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Pestiferous Occurrence and Suppression of *Heortia vitessoides* in Agarwood: A Review

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Abstract

Agarwood is a resinous wood highly prized in perfumery and pharmaceutical industries. It is produced in the stem, branches, and roots of the *Aquilaria* and *Gyrinops* species of Thymalaeaceae family. *Aquilaria* species are commonly distributed and maintained as plantations in the Asian region which are often attacked by various pests and pathogens. Among them, *Heortia vitessoides* (Lepidoptera: Crambidae), stands out as the most destructive defoliator in *Aquilaria* plantations. *H. vitessoides* larvae feed gregariously and voraciously on foliage, thereby reducing agarwood production, and causing substantial economic losses. Defoliation occurs in varying degrees accounting for 30-70% of planted acres of *Aquilaria* species monthly, leading to their stunted growth and mortality. Various control methods have been introduced to protect agarwood plantations against *H. vitessoides* infestations. Biological control measures involve the use of fungi (*Beauveria bassiana, Metarhizium anisopliae*), predators (*Canthecona furcellata*), parasitoids (*Trichogramma pintoi*), and cytoplasmic polyhedrosis viruses. Chemical insecticides (avermectin, spinosad, etc.) have also been widely used, which have caused residues in agarwood, deleterious impacts on the environment as well as to non-target organisms, especially the natural enemies of *H. vitessoides*, thereby encouraging secondary pest outbreaks. Molecular control includes knockdown of *ß*-N-acetylglucosaminidase gene to disrupt their molting process and suppression of juvenile hormone diol kinase gene to delay the pest's pupation. Soil management tactics (moisture content/ substrate type modifications, soil cultivation practices, and mulching) have been investigated aiming at suppressing soil-pupation behaviors to reduce the populations' emergence success. Trembler grid lamps and trap plants have also been employed to lure pests away from their host plants. In addition, the role of plant-derived volatiles in guiding *H. vitessoides* females toward their host plants for oviposition has been studied to facilitate the designing of attractants for pest control. Apart from the heavy use of insecticides, none of the above methods are known to be effective in controlling this pest. In view of the above shortcomings of long-practiced control measures, efficient and eco-friendly control measures against *H. vitessoides* are urgently needed, and use of their pheromones might be a better alternative. Identification and isolation of sex pheromones from *H. vitessoides* have so far not been reported and would be a challenge, largely due to the nanogram-quantities of pheromone released and their proneness in degradation (oxidation, isomerization, and polymerization). Appropriate structural modifications of these natural pheromone compounds, however, can overcome those practical hurdles by developing synthetic analogues (viz. parapheromones), which are more economical, thus replacing natural pheromones in pest control. Hence, organic synthesis of pheromones would lead to introducing a species-specific sustainable way of protecting agarwood from *H. vitessoides* attacks and to safeguard their economic value while preserving environmental value and biodiversity.

Keywords: *Heortia vitessoides*, *Aquilaria*, Defoliator, Control methods, Sex pheromone, plant extracts