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Survey and Surveillance of *Curculio c-album* and *Conogethes punctiferalis* on Jamun (*Syzygium cuminii*)

R. B. Hirekurubar[1], M. H. Tatagar[2], G. K. Ramegowda[3], Suvarna Patil[4], A. I. Sabarad[1], Mahantesha B.N. Naika[1] and A. B. Mastiholi[4]

[1]Dept. of Entomology, Kittur Rani Channamma College of Horticulture (KRCCH), Arabhavi, UHS, Bagalkot, Karnataka (591 218), India
[2]Dept. of of Entomology, College of Horticulture, Sirsi, UHS, Bagalkot, Karnataka (581 401), India
[3]Dept. of Entomology, College of Horticulture, Yelwal, Mysuru, UHS, Bagalkot, Karnataka (571 130), India
[4]Regional Horticultural Research and Extension Centre, Kumbapur, Dharwad, UHS, Bagalkot Karnataka (580 005), India

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Corresponding bhrenuka@gmail.com

0000-0002-2246-2412

ABSTRACT

Fixed plot survey was carried out at fortnightly intervals from March to July, 2021 and 2022 jamun fruiting season at six locations of Belagavi district of Karnataka, India. Survey locations comprised in the study were fruit orchard of KRC College of Horticulture Arabhavi, Dupadal, Ankalagi, Kolavi, Kaitanal and Hidkal Dam with six available varieties *viz*., Dupadal, Kolavi local, Kaitanal local and Hidkal Dam local, Konkan Bahadoli and AJG-85. Pooled data of 2021 and 2022 for fruit damage due to fruit and seed weevil, *Curculio c-album* revealed that pest incidence starts with an onset of fruit formation and continues till harvesting of fruits. The overall mean fruit damage percentage ranged from 12.3–41.5% with peak incidence during second fortnight of June. Across all the locations highest (50.1%) fruit damage was noticed in Dupadal variety at Dupadal and at the same time less (19.0%) fruit infestation was observed in AJG-85 at Arabhavi. The overall mean of jamun fruit damage due to *Conogethes punctiferalis* ranged from 0–3.6% with peak incidence during II fortnight of June. Correlation analysis between percentage fruit infestation due to C*urculio c-album* and *Conogethes punctiferalis* with prevailing major weather parameters were studied in *cv*. Konkan Bahadoli. The fruit infestation due to *C. c-album* and *Conogethes punctiferalis* was negatively correlated with temperature, positively correlated with relative humidity. *C. c-album* had positive correlation with rainfall whereas *C. Punctiferalis* was negatively correlated with rainfall.

KEYWORDS: *Conogethes punctiferalis*, fruit infestation, Jamun, seed weevil

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1. INTRODUCTION

Jamun (*Syzygium cuminii*) belong to the family myrtaceae, is also scientifically known as *Syzygium jambolana* and *Eugenia cuminii*. It is commonly called as Duhat, Jam, Jaman in Hindi, Brahaspati in Sanskrit and Nerale in Kannada. Jamun tree is said to be indigenous to India. Burma, India, Srilanka and Andaman Islands are centers of origin of jamun (Zeven and de Wet, 1982). Presently jamun trees are being cultivated all over the Asian subcontinent, South America, Eastern Africa, Madagascar, Hawaii and Florida parts of USA. It is being introduced in many tropical countries like California, Algeria, West Indies and Israel (Warrier et al., 1996). Jamun is grown in tropical and subtropical parts of India *viz*., Maharashtra, Haryana, Gujarat, Rajasthan, Bihar, Punjab, Madhya Pradesh, Jharkhand, Uttar Pradesh, Chhattisgarh, Tamil Nadu, Karnataka, Andhra Pradesh and Kerala in wild and semi-wild conditions. Jamun tree can tolerate sodic and saline soils of degraded lands including ravines with soil pH up to 10.5 (Singh et al., 2009). Jamun fruits were harvested and collected by the village people and sold in the local market (Singh et al., 2011).

It is gaining importance owing to a wide range of pharmacological properties documented through scientific studies, the seeds are claimed to contain alkaloid, jamosine and glycoside jambolin or antimellin, which halts the diastatic conversion of starch in to sugars. Seeds are gaining much more value (Kumar et al*.,* 2011, Singh et al., 2011, Singh and Singh, 2012).

Fruit contains sugar (8.09%), non-reducing sugar (9.26%) and sulfuric acid (1.21%). It also encompasses glucose, fructose, mannose and galactose as the principal sugar moieties. Fruit contains the mineral elements like Ca, Mg, Na, K, Cu and vitamins such as thiamine, riboflavin, nicotinic acid *etc* (Dagadkhair et al., 2017).

Jamun pulp comprises of 82.19±2.46% moisture, 2.15±0.06% crude protein, 0.83±0.02% crude fat, 1.76±0.05% crude fibre content, 2.04±0.06% ash and 11.03±0.33% nitrogen free extracts. Whereas, jamun seed contains moisture (16.34±0.49%), crude protein (1.97±0.59%), crude fat (0.65±0.01%), crude fibre (4.19±0.12%), ash (2.18±0.06%) and nitrogen free extracts (74.67±2.24%). Apart from these seeds also contain albumen, fat, glycosides, an alkaloid called jambosine, resin, ellagic acid, quercetin, gallic acid, and traces of zinc, vanadium, chromium, sodium, and potassium (Ahmad et al*.,* 2015).

Though jamun has various medicinal properties it is being infested by as many as 78 number of insects which includes Lepidoptera (34 species), Hemiptera (26 species), Coleoptera (8 species), Thysanoptera (6 species) and Diptera (5 species) (Rajeshkumar et al., 2010).) Seed weevils like *Curculio c-album* Fabricius, *Apotomorrhinus cribratus* (Sch.) and *Sitophilus rugicollis* Casey infest jamun fruits between May to August months (Talwar, 2014). In Karnataka about 26 insect pest species are found infesting jamun tree of which eight species needed identification, which includes fruit/seed boring lepidoptera (Pooja et al., 2019). Recently a eulophid seed borer, *Anselmella kerrichi* (Hymenoptera:Eulophidae) caused heavy infestation (62.60%) of jamun fruits (Kamalajayanthi et al., 2019 and Subramoniam et al., 2019). Among the fruit borer complex *Curculio c-album* is a pest of economic importance which caused more than 90% fruit damage and *Conogethes punctiferalis* Guenee bored twigs and fruits of jamun (Pooja et al*.,* 2019, Hiremath et al., 2021).

Since *Curculio c album* and *Conogethes punctiferalis* are emerging as major pests of jamun, literature on their seasonal occurrence and damaging symptoms is scanty hence survey on seasonal incidence of *Curculio c-album* and *Conogethes punctiferalis* was undertaken in jamun growing villages of Belagavi district, Karnataka.

2. MATERIALS AND METHODS

Fixed plot surveys were carried out at fortnightly intervals from March to July, 2021 and 2022 at six locations of Belagavi district of Karnatka, India.

2.1. 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×3 m spacing were selected for the survey. State Department of Horticulture farm at Dupadal (16˚13'05" N, 74˚45'36" E and 701.11 m) where, jamun Dupadal variety was planted at 8 m×8 m spacing (40 years old) orchard selected for study. Similarlly, at Ankalagi (16˚00'32" N, 74˚41'27" E and 791.55 m) in farmer field in Dupadal variety, planted at 8 m×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 621.21m) 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×10 m distance trees are selected for research work. Plant protection measures were not taken up in all places except at Ankalagi.

2.2. Method of data collection

Number of fruits damaged (oviposition injury/feeding marks or malformed fruit) due to *C.c-album* and *C. punctiferalis* in a bunch were recorded based on their symptoms of damage 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 infestation percentage was worked out by using the following formula.

Fruit damage (%) =(Number of infested fruits×Total number of fruits)×100…….(1)

Impact of weather parameters on the seasonal occurrence of *Curculio c-album* and *Conogethes punctiferalis* in Konkan Bahadoli variety at Kittur Rani Channamma College of Horticulture, Arabhavi was studied. Daily weather data (Maximum and minimum morning and afternoon temperature, morning and afternoon relative humidity and rainfall) was collected from meteorological observatory of Agricultural Research Station, Arabhavi. Correlation between pooled data of *Curculio c-album* and *Conogethes punctiferalis* with weather parameters was analysed using OPSTAT software.

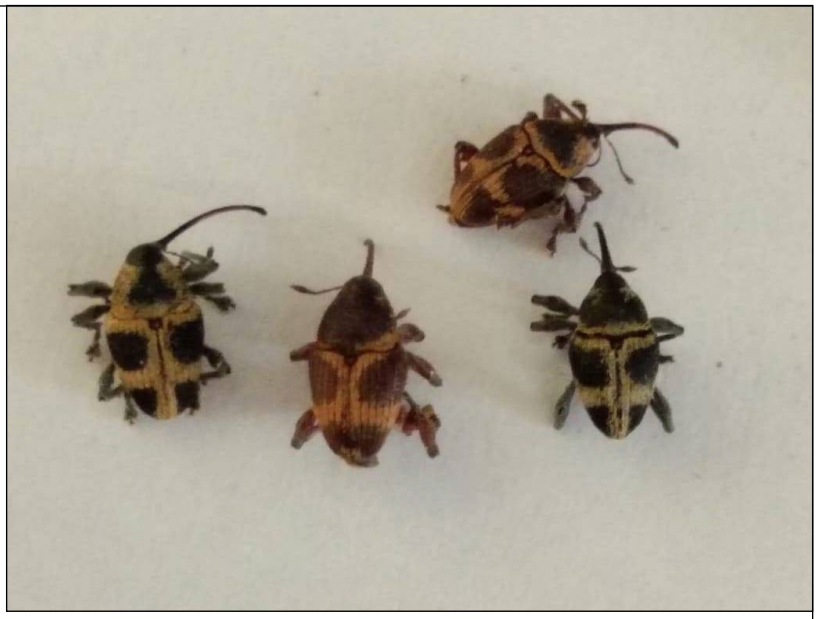
3. RESULTS AND DISCUSSION

3.1. Pest description

3.1.1. Fruit and seed weevil, Curculio c-album (Coleoptera: Curculionidae)

The adult weevils are small, brown, black and orange in colour with white scales along the all margin of elytra. Adult size varies from 7 mm to 8 mm with 3 mm long curved snout. Antenna originated from mid of snout. Females lay creamy white eggs in mesocarp of fruits, Grubs are creamy white in colour "C" shape, brown coloured head capsule, early instar grub is 0.2 to 0.3 mm in size and it's head white in colour and fully grown grub is 5 mm in size with brown head and well developed mandibles (Figure 1).

A. Adult



B. Adult: Colour morphs

C. All stages grubs

Figure 1: *Curculio c- album* (Coleoptera: Curculionidae)

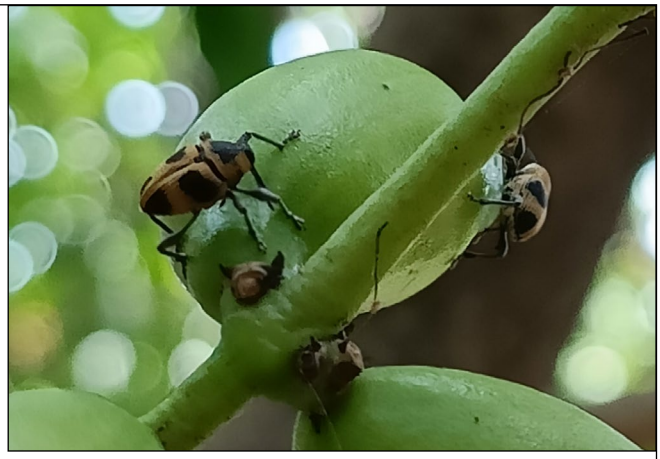
3.1.2. Damaging symptoms

Adults feed on fruits by inserting its snout in to the pulp. The attacked fruits when green (raw) shows several dark spots on their surface. The area around the feeding holes becomes depressed in ripening fruit thus deforming the ripe fruit. Adults are active throughout the fruiting season and attack all stages of fruits. Adult lay eggs in the mesocarp fruits and grubs tunnels into the seed and feeds on internal content of seeds (Figure 2 and 3) and fully grown grub comes out of fruits becomes curved, stiff and hard and enters into diapause in soil till next fruiting season.

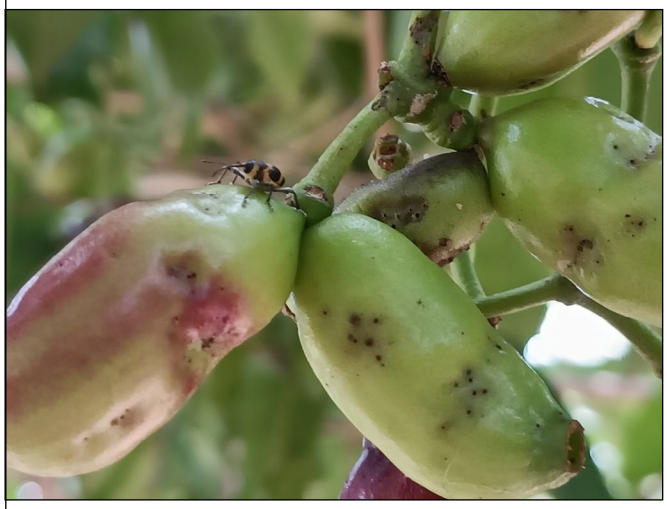
3.1.3. Infestation of Curculio c-album on jamun fruits at different locations

In Dupadal variety, fruit infestation ranged from 32.5–59.8% and 15.0–50% at Dupadal and Ankalagi,

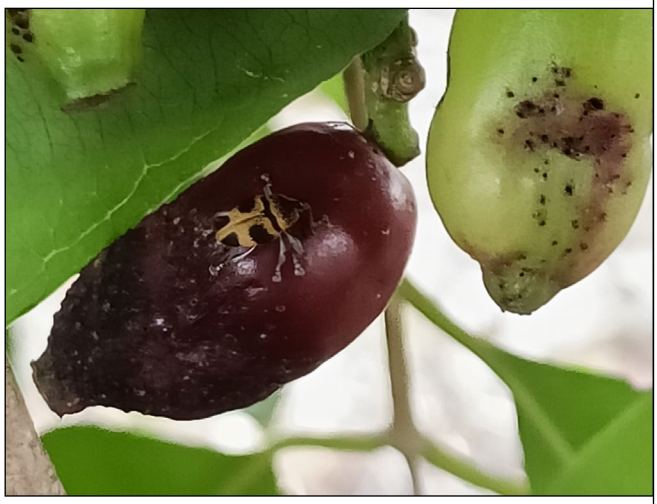
A. Immature fruit drop



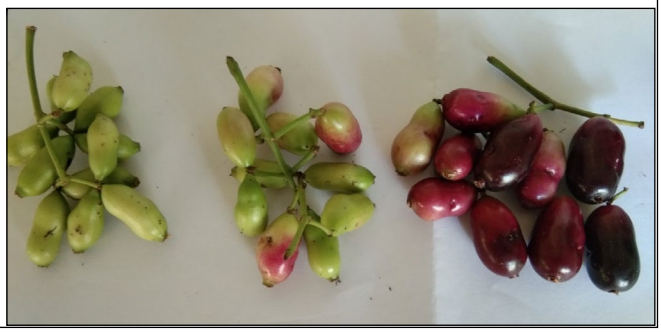
B.Adult damaging immature fruit



C. Adult damaging preripened fruit



D. Adult damaging ripened fruit



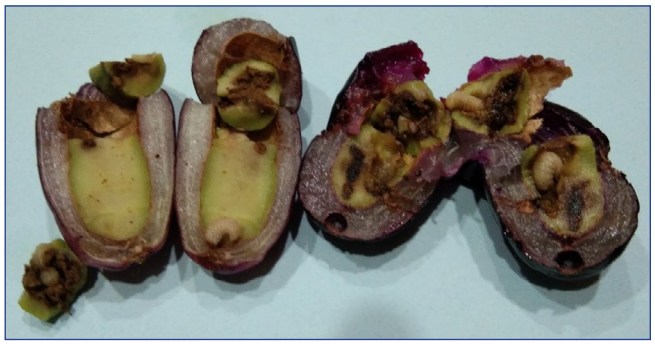
E. Different stages of fruits damaged by adult

Figure 2 : External damaging symptoms of *Curculio c- album* on jamun fruits

A. Grub entry into seed

B. Grub tunnelling in the seed

C. Grub damaging the seed



D. Severely infested seeds by the grubs

Figure 3: Internal damaging symptoms of *Curculio c- album* grub on jamun fruits

respectively. Hidkal Dam Local variety recorded 10.8–28.0% fruit damage. Kolavi and Kaitnal local varieties recorded 0–39.0 and 0–48.0% jamun fruit infestation, respectively. At Arabhavi Konkan Bahadoli (KB) and AJG-85 varieties recorded 8.3–50.8 and 7.0–34.3% fruit infestation, respectively. The overall mean jamun fruit damage ranged from 12.3±9.6–41.5±12.9% with peak incidence during II fortnight of June. Among all the locations highest (50.1±9.5%) jamun fruit damage was registered in Dupadal variety at Dupadal and at the same time less (19.0±9.1%) fruit infestation was noticed in AJG-85 at Arabhavi (Table 1). Variation in level of fruit infestation might be due to inherent property of varieties which has to be confirmed. Pooja (2019) reported 100% fruit yield damage in Mysuru, Bahadoli, GKVK-2 and Dupdal jamun varieties, where fruit damage was due to fruit borer complex which included *Curculio c-album*, *Conogethes punctiferalis* and two unidentified lepidopteran insects.

3.1.4. Fruit borer, conogethes punctiferalis guenee (Lepidoptera: Crambidae)

Adult is yellow with black spots on wings. Early stage larva is cream in colour and turns reddish brown in late stage and measures 8.0 mm in size. Pupa is brown in colour and measure up to 10.0 mm in size (Figure 4).

3.1.5. Damaging symptoms

Larvae found feeding on seeds of jamun, bored holes plugged with excreta are external symptoms of damage (Figure 4).

Table 1: Incidence of *Curculio c-album* on jamun, in Belagavi district, Karnataka, India

	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	32.5	15.0	10.8	9.0	3.5	8.3	7.0	12.3±9.6
April II	42.8	19.5	15.8	15.0	15.3	15.5	9.3	19.0±10.9
May I	55.3	31.0	21.5	25.3	24.0	28.5	13.3	28.4±13.1
May II	56.5	40.8	24.3	29.0	31.5	30.8	18.5	33.0±12.4
June I	57.5	42.3	26.5	34.5	41.3	34.5	21.0	36.8±11.9
June II	59.8	50.0	23.3	39.0	48.0	43.8	27.0	41.5±12.9
July I	53.0	48.5	28.0	29.3	31.0	50.8	34.3	39.3±11.0
July II	43.3	28.3	20.8	0.0	0.0	40.0	22.0	22.0±17.2
Mean±SD	50.1±9.5	34.4±13.1	21.3±5.7	22.6±13.4	24.3±17.1	31.5±14.2	19.0±9.1	29.0±10.5

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

A. Fruit damage B. Larva C.Pupa D. Adult

Figure 4: Fruit borer, *Conogethes punctiferalis*

Pooled data on percentage of fruit infestation due to *Conogethes punctiferalis* in jamun revealed that *Conogethes punctiferalis* Guenee infested jamun fruits during entire June month and I fortnight of July in all locations. In Dupadal variety fruit infestation ranged from 0–5.1% and 0–3.6% at Dupadal and Ankalagi, respectively. Hidkal Dam Local variety recorded 0–4.5% fruit damage. Kolavi and Kaitnal local varieties recorded 0–1.8 and 0–2.8% jamun fruit infestation, respectively. At Arabhavi Konkan Bahadoli and AJG-85 varieties recorded 0–3.7 and 0–4.5% fruit infestation, respectively. The overall mean jamun fruit damage ranged from 0–3.6±1.1% with peak incidence during II fortnight of June. Among all the locations highest (1.7±2%) jamun fruit damage was registered in Dupadal variety at Dupadal and at the same time less (0.5±0.8%) fruit infestation was noticed in Kolavi local variety at Kolavi (Table 2). Pooja et al. (2019) recorded the *Conogethus punctiferalis* Guenee damage on twigs and fruits and documented as the first report on jamun. In guava *C. punctiferalis* caused 16% fruit damage during 3rd and 5th week of August (Kumar and Kalkal, 2022.)

3.4. Correlation study on curculio c-album and weather parameters

Results of correlation analysis between pooled values of fruit infestation in Konkan Bahadoli variety with prevailing major weather parameters are presented in the Table 3. Significantly negative correlation of *Curculio c-album* was observed with morning maximum temperature(r=-0.92) and morning minimum temperature (r=-0.91). However morning and afternoon relative humidity had significantly positive correlation with *C. c-album* fruit infestation and non significant positive correlation was observed with rainfall (r=0.51). whereas *Conogethus punctiferalis* had non

Table 2: Incidence of *Conogethes punctiferalis* on jamun, in Belagavi district, Karnataka, India

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	0	0	0	0	0	0	0±0
April II	0	0	0	0	0	0	0	0±0
May I	0	0	0	0	0	0	0	0±0
May II	0	0	0	0	0	0	0	0±0
June I	4.5	2.4	4.1	1.5	2.1	2.1	2.8	2.8±1.1
June II	5.1	3.6	4.5	1.8	2.8	3.7	3.6	3.6±1.1
July I	3.6	2.7	3.3	1.0	2.8	3.0	4.5	3.0±1.1
July II	0	0	0	0	0	0	0	0±0
Mean±SD	1.7±2	1.1±1.5	1.5±2.1	0.5±0.8	1.0±1.4	1.1±1.6	1.4±1.9	1.2±0.4

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

Table 3: Influence of weather parameters on the seasonality of Curculio c-album and Conogethes punctiferalis on jamun

Sl. No.	Weather parameters	Correlation coefficient (r) value	
		Curculio c-album	*Conogethes punctiferalis*
1.	Maximum morning temperature (°C)	-0.92**	-0.57
2.	Minimum morning temperature (°C)	-0.91**	-0.64
3.	Morning relative humidity (%)	0.85**	0.60
4.	Maximum afternoon temperature (°C)	-0.92**	-0.60
5.	Minimum afternoon temperature (°C)	-0.93**	-0.71*
6.	Afternoon relative humidity (%)	0.91**	0.48
7.	Rainfall (mm)	0.51	-0.08

** Correlation is significant at $p \leq 0.01$ level table r=0.83;
* :Correlation is significant at $p \leq 0.05$ level table r=0.70

significant correlation with weather parameters except with morning temperature. Hence many more years data is required to draw the inference.

4. CONCLUSION

The overall mean fruit damage percentage due to *C. c-album* ranged from 12.29–41.54 with peak incidence during second fortnight of June. Across all the locations highest (50.1%) fruit infestation was observed in Dupadal variety at Dupadal and lowest fruit damage (19.1%) was observed in AJG-85 at Arabhavi. The fruit infestation percentage due to *C. c-album* and *Conogethes punctiferalis* was negatively correlated with temperature, positively correlated with relative humidity. *C. c-album* was positively correlated with rainfall and *C. punctiferalis* was negatively correlated with rainfall.

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