# *Introduction*

# CHAPTER I
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The coconut palm (*Cocos nucifera L.*) is the cornerstone of tropical agriculture, renowned for its versatility and significance to both local and global economies. It serves as a primary source of food, fiber, and other valuable products. Globally, coconuts are cultivated across more than 12 million hectares, with major production hubs in countries like Indonesia, Philippines, India, Brazil, and Sri Lanka. According to the Food and Agriculture Organization (FAO), the annual global production of coconuts stands at approximately 66674 million nuts in the year 2021, generating substantial revenue and providing livelihoods for millions of smallholder farmers. India is the second-largest producer of coconut, with 21734 million nuts being produced in 2023-24. The state Kerala often referred to as the "land of coconut trees" as its name was derived from the word "*Kera*" meaning coconut, significances how the coconut cultivation is intertwined with the culture. The state accounts for about 30 per cent of India's total coconut production, with approximately 7.6 lakh hectares dedicated to coconut farming (CDB, 2024).

Despite its economic importance, coconut cultivation faces several challenges, with pest infestations being a major concern. Statistical data highlights the impact of these issues on production. Coconut production in the state declined from 6,980.30 million nuts with a productivity of 9,175 nuts per hectare in the financial year 2019-20 to 5,628.42 million nuts with a productivity of 7,402 nuts per hectare in the financial year 2022-23 (CDB, 2024).

Sucking insects, although not usually included in the lists of key pests, can become important pests because of the direct damage they cause to the palms. They also secrete sugary substances that serve as a substrate for sooty mold (*Capnodium spp.*), which in turn reduces the photosynthetic capacity of the plant, and thereby decreases plant productivity. Among the sucking insects, whiteflies are one of the major concerns because they attack numerous crops worldwide and can significantly reduce crop yields (Omena *et al.,* 2012). The judicious application of suitable plant protection agents on

need-based manner by a suitable sprayer is one of the powerful techniques for pest management (Chowdappa *et al*., 2018). The selection and application rate of these chemicals has direct impact on the water pollution and ecological imbalance, as their active ingredients have different level of toxicity (Chambers *et al.,* 2014).

The conventional practice of spraying coconut palms/tall trees for pest is commonly done using rocker sprayers, which includes a manual piston pump, high-pressure hose, and spray lance. Operators manually pump to build pressure, forcing the liquid through the nozzle to cover the canopy. While the extendable lance helps reach the lower and middle canopy, it often fails to cover the entire height of the palm. The spray consists of both coarse and fine droplets, with fine droplets prone to drift, leading to significant spray loss and reduced efficiency. Operators use a sweeping motion for coverage, but the high liquid volume results in wastage through dripping and increased drift, contaminating nearby vegetation, soil, and water bodies. The intermittent pumping action causes pressure fluctuations, leading to inconsistent spray patterns and uneven pesticide distribution, resulting in both over-application in some areas and insufficient coverage in others, ultimately reducing pest control effectiveness. Additionally, operators face health risks due to exposure to pesticide fumes. Power sprayers offer better reach, speed, and efficiency but come with drawbacks like chemical drift, high energy use, and maintenance needs. Considering these factors, such as the height of coconut palm and, length of a coconut leaf, spraying in an open space, chances of spray drift and moreover, the species to be controlled are flying vectors, air-assisted sprayer is the best suited.

Electrostatic spraying is an innovative and efficient technology in agriculture, gaining significant attention as an effective strategy for pest management. It addresses critical challenges such as spray liquid wastage, environmental pollution, and groundwater contamination while offering a unique wrap-around deposition effect (Patel *et al*., 2017). By imparting an electrostatic charge to spray droplets, this system ensures they are attracted to plant surfaces, including hard-to-reach areas like the undersides of leaves, thereby enhancing coverage, adhesion, and uniformity (Appah *et al*., 2019). The concept of employing electrostatics for droplet deposition originated in

the early 1930s and was later adapted for agrochemical applications in the 1980s (Law, 1983). Recognized as a sustainable solution, electrostatic spraying minimizes chemical wastage, reduces drift, and increases deposition efficiency, making it a highly appropriate method for applying protective liquids with precision and environmental responsibility. (Doddamani *et al*., 2019). Considering the factors such as equipment cost, ease of use, and manpower requirements, a portable device would be most suitable for Indian farmers. Hence, developing labour friendly portable air-assisted electrostatic sprayer seems to be need of the hour.

The primary objective of this research is to design and develop an air assisted electrostatic nozzle suitable for coconut palms, with the following specific objectives:

1. To study the plant parameters needed for the design of a light weight self-atomizing air assisted nozzle with electrostatic charging system.
2. To design and develop an air assisted electrostatic sprayer for the management of sucking pest in coconut.
3. To evaluate the spray deposition characteristics on targeted leaf area.
4. Assessment of the biological efficacy of the sprayer.