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In vitro biology of *Columbicola bacillus* (Phthiraptera: Ischnocera)

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Abstract: An ischnoceran louse, *Columbicola bacillus* infesting Ring dove, *Streptopelia decaocto* was subjected to *in vitro* experimentation. The data obtained through *in vitro* experimentation was utilized to construct the life table and to determine its intrinsic rate of natural increase (rm). The value of rm appeared to be 0.054. At this rate, the population of *C. bacillus* is supposed to be double after 12.95 days, indicating that it is moderate breeder.

Keywords: Intrinsic rate, Ischnocera, Life table, Phthiraptera, Population expansion

INTRODUCTION

Population growth rate of any organism depends upon its reproductive potential and the length of the generation. A look on literature reveals that the reproductive potentials of phthirapteran species reportedly differ considerably. Some species may be considered fast breeder than the others (arbitrarily). The value of the intrinsic rate of natural increase (rate of increase per head in a population which has attained a stable age distribution; denoted by rm) of any organism provides vital clues regarding its rate of population expansion. During last few years some workers have tried to compute the intrinsic rate of natural increase of selected species on the basis of data obtained through *in vitro* experimentation (Saxena *et al.*, 2007, 2009; Gupta *et al.*, 2007, Arya *et al.*, 2009). Intrinsic rate of natural increase of two mammalian ischnoceran have also been indicated (Murray and Gordon, 1969; Rust, 1974). Since the values of rm of the species studied so far, varied considerably, it was found worthwhile to determine the life table statistics of one more ischnoceran louse. Moreover, the rm of any Eurasian Collered Dove lice has yet not been investigated. In the present paper an attempt has been made to compute the intrinsic rate of natural increase of *Columbicola bacillus* infesting Eurasian Collered Dove (*Streptopelia decaocto*) (Frivaldszky, 1838), on the basis of data obtained through *in vitro* experimentation on the aforesaid lice.

MATERIALS AND METHODS

Eurasian Collered Dove were trapped alive (during 2010-2011, in district Rampur,U.P.) and subjected to delousing (manually). Few feathers were gently taken out amd the deloused bird released in wild. Feathers bearing fresh eggs of *C. bacillus* were gently cut from the host body and incubated in culture vials (at 35±1°C, 75-82% RH), to record the incubation period. Freshly emerged nymphal instars were reared on the host feather diet, to determine the duration of three nymphal instars. Likewise, the colonies of apparently freshly moulted healthier adult lice were reared *in vitro* condition (in batches) to determine the adult longevity Culture vials were examined daily. The construction of the life table and computation of value of rm ($\sum e^{-rmx} lxmx = 1$; where e=base of natural logarithms; x = age of individuals in days; lx = number of individuals alive at age x as a proportion of one; mx = number of female offsprings produced/ female in the age interval x), net reproductive rate ($Ro= \sum lxmx$), the innate capacity of increase (rc= logeRo/ Tc), the precise generation time (T= loge Ro/ rm), the finite rate of increase ($\lambda = e^{rm}$) and the doubling time of population (DT= log2/ log λ) was based on the method given by Birch (1948), Leslie and Park (1949), Evans and Smith (1952), Howe (1953) and also followed by Saxena *et al.* (2007, 2009), Gupta *et al.* (2007) and Arya *et al.* (2009).

RESULTS AND DISCUSSION

The results relating to *in vitro* rearing on *C. bacillus* have been presented in Table 1. The life table (Table 2) was constructed following the lines suggested by the aforesaid workers. In a separate study by authors (communicated elsewhere) relating to population composition, the male/ female ratio in natural population of *C. bacillus* was recorded as 1:1.3. Hence, the maternal frequency (mx, the average number of female eggs produced) was computed by multiplying the daily average egg rate by a factor of 0.52. In Table 2, the lx function indicates the probability of birth of a female being alive at age X, when lo is taken as unity. It may be noted that, while preparing the survivorship table, it was presumed that all the eggs laid were fertile and the nymph mortality on the host (*in vivo*) would be negligible. Few more vital

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Table1. *In vitro* bionomics of *C. bacillus* reared at 35 ± 1^{0}C, 75- 82 % RH, at feather diet.

Adult life span (male)	13.27± 6.11 days (2-26 days, n=150)
Adult life span (female)	15.53± 8.61 days (2-32 days, n=150)
Total number of egg produced	1894
Egg produced during life span (egg laid / female during life span)	12.63
Egg rate / female /day	0.52
Incubation period	4.17± 0.98 days (range: 4-7 days, n=178)
Duration of I nymphal instar	5.10± 1.06 days (range: 4-8 days, n=124)
Duration of II nymphal instar	5.30± 1.03 days (range: 4-7 days, n=94)
Duration of III nymphal instar	6.01± 0.84 days (range: 4-7 days, n=76)
Net reproductive rate	6.20
Gross reproductive rate	12.37
Mean length of generation	35.93 days
Finite rate of increase	1.055
Precise generation time	33.79 days
Finite rate of increase	1.055

statistics of the louse have been indicated in the Table 1. The rm of the louse was computed by using the trial values to find the value which satisfied the equation $\sum e^{-rmx}lxmx = 1$. In Table 2 when rm= 0.054, the summation of $e^{-rmx}lxmx$ for each age (in which mx>0) appeared to be 1.006. At this rate (rm= 0.54) the population of *C. bacillus* is supposed to double after 12.95 days.

The scrutiny of literature shows that the intrinsic rate of natural increase of eight ischnoceran species e.g. *Goniocotes gallinae* (infesting the domestic fowl, *Gallus gallus domesticus*), *Brueelia amandavae* (occurring on Red avadavat, *Amandava amandava*), *B. cyclothorax* (parasitizing house sparrow, *Passer domesticus*), *Sturnidoecus bannoo* (parasitizing common Myna, *Acridotheres tristis*), *Neopsittaconirmus elbeli* (infesting Indian parakeet, *Psittacula eupatria*), *Columbicola columbae* (occurring on domestic pigeon, *Columba livia*), *Anaticola crassicornis* (parasitizing Mallard duck, *Anas platyrhynchos*) and *Brueelia plocea* (infesting Common baya, *Ploceus philippinus*) have been recorded, so far (Saxena *et al*., 2007, 2009; Gupta *et al*., 2007; Arya *et al*. 2009). The values of intrinsic rate of natural increase of the aforesaid species have been recorded as 0.07, 0.031, 0.032, 0.049, 0.050, 0.053, 0.074 and 0.045. Likewise, the doubling time (10.63, 23.45, 21.35, 14.21, 13.93, 14.2, 9.0 and 15.41) of aforesaid species also exhibited considerable variations. In comparison to earlier studies species, the Ring dove louse, *C. bacillus* appears to be moderate breeder as its rm equaled 0.054 and the doubling time remained 12.95 days. Presumably, the fast breeding species may build their population at faster rate (than moderate and slow breeders) and consequently may cause extensive damage to feathers of the host. On the other hand, slow breeders may exhibit low prevalence and intensity of infestation and thus causing minimal effect on host plumage. The moderate breeders like *C. bacillus* presumably are supposed to exhibit intermediate condition in this regard.

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Table 2. Lifetable, fecundity and rate of increase of *C. bacillus.*

X	lx	mx	lxmx	Xlxmx	rmx	e^{-rmx}	$\sum e^{-rmx} lxmx$
0-21	Immature stage of *C. bacillus*						
22-24	Pre-oviposition period						
25.0	1.00	0.00	0.00	0.00	1.350	0.26	0.000
26.0	0.97	0.04	0.03	0.90	1.440	0.246	0.009
27.0	0.92	0.14	0.12	3.37	1.458	0.233	0.029
28.0	0.89	0.23	0.21	5.82	1.512	0.22	0.046
29.0	0.85	0.30	0.26	7.44	1.566	0.209	0.054
30.0	0.84	0.67	0.56	16.85	1.620	0.198	0.111
31.0	0.78	0.70	0.55	16.98	1.674	0.187	0.103
32.0	0.75	0.82	0.61	19.52	1.728	0.178	0.108
33.0	0.71	0.78	0.55	18.08	1.782	0.168	0.092
34.0	0.69	0.71	0.49	16.50	1.836	0.159	0.077
35.0	0.63	0.64	0.40	14.07	1.890	0.151	0.061
36.0	0.55	0.64	0.35	12.73	1.944	0.143	0.051
37.0	0.53	0.66	0.35	12.83	1.998	0.136	0.047
38.0	0.49	0.66	0.32	12.12	2.052	0.128	0.041
39.0	0.45	0.67	0.31	11.9	2.106	0.122	0.037
40.0	0.42	0.59	0.25	9.98	2.160	0.115	0.029
41.0	0.41	0.56	0.23	9.38	2.214	0.109	0.025
42.0	0.37	0.57	0.21	8.74	2.268	0.104	0.022
43.0	0.34	0.41	0.14	5.96	2.322	0.098	0.014
44.0	0.33	0.49	0.16	7.02	2.376	0.093	0.015
45.0	0.30	0.49	0.15	6.55	2.430	0.088	0.013
46.0	0.26	0.29	0.08	3.51	2.484	0.083	0.006
47.0	0.23	0.24	0.06	2.61	2.538	0.079	0.004
48.0	0.21	0.40	0.08	3.99	2.592	0.075	0.006
49.0	0.17	0.21	0.03	1.70	2.646	0.071	0.002
50.0	0.15	0.18	0.03	1.39	2.700	0.067	0.002
51.0	0.13	0.27	0.03	1.77	2.754	0.064	0.002
52.0	0.09	0.07	0.01	0.36	2.808	0.060	0.000
53.0	0.06	0.00	0.00	0.00	2.862	0.057	0.000
54.0	0.04	0.35	0.01	0.75	2.916	0.054	0.001
55.0	0.007	0.00	0.00	0.00	2.970	0.051	0.000
							1.006

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