Asian weaver ants, *Oecophylla smaragdina* (Fabricius, 1775) (Hymenoptera: Formicidae): A natural solution for orchard pest management

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Abstract

Certain species emerge as inconspicuous heroes in the complex symphony of the natural world. An intriguing instance of sustainable pest control in fruit orchards is demonstrated by the Asian weaver ants *Oecophylla smaragdin*a (Fabricius). These industrious insects have garnered attention for their capacity to mitigate pest infestations in orchard situations. They are renowned for their intricate nest construction and collaborative foraging methods. This article examines the role of Asian weaver ants in orchards as a natural and non-chemical method of pest management. The "Asian weaver ant" or "red ant" is a species of ant that is commonly found on trees in various parts of world. Weaver ants are intriguing organisms due to their unique nest-building behaviour and possess distinctive ecological characteristics serving as valuable partners in promoting sustainable agriculture. Weaver ants provide a practical alternative to traditional pesticides for safeguarding against agricultural pests. Their role in biocontrol provides proof of the potential of organic pest control strategies. Integrating weaver ants into pest management programs can be beneficial for both the economy and nature as agriculture transitions towards more sustainable practices. Weaver ants play a crucial role in maintaining the delicate equilibrium between agricultural productivity and environmental conservation. To promote the widespread utilization of weaver ants in pest control, it is imperative to educate and motivate farmers to take advantage of the numerous benefits offered by this insect.

In the intricate dance of nature, certain species emerge as unsung heroes, silently orchestrating ecological balance. Among them are the Asian weaver ants *Oecophylla smaragdina (*Fabricius), whose presence in fruit orchards offers a fascinating case study in sustainable pest management (Sangma and Prasad, 2021). These industrious insects, renowned for their intricate nest-building and cooperative hunting strategies, have garnered attention for their potential to mitigate pest infestations in orchard ecosystems (*Hawkeswood et al., 2020*). This article delves into the role of Asian weaver ants as a natural solution for orchard pest management.

Fig 1. Red ants found in Litchi orchard, ICAR-NRCL

The 'Asian weaver ant' or 'red ant' is an arboreal species of ant that is found ubiquitously in Asian countries including Australia, Indonesia, Philippines, China, Taiwan and India. Weaver ants are fascinating creatures known for their unique nest-building behaviour (Fig 1). They build nests by weaving leaves together, hence their name. These ants play an important role in maintaining ecological balance and act as effective biological control agents against various agricultural pests. The Asian weaver ant is scientifically known as *O. smaragdina* (order

Hymenoptera, family Formicidae). These ants form colonies with multiple nests in trees, each nest being made of leaves stitched together using the silk produced by the ant larvae, hence the name '*oecophylla*'[Greek for 'leaf-house'].

Behaviour

Weaver ants are highly territorial and aggressively defend their territories against intruders. They are found in abundance in African-tropical regions and the Indo-Pacific terrestrial region (Offenberg, 2021). There are two main species– *O. longinoda*, which is found in equatorial Africa, and *O. smaragdina,* which is found in the Indian subcontinent and Southeast Asia (*Rwegasira et al., 2020*). Workers and major workers are mostly orange in colour. Workers are 5–7 millimetres (0.20–0.28 in) long. They collect honeydew to care for the larvae. Major workers are 8–10 millimetres (0.3–0.4 in) long, with long strong legs and large mandibles. They forage, assemble and expand the nest. Queens are typically 20–25 millimetres (0.8–1.0 in) long, and normally greenish-brown, giving the species its name smaragdina (Latin: emerald) (antARK, 2024).

Habitat

It is an arboreal species, which makes its nest among the leaves of trees. Nests are constructed during the night, with major workers weaving the exterior and workers completing the interior structure. An ant colony may consist of several nests on one tree, or nests may be spread over several adjacent trees. The number in colonies can reach five lakhs. In one example, a colony occupied 151 nests distributed among twelve trees. In each colony, there is a queen in one of these nests, and her offspring are carried to other nests in the colony. The average life of a mature colony may be eight years.

Biocontrol capability

Recent studies have highlighted the usefulness of weaver ants in controlling agricultural pests. Extensive data is available on their habits, foraging behaviour, social organization and nesting behaviour. People in southern China in 1st millennium BC used weaver ants to protect their citrus orchards in the early 20th century (Sangama and Prasad, 2021), and they also used bamboo to accommodate movement in the branches of nearby trees (Offenberg et al., 2013) to promote ant nests and colony expansion. Weaver ants are thought to be the only arthropod predator that preys on the pest Luprops tristis, a nuisance in rubber plantations. They have been used successfully to control pests in cashew, citrus and mango orchards.

Fig. 2. Colonization of red ants in mango

Some specific examples

Citrus

These ants hunt various insects that damage orange, tangerine, lemon, pomelo trees and other fruit trees. The aggressive behavior of weaver ants helps keep various insects away from flushing shoots, as they can capture nymphs directly for their food supply. Studies conducted by Peng and Christian (2005a) showed that weaver ants were effective in controlling the fruit-spotting insect on cashew and mango crops. Nalini and Ambika (2019) found that weaver ant pheromone was effective in deterring herbivorous insects and fruit flies.

Mango

Weaver ants play a beneficial role in mango orchards by providing natural pest control and contributing to the health of the ecosystem. Integrating red ants into integrated pest management strategies can help reduce dependence on chemical pesticides and promote sustainable agricultural practices in mango cultivation. Weaver ants (*O. smaragdina*) were

evaluated as biocontrol agents against mango hopper (*Idioscopus clypealis*) in mango orchards by Peng and Christian (2005b) (Fig. 2). The results showed that it is an effective biocontrol agent. The presence of these ants resulted in healthier inflorescence/plant (77.00%) and also increased fruit set/inflorescence (11.25%). Hopper numbers were effectively reduced during the 2nd to 28th day after exposure to ants. The results showed that they are effective in causing mortality or enabling antixenosis behaviour (Ferdous and Jahan, 2021). Colonies inhabiting mango trees (Mangifera indica) in Darwin, Australia were found to deposit significant amounts of nitrogen on their host trees through their waste. This deposition increased when ants were provided access to additional sucrose resources (Pinkalski et al., 2016).

Litchi

Weaver ants provide versatile benefits to litchi orchards, acting as guardians of both crop health and ecological harmony. As voracious predators, they tirelessly hunt down insects that threaten litchi trees, effectively curbing the need for chemical pesticides. Furthermore, their simple nest-weaving habits deter not only herbivorous insects, but also birds, and thus prevent potential damage to litchi fruits and leaves (Fig. 3).

Beyond pest control, weaver ant colonies can indirectly enhance soil health by accumulating organic matter, promoting fertility and microbial activity. Although they are not primary pollinators, their activities within orchards may inadvertently facilitate pollination to some extent, contributing

Fig. 3. Nest of Asian weaver ant on litchi trees

Fig. 4. Foraging activities of Asian weaver ant on litchi trees

Fig. 5. Weaver ants predating on a litchi pest ash weevil (*Myllocerus undecimpustulatus* Marshall)

to overall ecosystem dynamics (Fig. 4 and 5). By maintaining ecological balance and reducing reliance on harmful pesticides, the integration of weaver ants into orchard management embodies a sustainable approach to pest control, promoting agricultural resilience and biodiversity conservation. Overall, weaver ants play a valuable role in litchi orchards by providing natural pest control, protecting trees from herbivores, contributing to soil health, and promoting ecosystem balance. Integrating these ants into orchard management practices for sustainable agriculture can increase sustainability and productivity while reducing the environmental impact of chemical pest control methods.

Coconut

Weaver ants are used selectively to control the pest, coconut bug (*Pseudotheraptus wayi*). *O. longinoida* is a natural enemy of the coconut bug, an insect that has caused the loss of 67% of the coconut crop in Tanzania. The weaver ant competes with other species of ants living among coconut trees, and is sometimes displaced by the ground-dwelling *Pheidole megacephala*. However, the weaver ant is much more effective as a biological pest control agent, and baits are used to selectively control *P. megacephala*, allowing the weaver ants to thrive and effectively control the coconut bug (Ashwathi and Thomas, 2014).

West African orchards

Oecophylla longinoda plays an important role as a biological control agent against fruit flies in West African orchards and, by extension, also in forest and savanna ecosystems within sub-Saharan Africa (Van Mele et al., 2007). These weaver ants are one of the most effective and efficient predators of arthropods in perennial tropical tree crops; their presence also acts as a deterrent to insect herbivores, particularly tephritid female fruit flies, due to the semiochemicals they produce. Emerging African markets for organic and sustainably-managed fruits and nuts have encouraged an interest in the use of weaver ants. Protection of tropical forests and savannas is ecologically and environmentally crucial and also essential for the protection of *O. longinoda.*

Other utility- Increased activity of parasites (parasitoids)

Fanani et al. (2020) examined the influence of these species on the introduced parasitoid *Anagyrus lopezi*, a species used to control the invasive cassava mealybug *Phenacoccus manihoti* (Hemiptera:

Pseudococcidae). They found that when ants were absent the average time spent foraging by individual parasitoids was significantly longer (27.39 minutes) compared to when ants were present (2.47- 4.68 minutes). As a result, parasitoids spent less time in finding hosts and a longer time in handling hosts. This resulted in more oviposition activities and a 2-3-fold increase in parasitism and the number of wasps that emerged from their hosts.

Are these ants truly blessings for orchards, or do they pose a menace to agricultural practices?

Ecological blessings

1. Natural Pest Control: Weaver ants are voracious predators, preying on a variety of insects such as caterpillars, aphids, and fruit flies, which are common pests in orchards. Their presence helps in naturally controlling pest populations, reducing the need for chemical pesticides.
2. Orchard Health: By targeting pests, weaver ants indirectly contribute to the overall health of fruit trees. This pest control service can lead to improved fruit quality and yield, benefiting orchard productivity.
3. Ecosystem Services: Beyond pest control, weaver ants play essential roles in ecosystem functioning, such as nutrient cycling and seed dispersal. Their presence contributes to the biodiversity and ecological balance of orchard ecosystems.

Agricultural menace

1. Tending behaviour: Weaver ants exhibit tending behaviour, where they 'milk' honeydew-producing insects for their sugary secretions. While this behaviour benefits the ants, it can also promote the growth of honeydew-producing pests, such as scale insects and aphids, which may damage fruit trees if left unchecked.

2. Damage to fruit: In some cases, weaver ants have been observed causing damage to ripe fruits by creating galleries in the flesh, leading to spoilage and economic losses for farmers. This behaviour is particularly problematic in orchards with high ant densities.

3. Human interaction: Weaver ants can be aggressive defenders of their territories and may pose a nuisance or even a danger to orchard workers during fruit harvesting and other agricultural activities. Their stings can cause discomfort and allergic reactions in some individuals.

Advantages of using weaver ants for biocontrol

- Reduction in chemical use: Because weaver ants are natural predators, the need for chemical pesticides is greatly reduced, resulting in an eco-friendlier approach to farming.
- Sustainable pest management: Unlike insecticides, to which insects can develop resistance, weaver ants provide a long-term solution without the risk of building resistance.
- Improved pollination: These ants can also contribute to the pollination process, indirectly helping the reproductive success of plants.
- Economic benefits: Farmers can save on pesticide costs and potentially earn more due to higher crop quality.

Challenges and future prospects

Although the benefits are obvious, there are challenges in integrating weaver ants into agricultural practices:

- Ant Management: It is important to maintain the right balance of ant population. Too little can be ineffective, while too much can cause them to become a nuisance.
- Crop specificity: Not all crops may benefit from weaver ants; Research is needed to identify which crops are most suitable.
- Farmer education: Farmers need to be educated about how to manage weaver ants effectively and safely. This ant keeps harmful insects away from the area around its nest, thereby providing protection to the plants from harmful insects.

Apart from this, this ant also helps in making the soil aerated and fertile, thereby providing the plant roots with the necessary oxygen for better growth. On the other hand, weaver ants also have some negative effects. This ant makes its nests by damaging and stitching leaves, which can affect plant growth and

photosynthesis processes. Additionally, if ant numbers become excessive, it can become an additional burden to plants.

Conclusions

Weaver ants are not only remarkable in their ecosystem but also serve as valuable allies in sustainable agriculture. Weaver ants provide a promising alternative to chemical pesticides in the protection of agricultural pests. Their role in biocontrol is a testament to the potential of natural pest management solutions. As agriculture moves toward sustainable practices, the use of weaver ants may become a standard component of integrated pest management programs, benefiting both the environment and the economy. The balance between ecological conservation and agricultural productivity is delicate, and weaver ants play a vital role in maintaining this balance. Educating farmers and promoting the benefits of using weaver ants for pest control is essential for their widespread adoption.

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