Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(1): 1336-1340

Received: 07-11-2020
Accepted: 09-12-2020

LU Raut
Post Graduate Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AR Walunj
Scientist-I (Entomology), AICRP on AZF, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

PE More
Scientist-I (Pathology), AICRP on AZF, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
LU Raut
Post Graduate Student, Department of Agricultural Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Seasonal incidence and management of pests infesting jamun (*Syzygium cuminii* L.)

LU Raut, AR Walunj and PE More

Abstract
An experiment was carried out on jamun orchard located at Research farm of AICRP on Arid Zone Fruits, Department of Horticulture, M.P.K.V., Rahuri during the period of February, 2019 to December, 2019 to study the seasonal incidence and management of pests infesting jamun (*Syzygium cuminii* L.). The peak level of infestation of leaf eating caterpillar was noticed during the month of November (47th MW) and recorded 28.71% leaf damage. Whereas, the chafer beetles, leaf miner and fruit borers peak level of infestation was noticed during the month of June (25th – 26th MW) and recorded 19.18%, 1.87% and 67.70% damage respectively. Correlation studies indicated that, the leaf eating caterpillar and fruit borer were found positively correlated with minimum temperature, relative humidity I & II and rainfall. Whereas, the chafer beetles and leaf miner were found positively correlated with maximum temperature and minimum temperature. The pooled data on efficacy of various treatments revealed that, the treatment with NSE 5% was found the most effective treatment for the management of leaf feeders and fruit borer infestation which was found at par with the treatment of Azadiractin 10000 ppm @ 2 ml/ lit. of water and Neem oil @ 2 ml/ lit. of water and recorded least leaf eating caterpillar damage in the range of 7.19 to 8.36 per shoot per branch and fruit borer damage was recorded in the range of 6.37 to 9.17 % as against 42.67 % in untreated control. As regards the yield of jamun, the treatment with NSE 5%, Azadiractin 10000 ppm and Neem oil @ 2 ml/ lit. of water registered the higher fruit yield i.e., 30.54, 28.45 and 27.25 kg/tree respectively.

Keywords: Jamun, *Meridarchis scyrodes*, *Carea subtilis*, *Adoretus spp.*, *Acrocercops spp.*

Introduction
Jamun, *Syzygium cuminii* L. (Myrtaceae) is a very common, large evergreen tree of Indian subcontinent. In India the maximum numbers of jamun trees are found scattered throughout the tropical and subtropical regions. It is widely grown in the larger parts of India from the Indo-Gangetic plains in the north to Tamil Nadu in the South (Kumar *et al*. 2010) [11]. India is the second largest producer of the fruits in the world. World production of jamun is estimated to 13.5 million tonnes, out of which 15.4% is contributed by India. In India Maharashtra is the largest jamun producer state followed by Uttar Pradesh, Tamil Nadu, Gujarat and Assam (Anon., 2014) [1]. There are lot of major and minor pests which infest leaves, flowers, fruits, seeds and barks, but the perusal of literature reveals that there is no consolidated account available on the insects associated with jamun in India except a major contribution was made by Butani (1979) [5]. Among the pests, fruit borer and leaf feeders *viz*., leaf eating caterpillar, chafer beetles and leaf miner causes severe damage to tree in which the leaf eating caterpillar (*Carea subtillis*) infest the leaves and may defoliate the tree (Singh *et al*. 2009) [14]. Whereas, the fruit borer (*Meridarchis scyrodes* M.) has been reported one of the serious pests in southern states like Gujarat, Maharashtra, A.P., Karnataka, etc. of India and it causes up to 70% yield loss in ber under severe infestation (Haldhar and Maheshwari, 2018) [8], to control these pests farmers solely rely upon insecticides as the first line of defense to get immediate action. Abuse of insecticides has aggravated the pest problem leading to resurgence, outbreak of secondary pests, residues in fruits and development of insecticidal resistance. So that selection of ecofriendly insecticides which is safe to natural enemies and free from pesticide residues. Therefore, present investigation was undertaken to formulate pest management programme strategies.

Materials and Methods
The present experiment was carried out at jamun orchard located at Research farm of AICRP on Arid Zone Fruits, Department of Horticulture, M.P.K.V., Rahuri during the period of

February, 2019 to December, 2019. The studies on seasonal incidence and management of jamun insect pests were carried out at AICRP on Arid Zone Fruits MPKV, Rahuri. All the experimental trees in the orchard were kept free from application of insecticides. All other agronomical practices were followed as per the recommendation made by MPKV, Rahuri. Ten trees were randomly selected from the orchard of variety Kokan Bahadoli and the monitoring of pest's incidence was carried out during the period of February 2019 to December 2019. Observations were recorded at weekly interval from the 5th to 52nd MW. To evaluate the bioefficacy of different botanical and biopesticide treatments against major insect pests infesting jamun. There were seven botanical and biopesticide treatments replicated thrice in the randomized block design. The treatments included are *Metarhizium anisopliae* 1.15%WP, *Beauveria bassiana* 1.15%WP, Neem oil @ 2 ml/ l., Karanj oil @ 2ml/ l., Azadiractin 10000 ppm, NSE 5% and untreated control. The respective treatments were sprayed on jamun at vegetative and flowering stage. Three sprayings were carried out at the interval of fifteen days. The observation of pest's infestation was made one day before the first spray as precount and post count on 3rd, 7th and 14th days after each spray.

The observations on leaf feeders were assessed by counting damaged leaves by caterpillar at weekly interval from 5th meteorological week (February 2019) to 52nd meteorological week (December 2019). The total number of damaged and healthy leaves of randomly selected leaves from four branches of same length (1.5 ft. each) on each tree was observed. The per cent leaf damage was calculated as follows.

$$\text{Per cent damage} = \frac{\text{Number of damaged leaves}}{\text{Total number of observed leaves}} \text{ X } 100$$

The observation on incidence of fruit borer were recorded by randomly selecting four branches of same length (1.5 ft. each) on the tree from top, middle and bottom at weekly interval from fruit setting to harvest (14 MW to 28 MW of 2019). The per cent fruit damage was worked out by counting infested fruits as well as healthy fruits and then cumulative per cent fruit damage after harvesting was worked out.

To study the impact of weather factors on pest abundance a simple correlation of pest population with different weather parameter were worked out. The data on percent infestation of pests were converted into arcsine transformed values and the data on yield were transformed in kg/plant then subjected to statistical analysis to find out the significance of treatments.

Results and Discussion

It is revealed from the data presented in the Table 1 that; the degree of damage due to leaf eating caterpillar was in the range of 5.50 to 28.71 per cent and the incidence gradually increased up to the third week of November and reached its peak i.e., 28.71 per cent leaf damage/ shoot/ branch in (47th MW). The damage of chafer beetles was found in the range of 7.25 to 19.18 per cent during the period of experimentation and the incidence gradually increased up to the fourth week of June and reached its peak i.e., 19.18 per cent leaf damage/ shoot/ branch in (26th MW). Leaf miner damage was found in the range of 0.12 to 1.87 per cent during the period of experimentation and the incidence gradually increased up to the third week of June and reached its peak i.e., 1.87 per cent in (25th MW). Whereas, the degree of damage due to fruit borer was in the range of 2.85 to 67.70 per cent during the period of experiment and the incidence gradually increased up to the third week of June and reached its peak i.e., 67.70 per cent fruit damage in (25th MW). Keeping in the view to above results during investigation, it was noticed that the literature on this aspect was found negligible. However, the present findings were found confirmative with the result of Haldhar *et al.* (2016) [7] reported that, the chafer beetles become active with the onset of the rainy season when new growth starts. They cause heavy damage to developing foliage of ber during the month of June to August, Singh *et al.* (2009) [14] reported that, the jamun leaf miner (*Acrocercops syngramma* and *Acrocercops phaeospora*) causes heavy damage during the reproductive phase i.e., from April to September.

It was evident from the data presented in the Table 2 that, the leaf eating caterpillar had highly positive significant correlation with minimum temperature (r = 0.304), morning relative humidity (r = 0.707), evening relative humidity (r = 0.667) and rainfall (r = 0.667). The chafer beetles were found positively significantly correlated with maximum and minimum temperature at (r = 0.447) and (r = 0.373) respectively. Whereas, the leaf miner was found positively significantly correlated with maximum and minimum temperature at (r = 0.585) and (r = 0.703) respectively. However, the fruit borer had positive significant correlation with minimum temperature (r = 0.864), morning relative humidity (r = 0.524), evening relative humidity (r = 0.593) and rainfall (r = 0.344). The present findings were found confirmative with the results of Thorat (2018) [16] reported that there was positive correlation between leaf eating caterpillar incidence and evening humidity in ber. Bajad *et al.* (2019) [2] reported that there was positive correlation between scarab beetles and minimum temperature. Kumar *et al.* (2018) [10] reported that white grub adult showed highly significant positive correlation with temperature (r =0.89, 0.93), (r =0.86, 0.91) and Kanhar *et al.* (2017) [9] reported that, there was negative non-significant correlation between mango leaf miner, *Acrocercops syngramma* (M.) and relative humidity. Gopali *et al.* (2003) [6] reported that, there was negative correlation between ber fruit borer and the maximum temperature (r = -0.75) and Nandihalli *et al.* (1996) [12] reported that, the fruit borer (*Meridarchis scyrodes* M.) was positively correlated with the temperature and negatively correlated to relative humidity, which was found more or less similar with the present results of investigation.

The data presented in Table 3, revealed that, the leaf eating caterpillar damage prior to sprayings was ranged between 13.00 to 15.50 per cent found statistically non-significant. After three sprays, the pooled efficacy of NSE 5% was found the most effective control against leaf eating caterpillar and recorded least mean leaf damage of 7.99 per cent which was found at par with the treatment of Azadiractin 10000 ppm @ 2 ml/ l. of water and Neem oil @ 2 ml/ l. of water which recorded 7.80 and 8.36 per cent damage respectively followed by Karanj oil @ 2ml/ l. of water which recorded 8.77 per cent damage followed by *Beauveria bassiana* 1.15%WP @ 6 g/l. of water which recorded 13.29 per cent and *Metarhizium anisopliae* 1.15%WP @ 6 g/l. of water recorded 13.71 per cent damage as against, the untreated control recorded the highest 18.14 per cent damage/ shoot/ branch. Keeping in the view to above results during investigation, the literatures on this issue was found negligible. However, the present result of investigation found confirmative with the result of Bochare *et al.* (2018) [4] reported that, the NSE 5% were found most effective in reducing the population of green semilooper and

tobacco leaf eating caterpillar on soybean and Berani *et al.* (2018) [3] reported that, the Azadirachtin 0.15 EC 0.0006 %, NSKE 5%, neem oil 0.3% were found highly effective in managing *Spilosoma oblique* Walker and *Maruca testulalis* (Geyer) in black gram.

As regards the chafer beetles damage before sprayings was ranged between 15.16 to 17.45 per cent showing statistically non-significant. After three rounds of spray, the pooled efficacy of NSE 5% was found the most effective control and recorded least mean leaf damage of 9.74 per cent, which was found at par with the treatment of Azadiractin 10000 ppm @ 2 ml/ l. of water and Neem oil @ 2 ml/ l. of water which recorded 10.90 and 11.28 per cent respectively followed by Karanj oil @ 2ml/ l. of water recorded 11.71 per cent followed by *Beauveria bassiana* 1.15%WP @ 6 g/l. of water which recorded 13.29 per cent and *Metarhizium anisopliae* 1.15%WP @ 6 g/l. of water recorded 13.71 per cent as against, 18.15 per cent damage/ shoot/ branch recorded in untreated control. Keeping in the view to above results during investigation, the literature on this issue was found negligible. However, the present result of investigation found confirmative with the result of Nizamani *et al.* (2014) [13] reported that, the significant reduction in the infestation of jujube beetle (*A. pallens*) was obtained with Neem Seed Extract (NSE).

It is revealed from the data presented Table 4 that, as regards the fruit borer damage, all the treatments were found effective over control and recorded the fruit damage in the range of 6.37 to 17.48 per cent as against 42.67 per cent in untreated control. Among the all treatments, the treatment with NSE 5% was found the most effective control against fruit borer and recorded least fruit damage of 6.37 per cent, which was found at par with the treatment of Azadiractin 10000 ppm @ 2 ml/ l. of water and recorded 8.32 per cent damage, followed by Neem oil @ 2 ml/ l. of water recorded 9.17 per cent damage followed by *Beauveria bassiana* 1.15% WP @ 6 g/l. of water recorded 13.84 per cent damage, *Metarhizium anisopliae* 1.15% WP @ 6 g/l. of water recorded 15.90 per cent damage and Karanj oil @ 2ml/ l. of water recorded 17.48 per cent damage. Keeping in the view to above results during investigation, the literature on fruit borer of jamun was found scanty. However, the present result of investigation found confirmative on the other fruit crops with the results of Yelshetty *et al.* (1996) [17] reported that, the plant treated with NSKE 5% maintain their efficacy against fruit borer by recording 15.91% fruit damage in ber. However, 48.50% of fruit damage was recorded in untreated control. Srinivasulu *et al.* (2017) [15] reported that, the NSKE 5% recorded the lowest per cent borer damage (28.12) against ber fruit borer. As regards the fruit yield, the treatment with NSE 5% was found the most effective treatment which recorded the highest marketable yield of 30.54 kg/tree, followed by Azadiractin 10000 ppm @ 2 ml/ l. of water recorded 28.45 kg/tree and Neem oil @ 2 ml/ l. of water recorded 27.25 kg/tree. As against, only 14.26 kg/tree fruits were recorded in untreated control. Keeping in the view to above results during investigation, the present result of investigation found confirmative on other fruit crops reported by Srinivasulu *et al.* (2017) [15] recorded the highest fruit yield (73.85 kg/plant) were obtained with the treatment of NKSE 5% against fruit borer in ber.

Table 1: Seasonal incidence of leaf feeder's viz., leaf eating caterpillar, chafer beetles, leaf miner and fruit borer.

M.W. No.	Mean percent infestation				Weather Factors				
	Leaf eating caterpillar	Chafer beetles	Leaf miner	Fruit borer	Temperature (^{0}C)		Relative humidity		Rainfall (mm)
					Max.	Min.	RH –I (%)	RH-II (%)	
5.	5.5	7.25	0.12	0	29.4	11.3	58	31	0
6.	5.8	7.9	0.25	0	27.2	10.3	60	42	0
7.	5.1	7.55	0.3	0	27.7	10.4	53.43	29.43	0
8.	6.7	8.35	0.65	0	27.6	9.1	54	29.29	0
9.	4.57	8.28	0.82	0	31.8	14.1	55.14	27.71	0
10.	5.8	9.4	0.9	0	34.7	15.4	49.86	24.43	0
11.	5.77	9.88	0.7	0	31.9	13	47.29	19.71	0
12.	6.75	10.27	0.72	0	33.3	14.1	45.14	19.86	0
13.	8.97	10.48	0.65	0	35.5	16	51.43	16.14	0
14.	8.75	10.37	0.82	2.85	36.4	16.1	46.14.	14.71	0
15.	9.87	11.43	0.85	4.12	39.3	18.8	39.57	13.14	0
16.	8.8	11.4	1.12	7.05	39.7	20	38	14	0
17.	10.7	11.85	1.25	13.82	40.4	21.2	35.28	13.43	0
18.	10.92	12.46	1.25	20.24	37.1	19.2	45	18.57	4.4
19.	10.1	12.05	1.3	28.36	41.3	24	30.57	11.71	0
20.	11.77	13.88	1.32	36.21	39.1	20.7	37.29	15.86	0
21.	11.35	14.04	1.4	43.6	39.3	21.7	44.29	17.57	0
22.	11.52	14.76	1.42	52.92	40	21.8	34.57	14	0
23.	11.1	15.55	1.58	60.5	41.3	25.5	38.29	16.29	0
24.	12.7	17.85	1.62	62.3	41.2	23.5	39.14	19	0
25.	12.8	18.4	1.87	67.7	39.2	26.1	51.43	30.29	7
26.	12.37	19.18	1.85	65.00	37.2	24.9	58.71	35.14	0.4
27.	13.2	19.1	1.82	63.42	36.1	24.3	69.86	40	182
28.	13.5	18.75	1.7	61.00	31.4	23.8	80.71	60.29	51.4
29.	12.6	18.3	1.6	0	30.6	23.5	79	63	3.8
30.	13.39	17.7	1.42	0	32	23.6	76	56.57	32
31.	13.77	17.38	1.32	0	33.8	23.2	71.43	51.29	18.4
32.	14.00	17.00	1.3	0	30.5	23.6	78.43	68.14	47.8
33.	14.77	16.6	1.2	0	27	22.9	87	77.43	0
34.	16.00	16.37	1.00	0	28	23.3	80.57	68.14	0

35.	16.77	15.94	1.00	0	31	22.5	75.14	59.57	0
36.	17.75	14.87	0.92	0	32.5	21.3	72.43	47.57	87.2
37.	19.57	14.78	0.87	0	32	23	75.14	55.71	3
38.	20.53	12.76	0.6	0	30	23.3	77.57	70.57	21.6
39.	23.6	11.3	0.5	0	28.8	22.5	78.57	68.43	84.2
40.	22.00	10.00	0.42	0	29.8	21.7	83.57	71	36.6
41.	23.46	8.23	0.35	0	30.2	21.9	83.43	66.86	7.8
42.	24.5	7.25	0	0	31.1	21.1	80.57	58.71	2.8
43.	25.53	7.2	0	0	31.7	21.1	77	50.29	52.4
44.	26.00	5.12	0	0	28.3	18.6	81.57	67.71	141.8
45.	26.5	3.00	0	0	25.7	20.8	87.14	79.57	4
46.	27.25	2.7	0	0	30.4	21	84	58.57	23.4
47.	28.71	1.5	0	0	31.1	18.4	76.14	46.14	2
48.	27.46	1.00	0	0	29.7	16.7	73	48	0
49.	25.6	0.7	0	0	30	15.2	74	45.29	0
50.	23.00	0	0	0	30.47	15.9	73.86	44.24	0
51.	20.18	0	0	0	28.77	16.4	71.14	46.86	0
52.	18.13	0	0	0	29.65	16.3	74.29	42	0

Table 2: Correlation of weather parameters with pest incidence on jamun

Variable	Meteorological parameters				
	Max. Temp. (^{0}C)	Min. Temp. (^{0}C)	R.H-I (%)	R.H-II (%)	Rainfall (mm)
Leaf eating caterpillar	-0.404*	0.304*	0.707*	0.667*	0.667*
Chafer beetles	0.447*	0.373*	-0.209	-0.066	-0.066
Leaf miner	0.585*	0.703*	-0.158	-0.124	0.187
Fruit borer	-0.138	0.864*	0.524*	0.593*	0.344*

Note: *Significant at 5% p = 0.2907

Table 3: Pooled efficacy of different botanicals and biopesticides treatment against leaf eating caterpillar and chafer beetles on jamun (Av. of three sprays)

Tr. No.	Treatments	Dose ml/l	Percent damage									
			Leaf eating caterpillar					Chafer beetles				
			Precount	3 DAS	7 DAS	14 DAS	Mean	Precount	3 DAS	7 DAS	14 DAS	Mean
T_1	*Metarhizium anisopliae*	6.0 g/l	15.03 (22.80)	12.02 (20.19)	11.33 (19.55)	11.00 (19.25)	11.45 (19.66)	16.83 (24.18)	14.29 (22.14)	13.61 (21.58)	13.24 (21.27)	13.71 (21.660
T_2	*Beauveria bassiana*	6.0 g/l	15.34 (23.04)	11.59 (19.80)	11.10 (19.30)	10.63 (18.88)	11.11 (19.32)	16.11 (23.64)	13.99 (21.91)	13.06 (21.10)	12.83 (20.88)	13.29 (21.30)
T_3	Neem oil	2.0 ml/l	13.00 (21.11)	9.07 (17.29)	8.46 (16.64)	7.55 (15.64)	8.36 (16.52)	15.62 (23.26)	11.92 (20.11)	11.13 (19.38)	10.79 (19.08)	11.28 (19.52)
T_4	Karanj oil	2.0 ml/l	14.25 (22.15)	9.52 (17.72)	8.81 (17.01)	7.98 (16.08)	8.77 (16.94)	16.10 (23.63)	12.18 (20.34)	11.73 (19.95)	11.21 (19.47)	11.71 (19.92)
T_5	Azadiractin (10000 ppm)	2.0 ml/l	13.37 (21.43)	8.49 (16.66)	7.83 (15.97)	7.08 (15.12)	7.80 (15.92)	15.16 (22.89)	11.46 (19.69)	10.84 (19.12)	10.41 (18.68)	10.90 (19.17)
T_6	NSE 5%	50 gm/l	13.33 (21.41)	7.99 (16.11)	7.09 (15.10)	6.50 (14.43)	7.19 (15.21)	15.50 (23.15)	10.59 (18.86)	9.69 (17.95)	8.95 (17.23)	9.74 (18.01)
T_7	Untreated control		15.50 (23.16)	16.24 (23.75)	16.27 (23.76)	16.12 (23.64)	16.21 (23.72)	17.45 (24.66)	18.15 (25.20)	18.20 (25.23)	18.08 (25.14)	18.14 (25.19)
	S.E.		0.66	0.60	0.78	0.66	0.68	1.02	0.85	0.96	1.05	0.95
	CD@5%		NS	1.85	2.40	2.03	2.09	NS	2.62	2.95	3.24	2.94

Note: 1) DAS = Days after spray, 2) NS = Non-Significant
3) Figures in the parenthesis are arcsine transformed values.

Table 4: Effect of different botanicals and biopesticides treatment against fruit borer and yield of jamun

Tr. No.	Treatments	Dose ml/l	Average percent fruit damage	Average yield (Kg/tree)
1.	*Metarhizium anisopliae*	6.0 g/l	15.90 (23.46)	22.07
2.	*Beauveria bassiana*	6.0 g/l	13.84 (21.81)	23.62
3.	Neem oil	2.0 ml/l	9.17 (17.59)	27.25
4.	Karanj oil	2.0 ml/l	17.48 (24.68)	21.31
5.	Azadiractin (10000 ppm)	2.0 ml/l	8.32 (16.69)	28.45
6.	NSE 5%	50 gm/l	6.37 (14.33)	30.54
7.	Untreated control	-	42.67 (40.77)	14.26
	S.E.		1.30	1.65
	CD @ 5%		3.99	5.07

Note: Figures in the parenthesis are arcsine transformed values.

Conclusion

Studies on seasonal incidence of insect pests hold a promising opportunity to development of management tactics relevant to the control of insect pests. For example, knowing the vulnerability in the life cycle i.e., seasonal cycle, behaviour etc. plays an important role in suppressing the pest density. During the period of experiment, the peak incidence of insect pests was noticed on the onset of monsoon. Therefore, detailed investigations on insect pests in relation to the impact of weather conditions in jamun ecosystem assume practical importance. It can be concluded from the present investigation that, three sprays of NSE 5% found to be highly effective in reducing the infestation of leaf feeders and fruit borer which was found at par with the treatment of Azadiractin 10000 ppm@ 2ml/l of water and Neem oil @ 2 ml/l on jamun.

References

1. Anonymous, Indian Horticultural Database, National Horticultural Board 2018.
2. Bajad VV, Undirwade DB, Dhonde SV, Dadmal SM. Incidence of scarab beetles collected through light trap at Akola vicinity of Maharashtra with reference to Scarabaeidae of Coleoptera. Journal of Entomology and Zoology Studies 2019;7(2):405-409.
3. Berani NK, Godhani PH, Bhatt NA. Bio-efficacy of botanical insecticides against lepidopteran insect pest infesting black gram. Journal of Entomology and Zoology Studies 2018;6(4):642-646.
4. Bochare GD, Undirwade DB, Shinde SS, Dhandge SR. Evaluation of Microbials and Botanicals against Defoliators of Soybean. International Journal of Pure Applied Bioscience 2018;6(5):62-67.
5. Butani DK. Insects and Fruits. Periodical Expert Book Agency, D-42, Vivek Vihar, Delhi 110032. 1979, 415.
6. Gopali JB, Sharana Basappa, Yelshetty S. Incidence of ber fruit borer, *Meridarchis scyrodes* M. (Lepidoptera: Carposinidae) in relation to weather parameters. Insect Environment 2003;9(4):165-166.
7. Haldhar SM, Deshwal HL, Jat GC, Berwal MK, Singh D. Pest scenario of ber (*Ziziphus mauritiana* Lam.) in arid regions of Rajasthan: a review, Journal of Agriculture and Ecology 2016;1:10-21.
8. Haldhar SM, Maheshwari SK. Insect-pests management in arid and semi-arid horticultural crops. Technical bulletin no: 64, ICAR- CIAH, Bikaner 2018.
9. Kanhar KA, Kanher FM, Panhwar R, Tunio SA, Shaikh AM, Awan RRH. Parasitoids associated with mango leaf miner, *Acrocercops syngramma* (M.) Lepidoptera: Gracillariidae in Mango Orchard. Journal of Entomology and Zoology Studies 2017;5(4):1582-1588.
10. Kumar R, Ahad I, Rehman SA, Dorjey S. Impact of weather parameters on population dynamics of soil borne insect pests infesting oats (*Avena sativa* L.) in North Kashmir. Journal of Entomology and Zoology Studies 2018;6(3):533-537.
11. Kumar R, Ramamurthy V, Sharma G. Checklist of insects associated with Jamun (*Syzygium cuminii* Skeels) from India. Biological Forum- An International Journal. 2010;2(1):1-5.
12. Nandihalli BS, Kuberappa GC, Viswanathappa KR. Survey of insect pests of potato in Hassan, Karnataka. Mysore Journal of Agricultural Science 1996;30:138-141.
13. Nizamani IA, Rustamani MA, Nizamani SM, Khaskheli Ibrahim M. Integrative approaches for the management of jujube beetle, *Adoretus pallens*. International Journal of Development Research 2014;4(1):2225-2229.
14. Singh AK, Bajpai A, Singh VK, Ravishankar H, Tondon DK. The Jamun (*Syzygium cuminii* Skeels). Technical Bulletin, central institute for subtropical horticulture (ICAR) Lucknow 2009, 20-21.
15. Srinivasulu B, Subramanyam K, Rajeshwari G, Deepthi P. Influence of spray time of botanicals and insecticides on ber fruit borer, *Meridarchis scyrodes* Meyrick. Pest management In Horticultural Ecosystem 2017;23(2):174-175.
16. Thorat SJ. Evaluation of promising genotypes of ber (*Zizyphus mauritiana* L.) against pest complex. Thesis (Unpublished) submitted to MPKV, Rahuri 2018.
17. Yelshetty S. Management of Ber Fruit Borer, *Meridarchis scyrodes* M. (Carposinidae: Lepidoptera). Karnataka Journal of Agricultural Science 1996;9(3):529-532.