

# Efficacy of Two Insecticides: Methyl Carbamate and Aluminium Phosphide on Leishmaniasis Vectors in Varamin, Iran

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## Abstract

**Background:** Leishmaniasis is a prevalent tropical parasitic disease, which is caused by *Leishmania protozoa*. The infection can be limited in immune-competent individuals; however, in immune-compromised individuals it could proceed to chronic and ulcerative disease. The reservoirs are carnivores, and rodents and its vectors are Phlebotomus and Lutzumia.

**Methods:** The prevalence of different species of Phlebotomus populations and the effects of insecticides on them are investigated in Abardejhe district located in southeast of Tehran, Iran. Tablets of aluminum phosphide (3 g) and residual formulation of methyl carbamate at concentrations of 1 and 2 g/m<sup>2</sup> were used in rodents' burrows.

**Results:** Phlebotomus population was highly sensitive to both insecticides used here, and their population significantly decreased by 80% within two months after application of insecticides. The effects of methyl carbamate at concentrations used lasted two months longer than that of aluminum phosphide.

**Conclusion:** Control and prevention of Leishmania infection depends on the habitat and behavior of vectors and reservoirs. Periodic insecticide spraying, using residual compound inside and outside residential areas, as well as breeding places of sandflies, specially rodent's burrows, are shown to be very effective.

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**Keywords** • Leishmaniasis • phlebotomus • methyl carbamate • aluminum phosphide

## Introduction

**L**eishmaniasis is a polymorphic disease of the skin and viscera caused by an intracellular protozoan.<sup>1,2</sup> Zoonotic cutaneous Leishmaniasis (ZCL) is a major health problem in rural areas of Iran,<sup>3</sup> and recently new foci of ZCL were reported in several regions.<sup>4</sup> This phenomenon is believed to be the result of malaria control programs interruption and human immigrations.<sup>5</sup> Indoor and outdoor residual insecticide spraying is a commonly used technique for obtaining a reduction of vector man contact during leishmaniasis control programs in endemic foci.<sup>6</sup> Many authors have reported that residual insecticide spraying reduces sandfly density and, therefore, leishmania transmission in various

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localities.<sup>7-10</sup> For the first time the existence of resistant population of *Phlebotomus papatasi* to DDT, in Kala-azar epidemic areas of Bihar, a state of India, was reported by Kaul et al.<sup>11</sup> According to WHO reports,<sup>12</sup> many countries that have used insecticides such as malathion and fenitrothion were able to control sandflies.

There are endemic foci of leishmaniasis in Abardejhe-Varamin, southeast of Tehran, Iran. The presence of rodents and Tamarisk trees has made this area a suitable place for phlebotomus activity. Previous studies have indicated that rodents and phlebotomus living in the middle east were infected with *Leishmania*.<sup>13</sup> Since *Phlebotomus papatasi* and *Phlebotomus sergenti* are the main vectors of *Leishmania* in this region, two insecticides; Aluminum phosphide (AIP) and methyl carbamate (MC) are used in outdoor under field conditions to evaluate and compare the reduction of sandflies density within the biogeographically areas treated.

**Materials and Methods**

Five active colonies of wild rodents were selected by simple random sampling (with random number table) in the tropical ecosystem of Abardejhe 110 Km Southeast of Tehran, Iran. Each colony covered an area of about 20 m<sup>2</sup> and was 40 to 60 meters apart. There were approximately 12 to 20 burrows in each colony, each with 2 to 3 rodent families. One colony maintained as control, the second and third colonies were treated with AIP tablets (3 g Phostoxin per tablet, Chem & Pharm Producers Association, China). Two tablets of AIP were placed at 20-25 cm deep in all burrows of the

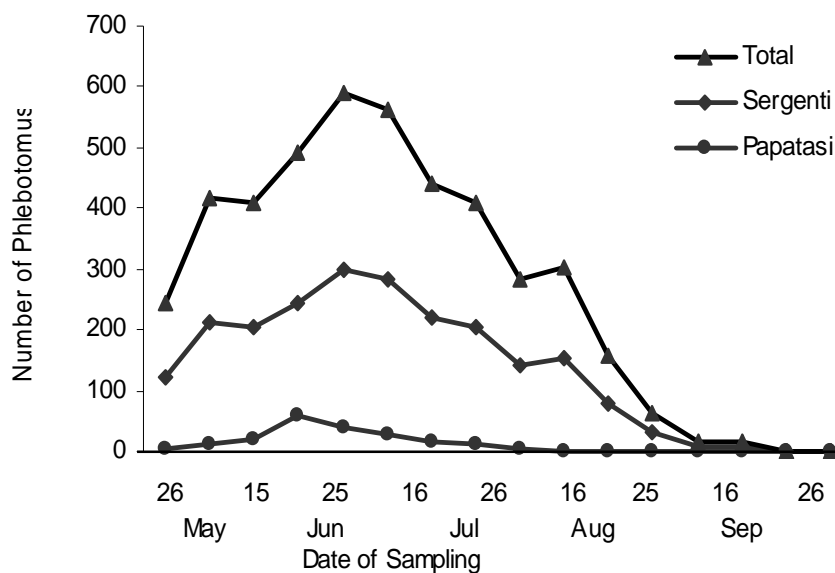
second colony and for third colony the number of tablets doubled. The fourth and fifth colonies were treated with one and two g/m<sup>2</sup> MC (Ficam D: Agr Evo, Hoechst, Germany) respectively.

The status of phlebotomus population was monitored using funnel traps. The traps were placed in control colonies one hour before sun rise and one hour after the sunset. Sampling was carried out three times per month, from early spring to the end of autumn, and the density of each population was calculated. The collected phlebotomus were transferred to the Department of Parasitology of Pasteur Institute, Tehran, Iran, and their species were recognized with phlebotomus morphological key.<sup>14</sup>

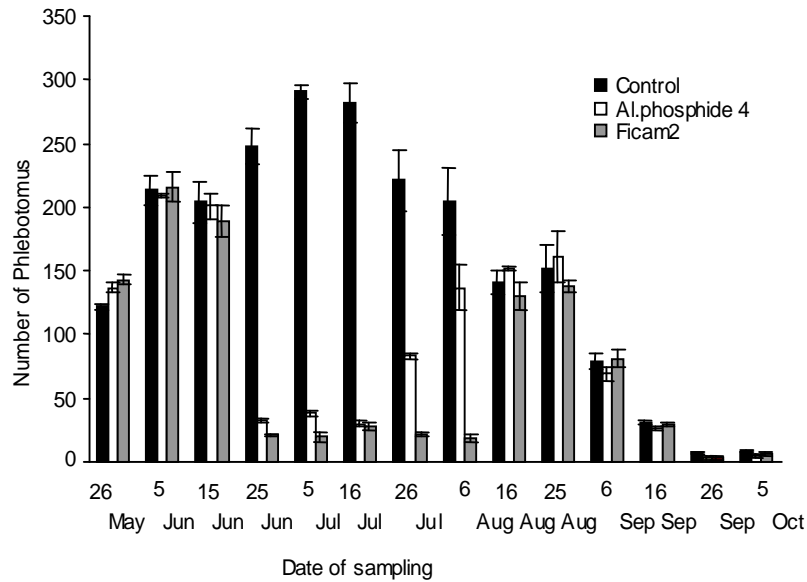
**Results**

During five months period of the study, a total number of 2575 phlebotomus were collected from control and tests colonies. They were categorized as *Phlebotomus papatasi* and *sergenti*. The activity of phlebotomus started at the beginning of the spring and the frequency of their population increased during the first two months of the summer. However, their activity and their frequency was minimum at the beginning of autumn. (Fig 1)

This field assay showed an 80% mortality rate with both insecticides. It is interesting to mention that the residual effects of both insecticides were similar during the first month of the spraying. Although the residual activity of AIP decreased two months after spraying, the remnant effects of MC were still high which coincided with the high frequency of *Phlebotomus* (Fig 2). The activity and frequency rate of the



**Fig1:** Frequency and activity of phlebotomus population in Varamin district



**Fig 2:** The comparison effects of two insecticides Methyl carbamate & Al.phosphide on Phlebotomus population with that on control group

fourth and fifth colonies of rodents revealed that the residual effects of MC lasted significantly longer than of AIP.

**Discussion**

Indoor and outdoor residual insecticide spraying is a commonly used technique for the reduction of vector man contact in endemic foci of Iran. Chemical control of Leishmaniosis and elimination of infected reservoirs are the main Leishmaniasis control programs.<sup>15</sup> Alternative methods for the protecting humans against Leishmaniosis are impregnating bed nets and screens with insecticide, body repellents and pheromone baits used against mosquito phlebotomus sandflies.<sup>16</sup>

After the first report on DDT resistant population of *Phlebotomus papatasi*, laboratory and field studies have documented the resistance of other sandflies population including *Phlebotomus papatasi* and *argentipes* as well as *sergentomia shortii*.<sup>17</sup> A study performed in Italy by Lavagnino and his colleagues demonstrated that Sicilian phlebotomus populations were resistant to DDT, malathion and permethrin.<sup>18</sup>

Several investigators have reported that the residual sprayed insecticides had reduced sandfly densities.<sup>19,20</sup> The efficacy of deltamethrin (25 mg/m<sup>2</sup>) on various sandfly species, in an endemic area, for cutaneous *Leishmaniosis* is evaluated by Falcao et al.<sup>21</sup> They concluded that application of deltamethrin reduces sandfly, when applied to the surface of concrete and lime painted walls, the populations of sandflies decreased by 50% and the mortality rate of *Lut-*

*zomyia intermedia* by 100%.<sup>21</sup> Whereas, in all these assays the mortality rates of *Lutzomyia longipalpis* were low, even reaching to zero.<sup>22</sup>

Mutinga et al. reported that mortality rates of *Phlebotomus martini*, exposed to cotton cloths impregnated with 0.5 mg /m<sup>2</sup> permethrin, under laboratory condition, were 76.8% and 48.5%, six and nine months after treatment receptively.<sup>20</sup> The residual activity of the insecticide was only satisfactory when the treated surface was wood. One hundred percent mortality rates were observed with deltamethrin at 25 mg/m<sup>2</sup> and cipermethrin at 125 mg/m<sup>2</sup>.<sup>23</sup> Our results about the efficacy of insecticides under field conditions were similar to those of other researchers who used different insecticides on special surfaces, such as wall or animal dwelling, at laboratory conditions.<sup>15</sup> The mortality rate of *Phlebotomus papatasi* and *sergenti* in response to MC was 80%, its residual activity was satisfactory for two months after exposure and its effect was more than AIP.

The outdoor insecticide spraying is an important strategic entomological activity for leishmaniasis control programs in field conditions. This assay was monitored for two months after treatment with methyl carbamate and aluminum .phosphide in field conditions. The density of the phlebotomus was observed to be particularly low after treatment. However, a comprehensive review of existing information on sandfly susceptibility to insecticides is particularly difficult since published data are diverse in the literature. Thus before planning any control measure against leishmania vectors, a study should be done in order estab-

lishes the base line of susceptibility to representative insecticides.

### Conclusion

Rodent-fly and rodent cycle of leishmaniasis is still the major problem in the rural areas. Our evaluation demonstrated that the control programs reduce the incidence of phlebotomus population and therefore leishmania transmission. The results show that the field control method by using residual insecticides seems to be the most effective way to control the phlebotomus population in seasons that leishmania transmission will happen.

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