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Parasitisation behaviour of *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae) at various densities of *Planococcus citri* Risso

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ABSTRACT : The response of the encyrtid parasitoid, *Leptomastix dactylopii* Howard, to various densities of its host mealybug, *Planococcus citri* Risso, was investigated in the laboratory. Per cent parasitisation decreased, and adult parasitoid emergence increased, with the increase in host density. Development of immature stages did not differ among different density levels. Per cent female progeny was greater at lower densities. A positive correlation between density and the number of adults emerged, and a negative correlation between density and parasitisation was observed. A parasitoid: host ratio of 1: 100 was optimum for parasitoid use and mass production of *L. dactylopii*.

Planococcus citri Risso (Homoptera: Pseudococcidae) is a serious pest of citrus, pomegranate, guava, fig and many ornamental plants. *Leptomastix dactylopii* Howard was introduced into India from the West Indies for evaluation against *P. citri*. It is a specific parasitoid of *P. citri* as far as field attack is concerned, but in the laboratory it can be reared on *Planococcus maritimus* Ehrhorn, *P. comstocki* Kuwana, *P. lilacinus* Cockerell, *P. pacificus* Cox and *Phenococcus solani* Ferris (Bees, 1939; Clancy, 1944; Lloyd, 1964; Krishnamoorthy, 1988; Nagarkatti *et al.*, 1992). In India, release of *L. dactylopii* in citrus orchards and its recovery after two years suggested possible permanent establishment (Krishnamoorthy, 1990; Nagarkatti *et al.*, 1992). It is, therefore, potentially an effective control agent of *P. citri*. To mass produce this exotic parasitoid, determining the most efficient host density is essential. This led to evaluate the effects of host density on the reproductive and developmental biology of *L. dactylopii*.

MATERIALS AND METHODS

Citrus mealybug was reared on pumpkin fruits (*Cucurbita moschata* Duch.) as described by Singh (1978). *Leptomastix dactylopii* is being continuously reared in the laboratory on *P. citri*.

The experiment was initiated by allowing crawlers to settle on pumpkin fruits, and 20-day old *P. citri* were used for the experiment. This age is most suitable for rearing of this parasitoid (Krishnamoorthy, 1988). A clear plastic container (7.4 × 6.5 cm) bottom was cut and the cut end fixed over known number of mealybugs, i.e., 25, 50, 75, 100, 150, 200, 250, and 300 with the help of melted paraffin wax. A window on the side was cut in the

lid and fine brass wire mesh was heat sealed across it to provide aeration. Fine streaks of concentrated honey were provided inside the container for adult parasitoids to feed upon. In each container, one mated female parasitoid was released for 24 hours. There were five replications for each density level. After exposure time, plastic containers (structure fixed over pumpkins) were removed from pumpkin fruits and exposed mealybug infested pumpkin fruits were transferred in the insect rearing cages (30 cm^3 size). At each density level, observations were made on per cent parasitisation, number of adult parasitoids emerged, developmental time, and sex ratio.

Completely randomised block design with one parasitoid, eight density levels and five replications was followed. ANOVA was carried out to determine statistical differences between various treatments. A regression analysis was conducted using formula $y=a+bx+cx^2$, where y = number of adults obtained and per cent parasitisation and x = density. All studies in the laboratory were conducted at 27 ± 1.5°C and 60.0 ± 5% R.H., and a photoperiod of 14L: 10D.

RESULTS AND DISCUSSION

The results indicated that the lowest density, when 25 mealybugs were presented, *L. dactylopii* parasitised 92.0 per cent of them. At 50 to 100 density levels, a marginal decline was observed. With a further increase in density from 150 to 300 per parasitoid, parasitisation declined significantly (P = 0.05). The number of adult parasitoids increased with the increase in host density. An increase of 6-fold was obtained as host density increased from 25 to 300 per parasitoid (Table 1).

The decrease in parasitisation recorded (with the increasing host density) is similar to findings by Balla and Kumar (1991), who reported decrease in parasitisation when

Table 1. Response of *Leptomastix dactylopii* to various densities of *Planococcus citri*

Prey density	Parasitisation (%)	No. of adults obtained	Developmental period (days)	Female progeny (%)
25	92.0 [a]	23.0 [a]	16.6	46.0 [a]
50	86.0 [a]	43.0 [b]	15.6	45.0 [a]
75	81.3 [b]	61.0 [c]	16.3	46.3 [a]
100	78.0 [b]	78.3 [d]	16.0	36.6 [b]
150	61.3 [b]	92.3 [e]	15.7	24.0 [c]
200	58.0 [c]	116.3 [f]	15.7	21.0 [d]
250	50.7 [d]	127.6 [g]	15.7	29.0 [c]
300	43.0 [d]	131.6 [g]	15.3	31.0[b]
Letters in the column followed by the same letter are not significantly different				
S.Em.±	3.12	2.6	0.4	1.9
C.D. at 5%	9.5	7.8	-	5.8
F – test	**	**	NS	**

Phthorimaea operculella Zeller egg density increased from 2 to 100 per female parasitoid, *Chelonus blackburni* Cameron. Summy *et al.* (1985) observed that *Encarsia opulenta* Silvestri emergence increased from 0.1 to 27.5 as density of its host *Aleurocanthus woglumi* Ashby increased from 5 to 250 per parasitoid. The present findings, therefore, conform to earlier observations.

The developmental period of immature *L. dactylopii* did not differ significantly among host densities. It varied from 15.3 to 16.6. However, the availability of higher densities to parasitoid affected the percentage of adult females in the population. Per cent emerged female progeny was greater between 25–75 host per parasitoid than at higher host densities (P=0.05) (Table 1). Zinna (1959) reported that *L. dactylopii* required 14 to 18 days to complete development at 28°C, and 15.2 days developmental period was recorded at 26 ± 2°C (Krishnamoorthy, 1988). In the present study, developmental period of 15.3 to 16.6 days was recorded at 27 ± 1.5°C.

Parasitisation by *L. dactylopii* at various host densities of *P. citri* reflects type II functional response (Fig. 1). The regression curve was fitted between density and parasitisation $y=5.59+0.81x-0.0013x^2$, and between density and the number of parasitoids emerged ($y=98.76-0.36x+0.003x^2$). It shows a positive correlation with adults obtained and negative correlation with parasitisation. R^2 for density and adults emerged was 0.96, and for density and per cent parasitism was 0.96.

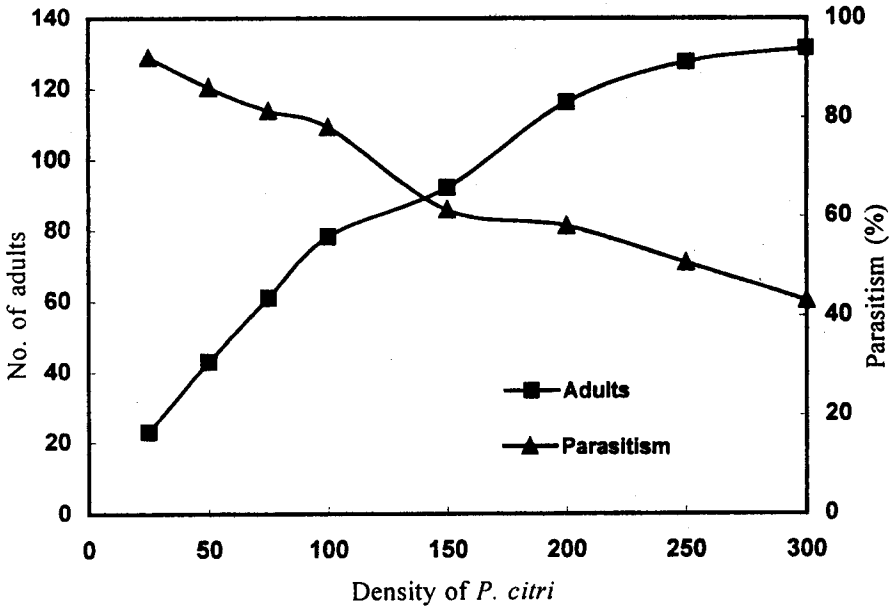

Fig. 1. Relation between *Planococcus citri* density and number of adult parasitoids and parasitism.

Thus, for mass production of the parasitoid, a parasitoid: host ratio of 1:100 appears to be optimum as host used and sex ratio is significantly higher. At higher densities more than 50 per cent host remained unutilised.

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REFERENCES

Ballal. C.R. and Kumar, P. 1991. Response of *Chelonus blackburni* (Hym.: Braconidae) to different ages and density of potato tuber moth eggs. *Entomophaga*, **36**: 513-518.

Bees. H.A. 1939. Investigation on the resistance of mealybugs (Homoptera) to parasitisation by internal hymenopterous parasites, with special reference to phagocytosis. *Ann. ent. Soc. Am.*, **32**: 189-226.

Clancy. D.W. 1944. Experimental parasitization studies with the comstock mealybug. *J. econ. Ent.*, **37**: 450-452.

Krishnamoorthy, A. 1988. Host range, development and sex-ratio of *Leptomastix dactylopii* on citrus mealybug, *Planococcus citri*. *J. biol. Control*, **2**: 8-11.

Krishnamoorthy, A. 1990. Evaluation of permanent establishment of *Leptomastix dactylopii* Howard against *Planococcus citri* in citrus orchard in India. *Fruits*, **45**: 29-32.

Lloyd. D.C. 1964. The effect of rearing in an unnatural host on the oviposition response of *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae). *Commonwealth Inst. biol. Control. Tech. Bull.* **4**: 113-120.

Nagarkatti. S., Singh, S.P. Jayanth, K.P. and Bhumannavar, B.S. 1992. Introduction and establishment of *Leptomastix dactylopii* How. against *Planococcus* species in India. *Indian J. Pl. Prot.*, **20**: 102-104.

Singh. S.P. 1978. Propagation of coccinellid beetle for the biological control of citrus and coffee mealybugs. *Proc. scienti. Conf. Coffee & Cardamom, CPA, Madikeri, Karnataka*. 2 pp.

Summy. K.R., Gilstrap, F.E. and Hart, W.G. 1985. *Aleurocanthus woglumi* (Hom.: Aleyrodidae) and *Encarsia opulenta* (Hym.: Encyrtidae): Density-dependent relationship between adult parasite aggregation and mortality of the host. *Entomophaga*, **30**: 107-112.

Zinna. G. 1959. Ricerche sugli insecti entomofagi, I. specilizzazione entomoparassitica negli Encyrtidae: studio morfologica etologicioe, fisologico del *Leptomastix dactylopii* Howard. *Bull. Lad ent. Agric. Portici*, **118**: 1-150.

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