J. Biol. Control, 18(1): 51-56, 2004

Efficiency of stage specific parasitoids in the biological suppression of coconut leaf eating caterpillar, *Opisina arenosella* Walker

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ABSTRACT: **A systematic surveillance of coconut leaf eating caterpillar, *Opisina arenosella* Walker and its important parasitoids was carried out on young and old coconut palms in interior and coastal areas of Karnataka during 1996-1997. Among the parasitoids recorded, *Apanteles taragamae* Viereck was active during summer and rainy seasons in coastal and interior areas, respectively. *Meteoridea hutsoni* Nixon and *Brachymeria* spp. predominated during winter and summer seasons, respectively, and showed their perfect synchronization with high population of *O. arenosella*. Studies on the effect of abiotic factors on the activity of these parasitoids showed variation between the species, regions and palm ages.**

KEY WORDS: Coconut, biocontrol, natural enemies, *Opisina arenosella*, parasitoids

INTRODUCTION

Several natural enemies have been reported to be associated with *Opisina arenosella* Walker. However, their role as effective biocontrol agents has not been assessed under different agro-ecosystems. The larval parasitoids of *O. arenosella* do not exert any significant level of natural pest suppression in Kerala (Pillai and Nair, 1993). Pupal parasitoids play a vital role in pest suppression, but have certain limitations for colonization and distribution. Nadarajan and ChannaBasavanna (1980) recorded the efficiency of *Apanteles taragamae* Viereck, *Goniozus nephantidis* (Muesebeck) and *Brachymeria* spp. in Bangalore. Pushpalatha and Veeresh (1995) reported that *A. taragamae* and *nephantidis* and larval predator, *Parena nigrolineata* Chaudoir did not play a significant role in regulating the pest population in interior Karnataka. Ghosh and Abdurahiman (1985) discussed the role of hyperparasitoids in dampening the effect of primary parasitoids in Kerala. In view of these contradictory reports, a systematic surveillance of the pest and its important parasitoids was taken up in interior and coastal areas of Karnataka, in order to gain insight into their seasonal fluctuation and relative importance.

MATERIALS AND METHODS

Surveillance of parasitoids of *Opisina arenosella*

The study was conducted in coastal and interior areas of south Karnataka. Observations on the per cent parasitism were recorded at monthly interval during September 1996-August 1997 in *O.*

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arenosella 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 933.9 metres above sea level in the interior area. Sampling plan for surveillance was adopted as per George *et al.* (1982).

Effect of abiotic and biotic factors

Meteorological data were obtained from Agricultural Research Station (UAS), Brahmavar, Udupi, South Kanara district for coastal and from Regional Research Station, Vishweshwariah Canal Farm, Mandya, for interior area. Based on the meteorological data, four seasons in Karnataka can be classified as post-monsoon, mild winter, mild summer and monsoon. Data were collected on larval and pupal parasitoids of *O. arenosella* on young (5-15 years old and 10-15 meters height) and old coconut palms (<15 years old and 15-30 meters height) selected for the study. Seasonal variation in the activity of parasitoids was analysed by two-way ANOVA and means were separated by CD values when ANOVA was significant. Correlation analysis was done between the population of *O. arenosella* and parasitism by these parasitoids. Effect of weather on the activity of parasitoids was also analysed.

RESULTS AND DISCUSSION

1. *Apanteles taragamae*

Significant difference was not observed in the per cent parasitism of *A. taragamae* between coastal and interior areas (Table 1). Seasonal analysis revealed that in coastal area parasitoid was active during winter and summer, whereas in interior area during rainy season. Parasitism ranged 0.75-3.26 per cent (Table 1). Nadarajan and ChannaBasavanna, (1980) observed highest parasitism (15.0%) by *A. taragamae* during September in interior Karnataka. Contrary to the above findings, Pushpalatha (1992) reported its efficiency during March-June and absence during November in Bangalore area. Ghosh and Abdurahiman (1987) reported that the parasitism

Table 1. Seasonal activity of *Apanteles taragamae* in coastal and interior areas

Season	Per cent parasitism by *Apanteles taragamae*					
	Young palm (5-15yrs.)			Old palm (<15yrs.)		
	Coastal	Interior	Seasonal mean	Coastal	Interior	Seasonal mean
Post- monsoon	1.16(4.36)	0.34(2.36)	0.75(3.36)	0.42 b (1.87)	1.68 (6.95)	1.05(4.41)
Winter	0.68(4.07)	0.89(5.28)	0.79 (4.67)	3.58 (10.09)	2.95 (9.47)	3.26(9.78)
Summer	5.65(13.67)	0.00(0.00)	2.83(6.83)	1.29 a (5.54)	0.00(0.00)	0.65 (2.77)
Rainy	0.00(0.00)	2.49 (8.93)	1.25 (4.46)	0.00(0.00)	3.27 (8.93)	1.63 (4.46)
Zonal mean	1.87(5.52)	0.93(4.14)	1.402 (4.83)	1.33(4.38)	1.97(6.34)	1.65(5.36)
CD (P=0.05)						
A means		NS			3.88**	
B means		NS			NS	
A x B means		3.67**			5.49**	

** Significant at 1%

Figures in parentheses are angular transformed values.

by *A. taragamae* during 1983-1985 showed wide fluctuation (1.61-15.38%) from January to September in Thikkodi area of coastal Kerala, where parasitism was high during September. In Sri Lanka, Perera (1993) reported increased activity of the parasitoid in dry areas. Above findings revealed its high adaptability to varied climatic conditions.

Parasitism by *A. taragamae* revealed significant positive correlation with larval population of *O. arenosella* in coastal area, whereas in interior area the relationship was non-significant (Table 4), which indicated that parasitoid was able to respond numerically to host density increase, only in the coastal area. Studies on the effect of abiotic factors on its activity also showed variation between the zones. In coastal area that received highest rainfall (1104-1715mm) the parasitism was significantly negatively correlated with relative humidity (Table 5). But in interior area, low rainfall (17.9-56.6 mm) during rainy season favoured activity of A. *taragamae*.

In both zones, hyperparasitoids were recorded only during January-March and July-August, when the primary parasitoid, *A. taragamae* showed its maximum activity in the field. Hyperparasitism ranged 5.0-30.0 per cent. Among the six species of hyperparasitoids recorded, *Aphanogmus manilae* (Ashmead) predominated. Ghosh and Abdurahiman (1987) reported that efficiency of *A. taragamae* was considerably impaired in the Malabar area of Kerala by the occurrence of several hyperparasitoids.

2. *Meteoridea hutsoni*

In the present study, *M. hutsoni* was recorded in coconut based cropping system (coffee mixed) in interior Karnataka for the first time throughout the study period on both young and old palms. It was not recorded in the coastal area. In interior Karnataka, highest parasitism by *M. hutsoni* was recorded during winter and lowest in summer (Table 2). Per cent parasitism ranged 3.96-19.24. Similarly, Mohammed *et al.* (1982) recorded 0.26-35.64 per cent parasitism in coastal north Kerala.

Significant positive correlation between parasitism by *M. hutsoni* and larval/ pupal population of *O.arenosella*, revealed density dependent relationship with pest population (Table 4). Due to continued pupal suppression during winter, the pest density was low during the following summer. Parasitism by *M. hutsoni* had a significant negative correlation with mean minimum temperature and rainfall on both young and old palms (Table 5) where fall in both mean minimum temperature (18 to 15°C), and rainfall (159.2 to 15.8mm) favoured the activity of *M. hutsoni* during November-February. Significant positive correlation with sunshine on old palms, revealed the favourable influence of light in the population build up at greater heights. Mohammed *et al.* (1982) and Ghosh and Abdurahiman (1984) reported that though it has limited distribution, it caused high percentage of parasitism in localized pockets in north Kerala. Based on this report, Pillai (1994)

Table 2. Seasonal variation in the parasitism by *Meteoridea hutsoni* in interior area

Palm age	Per cent parasitism				
	Post monsoon	Winter	Summer	Rainy	CD (P=0.05)
Young palm	11.16 (19.31)	18.74 (25.52)	5.25 (11.38)	9.13 (17.48)	7.45*
Old palm	10.63 (19.00)	19.24 (25.99)	3.96 (9.83)	6.42 (14.39)	5.51**

* Significant at 5% ** Significant at 1%

Figures in parentheses are angular transformed values.

remarked that owing to high parasitism in the areas of its distribution it can potentially supercede all other parasitoids and stressed for more research on its mass rearing techniques. Based on the present findings, which corroborated with the earlier reports, the prospects for utilizing *M. hutsoni* as an effective biocontrol agent of *O. arenosella* in Karnataka are bright.

3. *Brachymeria* spp.

Parasitism by *Brachymeria* spp. was significantly higher in interior than the coastal area on both young and old palms. *Brachymeria* spp. observed in the order of abundance were *B. nephantidis* > *B. lasus* > *B. atteviae* > *B. nosatoi*. In the coastal area, the parasitism was high on young (6.18%) and old palms (11.60%) during post-monsoon and summer, respectively (Table 3). It can be assumed that rainfall ranging from 112-314mm during post-monsoon might have restricted the activity of parasitoids to young palms, in coconut ecosystem. In interior area, parasitism ranged 4.54-8.95 and was significantly on par between the seasons, which indicated its uniform activity throughout the year (Table 3). Studies carried out by Nadarajan and ChannaBasavanna (1980) during September1974-August 1975 in interior area of Karnataka showed wide fluctuation in parasitism ranging from 3.0 to 48.0 per cent. Joy and Joseph (1977) and Mohammed *et al.* (1982), also recorded the efficiency of *Brachymeria* spp. in coastal Kerala. In south Kerala more than 50.0 per cent of natural pupal mortality was due to parasitism, mainly by the chalcidids, *B. nephantidis* and *B. nosatoi* (Pillai and Nair, 1981).

In both zones, significant positive correlation was observed between parasitism and pupal population of *O. arenosella* (Table 4), which revealed that parasitoids could buildup their population when the pupal population was high in the field. But Nadarajan and Channa Basavanna (1980) reported negative correlation between

Table 3. Seasonal activity of *Brachymeria* spp. in coastal and interior areas

Season	Per cent parasitism by *Brachymeria* spp.					
	Young palm			Old palm		
	Coastal	Interior	Seasonal mean	Coastal	Interior	Seasonal mean
Post- monsoon	6.18 (14.25)	6.39(14.49)	6.28(14.37)	9.03(17.41)	6.24(14.38)	7.63(15.89)
Winter	1.80 (6.66)	5.52(13.43)	3.66(10.05)	6.35(14.56)	8.95(17.32)	7.65(15.94)
Summer	4.12 (11.46)	5.17(13.03)	4.64 (12.25)	11.60(19.55)	4.54 (12.13)	8.07(15.84)
Rainy	0.00(0.00)	7.92(16.21)	3.96 (8.10)	0.00 (0.00)	8.68 (17.01)	4.34 (8.50)
Zonal Mean	3.02 (8.09)	6.25(14.29)	4.64 (11.19)	6.75(12.88)	7.10(15.21)	6.92(14.04)
CD (P=0.05)						
A means	2.73**			2.50**		
B means	1.93**			1.77*		
AxB means	3.86**			3.54**		

* Significant at 5%; ** Significant at 1%

A = Seasonal mean; B = Zonal mean; Ax B = Interaction mean

Figures in parentheses are angular transformed values.

parasitism and pupal population in Bangalore, which indicated that parasitoids had a control over the pest. Significant negative correlation with rainfall in both zones confirmed its less activity in more humid areas. In coastal area, the parasitism showed significant positive correlation with mean maximum temperature (Table 5). Pillai and Nair (1993) also reported that *B. nosatoi* has the capacity to tolerate prolonged drought, high summer temperature and low relative humidity.

Pillai and Nair (1995), while discussing the superiority of the solitary parasitoids over

Table 4. Correlation matrix for *Opisina arenosella* and its important parasitoids

Palm age	Parasitoid	Host stage	Correlation with host population	
			Coastal	Interior
Young palm	*Apanteles taragamae*	Second instar larva	0.760 **	0.050
	Brachymeria spp.	Pupa	0.515 **	0.621 **
	Meteoridea hutsoni	Pupa	Nil	0.904**
		Late instar larva	Nil	0.062
Old palm	*A. taragamae*	Second instar larva	0.423 **	0.115
	Brachymeria spp.	Pupa	0.513 **	0.853 **
	M. hutsoni	Pupa	Nil	0.785 **
		Late instar larva	Nil	0.452**

* * Significant at 1%

Table 5. Correlation matrix between abiotic factors and parasitoids of *O. arenosella*

Area/ parasitoid	Palm age	Max. Temp.	Min. Temp.	Relative humidity (FN)	Relative humidity (AN)	Sun-shine (Hours)	Rainfall (mm)
Coastal							
Apanteles taragamae	Young palm	0.28	0.03	-0.19	-0.42**	0.25	-0.16
	Old palm	0.20	-0.12	-0.45**	-0.43**	0.17	-0.18
Brachymeria spp.	Young palm	0.37*	0.09	-0.15	-0.26	0.09	-0.33*
	Old palm	0.37**	0.04	-0.29*	-0.27	0.01	-0.39**
Interior							
Apanteles taragamae	Young palm	-0.12	0.05	0.01	0.13	-0.14	0.10
	Old palm	-0.32*	-0.09	0.17	0.31*	-0.38**	0.03
Meteoridea hutsoni	Young palm	-0.30*	-0.50**	0.11	-0.07	0.20	-0.35*
	Old palm	-0.26	-0.73*	-0.11	-0.23	0.30*	-0.35*
Brachymeria spp.	Young palm	-0.00	-0.20	-0.18	-0.15	0.17	-0.29*
	Old palm	-0.26	-0.54**	-0.10	-0.04	0.05	-0.37*

* Significant at 5%, * * Significant at 1%

gregarious species in the biological suppression of the coconut caterpillar, have suggested the effective utilization of *A. taragamae*, *M. hutsoni* and *Brachymeria* spp. In the context of present findings also mass production and release of these three promising species can be taken up during rainy, winter and summer seasons, respectively, to bring about effective biological suppression of the pest, especially in interior Karnataka facing severe infestation by *O. arenosella*.

ACKNOWLEDGEMENTS

We are grateful to the Project Director, Project Directorate of Biological Control, Bangalore for the facilities provided; to Dr. M. K. Nair, former Director and Dr. V. Rajagopal, Director, CPCRI, Kasaragod for encouragement; to Dr. T. C. Narendran, Professor, Calicut University for the identification of natural enemies, and to Shri. C. H. Amarnath, Technical Officer, CPCRI, Kasaragod for statistical analysis and useful suggestions.

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