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Malaria control activities in Iran and novel evaluation of pyriproxyfen as an insect growth regulator (IGR) against malaria vectors in a malarious area

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Abstract

There are several measure for vector control including indoor residual spraying, using long lasting impregnated bednet and larviciding for malaria control in Iran. For the first time in the country, the pyriproxyfen 0.5 granule were evaluated in the laboratory (aquarium test), in southeastern Iran. The experiments was carried out in a malarious areas in Sistan and Baluchistan province, southern Iran during malaria transmission season in 2014. Laboratory tests of pyriproxyfen 0.5G at 3 and 5 g/m³ showed 5.5 months residual effect with 98.3-99.6% of inhibition of emergence (IE) compared to 77.5% as survival rate (SR) in untreated group. The findings revealed the promising horizons of pyriproxyfen application as larvicides against malaria vectors at south and southeastern Iran. It is strongly recommended special attention for use of this IGR at an integrated vector control program in the country.

Keywords: Iran, larvicide, malaria, Insect growth regulator

Introduction

Malaria is the most important infectious disease with the major priority in the health sector. Based on WHO estimate, 207 million cases of malaria occurred globally in 2012 resulted to 627 000 deaths [1]. The most routes of malaria cases are immigration from Afghanistan and Pakistan to southern and southeastern areas of Iran. The latest number of autochthonous cases in the whole country is 42 including 23 local malaria patients, 7 relapsed cases, 12 imported from the other districts by end of July 2016 [1].

Malaria control activities has long history and publication of several papers on different aspects of malaria including insecticide resistance monitoring, sibling species, molecular study, new record, novel methods for vector control, faunestic study, use of plants for larval control using bednets and long lasting impregnated nets, morphological studies, malaria epidemiology, ecology of malaria vectors, biodiversity, community participation, vector control, repellent evaluation, anthropophilic index of malaria vectors, training is designated as malaria training center by WHO. There are several reports on different aspects of malaria vectors recently [2-35].

At the present, the strategy of malaria vector control is based on using two methods, i.e. long-lasting insecticide treated bed nets (LLITNs) and residual spraying (IRS) which both methods targets the adult mosquitoes [1]. Hence, the malaria vectors have been showed enhanced tolerance or resistance to the most insecticides used in IRS and LLITNs programs and so the effectiveness of these methods put in question. Due to some promising characteristics of juveniles (Juvenile hormone analogues) such as safety to the environment and aquatic organisms, selective and specific effects on the target organism and small amounts (ppb) needed for cost and effective control of immature. Control of vector borne disease has become a major priority, with malaria receiving the main focus of attention and funding. However there are many other mosquito borne diseases such as dengue, Japanese encephalitis, and newly emerging problems such as the Chikungunya virus which has recently spread from Africa into southern European countries. Larval control as part of integrated with LLITNs or IRS. The mainstay of larviciding for many years has been temephos. It is an acetylcholinesterase inhibitor and resistance to temephos is now widespread [1].

Characteristic of larvicide for malaria vector control should be effective, safe, no cross resistance to current insecticides. Pyriproxyfen is a pyridine-based pesticide which is found to be effective against a variety of arthropods. The aim of this study was to evaluate the IGR pyriproxyfen against malaria vectors in a malarious area in southern Iran.

Materials and Methods

Study area: The present experiments was carried out in a malarious areas in, Sistan and Baluchistan Province, southern Iran in 2014 (Fig.1). The province is the second largest province in Iran with an area of 180,726 km² and a population of 2.5 million. The province today is the most underdeveloped, desolate, and poorest of Iran's provinces



Fig 1: Map of study area

Larvicide used: Pyriproxefen, Sumitomo chemical, trade name Sumilarv as granule of 0.5 was provided by Ministry of

Health (Fig.2)

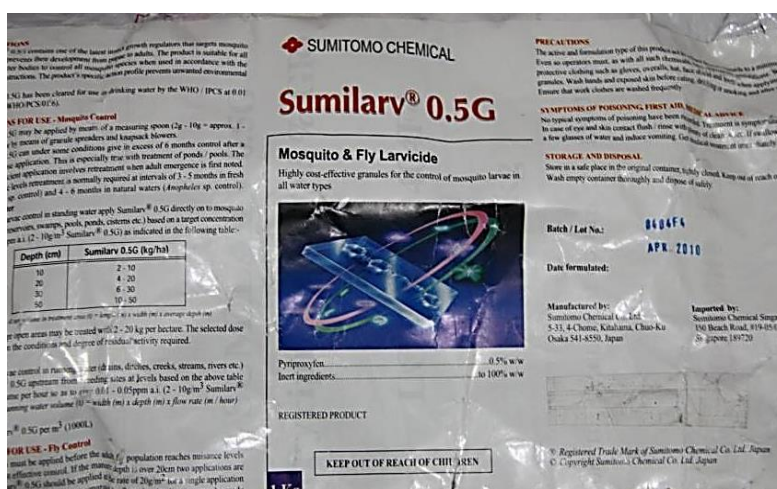


Fig 2: Pyriproxefen larvicide used for field evaluation

Experimental train in the laboratory: Fig. 3 shows the aquarium for evaluation of effectiveness of larvicide according to WHO methods



Fig 3: Aquarium for evaluation of effectiveness of larvicide

Statistical analysis

All the criteria for evaluation of larvicides was calculated according to the statistical methods. In the experiment the following criteria was measured; Mean of larval mortality (LM) , Mean of pupal mortality (PM) , Mean of adult mortality (AM) , Inhibition of emergence (IE) , Survival rage (SR) , Active control duration (ACD).

Results and Discussion

Evaluation at 3 gr/m³: Results of evaluation of pyriproxefen at 3 gr/m³ are shown in Fig. 4. Results showed that inhibition of emerge and survival rate was 98.3% and 1.7% respectively after 165 day post treatment.

Evaluation at 5 g/m³: Results of evaluation of pyriproxefen at 5 g/m³ is shown in Fig. 5. Inhibition of emerge and survival rate was 99.6% and 0.4% respectively after 165 day post treatment. The survival rate at control group was measured as 77.5%. Inhibition emergence

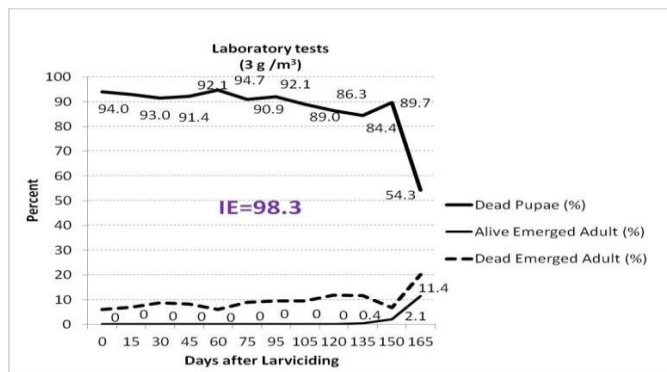


Fig 4: Efficacy of Pyriproxyfen 0.5G (3 g/m³) evaluated by aquarium test, Ghasserghand, Sistan and Baluchistan province

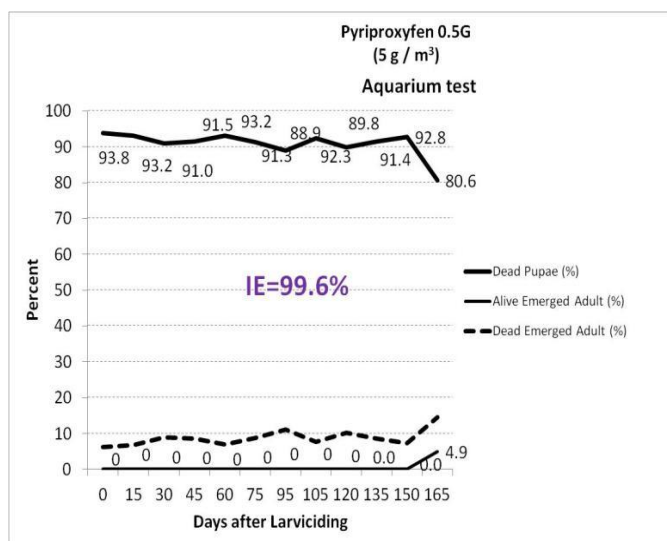


Fig 5: Efficacy of Pyriproxyfen 0.5G (5 g/m³) evaluated by aquarium test, Ghasserghand, Sistan and Baluchistan province

Variation of Immature Anopheline (untreated group) at aquarium test, Ghasserghand, Sistan and Baluchistan provinces is shown in Fig.6

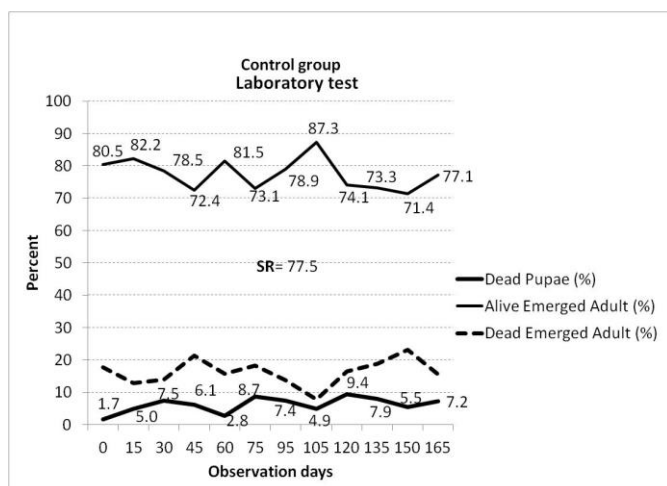


Fig 6: Variation of Immature Anopheline (untreated group) at aquarium test

in the present study of laboratory trials, Pyriproxyfen 0.5G (3 g/m³) against Anophelini using aquarium tests revealed the inhibition of emerge (IE) =98.3% and survival rate (SR) =1.7% for 165 days . The figures for 0.5G (5 g/m³) was IE=99.6% SR=0.4% respectively. There are several report on

efficacy of IGR against vectors [36-43]. The insect growth regulator pyriproxyfen was tested against *Aedes aegypti* at 0.01 and 0.02 mg of active ingredient (AI) per liter of water in 60-liter earthen jars. Both concentrations provided 100% control for 4 month in Malaysia [44]. In a trail in India Pyriproxefen at dosage of 0.02 ppm were used against *Aedes spp.*, *Culex spp.* and *An. quadrimaculatus*, Laboratory condition (tray). Inhibition of emerge was 53-100% after 2 weeks [45]. The LC₅₀ value against *Culex quinquefasciatus* using Sumito Chemical Co. (London) was 0.011 ppm for 12 Weeks [46]. In a trail in Sri Lanka, *An. culicifacies* exhibited complete Inhibition of Emerge at 0.1-0.01 ppm for six months in laboratory tubs [47]. The results in Florida against *Aedes spp.* *Cx. nigipalpus*, *An. quadrimaculatus* was 80-100% at 0.02 ppm several weeks under laboratory condition (tray) [48]

Conclusion

The findings revealed the pyriproxyfen application as larvicides against malaria vectors at south and southeastern Iran could be replaced with insecticides which cause resistant in malaria vectors. It is strongly recommended special attention for use of this IGR at an integrated vector control program in the country.

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