

SUSCEPTIBILITY OF *PHLEBOTOMUS PAPATASI* (DIPTERA: PSYCHODIDAE) TO DDT IN SOME FOCI OF CUTANEOUS LEISHMANIASIS IN IRAN

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ABSTRACT. The susceptibility of *Phlebotomus papatasi* to DDT was studied in field surveys at localities in different areas of Iran during 1985–88. In many parts of Iran houses had been treated with DDT for malaria control (1950–68). Tests were carried out in localities where the application of DDT had been discontinued since 1969. This investigation showed that *P. papatasi* from Isfahan is more tolerant to DDT than flies from other areas, probably a manifestation of DDT resistance.

Phlebotomus papatasi (Scopoli) is a troublesome biter and a well known vector of zoonotic cutaneous leishmaniasis and sand fly fever over most of its wide range of distribution. This species is widespread in the plains of Central Asia, the Middle East, the Mediterranean and Red Sea basins. In Iran it is widely distributed and is an important vector of zoonotic cutaneous leishmaniasis and sand fly fever.

The susceptibility of *P. papatasi* and other sand flies to various insecticides has been reviewed by Brown (1958), Brown and Pal (1971) and Schmidt and Schmidt (1969). In general it was known that sand flies are highly susceptible to insecticides, but that different sand fly species vary in susceptibility to DDT and dieldrin, and that *P. papatasi* was resistant to DDT in India (Rahman et al. 1982) and Turkey (World Health Organization 1986).

Susceptibility tests were performed with wild-caught specimens collected by aspirator, during 1985–88 from human dwellings in Mashhad, Isfahan and Khuzistan. These areas have had different spraying histories. In Mashhad city residual spray had not been applied but domestic space sprays were used. The Isfahan area was subjected to DDT spraying before 1969; after 1969 residual spray was not applied for mosquito control, but insecticides were used in agriculture as well as domestic sprays in human dwellings. In the Khuzistan area, residual spray had been applied with different insecticides: (1950–57 DDT; 1958–60 dieldrin; 1960–61 no insecticide applied; 1963–66 DDT; 1967–68 malathion and DDT; 1969–78 malathion; and 1979 up to present time, propoxur).

Sand flies were collected between July and October, the period of greatest sand fly prevalence in these areas. Females (blood-fed and half-gravid) were used in the tests.

The standard WHO test kit for determining insecticide resistance in adult mosquitoes

(World Health Organization 1970) was used throughout the study. This method was followed closely with only a slight modification. To prevent the sand flies escaping through the holding tube, the end was tightly covered with fine muslin.

In general, sand flies were exposed to papers impregnated with DDT (1, 2 and 4%) for 1 h, using 25 to 30 flies per dilution. A 2-h exposure period was used when testing sand flies from Isfahan, because 1-h exposures resulted in incomplete mortality at the highest test concentration. During the exposure period, room temperature ranged from 25 to 30°C and relative humidity from 55 to 70%.

After making final mortality counts at the end of 24 h, the survivors were killed with chloroform and stored separately in a labeled tube containing 70% alcohol for identification at a later date. The sand flies that died in the holding tube during the 24-h observation period were stored similarly for identification.

To determine the density of *P. papatasi* in sprayed and unsprayed resting places, collections were made with aspirators and sticky traps in 1,621 different indoor resting places in Mashhad, Isfahan, Gonbad-Kavus and Lotf-Abad.

The baseline LC50 value for DDT was 0.47%, determined in the unsprayed area of Mashhad in northeastern Iran in August 1970 (Seyedi Rashti 1971)¹. In susceptibility tests carried out on *P. papatasi* from the Isfahan area, the LC50 for DDT was 0.47% in September 1976 (Soltani 1977)², indicating no development of resistance.

¹ Seyedi Rashti, M. A. 1971. Sand flies of eastern part of Iran. M.S.P.H. thesis, Teheran University, School of Public Health, No. 483, Teheran, Iran. (in Persian).

² Soltani, A. A. 1977. Determination of susceptibility level of Isfahan sand flies. M.S.P.H. thesis, Teheran University, School of Public Health, No. 990, Teheran, Iran. (in Persian).

Table 1. DDT-susceptibility tests on *Phlebotomus papatasi* from Iran.

Locality and province	Date of test	% mortality after 24 h						
		1-h exposure			2-h exposure		Control	LC ₅₀
		1% DDT	2% DDT	4% DDT	4% DDT			
Kooh Sangi, Mashhad	Jul. 1985	3.4 (76)*	53.8 (88)	100 (98)	—	0 (64)	2.25	
Khajeh Rabi, Mashhad	Jul. 1986	32.2 (88)	60.0 (95)	100 (96)	—	0 (94)	1.70	
Shahporabad, Isfahan	Aug. 1985	2.3 (82)	16.6 (81)	75 (93)	100 (95)	0 (82)	3.00	
Komshecheh, Isfahan	Aug. 1985	5.4 (74)	47.1 (87)	76 (94)	100 (99)	0 (98)	2.60	
Komshecheh, Isfahan	Aug. 1986	7.8 (82)	64.0 (95)	100 (86)	—	0 (89)	2.00	
Omkolsum, Khuzistan	Oct. 1986	54.3 (82)	67.4 (85)	100 (92)	—	0 (96)	0.77	
Susangerd, Khuzistan	Oct. 1986	12.3 (89)	61.5 (89)	100 (81)	—	0 (89)	1.70	

* Figures in parentheses represent the number of sand flies at each concentration.

Our studies showed that the LC₅₀ value for DDT had increased to 2.3% and 3% in Mashhad and Isfahan, respectively (Table 1), revealing the nature of selection pressure in the absence of public health insecticide use. In respect to the density of sand flies, they were practically extinct in all areas where residual sprays had been systematically applied, but were abundant in unsprayed areas. Although the DDT LC₅₀ value for *P. papatasi* was as high as 3% in some areas, our collection results show that this species is still susceptible to residual-spray deposits of DDT in other areas (Table 2).

Resistance has been reported in *P. papatasi* (Rahman et al. 1982, World Health Organization 1986), but our work showed no such resistance based on criterion of 100% mortality on

exposure for 1 or 2 h to 4% DDT and nil or very low population density of *P. papatasi* in sprayed areas. Further studies are necessary to assess the potential of *P. papatasi* to develop DDT resistance in Iran and to explain the differences in susceptibility in different populations.

REFERENCES CITED

- Brown, A. W. A. 1958. Insecticide resistance in arthropods. W.H.O. Monogr. Ser. 38.
- Brown, A. W. A. and R. Pal. 1971. Insecticide resistance in arthropods (2nd edition). W.H.O. Monogr. Ser. 38.
- Rahman, S. J., B. L. Wattal, K. K. Mathur, G. C. Joshi and K. Kumar. 1982. Susceptibility of laboratory reared strain of *Phlebotomus papatasi* (Scopoli) to organochlorine insecticides. J. Commun. Dis. 14:122-124.
- Schmidt, M. L. and J. R. Schmidt. 1969. Insecticide susceptibilities of *Phlebotomus papatasi* (Scopoli) from Egypt and Sudan. J. Med. Entomol. 6:87-90.
- World Health Organization. 1970. Insecticide resistance and vector control. Seventeenth Report of the WHO Expert Committee on Insecticides. Tech. Rep. Ser. 443, World Health Organization, Geneva.
- World Health Organization. 1986. Resistance of vectors and reservoirs of disease to pesticides. Tenth Report of the WHO Expert Committee on Vector Biology and Control. Tech. Rep. Ser. 737, World Health Organization, Geneva.

Table 2. Density of *Phlebotomus papatasi* in visited areas of Iran, May-October, 1988.

Collection site	Number of resting places		Density/10 resting places	
	Sprayed	Un-sprayed	Sprayed	Un-sprayed
Room	668	64	0.1	110
Stable	310	34	0.2	129
Store	370	33	0	10
Toilet	125	17	0	20