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EFFICACY TRIALS ON MOSQUITOES WITH NEW MONOMOLECULAR FILM

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Abstract Trials have been conducted with Aquatain AMF, a silicone based self-spreading liquid for mosquito control, in many locations and environments around the world. The trials included *Anopheles*, *Aedes*, and *Culex* mosquitoes. The product has been shown to be effective in very difficult conditions where other mosquito control products have not been successful. It is classified as a larvicide, but the trials demonstrated that it is effective on pupae. The film discourages females from laying eggs on the surface.
Key words Silicone film; mosquito control.

INTRODUCTION

The product is a silicone based liquid for mosquito control (Bukhari and Knols 2009; Bukhari et al., 2011). It spreads across the surface of standing water, forming a very thin film. As the silicone polymer called polydimethylsiloxane or PDMS has a low surface tension, larvae and pupae cannot attach to the surface to breathe, causing them to drown. The product has an entirely physical action, and does not contain any toxic chemicals.

Silicones are an ideal polymer for this application, as they impart a strong spreading action which enables the film to spread around dense vegetation. Silicones are also resistant to ultraviolet light and oxidation, resulting in an extended period on the surface beyond the petroleum based larvicide oils. Finally, they do not present any danger to humans or the environment, degrading into harmless silicates. The trials have been undertaken in 14 countries, covering almost all continents and a wide variety of conditions. All of the trials have been independent, and many of them have been peer-reviewed.

MATERIALS AND METHODS

Due to its strong spreading action, most of the trials have been conducted by simple pouring the product on to the water surface at the recommended dosage (1 litre per 1000 square metres of surface area). For very difficult areas in which the water surface is discontinuous, spray equipment has been required. In most cases, larvae have been counted using standard dippers.

RESULTS AND DISCUSSION

Sri Lanka Medical Research Institute

Trials were conducted on a heavily polluted canal in central Colombo. The predominant species was *Culex*. All of the larvae in the treated zone died within one day and there was still a 98% reduction

two weeks after application. After four weeks, a 91% reduction was still observed, compared with the control area in which larval numbers had increased by 60% over the period.

Uganda Ministry Of Health

Trials were conducted at several sites in a swamp in Uganda. There was a 100% reduction in larvae after 12 hours at all sites, and no mortality in the control group. The trials were only conducted for a short period, so they couldn't draw any conclusions about longer term efficacy in this case.

Kenya Medical Research Institute and Wageningen University

Trial was conducted in a rice paddy in Kenya, following successful laboratory trials at Wageningen University in The Netherlands. The conditions were extreme, with heavy vegetation, slurries in part of the paddy, and workers coming in and out to weed the paddy field. Emergence of anopheline mosquitoes was reduced by 93% during the trial, and the authors concluded that the product is an effective agent for the control of mosquitoes in irrigated rice paddies. They also concluded that the product had no negative impact on non-target organisms, or on rice yields.

Cuba Directorate of Surveillance, Sancto Spiritus

Trials were conducted at five sites in the city of Sancti Spiritus in central Cuba. The sites were selected because other larvicides had been unsuccessful in reducing the population of larvae. They were either heavily vegetated, heavily polluted, or both – which explains why other larvicides didn't work. The number of larvae declined dramatically within 24 hours of application at all sites, to almost zero. After 15 days, they remained at around zero, although they had started to increase slightly at one of the sites.

Greece Directorate of Plant Produce Protection

Finally, these trials were conducted on a 1.2 hectare rice paddy in Greece. The paddy is divided into three sections, which are connected by channels. The rice plants were almost fully matured, creating dense vegetation and a challenge for the product to spread around all of the plants to cover the surface. It was applied at one side of the paddy only, in order to create the greatest challenge.

The larval mortality in section 1 - closest to where the product was applied – was 100% after three days, and was still at 75% on day 25 after application. The results weren't so impressive in sections 2 and 3, where larval mortality peaked at 80% and 40% respectively. However, the researchers noted that if the product had been applied at more locations, the results are likely to have been improved. They concluded that the product can provide larval control in habitats where other means of control are not effective.

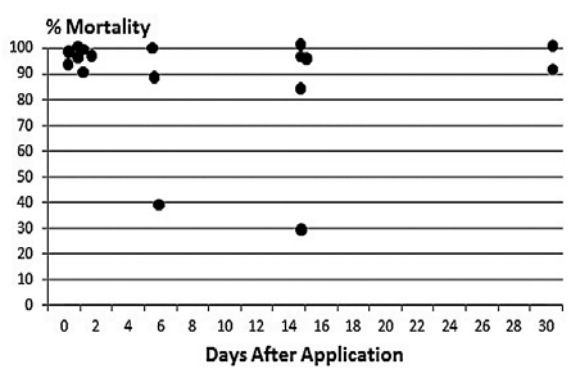

Figure 1. Mortality of Culex larvae.

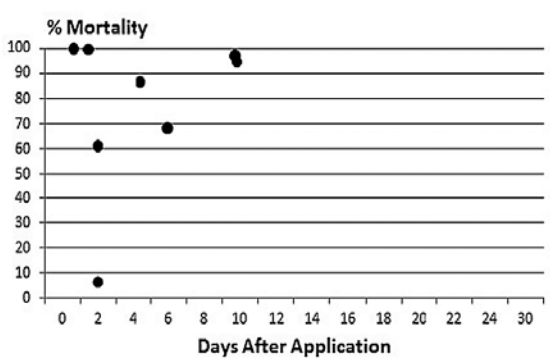

Figure 2. Mortality of Anopheles larvae.

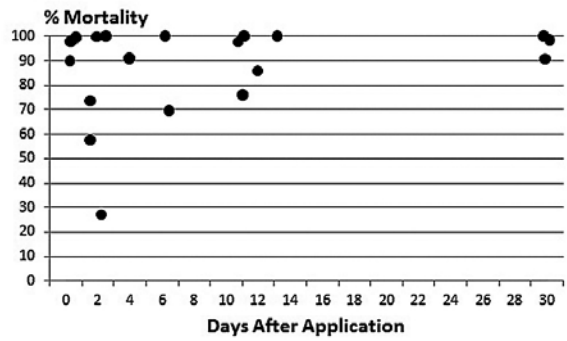

Figure 3. Mortality of Aedes larvae.

Figures 1, 2 and 3 show the results of all of the trials on C*ulex*, A*nopheles* and A*edes* larvae respectively. The product is very fast-acting and highly effective on *Culex* mosquitoes (Figure 1), with 90-100% mortality observed from Day 1 through to the duration. The two readings in the middle of the graph are those for the remote sections of the paddy field in Greece, where the product was deliberately applied at some distance away, in a heavily vegetated paddy, to gauge the limit of its spreading action.
For *Anopheles* mosquitoes (Figure 2) but the speed of action is slower. The pattern seems to be that the larvae die gradually over a period of days rather than within a day or so, as in the case of *Culex* larvae. Anopheles larvae may not come to the surface as frequently, and are therefore less affected by the film. However, after 10 days, or so, the result is the same. For *Aedes* mosquitoes – which transmit dengue fever – the results indicate (Figure 3) that the product is once again highly effective, but the timeframe for all of the larvae to die is around 10 days.

The impact on the pupae of all species is very rapid: within a few hours, all pupae are wiped out. No doubt this is because the pupae are at the surface at the final stage before emerging as adults, and they are immediately affected by the film. Also, no pupation has been observed in any of the trials.

The combined impact of the killing of all pupae and the absence of pupation is that there is no adult emergence after the film has been applied. Based on a limited number of trials: virtually no eggs are laid on the surface when the film is in place, but some females do drown while attempting to lay eggs.

CONCLUSIONS

In summary, the trials have shown that the product has multiple impacts on the mosquito lifecycle. Working through the various stages: the presence of the film discourages females from laying eggs; any larvae already in the water are wiped out, some of them within a day or so, and others gradually over a period of a few days; no pupation has been observed; and the pupae already in the water die very rapidly. With no pupae, there is no emergence of adults once the film is applied.

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