

Review

Seasonality and management of stone weevil, *Aubeus himalayanus* Voss (Curculionidae: Coleoptera): An emerging pest in Indian Jujube (*Ziziphus mauritiana* L.)

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The ber (*Ziziphus mauritiana* Lamarck) is an important fruit crop grown in arid and semi arid regions of India and elsewhere. Nutritionally, the fruits are rich in protein, phosphorus, calcium, carotene and vitamin C. In India, productivity tends to be low because of various biotic stresses such as pests and diseases. Of the various insect pests infesting ber, the stone weevil *Aubeus himalayanus* Voss (Coleoptera: Curculionidae) is a new threat to ber cultivation in India. This was recorded as a new pest of ber in India for the first time in the state of Andhra Pradesh in 1994. Serious attacks were later reported in Rahuri, Maharashtra and Jobner, in 1996, and in Karnataka during 1998. Recently, infestations of this pest were reported in Bikaner and Rajasthan in 2010 and in Bangladesh in 2009. The females lay their eggs on the stylar end of fruits, or rarely on the distal end. The newly emerged white coloured grubs enter the seeds by making a puncture in the endocarp of the immature fruits, and starts feeding on the soft seed coat. Later it enters the endosperm, feeds on it, and pupates within the seed. The weevil completes its life within a single fruit. The infestation results in severe fruit drop at the initial stage of fruit set. The damage intensity of the stone weevil varies with cultivars; stoned varieties are preferred more than the pulp rich varieties. Periodical monitoring of orchards for weevil incidence is essential for timely implementation of control strategies. Delayed detection makes management difficult as they enter the seed.

Key words: Ber, *Ziziphus mauritiana*, stone weevil, *Aubeus himalayanus*.

INTRODUCTION

The ber (*Ziziphus mauritiana* Lamarck) also called desert apple, jujube, Chinese apple, Badari (Sanskrit), Kul or Boroi, Ber (Hindi), Dongs, Bor, Beri, Indian plum, Permseret (*Anguilla*) is a tropical fruit tree species, belonging to the family Rhamnaceae (Balikai, 2013). In India it occupies a large area (22,000 ha) and it is popular dry land fruit crop for arid and semi-arid region of India

(Jamandar et al., 2009) and most of the cultivated areas are confined to the states of Rajasthan, Haryana, Punjab, Gujarat, Maharashtra and Uttar Pradesh in India. 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 fruits are quite nutritious, rich in vitamin C,

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Figure 1. Damage symptoms of stone weevil, *Aubeus himalayanus*.

second only to aonla and guava, and much higher than citrus and apple (Khera and Singh, 1976). The crop is gaining popularity among the growers because of its adaptability to adverse climatic conditions and good returns. However, the crop suffers great losses due to insect pests and diseases (Singh, 2008). The introduction of improved varieties and irrigation led to unpredictable changes in insect pests in this crop. In India, more than 130 species of insect pests were found to attack ber (Lakra and Bhatti, 1985), but very few reach the pest status. Jothi and Tandon (1995) reported 17 insect species, and Balikai (1998) reported a total of 22 insect and non-insect species in Karnataka. Likewise, Kavitha and Savithri (2002) documented about 23 insect species on ber from the state of Andhra Pradesh. However, pests such as the fruit fly, *Carpomyia vesuviana* Costa, chafer beetles, *Holotrichia consanguinea* Blanch and bark eating caterpillars, *Indarbela tetraonis* Moore; *Indarbela quadrinotata* Walker, and the ber butterfly, *Tarucus theophrastus* Fabricius are the major pests of ber in India, causing significant yield losses (Sharma and Bal, 2009; Karuppaiah et al., 2010).

In addition to these, the ber stone weevil, *Aubeus himalayanus* Voss (Coleoptera: Curculionidae) appears to be an emerging pest that has been reported from various regions of India (Balikai et al., 1998; Karuppaiah et al., 2010; Balikai et al., 2013). The pest is an emerging threat for ber production in India, especially in the northern region. However, in India available studies are very few and there is need to investigate the biology and management of this pest. In this study we reviewed the available information about this emerging pest, in order to present the data available to begin developing control strategies against this hardy insect in the near future.

PEST DESCRIPTION AND DISTRIBUTION

The adult weevils are small, dark in colour, and with a snout. The grubs are white in colour with red colour

marking on the body, c-shaped with brown coloured head capsule and are found inside the seeds (Balikai et al., 2009; Karuppaiah et al., 2010, 2011). The activity of the adults could be observed in the field during the morning and evening hours. The adult female weevil lays their eggs mostly on the stylar end; rarely on the distal end of fruits, and then covers the punctures with a brown encrustation. Upon hatching, the grubs enter the seed by through the endocarp of the immature fruit, and starts feeding on the soft seed coating. Later it enters the endosperm moving downward. After entering the seed, it starts feeding on the inner content of the seed, and pupates within the seed in hollow galleries, which has at this stage been completely eaten away. The weevil completes its life within a single fruit (Karuppaiah et al., 2010) (Figure 1). At the time of fruit maturity, infested fruits had a grub, a pupa or an adult. The infestation occurs in all the fruit stages; however it is prevalent in pea to pebble-size fruits. The attacked fruit had an abnormally enlarged calyx, and nearly half of the fruit towards the petiole turned reddish brown, with a rough surface. The remaining half portion towards the navel region remained greenish in colour. The infested fruits fail to attain full maturity and never increase in size more than pebble. This is because although the pest fed only on the seed portion of the developing fruit, it arrested any further development of the attacked fruit. The entry hole was healed up and closed while the exit hole was clearly seen (Balikai et al., 2009). The biology of this pest has not been studied so far.

Severe infestations of *A. himalayanus* have been reported from all major ber growing regions of India (Figure 2). It was recorded as a new pest of ber for the first time from the state of Andhra Pradesh in India (Gour and Sriramulu, 1994). Later, in Rahuri of Maharashtra and Jobner, Rajasthan during 1996 (Pareek and Nath, 1996), Karnataka (Balikai et al., 1998), and recently in Bikaner, district of Rajasthan (Karuppaiah et al., 2010, 2012). Severe damage of this pest at early stages of fruit development has also been reported from Bangladesh

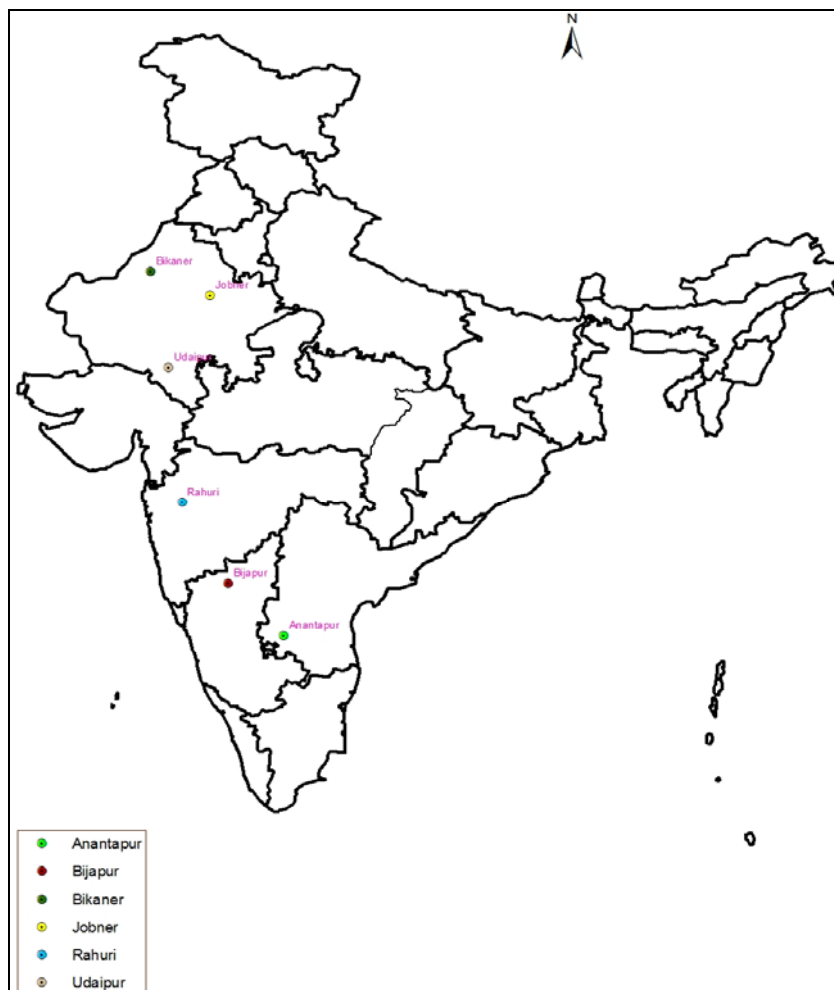


Figure 2. Distribution map for stone weevil in India.

(Qumruzzaman et al., 2009) (Table 1).

SEASONALITY

The activity of the weevil starts in the month of September and adult female lays their eggs from the blooming stage onwards. Severe damage could be observed during October, which is the fruiting month. The incidence could be noticed till the end of fruiting (October to February). In western Rajasthan, India, the pest was initially recorded during the first fortnight of October on cv Seb, and the second fortnight of October on cv Gola. The greatest infestation was registered during the first fortnight of December (Figures 3 and 4). Immature fruit drop was most pronounced during the second fortnight of November. The damage was severe in early variety cv Seb (Karuppaiah et al., 2010). The damage was noticed during July to August in Karnataka, and maximum damage was observed during July to August. Irrespective of varieties, the incidence was recorded during the

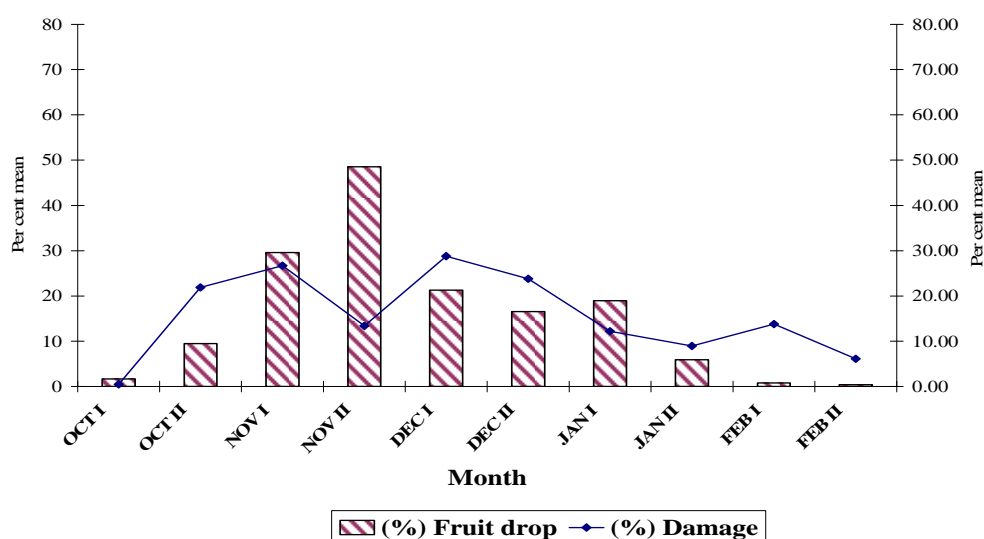
months of July to November (Balikai, 2009). The extent of damage also found to be associated with the pruning dates. Severe infestation of stone weevil among early pruned ber cultivar Umran were reported by Biradar et al. (2001). The intra tree distribution pattern of stone weevil incidence revealed no significant difference with different directions of the plant; however the incidence in different strata of the plant showed significant differences. The branches which are examined just above the ground (0-1 m), showed maximum (33%) infestation as compared to the branches at 1-2 m and above 2 m high from the ground. The branches near the ground might be suitable for adults, emerging from residues or surviving population in the tree. Generally infestation decreased from lower branches to top branches (Karuppaiah et al., 2010).

VARIETAL PREFERENCE

The influence of biophysical factors of ber fruits plays a

Table 1. Details of stone weevil incidence reported from different regions of India and Bangladesh.

S/N	Location	References
	India	
1	Anantpur (Andhra Pradesh)	Gour and Sriramulu (1994)
2	Rahuri (Maharashtra)	Pareek and Nath (1996)
3	Bijapur (Karnataka)	Balikai et al. (1998)
4	Jobner (Rajasthan)	Pareek and Nath (1996)
5	Udaipur (Rajasthan)	Srivastava and Nanda (1983)
6	Bikaner, (Rajasthan)	Karuppaiah et al. (2010)
7	Bangladesh	Qumruzzaman et al. (2009)

**Figure 3.** Fruits drop Vs. Stone weevil incidence on ber (Gola).

major role on damage intensity of ber stone weevil. The variety with high pulp stone ratio is attacked more than the lower pulp stone ratio and varieties like Umran and Seb seem to be more attractive for the egg-laying females. The mean damage of stone weevil was up to 23.63% in Gola and 43.28% in Seb at Rajasthan. Fruit dropping was more in Seb (73.48%) than the Gola (48.52%) cv (Karuppaiah et al., 2010). The maximum infestation of stone weevil was registered in cv Seb, followed by Mundia and Umran, and it reduce the yield an average of 10.3% (Srivastava and Nanda, 1983). The damage was severe in the cultivar Umran and the percent abnormal fruits due to weevil damage were between 5 and 10%. We speculate that the higher seed content was probably the reason for these higher damage levels (Balikai, 2009). Among the seven different cultivars observed for fruit weevil incidence, the maximum infestation was recorded in the cultivar Umran (38.9%) followed by Thar Sevika (35.75%), Seb (35.08%), Thar Bhubhraj (28.18%), Gola (24.59%),

Goma Kirti (21.65%) and Banarasi Kadaka (7.05%). The correlation between the bio-physical characters, pulp: stone ratio (PSR) of *ber* fruits reveals positive correlation with weevil infestation. The varieties with higher proportion of stone are more preferred by the adult weevil for egg laying and results suggests bio-physical characters of cultivars play major role in fruit weevil infestation (Karuppaiah et al., 2014).

MANAGEMENT

As the damage is hidden, the periodical monitoring of adult weevil activity will help detect the infestation on time. For its management, the spray schedule must be started from flowering to fruit set stage only. Spraying of Carbaryl 50 WDP 0.1% just before the fruit setting and repeat the sprays at three weeks interval was found effective and showed least adverse effect on honey bees activity (AICRP, 2004). Collection and destruction of adult

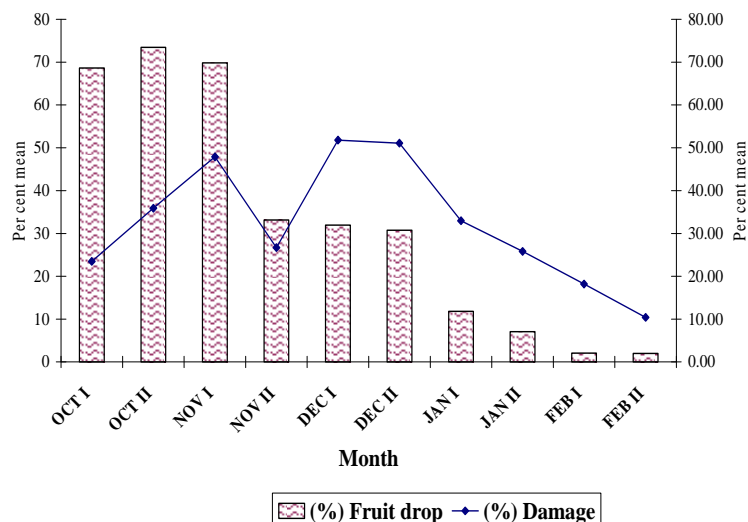


Figure 4. Fruits drop Vs. Stone weevil incidence on ber (Seb).

weevil immediately after detection can also reduce the population. Infested dropped fruits should be collected and burned to break the generation cycle (Karuppaiah, 2013). Application of spinosad 2.5 SC found to give significant reduction in weevil incidence and indoxacarb 14.5 EC, NSKE 5% and azadirachtin 2000 and 1000 ppm also found to be superior over control treatment in minimizing the weevil incidence (AICRP, 2012).

CONCLUSION

Ber stone weevil is a new threat to ber production in India as it causes direct loss to the fruit yield. The last few decades the incidence of this pest has been reported in various in few packets ber growing region of India in a sporadic manner. However, presently it seems to be regular pest of ber and severe damage has also been reported in major ber growing region of India. The distribution of stone weevil incidence reveals that the transport of planting material from one place to another place could be the reason for the pest establishment (Qumruzzaman et al., 2009). In India, hardly any studies have been conducted and little information is available about this emerging pest. While looking nature and intensity of damage it needs to be studied critically and being economically important, the detailed investigation on the biology and management protocol need to be developed for the successful management under changing climatic scenario.

Conflict of Interest

The authors have not declared any conflict of interest.

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