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. 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). Field studies carried out in Malaysia with Gokilaht-S 5% EC against Aedes aegypti, Ae. albopictus and Cx. quinquefasciatus demonstrated encouraging results.

Laboratory bioassays were carried out under controlled conditions and lethal doses were calculated using log-probit analysis. Tests were carried out against laboratory reared An. stephensi, Ae. aegypti and Cx. quinquefasciatus. The LD90 of cyphenothrin space spray was 0.28 mg a.i./m2 against An. stephensi and Ae. aegypti and 0.46 mg a.i./m2 against Cx. quinquefasciatus whereas LD50 of An. stephensi was 0.062 mg a.i./m2; Ae. aegypti 0.073 mg a.i./m2 and Cx. quinquefasciatus was 0.13 mg a.i./m2. 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/F1 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. 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 formula7. 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 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. 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 achieve the desired level of efficacy.

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**References**