



## Unseen Invaders: The Evolutionary Success and Agricultural Implications of the Pharaoh Ant, *Monomorium pharaonis* (L.)

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### Abstract

The Pharaoh ant, *Monomorium pharaonis* (L.) is an invasive species of global significance, causing major medical, economic and agricultural problems. It is a highly successful evolutionary model based on polygynous colony structure, cryptic nesting habits, rapid reproduction and highly efficient foraging. This is primarily linked to its indoor pest status but it is also found in greenhouses and storage facilities and causes damaging ecological ripples in agricultural systems. In contrast to beneficial ants living in the soil, *M. pharaonis* provides little benefit to soil aeration, but instead disrupts crops and is a possible vector for pathogens. In this review, a detailed description of its morphology, distribution and biology is provided and its ecological impact and current management approaches in public health and agricultural environments are discussed.

**Keywords:** Agricultural pest, Invasive species, *Monomorium pharaonis*, Pest management

### Introduction

*Monomorium pharaonis* (L.) is a ant species with a high degree of synanthropy and cosmopolitan distribution. Unlike most formicids that occupy natural niches, the Pharaoh ant thrives within anthropogenic environments, including residential complexes, healthcare facilities and food service industries. The species is an evolutionary success story because of its small size, rapid reproductive rate and secretive nesting habits which together make it an even more important public health hazard and mechanical vector of disease-causing organisms. Its effect on agricultural ecosystems in addition to its urban infestations is complex and often negative. The ants actively protect honeydew-producing species from natural predators by engaging in mutualistic relationships with hemipteran pests like aphids, scale insects and mealybugs, thereby indirectly enabling crop damage. Furthermore, their presence in storage facilities results in contamination of commodities and their potential role as mechanical vectors of plant diseases reduces the efficacy of traditional biological control. Hence, detailed knowledge of their socio-biology and ecological interactions is of utmost importance for the development of robust

integrated pest management (IPM) strategies.

### Origin and Global Distribution

Pharaoh ant is a cosmopolitan species, thought to have originated in the afrotropical region. It has spread to every continent except Antarctica thanks to international trade and human migration. It is still very common in tropical and subtropical areas such as India where high humidity and ambient warmth create perfect conditions for its development, but it has also adapted to temperate climates by exploiting heated indoor microclimates (Wetterer, 2010). And ant capacity to flourish in a wide range of environments that makes it one of the most geographically widespread and resilient ant species on Earth.

### Morphological Characteristics

The small size of *M. pharaonis* means that it is often detected late, in the first stage of infestation. The workers are monomorphic, usually 1.5 to 2.0 mm in length, pale yellow to reddish-brown in color, with a gaster that is often darker. Lateral and anterior view of pharaoh is given in figures 1 and 2 (Sarnat *et al.*, 2013). Queens are notably bigger (3.0-4.0 mm) and more darkly pigmented and alate males are

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primarily specialized for reproductive purposes and have a short lifespan. Morphologically, the species is characterized by 12-segmented antennae with a distinct three-segmented club, a character of importance for accurate taxonomic discrimination.



Figure 1: Lateral view of *Monomorium pharaonis* (L.)



Figure 2: Anterior view of Pharaoh ant

### Life Cycle and Metamorphosis

*Monomorium pharaonis* undergoes complete metamorphosis (holometabolism) and is highly temperature sensitive in its developmental rates. The tiny white eggs hatch in 5-7 days in the best of circumstances. The next larval stage lasts approximately 18 to 22 days and workers feed larvae a protein-rich diet to allow rapid somatic growth. The pupal stage is normally exarate (naked) and lasts 9-12 days. Upon eclosion, adults differentiate into specialized castes (workers, males, or queens) according to the nutritional status and demographic requirements of the colony. Workers and males have relatively short life spans (4-10 weeks and 3-5 weeks, respectively); whereas queens can live for several months, allowing for constant oviposition and exponential growth of the colony (Rajakumar et al., 2024).

### Habitat and Nesting Behaviour

The species is strongly associated with warm (27-30 °C) and humid microclimates, which explains its success in tropical and indoor temperate environments. *M. pharaonis*

is characterized by what is called “diffuse nesting” or polydomy in which multiple sub-colonies are established and connected throughout a structure in concealed sites such as wall voids, electrical insulation and furniture. Such a decentralized architecture makes it very hard to detect and eradicate. In temperate zones it is mainly an indoor pest, but it flourishes in tropical agricultural situations in soil, leaf litter and crop residues, particularly in irrigated greenhouses and high-moisture fields.

### Colony Structure and Reproductive Strategy

The social organization of the Pharaoh ant is characterized by extreme polygyny, with colonies supporting 5 to over 200 coexisting queens. This structure increases reproductive resilience, because loss of one individual queen does not compromise the viability of the colony. In contrast to many formicids that use nuptial flights, *M. pharaonis* reproduces mainly by budding (sociotomy), in which a subset of workers and queens leave to form a satellite colony nearby. This mechanism allows for rapid, localized infestation and enables the species to bypass the high-risk mating flight phase characteristic of other ants.

### Feeding Ecology

*M. pharaonis* is an opportunistic omnivore with a broad nutritional spectrum scavenging carbohydrates (sugars/syrups), proteins (meat/carrion) and lipids (oils). Farana, in particular, is employed in complex pheromone communication to generate recruitment trails, thereby optimizing foraging efficiency. They are mutualistic with hemipteran pests, such as aphids and mealybugs, in agricultural contexts, protecting them from parasitoids in return for honeydew and thus unknowingly increasing crop damage and making the pest control more challenging.

### Medical and Economic Significance

The Pharaoh ant is a serious public health threat, as it is a mechanical vector of pathogenic bacteria such as Salmonella, Staphylococcus and Pseudomonas. They are found in the sterile environment of hospitals, where they feed on medical waste and present a serious risk of cross contamination. From an economic standpoint, infestations cause significant damage to processed food contamination and deterioration of storage packaging materials (Alharbi et al., 2019).

### Management Strategies

Effective Integrated Pest Management (IPM) for *M. pharaonis* depends on slow-acting baits that are not repellent, rather than contact insecticides. The classic repellent sprays (pyrethroids like Deltamethrin) are self-defeating, as they cause stress-induced budding and colony fragmentation and dispersion. Baits utilizing active ingredients such as fipronil, indoxacarb, or boric acid combined with attractants (sucrose or protein-based) ensure toxicant transfer to the queens and brood.

### Conclusion

*M. pharaonis* is evolutionary successful due to their adaptive nesting, polygynous social structure and resilient budding strategies. The dual role of this species being a health threat

in the urban environment and a pest in agriculture calls for an integrated approach based on biology for effective management. The aim should be the elimination of the colony rather than localized suppression.

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