Fecundity and life table of different morphotypes of *Phlebotomus argentipes* (Diptera: Psychodidae)

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Abstract *Phlebotomus argentipes* Annandale and Brunetti (Diptera: Psychodidae), the established vector for Visceral Leishmaniasis (VL) have shown some morphological variations in India and its subcontinents. The variable egg laying capacity was found in different morphotypes of *P. argentipes* with maximum in type III followed by type I and II. The fecundity was enhanced by providing 25% glucose soaked filter paper surface in all types. However, significant increase was found in type-I ($P < 0.05$). The differences in fecundity indicate the biological variations among *P. argentipes* population. The findings will be helpful in searching out the sibling species among *P. argentipes* population.

Keywords Sandfly · *Phlebotomus argentipes* · Fecundity · Glucose · Filter paper

Introduction

Visceral leishmaniasis is a major health problem for people in states of Bihar, Jharkhand, Uttar Pradesh and West Bengal of India. It is caused by a protozoan parasite *Leishmania donovani* Laveran and Mensil (Kinetoplastida: Trypanosomatidae) and transmitted by the established vector *Phlebotomus argentipes* Annandale and Brunetti (Diptera: Psychodidae) (Swaminath et al. 1942). *P. argentipes* is both anthropophilic and zoophilic in nature (Dinesh et al. 2000;

Hati et al. 1981). Some morphological variations have been reported in the populations of *P. argentipes* like morpho-species type A and B in South India (Illango et al. 1994). The North Indian populations have also shown abnormality in ascoids (Dinesh et al. 2005a). Based on the relative length of ascoid and antennal segment fourth, *P. argentipes* population was grouped into three types—I, II and III (Dinesh et al. 2005b). The shorter relative length of ascoid and the respective antennal segment fourth was considered as anthropophilic population acting as vector of VL and longer zoophilic forms were considered as non vector in North Indian population of *P. argentipes* (Lane and Rahman 1980).

Phlebotomus argentipes was known to show some geographical variations (Lewis 1957). *P. argentipes* may be a species complex including zoophilic and anthropophilic species in some area (Bray 1974). The biological studies of these various forms have not been established so far. Hence, a study on developmental stages in life table of different forms of *P. argentipes* was initiated with the fecundity.

Materials and methods

Sand flies were collected from villages; Bahapur, Gulmehiyabagh, Nathachak and Khashpur of Patna district using aspirator and flashlight during 06.00–8.00 am in the month of May 2007. The gravid females were confined individually in labeled micro centrifuge tube (1.5 ml capacity) prepared for egg laying by making minute holes on sides and plugging with cotton to make it airy. A piece of filter paper measuring $1.5 \times 2.5 \text{ cm}^2$ soaked with ordinary water corresponding to natural habitat and additional support as 25% glucose solution inserted in separate vials. The vials were kept at optimum temperature of

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25°C $\pm$ 2 and relative humidity 70–75% inside the insectariums (Fig. 1). After egg laying eggs were counted under dissecting microscope from both treated filter papers. The head of sandflies were mounted in Hoyer's medium for typing by measuring ascoid and antennal segment fourth. The statistical analysis was carried out using Mann–Whitney–Wilcoxon test.

Results

Out of 101 Female *P. argentipes*; type I, II and III were found 44.1, 25.4 and 30.5%, respectively. However, only 58.4% of *P. argentipes* laid the eggs and 28.7% died without egg laying in spite of similar conditions provided. Out of which 11.9% *P. argentipes* did not oviposit and they survived up to longest 10 days. After oviposition sand flies died within 2–4 days. The statistical analysis for normality of the data was verified and was found that the data were extremely skewed (AM $\neq$ Median $\neq$ Mode). Considering this, the first test was applied to test null hypothesis that egg lying capacity of *P. argentipes* within each type was same when exposed to either water soaked or glucose soaked filter papers. It was observed that the egg lying capacity of *P. argentipes* of type-I was significantly greater

Fig. 1 Individual *P. argentipes* confined purposely made micro centrifuge tube for egg laying

Fig. 2 Fecundity in different forms of *P. argentipes*

($P < 0.05$) when exposed to glucose soaked filter papers (Median = 23.5) as compared to water-soaked filter papers (Median = 6.5), but no differences were observed for *P. argentipes* of type-II ($P > 0.05$) and type-III ($P > 0.05$).

The overall egg laying capacity of *P. argentipes* was significantly much greater (Mann–Whitney–Wilcoxon statistic, $T = 203.5$, normal approximation, $z = -4.81$; $P < 0.0001$) when exposed to glucose-soaked filter papers as compared to water-soaked filter papers (Table 1).

However, difference was found in fecundity among different forms of *P. argentipes* with maximum in type III followed by I and II (Fig. 2). The eggs were laid either in bunch or scattered in row on the surface of filter paper or wall of the micro centrifuge tube (Figs. 3, 4).

Discussion

The study on biological parameters of different morphological forms of *P. argentipes* is essential. In New World sandfly *Lutzomyia evandroi*, oviposition was found in cluster on wet filter paper placed in the flask with the mean number of eggs ranged from 21 to 50 (de Maria et al. 2001). A study on baseline biological growth data was obtained under laboratory conditions for four local populations of the Phlebotomine sandfly *P. papatasi* Scopoli (Diptera: Psychodidae) in different eco-regions at altitude between 368 and 1117 m in the Sanliurfa province of

Table 1 Egg laying capacity of different forms of *P. argentipes* on water and Glucose solution soaked filter paper

Statistical parameters	Type-I		Type-II		Type-III	
	Water	Glucose	Water	Glucose	Water	Glucose
Median	6.5	23.5	6	7	10	16
Range	2–15	2–47	2–10	5–35	6–25	4–55
<i>P. argentipes</i> (n)	14	12	8	7	7	11
Wilcoxon statistic (T)	31.5		16.5		31	
P-value	<0.05		>0.05		>0.05

Fig. 3 Oviposition in row by *P. argentipes*

Fig. 4 Oviposition in bunch by *P. argentipes*

Turkey. The developmental time period from egg to adult was found significantly different varying from, 36, 43, 45 and 49 days (Belen and Alten 2006). In the present study it was observed that life table was almost similar ranging from 25 to 30 days. The reproductive potentiality of sand fly; *Lutzomyia ovallesi* was evaluated feeding on different blood source like goat, cow, pig, human, dog and horse. The greatest fecundity was found 30.80 eggs per female (Noguera et al. 2006). In case of *P. argentipes* fecundity was reported 5–68 with an average of 32.66 (Kalra and Bang 1988) that is similar to the present study.

The differences in egg laying capacity in different forms of *P. argentipes* indicates the biological variations that can lead in further investigation of sibling species among the population.

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References

- Belen A, Alten B (2006) Variation in life table characteristics among populations of *Phlebotomus papatasi* at different altitudes. *J Vector Ecol* 31:35–44
- Bray RS (1974) Zoonoses in leishmaniasis. In: Soulsby EJJ (ed) *Parasitic zoonoses*. Bailliere Tindall, London
- de Maria F, de Freire MX, Janaina CM, Selma MJB (2001) Characteristics of the biological cycle of *Lutzomyia evandri* Costa Lima and Antunes, 1936 (Diptera: Psychodidae) under experimental conditions. *Memorias do Instituto Oswaldo Cruz* 96:883–886
- Dinesh DS, Kar SK, Kishore K, Palit A, Verma N, Gupta AK, Chauhan DS, Singh D, Sharma VD, Katoh VM (2000) Screening sand flies for natural infection with *Leishmania donovani*, using a non-radioactive probe based on the total DNA of the parasite. *Ann Trop Med Parasitol* 94:447–451
- Dinesh DS, Kishore K, Das P, Bhattacharya SK (2005a) Abnormality in *Phlebotomus argentipes* (Diptera: Psychodidae). *Curr Sci* 88:703
- Dinesh DS, Kishore K, Singh VP, Bhattacharya SK (2005b) Morphological variations in *Phlebotomus argentipes* Annandale and Brunetti (Diptera: Psychodidae). *J Commun Dis* 37:35–38
- Hati AK, Ghosh KK, Das S, De N, Sur S (1981) A longitudinal study on *Phlebotomus argentipes*/man contact in village in West Bengal, Document *WHO/VBC/81.801*. WHO, Geneva
- Illango K, Dhanda V, Srinivasan R, Sadanand AV, Lane RP (1994) *Phlebotomine sandflies* (Diptera: Psychodidae) of Tamil Nadu and Pondicherry, southern India, in relation to leishmaniasis. *Ann Trop Med Parasitol* 88:413–431
- Kalra NL, Bang YH (1988) Manual on entomology in visceral leishmaniasis, *WHO, SEA/VBC/35*. WHO, New Delhi
- Lane RP, Rahman SJ (1980) Variation in the ascoids of the sandfly *Phlebotomus argentipes* in a population from Patna, North India. *J Com Dis* 12:216–218
- Lewis DJ (1957) Some sandflies of Malaya. *Proc R Ent Soc Lond (B)* 26:165–171
- Noguera P, Rondon M, Nieves E (2006) Effect of blood source on survival and fecundity of the sandfly *Lutzomyia ovallesi* Ortiz (Diptera: Psychodidae), vector of *Leishmania*. *Biomedica* 26(Suppl):57–63
- Swaminath CS, Shortt HE, Anderson LAP (1942) Transmission of Indian Kala-azar to man by bites of *Phlebotomus argentipes* Ann and Brun India. *Indian J Med Res* 30:437–477