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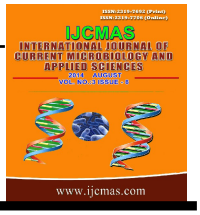

Original Research Article

Susceptibility Status of Rodent Fleas to Different Insecticides in Plague Endemic area Kolar, Karnataka, India

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A B S T R A C T

Plague is highly fatal and its transmission in the rodent population and human plague outbreak usually occur due to the close association of infected rodent fleas with the human being. Sporadic plague outbreak occurred after 1966 were in Himachal and Attibele in Karnataka (1983-84), Surat and Maharashtra (1994), Hatkoti, Shimla (Himachal Pradesh) (2002), Dangud village, Uttarkashi (Uttarakhand) (2004).Plague outbreak can be controlled by controlling rodent flea. The study on susceptibility status of rodent fleas helps in combating the plague outbreak. The findings provide information that the rodent fleas have developed resistance to DDT insecticide about 50 years back and still the status of BHC/DDT is same. This was also found true in Kolar area during our study. It was found that the present insecticide of the following seven insecticides representing four insecticide groups asOrganochlorine, Organophospate, Synthetic Pyrethroid and Carbamate were also showing varying susceptibility status as Malathion (0.5%) Deltamethrin (0.005%) Cypermethrin (0.0.0075%) Lamdacyhalothrin (0.05%) Methyl parathion (1.0%) and Methomyl (4%) except the BHC.

Introduction

Rodent fleas were considered as the main vector for plague transmission in rodents and human. Plague outbreak usually occur due to the close association of infected rodent fleas and human being. Plague is highly fatal in human being if not treated early. The third pandemic of plague started in 1890's and caused a heavy death toll (more than 25 million of deaths in India, (including Bangladesh and Pakistan) alone in two decades period (1898 – 1918), throughout the world (Samuel *et al.*,2008).

The dramatic reduction in the plague cases just after the Second World War was due to the development of antibiotics such as Streptomycin and Sulphonamide and it was also attributed to the universal use of DDT spray in rural areas for mosquito control, because the rodent fleas were also sensitive to DDT at that time (Biswas *et al*., 2011). The mortality rate of plague came down from 183 to 1.8 per lakh population and finally reached to zero level during 1967.

Mulbagal area of Kolar district reported a last case of plague in 1966. Sporadic cases of plague were also reported after 1967 from Himachal Pradesh, Attebele Karnataka in 1983 and 1984. The sylvatic plague incidences were detected and reported by plague surveillance unit of National Centre for Disease Control(formerly known as National Institute of Communicable Disease) in the tri-junction area of Karnataka, Andhra Pradesh and Tamil Nadu.

After a quiescence period of 28 years, plague re-emerged in 1994. Both types of plague (Bubonic and Pneumonic) cases were reported from Beed district of Maharashtra and Surat of Gujarat. The probable reason for this was the discontinuation of plague surveillance and control unit in these states. A lesson was learnt from this outbreak and plague surveillance and control units were re-started in both these states. Again after 8 years of long quiescence localized pneumonic plague outbreaks were reported from Hatkoti, Shimla (Himachal Pradesh) in 2002 and 2004 in Dangud village, district Uttarkashi (Uttarakhand).

The seriousness of plague was well documented by W.H.O. Twenty six countries had reported 53,417 cases 4060 (7.6 %) deaths to W.H.O. Though it is well known fact that the under reporting is always there due to various factors which are beyond the control of administration (Biswas *et al*., 2011).

Baltzard*et al.* (1958) studied and concluded that plague is not localized but time to time it shifts from one place to other due to the rodent migration and the vector too. The rodent fleas as main vectors are responsible for its continuity. Various biotic and abiotic factors are also responsible for the outbreaks of plague. The containment of plague was well done with the vector control by the use of DDT. But now the scenario has changedas the high population growth, rapid transport system and fast development of various pesticides/insecticides and antibiotic and their uncontrolled use in agriculture sector and in health sector will have some impact in almost all sphere of life and it might have affected the nature of the plague vector. Therefore,the present study is conducted to find out the susceptibility of the plague vector in India particularly in the plague endemic areas.

In the beginning the rodent fleas were very sensitive to DDT and now it has developed resistance (Biswas *et al.*, 2008). This is posing a threat and generates a further need tomake a priorstudy on the insecticide susceptibility status of rodent fleas in the plague endemic areas in India which may be of great help in cutting down the transmission of plague in the near future.We made the study on the susceptibility status of the insecticide available at presentwhich may have direct impact in the control of plague vector.

Materials and Methods

a) Sufficient test tubes were taken for the complete range of concentrations Aninsecticide impregnated paper and a control paper impregnated with oil alone, were cut into 50mmx 15mm size and folded to make a ‘Z’ shape and inserted into each of the test tubes. This was done to provide maximum exposure of insecticide to fleas.

b) Into each tube 10 fleas, were transferred from the flea colony by means of the aspirator unit. Each tube is closed by the fine-mesh gauze and placed vertically in the rack in dark during the exposure period.

c) At the end of a 60-minute exposure

period, the tubes were removed in the order in which they were set up and all the fleas transferred (by means of the aspirator) to clean tubes containing a clean non-impregnated paper. The holding tubes were then closed with gauze, returned to the rack, and placed in darkness. To minimize contamination of test insects with high concentrationsof insecticides during the transfer from treated to clean papers, aspiration was carried out with the control fleas first, then with the lowest conc. of insecticide, working up to the highest conc. The aspirator tube was thoroughly rinsed with acetone or alcohol and dried before transferring the fleas from papers treated with different insecticides. The exposure period was extended to 24 hours. The mortality was recorded in the first hour as well as at the end of 24 hours exposure period.Fleas unable to stand were counted as dead.

d) At the end of the test, the exposure papers were discarded andboth the dead and live fleas were processed further for proper identification. All the tested fleas were kept overnight in 10.0% KOH solution and mounted on glass slides with DPXmounting. All the test and control fleas are identified up to the species level.

e) After the preliminary test it was further diluted 1 in 10 and tested. This test involves 3 replicates at each of the chosen concentration giving partial and complete mortality.

f) Abbott's formula was applied if the control mortality was between 5% and 20% the percent mortalities to get the corrected mortality by,

$$\frac{\%\ test\ mortality - \%\ control\ mortality}{100 - \%\ control\ morality} * 100$$

However, if in the tests the control mortality was excess of 20% then test was unsatisfactory and repeated.

g) The test was repeated 4 times with the same population of fleas.The susceptibility status of the fleas was determined as per WHO procedures.

Results and Discussion

It was found that rodent fleas are still resistant against BHC. The present generation insecticides were found effective in controlling rodent flea population i.e. rodent fleas are susceptible to the insecticides which were tested, except BHC. In both parts of the experiments i.e. high and 10% less of the first concentration of insecticides, the Cypermethrin and Lamdacyhalothrin were showed 100% of flea mortality (Table: 1 and 2).

Total number of 461 fleas was exposed in which male and female of *X. astia* were identified 140 and 232 respectively whereas *X. cheopis* were 34 and 55 respectively. Fleas exposed for the susceptibility of *X. astia* and *X. cheopis* with the ratio of 4.17:1 (Table: 3).

The vector for plague is rodent flea that lives on rodent body and takes blood meal from the rodent. The plague transmission takes place from rodent to rodent through the infected rodent flea at the time when it sucks the blood form the host. The transmission can be interrupted by reducingthe fleas' population in the endemic areas. Many scientists had done the studies on the insecticide susceptibility of rodent fleas in different places at different periods in India e.g. Krishnamurthy *et al*.(1965); Chaturvedi *et al.*(1969); Kalra*et al*. (1974); Sant*et al*.(1971); Renapurkar (1990); Kumar*et al*.(1996) and Biswas *et al.* (2008).

Table.1 Insecticides studied for their impact on the rodent fleas

Pesticides/Insecticides	Company Name	Can Kill	% during purchase	Group
Deltamethrin	Chemical Wets & Flows Pvt. Ltd. Batch no. : CWANK 1207007	Fleas	25 %	Synthetic Pyrethroid
Cypermethrin [For rat & mice]	Agrochemical Pvt. Ltd. Batch no. 1015	Fleas, cockroaches, termites	25%	Synthetic Pyrethroid
Lamdacyhalothrin (Brand name-Karate) [For Rat & mice][Low toxic] [Class II type of toxic, where class I is most toxic & class IV is least toxic]	Syngenta Batch no. : SBS 1H102	Fleas, (Mouse, Rats) Mites, Cockroches	5%	Synthetic Pyrethroid
Methylparathion (Dimethyl parathion)	Multimin Agro Ltd. Batch no.: 07	Lice, aphids, Mites	50%	Organophosphate
Malathion	Insecticides (India) Ltd. Batch no. : CO 221	Fleas	50%	Organophosphate
BHC/Lindane(Beta-hexachlorocyclohexane) or (Benzene hexachloride)	Technical MAKAMAgrochem Pvt Ltd.	Fleas, Beetles	50% (Lipid solubility)	Organochlorine
Methomyl	E. I. Dupont India Pvt. Ltd. Batch no. : OCT11SV021	Fleas	40%	Carbamate

Table.2 Susceptibility of Rodent fleas to various Insecticides in high concentration

Sl. No.	Insecticide used and concentration	Mortality in tested Population			Percent Control Mortality	Mean Mortality
		Fleas exposed	Fleas died	Percent Mortality		
1	BHC (5.5%)	40	12	30	16.7	15.96
2	Malathion (5.0%)	35	30	85.7	16.7	82.8
3	Deltamethrin (0.05%)	38	35	92.1	16.7	91.2
4	Cypermethrin(0.75%)	33	33	100	16.7	99.96
5	Lamdacyhalothrin (0.05%)	36	36	100	16.7	99.96
6	Methomyl (4%)	30	21	70	16.7	63.96
7	Methyl parathion (1%)	30	25	83.33	16.7	79.95
8	Control (Nil)	30	5	16.7	16.7	

Second test at 1:10 further dilution

Table.3 Susceptibility of rodent fleas to various insecticides in 10% less concentration of the first concentration

Sl. No.	Insecticide used and concentration	Mortality in tested Population			Percent Control Mortality	Mean Mortality
		Fleas exposed	Fleas died	Percent Mortality		
1	Malathion (0.5%)	30	21	70	6.66	67.77
2	Deltamethrin (0.005%)	30	30	100	6.66	100
3	Cypermethrin(.075%)	33	33	100	6.66	100
4	Lamdacyhalothrin (.005%)	36	36	100	6.66	100
5	Methyl parathion (0.1%)	30	15	50	6.66	46.37
6	Control (Nil)	30	2	6.66	6.66	

Table.4 Identification of fleas exposed for susceptibility test

Sl. no.	Insecticide used	Fleas exposed	*X.astia*		*X.cheopis*	
			Male	Female	Male	Female
1	Malathion	65	20	32	5	8
2	Deltamethrin	68	20	36	5	7
3	Cypermethrin	66	24	30	6	6
4	Lamdacyhalothrin	72	19	34	7	12
5	Methyl parathion	60	21	33	2	4
6	Methomyl	30	8	14	2	6
7	BHC	40	13	21	3	3
8	Control	60	15	32	4	9
Total		461	140	232	34	55
Ratio of *X. astia* to *X. cheopis* =(372 : 89) i.e. =4.17 : 1						

Their finding varies from place to place. However,findings giveinformation that rodent fleas have developed resistance to DDT insecticide about 50 years back and still the status of BHC/DDT is same. This also found in Kolar area during our study. We too have found that the present insecticide of the following seven insecticides representing four insecticide groups as Organochlorine, Organophospate, Synthetic Pyrethroid andCarbamate were also showing varying susceptibility status.

The selection and dosages of the insecticides are important for the control measure. Hence the study on the susceptibility status of the flea to the insecticide plays a vital role if done in advance. It was observed from the present study, rodent fleas of Kolar district were found susceptible to the present generation insecticides as Malathion (0.5%) Deltamethrin (0.005%) Cypermethrin(0.0.0075%) Lamdacyhalothrin (0.05%) Methyl parathion (1.0%) and Methomyl (4%) except the BHC. It also found that *X. astia* was the dominant species which is less important than *X. cheopis* in plague outbreak.

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