



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2023; 12(3): 2874-2879  
© 2023 TPI  
[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 01-01-2023  
Accepted: 03-02-2023

**RB Hirekurubar**  
Kittur Rani Channamma College of Horticulture (KRCCH), UHS, Bagalkot, Karnataka, India

**MH Tatagar**  
College of Horticulture, Sirsi, UHS, Bagalkot, Karnataka, India

**Suvarna Patil**  
Regional Horticultural Research and Extension Centre (RHREC), UHS, Bagalkot, Karnataka, India

**Ramegowda GK**  
College of Horticulture, UHS, Bagalkot, Karnataka, India

**AI Sabarad**  
KRCCH, Arabhavi, UHS, Bagalkot, Karnataka, India

**Mahantesha BN Naika**  
KRCCH, Arabhavi, UHS, Bagalkot, Karnataka, India

**AB Mastiholi**  
RHREC, UHS, Bagalkot, Karnataka, India

**Corresponding Author:**  
**RB Hirekurubar**  
Kittur Rani Channamma College of Horticulture (KRCCH), UHS, Bagalkot, Karnataka, India

## Seasonal incidence of sucking pest and bark eating caterpillar on Jamun (*Syzygium cuminii* (L.) Skeels) in Karnataka, India

**RB Hirekurubar, MH Tatagar, Suvarna Patil, Ramegowda GK, AI Sabarad, Mahantesha BN Naika and AB Mastiholi**

### Abstract

This experiment was carried out at Kittur Rani Channamma College of Horticulture (KRCCH), Arabhavi, UHS, Bagalkot, Karnataka, India, from January to December during 2021 and 2022. The study orchard comprised of nine years old AJG-85 and Konkani Bahadoli jamun varieties. Observations on sucking insect pests and bark eating caterpillar were recorded. Among the sucking pest, shield back bug was noticed throughout the year. Tea mosquito bug incidence prevailed from I fortnight of January to I fortnight of May and again it was observed from November I fortnight to December II fortnight in both varieties. Whitefly incidence was noticed from I fortnight of February to I fortnight of May and II fortnight of November to II fortnight of December in AJG-85 and where as in Konkani Bahadoli whitefly incidence was observed from I fortnight of January. The occurrence of bark eating caterpillar was observed throughout the year in both varieties.

**Keywords:** AJG-85, bark eating caterpillar, konkani Bahadoli, shield back bug, tea mosquito bug

### Introduction

*Syzygium cuminii* (Family Myrtaceae) is also scientifically known as *Syzygium jambolanum* and *Eugenia cumini*. It is commonly called as Jamun. It is Duhat, Jam, Jaman in Hindi, Brahaspati in Sanskrit and Nerale in kannada. Jambolan plum, Malabar plum, Jambul, Indian blackberry, Black plum, Java plum, Indian Jamblang are the local names in different regions of the country. Jamun is an indigenous fruit crop of India. It is native to India, Burma, and Ceylon and Andaman Islands (Zeven and de Wet, 1982) [17].

Presently Jamun trees are found growing throughout the Asian subcontinent, South America, Eastern Africa, Madagascar, Hawaii and Florida parts of United States of America (Warrier *et al.*, 1996) [16]. Jamun plants are available throughout the Indian plains as well as in Kumaon hills up to 1,600 MSL. It is widely grown in the larger part of India from the Indo-Gangetic plains in the North to Tamil-Nadu in the south (Chaturvedi, 1956) [4].

Fruit contain sugar (8.09%), non-reducing sugar (9.26%) and sulfuric acid (1.21%). It also contains glucose, fructose, mannose, and galactose as the principal sugar moieties. The mineral constituents are Ca, Mg, Na, K, Cu and vitamins such as thiamine, riboflavin, nicotinic acid etc (Veigas *et al.*, 2007, and Dagadkhair, 2017) [15, 5]. Jamun pulp contains moisture content of 82.19±2.46%, crude protein 2.15±0.06%, crude fat 0.83±0.02%, crude fiber 1.76±0.05%, ash 2.04±0.06% and nitrogen free extracts (NFE) 11.03±0.33%. Whereas, Jamun seed consisted of moisture (16.34±0.49%), crude protein (1.97±0.59%), crude fat (0.65±0.01%), crude fiber (4.19±0.12%), ash (2.18±0.06%) and NFE (74.67±2.24%). Scientific studies have shown that the various extracts of jamun possess a wide range of medicinal properties such as antibacterial, antifungal, antiviral, anti-genotoxic, anti-inflammatory, free radical scavenging, antioxidant, hepatoprotective, anti-diarrheal, hypoglycemic and antidiabetic effects. Presences of anthocyanins, fibers and ellagitannins which are present in the pulp are important in reducing the oxidative stress-induced diseases. (Kumar *et al.*, 2011, Singh *et al.*, 2011 and Singh and Singh, 2012) [7, 12, 13].

In India, Butani and Jotwani (1975) [2] were the first to document the information about insect pest spectrum infesting jamun and their management options. Bark eating caterpillar, *Inderbela tetraonis* (Moore); thrips, *Rhipiphorothrips cruentatus* Hood; scale, *Aspidiotus destructor* Signoret and *Chloropulvinaria psidii* (Maskell); mulberry bug, *Halyss dentatus* Fabricius; whitefly, *Dialeurodes citri* Riley and Howard and hairy caterpillar, *Euproctis*

*fraternal* were infesting jamun besides, many other fruit trees for which few integrated pest management measures were recommended.

With these advantages jamun is gaining importance but it is being infested by many insects. Butani (1979) [3] reported 36 insect species feeding and breeding in jamun, among them bark eating caterpillar, *Inderbela tetraonis* (Moore) infestation was noticed from May to December, then over winter and pupate in late April. Presence of silken webs specially nears the forking of trunk or main branches are the typical symptoms of pest attack. Mulberry bug, *Halyss dentatus* Fabricius is found all over the India, swarms of nymphs and adults suck sap from main stems and trunk of the trees during summer. Scale insect, *Aonidiella aurantii*, *Aspidiotus destructor* Signoret and *Chloropulvinaria psidii* (Maskell), Psyllid, *Trioza jambolanae* Crawford forms galls on jamun leaves, whiteflies *Dialeurodes eugeniae* (Maskell) and *Singhiella bicolor* (Singh) are specific pests of jamun besides these other species like *Dialeurodes citri* Riley and Howard, *D. vulgaris* Singh, *Rhachisphora trilobitoides* (Quaintance and Baker) have also been recorded from various parts of India. Thrips, *Leeuwenia ramakrishnae* was reported as a specific pest of jamun and commonly found in south India. *Thrips floraum* was noted as minor pest of jamun, jamun fruit worm. At present more than 75 species of insect and mite pests have been documented (Rajeshkumar *et al.*, 2010 and Nayak, 2017) [10, 8]. Recently Pooja (2019) [9] studied the pest complex of 15 jamun varieties at RHREC, Bengaluru and reported 26 insect pest species infesting jamun tree. literature on seasonal occurrence and damaging symptoms of sucking pests is scanty hence the study was undertaken.

## Material and Methods

This experiment was carried out at Kittur Rani Channamma College of Horticulture (KRCCH), Arabhavi, UHS, Bagalkot, Karnataka, India, from January to December during 2021 and 2022. The study orchard comprised of nine years old AJG-85 and Konkan Bahadoli varieties planted 3 m x 3 m apart.

### 1. Study sites

The geographical location of Arabhavi, the study site is situated in the Northern Dry Zone (Zone-3), Region -2 of Agro climatic Zones of Karnataka state at 16° 13' 19" N, 74° 49' 60" E and 532.45 m latitude, longitude and above mean sea level, respectively. The experimental site consists of medium deep black soil. Arabhavi, area receives both south-west and north-east monsoon rains. The average annual rainfall is 522 mm, occurring during April to November with peak during September. It also gets water from Ghataprabha Left Bank Canal from October to March.

### 2. Method of data collection

Observations on sucking insect pests and bark eating caterpillar were recorded at fortnightly from five randomly selected and tagged plants in each variety. Observations on the number of insects in all four directions (east, west, south and north) either adults and/or immature stages per leaf or shoot or branch on a jamun tree were recorded as detailed below.

**Shield back bug:** Numbers of both nymphs and adults per shoot on randomly selected five shoots in all four directions per tree were recorded.

**Tea mosquito bug:** Number of infested leaves per shoot from five shoots were recorded in each direction from five randomly selected trees.

**Spiraling whitefly:** Numbers of spirals per leaf from five shoots were recorded in each direction from five randomly selected trees.

**Bark eating caterpillar:** Number of fresh and active galleries on the main trunk and branches per tree were recorded.

## Results and Discussion

The prevalence of sucking pest and bark eating caterpillar on jamun trees during 2021 are depicted in Table 1.

Shield back bug was prevalent throughout the year, in both varieties. The maximum number of 2.70 and 0.16 adults and nymphs per shoot were recorded in AJG-85 and Konkan Bahadoli, respectively during second fortnight of April and first fortnight of December.

Tea mosquito bug incidence prevailed from first fortnight of January to first fortnight May and again it was observed from November first fortnight to December second fortnight in AJG-85 as well as in Konkan Bahadoli. Maximum damage of 4.80 damaged leaves per shoot were recorded from AJG-85 during second fortnight of February. Where as in Konkan Bahadoli maximum of 3.00 damaged leaves per shoot were recorded during II fortnight of February.

In AJG-85 variety whitefly, incidence was observed from first fortnight of February to I fortnight of May with maximum (0.14) number of spirals per leaf, during March first fortnight. However, in Konkan Bahadoli incidence was registered from I fortnight of January to II fortnight of April with maximum (0.27) during first fortnight of March. In both varieties pest was also noticed from I fortnight of November to II fortnight of December.

Bark eating caterpillar incidence was observed throughout the year in AJG-85 as well as in Konkan Bahadoli. Maximum (1.40) numbers of active galleries per tree were recorded during first fortnight of May in AJG-85 and in Konkan Bahadoli maximum of 1.20 active galleries per tree were recorded during second fortnight of March. Similar trend was noticed during 2022 and data is presented in Table 2.

Pooled data of sucking pest of jamun and bark eating caterpillar is presented in Table 3. The occurrence of shield back bug was noticed throughout the year, in both varieties. The maximum number of 2.60 and 0.44 adults and nymphs per shoot were recorded in AJG-85 and Konkan Bahadoli, respectively during second fortnight of April and first fortnight of April.

Tea mosquito bug incidence prevailed from first fortnight of January to first fortnight May and again it was observed from November first fortnight to December second fortnight in AJG-85 as well as in Konkan Bahadoli. Maximum damage of 4.59 damaged leaves per shoot were recorded from AJG-85 during second fortnight of February. Where as in Konkan Bahadoli maximum of 2.98 damaged leaves per shoot were recorded during I fortnight of February.

In AJG-85 variety whitefly, incidence was observed from first fortnight of February to I fortnight of May with maximum (0.25) number of spirals per leaf, during March first fortnight. However, in Konkan Bahadoli incidence was registered from I fortnight of January to II fortnight of April with maximum (0.36) during first fortnight of March. In both varieties pest

was also noticed from I fortnight of November to II fortnight of December.

Bark eating caterpillar incidence was observed throughout the year in AJG-85 as well as in Konkan Bahadoli. Maximum

(1.66) numbers of active galleries per tree were recorded during first fortnight of May in AJG-85 and in Konkan Bahadoli maximum of 1.53 active galleries per tree were recorded during second fortnight of March.

**Table 1:** Population dynamics of sucking pest and bark eating caterpillar in AJG-85 and Konkan Bahadoli Jamun varieties at KRCCH, Arabhavi during 2021

Fortnight	Shield back bug (No. of adults and nymphs/shoot)		Tea mosquito bug (No. of damaged leaves/shoot)			Whitefly (No. of spirals/leaf)		Bark eating caterpillar (No. of active galleries/tree)	
	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	
January I	1.00	0.04	2.40	0.20	0.00	0.06	1.20	0.03	
January II	0.60	0.03	2.00	1.40	0.00	0.08	0.20	0.20	
February I	0.60	0.05	4.40	2.60	0.09	0.12	0.20	0.20	
February II	0.60	0.08	4.80	3.00	0.06	0.09	0.20	0.60	
March I	1.00	0.11	4.00	2.40	0.14	0.27	0.20	1.00	
March II	0.40	0.10	3.80	2.00	0.12	0.10	0.20	1.20	
April I	1.40	0.08	3.00	1.40	0.07	0.07	0.60	0.60	
April II	2.70	0.07	2.20	2.20	0.10	0.10	1.20	1.00	
May I	2.20	0.03	1.00	0.80	0.05	0.00	1.40	0.60	
May II	0.80	0.07	0.00	0.00	0.00	0.00	0.60	0.40	
June I	1.20	0.08	0.00	0.00	0.00	0.00	0.80	0.80	
June II	2.20	0.10	0.00	0.00	0.00	0.00	0.60	1.00	
July I	1.40	0.04	0.00	0.00	0.00	0.00	1.00	0.40	
July II	1.20	0.10	0.00	0.00	0.00	0.00	0.80	0.80	
August I	1.00	0.05	0.00	0.00	0.00	0.00	0.80	0.60	
August II	1.20	0.03	0.00	0.00	0.00	0.00	1.00	0.60	
September I	1.60	0.07	0.00	0.00	0.00	0.00	0.40	0.80	
September II	1.00	0.06	0.00	0.00	0.00	0.00	0.60	0.80	
October I	1.40	0.13	0.00	0.00	0.00	0.00	0.80	0.60	
October II	0.80	0.11	0.00	0.00	0.00	0.00	0.80	0.00	
November I	1.20	0.10	0.02	0.60	0.01	0.03	0.60	0.60	
November II	2.00	0.10	2.60	0.80	0.10	0.09	1.00	0.60	
December I	0.80	0.16	2.00	2.60	0.06	0.11	0.80	0.80	
December II	1.60	0.06	3.00	2.40	0.10	0.12	0.60	0.80	
Mean±SD	1.25±0.58	0.08±0.03	1.47±1.69	0.93±1.09	0.04±0.05	0.05±0.07	0.68±0.33	0.63±0.31	

**Table 2:** Population dynamics of sucking pest and bark eating caterpillar in AJG-85 and Konkan Bahadoli jamun varieties at KRCCH, Arabhavi during 2022

Fortnight	Shield back bug (No. of adults and nymphs/shoot)		Tea mosquito bug (No. of damaged leaves/shoot)			Whitefly (No. of spirals/leaf)		Bark eating caterpillar (No. of active galleries/tree)	
	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	
January I	1.25	0.26	3.20	1.24	0.00	0.10	1.02	0.14	
January II	1.04	0.12	2.02	2.05	0.00	0.26	0.34	0.28	
February I	1.00	0.24	3.44	3.36	0.24	0.32	0.25	0.32	
February II	0.85	0.14	4.38	4.02	0.28	0.38	0.32	0.84	
March I	0.60	0.18	4.20	3.20	0.36	0.45	0.31	1.40	
March II	0.60	0.16	4.82	2.23	0.32	0.24	0.30	1.86	
April I	1.58	0.80	3.24	2.41	0.24	0.16	0.64	1.16	
April II	2.50	0.14	2.46	2.28	0.18	0.20	2.12	1.20	
May I	2.40	0.22	1.25	1.22	0.26	0.00	2.10	1.36	
May II	1.20	0.12	0.00	0.00	0.00	0.00	0.80	1.14	
June I	1.02	0.16	0.00	0.00	0.00	0.00	1.20	1.82	
June II	1.80	0.28	0.00	0.00	0.00	0.00	1.24	1.02	
July I	1.20	0.10	0.00	0.00	0.00	0.00	1.46	1.44	
July II	1.50	0.11	0.00	0.00	0.00	0.00	0.80	1.82	
August I	0.90	0.14	0.00	0.00	0.00	0.00	0.34	0.26	
August II	1.20	0.21	0.00	0.00	0.00	0.00	1.06	0.22	
September I	1.40	0.15	0.00	0.00	0.00	0.00	0.52	0.12	
September II	0.82	0.08	0.00	0.00	0.00	0.00	0.81	0.42	
October I	2.20	0.15	0.00	0.00	0.00	0.00	0.78	0.60	
October II	1.20	0.16	0.00	0.00	0.00	0.00	0.92	0.02	
November I	1.50	0.12	0.42	1.23	0.21	0.12	0.76	0.14	
November II	1.60	0.14	3.16	1.44	0.14	0.25	1.04	0.26	
December I	0.80	0.20	4.28	2.50	0.22	0.20	1.08	0.32	

December II	2.10	0.16	3.21	2.24	0.16	0.10	0.92	0.46
Mean±SD	1.34±0.54	0.19±0.14	1.67±1.82	1.23±1.31	0.11±0.13	0.12±0.14	0.88±0.51	0.78±0.61

**Table 3:** Population dynamics of sucking pest and bark eating caterpillar in AJG-85 and Konkan Bahadoli jamun varieties at KRCCH, Arabhavi Pooled data.

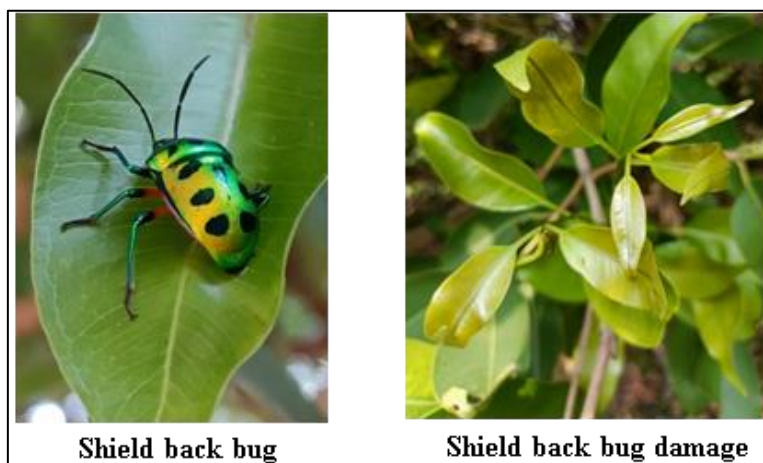
Fortnight	Shield back bug (No. of adults and nymphs/shoot)		Tea mosquito bug (No. of damaged leaves/shoot)		Whitefly (No. of spirals/leaf)		Bark eating caterpillar (No. of active galleries/tree)	
	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli	AJG -85	Konkan Bahadoli
January I	1.13	0.15	2.80	0.72	0.00	0.08	1.11	0.09
January II	0.82	0.08	2.01	1.73	0.00	0.17	0.27	0.24
February I	0.80	0.15	3.92	2.98	0.17	0.22	0.23	0.26
February II	0.73	0.11	4.59	3.51	0.17	0.24	0.26	0.72
March I	0.80	0.15	4.10	2.80	0.25	0.36	0.26	1.20
March II	0.50	0.13	4.31	2.12	0.22	0.17	0.25	1.53
April I	1.49	0.44	3.12	1.91	0.16	0.12	0.62	0.88
April II	2.60	0.11	2.33	2.24	0.14	0.15	1.66	1.10
May I	2.30	0.13	1.13	1.01	0.16	0.00	1.75	0.98
May II	1.00	0.10	0.00	0.00	0.00	0.00	0.70	0.77
June I	1.11	0.12	0.00	0.00	0.00	0.00	1.00	1.31
June II	2.00	0.19	0.00	0.00	0.00	0.00	0.92	1.01
July I	1.30	0.07	0.00	0.00	0.00	0.00	1.23	0.92
July II	1.35	0.11	0.00	0.00	0.00	0.00	0.80	1.31
August I	0.95	0.10	0.00	0.00	0.00	0.00	0.57	0.43
August II	1.20	0.12	0.00	0.00	0.00	0.00	1.03	0.41
September I	1.50	0.11	0.00	0.00	0.00	0.00	0.46	0.46
September II	0.91	0.07	0.00	0.00	0.00	0.00	0.71	0.61
October I	1.80	0.14	0.00	0.00	0.00	0.00	0.79	0.60
October II	1.00	0.14	0.00	0.00	0.00	0.00	0.86	0.01
November I	1.35	0.11	0.22	0.92	0.11	0.08	0.68	0.37
November II	1.80	0.12	2.88	1.12	0.12	0.17	1.02	0.43
December I	0.80	0.18	3.14	2.55	0.14	0.16	0.94	0.56
December II	1.85	0.11	3.11	2.32	0.13	0.11	0.76	0.63
Mean±SD	1.30±0.53	0.13±0.07	1.57±1.73	1.08±1.19	0.07±0.09	0.08±0.10	0.79±0.41	0.70±0.41

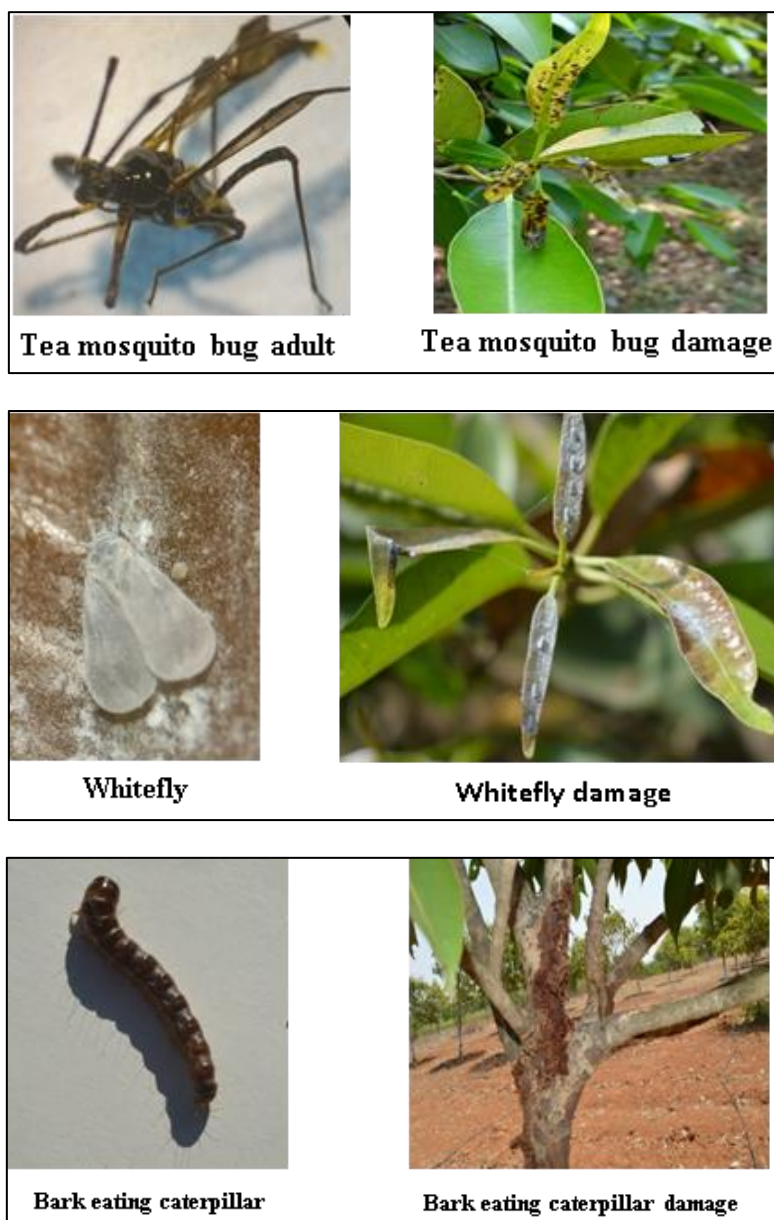
In present investigation prevalence of shield back bug was observed throughout the year, and their maximum incidence noticed during II fortnight of April and minimum during II fortnight of March. This is the first report of its kind on jamun tree. The same pest incidence was observed on ber fruit crop (Gaur *et al.*, 2020) [6].

For the first time, tea mosquito bug (TMB) incidence was noticed on jamun. The results on population dynamics revealed that TMB prevailed during January to May month and again it was observed during November to December month. Same pest seasonal incidence was reported by Bhaskar *et al.* (2015) [1] in cashew plantation with two peaks of tea mosquito bug population, during December and June,

coinciding with flowering and flushing, respectively (Plate 1). Presence of whitefly was observed at the study site with maximum (0.25) and (0.36) number of spirals per leaf during first fortnight of March in AJG-85 and Konkan Bahadoli, respectively. However, Pooja (2019) [9] reported that peak incidence of whitefly during first fortnight of January, which might be due to variation in the local weather conditions at different geographical locations.

Study revealed that occurrence of bark eating caterpillar incidence was observed throughout the year (Plate 1). Similarly, Singh *et al.* (2007) [11] and Pooja (2019) [9] observed the damaging symptoms of bark eating caterpillar in jamun tree.





**Plate 1:** Sucking pest and bark eating caterpillar infestation on Jamun

### Conclusion

Among the sucking pest, shield back bug and tea mosquito bug (TMB) incidence on jamun is a first report. The incidence of whitefly was noticed on new flush. The occurrence of bark eating caterpillar was observed throughout the year in both varieties. Hence further study on population dynamics of sucking pest and bark eating caterpillar over the years is required to build a pest calendar and to develop pest management strategies.

### References

1. Bhaskar H, Ragesh G, Zachariah G, Mathew J. Population Dynamics of Tea Mosquito Bug, *Helopeltis antonii* Signoret (*Hemiptera: Miridae*) in young cashew plantation of Cashew Research Station, Madakkathara, Kerala. *Acta Horti*, 2015, 423-428.
2. Butani DK, Jotwani MG. Trends in the control of insect pests of fruit crops in India. *Pest. Annual*. 1975;4:139-149.
3. Butani DK. *Insects and fruits*. Periodical Expert Book Agency, New Delhi, India; c1979.
4. Chaturvedi MD. Jamun is another of our prized trees. *Indian Farm*. 1956;5:17-19.
5. Dagadkhair AC, Pakhare KN, Todmal AD, Andhale RR. Jamun (*Syzygium cumini*) Skeels: A traditional therapeutic tree and its processed food products. *Int. J. Pure App. Biosci*. 2017;5(5):1202-1209.
6. Gaur RK, Kumar M, Sharma S, Yadav BS. Survey studies on insects and non insect pest associated with ber crop in South West Haryana. *J. Entomol. Zool. Stud*. 2020;8(2):856-863.
7. Kumar R, Misra KK, Mishra DS. Jamun: A boon for nature. *Indian Farmer's Digest*. 2011;43(11):38-39.
8. Nayak BM. Fauna of Tenuipalpid mites associated with fruit plants in Bengaluru and nearby places and some biological aspects of *Raoiellamac ferlanei* Prithchard and Baker. M. Sc. (Agri.) Thesis. University of Agricultural Sciences, Bengaluru, Karnataka, India; c2017.
9. Pooja. Studies on pest complex in jamun (*Syzygium cuminii* (L.) Skeels) varieties. M. Sc. (Hort.) Thesis, University of Horticultural Sciences, Bagalkot,

- Karnataka, India; c2019.
10. Rajeshkumar R, Ramamurthy VV, Sharma G. Checklist of insects associated with jamun (*Syzygium cuminii* Skeels) from India. Biol. Forum. Int. J. 2010;2:1-5.
  11. Singh S, Joshi HK, Singh AK, Lenin V, Bagle BG, Dhandar DG. Reproductive biology of jamun (*Syzygium cumini* Skeels) under semi arid tropics of western India. Hort. J. 2007;20(2):76-80.
  12. Singh S, Singh AK, Singh HP, Bagle BG, More TA. Jamun. ICAR. Bulletin; c2011. p. 1-46.
  13. Singh S, Singh AK. Enjoy new jamun variety. Indian J. Hort. 2012;57(3):9-11.
  14. RB Hirekurubar, MH Tatagar, Suvarna Patil, Ramegowda GK, AI Sabarad, Mahantesha BN Naika,, AB Mastiholi. Seasonal incidence of sucking pest and bark eating caterpillar on Jamun (*Syzygium cuminii* (L.) Skeels) in Karnataka, India. Pharma Innovation 2023;12(3):2874-2879.
  15. Veigas JM, Narayan MS, Laxman PM, Neelwarne B. Chemical nature stability and bioefficacies of anthocyanins from fruit peel of *Syzygium cuminii* Skeels. Food Chem. 2007;105:619-627.
  16. Warriar P, Nambiar V, Ramankutty C. Indian Medicinal Plants, Vol. V, Orient Longman Ltd., Hyderabad, 1996, 225-228.
  17. Zeven AC, de Wet MJM. Dictionary of Cultivated Plants and their Regions of diversity: excluding most ornamentals, forest trees and lowerplants. Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen; c1982. p. I-II.
  18. Vaja AS, Virani VR, Dhandge SR, Chudasama KA. Bio-efficacy of insecticides against sapota insect pest complex under Junagadh conditions. J. Ent. Zool. Stud. 2018;6(5):1899-1902.