

Pest scenario of ber (*Ziziphus mauritiana* Lam.) in arid regions of Rajasthan: a review

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Abstract

Indian jujube known as ber (*Ziziphus mauritiana* Lam.) is an extremely drought hardy and native fruit of India. However, the quality of fruits and productivity is not obtainable up to the standard. One of the reasons for it is infestation of insect pests on the vegetative as well as developing fruits, which ultimately leads to significant yield loss and quality attributes of the fruits. Though as many as 130 species of insect pests have been recorded in India, only few species have attained the pest status and cause substantial economic damage to ber. A total of 12 insect-pests infesting on ber have been recorded from hot arid region of Rajasthan. Out of these, three insects viz., Ber fruit fly (*Carpomyia vesuviana* Costa), fruit borer (*Meridarchis scyroides*) and stone weevil (*Aubeus himalayanus* Voss) were recorded as major pests with high infestation rate, whereas two insects (Ber butter fly, *Tarucus theophrastus* (Fabricius) and thrips, *Scirtothrips dorsalis* (Hood)) were recorded as moderate pests. As many as seven insect pests viz., grey weevil, *Myloccerus dentifer* (Fabricius), *M. blandus* Faust, *Amblyrrhinus poricollis* Schoenherr; leaf webber, *Synclera univocolis*; ber mite, *Larvacarus transitans*, bark eating caterpillars, *Indarbela* sp and termite, *Odontotermes* sp were recorded as minor pests. The incidence of fruit fly (*C. vesuviana*), fruit borer (*M. scyroides*) and stone weevil (*A. himalayanus*) were recorded on ber from October to February. The fruit fly infests most of the *Ziziphus* species grown in the world and cause severe yield loss up to 80% or even more. The average percent incidence of stone weevil, *A. himalayanus* was observed between 13.00 to 64.00 in fallen fruits and 12.00 to 59.33 on attached fruits of ber. The seasonal incidence of fruit borer, *M. scyroides* attained its

peak in the second fortnight of December (58.33%) in ber crop. The leaf feeder's viz., ber butterfly, leaf webber, mite, thrips and grey weevils were more active during June to September.

Key Words: Ber, pest scenario, *Ziziphus mauritiana*, arid region

Introduction

The ber (*Ziziphus mauritiana* Lamark) also called as desert apple, jujube, Chinese apple, Badari (Sanskrit), Kul or Boroi, Ber (Hindi), Dongs, Boroi, Bor, Beri, Indian plum and Permseret (Anguilla) is a tropical fruit tree species, belonging to the family *Rhamnaceae* (Balikai 2013). In India, the crop occupies large area (22,000 ha) and it is popular fruit crop for arid and semi-arid regions of India (Jamandar et al. 2009) and most of the cultivated areas are confined to Rajasthan, Haryana, Punjab, Gujarat, Maharashtra and Uttar Pradesh. To some extent its cultivation is also done in the states of Tamil Nadu, Andhra Pradesh, Karnataka, Bihar, Chhattisgarh, Madhya Pradesh, Assam and West Bengal. The crop is gaining popularity among the growers because it thrives well under adverse climatic condition and gives good return. The fruits are quit nutritious, contains higher quantity of vitamin C, second only to aonla and guava and much higher than citrus and apple (Khera & Singh 1976). In India, more than 130 species of insect pests are found to infest on *ber*, though very few have attained the pest status. Balikai (2009) reported a total of 22 insect and non-insect species in Karnataka. Likewise, Kavitha & Savithri (2002) documented about 23 insect species on *ber* from Andhra Pradesh. However, pests such as fruit fly *Carpomyia vesuviana* Costa, *Meridarchis scyrodes* Meyr, chafer beetle, *Holotrichia consanguine* Blanch and bark eating caterpillars, *Indarbela tetraonis* Moore; *Indarbela quadrinotata* Walker; *ber* butterfly, *Tarucus theophrastus* Fabricius and stone weevil, *Aubeus himalayanus* Voss are the major pests of *ber* in India which cause significant yield loss (Singh 2008; Sharma & Bal 2009; Karuppaiah et al. 2010; Haldhar et al. 2013; Karuppaiah et al. 2015). As many as seven insect pests viz., grey weevil, *Myloccerus dentifer* (Fabricius), *M. blandus* Faust, *Amblyrrhinus poricollis* Schoenherr; leaf webber, *Synclera univocolis*; *ber* mite, *Larvacarus transitans*, bark eating caterpillars, *Indarbela* sp and termite, *Odontotermes* sp were recorded as minor pests (Haldhar et al. 2012).

1. Fruitfly, *Carpomyia vesuviana* Costa (Tephritidae: Lepidoptera)

Fruit fly, *Carpomyia vesuviana* Costa (Diptera: Tephritidae) is the most destructive pest of ber in India. It is a monopahagous pest, infests only on *Zizyphus* species and contributes towards low yield and poor quality of fruits (Joshi & Shinde 1971; Lakra 1998; Muhammad 2006; Kavitha & Savithri 2002; Zavitha et al. 2002; Haldhar et al., 2012; Balikai et al. 2013). The pest causes the yield loss up to 80% under severe infestation (Batra 1953; Cherian & Sundaram 1941). The incidence of *C. vesuviana* reduces the yield from 13 to 20% per plant (Bagle 1992) and may even reach 90-100% (Joshi & Shinde 1971). The infestation occurs in all the wild and cultivated species viz., *Z. zizyphus*, *Z. mauritiana*, *Z. spina-cheresti*, *Z. numularia*, *Z. lotus*, *Z. jujube*, *Z.*

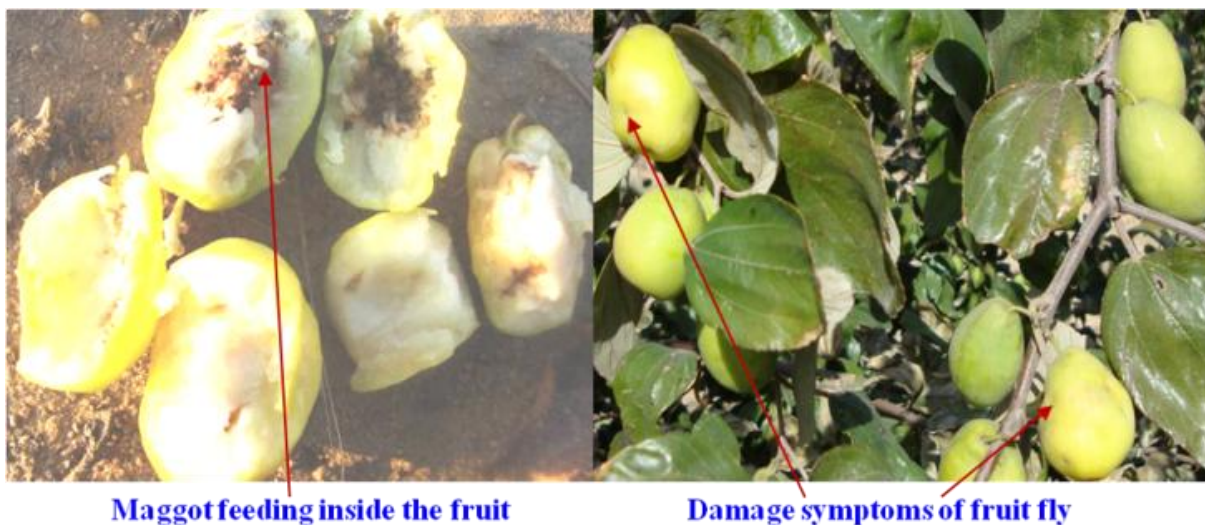
sativa and *Z. rotundifolia*. The adults are small yellow brown flies, smaller than housefly having brown bands on hyaline wings and black spots on the thorax. The maggots bore into the ripe fruits and feeds on the pulp. Full grown maggot after coming out of the fruit drops to the ground for pupation which usually takes place in the soil at a depth of 6 to 15 cm. Adults emerge out of the soil at the onset of flowering (Sangawan & Lakra 1992; Lakra & Singh 1983; Dashad et al. 1999).



Maggot white tapering anteriorly

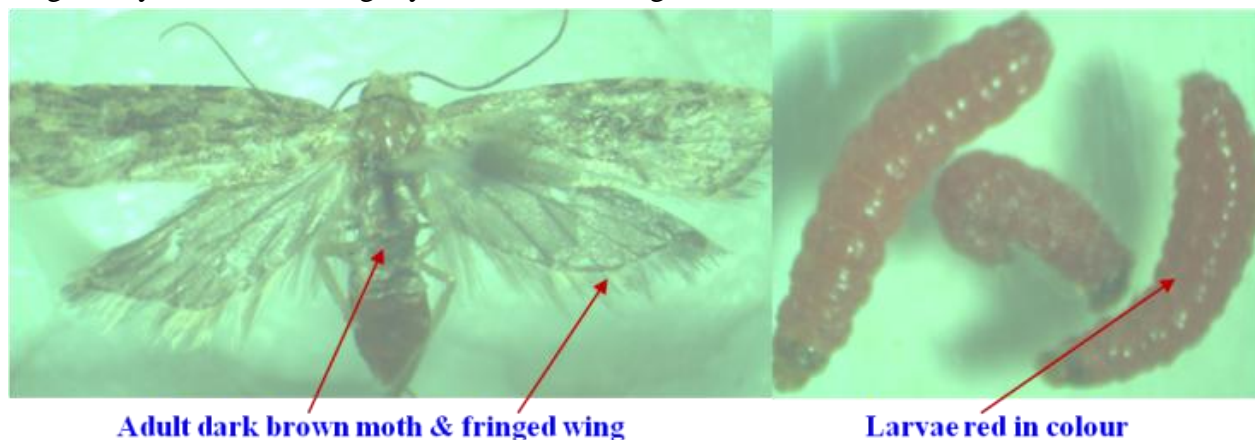
Distinctive pattern of black marks on scutellum, and distinct brown bands on wings

The adult fly lays their eggs singly in the young developing fruits after 2-5 days of emergence. Upon hatching, the maggot starts to feed on the pulp and make galleries with accumulated excreta and results into fruit rot. Infested fruits get deformed and their growth becomes arrested and in severe cases a large number of such fruits drop off (Batra 1953). Adult fly was also found to damage the fruits through ovi-punctures. They lay their eggs inside the epidermis and young maggots feed on fleshy and juicy pulp of fruits (Gupta & Sharma 2006; Singh 2008). Mated female preferred to oviposit in the central distal part of fruit and the oviposition retarded the growth of surrounding tissues causing depression in the fruits, the deformity being more apparent in young fruits with oviposition holes (Lakra & Singh 1983). *C. vesuviana* incidence increased with attainment of maturity and size of fruits (Arora et al. 2001). In Northern India infestation occurs during November to April, the fly activity gets high at the time of fruit maturity and there given upto 2 to 3 generation during the active period (Batra, 1953).



2. Fruit borer, *Meridarchis scyroides* Meyr (Carposinidae: Lepidoptera)

The fruit borer, *Meridarchis scyroides* (Lepidoptera: Carposinidae) is a serious pest in Southern and western India (Sonawane & Dorge 1971; Pareek & Nath 1996; Balikai 2013). The moths lay eggs on fruits at pea stage and upon hatching the newly emerged caterpillars bore into fruits and feed on the pulp near seed and accumulate fecal. Adult is small, dark brown in colour with fringed wings. Early instar larva is light yellowish and full-grown ones is red in colour.



The borer causes up to 70% yield loss under severe infestation (Sonawane 1965). The first and second instar larvae feed on the fruit superficially but third to fifth instar larvae feed internally and damage the pulp around the seed. At initial stages of fruit development, the full grown larvae feed on the soft immature seed. The occurrence of fruit borer was positively correlated with the temperature and negatively correlated to relative humidity and wind speed (Nandihalli et al. 1996). The infestation initiates during November and the peak incidence occurs during end of December (Gopali et al. 2003). The adult female lays an average of 13.29 eggs and incubation period was found to be 4-5 days. The larval and pupal stages get completed

in 14-18 and 8-9 days, respectively. Under laboratory conditions at $31 \pm 1^\circ\text{C}$ and 60-80% R.H, the life cycle completes within 26-32 days. Longevity of adult male and female were observed to be 3-4 and 4-5 days, respectively (Jothi & Tandon 1993).



Larvae feeding inside the fruit

Damage symptoms of fruit borer

3. Stone weevil, *Abeus himalayanus* Voss (Curculionidae: Coleoptera)

The stone weevil, *Abeus himalayanus* Voss was recorded as a new pest of ber for the first time from Andhra Pradesh state of India (Gour & Sriramulu 1994). Later, it was also reported from Karnataka, India by Balikai et al. 1998. Severe damage incidents of this weevil was also reported from the ber orchards of Rahuri, Maharashtra and Jobner, Rajasthan in 1996 (Srivastava & Nanda 1983) and recently in the Bikaner district of Rajasthan during 2010 (Karuppaiah et al. 2010; Haldhar *et al.*, 2012). So it seems to be an emerging pest in ber growing regions of India. The adult weevils are small, dark in colour with snout. The grubs are white in colour with red marking on the body, which are present inside the seeds (Balikai et al. 1998; Karuppaiah et al. 2010). The adult beetle was mostly active during morning and evening hours.



Egg laid mark at stylar end



Grub



Adult

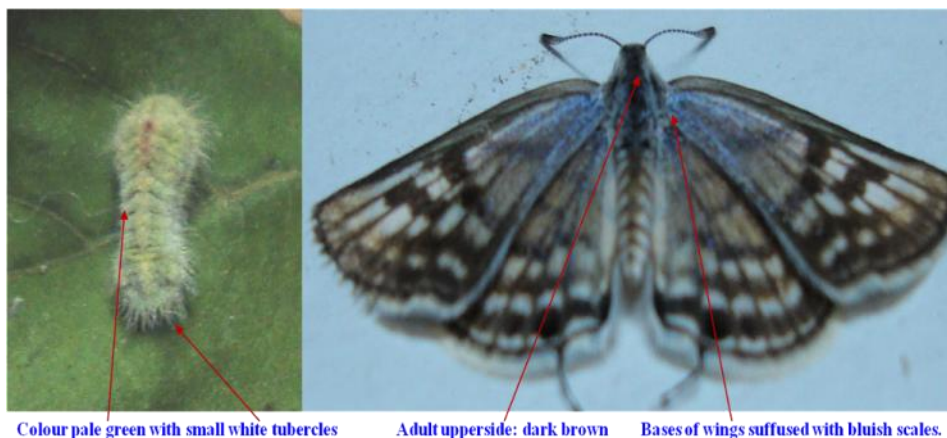
The adult female weevil lays its eggs on the stylar end of fruits and newly hatched grubs enter into seed by making puncture in endocarp at immature stage and starts feeding on the soft seed coat and later it enters into endosperm moving downward. After entering into the seed, it starts

feeding on inner content of the seed, and pupates within the seed by making hollow galleries. The weevil completes its life within a single fruit (Karuppaiah et al. 2010; Haldhar *et al.*, 2012). The infested fruits were round in shape and varied in size ranging from pea to pebble. This is because of the fact that the pest fed only on the seed portion of developing fruit and arrested further development of the fruit. The entry hole was healed up and closed while the exit hole was clearly seen. Looking at the nature of damage and its incidence pattern, it could be concluded that the pest enters into the fruits in the early stage of its development and the entry hole gets healed up (Balikai et al. 2009; Haldhar *et al.*, 2012; Karuppaiah 2013). The adult weevil starts to lay the eggs from the glooming stage onwards and damage symptoms could be observed from October to February. The greatest infestation occurred during the first fortnight of December. Immature fruit drop was most pronounced on the second fortnight of November (Karuppaiah *et al.*, 2010). The damage was noticed during July to August in Karnataka. Irrespective of varieties, the incidence was recorded during the months of July, August, September, October and November (Balikai, 2009). The variety with high pulp stone ratio was preferred over varieties which are having lower pulp stone ratio. The varieties Umran and Seb were attracted more for egg laying. The mean damage was 23.63% in Gola and 43.28% in Seb and fruit dropping was more in Seb (73.48%) than in Gola (48.52%) (Karuppaiah et al. 2010; Haldhar *et al.*, 2012). The damage was severe in the cultivar Umran and the per cent abnormal fruits due to weevil damage were 5-10% (Balikai 2009).



4. Ber butterfly, *Tarucus theophrastus* (Fabricius) (Lycanidae: Lepidoptera)

Blue butterfly *Tarucus Theophrastus* (Lycanidae: Lepidoptera) is an important defoliator pest of ber and cause leaf damage up to 25-40% during the sprouting of new shoots (Karuppaiah et al. 2010; Haldhar *et al.*, 2012). The larvae also damages the flower buds and tender shoots. The metallic blue colour butterfly have its wing tail in the posterior end of the hind wing. The larvae are small flat, green in colour with sparse hairs on their body. Most of the time larvae are associated with the ant due to their sugary secretion from anus.



The larvae feeds on sprouting tender shoots, leaves and flower buds. Infested leaves gives whitish look due to chlorophyll feeding and finally the leaves are left with long streaks. The extent of damage was 25-40%. The infestation starts from June and peak incidence occurs during third week of October with a peak population in the first week of August. The population showed positive correlation with maximum and minimum temperatures and negative correlation with relative humidity and rainfall (Kavitha & Savithri 2002).



5. Bark eating caterpillar, *Indarbela tetraonis* Moore; *Indarbela quadrinotata* Walker (Cossidae: Lepidoptera)

The incidence of this caterpillar pest was observed to be more in ill maintained old orchards. Bark eating caterpillar attack on ber causes heavy losses if the damage is severe (Singh 2008; Azam-Ali et al. 2006). The adult moths are pale in colour and with grey colour markings on the forewings. Eggs are brown in colour and oval in shape. The full grown larvae is dark brown in colour and 37-50 mm long with dark head and body covered with long thin hairs. The presence of bark eating caterpillar can easily be detected by presence of webs at forks or angle. The moth lays its eggs on bark of the branches, upon hatching they settle at forks or angles of branches and feeds on bark during night, remaining concealed during daytime in tunnel made at junction of branches. Feeding on bark hardly affects plants, it is tunnel made by larva for its shelter, which

inflicts the actual loss. The junction point is rendered weak due to tunnel. During bearing period when fruits develop, pressure at forks is greatly increased due to weight of fruits, resulting in cleavage of branch at fork or angle and starts drying. Thus, a single larva can spoil the produce of entire branch (Singh 2008). The moth lays eggs at the onset of rainy season in batches of 15-25 eggs and a moth lays about 300 eggs and the incubation period lasts 8-10 days. Early instars are brown in colour and matured larvae are dark brown in colour. The caterpillars pupate during the summer for about four weeks and from the pupae adult moths emerge, mate and lay eggs again (Azam-Ali et al. 2006).



Ribbon like or pipe like webbing on the stem near forks or angles of branches

6. Chafer Beetles, *Adoretus decanus*, *A. kanarensis*, *A. stoliezkae*, *A. pallens*, *A. versutus*,

***Holotrichia consanguinea* (Coleoptera: Scarabaeidae)**

Chafer beetles devour ber leaves mainly during the night. They become active with the onset of the rainy season when new growth starts. They cause heavy damage to developing foliage of ber during June to August. Leaves become just like sieves and, in severe cases, the whole tree is rendered leafless. They also damaged the nursery, where adults defoliate the leaves and grubs griddle the main roots causing seedlings to die. Eggs are laid in the soil during the early part of the rainy season (May to August in north India). Larvae hatch out in one week and feed on roots and vegetation. Adults emerge with the onset of rains. There is only one generation per year (Singh 2008; Balikai 2009; Karuppaiah et al. 2010; Haldhar *et al.*, 2012).

7. Mites *Eriophyes cernus* (Acari: Eriophyidae), *Larvacarus transitans*, *Eutetranychus orientalis* (Acari: Tetranychidae)

There are three mite species found to be associated with ber trees in India. The activity of mite species, *Eriophyes cernuus* occurs throughout the year in India (Mukherjee et al. 1994; Pareek and Nath 1996). Mites produce galls on twigs, branches in floral buds (Yamdagni and Gill 1968; Singh 2008). Feeding of mite on ber induce gall formation which contains higher amount of total carbohydrates, reducing sugars and greater α -amylase activity as compared to the normal tissue (Tandon et al. 1976; Tandon and Arya 1979). The malformation occurs during new growth

period, *i.e.*, a month after pruning and continue for 3-4 months. On an average 30-35 per cent infestation (with 10-15 galls/ plant) may be recorded and about 90 per cent incidence with 1-2 galls/plant was recorded in a newly established (Ravikumar et al. 1999) orchard. The fungus, *Fusarium demicellulare* also found on the galls seems to check the development and spread of galls during the initial stages (Singh and Singh 1978). The incidence of mite *L. transitans* was also recorded on ber with its peak activity during June.

8. Lac Insects, *Kerria lacca* and *K. sindica* (Hemiptera: Lacciferidae)

Ber is one of the host plants of lac insects, *K. lacca* and *K. sindica* (Li and Hu 1994). The small insects become active in summer (April-May), secrete a thick, resinous substance which envelopes their bodies. The secretions form a hard crust on the twigs, which is collected to form a commercial resin, lac. Lac production is an important business in India. However, the insect devitalizes the tree and causes great loss in fruit production. It sucks the sap from the branches, and ultimately kills the tree. An infestation of 5000 nymphs/100 cm twigs causes a loss of 52.5-58.5% fruit yield (Lakra and Kher 1990). However, the production of lac and fruits cannot be done simultaneously.

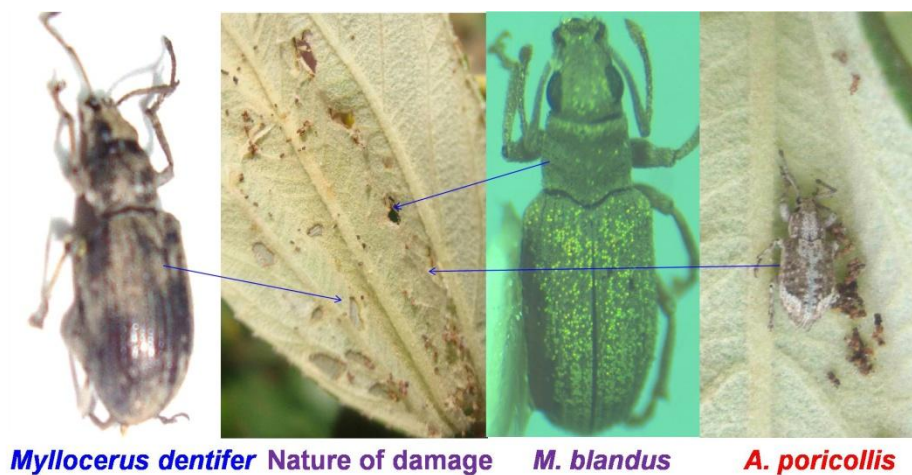
9. Termite, *Odontotermes obesus* (Rambur) (Termitidae: Isoptera)

Termite causes damage to the seedlings and budded plants and about 49 per cent of ber tree were found to be infested with termite (Karuppaiah et al. 2010 and 2012; Haldhar *et al.*, 2012). The activity is mainly on the bark of main trunk.



10. Gray Weevil, *Mylocerus dentifer* (Fabricius), *M. blandus* Faust, *Amblyrrhinus poricollis* Schoenherr (Curculionidae: Coleoptera)

The activity of gray weevil and grubs are mostly from July to September. The nymphs are covered with silken web within the rolled leaves. Both stages of this pest cause severe damage to ber. Weevils feed on young leaves, flowers and buds. The damaged young leaves have serrated margin (Karuppiah *et al.*, 2010; Haldhar *et al.*, 2012).



Myllocerus dentifer Nature of damage

M. blandus

A. poricollis

11. Other Insect Pests

Many insects like hairy caterpillar (*Euproctis fraternal* Moore and *Thiacidas postica* Walker), Green striped leaf hopper (*Eurybrachys tomentosa* Fab), Jassid (*Amrasca biguttula biguttula* Ishide), Spittle bug (*Machaerota planitae* Distant), Cow bug (*Tricentrus bicolor* Distant), Thrips (*Scirtothrips dorsalis* Hood), Leaf gall (*Phyllodiplosis jujubae* Grover), Weevil (*Xanthachelus superciliosus* Gyll), Grape mealy bug (*Maconellicoccus hirsutus* Green) etc have been considered as minor pest of ber which cause damage occasionally. Among these, the hairy caterpillar causes serious defoliation during sprouting stage. The remaining pests are considered as negligible.

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