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A Study on Abundance and Control of Sandflies (Diptera:Psychodidae) in Al-Gassim Region, Saudi Arabia

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Abstract: Owing to the importance of sandflies in the transmission of cutaneous *Leishmaniasis* in Al-Gassim Region, Saudi Arabia, this study was carried out. The main objective was to describe the prevalence and distribution of sandflies and their susceptibility to insecticides used in three different areas in the region. Castor oil coated paper traps and insect collecting aspirators were employed in sampling three different environments in three selected sites in Al-Gassim, for two seasons. Two pyrethroid-based insecticides, Scidco Fog (0.54% permethrin +0.15% S-Bioallethrin +0.75% piperonyl butoxide) and Aralin (2% tetramethrin +11% cypermethrin +18% piperonyl butoxide) were used for sandfly control, for two active seasons. The results of the study indicated that only one species of sandflies, *Phlebotomus papatasi*, predominates in the region and that 38.7 and 36.5% of all the insects collected were in farms and primitive houses, respectively. The performance of Scidco Fog was superior over Aralin, their effect was 91.9 and 81.1%, respectively.

Key words: Sandflies, *Cutaneous leishmaniasis*, control, Al-Gassim Region, Saudi Arabia, Scidco Fog, Aralin

INTRODUCTION

The sandfly is among some of the most medically important insects. The females, being blood feeders, transmit many viral, bacterial and protozoal diseases especially cutaneous and visceral Leishmaniasis. Both diseases are caused by a protozoan belonging to the Genus *Leishmania*. *Leishmaniasis* is endemic in 88 countries, in 4 continents. Seventy-two of these countries are considered as developing countries that are located in the equatorial and semi-equatorial regions^[1,2]. Approximately 1.5-2 million people develop new infections each year and 350 millions are subjected to infection by Leishmaniasis due to their presence in endemic areas.

Prevention of the spread of *Leishmaniasis* includes getting rid of the causative organisms and the vector, which is the sandfly. There are two genera of sand flies: *Phlebotomus* and *Sergentomyia* and five Species namely: *Ph. papatasi*, *Ph. sergenti*, *S. dentate*, *S. palestinensis* and *Ph. perlifewi*^[3-9]. Three subspecies were also reported: *Ph. perniciosus tobbi*, *Ph. major syriacus* and *Ph. chinesis balcanicus*. The infective species of *Leishmania* can be differentiated on the basis of ultrastructural appearance and immunological tests into several types^[10,11]. *Leishmania donovani* and *L. tropica* occur predominantly in Europe, Africa and Asia. While *L. mexicana* and *L. brasiliensis* are restricted to Central and South America. It was found that cutaneous *Leishmaniasis* (known as the Oriental sore) occurs due to infection by the three species of *Leishmania tropica*

complex (*L. tropica*, *L. major* and *L. aethiopica*). Dry (an anthroponosis of urban areas) and wet (a zoonosis of rural areas) leishmaniasis were due to infection by first and second species of the *L. tropica*, respectively. *L. major* is the predominant species in the Middle East, Afghanistan, India, North Africa and Subsaharan Africa from Senegal across to Central Sudan. The vectors for *L. tropica* include *Phlebotomus papatasi* in Asia and *P. perfliewi* in Europe. Infection is zoonotic with rodents, especially rats and gerbils, serving as reservoir hosts. The main vector for *L. major* in gerbils is *Ph. caucasicus*. The disease spread to man by *Ph. papatasi*^[12,13]. *L. major* is the prevalent species in Saudi Arabia and its vector is *Ph. papatasi*^[14].

According to Al-Lahem^[9], the first appearance of the group of sandflies was usually at the end of April and the beginning of May when temperatures rose above 10°C and its activity continued up to the end of November. The adult insects disappeared and the larvae entered the fourth larval instar, hibernating phase, when the temperature declined below 10°C. Singh^[15] mentioned that the prevalence of females showed a definite correlation with temperature and a moderately negative correlation with relative humidity. The high prevalence of females in higher temperature indicates their ability to withstand these temperatures and can be considered a matter of epidemiological importance as it may aid in the transmission of *Leishmaniasis* in arid conditions.

The daily activity of sandflies usually begins at dusk, where two peaks of male activity were observed, with a

small increase at midnight. The females that feed on blood exhibit highest activity in the first half of the night and just before dawn. The activity of females not nurtured on blood continued regularly all night and nearly all the insects hide after sunrise in their Biotope^[9]. It was observed that sandflies dwell in stone heaps, garbage and dump hills, rifts of trees, holes and clefts, house roofs and in livestock quarters.

Strategies to control Leishmaniasis rely on early diagnosis and treatment. In some countries, with endemic disease, control programs are designed to prevent infection in human beings by vector control such as house spraying with residual insecticides and reservoir control such as culling of infected dogs^[16,17].

Phlebotomine sandflies are well known vectors of important diseases such as cutaneous and visceral *Leishmaniasis* in many parts of the world, especially the warmer tropical and subtropical countries including Saudi Arabia. Al-Gassim Region, Central Saudi Arabia, is endemic for cutaneous Leishmaniasis. Many species of sandflies are known to be involved in the transmission of the disease.

The main objective was to describe the prevalence and distribution of sandflies and their susceptibility to insecticides used in three different areas in the region.

MATERIALS AND METHODS

Study period and areas: The study was carried out in the period from April to October 2001 and then repeated in 2002 during the same period. Field cruises were accomplished in 3 different areas (Al-Meznib, Ein El-Gawa and Al-Badaea; i.e. areas I, II and III, respectively). These areas are located in rural districts in Al-Gassim Governorate, in Central Saudi Arabia, which is characterized by its desert climate that is very hot in summer and quite cold in winter^[18].

Sandfly collection: Sandflies were collected from two types of habitats: indoor resting places (bedrooms, animal quarters and warehouses) using aspirators and outdoor fixed places, using sticky traps (castor oil coated white papers) from the beginning of April to the end of October

of the active season. The number and sex of the collected sandflies in each area were determined and recorded.

Control procedures: Two pyrethroid insecticides, diluted with diesel oil, were used in this study as fog: Scidco Fog (Saudi Company for chemical insecticides and detergents Ltd.) and Aralin (Arabian company for chemical products). Detailed account of the two insecticides are given in Table 1. Scidco Fog was used in areas I, II and III in 2001 (April-October), whereas Aralin was used in the same areas in 2002, in the same period. The type of environment treated in each area is indicated in Table 2.

Statistical analysis: Statistical analysis of the data was done according to Bailey^[19].

RESULTS AND DISCUSSION

The adult sandflies collected during the study period from April and October in 2001 and 2002, in the three different locations in Al-Gassim region, are formed primarily of *Phlebotomus paptasi* which is apparently the dominant species in these areas. This was in good agreement with the findings of Magzoub *et al.*^[14] who reported that *Ph. paptasi* is responsible for the great majority of cutaneous *Leishmaniasis* in this area. The highest number of sandflies was found in local farms comprising about 38.7% of the total insects collected, followed by primitive houses (36.5%) and modern houses (24.8%) (Table 2). This confirms the intimate relationship between sandflies and their mammalian hosts (rodents) which usually prevail in such farms and primitive unsanitary locations.

The observed high prevalence (Table 2) of sandflies in the at high temperatures and low humidity, characterizing this region, can be considered as a matter of epidemiological concern. This does not contradict the findings of Singh^[15]; Yaghoobi and Akhavan^[20] and Al-Lahem^[9]. Survival of sandflies in these conditions can favor the spread of *Leishmaniasis* in these areas. The behavior of sandflies which began their daily activity at dusk, with two peaks of male activity, blood-fed females which showed highest activity during the first half of the

Table 1: General information on the insecticides used

Insecticide	Treated sites	Target insects	Form of spray	Dilution*	Rate used/hectare	Composition (wt./vol.)
Scidco Fog 45	Outdoor	Flying insects	Flying insects	1:150	0.5 L	0.54% permethrin (25:75 cis trans) 0.15% S-Bioallethrin 0.75% piperonyl butoxide
	Indoor	" "	" "	1:30	100 L/500 cu ft.	" " "
Aralin 2/11	Outdoor	Flying insects	Flying insects	1: 70	0.5 L	2% tetramethrin 11% Cypermethrin.
	Indoor	" "	" "	1:70	100 L/500 cu ft.	18% piperonyl butoxide " " "

*The insecticides were diluted using diesel oil to obtain the same ratio of dilution

Table 2: Total number of sandflies collected in three different environments in Al-Gassim

Year	Area	No. of Insects collected (Unsexed)		
		Farms	Primitive mud houses	Modern houses
2001	I	170	205	95
	II	290	205	210
	III	88	169	96
2002	I	295	135	205
	II	335	235	175
	III	97	254	35
Total		1273	1203	816
% of grand total=3292		38.7	36.5	24

Table 3: Effect of control procedures against Sandflies in three areas and three types of environments in Al-Gassim

Year	Area	Insecticide	No. of insects					
			Pre-spray			Post-spray		
			M	F	T	M	F	T
2001	I	Skid.	68	96	164	8	4	12
	II	Skid.	74	93	167	6	10	16
	III	Skid.	51	64	155	2	11	13
	Total		193	293	486	16	25	41
	%		39.7	60.3	--	39.0	61.0	--
2002	I	Aralin	59	129	189	16	24	41
	II	Aralin	124	72	196	9	10	19
	III	Aralin	37	14	51	4	4	8
	Total		220	215	436	29	39	68
	%		50.6	49.4	--	42.6	57.4	--

M = male, F= female, T= total

Table 4: Comparison between number and percentage of Sandflies before and after spray in three areas in Al-Gassim

Year	Area and insecticide	Number of insects		
		Before spray	After spray	
			Number (%)	% kill
2001	I Skid.	164	12(7.3)	92.7
	II Skid.	167	16(9.5)	90.4
	III Skid.	155	13(8.4)	91.6
	Mean±SD	164	13.7±2.1	91.5±1.6
2002	I Aralin	189	41(21.7)	78.3
	II Aralin	196	19(9.6)	90.4
	III Aralin	51	13(25.4)	74.6
	Mean±SD	189	24.3±14.7	81.1±8.3

* %age to total before spray in parenthesis

* % kill = No. before spray - No. after spray / No. before spray X 100

night and continued until dawn and females not nurtured on blood which continued regularly all night^[9], necessitated that control procedures be applied during this activity period. Two insecticides (Scidco Fog and Aralin diluted with diesel oil) used as means of eradicating the sandflies were applied during this period of peak activity (April-October) in the different environments.

The results revealed that Scidco Fog, which was used in areas I, II and III in 2001, had a much better effect regarding eradication of the sanflies than Aralin that was used in the same areas in 2002 (Table 3). It was found that the mean number of insects remaining after spray in Scidco Fog areas is 13.7±2.1 while in case of Aralin it

is 24.3±14.7 (Table 4). The overall percentage kill was 91.5 and 81.1% for Scidco Fog and Aralin, respectively (Table 4). However, this apparently higher efficiency of Scidco Fog against sandflies could probably be compensated for by the larger amount of diesel oil used for Scidco Fog in comparison to Aralin.

Chemical insecticides, when used properly, have been of tremendous benefit to man and his environment especially in developing countries, where they are used to eradicate insect-born endemic diseases. On the other hand, their excessive misuse or careless use without sufficient knowledge of their toxic effects, may result in serious health hazards to man, if spilled on the skin or inhaled^[21-25]. In addition, potential future hazards to human health and wildlife can also be created by residues from some insecticides that may build up in the food chain and cause widespread contamination of the environment. The two insecticides used in this study are classified between the safest insecticides. No much harm can be expected on human beings or on the environment due to inclusion of these two insecticides in sandfly control programs.

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