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Eco-friendly pest management strategies for genus eudocima: An overview

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Abstract
Eudocima belonging to the family Noctuidae of order Lepidoptera is a diligent pest of various fruit crops and occurs in tropics worldwide. Eudocima are the dominant primary fruit piercers, accompanied by several secondary fruit feeders resulting in extensive damage to various cash crops as well as horticultural crops. There is a severe infestation of fruit piercing moths spp. in India and their infestation affects the fruit crop production. The present review article flashes on various aspects of fruit piercing moths (Eudocima) including pest management strategies in order to combat the infestations.

Keywords: Eudocima, fruit piercers, damage, cash crops, fruit crops, pest management

Introduction

Lepidoptera is the second largest order of class Insecta and the foremost captivating group comprising of the moths and butterflies which are well known to every spectator in nature, of which the moth has been altogether considered by numerous analysts. Fruit-piercing moths are probably the one of the largest groups of phytophagous insects (Scoble 1992) [24]. The Noctuidae are heartily built moths that includes more than 35,000 known species out of conceivably 100,000 aggregates, in more than 4,200 genera. The Forty-eight species as of now recognized inside Eudocima (Zilli & Hogenes 2002, Brou & Zilli 2017) [30, 31], and found within the world's tropics with occasional expansion into mild locales.

Concurring to a review In India, approximately 12 species were found. It attacks on a variety of economically important crops, such as citrus, pomegranate, guava, mango, papaya, grapes and tomato etc., (Sundarababu and David, 1973) [27]. Fruit piercing moths are severe pests of numerous fruit crops throughout tropical and subtropical belts (Leong and Kueh, 2011) [12]. Moths of the genus Eudocima are the dominant primary fruit piercers, accompanied by several secondary fruit feeders resulting in extensive damage to various horticultural crops. Considering the drawbacks with the usages of insecticides, entomologists around the world are trying to get to the bottom of this issue in an eco-friendly way. Implication of pheromone ecofriendly strategies in agricultural lands proves as a useful solution in this regard. The present article flashes on the various aspects of fruit piercing moth of genus Eudocima with special reference to their ecofriendly management.

International Status

Many Researchers from different parts of the world have carried out studies on various aspects of Eudocima including their management. In numerous subtropical and tropical zones, including portions of the western Pacific Southeast Asia, and Africa, fruit-piercing moths are serious pests of ready and developing fruit (Waterhouse and Norris 1987) [29]. *Eudocima fullonia* (Clerck), the most common pest species, is found in Australia and western Pacific nations, including Modern Caledonia (Waterhouse 1997). Although cosmopolitan within the Pacific, Waterhouse and Norris (1987) [29] show that *E. phalonia* began within the Indo-Malaysian locale. Adult fruit-piercing moths have a long, thick proboscis that's suited to enter the skin of hard, undamaged fruit, permitting the moths to nourish on the juice and pulp inside. Secondary microorganism invasions grow into harmed tissues, creating spoiled and untimely fruit drops (Sands *et al*., 1993) [20]. *E. phalonia* is isolated into two biotypes. *E. phalonia* hatchlings eat on Erythrina spp. (Fabaceae) as well as vines of the family Menispermaceae in Papua New Guinea (PNG) and other Pacific islands, but they exclusively nourish on Menispermaceae in Australia, Southeast Asia, and Africa (Sands and Chan 1996) [21]. Moths travel from the tropics to the calm parts of eastern Australia each year during the warmer months (Sands *et al*., 1991) [22], and their amount varies with climate variance from year to year (Mosse-Robinson 1968) [16].

In New Caledonia, breakouts are most common after expanded periods of dry spells (Cochereau 1977) [6]. Innate natural enemies in western Pacific nations, such as New Caledonia, do not inhibit the development of moth populaces, which infest plantations and dispense critical harm (Cochereau 1977) [6]. In Papua New Guinea, however, *E. phalonia* is neither productive nor a disturbance, and its populace is expected to be dwindling due to parasitoids (Sands and Broe 1991) [22]. A larval parasitoid Winthemia Caledonian Mesnil (Diptera: Tachinidae) from New Caledonia was transplanted interior of the locale in early attempts to control *E. phalonia* (Cochereau 1977) [6]. Tran *et al*., (2019) [28] integrated Pest Management of Longan (Sapindales: Sapindaceae) in Vietnam and his management studies described the pest of fruit-piercing moths of single species of *E. phalonia* (L). Leong and Kueh, (2011) [12] observed that the implication of horticulture mineral oil provided a significant decrease in fruit damage in Malaysia. Light sources such as UV radiation, black lights, and mercury lamps have strong attraction, that attract nocturnal insects such as moths (Cowan and Gries, 2009) [7]. All these works indicate that fruit-piercing moths belonging to genus Eudocima are one of the serious pests of various horticultural crops worldwide and ecofriendly management of such pests is essential to control severe infestation with ecological maintenance.

National Status

Many researchers from India have conducted studies on various aspects of fruit-piercing moths including their eco-friendly management. Muniappan *et al*., (2002) [18] suggested an integrated method utilizing biological control, food lure, bagging fruits, netting rows of vegetable crops and netting individual fruit trees for the control of fruit piercing moths. Reddy *et al*., (2006) conducted a study on the attraction of the fruit-piercing moth *Eudocima phalonia* to different fruit baits. They used 15 fruit baits to attract the moths. Use smoke as a deterrent to moths Eudocima spp. in pomegranate gardens after dusk and appears to be quite effective (Balikai *et al*., 2009) but this method is limited by climatic conditions (wind, rain), which can sometimes seriously reduce its effectiveness. Kamala Jayanthi *et al*., (2010) [11] studied the effect of neem oil (Melia azedarach, Meliaceae) on guava and pomegranate fruits which was able to repel moths such as *E. materna*. Balikai *et al*., (2011) [2] reported that *E. fullonia*, *E. materna*, and *E. homaena* were the major fruit-piercing moths on the pomegranate from Karnataka.

Gurule and Nikam (2011) [9] reported the common occurrence of three species of fruit-piercing moths (*E. phalonia*, *E. homaena*, and *E. materna*) in North Maharashtra from Nasik, Dhule, Jalgaon, and Nandurbar districts. Bhumannavar and Viraktamath (2012) [4] reported that nylon nets of 1cm mesh extended on each orchard line can be a possible alternative for short-term management of fruit-piercing moths in pomegranate plantations in south India and orange in central India. Patel *et al*., (2016) [19] reported the occurrence of fruit-piercing moths *E. materna* and *E. homaena* on tomato crops in the Panchmahal district of middle Gujarat. Chikkalaki *et al.*, (2018) [5] concluded that an electronic moth repellent designed by them decreases the percentage of fruit-sucking moths. Kulkarni *et al.*, (2018) carried out an investigation to test the response of fruit sucking moth, *Eudocima materna* L. larvae to different host plants and efficacy of biorationals and concluded that, the biopesticides *viz*., *B. thuringiensis*, *P. luminescens* and *Beauvaria bassiana* can be used as a promising bioagents for the management of fruit sucking moth larvae. Magar *et al*., (2019) studied the effect of Natural parasitoids of fruit piercing moth, Eudocima spp. and observed that *Goniophthalmus halli* showed parasitization on other species of Eudocima. *E. materna* was the specific host of *E. maternus*. Non-fruit-based baiting techniques were screened by Mallikarjun *et al*., (2019) [15] for trapping the fruit-sucking moths *E. materna*, but this technique was not so successful. Shendge and Chavan (2019) [25] reviewed the diversity, seasonal abundance, biology and management practices against fruit piercing moths of genus Othreis and concluded that there are about 12 species belonging to genus Othreis family Noctuidae order Lepidoptera occurring throughout India, which are severe pests of various crops. Singh *et al*., (2023) [26] conducted a field study to explore the feasibility of an IPM module devised for the ecofriendly management of fruit-piercing moths in citrus crop fields of Punjab including cultural practices, HMOs, botanicals, poison bait traps, netting and light traps.

Economic Aspects

Eudocima is a polyphagous insect, commonly known as the fruit-sucking moth. The range of these butterflies includes India, Africa, Southeast Asia, Australia and the South Pacific. It feeds on a variety of commercially important horticultural crops including pomegranates, citrus, guava, mango, papaya, carambola, grapes, lychees, etc. The moth feeds by penetrating its strong proboscis, enters the peel of ripe or unripe fruit and absorbs the juice. It is the most common pest in the world and causes damage to fruit production. Some workers noticed damage to many types of fruit. Mote *et al.*, (1991) [17] observed damage to pomegranates in Maharashtra with the help of Othreis and Achaea. Fay and Halfpapp (1993) [8] found very large differences in fruit weight, colour, Brix, and pH between damaged and undamaged lychee and carambola fruit. Bhumannavar and Viraktamath (2001) [3] studied the nature and extent of damage caused by caterpillars on pomegranates. the genus Eudocima, are considered as of the most severe crop pests worldwide. Damages associated with this pest are substantial on more than 100 horticultural crops and affect their yield (Leroy *et al*., 2021) [13]. These moths cause severe damage to various horticultural crops and can affect the overall yield. Advanced research on effective management strategies, focusing on ecofriendly methods is required in order to tackle the severe infestations of such pests.

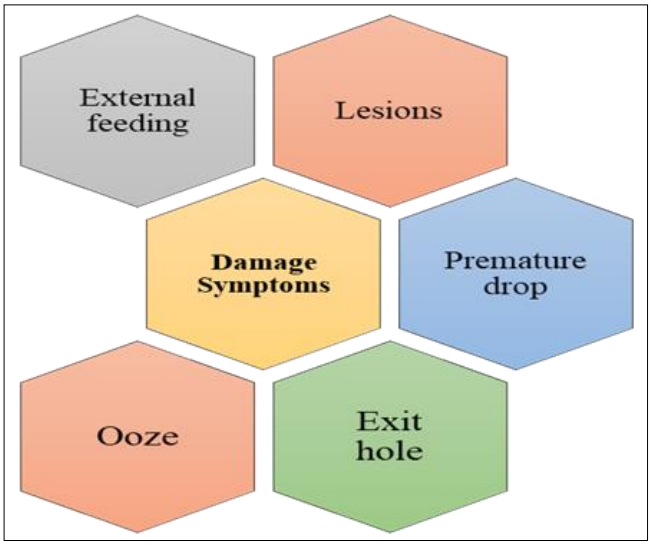

Fig 1

Photo Plate 1: *E. materna* & its predaceous behaviour

Ecofriendly Management of Eudocima: (ICAR 2021, Singh *et al.*, 2023) [26]

- Destruction of alternate weed hosts.

- Use of Alternate host plants may avoid damage to main crops.
- Disposal of decaying fruits.
- Creating smoke can deter the moths.
- Use of nets in case of citrus trees.
- Spraying of botanical extracts such as neem extract, dharek extract, HMOs etc.,
- Bagging of fruits with polypropylene white bags / butter paper bags.

Conclusion

The present article has attempted to assemble all the relevant information regarding various aspects of fruit piercing moth, Eudocima including their ecofriendly management. Numerous entomologists have observed severe infestations of these pest on different crop fields and also suggested several management strategies. These recommended strategies should be adopted by farmers because they are easily available, least cost and with maximum return. This would increase crop yield, quality and export trends.

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