SUSCEPTIBILITY STATUS OF *PHLEBOTOMUS PAPATASI* TO DDT IN THE MOST IMPORTANT FOCUS OF ZOONOTIC CUTANEOUS LEISHMANIASIS , ISFAHAN PROVINCE , IRAN

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Abstract

With regard to the importance of determining the susceptibility level of sandflies to insecticides in control operations specially in leishmaniasis foci , the susceptibility status of *P.papatasi* collected from indoors in several villages in the rural districts of Varzaneh and Borkhar , Isfahan was tested against 4.0% DDT following a standard WHO technique during 1991-92. This species is the main vector of zoonotic cutaneous leishmaniasis and sandfly fever to man. In this program 72 series of susceptibility tests were carried out on a total of 2360 fed *P.papatasi* collected by aspiration from 6 villages in two rural districts. Our studies showed that *P.papatasi* is tolerant to DDT in the rural district of Borkhar , north of Isfahan. LT50 and LT90 values were calculated in both areas. Comparisons of LT90 of the two population of *P.papatasi* in Varzaneh and Borkhar rural districts showed significant differences between them.

Introduction

Phlebotomus papatasi is widely distributed species , which occurs from the Atlantic ocean in the west and to eastern India in the east. Northern border is the Aral sea in central Asia and southern border is in Africa and southern India in Asia (4).

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This sandfly is a usual speices in Eastern Mediterranean region. It is an important vector of zoonotic cutaneous leishmaniasis (ZCL) and sandfly fever to man in Iran , specially in the rural areas , north and east of the city of Isfahan (7,2,11,12,13,8,17). *Phlebotomus papatasi* is found domestic and wild in different parts and occurs mainly in the plains of our country.

Resistance to DDT in this species was first recognized in the north of Bihar (3) and then in Turkey (15). These records suggest that the susceptibility of sandflies in other parts of the world should be examined , specially in a big focus as Isfahan area where ZCL is hyperendemic. Determination of the susceptibility level of a major vector species such as *P.papatasi* to insecticides is very important in control operations and also the selection of insecticides. The selected villages are a part of endemic focus of Isfahan. In these villages DDT house spraying , using 75% w.d.p.,2g/m^2 was implemented one round per year started in 1952 and up to 1959 seven rounds of spraying with this insecticide have been completed for anopheline control but since 1959 , residual house spraying was discontinued due to settling these villages under consolidation phase of malaria control (5). Chlorinated compound (e.g.lindane) ; organophosphorus compunds (e.g.diazinon and zoolon) ; Carbamates (e.g.sevin) and Pyrethroids (e.g.sumicidin and ambosh) are presently used in agriculture in Borkhar rural district. Meanwhile , DDT , lindane , bromophos methyl , sevin and negon were also used in two rounds (May-Sept.) of outdoor residual spraying per year for control of sandflies and other arthropods by Shahid Babai air force station in the past three years. It should be mentioned that one round of DDT space spraying was implemented by Agriculture Organization of Isfahan province to combat phlebotomine vectors of leishmaniasis in 1991 in this area.

Materials and methods

The susceptibility tests were carried out in the following villages which are situated on the plain: Aboulkheir , Tahmooresat and Kafarved (Varzaneh rural district) about 73-98 km south east of Isfahan and Habibabad,

Parvaneh and Aliabadchi (Borkhar rural district) about 30-48 km north of the city of Isfahan (Fig. 1). All tests were carried out using a field population of blood fed and half-gravid female *P.papatasi* collected from indoor resting places from 06:00 till 10:00 A.M. during August and September , the second and the largest peak of sandflies activity in these areas. Meanwhile , the highest transmission rate of leishmania infection occurs in the middle of September. The sandflies to be tested were caught by aspirator tube and were kept in paper cups during the transport to the laboratory. Sufficient relative humidity was assured by placing small pieces of cotton wool impregnated with water on the top of the cups. The method used for the test was that recommonded by the World Health Organization (14,16). Papers impregnated with DDT at the concentration of 4.0% were supplied by WHO. Papers treated with olive oil only were used for the controls.

The multiple exposure time were 5,10,15,20,30,60,120 and 180 minutes. The sandflies were transferred to clean holding tubes after exposure to the toxicant and the percentage mortality was determined 24 hours later. No mortality corrections were necessary by Abbott's formula (1) , because all the sandflies of the control were alive.

Results and discussion

In Varzaneh rural district , as shown in table 1 , the mortality rates for 4.0% DDT after 5,10,15,20,30,60 and 120 minutes of exposure time followed by 24 hours recovery time were 1.4% , 7.04% , 35.93% , 48,51% , 70.52% , 97.54% and 100% with LT50 and LT90 of 20.15 and 43 minutes respectively in the village of Kafarved.

DDT test (4%) for one hour exposure time on *P.papatasi* caused 98.61% mortality in the villages of Aboulkheir and Tahmooresat (Table 1). Comparisons of the results of susceptibility tests on *P.papatasi* to DDT in the studied villages showed that this species is susceptible to DDT in two neighbouring villages (Aboulkheir and Tahmooresat) but less susceptibility to DDT in the village of Kafarved.

In Borkhar rural district the susceptibility status of field strain of *P.papatasi* to 4.0% DDT are given in table 2. The mortality rate after 5,10,15,20,30 and 60 minutes exposure time followed by a 24hr recovery period were 11.3% , 30.1% , 40% , 51.3% , 67.2% and 88.8% respectively. When the exposure time was increased to 90,120 and 180 minutes , the mortality rates showed 95.2% 98.8% and 100% with LT50 and LT90 values of 18.12 and 63.31 minutes respectively.

With regard to 88.8% mortalities in one hour exposure time (Table 2), it could be concluded that *P.papatasi* is tolerant to DDT and verification is required in the field population , in Borkhar rural district.

Comparisons of susceptibility of the two populations of *P.papatasi* in Varzaneh and Borkhar rural districts didn't show any significant differences between the LT50 of the two strains , but the LT90 showed significant differences between them (LT90 of Varzaneh=43 minutes , LT90 of Borkhar=63.3 minutes). The resistance ratio of *P.papatasi* in Borkhar was also calculated. The two strains showed a resistance ratio of 1.5 that of the population of this species in Varzaneh.

The susceptibility of *P.papatasi* was studied in the rural district of Borkhar in September 1976 (9). The results didn't show any evidence of resistance in this species.i.e. 100% mortality was observed in 1 hr exposure time. Other tests made in the same area in August 1985 showed the emergence of low level DDT resistance in this species (10). Our present study indicated that since 1976 the susceptibility of *P.papatasi* has been changed and the strain has become tolerant to DDT in this area.i.e. 88.8% mortality was observed in 1 hour exposure time.

In Iran DDT is still a main candidate insecticide for sandfly control. The appearance of tolerance in *P.papatasi* might be as the result of either DDT application or related compound in public health or agricultural pest control. If the application of this insecticide continued in the area , the development of DDT resistance in *P.papatasi* is unavoidable as it happened in *P.papatasi* and *P.argentipes* in Bihar , India (3,6).

On the basis of the results of these studies , a careful systematic checking of the susceptibility level of sandflies in other parts of Iran , specially in foci of leishmaniasis is recommended.

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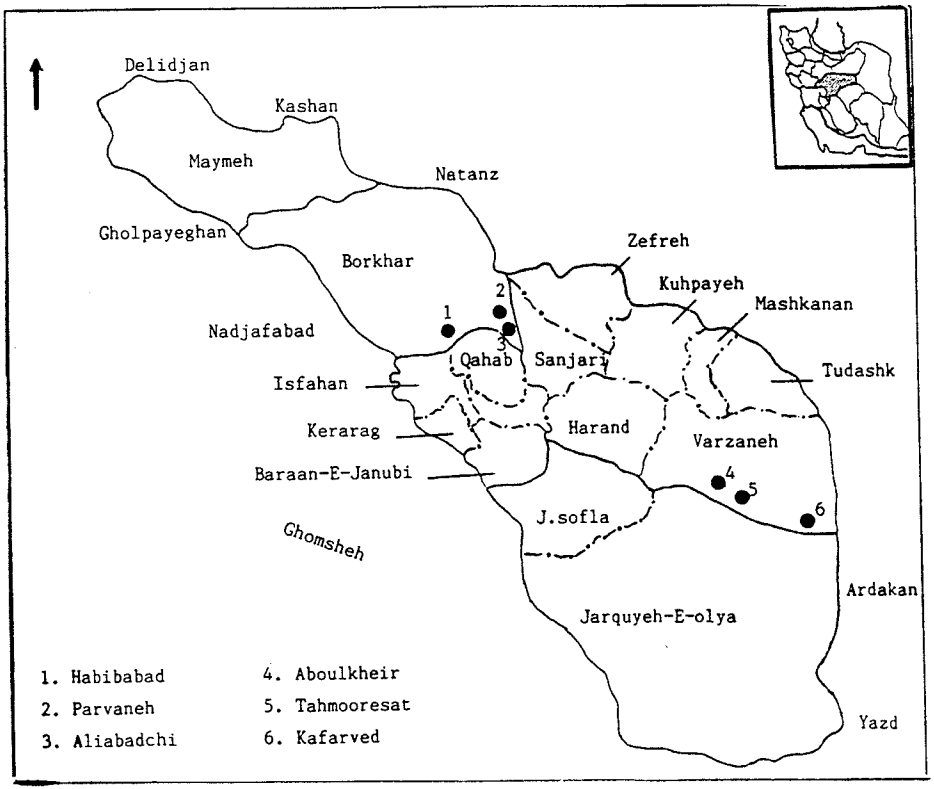

Fig 1- Map showing the selected villages on the north and southeast of Isfahan , Iran.

Table 1- Results of DDT susceptibility tests on *Phlebotomus papatasi* in Varzanch rural district , Isfahan.

Village	Temperature	Exposure time	% Mortality after 24 hrs recovery	
	Min-Max^{0C}	(minutes)	Control	DDT 4.0%
Kafarved (Sept. 1990)	22-24	5	0 (35)	1.4 (74)
	20-22	10	0 (38)	7.04 (71)
	24-27	15	0 (32)	35.93 (64)
	23-26	20	0 (58)	48.51 (101)
	24.5-28	30	0 (61)	70.52 (95)
	24-26	60	0 (64)	97.54 (163)
	23-27	120	0 (49)	100 (91)
Aboulkheir & Tahmooresat (Sept. 1990)	24-25	60	0 (44)	98.61 (72)

LT50 = 20.15 minutes , LT90 = 43 minutes
Relative humidity : 70-75%
The figures in parentheses represents the number of sandflies tested.

Table 2- Results of DDT susceptibility tests on *Phlebotomus papatasi* in Borkhar rural district , Isfahan.

Village	Temperature	Exposure time	% Mortality after 24 hrs recovery	
	Min-Max^{0C}	(minutes)	Control	DDT 4.0%
Habibabad , Parvaneh & Aliabadchi (Aug. 1991)	22-25	5	0 (46)	11.3 (97)
	21-26	10	0 (37)	30.1 (73)
	24-26	15	0 (48)	40 (95)
	22-25	20	0 (41)	51.3 (80)
	23-26	30	0 (57)	67.2 (116)
	24.5-26	60	0 (42)	88.8 (107)
	21-25	90	0 (45)	95.2 (83)
	22-25	120	0 (34)	98.8 (82)
	21.5-26	180	0 (21)	100 (66)

LT50 = 18.1 minutes , LT90 = 63.3 minutes
Relative humidity : 70-75%
The figures in parentheses represents the number of sandflies tested.

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