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First report of fruit borer, *Meridarchis scyrodes* Meyrick (Lepidoptera: Carposinidae) on Jamun in Karnataka, India

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Abstract
Fixed plot survey was carried out to know the extent of Jamun fruit damage caused by *Meridarchis scyrodes* at different locations. Observations were recorded at fortnight intervals from March to July, 2021 and 2022 Jamun fruiting season at five locations of Gokak taluk and one location of Hukkeri taluk in Belagavi district of Karnataka, India. Survey locations comprised in the study were KRCCH Arabhavi, Dupadal, Ankalagi, Kolavi, Kaitanal and Hidkal Dam with six available varieties (Dupadal, Kolavi local, Kaitanal local and Hidkal Dam local, Konkan Bahadoli and AJG-85). Pooled data depicted the peak incidence of *M. scyrodes* during II fortnight of June. Highest (58.25%) pest infestation was observed during I fortnight of July in Hidkal Dam local variety, at the same time less (12.50%) pest infestation on fruit was observed in Dupadal variety at Dupadal. Correlation analysis between mean values of per cent fruit infestation due to *M. scyrodes* with prevailing major weather parameters during fruiting season of 2021 and 2022 were studied in *cv*. Konkan Bahadoli. The fruit infestation due to *M. scyrodes* was negatively correlated with temperature, positively correlated with relative humidity in both the years and *M. scyrodes* had positive and negative correlation with rainfall during 2021 and 2022, respectively.

Keywords: AJG-85, fruit infestation, Jamun fruit borer, Konkan Bahadoli, *Meridarchis scyrodes*

Introduction
Jamun (*Syzygium cuminii* (L.) Skeels) is gaining importance owing to a wide range of pharmacological properties documented through scientific studies (Kumar *et al.*, 2011; Singh *et al*., 2011 and Singh and Singh, 2012) [6, 12, 13]. Even though the acreage under Jamun planting or cultivation is increasing in the last two decades in peninsular India, due to lack of systematic documentation about Jamun, it has remained as an underutilised and less understood indigenous fruit tree of India which is grown wildly and semi-wildly in tropical and subtropical parts of India (Singh *et al.*, 2011) [12]. Insect pest spectrum of Jamun has over a century of history in India (Iyer, 1919) [4] and at present more than 75 species of insect and mite pests have been documented (Rajesh Kumar *et al*., 2010 and Nayak, 2017) [10, 7]. Among these, only the bark eating caterpillar, seed and fruit borer complex appeared to be of major concern which needed attention to protect the economic value (Pooja *et al.*, 2019, Kamalajayanthi *et al*., 2019, and Hiremath *et al*., 2021) [9, 5, 3]. *Meridarchis scyrodes* (Lepidoptera: Carposinidae) is a major pest of ber fruits in southern and western India. Eggs are laid on fruits of ber at pea stage and after hatching caterpillars tunnel into the pulp of fruits and feed on the fleshy pulp near seed and contaminate fruits by faecal matter. Adult moth is medium, dark grey with fringed hind wings. Early stage larva was light yellowish and full-grownup larva was red. *M. scyrodes* causes about 70 per cent yield loss in case of severe incidence (Sonawane, 1965) [14]. The fruit borer, *Merdarchis scyrodes* M. has been reported widely distributed in the country (Butani, 1979) [1] which commonly occurred in Maharashtra on ber and recently recorded in Jamun (Walunj and Kulkarni, 2020) [15]. Since fruit borer, *Meridarchis scyrodes***,** is emerging as a major pest of Jamun, literature on its seasonal occurrence and damaging symptoms is scanty hence survey on seasonal incidence of *M. scyrodes* was undertaken in Jamun growing villages of Belagavi district, Karnataka with Kittur Rani Channamma College of Horticulture (KRCCH), Arabhavi, UHS Bagalkot, Karnataka as a main centre during 2021 fruiting season.

Materials and Methods

Fixed plot surveys were carried out at fortnightly intervals from March to July, 2021 and 2022 at five locations of Gokak taluk and one location of Hukkeri taluk in Belagavi district of Karnatka, India.

Study sites

Survey locations comprised in the study were KRCCH, Arabhavi 16° 13' 19" N, 74° 49' 60" E and 532.45 m latitude, longitude and above mean sea level, respectively. At Arabhavi location, orchard of AJG-85 and Konkan Bahadoli varieties (9 years old) planted at 3 m x 3 m spacing were selected for the survey. State Department of Horticulture farm at Dupadal (16° 13' 05" N, 74° 45' 36" E & 701.11 m) where, Jamun Dupadal variety was planted at 8 m x 8 m spacing (40 years old) orchard selected for study. Similarly, at Ankalagi (16° 00' 32" N, 74° 41' 27" E and 791.55 m) in farmer field in Dupadal variety, planted at 8 m x 8 m apart (10 years old) field identified for study. Traditionally Jamun growing farmer fields at Kolavi (16° 02' 32" N, 74° 49' 48" E & 712.46 m), where Kolavi local variety (40 years old) planted on bunds and at Kaitanal (16° 03' 16" N, 74° 48' 48" E and 621.21 m) Kaitanal local variety (50 years old) planted on fields were selected for research study. The Jamun orchard at Horticulture Research and Extension Centre (HREC), Hidkal Dam (16° 09' 49" N, 74° 34' 54" °E and 661.18 m) where local variety (50 years old) planted at 10 m x 10 m distance trees are selected for research work. Plant protection measures were not taken up in all places except at Ankalagi

Method of data collection

Number of fruits damaged (oviposition injury/feeding marks or malformed fruit) in a bunch were recorded with onset of fruiting till the end of the season. Total number of fruits and infested fruits per five bunches per plant in all four directions were recorded and per cent infestation will be worked out

$$\text{Per cent fruit damage} = \frac{\text{Number of infested fruits}}{\text{Total Number of fruits}} \times 100$$

Correlation between mean values of per cent fruit infestation in Konkan Bahadoli variety at KRCCH, Arabhavi with prevailing major weather parameters *viz*., Maximum and minimum morning and afternoon temperature, morning and afternoon relative humidity and rainfall prevailing during the course of study by using OPSTAT software which is available online to study the combined impact of weather parameters on the seasonal occurrence of fruit borer, *Meridarchis scyrodes* infestation during fruiting seasons of 2021 and 2022.

Results and Discussion

Pest description

Fruit borer, *Meridarchis scyrodes* Meyrick (Lepidoptera: Carposinidae)

Larva is internal seed borers, early stage larva was transparent to cream in colour grown up larva is red in colour with black posterior end, the grown-up larvae moved out of seed and fruit before pupation. Pupated in a tight and thin papery silken cocoon and even brownish bare pupa was also observed in laboratory. Adults were smoky in colour, tiny measuring 7.50±0.01mm in size with a wing span of 13.00±0.10mm with fringed hind wings (Plate 1).

Damaging symptoms

Meridarchis scyrodes (Lepidoptera: Carposinidae) is emerging as a major pest of Jamun fruits in Karnataka, India. Eggs are laid on fruits of Jamun at pre ripening stage and after hatching caterpillars tunnel into the pulp of fruits and reach the seed and feed on internal content of seed and spoil the pulp with faecal matter. Infestation of *M. scyrodes* on fruits was identified by the presence of pin holes filled with excreta, which was confirmed by dissection of such infested fruits revealing spoiled pulp and bored seeds (Plate 2).

Infestation of *Meridarchis scyrodes* on Jamun fruits at different locations

Observations on *Meridarchis scyrodes* infestation were recorded from the beginning of fruit initiation (first fortnight of April) and continued up to the end of the season (second fortnight of July), infestation of *M. scyrodes* on fruits was identified by the presence of pin holes filled with excreta, which was confirmed by dissection of such infested fruits revealing spoiled pulp and bored seeds.

During 2021, fruit infestation observations data is represented in Table 1. Fruit infestation was initiated from first fortnight of May in Hidkal Dam Local variety (18.50%) at Hidkal Dam and in rest of the varieties it was observed in second fortnight of May. Per cent fruit infestation ranged from 4.00 to 14.50 and 0.50 to 11.50 in Dupadal variety at Dupadal and Ankalagi respectively. The per cent Jamun fruit damage of 18.50 to 62.00 per cent was noted in Hidkal Dam Local variety (Hidkal Dam), the per cent fruit infestation ranged from 0.00 to 16.00 and 0.00 to 16.52 in Kolavi and Kaitnal Local varieties respectively. The pest incidence recorded at Arabhavi ranged from 3.51 to 29.00 per cent and 7.50 to 24.00 per cent at Arabhavi in Konkan Bahadoli and AJG-85 varieties respectively. Irrespective of all varieties peak 20.36±12.63 incidence was noticed during second fortnight of June. The overall highest (30.00%) fruit infestation was observed in Hidkal Dam Local variety and lowest fruit infestation (4.19%) was recorded from Kolavi Local variety.

During 2022 fruiting season, initiation of fruit damage was noticed in second fortnight of May in all varieties in except Hidkal Dam Local variety, where pest infestation started during I fortnight of May. Per cent Jamun fruit damage ranged from 4.00 to 17.00 and 3.50 to 16.50 in Dupadal variety at Dupadal and Ankalagi respectively. In Hidkal Dam local variety, the per cent fruit damage ranged from 16.50 to 54.50. Per cent fruit damage ranged from 0.00 to 30.50 and 10.00 to 28.00 in Kolavi and Kaitanal Local varieties, respectively. At Arabhavi the range was 8.50 to 35.50 per cent and 0.50 to 16.00 per cent in Konkan Bahadoli and AJG-85 varieties respectively. Highest average per cent fruit infestation across the varieties was 28.81±21.55 in Hidkal Dam Local and lowest was 5.25±7.21 per cent in AJG-85. Overall peak incidence 25.71±14.43 was recorded during II fortnight of July (Table 2).

Pooled data of 2021 and 2022 Jamun fruiting seasons revealed that the occurrence of this pest noticed from first I of May and persisted till harvesting of fruits (second fortnight of July). Mean per cent fruit damage ranged from 2.50±6.61 to 22.79±11.89 with peak incidence during second fortnight of June. In Dupadal variety the per cent fruit damage ranged from 4.00 to 14.25 per cent and 2.00 to 13.75 per cent at Dupadal and Ankalagi, respectively. In Hidkal Dam Local variety the pest infestation range was 17.50 to 58.25.

Similarly, per cent fruit damage ranged from 0.00 to 18.50 and 0.00 to 22.25 in Kolavi and Kaitnal Local varieties, respectively. At Arabhavi, Konkan Bahadoli and AJG-85 varieties recorded 6.00 to 30.00 and 5.25 to 19.00 per cent fruit infestation, respectively (Table 3).

Across all the varieties, the overall highest (29.41±2.68%) fruit infestation was registerd in Hidkal Dam Local variety and lowest fruit damage (5.19±5.72%) was recorded in Ankalagi Local variety at Dupadal. The mean per cent fruit infestation in all the selected varieties ranged from 2.50±6.61 to 22.79±11.89 per cent.

Pooled data depicted the peak incidence of *M. scyrodes* during II fortnight of June. Highest (58.25%) pest infestation was observed during I fortnight of July in Hidkal Dam local variety, at the same time less (12.50%) pest infestation on fruit was observed in Dupadal variety at Dupadal.

This could be due to the coincidence *M. scyrodes* occurrence at ripening stage of Jamun fruits. These findings are in conformity with a result of Raut *et al*. (2019) [11] who reported that, *M. scyrodes* caused almost 67 per cent infestation with peak level during June (25th to 26th SMW). Whereas, *M. scyrodes* and *Meridarchis reprobata* were listed as minor Jamun fruit borers (Rajeshkumar *et al*., 2010) [10].

Correlation study on *Meridarchis scyrodes* M. and weather parameters

Significantly negative correlation of *M. scyrodes* fruit infestation with morning maximum temperature (r = - 0.795, $p \leq 0.05$) was observed during 2021. Similar correlation was noticed during 2022 (r = - 0.779). Significantly negative correlation was observed with morning minimum temperature (r = -0.782, $p \leq 0.05$ level) during 2021 and also during 2022 (r = -0.767). Fruit borer infestation had significantly negative correlation with afternoon maximum temperature during 2021 (r = - 0.751) and as well as in 2022 (r = - 0.820) at 5 per cent level. Fruit borer infestation was significantly negatively correlated with afternoon minimum temperature during 2021 (r = - 0.756) at 5 per cent and whereas, in the year 2022 significantly negative correlated (r = - 0.860) at 1 per cent level was observed. However, morning relative humidity had significantly positive correlation during 2021 (r = 0.792) and 2022 (r = 0.832). Non-significant positive correlation (r = 0.702) of pest infestation was observed with afternoon relative humidity (2021). Whereas, in the year 2022, significantly positive correlation (r = 0.799) was observed. Non-significant positive correlation of *M. scyrodes* was observed with rainfall (r = 0.641) at 5 per cent ($p \leq 0.05$ level) during 2021. Whereas, non-significant negative correlation (r = - 0.133) was noticed during 2022 (Table 4.)

This might be due to irregular distribution of rainfall during the period. This correlation study was in accordance with Raut *et al*. (2021) who reported that fruit borer was found positively correlated with morning and afternoon relative humidity as well as with rainfall. Gopali *et al.* (2003) [2] reported that, there was negative correlation between maximum temperature and ber fruit borer, *Meridarchis scyrodes* which was found more or less similar with the results of present investigation.

Table 1: Incidence of *Meridarchis scyrodes* on Jamun in Belagavi district, Karnataka, India during 2021

Locations (Varieties) / Fortnight	Fruit infestation (%)							
	Dupadal (Dupadal)	Ankalagi (Dupadal)	HREC Hidkal Dam (Local)	Kolavi (Local)	Kaitnal (Local)	KRCCH Arabhavi (KB)	KRCCH Arabhavi (AJG-85)	Mean ±SD
April I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
April II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
May I	0.00	0.00	18.50	0.00	0.00	0.00	0.00	2.64±6.99
May II	4.00	0.50	33.00	9.50	1.50	0.00	0.00	6.93±11.98
June I	10.50	3.50	39.00	16.00	14.50	3.50	10.00	13.86±12.10
June II	14.50	11.50	42.50	4.50	16.50	29.00	24.00	20.36±12.63
July I	8.00	11.00	62.00	3.50	8.00	24.50	13.50	18.64±20.23
July II	12.00	7.50	45.00	0.00	0.00	16.00	7.50	12.57±15.44
Mean±SD	6.13±5.91	4.25±5.04	30.00±22.13	4.19±5.84	5.06±7.01	9.13±12.21	6.88±8.75	9.38±8.14

KRCCH: Kittur Rani Channamma College of Horticulture, Arabhavi, UHSB.
HREC: Horticulture Research and Extension Centre, Hidkal Dam, UHSB. KB: Konkan Bahadoli

Table 2: Incidence of *Meridarchis scyrodes* on Jamun in Belagavi district, Karnataka, India during 2022

Locations (Varieties)/Month	Fruit infestation (%)							
	Dupadal (Dupadal)	Ankalagi (Dupadal)	HREC Hidkal Dam (Local)	Kolavi (Local)	Kaitnal (Local)	KRCCH Arabhavi (KB)	KRCCH Arabhavi (AJG-85)	Mean ±SD
April I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
April II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
May I	0.00	0.00	16.50	0.00	0.00	0.00	0.00	2.36±6.24
May II	4.00	3.50	27.50	10.00	10.00	0.00	0.00	7.86±9.59
June I	11.50	5.00	41.00	21.00	25.50	8.50	0.50	16.14±14.01
June II	14.00	12.00	51.50	30.50	28.00	26.50	14.00	25.21±13.87
July I	17.00	16.50	54.50	22.50	18.00	35.50	16.00	25.71±14.43
July II	13.00	12.00	39.50	0.00	0.00	18.50	11.50	13.50±13.37
Mean±SD	7.44±7.17	6.13±6.52	28.81±21.55	10.50±12.51	10.19±12.12	11.13±14.08	5.25±7.21	11.35±8.03

KRCCH: Kittur Rani Channamma College of Horticulture, Arabhavi, UHSB.
HREC: Horticulture Research and Extension Centre, Hidkal Dam, UHSB. KB: Konkan Bahadoli

Table 3: Incidence of *Meridarchis scyrodes* on Jamun in Belagavi district, Karnataka, India during 2021 and 2022 (Pooled)

Fruit infestation (%)								
Locations (Varieties)/ Month	**Dupadal (Dupadal)**	**Ankalagi (Dupadal)**	**HREC Hidkal Dam (Local)**	**Kolavi (Local)**	**Kaitnal (Local)**	**KRCCH Arabhavi (KB)**	**KRCCH Arabhavi (AJG-85)**	**Mean ±SD**
April I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
April II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00±0.00
May I	0.00	0.00	17.50	0.00	0.00	0.00	0.00	2.50±6.61
May II	4.00	2.00	30.25	9.75	5.75	0.00	0.00	7.39±10.65
June I	11.00	4.25	40.00	18.50	20.00	6.00	5.25	15.00±12.71
June II	14.25	11.75	47.00	17.50	22.25	27.75	19.00	22.79±11.89
July I	12.50	13.75	58.25	13.00	13.00	30.00	14.75	22.18±17.08
July II	12.50	9.75	42.25	0.00	0.00	17.25	9.50	13.04±14.35
Mean±SD	6.78±6.38	5.19±5.72	29.41±21.68	7.34±8.29	7.63±9.59	10.13±13.00	6.06±7.58	10.36±8.54

KRCCH: Kittur Rani Channamma College of Horticulture, Arabhavi, UHSB.
HREC: Horticulture Research and Extension Centre, Hidkal Dam, UHSB. KB: Konkan Bahadoli

Table 4: Influence of weather parameters on the seasonality of *Curculio c-album* on Jamun Konkan Bahadoli variety during 2021 and 2022 fruiting season

Sl. No.	**Weather parameters**	**Correlation coefficient (r) value**	
		2021	**2022**
1	Maximum morning temperature ^{0}C)	-0.795*	-0.779*
2	Minimum morning temperature (^{0}C)	-0.782*	-0.767*
3	Morning relative humidity (%)	0.792*	0.832*
4	Maximum afternoon temperature (^{0}C)	-0.751*	-0.820*
5	Minimum afternoon temperature (^{0}C)	-0.756*	-0.860**
6	Afternoon relative humidity (%)	0.702	0.799*
7	Rainfall (mm)	0.641	-0.133

** Correlation is significant at $p \leq 0.01$ level table r = 0.834
* Correlation is significant at $p \leq 0.05$ level table r = 0.706

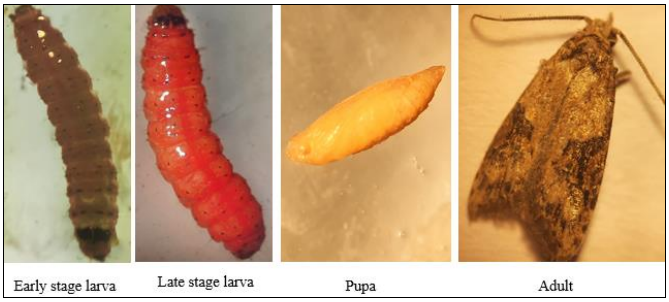

Plate 1: Life cycle of *Meridarchis scyrodes*

Plate 2: Damaging symptoms of *Meridarchis scyrodes*

Conclusion

Pooled data of 2021 and 2022 Jamun fruiting season revealed that mean per cent fruit damage due to *M. scyrodes* ranged from 2.50 to 22.79 with peak incidence during second fortnight of June. Highest (58.25%) fruit infestation was observed during first fortnight of July in Hidkal Dam local variety, at the same time less (12.50%) fruit damage was observed in Dupadal variety at Dupadal.

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