



# Insect pest diversity on mango in the nursery under humid tropics of Gujarat, India

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**ABSTRACT:** Studies were conducted at Navsari Agricultural University (NAU), Navsari during May, 2022 to April, 2023 to study the Arthropods infesting mango in nursery under humid tropics. Results revealed that total thirty-one insect-pests damaging mango mother plants in nursery. Twelve leaf eating caterpillars or defoliator viz., leaf- webber, common baron, leaf miner, tussock hairy caterpillar, flush caterpillar, lymantrid caterpillar, slug caterpillar, looper, leaf-roller, leaf cutter, yellow tail moth, and different grasshopper spp. were found damaging new young leaves and shoots. Three shoot damaging insect pests viz., shoot borer, stem miner, and shoot midge were observed. Thirteen sucking insect-pests viz., mango hoppers, thrips, plant hopper, leaf gall midges, mealybugs and scales; three leaf defoliating beetles and weevils viz., the leaf cutting weevil, grey or ash weevil and leaf beetle were observed infesting mango plants in nursery. Pest calendar was also prepared based on their period of activity throughout the year.

**Keywords:** Mango, Arthropods, Diversity, Nature of damage, Nursery, Shoot feeders

## INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most widely grown fruits in tropical and subtropical regions of the world. In India, the area under mango cultivation is 2350 thousand ha with a production of 20772 thousand MT (Anon., 2022). In Gujarat, the area under mango cultivation is 173517 ha with production of 960172MT (Anon., 2023). At the global level, mango is attacked by 492 species of insects, 17 species of mites and 26 species of nematodes (Tandon and Verghese, 1985). Among them, 188 insect species have been reported from India (Srivastava, 1997). Approximately 127 of these species are foliage feeders or shoot feeders (Pena *et al.*, 1998; Kannan and Rao, 2006; Preetha, 2013; Sathe *et al.*, 2015; Anant, 2016; Munj *et al.*, 2019 and Vanitha, 2020; Khimani and Chavan, 2023). Commercial cultivation of mangoes, characterized by the area expansion, changing cropping patterns, varietal replacements, increased chemical interventions, has altered the pest complex and pest community structures significantly (Reddy *et al.*, 2018). Very little information is available on status of insect-pests of mango in nursery from South Gujarat. Considering the importance of pests of mango in nursery and to fill the gaps in the literature regarding the diversity and nature of damage of shoot feeders of mango in nursery from humid tropics of South Gujarat, the present study was conducted.

## MATERIALS AND METHODS

The studies on shoot feeders of mango was conducted at Model Nursery, ASPEE College of Horticulture, Navsari

Agricultural University (NAU), Navsari (20°55'27.43 N latitude and 72°53'31.85 E longitude) during three different seasons pre-monsoon season (February to May, 2022); monsoon season (June-September, 2022) and post-monsoon season (October, 2022 to January, 2023) under humid tropics. Ten mother plants of mango (> 10 years old) irrespective of the variety were selected randomly. The occurrence of the insect-pests on leaves and shoots was recorded, collected and documented. The different life stages were collected from the field was brought to the Post Graduate Laboratory, Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari for rearing. Fresh food in form of mango leaves, shoot was provided regularly. The observations on their external morphology, nature of damage and behaviour were also recorded. Based on their nature of damage in field and also in laboratory, these pests were categorized as leaf eating caterpillars or defoliator, insect-pest damaging shoots, sucking pests and leaf eating beetles and weevils. Mango rootstocks grow in polythene bags and prepared softwood grafts in green shade-net house and poly-tunnel were also observed regularly. Based on the available literature and with the help of taxonomist, efforts have also been made to identify these insects up to genus and species level. Pest calendar was also prepared based on their period of activity throughout the year.

## RESULTS AND DISCUSSION

During present study total thirty-one Arthropods were reported as shoot feeder of mango in nursery (Table-1).

### A. Leaf and shoot defoliators

Incidence of leaf webber, *Orthega exvinacea* Hampson (Fig. I-1) was observed during September to March. Larvae were greenish in color with slender body. Early instar fed by scrapping the leaf surface, later webbed the leaves and fed inside. On heavy feeding, only midribs with network of veins were left and webbed bunches of leaves were found dried. Several caterpillars were found in a single web. Earlier the incidence of leaf webber (*O. exvinacea*) was recorded during mid-July to mid-March (Kavitha, 2004) and peak activity during August to October (Reddy and Sreedevi, 2016). This is also the major pest of mango in Nepal (Shrestha *et al.*, 2022). Likewise, incidence of flush or shoot caterpillar, *Penicillaria jocosatrix* Guenée (Fig. I-2 to 5) was observed during July to September and March to April (Table 2). The larva was stout, centrally wide, smooth, and green with small blotches. The head was also green with spots. Mature larva becomes purple. The forewings were dull purple with several darker stripes and a dark-grey purple spot near the apical end. The hind wings are white with a central black spot and a broad dark border. The resting position of moth is different, with the abdomen curled up over the body, and the wings found wavy. Munj *et al.* (2019) from Konkan region of Maharashtra observed the infestation of this pest on root stocks in mango nursery.

The infestation of common baron, *Euthalia aconthea* Cramer (Fig. I- 6 to 8) was observed during July to September (Table 2). This is greyish brown butterfly with black and white markings on wings. The underside was also brown with a black marginal spots on the hind wings. The caterpillar was green with a yellowish dorsal stripe. Spines with branching pattern were observed beyond the caterpillar's body. The pupa was quadrangular in shape and dark green initially which turn brownish black. This is an important pest on mango in Jammu region (Tara

and Gupta, 2016). Recently it has been reported as a pest of mango in the Andaman and Nicobar Islands, India (Purthi *et al.*, 2023). Incidence leaf miner, *Acrocercops syngamma* Meyrick (Fig. I- 9 to 12) was observed during September to December and March to April (Table 2). Mature larva of leaf miner was reddish in color with slender body. Pupation takes place mostly in the soil and occasionally in the leaf-folds in a thin cocoon. The adult have red eyes and silver grey in colour. Larvae were found mining and feeding on leaf tissues, resulted in white papery spots on leaves which were filled with excreta. Average three to four larvae were also seen in single leaf house. In past, *A. syngamma* reported as a major pest of mango and damages to newly emerged flushes of mango plants during August to November (Kanhari *et al.*, 2016; Kannan and Rao, 2006 and Vanitha, 2020).

Tussock hairy caterpillar (*Euproctis* sp.) (Fig. I- 13 to 15) is a polyphagous pest observed on new flushes of mango from March to April and July to September (Table 2). The fully grown caterpillar was yellowish to greyish with red stripes on the prothorax. Paired lateral tufts of hair were also observed on each segment of the body. Tail like brownish hairy tuft is also observed on the last abdominal segment. Mature larva pupate in cocoon made of silk which was elongated with tapering ends. Moth is yellow with pale transverse lines and black spots on the forewing. Hairy Lymantrid caterpillar, *Lymantria* sp. (Fig. I- 16 to 17) was observed during June to October. Female laid eggs in mass covered with yellowish/ brown hairs. The female was sluggish with rudimentary wings, whereas male had well developed wings and bipectinate antennae. The caterpillar was preferred 2-3 week old leaves which had distinctly colored spots along its back, five pairs of blue spots behind the head, and six pairs of red spots to the rear. Earlier Kannan and Rao (2006) and Preetha (2013) also reported this pest on young plants as shoot feeders of mango in Andhra Pradesh and Kerala respectively.

**Table 1. Arthropods infesting mango in nursery from humid tropics of South Gujarat**

Common name	Scientific name	Order: Family
<b>Leaf eating caterpillars or defoliators</b>		
Leaf Webber	<i>Orthega exvinacea</i> Hampson	Lepidoptera: Pyralidae
Common baron	<i>Euthalia aconthea</i> Cramer	Lepidoptera: Nymphalidae
Leaf miner	<i>Acrocercops syngamma</i> M.	Lepidoptera: Gracillariidae
Tussock hairy caterpillar	<i>Euproctis</i> sp.	Lepidoptera: Nolidae
Flush caterpillar	<i>Penicillaria jocosatrix</i> G.	Lepidoptera: Noctuidae
Lymantrid caterpillar	<i>Lymantria</i> sp.	Lepidoptera: Erebiidae

Slug caterpillar	<i>Latoia lepida</i> Cramer	Lepidoptera: Limacodidae
Looper	<i>Perixera illepidaria</i> Guenée	Lepidoptera: Geometridae
Leaf roller	<i>Dudua aprobola</i> Meyrick	Lepidoptera: Tortricidae
Leaf cutter	<i>Palumbina glaucitis</i>	Lepidoptera: Gelechiidae
Yellow tail moth		Lepidoptera: Lymantriidae
Different grasshopper spp.		Orthoptera
<b>Shoot damaging pests</b>		
Shoot borer	<i>Chlumetia transversa</i> Walker	Noctuidae: Lepidoptera
Stem miner	<i>Spulerina</i> sp.	Lepidoptera: Gracillariidae
Shoot midge	<i>Erosomyia indica</i> Felt.	Diptera: Cecidomyiidae
<b>Sucking Pests</b>		
Mango hopper	<i>Amritodus atkinsoni</i> Lethierry	Homoptera: Cicadellidae
	<i>Idioscopus clypealis</i> L.	Homoptera: Cicadellidae
Thrips	<i>Scirtothrips dorsalis</i> Hood	Thysanoptera: Thripidae
Plant hopper	<i>Scolypopa</i> sp.	Homoptera: Ricaniidae
Leaf gall midge	<i>Procontarinia matteiana</i> K.	Diptera: Cecidomyiidae
	<i>Drosicha mangiferae</i> Green	Hemiptera: Pseudococcidae
	<i>Icerya seychellarum</i> W.	Hemiptera: Monophlebidae
	<i>Rastococcus spinosus</i> R.	Hemiptera: Pseudococcidae
	<i>Rastrococcus iceryoides</i> G.	Hemiptera: Pseudococcidae
	<i>Phenacoccus</i> sp.	Hemiptera: Pseudococcidae
	<i>Aulacaspis tubercularis</i> N.	Hemiptera: Coccidae
	<i>Philephedra tuberculosa</i> H.	Hemiptera: Coccidae
Mealy bug and scale	<i>Ceroplastes</i> sp.	Hemiptera: Coccidae
<b>Leaf eating beetles and weevils</b>		
Leaf cutting weevil	<i>Deporaus marginatus</i> Pascoe	Coleoptera: Curculionidae
Grey weevil	<i>Myloccerus</i> spp.	Coleoptera: Curculionidae
Leaf beetle	<i>Basilepta</i> sp.	Coleoptera: Cerambycidae

The young larvae of slug caterpillar, *Latoia lepida* Cramer (Fig. I- 18 to 20) was observed during October to March and fed on the lower epidermis of the leaf. As they mature, the whole leaf blade was eaten leaving the midribs. Egg were flat shiny eggs on the under surface of leaves. Larva had greenish body with white lines. The pupa was very hard and formed in chocolate

brown shell like silken cocoon. Later on, it converted into dark ash colour. The population of *Parasa lepida* was reported from May to December on mango with maximum infestation of 26.4 per cent during fourth week of August (Chaudhary *et al.*, 2018). Preetha (2013) also reported this pest as shoot feeders of mango in Kerala.

**Table 2. Pest calendar of Arthropods infesting mango in nursery during 2022-23**

Name of the pest	Plant part affected	Pre-monsoon season 2022				Monsoon season 2022				Post-monsoon season 2022-23			
		Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
<i>O. exvinacea</i>	L	+	+	-	-	-	-	-	+	+	+	+	+
<i>E. aconthea</i>	L	-	-	-	-	-	+	+	+	-	-	-	-
<i>A. syngramma</i>	L	-	+	+	-	-	-	-	+	+	+	+	-
<i>P. jocosatrix</i>	L & S	-	+	+	-	-	+	+	+	-	-	-	-
<i>Euproctis</i> sp.	L	-	-	-	-	-	+	+	+	-	-	-	-
<i>Lymantria</i> sp.	L	-	-	-	-	+	+	+	+	+	-	-	-
<i>L. lepida</i>	L	+	+	-	-	-	-	-	-	+	+	+	+
<i>P. illepidaria</i>	L	-	-	-	-	-	-	-	+	+	+	+	-
<i>D. aprobola</i>	L	-	+	+	+	-	-	-	+	+	+	+	-
<i>E. similis</i>	L	-	-	-	-	-	-	+	+	+	-	-	-
Grasshoppers	L	+	+	+	+	+	+	+	+	+	+	+	+
Leaf cutter	L	-	-	-	-	-	+	+	+	-	-	-	-
<i>C. transversa</i>	L	+	+	-	-	-	-	-	+	+	+	+	+
<i>Spulerina</i> sp.	L	-	-	-	-	-	-	-	+	+	+	+	-
<i>E. indica</i>	S	-	+	+	-	-	-	-	-	+	+	+	-
<i>A. atkinsoni</i>	L & S	+	+	+	-	-	-	-	-	+	+	+	+
<i>I. clypealis</i>	L & S	+	+	+	-	-	-	-	-	+	+	+	+
<i>S. dorsalis</i>	L	+	+	+	+	-	-	-	-	+	+	-	-
<i>Scolypopa</i> sp.	L & S	-	-	-	-	-	+	+	+	-	-	-	-
<i>P. matteiana</i>	L	+	+	-	-	-	-	-	+	+	+	+	+
<i>P. tuberculosa</i>	L	+	+	+	-	-	-	-	-	-	-	-	+
<i>Ceroplastes</i> sp.	L	+	+	+	-	-	-	-	-	-	-	-	+
<i>R. spinosus</i>	L	+	+	+	-	-	-	-	-	-	+	+	+
<i>R. iceryoides</i>	L	+	+	+	-	-	-	-	-	+	+	-	-
<i>I. seychellarum</i>	L	+	+	+	+	-	-	-	-	-	+	+	-
<i>Ceroplastessp</i>	L	+	+	+	-	-	-	-	-	-	+	+	+
<i>Phenacoccus</i> sp.	L	+	+	+	+	-	-	-	-	-	-	-	+
<i>D. marginatus</i>	L	-	-	-	-	+	+	+	+	+	-	-	-
<i>Mylocerus</i> spp.	L	-	-	-	-	+	+	+	+	+	+	-	-
<i>Basilepta</i> sp.	L	-	-	-	-	+	+	+	+	-	-	-	-

**L:** leaves, **S:** shoots, ‘-’: Incidence absent, ‘+’: Incidence present

The incidence of looper, *Perixera illepidaria* Guenée (Fig. I-21 to 23) was observed during September – December. There was much variation in the colour of larvae of different instars from black to dark brown with

bands. The larvae made silken threads that descended vertically between tree branches and some larvae were seen hanging from them. Silken threads allowed larval movement from damaged twigs to healthy leaves. Larvae



mostly fed on young leaves. The pupae were green and turned brown before adult emergence. *P. illepidaria* was first reported on litchi in Bihar (Kumar *et al.*, 2014). This is an emerging pest on mango, mainly infests mango inflorescence (Soumya *et al.*, 2021).

Similarly incidence of leaf roller, *Dudua aprobola* Meyrick (Fig. I-24 to 26) was observed during September to December and March to May when new vegetative flush appeared. Eggs were laid in axils of leaves. The young larvae tunneled into the axil and

damaged new leaves. The mature larvae are yellowish green, except for the black head. The brown pupa is formed in a cocoon in a curled leaf. The adult is pale brown with dark markings, and a wingspan up to 20 mm. In later stages the larvae rolled the leaves inward from edges and fed from inside. Soumya *et al.* (2017) at Bengaluru recorded the incidence of *D. aprobola* from October to May and peaked in November and December, when new vegetative flush appeared and panicle initiation began.

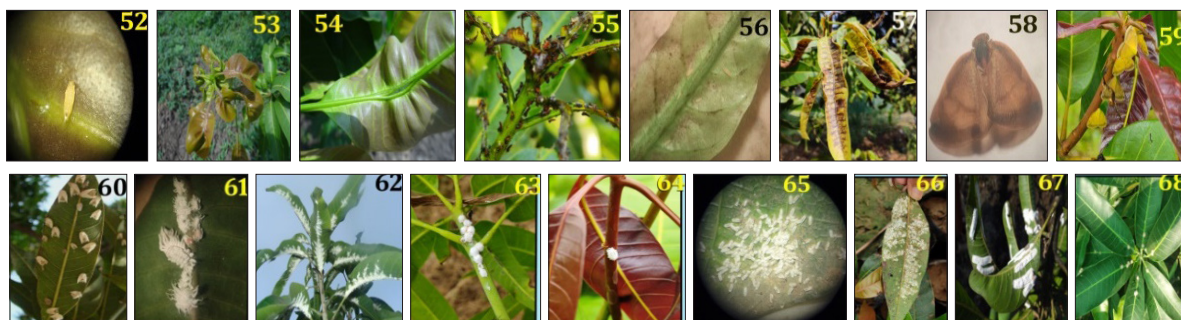
### Leaf Defoliators



### Pests Damaging Shoots



### Sucking Insect Pests



### Leaf Eating Beetles and Weevils



**Fig. 1 Shoot feeders of mango in nursery under humid tropics**

Leaf cutter, *Palumbina glaucitis* (Meyrick, 1907) (Fig. I-27 to 31) also occurred from July to October in scattered manner on new shoots. Green larva with brown head makes a portable leaf cases by cutting the leaf along the edges into small irregularly shaped pieces (mostly circular and semi-circular). Later, many small leaf pieces (4 to 8) were aggregated and stacked into a compact and circular leaf case. The larvae live and feed inside the case and can move from one place to another by carrying it. Pupation also occurs inside it. The adult emerges by leaving the pupal exuvia inside the case. Adult is silver-grey coloured with white marking on forewings and hind wings with broad hairy margins.

Incidence of black Yellow tail moth (*E. similis*) (Fig. I- 32) caterpillar with yellowish longitudinal band and red strip dorsally was observed during August to October. Numerous long hairs and minute white spots were present on body. Caterpillars were found biting leaves. Earlier, Preetha (2013) and Anant (2016) reported yellow tail moth (*E. similis*) on mango. Incidence of nymphs and adults of different grasshoppers (Fig. I- 33 to 35) were also observed to fed on margins of the leaf blade throughout the year.

#### A. Arthropods Damaging Shoots

Larva of shoot borer, *Chlumetia transversa* Walker (Fig. I- 36 to 42) was dark pink in color with brown head tunneling the tender shoots and excreta were found at the entry point and the shoot becomes hollow. Heavy infestation results in leaf abscission and wilting of shoots. Pupation occurs at damaging site (shoot tunnel) and also in soil in form of earthen cocoon. Adult moths are stout grayish brown in colour with wings having wavy lines. Incidence was observed during October to December and January to March. Choudhury (2015) observed maximum population of shoot borer during May to October. Munj *et al.* (2019), Kannan and Rao (2006) and Vanitha (2020) recorded infestation of *C. transversa* in root stocks in nursery.

Characteristic, papery white to dirty white mines due the infestation of stem miner, *Spulerina* sp. (Fig. I- 43

to 46) were observed at the bases of young shoots and emerging flushes of mango. The larvae were yellowish white and had a distinctive, segmented appearance. The larvae remain hidden inside the mines and continue to feed and come out just before pupation. Pupation took place inside transparent silken cocoons on leaves. The adult moth is narrow and elongate. The forewings are covered with brownish scales. They fed under the epidermis at the bases of young shoots and flushes of mango resulted in the formation of characteristic whitish, papery thin mines. Incidence was observed during October to December. Poorani and Thanigairaj (2022) recorded the incidence of mango stem miner *S. pulerina sonoma* (Meyrick), a poorly known pest, is recorded from Tamil Nadu, India.

Incidence of shoot gall midge, *Erosomya indica* Felt. (Fig. I-47-50) was observed during October to December and March to April. Infested mango buds and shoots found with small raised galls containing a yellow larva. Small blackish emergence holes were found on galls. Affected plant parts got shriveled and died. Ahmed *et al.* (2005) reported that mango midge (*E. indica*) has become a major pest of mango and is found in all mango growing countries of the world. Sixteen species of midges are known to attack mango in Asia where this plant is indigenous. The midge infests and damages the crop at three different stages.

#### B. Sucking Arthropods

Incidence of mango hopper, *A. atkinsoni* and *Idioscopus* sp. (Fig. I- 22 to 55) was observed during October to November and during March to April. Adults of mango hopper were possessed wedge shaped body with broad head and scutellum. Eggs were found in slits, which were made in midrib on underside of leaves. Nymphs and adults both were found aggregated on leaves and suck the sap. Besides, they secreted honey dew and resulted in development of black sooty mold on leaves. Likewise incidence of Thrips, *S. dorsalis* (Fig. I- 56 to 57) was observed during October to November and February to May. Both nymphs and adults suck the



sap from the new flush and tender shoots which resulted in shiny silver and upward curled brown leaf edges and stunted growth. In Past Kavitha (2004) Preetha (2013), Sharma (2015), Choudhury (2015), Reddy and Sreedevi (2016), Anant (2016), Munjet *et al.* (2019) and Bana *et al.* (2019) reported the incidence of hopper and thrips in mango.

Adults plant hopper, *Scolypopasp.* (Fig. I- 59) were found resting on young leaves and also on the new shoots of mango and sucks the sap. Adults possessed yellowish forewings with dark brown patches at the base and margin. Black spots were present at each side of posterior margin in the forewings. Incidence was observed during July to October. Leaf gall midge, *P. matteiana* (Fig. I- 51) incidence was observed during July to November. Yellowish, minute larvae were found in raised galls. Infestation was resulted in dropping of leaves.

Different species of mealybugs viz., mealy bugs and scales, *Drosicha mangiferae* Green (Fig.I-60), *Icerya seychellarum* West wood (Fig.I-61), *Rastococcus spinosus* Robinson (Fig.I-62), *Rastrococcus iceryoides* Green (Fig.I-63), *Phenacoccus* sp. (Fig.I-64), *Aulacaspis tubercularis* Newstead (Fig.I-65,66), *Philephedra tuberculosa* Hawaii (Fig.I-67), and *Ceroplastes* sp.(Fig.I-68) were observed during January to April and November to December. Nymph and adults of mealy bugs were found sucking the sap from young leaves and new shoots. Development of sooty mold was observed due to honey dew secretion followed by drying of leaves. Sharma (2015) recorded infestation of mealy bug during January to May with peak in March in mango. Munj *et al.* (2019) and Reddy and Sreedevi (2016) also reported mealy bug infesting mango.

### C. Leaf Eating Beetles and Weevils

Mango leaf cutting weevil, *D. marginatus* (Fig.I-69 to 72) infestation was observed during June to October. Adults were found shiny black with reddish orange head and prothorax. Adults of both sexes were observed infesting young leaves by scrapping, which resulted in curling and drying of leaves. However, female adults were found cutting young leaves from the base after ovipositing eggs singly in leaf tissue by making pouch parallel to the midrib. Fully grown third instar grubs exited leaf galleries by rupturing the epidermal layer of fallen infested mango leaves. Pupae were shiny white in color with visible pair of large black compound eyes. Infestation was resulted in defoliation of new flushes of mango. Earlier infestation of *D. marginatus* was reported

by different workers all over the country (Kannan and Rao, 2006; Preetha, 2013; Sathe *et al.*, 2015; Reddy and Sreedevi, 2016; Anant, 2016; Balaji and Kumar, 2018; Munj *et al.*, 2019 and Vanitha, 2020).

Likewise incidence of grey weevil/ ash weevil, *Myloccerus* spp. (Fig.I-73 to 74) was observed during June to November. Ashy grey to whitish adults with stout body were observed. Adults were found feeding by biting leaf lamina. According to Kannan and Rao (2006) and Vanitha (2020) ash weevil is also a major pest in Nursery. Leaf beetle, *Basilepta* sp. (Fig.I-75) incidence was observed during June to September. The scrapping type of damage was caused by adults of this beetle which was same as caused by leaf cutting weevils. Windowpanes (papery patches) and numerous holes on leaves were produced. Damaged leaves lose vigor, curled upward, became brownish and finally dried.

Earlier, Aye (2020) documented 17 species of insect-pests of mango viz., *Leptocentrus taurus*, *I. Clypealis* and *I. nitidulus*, *Dictyophara pannonica*, *Lawana conspersa*, *Ricania* sp., *Scolypopa australis*, *Aphis gossypii*, *Myzus persicae*, *I. Aegyptica* and *I. seychellarum*, *A. tubercularis*, *P. longispinus*, *B. rufomaculata*, *Hypomeces squamosus*, *Sternochetus mangiferae* and *B. dorsalis*. The present finding are more or less in coformity with earlier workers.

Considering the ensuing climate change and entry of invasives, a continuous monitoring and vigil on pest scenario is essential.

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### REFERENCES

- Ahmed, W., Nawaz, M. A., Saleem, B. A. and Asim, M. 2005. Incidence of mango midge and its control in different mango growing countries of the world. *International Conference on Mango and date Palm: Culture and Export, Pakistan*, pp.98-101.

- Anant, A.K., 2016. Studies on insect-pests of mango with special reference to seasonal incidence and management of mango leaf hoppers. *Master of Science in Entomology*.
- Anonymous. 2022. Area and production estimates of horticulture crops 2021-22 (Final). Department of Agriculture and Farmers Welfare, Govt. of India. <https://agriwelfare.gov.in/en/StatHortEst>
- Anonymous. 2023. Zone wise/district wise estimated area, production and productivity of fruit crops for the year 2022-23. Director of Horticulture. Agriculture, Farmers Welfare and Co-operation Department, Government of Gujarat. <https://doh.gujarat.gov.in/horticulture-census.htm>
- Aye, M. M. 2020. Seasonal occurrence of insect pests on mango *Mangifera indica* L. cv. Sein-ta-lone in Meiktila environs. *Meiktila University Research Journal*, **11**(1): 316-321.
- Balaji, R. K. and Kumar, K. 2018. Arthropod diversity in mango at Karaikal. *Indian Journal of Entomology*, **80**(4): 1465-1477.
- Bana, J.K., Sushil kumar and Sharma, H. 2018. Diversity and nature of damage of mango insect pests in South Gujarat ecosystem, *Journal of Entomology and Zoological Studies*, **6**(2): 274-278.
- Chaudhary, N. J., Rajput, V. S., Chauhan, R. P., Rabari, P. H., Chaudhary, D. M. and Patel, R. K. 2018. Infestation of slug caterpillar *Parasa lepida* (L.) (Lepidoptera: Limacodidae) on mango. *Journal of Entomology and Zoology Studies*, **6**(1): 1571-1575.
- Choudhary, S. K. 2015. Diversity and nature of damage of mango insect pests at Kaliachak –II block of Malda, West Bengal, India. *Journal of Entomology and Zoological Studies*, **3**(4): 307-311.
- Kanhar, K. A., Sahito, H. A., Kanher, F. M., Tunio, S. A. and Awan, R.R.H. 2016. Damage percent and biological parameters of leaf miner *Acrocercops syngamma* (Meyrick) on different mango varieties. *Journal of Entomology and Zoological Studies*, **4**(4):541- 546.
- Kannan, M. and Rao, N. V. 2006. Influence of age and stage of the host plant on insect pests of mango (*Mangifera indica* L.). *International Journal of Agricultural Science* **2**(2): 351-353.
- Kavitha, K. 2004. *Studies on important pests of mango* (Doctoral dissertation, Acharya Ng Ranga Agricultural University Rajendranagar, Hyderabad).
- Khimani, V. M. and Chavan, S. M. 2023. Population dynamics of mango leaf cutting weevil (*Deporaus marginatus* Pascoe) in relation to abiotic factors and varietal screening of mango mother plants in nursery. *Biological Forum – An International Journal*, **15**(11): 526-532.
- Kumar, V., Reddy, P. V. R., Anal, A. K. D. and Nath, V. 2014. Outbreak of the Looper, *Perixera illepidaria* (Lepidoptera: Geometridae) on Litchi, *Litchi chinensis* (Sapindales: Sapindaceae) - A New Pest Record from India. *Florida Entomologist*, **97**(1):22-29.
- Munj, A. Y., Sawant, B. N., Malshe, K. V., Dheware, R. M. and Narangalkar, A. L. 2019. Survey of important foliage pests of mango from South Konkan region of Maharashtra. *Journal of Entomology and Zoological Studies*, **7**(1): 684-686.
- Patel, J. R., Patel, M. B., Radadia, G. G., Shah, A. A. and Pandya, H. V. 1997. Insect pest management in mango nursery. *Journal of Applied Horticulture*, **3**(2): 125-128.
- Pena, J. E., Mohyuddin, A. I. and Wysoki, M. 1998. A review of the pest management situation in mango agro ecosystems. *Phytoparasitica*, **26**(2): 1-20.
- Poorani, J. and Thanigairaj, R., 2023. Incidence of mango stem miner, *Spulerina isonoma* (Meyrick) and first record of its parasitoid.
- Preetha, L. 2013. Shoot feeders of mango and their management. *Thesis M.Sc. (Agri.)*, Kerala Agricultural University, Kerala, 68 p.
- Purti, N., Singh, L. and Pandey, A.K. 2023. New hosts for the Andaman Baron butterfly, *Euthalia acontheacontius* (Hewitson, 1874) (Lepidoptera: Nymphalidae) in an Island Ecosystem. *Journal of the Andaman Science Association*, **28**(2):173-187.
- Reddy, P. V. R., Gundappa and Chakravarthy, A. K. 2018. Pests of mango. In: *Pests and Their Management*. Eds. Omkar. Springer Nature. ISBN: 978-981-10-8686-1 pp. 415-440.



- Reddy, P. V. R. and Sreedevi, K. 2016. Arthropod communities associated with mango (*Mangifera indica* L.): diversity and interactions. In Economic and ecological significance of arthropods in diversified ecosystems. Springer, Singapore, pp. 271-298.
- Sathe, T. V., Patil, S. S., Khamkar, A. G. and Khairmode, P. V. 2015. Biology, ecology and control of weevils (Curculionidae: Coleoptera) on mango *Mangifera indica* Linn. from Western Maharashtra. *Biolife*, **3**(4): 783-787.
- Sharma, R. 2015. Population dynamics of insect pests and pollinators associated with *Mangifera indica* Linn. *Thesis Ph.D. (Agri.)*, G. B. Pant University of Agriculture and Technology, Uttarakhand, 199 p.
- Shrestha, S., Chaudhary, M., Upadhyaya, N. and Khanal, D. 2022. Mango leaf webber (*Orthaga euadrusalis* Walker); A potential threat in Tropical Plains of Nepal. *Nepalese Horticulture*, **16**: 55-62,
- Soumya, B. R., Verghese, A. and Kamala Jayanthi, P. D. 2017. Diversity and economic status of Lepidopteran insect-pest on two major varieties of mango. *Journal of Entomology and Zoological Studies*, **5**(3): 838-843.
- Soumya, B. R., Rashmi, M. A. and Verghese, A. 2021. Bioecology of the mango inflorescence caterpillar, *Perixeraillepidaria* Guenée and record of its feeding on mango fruits. *Pest Management in Horticultural Ecosystems*, **27**(1): 22-26.
- Srivastava, R. P. 1997. *Mango Insect Pest Management*. Intl. Book Distributors Co., Lucknow, UP, 272 p.
- Tandon, P.L. and Verghese, A. 1985. World list of insect, mite and other pests of mango.
- Tara, J. and Gupta, M. 2016. First record of *Euthalia aconthea* (Lepidoptera: Nymphalidae), an important pest on Mango (*Mangifera indica*) from Jammu region. *International Journal of Entomology Research*, **1**(1):01-03.
- Vanitha, K. 2020. Insect pests common in cashew and mango. Agriculture and food: *e-newsletter*, **2**(10): 447-449.

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