



Incidence, intensity and management of bark eating caterpillar, *Indarbela* sp. infesting fruit trees in Himachal Pradesh, India

DIVENDER GUPTA*, SUNIL NARAM and R. S. BHATIA

Department of Entomology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni Solan - 173 230,
Himachal Pradesh, India

*Email: divender@rediffmail.com

ABSTRACT: The study on the incidence, intensity and management of bark eating caterpillar *Indarbela* sp. revealed that in low hills of Himachal Pradesh the incidence varied between 91.5 and 98.0 per cent in citrus, litchi, mango and guava orchards with litchi as the most preferred host (with caterpillar incidence index value of 3.95). In mid hills, the incidence ranged between 90.0-94.5 per cent in plum, apricot and pear orchards. Based on the index of caterpillar incidence value, plum was the most preferred host (6.67). In high hills the incidence of pest was negligible (0.0-7.0 %). The poorly managed orchards of mango and citrus were more prone to attack with an incidence of 88 and 92 per cent in comparison to 20 and 24 per cent in well managed orchards, respectively. Young orchards were less prone to bark eating caterpillar infestation with an incidence of 16 and 20 per cent in comparison to 88 and 80 per cent in old orchards of mango and citrus, respectively. Among different management practices evaluated in plum orchards, thrusting of flexible wire plus plugging the hole with mud; thrusting of wire plus pouring of methyl parathion (0.1%) in bore hole with syringe and plugging with mud, and thrusting of wire plus pouring of DDVP (0.15%) and plugging with mud proved very effective (90-100% control) in managing the pest.

Keywords: Bark eating caterpillar, fruit crops, *Indarbela*, seasonal incidence

INTRODUCTION

Bark eating caterpillar, *Indarbela* sp. (Lepidoptera : Metarbelidae) is a polyphagous pest infesting a large number of plant species. There are 13 species of the genus of which, *I. quadrinotata* (Walker), *I. tetraonis* (Moore) and *I. dea* (Swinhoe) are of economic importance. The pest has been reported to infest 70 plant species across fruits, forests and avenue plantations (Verma and Khurana, 1978). The caterpillar is nocturnal in nature and feeds on the bark of the host plant under a frass ribbon and remains hidden inside the galleries formed at the forking points on trunk and branches during the day, making its management difficult. Different methods have been suggested from time to time for the management of bark caterpillar which include; injecting kerosene, chloroform and petrol (Srivastava, 1972), insecticides (Verma *et al.*, 1972), granule placement in the galleries (Verma, 1985) and spot treatment through insecticide sprays (Sandhu *et al.*, 1987; Mathew and Rugmini, 1998). For taller trees under forest situations, insecticide sprays using power sprayers have been recommended (Sangha and Makkar, 2005). Keeping in view the gradual increase in the incidence, intensity and host range of the pest, the present investigations were planned to find out relative incidence and intensity of the bark-eating caterpillar on important fruit crops of different

regions of the state (Himachal Pradesh) and evaluate different tactics for its management.

MATERIALS AND METHODS

The observations on the host range were taken throughout the study period and even a single ribbon was considered. The observation on the colour of the frass ribbon was also taken. The investigations on incidence and intensity were carried out in three different regions *i.e.* low, (up to 900m AMSL), mid (900-1500m AMSL) and high hills (>1500m AMSL) of Himachal Pradesh during peak period (September-October) of infestation. In all, seven locations were selected; two each in low (Una and Jachh) and high hills (Shimla and Jubbal) and three (Nauni, Kandaghat and Gaura) in the mid hill region. In low hills, the fruit crops namely citrus (mandarin), litchi, mango and guava; in mid hills plum, apricot and pear and in high hills apple and pear were selected for the study. At each location, two orchards were selected for recording observations on the incidence and intensity of the pest on 50 randomly selected trees/ orchard. The presence of frass ribbon on trees with freshly eaten bark was considered as the sign of infestation. Per cent tree infestation was also recorded in each case. For quantifying the intensity of infestation, number of active holes/ infested tree were counted which later was

converted into the index of caterpillar incidence as per the method given by Verma and Khurana (1976).

$$\text{Index of caterpillar incidence} = \frac{\text{per cent trees infested} \times \text{mean no. of active holes/infested tree}}{100}$$

For making comparisons between well managed and poorly managed, and young (< 6yrs old) and old (>15 yrs) orchards, the study was conducted only in the low hills (Jachh, 480m AMSL) that too in mango and citrus orchards. For evaluating the effectiveness of the management practices, 11 treatments including control were tried during the peak (September- October) period of activity of the pest at two locations in the mid hills *i.e.* one in the plum block of Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan and the other in a farmer's field at Kandaghat. Two live holes /tree were marked for evaluating the efficacy of the treatment and four such marked trees /treatment were selected at both the locations. The trial was laid in a randomized block design and data on mortality were recorded at 7, 14, 21 and 28 days post treatment. The data so obtained were converted into per cent mortality. The cessation of ribbon elongation and no freshly eaten bark were fixed as the criteria for caterpillar mortality, which means that the holes where no further growth of the frass ribbon was noticed were considered as inactive or dead.

RESULTS AND DISCUSSION

Host Range: The observations recorded on the host range of the pest indicated that that in all, there were 30 plant species attacked by the pest (Table 1), of which, 16 belonged to fruit category and 14 to forest and avenue plantations. Earlier, Bhalla and Pawar (1977) reported a number of host plants of *Indarbela* sp. from the state. However, from Uttar Pradesh, Tandon and Lal (1978) reported infestation of the pest on 33 plant species distributed across 18 genera and 19 families. Verma and Khurana (1978) recorded as many as 70 plant species as the host plants of *Indarbela* sp. from Haryana. The data collected on the colour of the frass ribbon revealed that the colour of the ribbon varied between chocolate brown, brown through light brown. The colour of frass ribbon was found to be influenced by the colour of host tree bark. For example, it was light brown in mango and citrus and chocolate brown in litchi trees.

Incidence and Intensity: The data recorded on the incidence and intensity of the pest (Table 2) indicate that though the infestation of the pest was recorded in all the three regions of the state, however, the incidence was very low in the high hills ranging only between 0.0 to

7.0 per cent. The low and mid hills however, showed very high incidence of the pest. Under low hills, the incidence of the pest varied between 91.5 to 98.0 per cent among the four fruit crops, of which, litchi was the most preferred host recording 98.0 per cent mean infestation. Earlier, Verma and Khurana (1976) reported 20 to 100 per cent incidence of the pest on different fruit crops from Haryana. A low level (52.90 per cent) of infestation compared to the present studies however, has been reported on citrus by Thakur and Thakur (1998) from the state which differs from the present findings and also indicates the gradual increase in the level of infestation by the pest and its attainment of importance with the passage of time indicating thereby the increasing trend of incidence of the pest. The mean number of active holes/tree was observed to range between 1.46 and 4.04 in different crops. Earlier, Verma and Khurana (1978) reported this range to vary between 1.0 and 32.0 in different fruit crops maximum being in aonla indicating the preference of the pest for the aonla crop. The index of caterpillar incidence on the crops was calculated to be 1.34 (mango), 1.40 (citrus), 1.78 (guava) and 3.95 (litchi) in the present studies which differed marginally among the crops from the similar studies conducted by Verma and Khurana (1978) in Haryana where the respective values for different fruit crops were recorded to be 0.36 (mango), 0.19 (litchi), 1.85 (guava) and 21.34 (aonla) trees.

The perusal of the data for pest incidence presented in the Table 2, revealed that in mid hill conditions, the mean incidence in plum, apricot and pear was recorded to be 94.5, 90.0 and 93.0 per cent, respectively. Among these crops, plum was the most preferred tree species at all the three locations studied as indicated by the index of caterpillar incidence. The mean number of live holes varied between 2.11 and 7.06 in the three crops. Verma (1985) recorded severe infestation of the caterpillar, *Indarbela quadrinotata* on plum with a maximum of 18 active holes/ tree (mean 13 holes/tree) corroborating the present results. Similarly, while working on the bark eating borers of fruit, avenue and forest trees in Haryana, Verma and Khurana (1978) recorded 5.2 holes/tree on plum whereas Thakur and Thakur (1998) reported on an average 4.6 to 7.4 holes on plum, 1.0-1.5 in pear and 2-9 holes/tree in apricot, from the mid hill regions of the state. Both these studies corroborate the present findings. The mean values of infestation index for three crops in the present studies were found to be 1.90 (apricot), 2.07 (pear) and 6.67 (plum). Verma and Khurana (1978) recorded the value as 3.45 for pear in plains which is mid way the values obtained in the present work.

Table 1. Host range of bark-eating caterpillar, *Indarbela* sp. in Himachal Pradesh

Common Name	Scientific Name	Colour of frass ribbon
Citrus	<i>Citrus reticulata</i>	Light brown
Litchi	<i>Litchi chinensis</i>	Chocolate brown
Guava	<i>Psidium guajava</i>	Light brown
Mango	<i>Mangifera indica</i>	Chocolate brown
Apricot	<i>Prunus armeniaca</i>	Light brown
Loquat	<i>Eryobotrya japonica</i>	Chocolate brown
Pear	<i>Pyrus communis</i>	Brown
Plum	<i>Prunus domestica</i>	Light brown
Apple	<i>Malus domestica</i>	Light brown
Almond	<i>Prunus amygdalus</i>	Light brown
Peach	<i>Prunus persica</i>	Light brown
Jamun	<i>Syzygium cumini</i>	Light brown
Olive	<i>Olea europea</i>	Light brown
Aonla	<i>Emblica officinalis</i>	Brown
Pomegranate	<i>Punica granatum</i>	Light brown
Asoka Tree	<i>Saraca asoca</i>	Light brown
Bottle brush	<i>Callistemon lanceolatus</i>	Light brown
Gulmohar	<i>Delonix regia</i>	Light brown
Weeping willow	<i>Salix babylonica</i>	Light brown
Arjun tree	<i>Terminalia arjuna</i>	Light brown
Kikar	<i>Acacia nilotica</i>	Dark brown
Silver oak	<i>Grevillea robusta</i>	Light brown
Eucalyptus	<i>Eucalyptus citriodora</i>	Chocolate brown
Khair	<i>Acacia catechu</i>	Light brown
Kachnar	<i>Bauhinia variegata</i>	Light brown
Teak	<i>Tectona grandis</i>	Brown
Mulberry	<i>Morus alba</i>	Light brown
Peepal	<i>Ficus religiosa</i>	Light brown
Poplar	<i>Populus deltoides</i>	Light brown
Beul	<i>Grewia optiva</i>	Light brown

The high hill regions represented by Shimla and Jubbal recorded very low (4.0-7.0%) incidence and intensity (caterpillar incidence index range 0.04-0.08) of the pest. Out of the two locations, none of the crops in the latter (Jubbal) had any traces of pest attack. In the former location however, only apple and pear showed some incidence whereas, the almond crop was observed to be free from the bark-eating caterpillar attack. The average number of live holes in apple ranged from 1-2 with caterpillar incidence index of 0.08, whereas, on pear the value of the caterpillar incidence index was lower (0.04) while the number of live holes remained the same.

Earlier, Thakur and Thakur (1998) while studying the incidence of bark-eating caterpillar, *I. quadrinotata* on fruit crops also pointed out that beyond an elevation of 1400 m AMSL the infestation of pest is negligible which corroborates the present findings.

The observations recorded on the relative incidence on the poorly managed /well managed (Table 3) and old/young orchards (Table 4) of mango and citrus under low hill (Jachh conditions) indicated that the incidence and intensity of the pest, *Indarbela* sp. was very high both in the old and unmanaged orchards compared to their

Table 2. Incidence and intensity of bark eating caterpillar *Indarbela* sp. on major fruit crops

Region	Crop	Incidence (%)	No. of active holes/tree	Index of caterpillar incidence
Low Hills (<900 m AMSL)	Citrus	93.0	1.51	1.40
	Litchi	98.0	4.04	3.95
	Mango	91.5	1.46	1.34
	Guava	96.5	1.84	1.78
Mid Hills (900-1500 m AMSL)	Plum	94.5	7.06	6.67
	Apricot	90.0	2.11	1.90
	Pear	93.0	2.23	2.07
High Hills (>1500 m AMSL)	Apple	7.0	1.14	0.08
	Pear	4.0	1.13	0.04
	Almond	0.00	0.00	-

Table 3. Incidence and intensity of bark-eating caterpillar, *Indarbela* sp. in poorly managed and well managed orchards of mango and citrus at Jachh

Crop	Status	Infestation (%)	Avg. no. of active holes/tree	Index of caterpillar incidence
Mango	Managed	20.0	0.6 (1-2)	0.12
	Poorly managed	88.0	9.8 (5-17)	8.62
Citrus	Managed	24.0	2.0 (1-4)	0.48
	Poorly managed	92.0	8.0 (4-12)	7.36

Table 4. Incidence and intensity of bark-eating caterpillar in young and old orchards of mango and citrus at Jachh

Crop	Status	Infestation (%)	Avg. no. of active holes/tree	Index of caterpillar incidence
Mango	Young (<6 yrs)	16.0	1.0 (1)	0.16
	Old (>15yrs)	88.0	3.0 (1-5)	2.44
Citrus	Young (<6 yrs)	20.0	1.4 (1-2)	0.28
	Old (>15 yrs)	80.0	8.5 (4-10)	6.8

counterparts. In mango crop, the pest incidence was 20 per cent in managed orchards as against 88.0 per cent in the unmanaged one. The caterpillar indices for the two categories were calculated to be 0.12 and 8.62, respectively. On the contrary, the values for citrus crop were still higher i.e. for incidence (24.0 and 92.0), however, value for caterpillar index was relatively higher (0.48) in managed orchard as against 7.36 in the poorly managed one. In a similar study conducted on Nagpur Mandarin, Shivankar and Rao (2004) also recorded higher (62.4%) infestation of the pest under unmanaged conditions compared to the managed ones (34.96%) which support the present work.

The data obtained in the studies on the relative incidence and intensity of the pest on young/ old orchards of the two crops (mango and citrus) revealed that the infestation of the caterpillar was 16.0 and 20.0 in young orchards as against 88.0 and 80.0 per cent in the old orchards of the two crops, respectively. However, the corresponding values for the indices of the caterpillar incidence were 0.16 and 0.28 (young) and 2.44 and 6.80 (old orchards), respectively. Shivankar and Rao (2004) reported about 20.0 per cent infestation in young (5-10 yrs) trees of Nagpur Mandarin and 49.2 per cent in older trees (>16 yrs) in healthy orchards whereas, in the declining orchards the respective values were 48.1 and 76.16 per cent which corroborate with the present

findings. Similar observations with respect to plant age and management status have been reported from different parts of the country by the earlier workers (Mann and Bindra, 1978; Butani, 1979; Verma, 1985; Sandhu *et al.*, 1987, Lakra, 1999 and Balikai *et al.*, 2011) which confirm the findings of the present work. One probable reason for the low infestation in young orchards is less forkings for hiding of caterpillars in comparison to older trees.

Management: The data recorded on the efficacy of different treatments/ methods for two locations

(Nauni and Kandaghat) representing mid hill conditions are presented in Table 5 and 6. The perusal of the data indicate that at both the locations the three methods/ treatments *viz.*, thrusting of wire + plugging with mud, thrusting of wire + pouring of bore hole with methyl parathion (0.1%) + plugging with mud and thrusting of wire + pouring of bore hole with DDVP (0.15%) + plugging with mud were found to be quite effective as very high (90 - 100 %) mortality of larva was recorded after 7 days of the treatment. These were closely followed by swabbing treatments of chlorpyrifos (0.04%) and methyl parathion (0.1%) providing 79 to 97

Table 5. Relative effectiveness of different management practices against bark-eating caterpillar, *Indarbela* sp. infesting plum at Nauni

Treatment	Per cent mortality at DAT				
	7	14	21	28	Mean
Chlorpyrifos (0.04%) spray	25.00 (30.00)	25.00 (30.00)	75.00 (60.50)	75.00 (60.50)	50.00 (45.25)
Methyl parathion (0.1%) spray	87.50 (68.87)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	96.88 (84.72)
Swabbing with methyl parathion (0.1%)	75.00 (68.77)	87.50 (68.87)	87.50 (68.87)	87.50 (68.87)	84.38 (68.84)
Swabbing with Chlorpyrifos (0.04%)	87.50 (68.87)	87.50 (68.87)	87.50 (68.87)	87.50 (68.87)	87.50 (68.87)
Thrusting of wire + plugging holes with cotton swab dipped in methyl parathion (0.2%)	87.50 (68.87)	87.50 (68.87)	100.00 (90.00)	100.00 (90.00)	93.75 (79.43)
Thrusting of wire + plugging holes with cotton swab dipped in DDVP (0.15%)	37.50 (37.47)	37.50 (37.47)	76.25 (60.67)	87.50 (68.87)	59.69 (51.12)
Thrusting of wire + plugging holes with mud	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
Thrusting of wire + pouring of methyl parathion (0.1%) + plugging holes with mud	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
Thrusting of wire + pouring of DDVP (0.15%) + plugging holes with mud	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
Removing of frass ribbons	37.00 (37.47)	50.00 (45.00)	50.00 (45.00)	62.50 (51.94)	49.87 (46.35)
Control	0.00 (0.57)	0.00 (0.57)	12.50 (20.00)	12.50 (20.00)	6.25 (14.48)
CD (p=0.05)					15.47

DAT: Days after treatment Figures in parentheses are angular transformed values
CD (p=0.05) Intervals = 9.38 Interaction = 22.79

Table 6. Relative effectiveness of different management practices against bark-eating caterpillar, *Indarbela* sp. infesting plum at Kandaghat

Treatment	Per cent mortality at (DAT)				
	7	14	21	28	Mean
Chlorpyrifos (0.04%) spray	22.50 (27.97)	22.50 (27.97)	67.50 (54.94)	67.50 (54.94)	45.00 (41.45)
Methyl parathion (0.1%) spray	78.75 (62.03)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	87.19 (69.18)
Swabbing with methyl parathion (0.1%)	67.50 (54.94)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	84.37 (67.40)
Swabbing with chlorpyrifos (0.04%)	78.75 (62.03)	78.75 (62.03)	78.75 (62.03)	78.75 (62.03)	78.75 (62.03)
Thrusting of wire + plugging holes with cotton swab dipped in methyl parathion (0.2%)	78.75 (62.03)	78.75 (62.03)	90.00 (71.56)	90.00 (71.56)	84.37 (66.79)
Thrusting of wire + plugging holes with cotton swab dipped in DDVP (0.15%)	33.75 (35.06)	69.81 (56.17)	78.75 (62.03)	78.75 (62.03)	65.26 (53.82)
Thrusting of wire + plugging holes with mud	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)
Thrusting of wire + pouring of methyl parathion (0.1%) + plugging holes with mud	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)
Thrusting of wire + pouring of DDVP (0.15%) + plugging holes with mud	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)	90.00 (71.56)
Removing of frass ribbons	33.75 (35.06)	56.25 (48.45)	67.50 (54.94)	67.50 (54.94)	56.25 (48.37)
Control	0.00 (0.57)	0.00 (0.57)	11.25 (19.37)	22.50 (27.97)	8.44 (12.12)
Mean	60.34 (50.39)	68.73 (61.60)	76.70 (62.06)	77.72 (62.84)	-

DAT: Days after treatment

Figures in parentheses are angular transformed values

CD (p=0.05) Treatment = 13.89 Intervals = 8.38 Interaction = 27.78

per cent mortality of the caterpillars of *Indarbela* sp. Removal of frass ribbon alone was able to provide 49 - 56 per cent mortality of the pest which was reasonably superior to the one (45-50 %) obtained from chlorpyrifos (0.04%) spray. In control, however, very low mortality (6.25 and 8.44 %) of the pest larvae was obtained at the two locations. An injection of 5 ml methyl parathion (0.05%) and dichlorvos (0.0125%) have also been reported to be effective against *I. quadrinotata* larvae (Verma *et al.*, 1972) which support the present work where pouring of insecticidal emulsion in the bore hole followed by mud plastering resulted in significant

control of the pest. Sandhu *et al.* (1987) reported spot spraying of monocrotophos (0.05%) to be most effective treatment causing 90.3- 95.6 per cent mortality of the pest on oranges compared to ber (72.3-78.2 %). Sangha and Makkar (2005) reported Sevin 50WP treatment as the most effective one causing 96.8 per cent larval mortality using motorized sprayer when applied on poplar *Populus deltoides*. Cotton swabs soaked with 10ml of either dichlorvos or petrol when inserted into the tunnels bored by the metarbelid, *Indarbela* sp., dichlorvos gave 100 per cent control whereas, petrol provided 96.7 per cent control after 7 days. Subsequent infestation was not

noticed for up to 60 days after treatment (Patil *et al.*, 1990). In the present study also, plugging of bore hole with dichlorvos laden cotton swab proved effective.

From the study, it can be summarise that on the basis of index of caterpillar incidence, in low hills among subtropical fruits, litchi was the most preferred host followed by guava, mango and citrus. In the mid hills, the order of preference of the host by *Indarbela* sp. was plum followed by pear and apricot whereas in the high hills though the infestation was negligible but the order of preference was apple followed by pear. In order to have less infestation of the metarbelid, *Indarbela* sp., the orchards should be kept healthy using good agricultural practices. For the management of the pest, thrusting of flexible wire in the active holes and plugging with mud has been found quite effective and this is one of the best ecofriendly and economic method for the pest management even today. Further, removal of the frass ribbon alone can reduce the infestation upto 50 per cent. However, if it is not possible, then we can use spray of methyl parathion (0.1%) on the infested portions. The old orchards, if neglected, are more prone to the pest attack.

REFERENCES

- Balikai, R. A., Kotikal, Y. K. and Prasanna, P. M. 2011. Status of pomegranate pests and their management strategies in India. *Acta Horticulturae*, **890**: 569-583
- Bhalla, O. P. and Pawar, A. D 1977. *A survey study of insect and non insect pests of economic importance in Himachal Pradesh*. Tiku and Tiku Kitab Mahal, Bombay, 80 p.
- Butani, D. K. 1979. *Insects and Fruits*. Periodical Expert Book Agency, Delhi, 415pp
- Lakra, R. K. 1999. Insect pests of some under exploited fruits and their management. IV. Aonla (*Embllica officinalis* Gaertn) A. Lepidopterous pests. *Haryana Journal of Horticulture Science*, **28**(2):1-11.
- Mathew, G. and Rugmini, P. 1998. Control of bark-eating caterpillar, *Indarbela quadrinotata* in forest plantation of *Paraserianthes falcuturia*. *Indian Journal of Environmental Toxicology*, **8**(1): 37-40.
- Mann, G. S. and Bindra, O. S. 1978. On the incidence of bark eating caterpillar on different cultivars of guava in Punjab. *Punjab Horticulture Journal*, **27**(1&2) : 97-98.
- Sandhu, G. S., Sohi, A. S. and Batra, R. C. 1987. Comparison of different control methods for the management of bark eating caterpillar, *Indarbela quadrinotata* Walker (Metarbelidae: Lepidoptera) infesting fruit and avenue trees in Punjab. *Punjab Horticultural Journal*, **27**(3-4) : 255-259.
- Sangha, K. S. and Makkar, G. S. 2005. Field evaluation of different insecticides against bark eating caterpillar, *Indarbela quadrinotata* (Walker) on *Populus deltoids*. *Indian Forester*, **131**(5): 694-700.
- Shivankar, V. J and Rao, C. N. 2004. Menace of bark eating caterpillar (*Indarbela* spp.) in citrus orchards of Maharashtra. *Pest Management in Horticulture Ecosystems*, **10**(2): 203-206.
- Srivastava, O. S. 1972. Chemical control of bark eating caterpillar, *Indarbela quadrinotata* Walker (Lepidoptera: Metarbelidae) in guava trees. *Indian Journal of Agricultural Sciences*, **42**(9): 847-848.
- Tandon, P. L and Lal, B. 1978. A note on host plant spectrum of the bark eating caterpillar, *Indarbela* sp. (Metarbelidae: Lepidoptera). *Indian Journal of Horticulture*, **36**: 78-79.
- Thakur, R. K. and Thakur, J. R. 1998. Incidence of bark eating caterpillar, *Indarbela quadrinotata* (Walker) on fruit trees in Himachal Pradesh. *Pest Management and Economic Zoology*, **6**(1): 73-75.
- Verma, T. D. 1985. Incidence and chemical control of bark eating caterpillar, *Indarbela quadrinotata* Walker on plum trees, *Indian Journal of Agricultural Sciences*, **55**(2): 131-132.
- Verma, A. N. and Khurana, A. D. 1976. Survey on the incidence of bark eating caterpillar, *Indarbela* spp. on different fruit trees in Haryana. *Haryana Agricultural University Journal of Research*, **2**: 93-96.
- Verma, A. N and Khurana, A. D. 1978. Bark eating borers (*Indarbela* spp.). The pest of fruit, avenue and forest trees in India and South East Asia. *Haryana Journal of Horticultural Science*, **7**(1-2): 40-46.
- Verma, A. N, Khurana, A. D., Singh, R. and Bhanot, J. P. 1972. Control of bark eating caterpillar, *Indarbela quadrinotata* (Walker) with insecticide soaked cotton plugs. *Haryana Journal of Horticultural Science*, **1**: 79-82.

MS Received : 16 May 2014
MS Accepted : 15 June 2014