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# Efficacy of Cyphenothrin (Gokilaht®-S 5% EC) as space spray against mosquitoes in sentinel cages

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Thermal fogging with malathion or aerosol space spraying of pyrethrum extract (2%) is commonly used to control malaria vector population in urban areas in India, and to prevent malaria and dengue transmission, particularly during the outbreaks of these diseases. However, resistance to malathion, particularly in *Anopheles stephensi* (Diptera: Culicidae), the urban malaria vector in India, has been reported from different areas in India[1–4]. Due to development of resistance in vector mosquitoes there is a continuous need of efficacious insecticides for vector control operations.

A new synthetic pyrethroid, Gokilaht®-S 5% EC, commonly known as Cyphenothrin (chemical name (S)-α-cyano-3-phenoxybenzyl(1R)-cis, trans-chrysanthemate), developed by M/s. Sumitomo Chemicals India Pvt. Ltd. and cleared by WHOPES was evaluated as a space spray/fog for its efficacy against three vector mosquitoes in field conditions. Cyphenothrin has been classified as moderately toxic by International Programme on Chemical Safety (IPCS). Trials carried out elsewhere showed promising results against mosquito (*Culex pipiens),* housefly (*Musca domestica*), and German cockroach *(Blatella germanica)*[5]. Field studies carried out in Malaysia with Gokilaht-S 5% EC against *Aedes aegypti*, *Ae. albopictus* and *Cx. quinquefasciatus* demonstrated encouraging results[5].

Laboratory bioassays were carried out under controlled conditions and lethal doses were calculated using log-probit analysis[6]. Tests were carried out against laboratory reared *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus.* The $LD_{90}$ of cyphenothrin space spray was 0.28 mg a.i./$m^2$ against *An. stephensi* and *Ae. aegypti* and 0.46 mg a.i./$m^2$ against *Cx. quinquefasciatus* whereas $LD_{50}$ of *An. stephensi* was 0.062 mg a.i./$m^2$; *Ae. aegypti* 0.073 mg a.i./$m^2$ and *Cx. quinquefasciatus* was 0.13 mg a.i./$m^2$. Field evaluations were carried out in selected localities in Delhi, Ghaziabad (Uttar Pradesh) and Faridabad (Haryana), India. In each city, six localities which are distantly located from each other were selected for field evaluation. Laboratory-reared/$F_1$ progeny of the field mosquitoes of a particular locality were used in cage bioassays. The mosquitoes collected from a particular locality were used in the same locality in cage bioassays.

Two dosages of Gokilaht-S 5 EC, 1.0 and 3.5 g a.i./ha were selected as tested elsewhere[5]. These dosages were achieved by mixing the required quantity of Gokilaht-S 5 EC in kerosene oil, which was then sprayed by Van fog machine in open space around houses in outdoors with a spray volume of 0.5 l/ha. The doses were tested on a separate day and separate houses in a particular locality. Cages each with 20 laboratory-reared, sucrose-fed adult females aged 2–5 days were placed at 50 m downwind and 1.5 m above the ground level before fogging. Fogging was carried out in selected localities in the evening hours. After one hour of fogging the mosquitoes knocked-down were scored and the cages were brought to the

laboratory carefully. Mosquitoes were transferred to holding cages, provided with 10% glucose soaked cotton and kept for 24 h observation. Mortality was scored after 24 h holding. The temperature and relative humidity during fogging trials were 24–29°C, and 62–86% respectively. Data of the particular locality in a particular city were pooled and corrected percent mortality was calculated using Abbott's formula[7]. Two-way ANOVA was performed to test the statistical significance among the mosquito species as well as among the areas. Data on perceptions of the inhabitants were recorded in standard pre-structured questionnaire.

Percent mortalities of test mosquitoes scored after 24 h holding are shown in Fig. 1. The average mortality of *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus* in the six localities in Delhi was 84.66, 82.2 and 44.68% respectively @1 g/ha, whereas fogging @ 3.5 g/ha produced an average mortality of 96.3, 89.5 and 76.23% respectively. There was a highly significant difference in mortalities among the species for both the doses tested ($p$ <0.001).

In Ghaziabad City, fogging @1 g/ha produced 87.66, 84.38 and 55% mortality in *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus* respectively, whereas fogging @ 3.5 g/ha produced an average mortality of 97.46, 94.95 and 73.8%, respectively. In Ghaziabad City too, there was a highly significant difference in mortalities among the species for both the doses

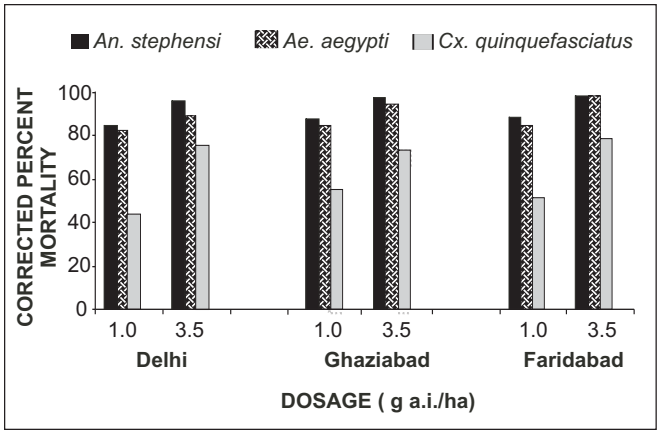


*Fig. 1:* Average mortality of mosquitoes exposed to cyphenothrin thermal fogging in three study areas

tested ($p$ <0.001). In Faridabad City, fogging @1 g/ha produced 88.16, 84.58 and 51.5% mortality in *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus* respectively, where as fogging @ 3.5 g/ha produced an average mortality of 99, 97.76 and 78.53% respectively. The results showed low degree of susceptibility in *Culex* mosquitoes as only 51.5 and 78.53% mortality was recorded at both doses. In Faridabad City also, there was a significant difference in mortalities among the species for both the doses tested ($p$ <0.001).

Two-way ANOVA indicated significant difference in mortalities of *An. stephensi* and *Cx. quinquefasciatus* among localities @ 1 g/ha and in case of *Ae. aegypti* the difference was not statistically significant. In case of 3.5 g/ha dose, significant difference was observed in *Aedes* mosquitoes only among the localities ($p$ <0.05). There was a significant differences in mortalities of test mosquitoes when compared inbetween the doses ($p$ <0.05) and 3.5 g/ha dose was found superior than 1 g/ha. No adverse events such as vomiting, nausea, headache, itching, eye irritation, etc. were reported by the inhabitants.

In the present study, fogging in outdoor conditions with Gokilaht-S 5 EC, a synthetic pyrethroid with moderate safety, @ 1 g/ha, showed an average mortality of 86.82% in *An. stephensi* in cage bioassays. However, Gokilaht-S 5 EC fogging@ 3.5 g/ha resulted in an average mortality of 97.58% in *An stephensi*, 94% in *Ae. aegypti* and 76.17% in *Cx. quinquefasciatus* in all the study areas. No significant difference was observed in mortalities of mosquitoes when compared between the study sites and there was a significant difference between the species in all the localities.

In an earlier study in Malaysia, Gokilaht-S 5 EC at 3.5 g/ha induced KD rates of 93 and 94% after 20 min and 24 h mortality rates of 96 and 92% against *Ae. aegypti* and *Ae. albopictus* respectively. Dosages of 1 and 0.5 g/ha of this formulation induced lower but significant knockdown and mortality in both mosquito species. At all dosages, Gokilaht-S 5 EC

showed low adulticidal activity against *Cx. quinquefasciatus*, with <50% mortality at 24 h post-fogging. However, Gokilaht-S 5 EC at 3.5 g/ha induced 79% knockdown at 60 min post-treatment[5]. These results clearly show that Cyphenothrin can be used as a replacement of malathion and pyrethrum for thermal fogging, particularly against malaria vector *An. stephensi* in areas where this species has developed resistance to malathion and 3.5 g/ha dose shall be appropriate to achive the desired level of efficacy.

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## References

1. Kumari R, Thapar BR, Das Gupta RK, Kaul SM, Shiv Lal. Susceptibility status of malaria vectors to insecticides in India. *J Commun Dis* 1998; *30*(3): 179–85.
2. Mittal PK, Wijeyratne P, Pandey S. Status of insecticide resistance of malaria, kala azar, Japanese encephalitis vectors in Bangladesh, Bhutan, India and Nepal (BBIN). Available from: *http://www.phishare.org/files/1944_AR_129_Status_Insect_Format.pdf.* EHP Project 26568/EXANEMDR, March 2004.
3. Mukhopadhyay AK, Chakraborty S, Karmarkar PK, Banerjee P. Insecticide susceptibility status of *Anopheles stephensi* (Liston) in selected areas of Calcutta, India. *J Public Health* 1996; *40*(4): 130–3.
4. Pillai MKK. Vector resistance to insecticides. *Proc Nat Acad Sci India* 1996; *68* (B): 77–97.
5. *Review of Vectobac WG, Permanet, Gokilaht-S 5 EC, Report of the seventh WHOPES working Group Meeting.* Geneva: World Health Organization 2004. WHO/CDS/WHOPES/2004 .8.
6. Finney DJ. *Probit Analysis.* Cambridge: Cambridge University Press 1977.
7. Abbott WS. A method for computing the effectiveness of insecticide. *J Econ Entomol* 1925; *18:* 265–7.

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