



E-ISSN: 2320-7078

P-ISSN: 2349-6800

[www.entomoljournal.com](http://www.entomoljournal.com)

JEZS 2020; 8(2): 856-863

© 2020 JEZS

Received: 16-01-2020

Accepted: 18-02-2020

**Ram Karan Gaur**

Chaudhary Charan Singh

Haryana Agricultural

University, Regional Research

Station, Bawal, Haryana, India

**Mukesh Kumar**

Chaudhary Charan Singh

Haryana Agricultural

University, Regional Research

Station, Bawal, Haryana, India

**Sushil Sharma**

Chaudhary Charan Singh

Haryana Agricultural

University, Regional Research

Station, Bawal, Haryana, India

**Bijender Singh Yadav**

Chaudhary Charan Singh

Haryana Agricultural

University, Regional Research

Station, Bawal, Haryana, India

**Corresponding Author:****Ram Karan Gaur**

Chaudhary Charan Singh

Haryana Agricultural

University, Regional Research

Station, Bawal, Haryana, India

## Survey studies on insects and non insect pest associated with ber crop in South West Haryana

**Ram Karan Gaur, Mukesh Kumar, Sushil Sharma and Bijender Singh Yadav**

### Abstract

The survey aimed to document the occurrence of insect and non insect pest of ber fruits grown in South West Haryana. The fifteen insect-pests including non insect pest, infesting ber have been recorded during the study. The five pest i.e. Ber fruit flies (*Carpomyia vesuviana* Costa and *Bactrocera dorsalis* Hendel), fruit borer (*Meridarchis scyrodes* Meyrick) lac insect, (*Laccifer lacca* kerr), Defoliating beetle (*Holotrichia consanguinea* Blanch.) and fruit bats, *Pteropus* spp. were recorded as major pests. The surveys revealed that cumulative infestation of *Carpomyia vesuviana* Costa and *Bactrocera dorsalis* Hendel ranged from 5.0-36.0 and 8.0-44.0 per cent during 2017-18 and 2018-19 in different districts of South West Haryana. The current study has shown that lac insects caused plant infestation varied from 4.0-7.0 per cent during 2017-18 and 6.0- 8.0 per cent during 2018-19 in various districts of south west Haryana It is estimated that production losses due to insect pests and non insect pest are around 30 per cent in ber crop.

**Keywords:** Fruit flies, fruit borer, fruit bats, hard gall mite, caterpillar

### Introduction

In India, about 169 million hectares of the total geographical area is under arid and semi arid regions, spread over different parts of the country. Out of this about 38.7 million hectares under arid region is spread over mainly in the states of Gujarat, Rajasthan., Punjab, Haryana, Karnataka, Andhra Pradesh besides cold arid region situated in Leh, Laddakh and Himachal Pradesh (Sharma *et al.*, 2013) [28]. Indian arid zone is characterized by high temperature and low and variable precipitation, which limit the scope for high crop productivity. The arid fruits have significant contribution in total fruit production of the country. It has also been realized that the arid horticulture in south west Haryana helps in stabilizing the ever degrading ecosystem besides ensuring economic returns to the farmers. However, these conditions greatly favor the development of high quality produce in a number of fruit crops such as ber (*Ziziphus mauritiana*), aonla (*Embllica officinalis*), bael (*Aegle marmelos*), and lasoda (*Cordia myxa*). The ber also known as desert apple is a major crop extensively cultivated in the arid and semi arid region of Rajasthan, Haryana, Punjab, Gujrat and other parts of India. Ber crop is becoming popular for nutritional and health security as the fruit have higher amount of vitamin C, second after guava and aonla and more than apple and citrus (Khera and Singh1976) [17]. There are many reasons for low productivity of the ber fruits. Hot arid region are marked by abiotic limitations such as high temperature, high potential evapo-transpiration, low erratic rainfall, low soil fertility, poor quality of ground water, etc., which lead to poor crop growth and yield. Apart from the climatic limitations, the biotic factors like pests and diseases are also one of the limiting factors for ber crop production. Due to attack of insect pest on crops, yield of crop and market value reduced and farm cost increased. Effects of insect pests on crops include decline of yield, transmission of diseases, reduction of market yield and increase in farm cost. The survey of insect pest and non insect pest is important, because control measures became uneconomical, environmentally harmful; residues increased into the soil and causing pesticide resistance if pest population not taking into consideration. The information regarding the occurrence of insect-pests on ber fruits in south west Haryana is scanty. The objective of the study was to identify the status of various insect pest and non insect pest of ber crop in South West Haryana. Hence the present studies were undertaken to record the pests associated with ber fruits.

## Materials and Methods

Surveys were carried out in two consecutive year (2017-18 and 2018-19) in ber growing districts of South West Haryana. It was conducted to record the insects and non insect pest associated with ber fruit plants and also to study their incidence and nature of damage. Farmers' orchards (18 orchards) varied from 0.4 to 1.0 ha were selected. The ten plants per orchard were selected at random, tagged for counting the pests population and their infestation and observations taken in zigzag rows (Raja *et al.*, 2014) [25]. For fruit fly exit hole or deformation of fruit has been taken as identification mark of infestation. Fifty ber fruits from each trees were observed carefully to ascertain the infestation of ber fruit fly. The occurrence of fruit borer and per cent infestation was determined by counting the number of healthy and infested fruits (total fifty fruits/plant) at ten randomly selected plant. The larvae hole and brown frass along with larval fecal pellets accumulated around the entrance holes on fruit which is easily visible on fruit from a distance was considered as infested fruit. The data was recorded from different stratum of the tree. For hard gall mite and lac insects, ten branches/ plant were observed for infestation. The damage of bark eating caterpillar was recorded by observing the ribbon like structure on the stem and branch. The infested trees out of ten trees were counted and per cent infestation was calculated. For fruits bats, total infested ber in heaps and no. of heaps/acre were recorded. Population of cow bug and number of larval masses of hairy caterpillar were recorded from 25 cm length on ten randomly selected terminal twigs/plant and total ten plant were included in each orchards. The insects were preserved in 70 per cent alcohol for identification. The immature stages of the insects recorded on the plants were collected and reared to adult stage in the laboratory of RRS, Bawal. The species emerged, got identified from different sources.

## Results and Discussion

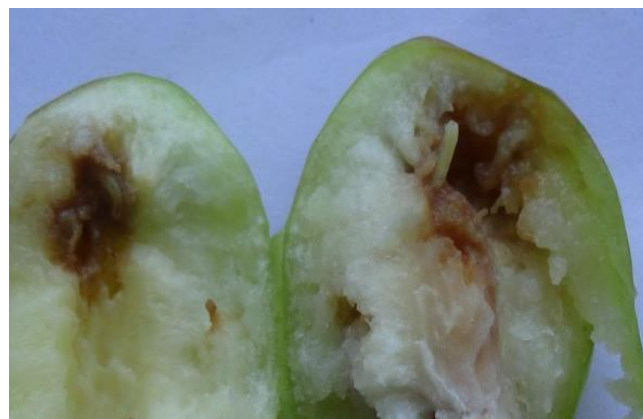
The 15 insects and non insect pests damaging ber crop have been observed from arid zone region of South West Haryana. Among these, five pests i.e. Ber fruit flies (*Carpomyia vesuviana* Costa and *Bactrocera dorsalis* Hendel), fruit borer (*Meridarchis scyroides* Meyrick), lac insect, (*Laccifer lacca* Kerr), defoliating beetles (*Holotrichia consanguinea*), and fruit bats, *Pteropus* spp were recorded as major pests. Ten insect pests viz., metallic shield bug *Scutellera perplexa* (Westwood), hard gall mite, *Eriophes cernus* (Masse), hairy caterpillars, *Euproctis lunata*, (Wlk.), tassar silk moth, *Anthearea paphia* (Linnaeus), bark eating caterpillars, *Indarbela* spp., thrips, *Scirtothrips dorsalis* (Hood), termite, *Odontotermes obesus* (Rambur), grey weevil, *Myloccerus dentifer* (Fabricius), cow bug, *Tricentrus bicolor* (Boheman), leaf webber, *Synclera univocolis*, were recorded as minor pests during survey.

Lakra and Bhatti(1985) [19] studied the insect pests of ber plant in India and reported 130 insect pest species. According to Jothi and Tandon (1995) [13], 17 insect pest species damaging ber plant in Karnataka state. Patil and Patil (1996a) [24] recorded ten insect species on ber plants. Balikai (1999) [4] recorded 22 insects and non-insect species damaging on ber plants in Karnataka. Butani (1979) [7] documented 80 insect species damaging ber trees in India. Gaur (2014) [9] recorded 12 species of insect pests on ber plants in South West Haryana. Twelve insect-pests recorded from ber plants in hot arid region of Rajasthan by Haldhar *et al.*, 2016 [10]. The

insects and non insect pest which were recorded during survey are being discussed below.

## Fruit flies

Eighteen ber orchard were surveyed during 2017-2018 and 2018 - 2019, respectively. Almost all the ber orchards were found infested with ber fruit flies. The fruit flies made galleries, infested fruits become deformed and matured early. The surveys conducted in different districts of south west Haryana revealed that cumulative infestation of *Carpomyia vesuviana* Costa and *Bactrocera dorsalis* Hendel (Diptera: Tephritidae) varied from 5.0 to 36.0 per cent and 8.0 to 44.0 per cent during 2017-18 and 2018-19, respectively. These fruit flies were recorded from October to April month in all the districts surveyed. The losses caused by these fruit flies are so high that it has considered as a limiting factor in successful cultivation of ber in Haryana. Lakra (1998) [18] reported six species of fruit flies, *Carpomyia vesuviana* Costa, *Carpomyia zizyphae* Agarwal & Kapoor, *Bactrocera dorsalis* Hendel, *B. correcta* Bezzi, *B.zonata* Saunders and *Bactrocera* spp. on ber fruit in India. The present finding corroborates with the finding of Bagle (1992) [2] who conducted the study on *C. vesuviana* and told that ber fruit fly caused yield reduction between 13.0 to 20.0 per cent per plant. The yield losses reached between 90.0 to 100.0 per cent (Joshi and Shinde 1971) [12]. In serious cases ber fruit fly causes yield loss between 80 to 100 per cent (Karuppaiah *et al.*, 2015) [14]. The damage occurred between August to October and losses between 63.0 to 80.0 per cent under severe infestation recorded by different researcher (Batra 1953; Cherian and Sundaram 1941) [6, 8]. Sarwar (2006) [27] recorded fruit flies species such as *Bactrocera zonata*, *Bactrocera dorsalis* and *Carpomyia* species as greatest enemies of the ber at Arifwala, Pakistan.



Damage symptoms of *B. dorsalis*



Damage symptoms of *C. vesuviana*



Deformed ber due to ber fruit fly

### Fruit borer

The young larvae of ber fruit borer, *Meridarchis scyroides*, Meyr. (Lepidoptera: Carposinidae) bore into fruits and feed upon pulp and full grown larvae accumulate excreta which may be seen outside the entrance hole. The infested fruits can be recognized from a distance. The colour of adult of ber fruit borer is dark brown and have fringed wings. The first instar larva is greenish and older ones is reddish. Earlier no report available regarding the pest occurrence in Haryana, but now due to climate change pest appeared and caused considerable damage to ber fruits in some districts of Haryana. The damage of fruit borer was recorded up to 6.0 per cent and 8.0 per cent in ber fruit during 2017-18 and 2018-19 in various districts of South West Haryana. The peak infestation was noticed in November and December month. These results are in general agreement with the findings of Sonawane & Dorge 1971<sup>[31]</sup>; Pareek & Nath 1996<sup>[22]</sup>; Balikai *et al.*, 2013<sup>[5]</sup> who reported that the fruit borer, *Meridarchis scyroides* as serious pest of ber in Southern and western India.



Symptoms of fruit borers infestation on ber fruits

### Lac insect

The lac insect, *Laccifer lacca* Kerr. (Hemiptera: Lacciferidae) sucks the sap from the branches and affected branches dry up and looking blackish. The larvae secrete the resinous substances around their body through certain glands and form a hard crust on the twigs. The secretion appears first as a shining layer which soon gets hardened after coming in contact with air. It was observed during survey that old plants were affected more than young plants. Survey revealed that plant infestation varied from 4.0-7.0 per cent during 2017-18 and 6.0- 8.0 per cent during 2018-19 in various districts of south west Haryana. It was observed during survey that

kaithali var. were more susceptible to lac insects as compared to other varieties. The peak infestation was observed in February and April months. Lakra and Kher 1990<sup>[20]</sup> reported that 5000 nymphs/100 cm twigs causes yield loss of 52.5 to 58.5 per cent. Singh *et al.*, (2014)<sup>[29]</sup> reported that *Ziziphus mauritiana* is one of the most popular lac host trees to rear rangeeni and kusmi strain of Indian lac insect *Kerria lacc* (Kerr).



Ber branches infested with lac insect

Close view of Lac insect *Laccifer lacca*

### Defoliating beetles

During survey, defoliating beetles, namely *Holotrichia consanguinea*, *Maladera insanabelis*, *Anomala dimidiata*, (Coleoptera: Scarabaeidae) were recorded as a major pest of ber in South West Haryana. The adults of defoliating beetles emerged during dusk from the soil with the first monsoon rains in June, they fly short and feed on the foliage of ber trees. In the following morning adults go back to soil, hide and lay eggs. The grub feed on roots of various crops and adult feed on leaves of ber plants. The findings of this survey revealed that in ber leaf defoliation occurred between 12.0 - 24.0 per cent during 2018 and 14.0-32.0 per cent during 2019. The damage was observed from the month of June to September. The leaves look like sieves type due to hole caused by beetles and, in severe infestation the whole tree is rendered leafless. Balikai (2009)<sup>[3]</sup> highlighted that chafer beetles caused severe infestation to foliage of ber during June to August and some time tree is completely defoliated.

*Holotrichia consanguinea**Maladera insanabelis**Anomala dimidiata***Fruit bats**

It was noticed during survey that fruit bats, *Pteropus* spp. (Chiroptera: Pteropodidae) caused serious damage to ber orchard in South West Haryana. A fruit bat pluck the ber fruit from the plant and suck the juice from the ber and expels the pulp and stone below the ber plant. The heaps of infested ber can be seen below the ber plant. During the fruiting season of 2017-18 and 2018-19, the damage to ber fruits by fruit bats was evaluated and estimated about Rs 6000-7000 loss per acre/season. The study indicated that ber fruits are good food source of fruit bats.



Fruit bat having ber in mouth

**Eriophyid mite**

Eriophyid mite, *Eriophes cernus* Masee (Acari: Eriophyidae) caused galls formation on branches of ber plant. Some time the infestation is so severe that 240-300 galls/plant were recorded in the month of September and October, 2018. During survey, 2.0 to 4.0 per cent plant infestation (18-24 galls/plant) was recorded due to eriophyid mite in 2018 and 4.0 to 8.0 per cent plant infestation (with 14-16 galls/ plant) during 2019. However, 80.0 to 86.0 per cent plant infestation with 2 to 4 galls/plant were recorded in both the years. Some of the researcher observed that mite species, *Eriophes cernus* found active right through the year (Mukherjee *et al.*, 1994; Pareek and Nath 1996) [21, 22]. Due to mites attack, hard galls were produced on twigs, and on floral buds (Yamdagni and Gill 1968; Singh 2008) [30, 32]. Ravikumar *et al.*, 1999 [26] observed that infestation between 30-35 per cent (with 10-15 galls/ plant) by mite was recorded and nearly 90 per cent infestation with 1-2 galls/plant, recorded in a newly established orchards.



Hard gall made by Eriophyid mite on ber

**Termite**

It was noticed during survey that termite, *Odontotermes obesus* (Rambur) (Isoptera: Termitidae). caused serious

infestation to ber trees. The termite damaged roots and bark, if the infestation is heavy the plant dry up and die. During survey in ber growing districts of Haryana, It was observed that infestation of termite varied from 8.0 to 12.0 per cent and 14.0 to 16.0 per cent during 2018 and 2019, respectively. The

infestation was recorded during March to July. Karuppaiah *et al.*, (2010) <sup>[15]</sup> and Haldhar *et al.*, (2012) <sup>[11]</sup> reported that 49 per cent of ber tree infested with termite during February to April.



Symptoms of termite on ber

### Hairy caterpillar

The earlier instars larvae of hairy caterpillar (*Euproctis lunata* Wlk.) (Lepidoptera: Lymantriidae) fed gregariously and scrapped the leaf from lower epidermis and fed upon the green matter. The congregating habit of the early instars larvae sometime continued even in the mature larvae. After the second moult, the larvae dispersed and fed voraciously on leaves. However, full grown larvae observed feeding on the upper surface of the leaf. In case of severe infestation,

complete leaf was consumed by larvae. Gaur (2014) <sup>[9]</sup> reported that hairy caterpillar, *Euproctis lunata* Wlk. as a major pest of castor crop in south west Haryana. During survey hairy caterpillar was also recorded on ber plant in different district of Haryana. However its infestation was very less i.e. 4.0 to 8.0 per cent in various ber orchards. Haldhar *et al.*, (2012) <sup>[11]</sup> also reported that hairy caterpillar, *Euproctis fraternal* Moore causes serious defoliation during sprouting stage.



Egg mass of *E. lunata* on ber leaf



Adult of *E. lunata* laying egg

### Thrips

During the existing study it was observed that ber fruits also suffered from the attack of thrips *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae). These are minute, slender insects with fringed wings. Thrips feeding on developing ber

fruits causes scarring while on mature fruits causes bleaching. The attack of thrips does not harm flavor or texture of the pulp and juice but customer expects perfect looking fruit and due to attack of thrips the fruits become unattractive. During survey 6.0-8.0 per cent and 4.0 -7.0 per cent fruits found

infested by thrips in 2017-2018 and 2018-2019, respectively. Balikai (2009) [3] and Haldhar *et al.*, (2012) [11] reported that *Scirtothrips dorsalis* caused miner infestation to ber fruits.



Ber infested with thrips

### Metallic shield bug

During survey, it was observed that *Scutellera perplexa* (Westwood) (Hemiptera: Scutellaridae) caused considerable damage to the ber fruits in south west Haryana. Earlier no report was available on this pest on *Ziziphus mauritiana* in Haryana. Nympha and adult of the bugs were recorded on ber trees. They suck the sap from tender twigs and ber fruits resulting in drying of the leaves and dark brown spot on the fruits. However, its population was low i.e. 4.0 to 6.0 adults/plant and fruit infestation was 2.0 to 4.0 percent during the study period. However, Parveen *et al.*, (2010) [23] reported that *Scutellera perplexa* (Westwood) a serious sucking pest of *Jatropha curcas* L. in Delhi and adjoining areas. They told that pest remained active throughout the year and severe damage to foliage and developing fruits between July and March. Population density was highest between September and November. Singh *et al.*, (2014) [29] carried out intensive crop survey and collected some insect pests associated with *Z. mauritiana* trees and reported ten new insect pest species on ber plant and *Scutellera perplexa* (Westwood) was one of the pest of *Ziziphus mauritiana*.



Metallic shield bug on ber

### Bark eating caterpillars

The current study has shown that bark eating caterpillars, *Indarbela* spp. (Lepidoptera: Cossidae) not a serious pest of ber plant in South West Haryana. The damages of bark eating caterpillar can be seen easily from a distance by the presence of ribbon like structure on the stem. Larvae feed on bark during night and they remain hidden in tunnel during daytime. The 1.0 to 4.0 percent plant infestation was recorded during 2017-18 and 2018-19. Bark eating caterpillars damaged ber plant besides many other crops and caused heavy losses (Singh 2008; Azam-Ali *et al.*, 2006) [30, 1]. They told that a single larva of bark eating caterpillars can spoil the produce of entire branch.

### Ber butterfly

Blue butterfly, *Tarucus theophrastus*, Fabricius (Lepidoptera: Lycaenidae) recorded as a miner pest of ber in South West Haryana. The larvae damage the leaves and flower buds and the damaged leaves have long strip like symptoms. The infestation was recorded between 8.0 to 12.0 per cent during July to October months of the study years. Karuppaiah *et al.*, (2010) [15] and Haldhar *et al.*, (2012) [11] reported that blue butterfly *Tarucus theophrastus* caused leaf damage during the sprouting of new shoots in ber between 25.0 to 40.0 per cent. According to Kavitha & Savithri 2002 [16], blue butterfly showed negative correlation with relative humidity and rainfall and positive correlation with maximum and minimum temperatures.



Damage symptoms of blue butterfly on ber

### Cow bug

The adults and nymphs of *Tricentrus bicolor* (Boheman) (Hemiptera: Membracidae) recorded on the branches of ber plant during survey. They suck the sap from leaf bud and branches and secret honey dew on which ant fed and protect them from predation. Peak population was recorded during September month. Heavy population of cow bug weakens the ber tree. The survey revealed that the population of cow bug was low (10-14 & 6-12 nymph/ adults on 20 cm.twig in respective years) and recorded as miner pest of ber. Balikai (2009) [3] also reported the cow bug, *Tricentrus bicolor* as minor pests on ber crop.



Cow bug on ber

### Other insect pests

The insect pests viz., grey weevil, *Mylocherus* spp, leaf webber, *Synclera univocolis* and Tassar silk moth, *Anthearea paphia* Linnaeus, were also recorded on ber plant. The infestation of these pests was very low in South West Haryana and recorded as miner pest of ber.

### Conclusion

The current study has shown that there were various insects pest and non insect pest attacking ber plants. The major pests

recorded during the study period were ber fruit flies, fruit borer, lac insect, defoliating beetles and fruit bats. The production loss due to insect pests and non insect pest is estimated around 30 per cent in ber crop. The result obtained from the study could be beneficial for further research on management of insect pests of ber plants in arid zone area. A better planning is required for early detection and reporting of infestations/ spread of new insect pest by establishing communication links between various departments and fruit growers.

### Acknowledgment

The authors would like to thank ICAR – AICRP AZF, Bikaner for providing financial support for this study. This study wouldn't also be successful without the hospitality and insightfulness of arid zone ber fruit growers to execute the survey during the year 2017-2019.

### References

1. Azam-Ali S, Bonkougou E, Bowe C, DeKock C, Godara A, Williams JT. Fruits for the future-2 (Revised edition), Ber and other jujubes. International Centre for Underutilized Crops, University of Southampton, Southampton, UK, 2006, 1-285.
2. Bagle BG. Incidence and control of fruitfly (*Carpomyia vesuviana* Costa) of ber (*Ziziphus mauritiana* Lamk.). Indian Journal of Plant Protection. 1992; 20(2):205-207.
3. Balikai RA. Insect Pest Status of Ber (*Ziziphus mauritiana* Lamarck) in India and Their Management Strategies. Acta Horticulturae. 2009, 840.
4. Balikai RA. Pest scenario of ber (*Ziziphus mauritiana* Lamarck) in Karnataka. Pest Management in Horticultural Ecosystem. 1999; 5(1):67-69.
5. Balikai RA, Kotikal YK, Prasanna PM. Global scenario of insect and non-insect pests of jujube and their management options. Acta Horticulture. 2013; 993:253-277.
6. Batra HN. Biology and control of *Dacus diversus* Conquillet and *Carpomyia vesuviana* Costa and important notes on other fruit flies in India. Indian Journal of Agricultural Science. 1953; 23:87-112.
7. Butani DK. Insects and fruits. International Book Distributors, 9/3, Rajpur Road, Dehradun- 1979, 415.
8. Cherian MC, Sunderam CV. In: Proceedings of the 20th Indian Science Congress III, 1941, 191.
9. Gaur Ram Karan. Status of insect pests of ber (*Ziziphus mauritiana*) in South West Haryana. In "International Conference on Changing Scenario of Pest Problem in Agri-Hort Ecosystem and their Management" Organised by Entomological Research Association Deptt. Of Entomology, Rajasthan college of Agriculture, held at MPUAT, Udaipur from, 2014, 102.
10. Haldhar SM, Deshwal HL, Jat GC, Berwal MK, Singh D. Pest scenario of ber (*Ziziphus mauritiana* Lam.) in arid regions of Rajasthan: a review. Journal of Agriculture and Ecology. 2016; 1:10-21.
11. Haldhar SM, Karuppaiah V, Sharma SK, Singh D. Insect-pests of ber (*Ziziphus mauritiana* Lam.) as influenced by abiotic factors in arid region of Rajasthan. In Global conference on "Horticulture for food, nutrition and livelihood options" organised by ASM foundation, New Delhi and OUAT, Bhubaneswar. Odisha during, 2012
12. Joshi HC, Shinde VKR. Control of ber fruit fly, *Carpomyia vesuviana* Costa (Tephritidae: Diptera). Indian Journal of Entomology. 1971; 33(2):142-147.
13. Jothi BD, Tandon PL. Present status of insect pests of ber in Karnataka. Current Research. 1995; 24(9):153-155.
14. Karuppaiah V, Haldhar SM, Sharma SK. Insect Pests of Ber (*Ziziphus mauritiana* Lamarck) and their Management. 'Insect Pests Management of Fruit Crops' edited by A. K. Pandey and Pramod Mall published by Biotech Books, New Delhi, 2015, 271-294.
15. Karuppaiah V, More TA, Sivalingam PN, Hanif Khan, Bagle BG. Prevailing insect pests of ber (*Ziziphus mauritiana* Lamrck) and their natural enemies in hot arid ecosystem. Haryana Journal of Horticultural Sciences. 2010; 39(3, 4):214-216.
16. Kavitha Z, Savithri P. Documentation of insect pests on ber. South Indian Horticulture. 2002; 50(1, 3):223-225.
17. Khera AP, Singh JP. Chemical composition of some ber cultivars (*Ziziphus mauritiana* L) Haryana Journal of Horticultural Sciences. 1976; 5(112):21-24.
18. Lakra RK. Insect pest of some under-exploited fruits and their management. II Jujube (*Ziziphus mauritiana* Lamk.). A Dipterous pest. Haryana Journal of Horticultural Sciences. 1998; 27(1):12-34
19. Lakra RK, Bhatti DS. In: Third National Workshop on Arid Zone Fruit Research, Rahuri, 1985.
20. Lakra RK, Kher S. Effect of incidence of lac insect, *Kerria lacca* (Kerr) on bearing and quality of jujube fruits in Haryana. Indian Journal of Plant Protection. 1990; 18(1):125-127.
21. Mukherjee IN, Singh PK, Singh J. Incidence and control of jujube gall mite (*Eriophyes cernus*) at Varanasi. Indian Journal of Agricultural Science. 1994; 64(5):343-345.
22. Pareek OP, Nath V. Ber In: Coordinated Fruit Research in Indian Arid Zone - A two decades profile (1976-1995). National Research Centre for Arid Horticulture, Bikaner, India. 1996, 9-30.
23. Parveen S, Khokhar S, Kamil Usmani Md, Ramamurthy VV. Bionomics of *Scutellera perplexa* (westwood) (Hemiptera: Scutelleridae), a sucking pest of jatropa with descriptions of immature stages. Entomological News. 2010; 121(5):401-408.
24. Patil P, Patil BV. Insect pests of ber in north Karnataka. South Indian Horticulture. 1996a; 44(3, 4):113.
25. Raja M, William SJ, David BV. Population dynamics of key insect pests of cabbage in Tamil Nadu. Indian Journal of Entomology. 2014; 76(1):01-07.
26. Ravikumar MR, Balikai RA, Somasekhara YM, Ryagi YH. Occurrence of shoot axis galls on ber, *Ziziphus mauritiana* Lamarck. Insect Environment. 1999; 4(4):121.
27. Sarwar Muhammad. Incidence of insect pests on ber (*Ziziphus jujube*) tree. Pakistan Journal of Zoology. 2006; 38(4):261-263.
28. Sharma SK, Singh RS, Bhargava R. Arid Horticulture: An Overview. Annals of Arid Zone. 2013; 52(3, 4):251-264.
29. Singh JP, Jaiswal AK, Monobrullah MD. First record of some insect pest on commercial lac host plant, *Ziziphus mauritiana* from India. Proceedings of the National Academy of Science, India-Section B:Biological Science. 2014; 86(2).
30. Singh MP. Managing menace of insect pests on ber. Indian Horticultur. 2008; 53(1):31 -32.
31. Sonawane BR, Dorge SK. Biology and control of fruit

- borer (*Meridarchis scyrodes* Meyrick) on ber. Poona Agriculture College Magazine. 1971; 61(1, 2):1-4.
32. Yamdagni R, Gill AS. Gall formation in floral buds of ber - a new threat to ber industry. Punjab Horticulture Journal. 1968; 8:259.