation of fecal pellets (frass). The extent of defoliation and the number of affected plants should be recorded to understand the distribution and severity of infestation. Regular surveillance can also help identify periods of increased pest activity and facilitate timely implementation of management measures.

Biological management

Naturally occurring parasitoids, predators and entomopathogens can contribute to the suppression of defoliator populations. Conservation of these natural enemies should form an important component of the integrated pest management programme. Unnecessary use of broad-spectrum insecticides should be avoided, as these chemicals may adversely affect beneficial organisms. The potential of biological control agents, including entomopathogenic fungi, bacteria and viruses, may also be evaluated against the red sanders defoliator. However, their effectiveness should be scientifically validated against the particular pest species under local environmental conditions before large-scale application.

Botanical management

The laboratory evaluation of *Chloroxylon swietenia* extracts demonstrated their potential as botanical antifeedants against the red sanders defoliator. Botanical insecticides and antifeedants may offer an eco-friendly alternative or supplement to conventional chemical insecticides and can potentially be incorporated into integrated pest management programmes. The present observations indicated that feeding deterrence increased with increasing concentrations of *C. swietenia* extract. Higher concentrations, particularly 1.0%, showed greater reduction in leaf consumption compared with lower concentrations. The reduced feeding activity indicates the presence of bioactive plant compounds that may interfere with the feeding behaviour of defoliator larvae. The potential advantages of botanical management include reduced dependence on synthetic insecticides, compatibility with IPM programmes and the utilization of naturally derived bioactive compounds. However, further research compounds required to standardize extraction



procedures, identify the active compounds responsible for antifeedant activity, evaluate formulation stability and shelf life, determine phytotoxic effects on red sanders and validate efficacy under field conditions. The effects of botanical extracts on natural enemies and other non-target organisms should also be assessed before recommending large-scale application.

Chemical management

Chemical insecticides should not be used indiscriminately for the management of red sanders defoliators. Before any chemical intervention, the defoliator species should be correctly identified and the severity of infestation should be assessed. Any pesticide application should comply with current pesticide registration, label recommendations and applicable forestry and environmental regulations. Where chemical intervention is scientifically justified and legally permitted, targeted application should be preferred over routine blanket spraying. The selection of an insecticide should be based on its effectiveness against the identified pest, safety to beneficial organisms and compatibility with the overall integrated pest management programme.

Integrated pest management strategy

An effective management strategy for the red sanders defoliator should integrate regular monitoring, cultural practices, mechanical removal of localized infestations, conservation of natural enemies and the use of scientifically validated botanical products. The following components may be integrated: Regular surveillance for larvae and feeding damage. Recording the incidence and severity of defoliation. Maintenance of plantation hygiene and plant vigour. Mechanical removal of larvae and heavily infested foliage where feasible. Conservation of parasitoids and predators. Evaluation and utilization of biological control agents. Use of Chloroxylon swietenia extracts as a potential botanical

antifeedant after further validation. Judicious and legally compliant use of chemical insecticides only when necessary.

Conclusion

Red sanders (*Pterocarpus santalinus* L. f.) is an economically and ecologically important forest species that requires sustainable protection from insect pests. Defoliators can cause substantial reduction in leaf area, resulting in reduced photosynthetic activity and poor plant growth, particularly when infestation is severe or repeated. Effective management of the red sanders defoliator should therefore be based on an integrated pest management approach rather than dependence on a single control method. Regular surveillance, early detection, maintenance of plant vigour, mechanical removal of localized infestations and conservation of natural enemies can collectively contribute to reducing pest damage. The laboratory evaluation of Chloroxylon swietenia extracts demonstrated promising antifeedant activity against the red sanders defoliator. The reduction in feeding activity with increasing extract concentration indicates the potential of this forest plant as a source of eco-friendly pest-management compounds. The integration of botanical antifeedants with cultural, mechanical and biological management practices may provide a sustainable strategy for the management of defoliators in red sanders plantations. Further studies are required to confirm the identity and biology of the major defoliator species, understand its seasonal incidence, standardize *C. swietenia* extract formulations and validate laboratory findings under field conditions.

References

1. Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18:265-267.



2. Finney, D.J. 1971. Probit Analysis. 3rd Edition, Cambridge University Press, Cambridge.
3. Isman, M.B. 2006. Botanical insecticides, deterrents and repellents in modern agriculture and an increasingly regulated world. *Annu. Rev. Entomol.*, 51:45-66.
4. Jeyasankar, A., Premalatha, S. and Elumalai, K. 2012. Biological activities of chloroxylon swietenia extracts against lepidopteran pests. *J. Biopestic.*, 5:95-100.
5. Kogan, M. and Goeden, R.D. 1970 The host-plant range and feeding behaviour of lepidopteran insects. *Entomol. Exp. Appl.*, 13:241-256.
6. Koul, O. 2008. Phytochemicals and insect control: An antifeedant approach. *Crit. Rev. Plant Sci.*, 27:1-24.
7. Pavunraj, M., Baskar, K. and Rajkumar, G. 2015 Antifeedant and growth inhibitory activity of plant extracts against insect pests. *J. For. Res.*, 26:221-228.
8. Prakash, A., Rao, J. and Nandagopal, V. 2008. Future of botanical pesticides in integrated pest management. *J. Biopestic.*, 1:1-12.
9. Schmutterer, H. 1990. Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. *Annu. Rev. Entomol.*, 35:271-297.
10. Senthil-Nathan, S. 2013. Physiological and biochemical effects of neem and other botanical insecticides on insect pests. *Environ. Sci. Pollut. Res.*, 20:2441-2463.