Colegio de Postgraduados

Distribution and importance of insects and mites associated with jackfruit (*Artocarpus heterophyllus* Lam)

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ABSTRACT

Objective: Due to the recent introduction and cultivation of jackfruit in Mexico, agronomic information regarding its associated pests remains limited. To enhance the agronomic understanding of this crop particularly concerning the insects and mites associated with it this work presents a comprehensive and updated review of phytophagous species across all regions where jackfruit (*Artocarpus heterophyllus*) is cultivated.

The review draws upon technical reports, scientific articles, databases, full texts from ScienceDirect and Scopus, as well as other specialized catalogs. A total of 81 insect species and one mite species have been identified in association with jackfruit cultivation worldwide. Among these, 48.3% cause damage to foliage, 26.3% infest shoots, 14.4% feed on the fruit, and 11.0% affect the branches.

The highest pest prevalence is reported in Asian countries such as India, the Philippines, and Bangladesh, where the primary pest is the shoot and fruit borer *Deaphania caesalis*, infesting approximately 27% of the fruits in Bangladesh and between 30% to 40% of plants in India. In contrast, in Mexico, the predominant pest is the branch borer *Neoptychodes trilineatus*, which affects up to 84.7% of jackfruit trees.

Keywords: Pests, tropical fruits, distribution.

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INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.), native to India, was introduced to Nayarit, Mexico, around 1985. This fruit tree is extensively cultivated in India, Malaysia, the Philippines, and Bangladesh (Rajkumar *et al*., 2018). In Mexico, its cultivation expanded from 15 hectares with a production of 1 ton in 1993 to 1,754.2 hectares and 36,717.38 tons in 2022, reaching a market value of 455.31 million pesos (SIAP, 2023). The majority of production is concentrated in Nayarit, although it is also cultivated in Jalisco, Michoacán, Colima, Hidalgo, and Veracruz, primarily for export to the United States. Agronomic information on pests associated with jackfruit remains scarce. In Mexico, the identity, biology, feeding habits, distribution, and management of these pests are largely unknown (Hernández-Fuentes *et al*., 2019). Although previous studies exist (Rodríguez-Palomera *et al*., 2017; Hernández-Fuentes *et al*., 2018-2022; Velázquez-Monreal *et al*., 2021; Arias-

Corpus *et al*., 2022), Khan *et al.* (2021) report over 250 insect species and eight mite species associated with jackfruit in other cultivating countries, with no specific data available for Mexico. This study provides a comprehensive review of insect and mite species associated with jackfruit, focusing exclusively on species confirmed through observations of adult insect emergence, visible field damage, and taxonomic verification by specialists.

MATERIALS AND METHODS

An exhaustive review was conducted using technical reports and various databases, including ResearchGate, Academia.edu, CABI Invasive Species Compendium, Crop Protection Compendium, Plantwise Knowledge Bank, as well as search engines such as Google Scholar and ScienceDirect. The names and taxonomic classifications of the reported species were cross-referenced with the Global Biodiversity Information Facility (GBIF) and the Catalogue of Life databases. Reports lacking species-level identification or failing to confirm phytophagous associations were excluded, as arthropods may be present on plant structures in non-phytophagous stages, such as resting or mating (Hernández-Fuentes *et al*., 2022). The biological status as a pest, the specific plant structures damaged, and the geographic distribution of each species were documented. Priority was given to compiling pest lists from other countries before incorporating those identified in Mexico's primary producing states: Nayarit, Colima, and Jalisco.

RESULTS AND DISCUSSION

A total of 81 insect species and one phytophagous mite species have been recorded in association with jackfruit (*Artocarpus heterophyllus*). The most represented orders are Hemiptera (43 species) and Coleoptera (18 species), while Orthoptera, Hymenoptera, and Acari each account for only one species. Most reports originate from Asian countries particularly India, the Philippines, and Bangladesh where jackfruit is extensively cultivated and exhibits greater genetic diversity. Rajkumari *et al.* (2014) reported 35 insect pest species in India, while Rajkumari *et al.* (2018) documented 38 species, and Kallekkattil *et al.* (2020) identified 51 species through direct sampling. Of the total species, 48.3% cause damage to foliage, followed by those infesting shoots (26.3%), fruits (14.4%), and branches (11.0%). Regarding mites, only *Tetranychus pacificus* has been reported, as documented by Hernández-Fuentes *et al.* (2019). Other mite species have been recorded on related plants such as *Paratetranychus biharensis* on *Artocarpus altilis* (Flechtmann *et al*., 1999) and *T. ludeni* on *A. incisa* (Gutierrez & Schicha, 1983) but they are not directly associated with jackfruit. Among the pests, branch and fruit borers are considered the most damaging (Tandon, 1998). *Diaphania caesalis* infests an average of 27% of fruits in Bangladesh (Khan & Islam, 2004) and 30-40% of jackfruit plants in India (Soumya *et al*., 2015). In Mexico, the primary pest is the branch borer *Neoptychodes trilineatus*, which causes significant damage by feeding on shoots and the skins of developing fruits (Hernández-Fuentes *et al*., 2022). An average incidence of two larvae per kilogram of dry wood was recorded, with 84.7% of trees examined showing signs of infestation. The red spider mite *T. pacificus* is also a major pest, causing visible foliar damage that can lead to premature leaf drop (Hernández-Fuentes *et al*., 2019).

Table 1. Insect and mite species associated with jackfruit *Artocarpus heterophyllus* Lam.

Order	Family	Species	Damage[1]	Country	Reference
Lepidoptera	Crambidae	*Diaphania* (=*Glyphodes*) *caesalis* Walker	a, b	India, Bangladesh, China	Butani (1978), Kham e Islam (2004), Soumya *et al.* (2015), Patel *et al.* (2016), Saha *et al.* (2017), Rajkumar *et al.* (2018), Ngangom y Bandyopadhyay (2018), Singh *et al.* (2018) Kallekkattil *et al.* (2019, 2020), Wang (2020), Hiremath *et al.* (2022)
		Glyphodes (=*Diaphania*) *bivitralis* Guenée	c	India	Butani (1978), Kallekkattil *et al.* (2020)
		Conogethes punctiferalis Guenée	a, e	India	Kallekkattil *et al.* (2020)
	Arctiidae	*Amata passalis* Fabricius	c	India	Kallekkattil *et al.* (2020)
		Eilema antica Walker	c	India	Kallekkattil *et al.* (2020)
	Lymantridae	*Olene mendosa* Hübner	c	India	Kallekkattil *et al.* (2020)
		Perina nuda Fabricius	c	India	Butani (1978)
	Bombycidae	*Trilocha varians* Walker	c	Philippines	Navasero *et al.* (2013)
	Metarbelidae	*lnderbela* (=*Indarbela*) *tetraonis* Moore	c	India	
Coleoptera	Attelabidae	*Apoderus tranquebaricus* J.C.Fabricius	c	India	Kallekkattil *et al.* (2020)
	Cerambycidae	*Glenea multiguttatta* Guérin-Méneville	c	India	Kallekkattil *et al.* (2020)
		Epepeotes luscus Fabricius	d	India	Butani (1978)
		Sthenias grisator Fabricius	d	India	Butani (1978)
		Apriona germari (=*germarii*) Hope	d	India	Butani (1978)
		Olenecamptus bilobus Fabricius	c	India	Kallekkattil *et al.* (2020)
		Batocera rufomaculata Degeer	d	India, Bangladesh	Butani (1978), Ahmed *et al.* (2013), Ngangom y Bandyopadhyay (2018), Kallekkattil *et al.* (2020)
		B. rubus L.	d	India	Butani (1978)
		Ptychodes trilineatus L. (=*Neoptychodes trilineatus*)	d	USA	Horton (1917)
	Curculionidae	*Myllocerus undecimpustulatus* Faust	c	India	Kallekkattil *et al.* (2020)
		M. discolor Boheman	c	India	Kallekkattil *et al.* (2020)
		M. dorsatus Fabricius	c	India	Kallekkattil *et al.* (2020)
		M. viridanus Fabricius	c	India	[16]Kallekkattil *et al.* (2020)
		Ochyromera artocarpi Marshall	a, e	India	Butani (1978), Ngangom y Bandyopadhyay (2018), Kallekkattil *et al.* (2020, 2021)
		Onychocnemis careyae Marshall	c	India	Butani (1978)
		Teluropus ballardi Marshall	c	India	Butani (1978)
		Platypus indicus H. Strohmeyer	d	India	Butani (1978)
Hemiptera	Plataspidae ("Plataspididae")	*Coptosoma siamicum* Walker	b, c	India	Kallekkattil *et al.* (2020)
	Aphididae	*Greenidea artocarpi* Westwood	b, c	India	Butani (1978), Kallekkattil *et al.* (2020)

Table 1. Continues...

Order	Family	Species	Damage[1]	Country	Reference
Hemiptera	Aphididae	*Toxoptera odinae* Van der Goot	b, c	India	Kallekkattil *et al.* (2020)
		T. aurantii Boyer de Fonscolombe	c	India	Butani (1978)
	Aprophoridae	*Clovia lineaticollis* De Motschulsky	b, c	India	Kallekkattil *et al.* (2020)
	Aleurodidae	*Aleurotrachelus caerulescens* Singh	c	India	Butani (1978)
		Pealius schimae Takahashi	c	India	Butani (1978)
		Aleurodicus rugioperculatus Martin	c	Sri Lanka	Dilrukshika *et al.* (2023)
	Cicadellidae	*Apheliona indica* Dworakowska & Singh Sohi	b, c	India	Kallekkattil *et al.* (2020)
		Kolla ceylonica Melichar	b, c	India	Kallekkattil *et al.* (2020)
	Coccidae	*Ceroplastes floridensis* Comstock	b, c	India	Kallekkattil *et al.* (2020)
		Ceroplastes rubens Maskell	b, c	India	Butani (1978)
		Chloropulvinaria psidii Maskell	b, c	India	Butani (1978)
		Coccus acutessimum (=*C. acutessimus* Fernald) Green	b, c	India	Butani (1978)
	Diaspididae	*Pinnaspis aspidistrae* Signoret	c	India	Butani (1978), Kallekkattil *et al.* (2020)
		Hemiberlesia lataniae Signoret	a, b, c	India	Butani (1978)
		Parlaspis papillosa Green	c	India	Butani (1978)
		Semelaspidus artocarpi Green	c	India	Butani (1978)
	Eurybrachidae	*Eurybrachis tomentosa* Fabricius	b	India	Kallekkattil *et al.* (2020)
	Margarodidae	*Drosicha mangiferae* Stebbing	b, d	India	Butani (1978), Kallekkattil *et al.* (2020)
		D. stebbingi Stebbing	b, d	India	Butani (1978)
		Icerya aegyptiaca Douglas	b, c	India	Butani (1978), Kallekkattil *et al.* (2020)
		I. seychellarum Westwood	b, c	India	Kallekkattil *et al.* (2020)
	Membracidae	*Leptocentrus scutellus* (scutellatus) Distant	c	India	Kallekkattil *et al.* (2020)
		Otinotus oneratus Walker	b	India	Butani (1978)
	Pentatomidae	*Eupaleopada cocinna* Westwood	b	India	Kallekkattil *et al.* (2020)
	Pseudococcidae	*Coccidohystrix insolita* Green	c, d	India	Kallekkattil *et al.* (2020)
		Ferrisia virgata Cockerell	a, b, c	India	Butani (1978), Kallekkattil *et al.* (2020)
		Nippaecoccus viridis Newstead	a, b, c	India	Butani (1978), Kallekkattil *et al.* (2020)
		Paracoccus marginatus Williams & Granara de Willink	a,b,c	India	Kallekkattil *et al.* (2020)
		Planococcus citri Risso	a, b, c	India	Kallekkattil *et al.* (2020)
	Tingidae	*Cysteochila delineata* Distant	c	India	Kallekkattil *et al.* (2020)
		Stephanitis charieis Drake & Mohanasundarum	c	India	Butani (1978)
		Alloiothucha artocarpi Horváth	c	Laos	Souma *et al.* (2022)
	Cercopidae	*Cosmoscarta relata* Distant	b, c	India	Butani (1978)
		Clovia lineaticollis Melichar	b, c	India	Butani (1978)

Table 1. Continues...

Order	Family	Species	Damage[1]	Country	Reference
Thysanoptera	Thripidae	*Jakthrips ignacimuthui* Bhatti & Ranganath	b, c	India	Kallekkattil *et al.* (2020)
		Pseudodendrothrips dwivarna Ramakrishna & Margabandhu	b, c	India	Butani (1978)
Orthoptera	Tettigoniidae	*Onomarchus uninotatus* Serville	c	India	Sreeja *et al.* (2023)
Diptera	Tephritidae	*Bactrocera umbrosa* Fabricius	a	Indonesia, Philippines	Ubaub y Rosales (2014), Manwan (2017)
		Drosophila melanogaster Meigen	a	Indonesia	Manwan (2017)
		Dacus dorsalis Hendel	a	India	Butani (1978)
	Cecidomyiidae	*Camptomyia artocarpi* Nayar	a	India	Butani (1978)
		Rubsaamenia artocarpi Nayar	a	India	Butani (1978)
	Therevidae	*Ptecticus rufus* Doleschall	a	India	Butani (1978)
		P. australis Schiner	a	India	Butani (1978)

1: a=fruits, b=sprouts, c=foliage, d=branches y e=flowers.

Table 2. Insect and mite species associated with jackfruit *Artocarpus heterophyllus* Lam. in Mexico.

Order	Family	Species	Damage[2]	Country	Reference
Coleoptera	Cerambycidae	*Neoptychodes trilineatus* L. (=*Ptychodes trilineatus*)	d	Mexico	Hernández-Fuentes *et al.* (2020, 2021, 2022), Horton (1917)
Hemiptera	Diaspididae	*Pinnaspis strachani* Cooley	a,b,c,d	Mexico	Hernandez-Fuentes *et al.* (2021), Arias-Corpuz *et al.* (2021)
		Pseudischnaspis bowreyi Cockerell	c	Mexico	Arias-Corpuz *et al.* (2021)
	Coccidae	*Milviscutulus mangiferae* Green	a,b,c,d	Mexico	Hernández-Fuentes *et al.* (2021), Arias-Corpuz *et al.* (2021)
	Pseudococcidae	*Ferrisia virgata* Cockerell	b, c		
		Maconellicoccus hirsutus Green	b,c	Mexico	Hernández-Fuentes *et al.* (2021)
	Coreidae	*Piezogaster odiosus* Stal.	c	Mexico	Hernández-Fuentes *et al.* (2018, 2021)
	Aphididae	*Toxoptera aurantii* Boyer de Fonscolombe	c	Mexico	Rodríguez-Palomera *et al.* (2017)
Hymenoptera	Formicidae	*Atta cephalotes* L.	c	Mexico	Hernández-Fuentes *et al.* (2021)
Acari	Tetranychidae	*Tetranychus pacificus* McGregor	c	Mexico	Hernández-Fuentes *et al.* (2019, 2021)

2:a=fruits, b=sprouts, c=foliage, d=branches y e=flowers.

CONCLUSIONS

A total of 42 references meeting the established methodological criteria were reviewed, with the majority of reports originating from Asian countries such as India, the Philippines, and Bangladesh, where jackfruit is widely cultivated. Among the identified species, 48.3% damage the foliage, followed by those infesting shoots (26.3%), fruits (14.4%), and branches (11.0%). Borer insects affecting branches, shoots, and fruits are responsible for the most severe damage. Notably, *Diaphania caesalis* infests an average of 27% of fruits and 30% to 40% of jackfruit plants, while *Neoptychodes trilineatus* can infest up to 84.7% of trees. Additionally,

the red spider mite *Tetranychus pacificus* causes premature defoliation, affecting up to 100% of the foliage. In Mexico, pest reports are relatively recent. Given the short cultivation history of jackfruit in the country, it is likely that some pest species are still in the process of dispersal and establishment within the main production areas.

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