



COMPARATIVE BIOLOGY AND PREDATORY POTENTIAL OF *Cryptolaemus montrouzieri* ON MEALYBUGS

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Abstract: Comparative biology of *Cryptolaemus montrouzieri* on *Maconellicoccus hirsutus* and *Pseudococcus citri* revealed that it had completed its life cycle successfully on both species. The mean total developmental period (egg to pupa) was 18.1 days, when reared on *P. citri* and it was 20.9 days in *M. hirsutus*. The adults developed on *P. citri* had high fecundity 284.2 eggs / female and longevity 47.0 days than those developed on *M. hirsutus*. Analysis on the growth indices of *C. montrouzieri* showed more preference on *P. citri* with high suitability index of 2.51 than *M. hirsutus* (1.78). Among two life stages, adults of *C. montrouzieri* was more voracious and each adult consumed an average 258.7, 352.1 and 217.3 numbers on *M. hirsutus* while, it was 323.8, 715.6 and 328.6 number of eggs, nymphs and adults for *P. citri*, respectively. The grubs required 221.1, 55.1 and 36.6 numbers of *M. hirsutus* and 1079.0, 341.3 and 41.0 number of eggs, nymphs and adults of *P. citri*, respectively to complete life stages. Out of different instars of *C. montrouzieri*, third and fourth instars required around 92.1, 78.5 and 85.9 per cent and 88.9, 93.5 and 79.0 per cent of total eggs, nymphs and adults of *P. citri* and *M. hirsutus* consumed, respectively.

Keywords: Biology, *Cryptolaemus montrouzieri*, mealybugs, predatory potential, instars.

1. Introduction

Coccinellids and many predators have the potential to harbor a diversity of parasites and pathogens under natural conditions. Generally, feeds on phytophagous insects and mites and could be well utilized in biocontrol programs. Whitecomb (1940) and Oncuer and Baylan (1982) in their findings stated that the *Cryptolaemus montrouzieri* grub consumed about 1325 to 3330 eggs of *Pseudococcus citri*. Mani and Thontadarya (1987) indicated that the *C. montrouzieri* grub consumed a total of 881.3 eggs or 259.0 nymphs or 27.5 adult females of *M. hirsutus* under laboratory conditions. Babu and Azam (1988) proved that the daily consumption of eggs of *M. hirsutus* by *C. montrouzieri* was more at 30 °C than at 20 °C.



However, the total number of eggs consumed during the entire larval period was found to be significantly greater at 20° C.

Jayaraman *et al.* (1988) concluded that predatory rate of adults of *C. montrouzieri* on *M. hirsutus* and *P. citri* was higher than that of *S. coccivora*, irrespective of their sexes. The data on the biology and feeding potential of *C. montrouzieri* on different types of mealy bugs is very few. A comparative study on the biology and feeding potential of *C. montrouzieri* on two different mealybugs, *Macronellicoccus hirsutus* and *Plannococcus citri* was therefore, carried out at Tamil Nadu Agricultural University.

2. Materials and Methods

2.1. Biology and growth indices of *Cryptolaemus montrouzieri*

The cultures of *M. hirsutus* and *P. citri* maintained on pumpkin were used for studying the biology of *C. montrouzieri*. Eggs obtained from *C. montrouzieri* were allowed to complete one generation on the respective hosts and were used for biological and predatory potential studies. Twenty-five fresh eggs were taken separately from the surface of *M. hirsutus* and *P. citri* infested pumpkin. Egg period was calculated by recording the day of oviposition and day of emergence. After eclosion, first instar grubs started to feed mealybugs and the developmental period for each instar was recorded by observing the moulted exuviae. Pupae of *C. montrouzieri* were collected and kept in adult emergence cage for the pupal period. Observations on pupal weight, adult emergence and sex ratio were made by the method (Sunil Joshi *et al.*, 1999). Various growth indices were calculated based on the data generated on biological parameters of *C. montrouzieri* on two mealybugs.

2.2. Predatory potential of *C. montrouzieri* on *M. hirsutus* and *P. citri*

The predatory potential of grub and adult of *C. montrouzieri* was studied on *M. hirsutus* and *P. citri* (Radke *et al.*, 1977). Experiment was conducted to determine the rate of consumption on different stages of mealybugs (eggs, nymphs and adults) by the predatory grubs. After hatching, each grub was confined in a polypot and provided with known number of host insects. Observations were made at 24 h interval and surviving host insects were



counted and removed. Fresh hosts were offered to the predatory grub until pupation. Number of host insects consumed by the grub in each instar and the total consumption during grub period were calculated. The feeding potential studies were conducted with ten grubs considering each one as replication.

Similarly to determine the rate of consumption on different stages of mealybugs (eggs, nymphs and adults) by the adults of *C. montrouzieri*, each adult was confined in a polypot and provided with known number of mealybugs. The number of mealybugs preyed by the adults / day was counted at 24 h interval till the adults were alive.

3. Results and Discussion

C. montrouzieri had successfully completed its life cycle on *M. hirsutus* and *P. citri*. The mean egg period of *C. montrouzieri* when reared on *P. citri* was 4.2 ± 0.3 days and 3.7 ± 0.4 days for *M. hirsutus*. Uniformly four grub instars were observed on both mealybugs, *M. hirsutus* and *P. citri* with a average duration of first, second, third and fourth instars lasting 3.0 ± 0.3 , 1.3 ± 0.2 , 3.2 ± 0.2 and 3.8 ± 0.4 days, respectively on *P. citri* and 2.9 ± 0.3 , 2.4 ± 0.2 , 3.3 ± 0.3 and 3.9 ± 0.4 days on *M. hirsutus*. The mean grub period of *C. montrouzieri* averaged 11.5 ± 1.0 and 12.6 ± 0.6 days on *P. citri* and *M. hirsutus*, respectively. The prepupal and pupal period of *C. montrouzieri* lasted 1.7 ± 0.3 and 4.9 ± 0.6 days and 1.8 ± 0.3 and 6.5 ± 0.3 days on *P. citri* and *M. hirsutus*, respectively (Table 1). *C. montrouzieri* showed more feeding preference on *P. citri* than *M. hirsutus*.

Table 1. Developmental periods of *C. montrouzieri* reared on *M. hirsutus* and *P. citri*

Life stages of <i>C. montrouzieri</i>	Developmental periods* on	
	<i>M. hirsutus</i>	<i>P. citri</i>
Egg (days)	3.7 ± 0.4	4.2 ± 0.3
Grub (days)		
I	2.9 ± 0.3	3.0 ± 0.3



II	2.4 ± 0.2	1.4 ± 0.2
III	3.3 ± 0.3	3.2 ± 0.2
IV	3.9 ± 0.4	3.8 ± 0.4
Total grub period (days)	12.6 ± 0.6	11.5 ± 1.05
Prepupal period (days)	1.8 ± 0.3	1.7 ± 0.3
Pupal period (days)	6.5 ± 0.3	4.9 ± 0.6
Total developmental period (days)	20.9 ± 5.4	18.1 ± 5.0
Pupation (%)	76.0 ± 0.6	86.0 ± 0.2
Adult emergence (%)	100	100
Fecundity (Nos.)	227.4 ± 11.5	284.2 ± 3.4
Sex ratio (♀:♂)	1: 0.5	1: 0.5
Oviposition period (days)	29.5 ± 0.7	34.7 ± 0.8
Longevity	40.7 ± 1.5	47.0 ± 1.0
Weight of Pupa (mg)	1.3 ± 0.03	1.4 ± 0.04
Weight of adult (mg)	11.2 ± 0.07	11.4 ± 0.06

*Mean of five replications

C. montrouzieri took 18.1 ± 5.0 days from egg to pupa when reared on *P. citri* while it was 20.9 ± 5.4 days on *M. hirsutus*. Although there was a slight variation in per cent pupation of *C. montrouzieri* with 8.6 ± 0.2 and 7.6 ± 0.6 days on *P. citri* and *M. hirsutus*, respectively, cent per cent adult emergence was recorded on two prey species studied (Table 1). *C. montrouzieri* had a maximum fecundity of 284.2 ± 3.4 eggs / female on *P. citri* in a oviposition period of 34.7 ± 0.8 days which was 227.4 ± 11.5 eggs/ female on *M. hirsutus* with a oviposition period of 29.5 ± 0.7 days. The sex ratio observed was 1: 0.5. The adult of *C. montrouzieri* survived for 47.0 ± 1.0 days when reared on *P. citri*, whereas



40.7 ± 1.5 days on *M. hirsutus*. The average pupa and adult weight of *C. montrouzieri* were 1.4 ± 0.04 and 11.4 ± 0.06 mg on *P. citri* and 1.3 ± 0.03 and 11.2 ± 0.07 mg on *M. hirsutus*.

Studies on the growth indices of *C. montrouzieri* on *M. hirsutus* and *P. citri* by keeping one mealybug species as constant indicated that the predator showed more preference to *P. citri* with high suitability index of 2.51, than for *M. hirsutus* (1.78) (Table 2).

Table 2. Growth indices of *C. montrouzieri* on *P. citri* and *M. hirsutus*

Life stages	<i>P. citri</i>	<i>M. hirsutus</i>
Larval-pupal index	-	2.427
Pupal weight index	-	1.080
Adult weight index	-	1.016
Adult emergence index	-	1.000
Development index	-	0.864
General growth index	7.50	6.013
Howe's growth index	0.110	0.095
Suitability index	2.51	1.78

Data obtained for *P. citri* was used to calculate growth indices of *M. hirsutus*

Grubs and adults of *C. montrouzieri* required a total number of 479.8 ± 102.5, 407.2 ± 151.6 and 253.9 ± 93.4 eggs, nymphs and adults of *M. hirsutus* to complete their life stages while the requirement of *P. citri* was 1402.9 ± 238.3, 1056.9 ± 291.8 and 369.6 ± 142.5.



The adults of *C. montrouzieri* was able to consume on an average of 258.7 ± 10.7 , 352.1 ± 10.3 and 217.3 ± 5.0 numbers of *M. hirsutus*, while it was 323.8 ± 9.0 , 715.6 ± 6.9 and 328.6 ± 7.8 number of eggs, nymphs and adults of *P. citri*. The grub required 221.1 ± 54.6 , 55.1 ± 12.5 and 36.6 ± 8.9 numbers and 1079.0 ± 273.9 , 341.3 ± 87.3 and 41.0 ± 7.2 number of eggs, nymphs and adults of *M. hirsutus* and *P. citri*, respectively. Among various instars of the predator, third and fourth instar were voracious and consumed 91.3 ± 10.4 , 11.1 ± 1.1 and 10.0 ± 1.3 number and 324.3 ± 3.2 , 141.0 ± 1.8 and 13.5 ± 1.4 numbers of eggs, nymphs and adults of *M. hirsutus*. Whereas, the third and fourth instar were consumed 112.4 ± 23.2 , 32.1 ± 1.6 and 21.4 ± 3.1 numbers and 635.2 ± 5.2 , 178.4 ± 6.1 and 18.9 ± 1.7 numbers of eggs, nymphs and adults of *P. citri*, respectively, which were 92.1, 78.5 and 85.9 per cent and 88.9, 93.5 and 79.0 per cent of total eggs, nymphs and adults of *M. hirsutus* and *P. citri* consumed, respectively. First and second instars consumed collectively 7.8, 21.4 and 14.0 per cent and 11.07, 6.4 and 20.9 per cent of eggs, nymphs and adults of *M. hirsutus* and *P. citri*, respectively. The consumption of first and second instar were 17.3 ± 1.0 , 11.8 ± 1.0 and 5.1 ± 0.9 numbers and 119.5 ± 8.3 , 21.8 ± 2.3 and 8.5 ± 1.1 numbers of eggs, nymphs and adults of *M. hirsutus* and *P. citri*, respectively (Table 3).

Table 3. Feeding potential of *C. montrouzieri* on *M. hirsutus* and *P. citri*

Life stages of <i>C. montrouzieri</i>	Numbers consumed (Mean \pm SD)					
	<i>M. hirsutus</i>			<i>P. citri</i>		
	Egg	Nymph	Adult	Egg	Nymph	Adult
Grub (Instar)						
I	4.3 ± 0.2	4.6 ± 0.6	2.1 ± 0.3	55.6 ± 2.8	7.4 ± 0.6	3.3 ± 0.3
II	13.0 ± 0.8	7.2 ± 0.4	3.0 ± 0.6	63.9 ± 5.5	14.4 ± 1.7	5.2 ± 0.8
III	91.3 ± 10.4	11.1 ± 1.1	10.0 ± 1.3	324.3 ± 3.2	141.0 ± 1.8	13.5 ± 1.4



IV	112.4 ± 23.2	32.1 ± 1.6	21.4 ± 3.1	635.2 ± 5.2	178.4 ± 6.1	18.9 ± 1.7
Total	221.1 ± 54.6	55.1 ± 12.5	36.6 ± 8.91	1079.0 ± 273.9	341.3 ± 87.3	41.0 ± 7.2
Adult	258.7 ± 10.7	352.1 ± 10.3	217.3 ± 5.0	323.8 ± 9.0	715.6 ± 6.9	328.6 ± 7.8
Total consumption	479.8 ± 102.5	407.2 ± 151.6	253.9 ± 93.4	1402.9 ± 238.3	1056.9 ± 291.8	369.6 ± 142.5

Mean of ten replications

Studies on the development of *C. montrouzieri* on *M. hirsutus* and *P. citri* indicated that *C. montrouzieri* was able to complete its life cycle successfully on the above species but preferred more on *P. citri* than *M. hirsutus*. There was variation in the egg period of *C. montrouzieri* when reared on *P. citri* (4.2 ± 0.3 days) and *M. hirsutus* (3.7 ± 0.4 days). The total grub period of *C. montrouzieri* was shortest (11.5 ± 1.0 days) on *P. citri* which was extended by 1.1 days on *M. hirsutus*. The above findings are in consonance with (Cole, 1933) and (Manjula, 1998).

C. montrouzieri took 18.1 ± 5.0 and 20.9 ± 5.4 days from egg to pupa when reared on *P. citri* and *M. hirsutus*, respectively. The mean number of eggs per female was 284.2 ± 3.4 with oviposition period of 34.7 ± 0.8 days when reared on *P. citri* and 227.4 ± 11.5 with a oviposition period of 29.5 ± 0.7 days on *M. hirsutus*. Similar observations were made by (Ruiz Castro, 1938) and (Niyazov, 1969). In India, Srinivasan (1987) observed that *C. montrouzieri* laid more number of eggs (252.6) when fed with *P. citri* than with *M. hirsutus* (204.9).

Grubs and adults of *C. montrouzieri* collectively required an average of 1402 eggs, 1056.9 nymphs and 369.6 adults of *P. citri* to complete its life stages indicating its high feeding preference on *P. citri* than *M. hirsutus*. The average number of eggs, nymphs and



adults consumed by *C. montrouzieri* was only 479.8, 407.2 and 253.9 numbers of *M. hirsutus* only. In all cases the highest feeding rate was observed by the fourth larval instar than other instars. This is in concurrence with the findings of Satyanarayanamurthy (1982). Similar findings were reported by (Kotikal and Sengonca, 1999) that all the stages of *C. montrouzieri* preferred *P. citri* than any other mealybugs. In the present investigations grubs and adults of *C. montrouzieri* consumed more number of nymphs than adults of *P. citri* which might be related to the body size of the nymphs and adults. The gradual increase in the feeding rate of older larvae might be due to their increased nutritional requirement.

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