Journal of Applied Horticulture, 16(3): 235-240, 2014

Prevalence of some threatening pests and disease of litchi (*Litchi chinensis* Sonn.) in Bihar state of India

Vinod Kumar*, Ajit Kumar Dubedi Anal and Vishal Nath

*National Research Centre for Litchi, Mushahari, Muzaffarpur, Bihar-842002, India. *E-mail: vinod3kiari@yahoo.co.in*

Abstract

Studies were conducted to assess the prevalence and damage caused by four threatening pests *viz.*, red weevil (*Apoderus blandus*), looper (*Perixera illepidaria*), leaf roller (*Dudua aprobola*), bagworm (*Eumeta crameri*) and one disease, 'leaf and twig blight' (caused by *Colletotrichum gloeosporioides* Penz., and *Gloeosporium* sp.) at National Research Centre for Litchi (NRCL) that were hitherto either unnoticed or of minor importance. Fixed plot surveys at the NRCL Experimental Farm and scouting surveys in farmers' litchi orchard in major litchi growing areas of Bihar state were conducted during 2011-2012. The studies revealed the damaging potential and period of occurrence of these pests and disease in the major litchi growing areas. *A. blandus* was prevalent round the year except during extreme cool and hot weather months whereas *P. illepidaria* was prevalent from September-November and *E. crameri* during November-February. Peak infestation of *D. aprobola* was during July-February. Infestation of *A. blandus*, *D. aprobola*, and *E. crameri* drastically affected the growth of tree whereas *P. illepidaria* damaged the September flush that bears panicle in the ensuing season. The 'leaf and twig blight' disease was prevelent from the beginning of August to the end of February. These pests and disease are now important not only in Bihar but also other litchi growing states of India. Considering their importance, there is a need for continuous surveillance particularly during the likely period of occurrence so that effective management strategies can be adopted. This paper reports occurrence of *E. crameri* on litchi for the first time from India.

Key words: Litchi, red weevil, looper, leaf folder, bagworm, leaf and twig blight

Introduction

Litchi or lychee (*Litchi chinensis* Sonnen) is one of the most important subtropical fruit trees of the family Sapindaceae. The translucent, flavoured aril or edible flesh of the litchi is popular as a table fruit in India, while in China and Japan it is preferred as dried or canned product. India is the second largest producer of litchi in the world after China with an area and production of 82,700 ha and 5,80,100 tonnes, respectively during 2012-13 (NHB, 2014). Litchi contributes significantly to the growers' economy in Bihar, West Bengal, Assam and Jharkhand states of India, and accounts for 78% of the total litchi production in the country. Bihar produces 45% of total litchi production and occupies nearly 40% of the area in India. The important litchi growing districts in Bihar are Muzaffarpur, Vaishali, Sitamarhi, West Champaran, East Champaran, Darbhanga and Samastipur.

Pests and diseases are one of the important constraints affecting production and quality of litchi. Insect pests infesting litchi in India have been recorded as fruit and seed borers (*Conopomorpha cramerella* Snellen, *C. sinensis* Bradley, *C. litchiella* Bradley) (Singh, 1975, 1978; Butani, 1977; Waite and Hwang, 2002; Nair and Sahoo, 2006), leaf mite (*Aceria litchi* Keifer) (Prasad and Singh, 1981; Singh and Raghuraman, 2011), leaf roller (*Dudua aprobola* Meyrick and *Dichocrosis festivalis* Swinh.) (Singh, 1971a; Singh and Kumar, 1992), leaf miner (*Conopomorpha litchiella*) (Singh, 1975; Butani, 1977; Nair and Sahoo, 2006), litchi bug (*Tessarotoma javanica* Thunberg) (Kumar *et al.*, 2008; Choudhary *et al.*, 2013), bark eating caterpillar (*Indarbela quadrinotata* Walker and *I. tetraonis* Moore) (Khurana and Gupta, 1972), ash weevil or little leaf notcher weevil (*Myllocerus delicatulus* Boh. *M. discolar* Boh., *M. undecimpustulatus* Fst., *M. undatus* Marshall) (Singh, 1974a; Singh, 1971b; Kumar *et al.*, 2011) and shoot borer (*Chlumetia transversa* Walker) (Butani, 1977; Waite and Hwang, 2002; Kumar *et al.*, 2011). The borer complex of litchi is most important as they extensively damage the developing and mature fruits, and reduce yields and marketability. In contrast to insect pests litchi trees are less affected by diseases in India as compared to many fruit bearing trees. So far the diseases of economic importance has been leaf spots (*C. gloeosporioides* Penz. and *Botryodiplodia theobromae* Pat.) and anthracnose (*C. gloeosporioides* Penz.) at pre-harvest stage, and fruit rots caused by several pathogens (*Aspergillus flavus* Link, *Cylindrocarpon tonkinense* Bugn., *Botryodiplodia theobromae* and *C. gloeosporioides* etc) at post-harvest stage (Prasad and Bilgrami, 1974; Awasthi *et al.*, 2005). Infection of litchi fruits by *Aspergillus*, *Penicillium* and *Rhizopus*, occurs during and after harvest through skin injury, whereas *Botryodiplodia* infects fruit either in the field or through the cut stem end during harvesting or handling (Nakasone and Paull, 1998).

During surveillance programme at NRCL, some insect pests and diseases that were hitherto either unnoticed or of minor importance, were found to cause extensive damage to litchi. Here, we report the seasonal occurrence and population of four foliage feeding pests, and incidence and severity of one disease of litchi. The diagnostic symptoms of damage as well as summaries of studies conducted to assess the occurrence and extent of damage by pests and disease in litchi are described.

Materials and methods

Scouting surveys in farmers' litchi orchard in major litchi growing areas of Bihar and fixed plot surveys at the NRCL Experimental Farm were conducted during 2011 and 2012 to record damage and severity of pests and disease. Monitoring of pest population was done by taking observations at monthly interval. Ten trees in an orchard/block were randomly selected and observations were recorded from all four cardinal directions on a portion of tree having approximately 150 leaflets. The mean numbers of insects/larvae per 100 leaflets were calculated. Infestation level of pests was recorded based on the per cent leaf area damaged during vegetative phase. For recording damage by loopers, every tree of the orchard blocks (having about 150 trees) were scored visually on the basis of per cent leaf area (the length and breadth of the leaf) damaged. They were categorized as partially (<50% top foliage) and highly (>50% top foliage) damaged tree categories. The symptoms of damage by the pest were described and the percent leaf damage was calculated.

Disease incidence in orchard was calculated based on number of trees showing blight symptoms on leaves. Percent infected leaflets in infected tree were calculated on the basis of observations on three branches of ten randomly selected trees in an orchard. A 9-point scale (1 = 0%, 2 = 1-5%, 3 = 6-10%, 4 = 11-20%, 5 = 21-30%, 6 = 31-40%, 7 = 41-60%, 8 = 61-80%, 9 = 81-100% leaf area damaged) was adopted for recording the disease severity. Thirty leaflets were collected from three randomly selected branches of the tree canopy and scored individually. These grades were later converted into percentage disease severity index (PDI) by using the formula given by Wheeler (1969) as under:

$$\text{PDI} = \frac{\Sigma\ (\text{Severity grade x no. of leaves})}{\text{Total no. of leaves observed x maximum grade}} \text{x } 100$$

Standard field and laboratory techniques were used for etiological studies of disease. The data were analyzed using SAS® 9.2 statistical computing software and subjected to analysis of variance (ANOVA). Data on insect counts were square root transformed whereas means of percent infected leaflets and the PDI were arcsine transformed before analysis. The F value, least significant differences (LSD) between means at 5% significance level (P = 0.05) and the standard error of means were computed.

Results

Red weevil (*Apoderus blandus* Faust.): Surveys of litchi orchards revealed the occurrence of the weevil, *A. blandus* Faust. (Coleoptera: Attelabidae), causing severe leaf damage on young shoots both in orchard trees as well as in nursery plants. It was a solitary feeder but extensively damaged young foliage and twigs. The insect fed on leaves by pricking the surface of leaf (Fig. 1A) resulting in drying of leaves from the pricked parts producing scorched appearance on twigs. Transverse puckering of affected leaves (Fig. 1B) was also observed. Young growing trees of less than five years old were highly damaged. The insect was bright brownish red in colour, about 5-7 mm in length and having elongated snout. The head, prothorax and elytra of the weevil were bright brownish red (Fig. 1C). The ventral side (abdomen) was pale brown, and parts of the mouth and claws were brownish red. The head was elongated triangular, strongly constricted behind. In the sitting position, the neck and the front portion of the insect body remained elevated and facing upward. The antennae were straight with a three segmented club, inserted in a prominent zone of the dorsal surface of rostrum. It had flat elytra without any protuberances. Legs were long and femora were clavate.

Fig. 1. Symptoms of damage by red weevil, *Apoderus blandus* (A and B) and the adult (C) (Enlarged)

Monitoring of red weevil at NRCL Experimental Farm during 2012 revealed that infestation of the weevil was throughout the year but it was low during December-January when minimum temperature was extremely low (<12^{0}C) and during May-June (temperature was very high, >34^{0}C). All the trees were found infested by red weevil. During 2012, the mean count per hundred leaflets varied significantly from 5.0 to 43.6 (P = 0.05) (Fig. 2). The least insect count was observed during December (5.0/100 leaflets) and May (7.3/100 leaflets) while maximum was during March (34.0/100 leaflets) and September (43.6/100 leaflets). During the peak population of the weevil, up to 30% lamina of young leaflets were damaged.

Looper (*Perixera illepidaria* Guenée): Infestation of loopers, *P. illepidaria* Guenée (Lepidoptera: Geometridae), was first noticed in September flush during 2011. Since then, looper was regularly observed on litchi trees in major litchi growing areas of Bihar. The period of occurrence of loopers in litchi was from September to November, the peak infestation being in October. Larva fed voraciously on lamina of young leaves leaving only the mid ribs and veins. They also sometimes fed on tender shoots. Within a week only bare rachis was left on the top canopy of the trees (Fig. 3). There was a lot of variation in the colour of larvae of different instar from black to dark brown with banded appearances (Fig. 4). The newly formed pupa was green in colour, which subsequently turned brown before adult emergence. The adult male was pinkish fawn, while females were uniformly pinkish.

The results revealed that during October 2011, the incidence of looper infested trees in different blocks at NRCL experimental farm was between 2.08 to 40.3% while it was between 35.4 to 84.5% in the farmers' orchard during October 2012. The trees

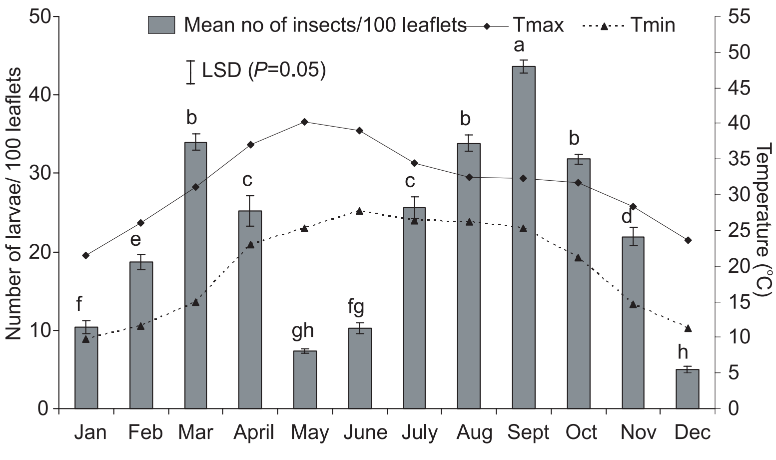

Fig. 2. Population of red weevil, *Apoderus blandus* at NRCL Experimental Farm, Muzaffarpur, Bihar during 2012. Vertical bars indicate standard error (SE) and the independent bar is least significant difference (LSD) at P=0.05. Different letters indicate significant difference between mean counts of various months.

Fig. 3. Symptoms of damage by *Perixera illepidaria* loopers on a litchi tree

Fig. 4. Infestation of *Perixera illepidaria* loopers on a litchi tree (A) and close-up view of last instar larvae (B)

having partially damaged canopies (<50% top foliage) ranged between 1.4-20.8% while trees with highly damaged canopies (>50% top foliage) were 0.7 to 29.4% at NRCL experimental farm during October 2011 (Table 1). In the farmers' orchard, trees with partially damaged canopies and highly damaged canopies were 28.8-100% and 0.0-71.2%, respectively during October 2012. Preference for cultivar by the pest was apparent in the orchards. Between the two widely cultivated litchi cultivars, 'Shahi' and 'China', a higher incidence and more damage to foliage was observed in 'Shahi'. The incidence of looper infested trees at NRCL farm having 'Shahi' and 'China' cultivars were 2.1-13.2 and 27.8-40.3%, respectively while farmers' orchard having 'Shahi', 'China' and both cultivars, the incidence were 44.2-84.5, 35.4-67.7 and 34.1-62.4%, respectively.

Leaf roller (*Dudua aprobola* Meyrick): High levels of infestation of leaf roller, *D. aprobola* Meyrick (Lepidoptera: Tortricidae) was observed on litchi trees during July to February 2012. Infestation occurred on young leaves after emergence of new flush. The larva rolled the leaves longitudinally and fed inside folded leaf laminae (Fig. 5). During 2012, the mean larval count per 100 leaflets varied significantly from 0.0 to 52.7 (P = 0.05). Peak infestation was observed during October-November and negligible during March to April (Fig. 6). A statistically significant difference in mean larval counts per 100 leaflets (P = 0.05) was observed among various orchards at NRCL farm and farmers' fields in Muzaffarpur district when tested by one-way ANOVA (Table 2). It was evident from the data that the mean number of larvae per 100 leaflets among the orchards significantly varied from 7.9 to 41.1. Comparatively higher mean count (28.4-41.1) was observed in litchi orchards of farmers than blocks of NRCL experimental farm (7.9-11.6). The range of numerical values of counts varied from 5.3 to 21.0 between different blocks at NRCL farm, whereas in farmers' orchard it was from 20.7 to 52.0. Preference of the pest to cultivars was not apparent though the values differed significantly between blocks as well as orchards.

Bagworm (*Eumeta crameri* Westwood): The infestation of bagworm, identified as *E. crameri* Westwood (Lepidoptera: Psychidae) was first seen on some trees at NRCL experimental farm during December 2011 which continued up to February, 2012. Later, it was also noticed in farmers' orchards. The infestation was also observed in the subsequent years between November and February. The temperature during the period of occurrence generally varied from 7.14 to 29.3^{0}C. Not all the trees in an orchard were infested. Many bagworms were seen attached upright on leaves, mostly on adaxial surface and some on petiole, internodes and upper thin branches of canopies. The mean number of bagworms/ 10 leaflets among infested trees during 2012 varied from 24 to 69.

Feeding resulted in scrapping of green tissues leading to initial appearance of brown patches on the leaves (Fig. 7). Foliage of the affected trees appeared bronzed when viewed from distance. Though bagworms are slow feeder, entire leaf lamina may be eaten over a month, leaving behind only a network of vein and veinlets. Unlike other pests, it preferred older leaves which had more tannin content. As the name suggest, the larvae of this insect is encased in a protective cone shaped case which always remained upright whether it fed or moved forward. The case was made from secretion, excreta as well as plant materials. When the case was forcefully removed, the larvae re-synthesized the case within two days. The movement of larvae was very slow and only the head came out of the case while feeding or movement. Once all the green tissues were exhausted it moved further for a few millimetres on the leaf lamina to feed on healthy tissues. The biology of this pest was attempted to be studied by rearing on litchi leaves in the laboratory (temp. 28 ± 1°C, RH 70 ± 5%, and 12:12 h L: D) but the larvae failed to pupate and metamorphose into the next stage.

Leaf and twig blight disease (*Colletotrichum gloeosporioides* Penz., and *Gloeosporium* sp.): A 'leaf and twig blight' disease was observed in litchi which was caused by *Colletotrichum*

Fig. 5. Symptoms of damage by leaf roller, *Dudua aprobola* on a litchi tree and the larvae (Inset)

Table 1. Incidence and damage of litchi loopers during October at the NRCL Experimental Farm and farmers' orchard

Plantation Block/ Orchard No.	Cultivars	Incidence of infested trees (%)	Trees in different levels of foliage damage (%) <50%	>50%
Year 2011 (NRCL Experimental Farm)				
Block I	'Shahi'	40.3	20.8	19.4
Block II	'Shahi'	24.3	16.0	8.3
Block III	'Shahi'	37.8	8.4	29.4
Block IV	'Shahi'	28.5	7.6	20.8
Block V	'China'	2.1	1.4	0.7
Block VI	'China'	13.2	9.7	1.4
Block VII	'China'	9.7	7.6	2.1
Block VIII	'Shahi'	38.9	16.7	22.2
Block IX	'Shahi'	23.6	17.4	6.3
Block X	'Shahi'	27.8	15.3	12.5
Year 2012 (Farmers' Field)				
Orchard 1	Mixed	56.9	39.0	61.0
Orchard 2	Mixed	62.4	37.9	62.1
Orchard 3	'Shahi'	72.0	31.7	68.3
Orchard 4	'Shahi'	56.9	33.7	66.3
Orchard 5	'Shahi'	59.7	40.3	59.7
Orchard 6	'Shahi'	82.5	28.8	71.2
Orchard 7	'Shahi'	84.5	41.1	58.9
Orchard 8	'Shahi'	72.5	31.0	69.0
Orchard 9	'China'	56.3	37.5	62.5
Orchard 10	'China'	65.5	31.9	68.1
Orchard 11	'China'	67.7	33.7	66.3
Orchard 12	'Shahi'	81.3	44.2	55.8
Orchard 13	Mixed	34.1	77.8	22.2
Orchard 14	Mixed	43.1	69.7	21.2
Orchard 15	'Shahi'	44.2	67.5	32.5
Orchard 16	'China'	35.4	100.0	0.0

Table 2. Incidence of leaf rollers, *Dudua aprobola* at the NRCL Experimental Farm and farmers' orchard in Muzaffarpur district of Bihar during November 2012

Block/ Orchard	Cultivars	Infested leaf or larval counts / 100 leaflets Mean	Range
Block I	'Shahi'	11.6 (3.41)	7.3-19.3
Block II	'Shahi'	9.2 (3.04)	6.0-21.0
Block III	'Shahi'	8.1 (2.85)	6.7-13.3
Block IV	'China'	8.4 (2.90)	5.7-10.7
Block V	'China'	7.9 (2.81)	5.3-10.3
Orchard 1	Mixed	39.2 (6.26)	25.0-47.7
Orchard 2	Mixed	35.4 (5.95)	33.0-41.0
Orchard 3	'Shahi'	28.4 (5.33)	25.0-34.0
Orchard 4	'Shahi'	26.2 (5.12)	20.7-31.7
Orchard 5	'China'	41.1 (6.41)	37.3-52.0
SE (m) ±	-	0.10	-
LSD (*P* = 0.05)	-	0.33	-

*Data in parentheses are square root transformed values.

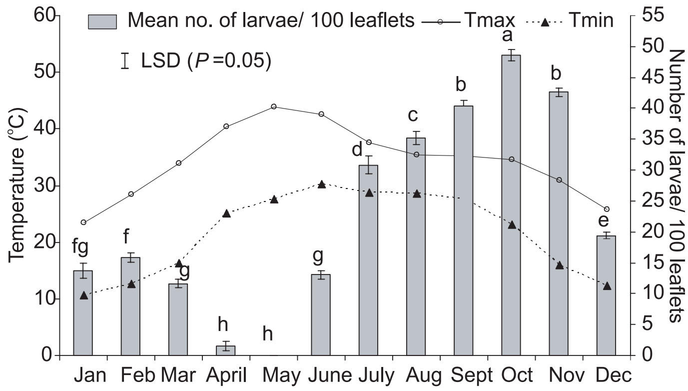

Fig. 6. Population of leaf roller, *Dudua aprobola* at NRCL Experimental Farm, Muzaffarpur, Bihar during 2012. Vertical bars indicate standard error (SE) and the independent bar is least significant difference (LSD) at P=0.05. Different letters indicate significant difference between mean larval counts of various months.

Table 3. Incidence and severity of 'leaf and twig blight' disease at the NRCL Experimental Farm and farmers' orchard

Block/ orchard no. and date of observation	Disease incidence (%)	Percent infected leaflets: Range*	Mean*	Standard deviation	Standard error	Percent disease severity index (PDI): Range**	Mean**	Standard deviation	Standard error
Block-I, NRCL, 22 Aug 2011	44.5	21.0-31.0	26.7	3.49	1.10	28.6-38.1	34.0	3.07	0.97
Block-II, NRCL, 22 Aug 2011	61.8	26.7-37.0	30.8	3.10	0.98	21.6-39..3	32.5	5.01	1.59
Farmers' orchard-I, 13 Feb 2012	66.3	27.7-69..3	46.2	12.46	3.94	31.9-47.8	39.5	4.75	1.50
Farmers' orchard-II, 13 Feb 2012	28.1	30.0-61.0	41.0	11.37	3.60	3.7-38.1	15.1	9.41	2.98
LSD (*P*=0.05)	-	-	4.9				4.2		
SE(m) ±	-	-	1.7				1.5		

* Thirty observations on 10 trees (3 observations per tree), ** PDI based on ten trees

gloeosporioides Penz., and *Gloeosporium* sp. The symptoms included as death of leaves on new shoots and appeared as tip dieback. The tan spots developed on the leaves produced typical blighted symptoms (Fig. 8). The twig blight along with infestation of foliage feeding pest complex not only severely hampered the young trees' growth but also reduced the potential fruit bearing flushes in grown-up orchards.

The disease was severe during August-September and January-February. The disease incidence was 44.5 to 61.8% in August 2011 at NRCL Experimental Farm, whereas it varied between 28.1% and 66.3% in farmers' orchard in February 2012. The percent infected leaflet in trees varied from 21.0 to 37.0 in two litchi blocks at NRCL Experimental Farm, whereas it was 27.7 to 69.3 in farmers' orchard. The PDI was in the range of 3.7 to

Fig. 7. Symptoms of damage on litchi leaves by bagworm, *Eumeta crameri* (A) and fully developed larva forcefully removed from their case (B)

Fig. 8. Symptoms of leaf and twig blight disease on litchi during

47.8 (Table 3). The means of percent infected leaflet and the PDI among trees varied significantly from 26.7 to 46.2 (P = 1.03) and 15.1 to 39.5 (P = 1.03), respectively.

Discussion

In recent years, several pests are being reported on litchi from India and so far were minor pest. *A. blandus* was reported for the first time in India by Singh (1974b). Later, infestation of *A. blandus* as emerging pest was reported from Bihar by Kumar *et al.* (2011). The ever-increasing degree of anthropogenic changes to the environment might be responsible for changes in dynamics of pest populations in litchi. We noticed the occurrence of *P. illepidaria* first time in 2011 and since then increasingly high population and damage to litchi tree is being observed. *P. illepidaria* is widely distributed in Thailand (Kuroko and Lewvanich, 1993) but not present in Australia (Nielsen *et al.*, 1996) and not reported earlier from India as pest of litchi (Kumar *et al.*, 2014). Schreiner and Nafus (1992) reported change in populations of four species of Lepidoptera including widespread occurrence of *P. illepidaria* after biological control of dominant pest species in mango *viz.*, the mango shoot caterpillar, *Penicillaria jocosatrix* Guenée. *P. illepidaria* caterpillars increased 10-fold after suppression of *P. jocosatrix*. Similar pest dynamics might be responsible for rising population of *P. illepidaria* in litchi in context of pesticides application vis-à-vis climate change. However, this needs further investigation to derive a definite conclusion.

The bagworm, *E. crameri* appears to be very common in the Indian subcontinent (Mathew and Nair, 1983; Ameen and Sultana, 1977). It was shown to have multiple hosts such as *Camellia thea*, *Acacia* sp., *Albizia falcataria*, *Casuarina equisetifolia*, *Eucalyptus grandis*, *Gmelina arborea*, and *Psidium guajava* in southern part of India (Nair, 1978; Mathew and Nair, 1986). We report for the first time the occurrence of *E. crameri* on litchi from India. In Bangladesh, bagworm infested a large number of plant species including *Litchi chinensis*, *Thuja* sp., *Quisqualis indica*, *Rosa* sp., *Punica granatum*, *Bougainvillea* sp., *Ficus religiosa* and *Saraca indica* (Ameen and Sultana, 1977). Various species of *Eumeta viz. E. japonica* (Li *et al.*, 1997), *E. minuscula* (USDA, 1999) and *E. variegata* (USDA, 1999) had been reported to be associated with stems, shoots, twigs and leaves of longan (*Dimocarpus longan*) in China. Ameen and Sultana (1977) had studied life cycle of *E. crameri*, however they could not ascertain the number of larval instars through which *E. crameri* undertakes metamorphosis to attain adulthood and did not commented on the phenomenon of case renovation, which is a characteristic feature of the life cycle of many bagworm species. Agrawal and Pati (2003) studied the phenomenon of larval case renovation in bagworms involving intricate mechanisms. They reported that *E. crameri* performs case renovation three times prior to its entry into the pupal stage. They also concluded that *E. crameri* had at least four larval instars during its life cycle, and it renovated its case at least once between two consecutive instars. After hatching, *E. crameri* metamorphosed into an adult within an average time lag of 91.4 days. However, we could not get different stages of *E. crameri* while rearing on litchi leaves.

The present study revealed damage potential and seasonal activities of the pests. *A. blandus* was prevalent round the year except extreme cool and hot weather months whereas *P. illepidaria* was prevalent from September-November and *E. crameri* during November-February. While *E. crameri* preferred older leaves, *A. blandus* and *P. illepidaria* fed on young leaves. For litchi fruit production, the flush that comes out in September is very important as it bears panicle in the ensuing season. Thus, the infestation of *P. illepidaria* will have a direct bearing on litchi fruit production. *P. illepidaria* preferred developing leaves that emerged during the month of September. The population of *P. illepidaria* started rising up rapidly from September reaching a peak in October and started declining in November. Similarly, infestation of *A. blandus*, *D. aprobola*, and *E. crameri* drastically affected the growth at various stages of the litchi tree. Particularly, a careful attention is required to prevent the nursery plants from infestation of *A. blandus*. Ray and Mukherjee (2012) also reported similar findings on incidence of *D. aprobola* in litchi.

Litchi had been free or rarely attacked from serious diseases, but incidence and severity of 'leaf and twig blight' is now causing economic damage. The damage to tree foliage during fruiting season, particularly in February, is more important which may lead to reduction in fruit yield and quality. Infection by *C. gloeosporioides* also cause anthracnose on fruits as well as post-harvest fruit rots. Hence, there is necessity for adoption of protective measures by the farmers for this disease. This disease was reported for the first time as emerging disease of litchi in India by Kumar *et al.* (2011).

The pests and disease reported in this article are not only important in Bihar but also in other states of India. We observed similar infestation of these pests and occurrence of the disease in farmers' orchard in Jharkhand, West Bengal, Assam, Odhisa and Chhattisgarh, except litchi grown in hills.

In conclusion, the present study would help in understanding the anticipated period of occurrence and severity of damage in major litchi growing areas of India which is essential in formulating pest management strategies including spray schedule of ecofriendly pesticides. Also, considering the high population and damage potential, there is need to undertake studies on the eco-biology, behaviour and spatial and temporal distribution of *P. illepidaria* and *E. crameri* during the likely period of occurrence.

Acknowledgements

Authors are grateful to Dr. V.V. Ramamurthy, Pr. Scientist and PI, Network Project on Insect Biosystematics (NPIB), Division of Entomology, IARI, New Delhi for identification of the weevil pest. The help received from Dr. P.V.R. Reddy, Principal Scientist, Indian Institute of Horticultural Research, Bangalore in identification of the pest is also thankfully acknowledged.

References

Agrawal, A. and A.K. Pati, 2003. Larval case renovation-A unique behaviour in bagworm moth, *Eumeta crameri* Westwood. *Curr. Sci.*, 85(12): 1674-1679.

Ameen, M.U. and P. Sultana, 1977. Biology of the bag-worm moth *Eumeta crameri* Westwood (Lepidoptera: Psychidae) from Dacca, Bangladesh. *J. Nat. Hist.*, 11: 17-24.

Awasthi, D.P., S. Sarkar, N.K. Mishra and S.A.K.M. Kaiser, 2005. Disease situation of some major fruit crops in new alluvial plains of West Bengal. *Environ. Ecol.*, 23: 497-499.

Butani, D.K. 1977. Pests of litchi in India and their control. *Fruits*, 32: 269-273.

Choudhary, J.S., S.C. Prabhakar, Moanaro, B. Das and S. Kumar, 2013. Litchi stink bug (*Tessaratoma javanica*) outbreak in Jharkhand, India, on litchi. *Phytoparasitica*, 41: 73-77.

Khurana, A.D. and O.P. Gupta, 1972. Bark eating caterpillars pose a serious threat to fruit trees. *Indian Farmers Dig.*, 5: 51-52.

Kumar, H., V. Mittal, A. Gupta and C.P. Singh, 2008. Population dynamics and seasonal occurrence of *Tessaratoma javanica* Thunberg in litchi orchards. *Ann. Plant Prot. Sci.*, 16: 70-73.

Kumar, V., A. Kumar and Vishal Nath, 2011. Emerging pests and diseases of litchi (*Litchi chinensis* Sonn.). *Pest Mgt. Hort. Ecosys.*, 17: 11-13.

Kumar, V., P.V.R. Reddy, A.K.D. Anal and Vishal Nath, 2014. Outbreak of looper, *Perixera illepidaria* (Lepidoptera: Geometridae) on Litchi, *Litchi chinensis* (Sapindales: Sapindaceae) - A New Pest Record from India. *Fla. Entomol.*, 97(1): 22-29.

Kuroko, H. and A. Lewvanich, 1993. Lepidopterous pests of tropical fruit trees in Thailand (with Thai text). Japan International Cooperation Agency, Tokyo.

Li, L., R. Wang and D.F. Waterhouse, 1997. The distribution and importance of arthropod pests and weeds of agriculture and forestry plantations in southern China. ACIAR, Canberra, Australia. Monograph 46. p.185.

Mathew, G. and K.S.S. Nair, 1983. The bagworm, *Petroma plagiophleps* Hamp. (Lepidoptera: Psychidae) spreads to the ornamental tree *Delonix regia* (Boj.) Rafin in Kerala, India. *Indian J. For.*, 6: 240-241.

Mathew, G. and K.S.S. Nair, 1986. Bagworms (Lepidoptera: Psychidae) of Kerala - Their potential as pests of tree crops. *Proceedings of the Third Oriental Entomology Symposium*, 21-24 February 1984, Vol. 2: 163-167.

Nair, M.R.G.K. 1978. *A Monograph on Crop Pests of Kerala and their Control*. Kerala Agricultural University, College of Agriculture, Vellayani, Trivandrum, p. 161.

Nair, N. and A.K. Sahoo, 2006. Incidence of *Conopomorpha cramerella* Snellen (Gracillariidae: Lepidoptera): A serious pest of litchi and its control in West Bengal. *Environ. Ecol.*, 24: 772-775.

Nakasone, H.Y. and R.E. Paull, 1998. Tropical fruits. In: *Crop Production Science in Horticulture* Series, No. 7. Wallingford, UK, CAB International, pp 173-207.

NHB, 2014. Indian Horticulture Database 2013. National Horticultural Board, Ministry of Agriculture, Government of India, Gurgaon, India, p 289.

Nielsen, E.S., E.D. Edwards and T.V. Rangsi, 1996. Checklist of the Lepidoptera of Australia. *Monographs on Australian Lepidoptera* Volume 4. Melbourne, Australia, CSIRO Australia.

Prasad, S.S. and R.S. Bilgrami, 1974. Investigations on diseases of litchi: VI. Post harvest diseases of fruit in India. *Plant Dis. Rep.*, 58: 1134-1136.

Prasad, V.G. and R.K. Singh, 1981. Prevalence and control of litchi mite, *Aceria litchii* Keifer in Bihar. *Indian J. Entomol.*, 43: 67-75.

Ray, R.R.R. and U. Mukherjee, 2012. Effect of abiotic factors on the incidence of litchi leaf roller, *Dudua aprobola* Meyrick (Lepidoptera: Tortricidae) in Bihar. *Pest Mgt. Hort. Ecosys.*, 18: 210-212.

Schreiner, I.H. and D.M. Nafus, 1992. Changes in a moth community mediated by biological control of the dominant species. *Environ. Entomol.*, 21: 664-668.

Singh, H. 1974a. Occurrence of *Myllocerus delicatulus* Boh. (Coleoptera: Curculionidae) on tender leaves of litchi (*Litchi chinensis* Sonn.). *Indian J. Entomol.*, 36: 238.

Singh, H. 1974b. *Apoderus blandus* Faust Coleoptera Curculionidae a new pest of litchi (*Litchi chinensis* Sonn). *Indian J. Entomol.*, 36: 239-40.

Singh, H. 1975. *Acrocercops cramerella* Snell. (Gracillariidae: Lepidoptera) as a pest of litchi in Uttar Pradesh and its control. *Indian J. Hort.*, 36: 238.

Singh, H. 1978. Pest complex of litchi in Dehradun and Saharanpur district of Uttar Pradesh. *Indian J. Entomol.*, 40(4): 464.

Singh, J. and M. Raghuraman, 2011. Emerging scenario of important mite pests in North India. In: G.J. de Moraes and H. Proctor (eds.) Acarology XIII: Proceedings of the International Congress. *Zoosymposium*, 6: 1-304.

Singh, M.P. 1971a. Occurrence of *Platypepla aprobola* Meyr. (Tortricidae: Lepidoptera) on litchi (*Litchi chinensis*) in North Bihar. *Indian J. Entomol.*, 33(1): 98.

Singh, M.P. 1971b. *Myllocerus discolar* Boh. and *Myllocerus* sp. *undecimpustulatus* Fst. (Coleoptera: Curculionidae) as pest of litchi (*Litchi chinensis*). *Indian J. Entomol.*, 33(2): 221.

Singh, Y.P. and V. Kumar, 1992. *Dichocrosis* (*Dichocrocis festivalis* Swinh. Lepidoptera: Pyralidae) - A new pest of litchi (*Litchi chinensis* Sonn). *J. Bombay Nat. Hist. Soc.*, 89(1): 137.

USDA, 1999. Importation of longan fruit with stems (*Dimocarpus longan*) from China into the United States- A Qualitative, pathway-initiated pest risk assessment. United States Department of Agriculture, Animal and Plant Health Inspection Service, May 1999.

Waite, G.K. and J.S. Hwang, 2002. Pests of litchi and longan. In: *Tropical fruit pests and pollinators: Biology, economic importance, natural enemies and control.* J.E. Pena, J.L. Sharp and M. Wyoski (eds.). CABI Publishing, Wallingford, UK. p. 331-359.

Wheeler, B.E.J. 1969. *An Introduction to Plant Diseases*. John Wiley and Sons Ltd., London.

Received: December, 2013; Revised: February, 2014; Accepted: March, 2014