Research Paper

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Study of seasonal variation in sandfly species found in Bihar with respect to Kala-azar in India

Epidemiology

KEYWORDS : Kala-azar, VL, seasonal variation

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ABSTRACT

Kala-azar i.e. Visceral Leishmaniasis is a dreaded disease caused by Leishmania donovani and transmitted by vector sandflies Phlebotomus argentipes. Kala-azar is now a global problem and as per WHO about 1/3rd cases are reported from Bihar itself. Over 700 species are found worldwide and around 46 species of sandflies are found in Bihar. Out of 46 species only 3 species have been found dominantly in Bihar viz. Pargentipes, P.papatasi and Sergentomiya babu. Uptill now, the control programmes against this vector has not achieved a complete success because of lack of knowledge of endemic foci of the sandflies. Study of seasonal variation in sandflies may help to recognize the correct time for the spray and other control programme.

Introduction

Sandflies have been found to be associated with warm climate and can be grouped into two categories, wet zone and arid zone species and this further limits the distribution of different types of leishmaniasis. In Bihar, three main species of sandfly are found viz: P.argentipes, P.papatasi and Sergentomiya babu. Favourable ecological factors for transmission of kala-azar and optimum for the sandflies have been categorized as follows by Napier (1926)

a. Alluvial soil
a. High sub-soil water
a. Monthly mean maximum temperature below 370C
a. Monthly mean minimum temperature above 7.20C
a. Annual rainfall 1250 mm or more
a. Mean annual relative humidity of 70% or more
a. Abundant vegetation

All the above ecological conditions has been found to prevail in most part of the northern and central region of Bihar and thus highly suitable for abundance of sandflies in these regions facilitating perennial transmission of kala-azar.

The critical density of vector has been reported to vary from 7-8 Man hour density in endemic foci of Bihar (Palit et al, 1988). Water bodies, vegetation and human settlement have been considered as important environmental variables favoring sandflygenic conditions.

There has been undoubtedly, a certain amount of association between a heavy rainfall and kala-azar incidence. Practically in all endemic areas, the normal annual rainfall is above 50 inches. Seasonal prevalence has been found to vary from year to year and it has been speculated to result from complex interplay of biotic potential, physical, biological and environmental resistance, which often operates against the early stages.

Material and Methods

Two techniques have been applied for the determination of seasonal variations among the three different species of sandflies focused in the present setup of research.

→ Laboratory method
→ Field collection (MHD determination) method.

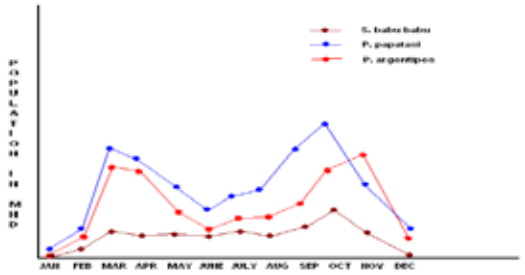
(A). Laboratory method— In this method, good colonies of three different species of sandflies have been maintained inside the insectorium of the laboratory. Wild adult sandflies have been transferred in the insectorium time to time. Different stages of sandflies have also been reared carefully in various rearing units in the laboratory.

Two types of units each have been maintained in the insectorium for all three types of sandfly species. Inside the one type of the insectorium, environmental conditions (mainly temperature and relative humidity) have been maintained to the optimum range required for the proper development of sandflies. Inside the other insectorium, no external effort has been made to balance the internal environmental conditions so that the environmental conditions inside the second type of insectorium matched with the usual external environmental conditions varying as per the fluctuation of different seasons.

In both types of insectorium, the number of viable eggs, all the four instars larvae, pupae and adults have been calculated and plotted in the table form for the comparison and further discussions.

(B). Field collection (MHD determination) method—In this method, the adults of various species have been captured from the three prominent places of their occurrences viz. human dwellings, cattle sheds and mixed dwellings in various places of one area in different seasons. By the calculation of mean and standard deviations, the average MHD has been calculated for the particular species in particular area and particular season. All the data have been arranged in the simple table form and discussions have been drawn by the statistical analyses (chart3).

Chart 3:- Monthly fluctuations in the three species of sandflies found in Bihar (Indoor and outdoor MHDs combined).



Five seasons have been undertaken in the account for these observations. These have been listed as—

i. Spring (Feb-Mar.)
ii. Summer (Apr.-June)
iii. Rainy (July-Sept.)
iv. Early cold (Oct.-Nov.)
v. Very cold (Dec.-Jan.)

RESULTS AND DISCUSSION: -

All the findings inside the laboratory conditions under two types of environmental conditions mentioned above have been listed under the following tables—

By the above mentioned tables 1 A-E and Table 2, following conclusions can be drawn-

Table 1 A. Observations in Spring season: -

Life-stage	Species	% of viable individuals(under condition A*)	% of viable individuals(under condition B*)
Eggs	P. arg	68.25	42.06
	P. papa	72.64	45.28
	S. babu	69.26	43.36
1-4 larval	P. arg	76.28	48.33
Instars	P. papa	79.25	49.66
	S. babu	73.85	46.28
Adults	P. arg	80.36	54.26
	P. papa	82.66	58.00
	S. babu	79.05	56.50

* Condition A= internal environment controlled
Condition B= internal environment like external climate

Table 1 B. Observations in summer season: -

Life-stage	Species	% of viable individuals(under condition A*)	% of viable individuals(under condition B*)
Eggs	P. arg	70.35	69.45
	P. papa	72.66	72.54
	S. babu	71.05	69.33
1-4 larval	P. arg	78.25	73.02
Instars	P. papa	81.55	76.84
	S. babu	78.66	74.21
Adults	P. arg	79.85	78.35
	P. papa	84.66	82.55
	S. babu	81.25	79.66

* Condition A= internal environment controlled
Condition B= internal environment like external climate.

Table 1 C. Observations in Rainy season: -

Life-stage	Species	% of viable individuals(under condition A*)	% of viable individuals(under condition B*)
Eggs	P. arg	72.26	75.28
	P. papa	76.66	79.66
	S. babu	73.50	74.07
1-4 larval	P. arg	78.66	78.05
Instars	P. papa	82.44	83.50
	S. babu	80.55	81.22
Adults	P. arg	79.25	79.00
	P. papa	84.00	83.26
	S. babu	82.37	84.05

* Condition A= internal environment controlled
Condition B= internal environment like external climate

Table 1 D. Observations in Early cold season: -

Life-stage	Species	% of viable individuals(under condition A*)	% of viable individuals(under condition B*)
Eggs	P. arg	71.28	75.06
	P. papa	73.58	79.54
	S. babu	72.33	76.22
1-4 larval	P. arg	74.26	78.02
Instars	P. papa	79.20	82.25
	S. babu	75.82	80.64
Adults	P. arg	78.28	79.00
	P. papa	85.26	84.56
	S. babu	82.66	83.29

* Condition A= internal environment controlled
Condition B= internal environment like external climate.

Table 1 E. Observations in Very cold season: -

Life-stage	Species	% of viable individuals(under condition A*)	% of viable individuals(under condition B*)
Eggs	P. arg	62.25	10.25
	P. papa	67.58	12.22
	S. babu	63.45	08.36
1-4 larval	P. arg	68.47	2.58
Instars	P. papa	71.55	4.89
	S. babu	68.80	4.06
Adults	P. arg	72.05	2.01
	P. papa	74.25	2.05
	S. babu	69.86	3.12

* Condition A= internal environment controlled
Condition B= internal environment like external climate.

Table 2 : Season wise differences in MHD of sandflies.

Species	District for observation	MHD in spring	MHD IN summer	MHD in rainy	MHD in early cold	MHD in very cold
P. arg	Patna	05	18	12	21	00
	Vaishali	09	24	20	29	02
	Muzaffarpur	08	21	18	31	02
	Darbhanga	08	25	16	24	01
P. papa	Patna	09	19	16	23	02
	Vaishali	12	28	23	35	04
	Muzaffarpur	13	26	22	34	03
	Darbhanga	10	24	24	36	04
S. babu	Patna	02	03	03	06	00
	Vaishali	04	06	05	11	00
	Muzaffarpur	05	08	05	10	01
	Darbhanga	03	07	04	13	02

- Eggs of all the three species of sandflies have been found to be very sensitive to the external environmental conditions. So, in the very cold season, i.e. within months of December, January and February, the survival rate of eggs has been recorded as low as 2-8%. Not only the larval instars but even the adult sandflies have also been found very sensitive to the external climatic conditions and in the very cold season, almost 80-90% adults have been found dead. The fourth instar larva and the pupal stage of sandflies undergo diapause in winter and adverse conditions. Fresh batches of adults from these diapausing larvae have been observed to readily establish themselves in the sprayed area, as DDT has only two weeks residual effect (Vyokov, 1980) which has been much less than the diapause duration of the sandfly larvae. Poor knowledge of diapause of sandfly has been found to result not only in an increase in the cost of the control Programme but in its low effectiveness as well. In spring season i.e. in February and March months, the average temperature has been found to be 15-300C and the relative humidity up to 75-80% level. These parameters help to increase the population of all the three sandfly species as diapause shown by the larval instars and pupa is overcome by this time. In the summer season i.e. within the months of April, May and June, the average temperature range has been found to be 35-480C with low relative humidity. The number of sandflies becomes less, although, eggs and larval instars are found in shady and humid places inside the human and cattle dwellings. In the rainy season i.e. during the

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months of July, August and September, the conditions are optimum for the sandfly growth. Excess rain in these three districts has been found as the main cause for the annual flood which destroys the larvae in masses. Usually during late September, optimum temperature ranges have been recorded .In the early cold season, i.e. during the October and November months, the temperature ranges have been recorded between 18-300C and the relative humidity also has been found above 80% within all the parts of Bihar. Just after the flood, organic debris and dampness has been found in plenty within all the houses, cattle sheds and the mixed dwellings providing most ideal condition for the development of sandflies. So in this season, the population graphs for all the three species of sandflies have been recorded to be maximum. For P. argentipes, the first peak population was recorded during March month, and second peak population was recorded during October month. The population has been found to be lower during the summer season and slightly raised during the rainy season. During the very cold season i.e. during the months of December and January the number of adult P. argentipes has been recorded to be minimum. Almost similar trend has been recorded for P. papatasi but in this case, the second peak population has been found in the month of November. Except the two months of December and January, when the population of Sergentomyia has been recorded almost zero, the net population of Sergentomyian sandflies has been found to be almost constant. The blunt peak as shown in the graph, during April and September-October months explain a slightly higher growth in the population of Sergentomyian sandflies.

- **Conclusion**
- Sandflies show a lot of behavioral changes according to different seasons. Knowledge of these trends will greatly help in vector control. The proper knowledge of seasonal variations among the different species of sandflies would prove very important for the functional control of these sandfly vectors

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