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Seasonal abundance of *Cardiastethus exiguus* Poppius, a potential anthocorid predator of *Opisina arenosella* Walker in Karnataka

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Abstract

A field surveillance was carried out during 1996-'97 in coastal and interior Karnataka, to study the seasonal abundance of *Cardiastethus exiguus* Poppius an important anthocorid egg predator of coconut leaf eating caterpillar, *Opisina arenosella* Walker. Data on seasonal variation in the population of *C. exiguus* revealed peaks during summer and post-monsoon seasons in coastal and interior areas, respectively on all ages of palms namely, seedlings, young and adult palms. The density of *C. exiguus* showed significant positive correlation with early larval population of *O. arenosella,* in both zones of Karnataka. Seasonal fluctuations in the population was dependent more on biotic factors than abiotic.

Key words: Abiotic factors, *Cardiastethus exiguus,* Karnataka, *Opisina arenosella,* seasonal abundance

Introduction

Anthocorids (pirate bugs) feed on aphids, thrips, mites, scale insects, eggs and early instar larvae of lepidopteran pests. Rao *et al.* (1948) reported *Orius* sp. as a predator of the eggs of *Opisina arenosella* Wlk. Abdurahiman *et al.* (1982) in their studies on the biology of *Cardiastethus* sp. reported that both the nymphs and adults fed on egg and early stage larvae of *O. arenosella.* Kapadia (1987) described the biology of *Cardiastethus* sp.nr. *nazarenus* Reuter, predating on the coconut caterpillar in Gujarat. Nasser and Abdurahiman (1990) recovered three species of anthocorid bugs, *viz., Cardiastethus exiguus* Poppius, *C. affinis* Poppius, and *Buchananiella sodalis* Buchanan & White from *O. arenosella* infested leaflets of coconut in Kerala. In interior Karnataka, although predatory potential and biology of *C. affinis* on *O. arenosella* was studied (Srinivasa, 1996), its effective utilization in the biocontrol of coconut caterpillar was not confirmed. Effective utilization of certain anthocorids as biocontrol agents holds considerable promise in view of their colonization rates, mobility, prey consumption efficiency and high fecundity potential (Ananthakrishnan and Suresh Kumar, 1985). Chandish *et al.* (2002) studied the biological parameters of *C. exiguus* on alternate host, *Corcyra cephalonica* Stainton and standardized a method for mass rearing of this predator. Present studies on the seasonal abundance of *C. exiguus* in coconut plantations were conducted in coastal and interior Karnataka, in view of its effective utilization as biocontrol agent of *O. arenosella.*

Materials and Methods

The study was conducted in two different agro-ecosystems or zones, i.e., coastal and interior areas of South Karnataka separated by a distance of about 500 km. Observations on the population of *O. arenosella* and its predator *C. exiguus* were recorded every month during September 1996-August 1997 in pest infested coconut plantations at Malpe of South Kanara district (12°27'N and 74°35' E) in coastal area and Somanahalli of Mandya district (12°18 N' and 76°42 E') at a height of 3,113 feet above sea level in the interior area. The gardens in coastal and interior areas were pure and mixed coconut cropping systems, respectively. The mixed cropping system involved coffee, guava, mulberry, banana and flowering shrubs as intercrops. Data was recorded from pest infested seedlings (5 year-old), young palms (5-15 years) and adult or old palms (above 15 years). The sampling plan for surveillance was adopted as per George *et al.* (1982).

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Data on temperature, relative humidity and rainfall were obtained from Agricultural Research Station (UAS), Brahmavar, S.K. district, for coastal area and Regional Research Station, Vishweshwarayya-canal Farm, Mandya, for interior area (Table 1). The seasons in Karnataka were classified as mild winter (December-February), summer (March-May), monsoon (June-August) and post-monsoon (September-November). Seasonal variation in the population of *C. exiguus* was analysed by two-way ANOVA and means were separated by CD values when ANOVA was significant. Correlation analyses were done between the population of *C. exiguus* and *O. arenosella.* Effect of weather on the population of *C. exiguus* was also analysed.

Results and Discussion

Present field surveillance in both coastal and interior areas of Karnataka have revealed the occurrence of *C. exiguus* in synchronized outbreaks. Observations on pest infested coconut leaflets revealed that nymphs and adults of *C. exiguus* feed actively on the egg mass and newly emerged larvae of *O. arenosella* concealed in the larval galleries and deposited their eggs very close to the eaten up or damaged eggs of the pest in the scraped portions of the infested leaflet. On both young and adult palms, significant difference was not observed in the population of *C. exiguus* between coastal and interior areas, whereas the density of its host, *O. arenosella* was significantly high in interior than in coastal zone; but on seedlings, the population of *C. exiguus* followed the same trend as that of the pest, where it was significantly higher in interior than in coastal areas (Table 2 and 3). This may be attributed to the fact that in coastal area, as seedlings harboured only negligible levels of pest population during post-monsoon due to heavy rainfall (1039.4-1715.3 mm), the population of its egg predator also declined drastically.

The population of *C. exiguus* was high during summer and post-monsoon seasons in coastal and interior areas, respectively, on all ages of palms, ie., seedlings, young and adult palms, and revealed its perfect synchronization with high population of *O. arenosella* (Table 3 and 4). In coastal area, peaks in the population of *C. exiguus* were recorded during November 1996 and March 1997, when temperature and humidity ranged 20-31°C and 65-85 per cent (Fig. 1). In interior area, peaks were observed during September 1996 and February 1997, where mean temperature and relative humidity

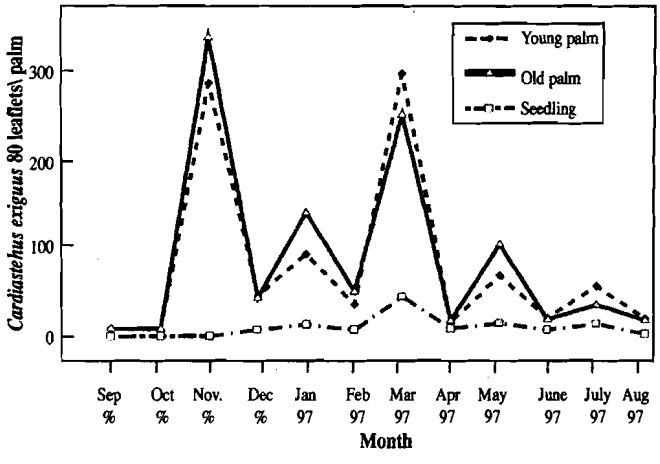

Fig. 1. Population density of *Cardiastehus exiguus* in coastal area

Table 1. Abiotic factors in coastal and interior Karnataka during 1996-1997

Months	Abiotic factors (Mean)											
	Temperature (°C)				Relative humidity (%)				Sunshine (hrs)		Rainfall (mm)	
	Maximum		Minimum		Forenoon		Afternoon					
	c	i	c	i	c	i	c	i	c	i	c	i
September 1996	30.6	28.6	22.5	20.3	89.4	93.7	83.4	65.0	4.4	5.5	313.8	363.5
October	30.4	28.7	20.5	19.2	89.6	92.0	83.4	60.0	6.6	5.8	112.2	159.2
November	31.8	28.8	19.3	17.6	80.9	91.0	72.9	56.0	7.8	6.5	0	5.6
December	31.0	26.8	18.9	14.9	75.4	89.0	60.3	58.0	9.2	6.0	0	52.6
January 1997	30.7	28.0	19.4	15.4	77.3	88.7	63.2	48.2	9.4	8.2	0	-
February	30.4	30.7	17.7	15.1	84.9	76.0	62.5	34.0	9.4	9.4	0	-
March	32.0	33.4	20.6	17.1	83.9	77.0	62.5	30.0	9.1	9.3	2.4	15.8
April	31.5	34.3	22.0	20.1	81.8	72.0	66.4	32.0	10.0	9.6	3.2	30.8
May	32.5	34.3	22.8	20.8	86.8	80.0	75.7	40.0	9.0	9.2	2.2	58.6
June	30.2	31.3	18.5	20.5	90.3	80.9	82.6	51.1	4.4	7.3	1104.2	27.2
July	27.6	29.2	17.6	20.0	94.1	87.6	89.9	59.8	1.5	4.5	1715.3	56.6
August	28.0	29.0	18.5	20.0	93.7	82.3	89.2	62.0	2.5	5.3	1039.4	17.9

c-Coastal area
i-Interior area

Table 2. Seasonal variation in the larval population of *Opisina arenosella* in Karnataka

Season	Seedling			Young palm			Adult palm		
	Coastal	Interior	Seasonal mean	Coastal	Interior	Seasonal mean	Coastal	Interior	Seasonal mean
Post- monsoon	20.25	236.25 b	128.25	478.75	1495.00c	986.88	938.75b	1657.50a	1298.13c
(Sept-Nov)	(4.47)	(15.07)	(9.77)	(21.11)	(38.49)	(29.30)	(30.34)	(40.62)	(35.48)
Winter(Dec-Feb)	336.25 a	197.50 c	266.88 a	1267.50	1605.00b	1436253	1142.50a	2222.50	1682.50a
	(18.31)	(13.95)	(16.13)	(35.25)	(39.98)	(37.62)	(33.70)	(46.99)	(40.34)
Summer(Mar-May)	341.25 b	101.25	221.25 b	2102.50	767.50	1435.00b	1887.50	1087.50c	1537.50b
	(18.46)	(9.96)	(14.21)	(45.76)	(27.47)	(36.62)	(42.84)	(34.36)	(36.59)
Rains (June-Aug.)	40.00	277.50 a	158.75	850.00	1692.50a	1271.25c	817.50c	1320.00b	1068.75d
	(6.31)	(16.31)	(11.31)	(29.14)	(40.85)	(34.99)	(28.52)	(36.23)	(32.37)
Zonal Mean	184.44	203.13	193.74	1174.69	1390.00	1282.34	1196.56	1596.88	1396.72
	(11.89)	(13.82)	(12.86)	(32.81)	(36.69)	(34.76)	(33.85)	(39.55)	(36.70)
CD(P=0.05)									
A means		2.213**			4.678*			4.585**	
B means		1.565**			3.308*			3,242**	
AxB means		3.129**			6.616**			6.485**	

** Significant at 5%* *** Significant at 1 %*
A = Seasonal mean
B = Zonal mean
AxB = Interaction mean
Figures in parentheses are square root transformed values
Values followed by different letters in the same column are not significantly different

Table 3. Seasonal abundance of *Cardiastethus exiguus* in Karnataka

Seasons	Seedling			Young palm			Adult palm		
	Coastal	Interior	Season mean	Coastal	Interior	Season mean	Coastal	Interior	Season mean
Post-monsoon	3.25	107.50	54.88 d	305.75 b	391.25 a	348.50	359.50 b	378.75 a	369.13 a
(Sept-Nov)	(1.29)	(10.32)	(5.81)	(17.47)	(19.64)	(18.55)	(18.83)	(19.33)	(19.08)
Winter(Dec-Feb)	24.00	60.50	42.25 b	172.50	230.00	201.25	233.75	372.50 b	303.13 b
	(4.65)	(7-69)	(6.17)	(13.11)	(15.11)	(14.11)	(15.18)	(19.02)	(17.10)
Summer(Mar.-May)	63.25	27.75	45.50 a	378.75 a	57.50	218.12	371.25 a	68.75	220.00
	(7.87)	(5.19)	(6.53)	(19.32)	(7.46)	(13.39)	(19.12)	(8.21)	(13.67)
Rainy(June-Aug.)	16.75	65.00	40.88 c	116.25	312.50 b	214.38	66.50	283.75	175.13
	(4.09)	(8.00)	(6.04)	(10.47)	(17.67)	(14.07)	(8.13)	(16.84)	(12.48)
Zonal mean	26.56	65.19 -	45.87	243.31	247.81	245.56	257.75	275.94	266.84
	(4.48)	(7.80)	(6.14)	(15.09)	(14.97)	(15.03)	(15.32)	(15.85)	(15.58)
CD (P=0.05)									
A means		NS			2.021**			2.370**	
B means		0.860**			NS			NS	
AxB means		1.721**			2.859**			3.352**	

** Significant at 5%*
*** Significant at 1%*
A factor - seasonal mean
B factor -zonal mean
AxB - Interaction between seasons and zones
Figures in parentheses are square root transformed values
Values followed by different letters in the same column are not significantly different

ranged between 20-30 °C and 58.0-87.0 per cent (Fig. 2). Nasser and Adburahiman (1990) also reported that *C. exiguus* laid maximum eggs from May to October (summer and post-monsoon) and lowest during November-January (winter) in coastal Kerala.

In both zones, the density of *C. exiguus* showed significant positive correlations with early larval population (Table 4), which indicated a density dependent aggregation. Similar findings were reported by Nasser

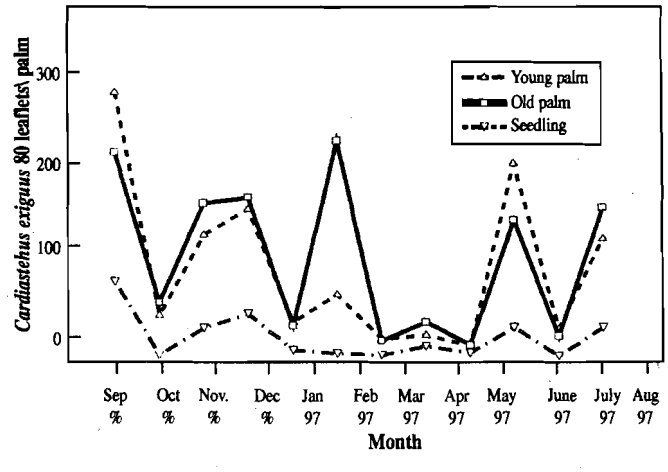

Fig. 2. Population density of *Cardiastehus exiguus* in interior area

(1992), where he has observed that predatory population was maximum in the fields in Kerala, when the egg and early larval stages of *O. arenosella* predominate in the field. Murdoch and Briggs (1996) commented that at moderate levels, density-dependent aggregation has a strong influence on host suppression and is desirable for successful biological control.

Table 4. Relationship between *Opisina armosetta* and *Cardiastethus exiguus*

Palm age	Correlation matrix with population of *Opisina arenosella*	
	Coastal	Interior
Seedling	0.6862 **	NS
Young palm	0.6640**	0.3916**
Adult palm	0.4792**	0.2856**

*** Significant at 1%*
NS = Not significant

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Table 5. Correlation matrix between abiotic factors and *Cardiastethus exiguus*

Areas/Predator	Palm age	Maximum temperature	Minimum temperature	Relative humidity (Forenoon)	Relative humidity (Afternoon)	Rainfall
Coastal						
Cardiastethus	Seedling	NS	NS	NS	-0.3842**	NS
exiguus	Young palm	0.4585**	NS	-0.3333*	-0.3525*	-0.2894*
	Adult palm	0.4978**	NS	-0.4000**	-0.3624*	-0.3579*
Interior						
Cardiastethus						
exiguus	Seedling	-0.3961**	NS	0.4349**	0.5216**	0.5881**
	Young palm	-0.4162**	NS	0.3979**	0.5324**	0.5081**
	Adult palm	-0.3858**	NS	NS	0.2866*	NS

** Significant at 5%*
*** Significant at 1%*
NS= Not significant

Present studies revealed that the correlation between the population of *C. exiguus* and abiotic factors, namely, relative humidity and rainfall was significantly negative in coastal zone, which indicated the dampening effect of heavy rains on its population. Nasser and Abdurahiman (1990) also reported the adverse effect of rainfall over population of anthocorids in coastal Kerala, but in interior zone, significant positive relationship with relative humidity and moderate rainfall was recorded (Table 5). Results indicated that moderate cold weather with relative humidity of 51-65 per cent and low rainfall (159.2-363.5 mm) had positive effect on its population size.

Based on the reverse trend obtained in two zones in the correlation between population of *C. exiguus* and climatic factors and the density-dependent aggregation of predator on pest population, it can be assumed that population fluctuation is dependent more on biotic factors than abiotic. However, Srinivasa (1996) reported that *C. affinis* maintained its population viable throughout the year, when correlations between its population and abiotic factors and biotic factors were nonsignificant.

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