Bio-efficacy of an organophosphorous bait (Snip®) against wild populations of synanthropic flies *Musca domestica* and *Lucilia* species

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Abstract: The common housefly, *Musca domestica* and the green-bottle fly *Lucilia* species are Diptera belonging to the Suborder Cyclorrapha. The former species is associated with mechanical transmission of certain diarrhoeal diseases such as dysentery, typhoid fever, and cholera, which afflict man. Other important diseases include, anthrax, eye infections and bovine mastitis. It is the manner in which *M. domestica* exudes a "vomit-drop" to sugar, dried blood, pus, excreta, sputum and other substances that makes it an efficient vector of human diseases. Bacteria may also adhere to the hairy body of the fly and to the hairy puvilli on the feet. *Lucilia* sp. is mostly associated with diseases of livestock such as sheep and fowls. This species causes myiasis of sheep called "strike", which results in larval development in the skin. Usually, environmental sanitation involving elimination of fly breeding sites by proper disposal of refuse, manure, compost, human excreta and other waste is the fundamental measure for fly control. However, there are instances where control has to be supplemented with insecticides. Among the most commonly used insecticidal methods of control is the use of baits. These are placed or applied to surfaces where adult flies congregate to feed. This control measure takes advantage of the fly's mechanism of feeding. This paper discusses findings of an experiment designed to test attractiveness and bio-efficacy of an organophosphate-based bait against *M. domestica* and *Lucilia* species.

Introduction

Domestic flies *Musca domestica* and *Lucilia* species are Diptera belonging to the families Muscidae and Calliphoridae, respectively (Clay *et al*., 1973). They are often linked to disease outbreaks because of their habits of frequenting rubbish dumps, rotting carrions, human/animal excreta and food or places or utensils used to prepare human food (Lapage, 1968). Transmission of diseases such as dysentery, typhoid fever and cholera is usually mechanical. In the process of feeding the fly exudes a "vomit-drop" in order to moisten the food before it is ingested (Lapage, 1968). It is in the process of moistening the food that the food becomes contaminated with disease pathogens. The hairy body of the fly and its hairy puvilli on the feet may also harbour disease pathogens such as bacteria, which may contaminate food or drink when the fly walks over it or drowns in it, respectively.

Control of houseflies using bait is a very effective method because the bait is formulated in the form that attracts the fly to feed (WHO, 1976; 1984). Bait in the form of granules can be sprinkled on any surface where flies congregate. Usually, the insecticide in the bait continues to cause mortality for a long period of time.

In this paper, we report results of an experiment designed to test the attractiveness of a granules formulation (bait) laced with azamethiphos 1 % in comparison with sugar. The bio-efficacy of the formulation against *M. domestica* and *Lucilia* species was also tested. The bait (Snip®), which contained azamethiphos (1 %) was formulated by Novartis® Animal Health Inc., Basel, Switzerland and distributed by Novartis® East Africa Ltd., Nairobi, Kenya. The bait was being evaluated for the purpose of registration for public use in Tanzania.

Materials and Methods

Plastic rulers were used to make quadrants measuring 30cm x 30cm. Before joining them with a strong glue (Araldite®), the end parts of each ruler were filed off in order to obtain an exact measure of 30cm x 30cm.

Pieces of filter paper (Whatman No. 1) were joined together to form single pieces measuring 30cm x 30cm. Additionally, filter papers soaked in risella, an inert oil used in WHO resistance test-kits for mosquitoes were also cut and joined to form larger pieces measuring 30 cm x 30 cm (WHO, 1975). These pieces were used for sprinkling bait in the quadrants. Granules were weighed out in small quantities of 0.6 g, which were sprinkled and spread out in each quadrant to be treated with the insecticide. The treatments were placed in public tea-rooms, restaurants and others where flies congregate. These experiments were conducted at Magugu town near the field station of the Tropical Pesticides Research Institute and treatments were as follows:

(i) Bait on Whatman No. 1. paper
(ii) Sugar on risella paper
(iii) Risella paper
(iv) Bait on risella paper
(v) Sugar on Whatman No. 1. paper
(vi) Whatman No. 1. paper

The different treatments i.e. quadrants were randomly allocated and placed approximately 2 m apart from each other. Collection of data involved scoring dead flies (enumerator) against total fly landings (denominator) on each treatment within a period of 1 hour. Data were analyzed using SPSS software (Kinnear and Gray, 1996) and comparisons were based on marginal means of total landing as a measure of attractiveness of the bait in comparison with sugar to which flies were normally attracted. Landing scores were converted to Log_{10} (n + 1) in order to reduce variance and normalize the distribution (Tabachnick and Fidell, 1996). Bio-efficacy of the bait against *M. domestica* was assessed on the basis of percent mortality and the data were analyzed using a linear model to compare marginal means. Corrected mortality of the two species was calculated using the Abbot formula (WHO, 1975). Dead and moribund flies were all grouped together and scored as dead. All flies knocked down by the insecticide were kept for 24 hours in paper cups covered with a netting material. Identification of the flies caught was done on the basis of morphological characters using the key provided by Clay *et al*., (1973).

Results

Only two species of synanthropic flies *M. domestica* and *Lucilia* sp. were found in the study area. A total of 6,479 *M. domestica* and 25 *Lucilia* sp. made landings on the six treatments described above (Table 1). The respective ratio of the two species was 259:1. The bait sprinkled on Whatman paper No. 1. attracted the highest number of both *M. domestica* (36.5 %) and *Lucilia* species (72 %). Ranking of attractiveness for the rest of the treatments to *M. domestica* in descending order, was: bait on risella (19.5 %); sugar on Whatman paper No.1. (18.9 %); sugar on risella (9.9 %) Whatman paper No.1. (7.7 %) and risella (7.5 %). The respective order for *Lucilia* species was sugar on risella (8 %); bait on risella (8 %); risella (8 %) and Whatman paper No. 1. (4 %). None of the flies kept for observation 24 hours post exposure were found to be alive.

Table 1: Total fly landings of *M. domestica* and *Lucilia* sp on different treatments

Species	Treatment	Total landings	Mortality (1hr)	Corrected mortality (%)
M. domestica	Snip®on Whatman	2,361	2,153	91.2
	Sugar® on risella	645	42	6.1
	Sugar on risella	1,258	120	9.1
	Risella	492	2	*
	Sugar on Whatman	1,228	0	0
	Whatman	495	0	*
Lucilia	Snip® on Whatman	18	15	83.3
	Sugar on risella	2	0	0
	Snip® on risella	2	0	0
	Risella	2	0	*
	Sugar on Whatman	0	0	0
	Whatman	1	0	*
	Total	6,504		

* Control

Multiple comparison of attractiveness of the different treatments by ANOVA (based on total landings made by *M. domestica* on these treatments during 1 hour of observation) showed that, the bait (Snip®) was significantly more attractive to *M. domestica* than risella-treated paper (P = 0.006), Whatman No. 1. paper (P = 0.006) and sugar on risella (P = 0.011). The bio-efficacy of the bait against *M. domestica* is summarized in Table 2., and shows clearly the difference between itself and the rest of the treatments. The bait caused significantly higher mortality than any of the other treatments (P<0.0001). On the basis of corrected mortality, the bait caused 92 % mortality of the *M. domestica* flies landing on the bait.

Table 2. Results of Duncan's homogeneity test as a measure of the differences among treatments in terms of bio-efficacy of the bait (Snip®) against *M. domestica* in relation to others

	Treatment	Number	Percent mortality	
			Subject 1	Subject 2
Duncan [a,b]	Sugar-whatman	5	0.0000	
	Whatman	5	0.0000	
	Risella	5	0.2326	
	Sugar-risella	5	6.8193	
	Snip-risella	5	12.0312	
	Snip-Whatman	5		85.0868
	Significance (P)		.127	1.000

Means for groups in homogeneous subsets are displayed based on Type III Sum of Squares. The error term is Mean Square (Error) = 117.166.
a, Uses Harmonic Mean Sample Size = 5.000.
b, Alpha = .05.

Discussion

The experiment conducted to assess the attractiveness and bio-efficacy of bait with azamethiphos 1% as the active ingredient showed the bait to be attractive and efficacious against *M. domestica* and *Lucillia* species. When data were pooled, the bait was significantly more attractive to *M. domestica* than sugar ($P < 0.05$). The proportion of *Lucillia* species was too small for statistical analysis (n = 25). Although a small percentage of *M. domestica* landing on risella paper with sugar and risella paper only died, it is unlikely that, these untreated papers caused mortality of the flies. Probably, the flies had previously landed on paper treated with bait. This is assumed to be the case because landing scores were based on any flies landing within the quadrant area, regardless of whether the fly stayed there or flew away later. Therefore, a fly could land on different treatments within an hour. However, since this factor was constant to all treatments, there was no need for any form of adjustment of the data. Although insecticide resistance of *M. domestica* to organophosphates has been reported in some populations (WHO, 1984) it did not appear to be prevalent in the study population. The bait was found to be efficacious against *M. domestica* and will therefore complement control measures of the fly in the near future.

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