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RECORD OF BER BUTTERFLY, *Leptotes plinius* FABRICIUS, 1793 (LYCANIDAE: LEPIDOPTERA) ON BER AND ITS POPULATION DYNAMICS IN PUNJAB, INDIA

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ABSTRACT

Surveys were carried out during 2015 to 2021 in the ber growing regions of Punjab, India to study the status of insect pest infestation in Indian jujube (ber). Roving surveys were conducted in the central zone, arid irrigated zone, Kandi area and Bet area of Punjab along with fixed plot surveys in Fruit Research Farm of the Punjab Agricultural University (PAU), Ludhiana, Punjab, India. During June-September, severe damage of larvae of a ber butterfly was observed which was later on identified as *Leptotes plinius* Fabricius. Damage of larval stage of this butterfly was observed on ber leaves and inflorescence in Ropar district of Punjab and the Fruit Research Farm, PAU, Ludhiana. Larval population ranged between 0.24 to as high as 42.5 larvae per 100 leaves. Similarly, leaf damage of up to 68% was observed during peak activity period of this insect-pest on ber leaves. Peak activity of this pest in 2015-16 was observed during first week of July, in 2017-19 during third week of July, in 2020 during second week of July, and in 2021 during third week of July. This is the first report of field infestation by *L. plinius* on ber from Punjab.

Keywords: Ber, Indian jujube, *Leptotes plinius*, Punjab, *Tarucus plinius, Ziziphus mauritiana*

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Ber (*Ziziphus mauritiana* Lam.) also known as Indian jujube, jujube or dessert apple is a tropical fruit tree belonging to family Rhamnaceae. In India, it is distributed in tropical, sub-tropical and warm temperate parts of the country. During 2018-19, ber was cultivated on an area of 50 thousand hectare with a total production of 513 thousand tonnes in India (Anonymous 2018). It is cultivated mainly in Uttar Pradesh, Rajasthan, Punjab, Haryana, Gujarat and Maharashtra. In Punjab, 35.83 thousand tonne production was recorded from an area of 2.01 thousand hectare during 2019-20 (Anonymous, 2020). Almost all parts of the tree i.e., fruits, leaves, bark, root, and seeds are used for various purposes (Khare, 1995; Heuzé *et al.,* 2020). Ber is a rich source of proteins, dietary fiber, vitamin A, vitamin C, fat and minerals. Dried fruits of ber are also a source of moisture, carbohydrates, fat, protein, sugar and fiber (Cheng *et al.,* 2000). Its leaves are of high nutritive value to animals and are eaten by cattle, camel and goats. Ber can play an important role in rehabilitation of resource poor regions, and is very crucial soil conservation in such areas owing to its extensive root system (Depommier, 1988).

In India, several workers have reported 17-130 insect and non-insect species infesting the ber plantation (Lakra and Bhatti, 1985; Jothi and Tandon, 1995, Balikai, 1999; Kavitha and Savithri, 2002). Among the various species, a few have attained the status of major pests of ber in India, *viz.* ber fruit fly (*Carpomyia vesuviana* Costa), ber butterfly (*Tarucus theophrastus* Fabricius), bark eating caterpillars (*Indarbela tetraonis* Moore; *Indarbela quadrinotata* Walker), chafer beetle (*Holotrichia consanguinea* Blanch), and stone weevil (*Aubeus himalayanus* Voss) (Singh, 2008; Sharma and Bal, 2009; Karuppaiah *et al.,* 2010). Among the minor pests of ber, leaf webber (*Synclera univocolis* Walker), grey weevil (*Myllocerus dentifer* (Fabricius), *M. blandus* Faust, *Amblyrrhinus poricollis* Schoenherr), ber mite (*Larvacarus transitans* Ewing), and termite (*Odontotermes* sp.) are important (Haldhar *et al.,* 2012). In Punjab, 37 insect and mite pests have been reported infesting ber tree (Singh, 2016). Besides, 28 bio-control agents belonging to orders Hymenoptera, Diptera, Coleoptera, Odonata, Dictyoptera and Aranae were reported as predators/parasites of the insect pests of ber tree in Punjab (Singh *et al.,* 2016). Recently, Singh *et al.* (2021) reported a fruit borer, *Cadra cautella* (Walker) on ber in Punjab. With introduction of new varieties and changing climatic conditions, the insect-pest complex undergoes dynamic changes. Thus, the present study was carried out with the objective of finding the new insect-pests in ber agro-ecosystem of Punjab.

MATERIALS AND METHODS

Study area

Roving surveys were conducted during 2015 to

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2021 in the ber growing regions of central zone, arid irrigated zone, Kandi area and Bet area of Punjab. Sub-mountainous region in Punjab near the Shivalik foothills along the border with Himachal Pradesh is locally known as Kandi area. Kandi area runs along the northeastern border of Punjab, and comprises the Punjab Shiwaliks and strip of undulating land below the hills in the districts of Hoshiarpur, Fatehgarh Sahib, Gurdaspur and Ropar (Rawat *et al.,* 2013) (Fig. 1). This region is characterised by rocky soil and fruits crops are grown on a large area. The floodplains along the rivers are locally known as Bet. Bet region has varying climatic conditions with soils belonging to submountain, meadow, mountain skeletal, brown hill and alluvial categories (ENVIS, 2021). Damage of *L. plinius* in ber trees was recorded in Ropar district of Punjab. Along with this, fixed plot surveys were also conducted at the Fruit Research Farm, Punjab Agricultural University (PAU), Ludhiana (30°54'02.8"N, 75°47'34.3"E), Punjab.

Experimental design

Randomly selected 20 ber trees per acre were observed for infestation of the insect-pests. The damage symptoms of the pest were recorded and photographs taken for documentation. Infested leaves were collected from the field and brought to laboratory. Larvae from infested leaves were reared in Fruit Entomology Laboratory, Department of Fruit Science, PAU, Ludhiana by keeping these in separate vials and feeding them on pesticide free ber leaves. Adults upon emergence were transferred to a separate jar and fed on 10 per cent honey solution. Larvae were transferred to 95 per cent alcohol in glass vials, and adults were pinned and labelled for identification. These larval and adult specimens were identified in the Insect Taxonomy Laboratory, Department of Entomology, PAU, Ludhiana. The insect was identified as *Leptotes plinius* Fabricius (*Tarucus plinius* Fabricius) (Lepidoptera: Lycaenidae) commonly named as the Zebra Blue or Plumbago Blue. It is a Lycaenid butterfly found in India.

Population and damage

The observations on larval population and damage on leaves were recorded at weekly intervals starting from first week of June to last week of September during 2015 to 2021. The number of larvae was recorded from randomly selected 5 ber trees with 100 leaves from four branches per tree. The damage on leaves in the form of streaks on the upper and lower leaf surface was observed and recorded as per cent leaf damage. To work out per cent damage, damage was recorded from 100 leaves per tree. For this purpose, 25 leaves from four different sides of each tree were selected, and per cent damage was calculated on the basis of number of infested leaves out of the 100 leaves.

RESULTS AND DISCUSSION

During the surveys, severe damage of *L. plinius* was observed on ber leaves and inflorescence at Fruit Research Farm, PAU Ludhiana during June-September. Larvae are green in colour on ventral surface and sides, reddish-brown on the back, and the body is marked with yellow or white diagonal stripes (Fig. 2A). Body of the larva is covered with fine hairs. Wings of the butterfly are translucent; when wings are expanded, the markings on underside can be seen from the upper side. Its unique identification characteristic is the black



Fig. 1. Map of Punjab showing districts where *L. plinius* was recorded

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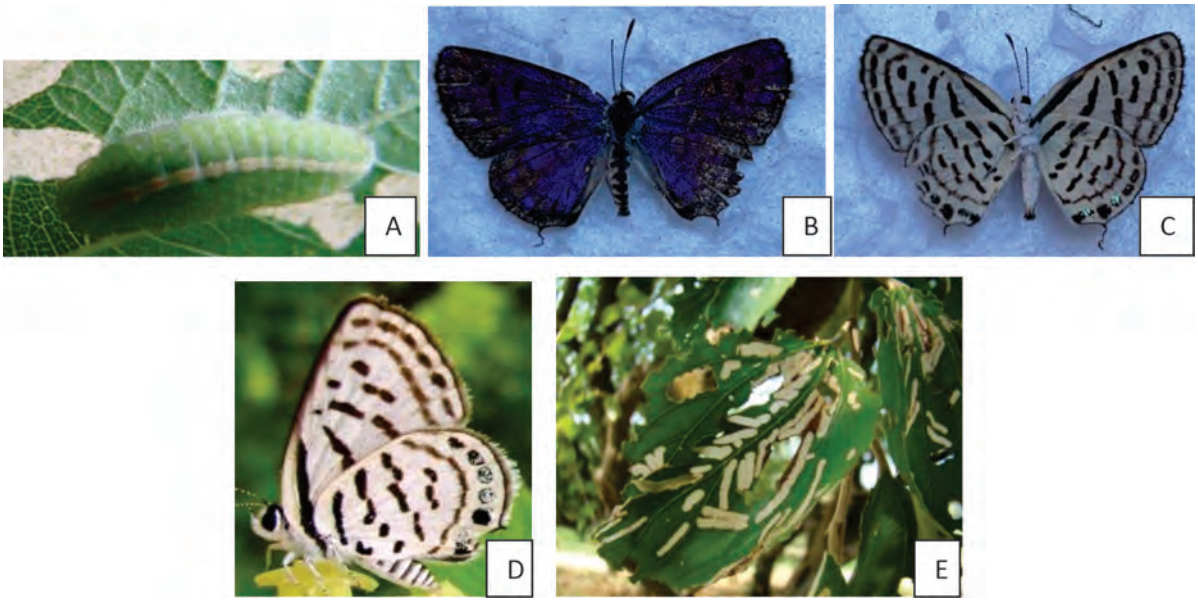


Fig. 2. Damage by *L. plinius* larvae in ber fruits and by adults on inflorescence-A. Larva, B. Adult (Dorsal View), C. Adult (Ventral View), D. Adult feeding on flower, E. Damage by larvae on ber leaf

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and white zebra pattern on the underside of the wings (Fig. 2B, C, D). Male butterflies can be distinguished by the pale violet-blue colour of the upper side of the wings, whereas the colour of wings of females is brown with violet-blue colour only near the base of the wings. Oviposition usually occurs on the buds of the flowering axes. In the rapid roving surveys at farmers' field in Ropar district, *L. plinius* was observed on the ber trees. The insect was observed mainly damaging the foliage and tender shoots of ber, and the typical symptoms of whitish long streaks on leaves were noticed.

Nature of damage

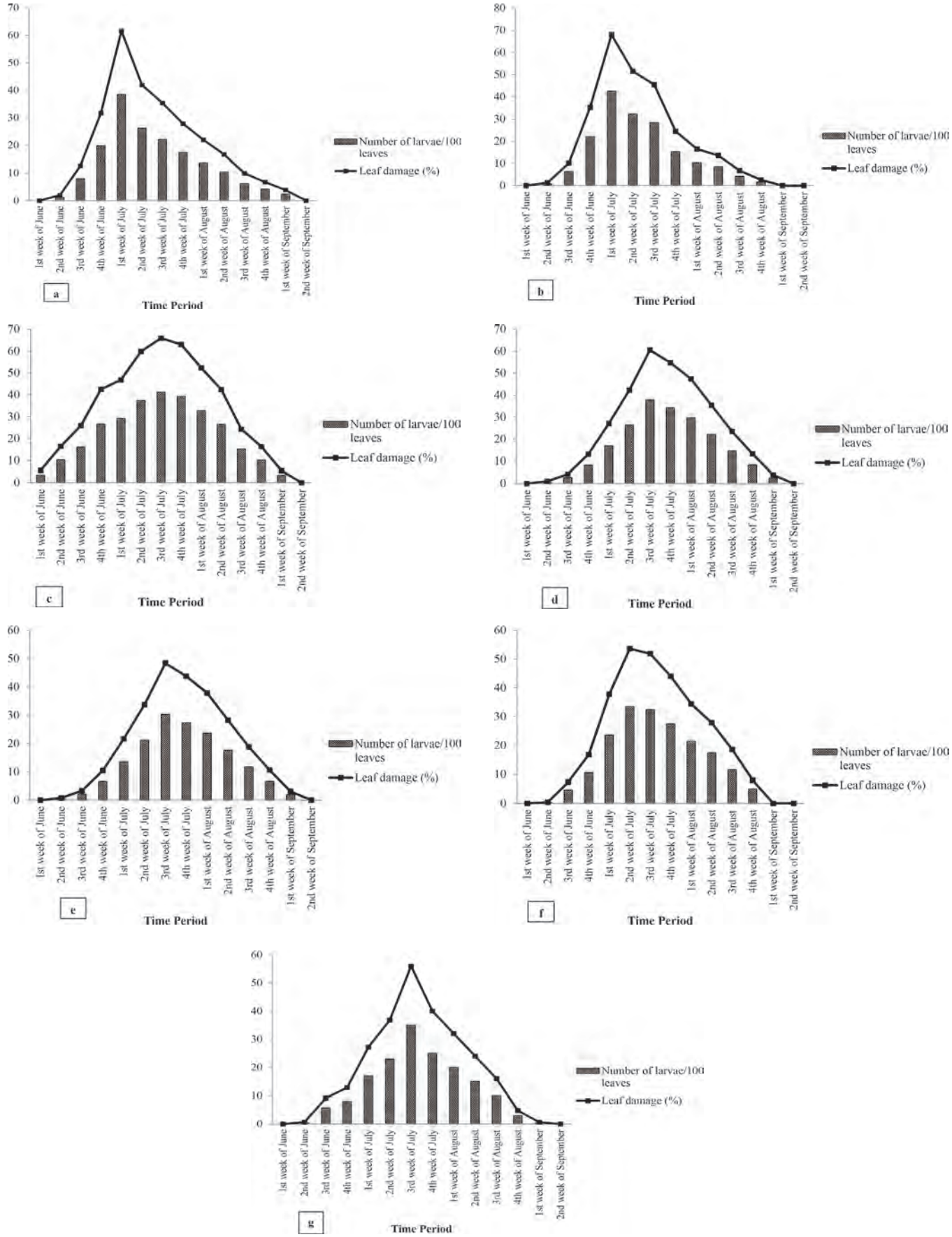
Larvae of this species feed mainly on tender shoots, young leaves and flower buds. Larvae feed on chlorophyll, which gives leaves whitish look, and long streaks form on the leaves (Fig. 2E). This species' larvae are reported to feed on flowers and buds of *Plumbago* species, *Sesbania bispinosa* (Jacq.) W. Wight and *Mimosa* sp. (Dunn, 2016; Kanagaraj and Kathirvelu, 2018). The adults mainly feed on the nectar from flowers of the host plants.

Seasonal activity

The population fluctuations of *L. plinius* were studied on ber trees during its period of infestation (June-September) from 2015-2021 (Fig. 3). During 2015 and 2016, the peak activity and leaf damage due to *L. plinius* was observed during 1st week of July with 38.5 larvae and 42.5 larvae/100 leaves, respectively (Fig. 3a and b). During 2017 to 2019, the peak activity was observed during 3rd week of July (Fig. 3c, d and e). The activity of butterfly started from 1st week of June (3.5 larvae/100 leaves) with leaf damage of 5.6% and continued upto 1st week of September (3.4 larvae/100 leaves) with leaf damage of 5.4% during 2017 (Fig. 3c and i). The observations on population fluctuations during 2018 showed that attack on leaves started during 2nd week of June (0.6 larvae/100 leaves) and continued upto 1st week of September (2.4 larvae/100 leaves) (Fig. 3d and h). Up to 60.48% leaf damage was observed during 3rd week of July. Similar trend was observed during 2019 with larval population ranging from 0.48 to 30.24 larvae/100 leaves (Fig. 3e). During 2020, larval population and leaf damage showed a progressive increase from 2nd week of June (0.24 larvae/100 leaves and 0.38% leaf damage) to 2nd week of July (33.5 larvae/100 leaves and 53.6% leaf damage). Thereafter, the larval population started declining and came down to 5 larvae/100 leaves during 4th week of August (Fig. 3f). The observations during 2021 revealed that *L. plinius* was active from 2nd week of June to 1st week of September with peak activity during 3rd week of July (35 larvae/100 leaves) (Fig. 3g and h).

Another ber butterfly, *T. theophrastus* has been reported to damage ber leaves during June-July at Ludhiana, Punjab (Sharma and Bal, 2009). They observed that on unpruned wild trees, damage appeared earlier than pruned trees. The activity of *T. theophrastus* was found associated with growth of fresh and succulent leaves on ber. *Tarucus theophrastus* feeds on leaves of ber causing 25-40 per cent damage during June-September in Bikaner, Rajasthan (Karuppaiah *et al.,* 2010). In Choa Sayidan Shah, Punjab (Pakistan),

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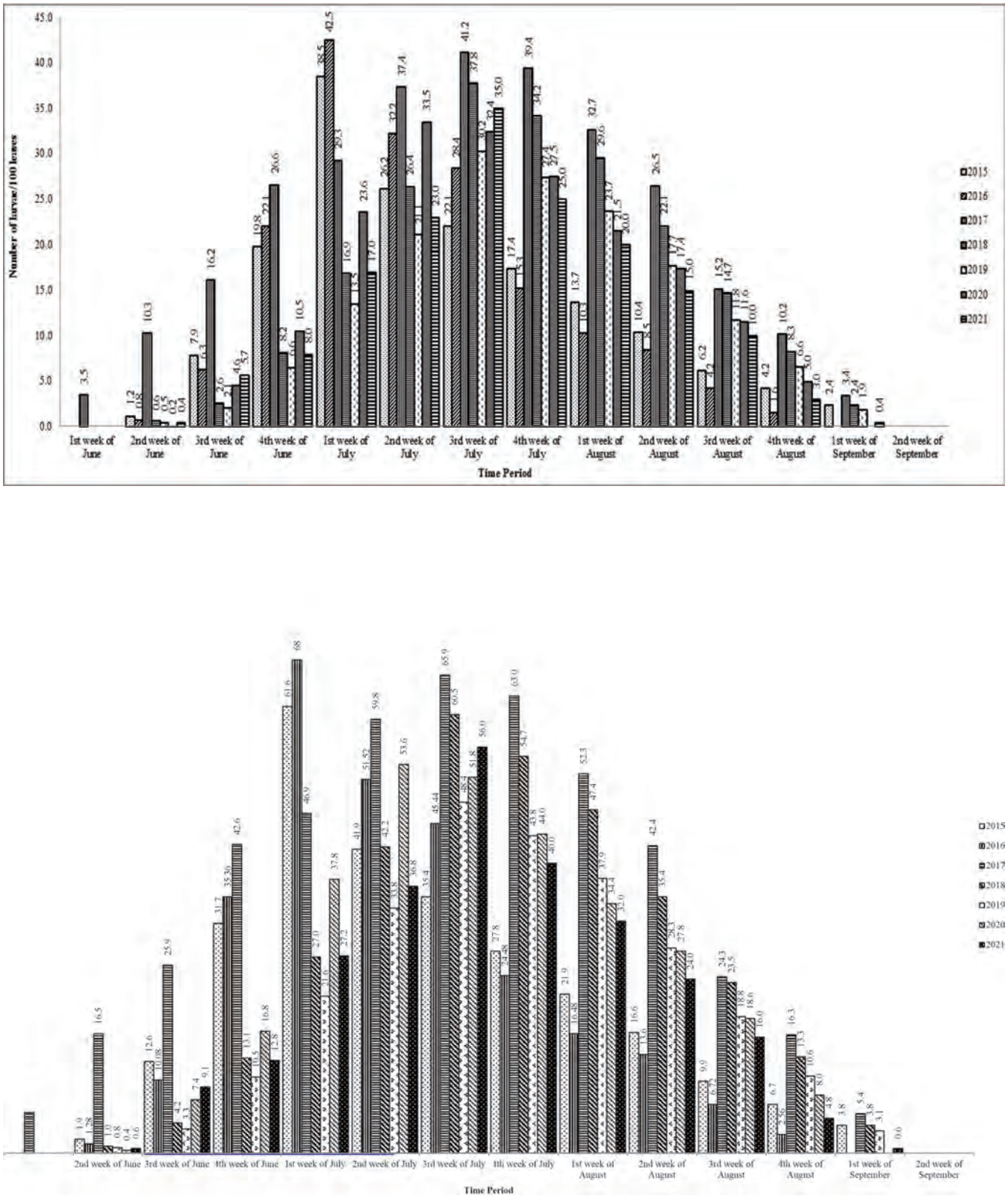


Fig. 3. Population fluctuations of *Leptotes plinius* on ber trees during a) 2015; b) 2016; c) 2017; d) 2018; e) 2019; f) 2020 and g) 2021; h) year-wise comparison of population of *L. plinius* on ber; i) year-wise comparison of leaf damage of *L. plinius* on ber

L. plinius was a common occurrence in botanical garden and grassland during the month of June (Khan and Hanif, 2016). During the pre-monsoon, monsoon and post-monsoon seasons, *L. plinius* was observed in Pakke Tiger Reserve, Seijosa, Arunanchal Pradesh (Sondhi and Kunte, 2016). *Leptotes plinius* is active during monsoon and post-monsoon season on variety of hosts including ber in Alwar, Rajasthan (Rani and Ahmed, 2021). On the other hand, it was active during summer and winter season in Matheran, Maharashtra (Sawant *et al.,* 2020). Bhowmik and Chowdhury (2021) reported that *L. plinius* activity was observed round the year in the areas with human interference in Kailasahar, Tripura.

Host Plants

Albizzia lebbeck (Linnaeus) (Bell, 1918; Wynter-Blyth, 1957; Kunte, 2000; Robinson *et al.,* 2010), *Celosia argentea* Linnaeus (Nimbalkar *et al.,* 2011; Chandekar and Nimbalkar, 2015), *Dyerophytum indicum* Kuntze (Kunte, 2006), *Indigofera* spp. Linnaeus (Wynter-Blyth, 1957; Kunte, 2000; Kunte, 2006; Robinson *et al.,* 2010), *Lantana camara* Linnaeus (Nimbalkar *et al.,* 2011, Chandekar and Nimbalkar, 2015), *Mimosa* spp. Linnaeus (Wynter-Blyth, 1957; Kunte, 2000; Kanagaraj and Karthivelu, 2018), *Plumbago* spp. Linnaeus (Bell, 1918; Wynter-Blyth, 1957; Kunte, 2006), *Sesbania bispinosa* (Jacq.) W. Wight (Bell, 1918; Wynter-Blyth, 1957; Kunte, 2000; Robinson *et al.,* 2010; Kanagaraj and Karthivelu, 2018), *Tephrosia purpurea* (L.) Pers. (Nimbalkar *et al.,* 2011; Chandekar and Nimbalkar, 2015), *Tridax procumbens* Linnaeus (Nimbalkar *et al.,* 2011; Chandekar and Nimbalkar, 2015), *Zizyphus mauritiana* Lamarck (Chandekar and Nimbalkar, 2015).

Distribution

Outside India

Australia (Braby, 2000; Dunn, 2016), Bangladesh (Shihan, 2016), Bhutan (Singh and Chib, 2014; Anonymous, 2017), Cambodia (Monastyrskii *et al.,* 2011), India (Sharma, 2014), Nepal (Tamang *et al.,* 2019), Pakistan (Mal *et al.,* 2014; Khan and Hanif, 2016), Sri Lanka (Jayasinghe *et al.,* 2021), Sulawesi (Vane-Wright and de Jong, 2003).

In India

Arunachal Pradesh (Gogoi, 2012; Sondhi and Kunte, 2016), Assam (Kaushik *et al.*, 2020), Gujarat (Dhabadkar and Prajapati, 2020), Madhya Pradesh (Harsh *et al.,* 2015; Kumar *et al.,* 2021), Maharashtra (Patil *et al.,* 2017), Meghalaya (Bora *et al.,* 2014), Nagaland (Naro and Sondhi, 2014), Odisha (Panda *et al.,* 2017), Tamil Nadu (Kanagaraj and Karthivelu, 2018), Tripura (Bhowmik and Chowdhury, 2021), West Bengal (Biswas *et al.,* 2019).

Synonyms

Hesperia plinius Fabricius 1793, *Syntarucus plinius* Fabricius 1793, *Tarucus plinius* Fabricius 1793 (Fabricius, 1793; Kunte, 2006; Basu *et al.,* 2019).

Taxonomy

Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Lepidoptera
Superfamily: Papilionoidea
Family: Lycaenidae
Genus: Leptotes
Species: *Leptotes plinius* Fabricius, 1793
Wingspan: 22-30 mm

Description of life stages

Larvae

Upper side pale greenish yellow, lilacine at side, narrow brownish median line which is followed by six brownish-red spots and eight diagonal short streaks. The colouring gets much more diffuse before pupating.

Pupae

Brown spots on dull yellowish profusely mottled body.

Adult male

Upperside decorated with dark violet in colour, in certain lights, a rich blue suffusion. Forewing with brownish-black markings. Underside white, Hind wing mottled with brownish black that leaves only basal, subbasal, medial and discal transverse lines or bands of ground-colour; medial and discal bands, highly irregular, small brownish markings, bands above a irregularly shaped, brown in colour, posterior half of the middle of the wing; terminal markings as on the fore wing but the subterminal spots larger, the apical one especially so, the tornal two spots jet-black and each encircled by a glittering slender ring of metallic green scales. Antenna, head, thorax and abdomen black in colour, antennae ringed white, thorax decorated with a little bluish pubescence and white beneath, palpi and abdomen are also white at beneath.

Adult female

Upper side forewing white, white to be seen between the brown markings superposed on it, these markings have the appearance of an irregularly formed V on a white background. Underside of the wings same as male but differ in the brown bands less broken, more regular. Antennae, cilia, head, thorax and abdomen are the same like male. Dry-season broods specimens are

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paler at upper side, in the male only anticiliary black lines to the wings. Underside markings on the wings, very similar but paler brown in colour and reduced in width so that greater extent of white ground-colour seen.

This is the first report of occurrence of *L. plinius* (*T. plinius*) on ber plants from Punjab. Damage on ber leaves and inflorescence was observed during June-September 2015-2021. This pest has been reported on a variety of host plants from India as well as other parts of the world. In Punjab, this insect has been recorded earlier but has not been reported on ber plants in the state. Population fluctuations as well as leaf damage by this insect-pest on ber have been recorded. Its life history in ber agroecosystem can further be explored towards developing an integrated pest management module for its eco-friendly management.

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Authors' contribution

Conceptualization research work and designing of experiments (SS); Execution of experiment and data recording (SS, NKD, RKS); Analysis of data and interpretation (SS,PCP); Preparation of manuscript (SS,PCP,NKD, RKS).

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