

# Biotic Potential of Three Coccinellid Predators on Various Diaspine Hosts

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## ABSTRACT

Biotic potential of three Coccinellid predators viz., *Chilocorus bijugus* (Muls.), *Chilocorus nigritus* (Fab.) and *Sticholotis madagassa* (Weise) were studied on various diaspine scales. *C. bijugus* and *C. nigritus* accepted all the hosts provided whereas, *S. madagassa* accepted only three hosts. When aqueous extract of sugarcane scale insect was sprayed over non-preferred host, *S. madagassa* could develop on two additional hosts. Developmental period on different hosts in case of *C. bijugus* and *C. nigritus* ranged from 33.5 to 41.4 and 32.3 to 35.1 days respectively, whereas *S. madagassa* developed faster on *Melanaspis glomerata* (Green) (33.4 days) than on other hosts. *S. madagassa* was also found to be more fecund on *M. glomerata*. *C. bijugus* showed relative preference for *Quadraspidiotus perniciosus* (Comst.), lived longer and produced larger progeny. *C. nigritus* fed and bred equally well on all the hosts provided, showing its wide acceptability and polyphagous nature. *C. nigritus* was found to be more promising on biotic parameters followed by *C. bijugus* and *S. madagassa*.

KEY WORDS: Biotic potential, coccinellid predators, diaspine scales

The armoured scale insects constitute one of the most important groups of pests in agriculture, especially in sub-tropical and tropical regions of the world (Clausen, 1978; Sankaran, 1986). Coccinellid predators are important biosuppression agents of diaspine scale insects. No efforts have so far been made to study the comparative development, their host range, fecundity and longevity on different diaspine scale insects. Therefore, studies on biotic potential of two indigenous coccinellids viz., *Chilocorus bijugus* (Muls.) and *C. nigritus* (Fab.) and on one exotic viz., *Sticholotis madagassa* (Weise), were conducted and the results are presented in this paper.

## MATERIALS AND METHODS

Nine species of host insects (Table 1) were reared on pumpkins except *M. glomerata* which was reared on sugarcane setts in the laboratory. All the predators viz., *C. bijugus*, *C. nigritus* and *S. madagassa* were field-collected and were initially reared in the laboratory on their natural hosts. Developmental period of the predators was recorded by releasing one pair of freshly emerged beetles on each of the hosts. Each treatment was replicated 4 times. Pumpkin fruits/sugarcane setts were observed daily for egg laying. Preoviposition, egg, larval and pupal periods were recorded on each host.

Experiments were conducted to determine the rate of host consumption by grubs and adults of the predators by releasing them on known scale insect population of same age group (20-25 days old). Observations were recorded daily on host insects consumed by grubs. Since adults lived for (35-87 days), host consumption was recorded every 5 days and mean host consumption was derived. This experiment was replicated 10 times. Observations on progeny production and longevity on various hosts were also recorded. In this, scale insect-infested material was changed every 15 days after the commencement of egg laying, because in preliminary tests it was found that if adults and grubs feed on the same fully infested pumpkin fruit till their entire longevity period, the pumpkin was not able to provide sufficient food material and some grubs were not able to complete their development. The experiments were conducted at  $27 \pm 1.8^\circ\text{C}$   $55 \pm 2.3\%$  RH.

## RESULTS AND DISCUSSION

The results indicated that egg period lasted 6.0 to 6.8 days for the three predators (Table 1). The length of developmental period of the four larval instars of 3 species of predators varied significantly with the host. *C. bijugus* took less time (21.4 days) on *Q. perniciosus* than on *M. glomerata* (26.6 days); *C. nigritus* (21.0 days) on *M. glomerata* than on *Lepidosaphes cornutus* Green (23.2 days). *S. madagassa* strongly preferred *M. glomerata* and grubs were able to complete development in 19.8 days while on *Q. perniciosus*

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TABLE 1. Developmental period of three coccinellid predators\* on various diaspine hosts

Host	Development period (in days)													Mean
	Egg			Larval			Pupal			Total				
	1	2	3	1	2	3	1	2	3	1	2	3		
<i>Melanaspis glomerata</i> (Green)	6.8	6.1	6.0	26.6	21.0	19.8	8.0	5.8	6.6	41.4	32.9	33.4	35.9	
<i>Quadraspidiotus</i> <i>perniciosus</i> (Comstock)	6.0	6.3	6.5	21.4	20.4	22.3	6.1	5.6	7.9	33.5	32.3	36.7	34.2	
<i>Aspidiotus destructor</i> Signoret	6.0	6.2	-	24.0	20.8	-	6.1	6.4	-	36.1	33.4	-	34.7	
<i>Aulacaspis tubercularis</i> Signoret	6.0	6.0	-	26.3	21.8	-	7.1	6.3	-	39.4	34.1	-	36.9	
<i>Hemiberlesia lataniae</i> (Newstead)	6.1	6.0	6.8	24.7	23.0	24.4	8.0	6.1	7.2	38.8	35.1	38.4	37.4	
<i>Aonidiella aurantii</i> (Maskell)	6.8	6.1	6.8	22.0	22.0	24.2	6.3	6.0	7.0	35.1	34.1	37.0	35.4	
<i>Chrysomphalus</i> <i>aonidum</i> (L)	6.2	6.0	-	23.4	21.7	-	7.1	6.5	-	36.7	34.2	-	35.4	
<i>Aonidomytilus albus</i> (Cockrill)	6.3	6.1	-	26.7	22.9	-	6.5	6.1	-	39.5	35.06	--	37.3	
<i>Lepidosaphes cornutus</i> Green	6.4	6.0	6.7	24.4	23.2	23.9	7.6	5.1	6.8	38.4	34.3	37.4	36.8	
										Mean	37.7	34.0	36.6	

\* 1. *Chilocorus bijugus* 2. *C. nigrinus* 3. *Sticholotis madagassa*

(-) indicates host not preferred.

	Hosts	Predators	Host x predators
C.D. at 5%	0.7	0.4	1.1

in 22.3 and in *Lepidosaphes cornutus* Green 23.9 days. Other hosts were not preferred. When aqueous extract as described by Quednau and Hubsch (1964) of sugarcane scale was applied on non-preferred hosts, mating was stimulated. However, egg laying was observed only on *H. lataniae* and *A. aurantii*. Larval period was found to be 24.4 and 24.2 days respectively on these two hosts. Total developmental period of *C. bijugus* ranged from 33.5 to 41.4 days, *C. nigrinus* 32.3 to 35.1 days and *S. madagassa* 33.4 to 38.4 days. Our studies on *C. nigrinus* corroborates with those of Ahmad (1970), on *C. bijugus* with Chamyuvadze (1976) and with Seshagiri Rao *et al.* (1978) on *S. madagassa*. But all of them studied the biology on a single host.

*C. nigrinus* which completed the development

in shortest time on all hosts (34.0 days) was found to be a better predator. Developmental period varied significantly with *C. bijugus* (37.7 days) and *S. madagassa* (36.6 days). *Q. perniciosus*, *A. destructor*, *A. aurantii* and *M. glomerata* were found to be better hosts with regard to the developmental period of all the three predators.

Host consumption rate by grubs of *C. bijugus*, *C. nigrinus* and *S. madagassa* ranged from 20.3 to 35.5; 29.7 to 38.0 and 11.4 to 14.8 scales per day on 20-25 days old scale insects of various hosts, respectively. Similarly, host consumption by adults ranged from 47.4 to 67.0, 60.7 to 71.4 and 3.0 to 30.4 respectively (Table 2). *C. bijugus* preferred *Q. perniciosus* and *A. aurantii* whereas *S. madagassa* preferred *M. glomerata* and *Q. perniciosus*. *C. nigrinus* did not exhibit strong

TABLE 2. Host consumption by grubs and adults of three predators\* on various hosts

Host	Host consumption (No./day)							
	Grubs				Adults			
	1	2	3	Mean	1	2	3	Mean
<i>M. glomerata</i>	28.4	32.0	14.8	25.1 <sup>b</sup>	48.3	63.0	30.4	47.2
<i>Q. perniciosus</i>	35.5	34.1	13.0	27.5 <sup>a</sup>	67.0	71.4	23.0	53.8
<i>A. destructor</i>	29.6	38.0	9.0	22.5 <sup>c</sup>	47.4	68.3	7.0	40.9
<i>A. tubercularis</i>	20.3	30.0	0.0	16.8 <sup>c</sup>	49.8	61.4	3.0	38.1
<i>H. lataniae</i>	31.8	33.6	11.4	25.6 <sup>a</sup>	58.0	67.6	20.6	48.7
<i>A. aurantii</i>	34.5	31.8	12.0	26.2 <sup>a</sup>	61.0	62.3	15.8	46.4
<i>C. aonidium</i>	30.3	29.7	0.0	20.0 <sup>d</sup>	57.0	60.7	8.2	42.0
<i>A. albus</i>	23.0	31.0	0.0	18.0 <sup>d</sup>	52.0	62.4	6.8	40.4
<i>L. cornutus</i>	32.0	30.0	13.0	25.0 <sup>b</sup>	59.0	65.6	22.8	49.1
Mean	29.5	32.2	12.4		55.5	64.7	15.3	

\* 1. *C. bijugus* 2. *C. nigrinus* 3. *S. madagassa*

C.D. at 5%	Hosts	Predators		Host x predators
		Grubs	Adults	
	Grubs	2.3	1.3	4.0
	Adults	3.3	1.9	5.7

preference for any hosts. However, grubs and adults of *C. nigrinus* consumed significantly higher number of prey insects than *C. bijugus* and *S. madagassa*. Earlier, Raghunath and Rao (1983) reported that *C. nigrinus* grubs and adults consumed 41.5 and 124 sugarcane scale insects per day. Raghunath and Rao (1980) also reported a consumption rate of 16.2 and 31.6 sugarcane scales by grubs and adults of *S. madagassa* per day. Our studies are in conformity with those on *S. madagassa*. The pre-oviposition period of the coccinellid predators ranged from 10 to 17 on different host insects (Table 3).

*C. bijugus* produced a high progeny of 93 on *Q. perniciosus* followed by 84, 81 and 80 on *H. lataniae*, *A. destructor* and *A. aurantii*. There was almost uniform progeny production on all hosts by *C. nigrinus*. *S. madagassa* produced a high progeny of 72 only on *M. glomerata*, thus confirming its preference for this host. It also produced a progeny of 54, 43, 23 and 15 on *Q. perniciosus*, *A. aurantii*, *L. cornutus* and *H. lataniae* respectively. Such differential response by the coccinellid *Menochilus sexmaculatus* Fab. has been reported on various aphids by Anand (1983).

Longevity of *C. bijugus* ranged from 56 to 87; *C. nigrinus* 70 to 81 and *S. madagassa* 15 to 64 on different hosts. *C. bijugus* and *C. nigrinus* lived for a long time on all hosts but *S. madagassa* lived for a long time on *M. glomerata*, *Q. perniciosus* and *A. aurantii* thus showing strong preference for them. Our results differ from those of Dorge *et al.* (1972) who reported a longevity of 12 and 15 days for male and female *C. nigrinus* respectively but in conformity with those of Puttarudriah and Channabasavanna (1953).

It can be concluded that *C. nigrinus* is the best predator due to its short developmental time, higher host consumption rate, fecundity and longevity. With respect to host consumption and fecundity, *C. nigrinus* was followed by *C. bijugus* and then by *S. madagassa*. Irrespective of the predator, combined analysis showed that *Q. perniciosus* is the most preferred host for both adults and grubs in terms of host consumption, higher fecundity and longevity. Longevity of *C. nigrinus* and *C. bijugus* were statistically on par. In the laboratory conditions *S. madagassa* showed poor performance by accepting only 5 of the nine hosts tested and also by its significantly lower fecundity and longevity. The information on the host range

TABLE 3. Preoviposition period, fecundity and longevity of three predators\* on various hosts

Host	Preoviposition period			Fecundity				Longevity (in days)			
	1	2	3	1	2	3	Mean	1	2	3	Mean
<i>M. glomerata</i>	13	12	10	79	80	72	77.0 <sup>a</sup>	74	79	64	72.3
<i>Q. perniciosus</i>	13	12	13	92	86	54	77.3 <sup>a</sup>	87	77	58	74.0
<i>A. destructor</i>	14	12	-	81	93	0	58.0 <sup>c</sup>	79	81	35	65.0
<i>A. tubercularis</i>	16	17	-	65	87	0	50.7 <sup>e</sup>	73	69	43	61.7
<i>H. lataniae</i>	14	15	14	84	79	15	59.3 <sup>c</sup>	81	70	49	66.7
<i>A. aurantii</i>	15	16	14	80	81	43	68.0 <sup>b</sup>	74	73	56	67.7
<i>C. aonidum</i>	17	17	-	77	72	0	49.7 <sup>e</sup>	72	70	28	56.7
<i>A. albus</i>	15	16	-	51	57	0	36.0 <sup>f</sup>	56	73	15	48.0
<i>L. cornutus</i>	14	13	14	66	71	23	53.3 <sup>d</sup>	79	82.7	36.3	66.0
Mean	-	-	-	75	78.4	23.0		75	75	42.7	

\* 1. *C. bijugus* 2. *C. nigritus* 3. *S. madagassa*

	Hosts	Predators	Hosts x Predators
C.D at 5%	F	4.9	2.8
	L	4.7	2.7
			8.5
			8.2

of the predators obtained from the above study can be used for making field releases on different hosts.

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### REFERENCES

- Ahmad, R. 1970. Studies in West Pakistan on the biology of one Nitidulid species and two Coccinellid species (Coleoptera) that attacks scale insect (Hemiptera:Coccoidea). *Bull. Ent. Res.*, 60, 5-16.
- Anand, R.K. 1983. Predation by *Coccinella septempunctata* Linn., and *Menochilus sexmaculatus* on five species of aphids. *Pranikae*, 4, 234-237.
- Chanyuvadze, H.F. 1976. The Indian *Chilocorus* - a predator of diaspine scale. *Zash. Res.*, 4, 51.
- Clausen, C.P. (Ed) 1978. Introduced parasites and predators of arthropod pests and weeds: A world review. *Agri. Handbook No.480 ARS USDA*, p 78.
- Dorge, S.K., Dalaya, V.P. and Pradhan, A.G. 1972. Studies on two predatory coccinellid beetles *Pharoscygnus horni* Weise and *Chilocorus nigritus* Fab., feeding on sugarcane scale *Aspidiotus glomeratus* Green. *Labdev J. Sci. Tech. (B) Life Sci.*, 10, 138-141.
- Puttarudriah, M. and Channabasavanna, G.P. 1953. Beneficial Coccinellids of Mysore - I. *Indian J. Ent.*, 15, 87-96.
- Quednau, F.W. and Hubsch, H.M. 1964. Factors influencing host finding and host acceptance pattern in some *Aphytis* species (Hymenoptera:Aphelinidae). *South African J. Agric. Sci.*, 7, 543-544.
- Raghunath, T.A.V.S. and Rao, B.H.K. 1980. Studies on the biology and feeding potential of *Sticholotis madagassa* Weise, an exotic predator on the scale insect of sugarcane, *Melanaspis glomerata* (Green). *Maharashtra Sug.*, 5, 17-20.
- Raghunath, T.A.V.S. and Rao, B.H.K. 1983. Studies on the feeding potential of *Chilocorus nigritus* F. (Coccinellidae: Coleoptera) on scale insect *Melanaspis glomerata* (Green) on sugarcane. *Co-op. Sug.*, 12, 191-192.
- Sankaran, T. 1986. *US PL-480 project report on survey for natural enemies of diaspine scale insects in South India*. pp.69.
- Seshagiri Rao, C., Venkateshwara Rao, S. and Rao, B.H.K. 1978. Studies on the biology of *Sticholotis madagassa* Weise (Coccinellidae: Coleoptera), exotic predator on scale insect, *Melanaspis glomerata* (Green) on sugarcane. *Indian Sug.*, 28, 453-454.