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Effectiveness of monoscreen traps for tsetse fly control

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Abstract

The effectiveness of G.lossina fluscipes monoscreen traps made out of different shades of locally-available blue (cotton/polyester) materials was evaluated under high tsetse fly(Glossina fluscipes) challenge on Buvuma Island, Lake Victoria, Uganda. This was performed using a 4 x 4 Latin square design replicated 3 times, so as to separate the trap positions and day effects from the treatment effect. A total of 12 trap positions were tested over 4 days. Overall, 27.53 % and 72.48 % of male and female tsetse flies were caught, giving a sex ratio of 1: 2.6. The index of increase in trap catches for female tsetse flies, relative to standard blue colour, were 0.3526 (deep blue), 0.6748 (medium blue) and 0.7089 (light blue). For male tsetse flies, the index of increase were 0.4255 (deep blue), 0.6312 (medium blue) and 0.7423 (light blue). For the female tsetse flies, no significant differences (P>0.05) occurred in tsetse catches between monoscreen traps made out of medium blue, light blue and standard (control) materials. However, for the male flies, the standard blue material (control) proved superior in tsetse catch than the other shades of blue materials.

Key words: Glossina fuscipes, tsetse fly catches

Introduction

The concept of using traps for controlling tsetse flies is by no means new (Leak, 1999). Traps have been developed to control tsetse without using insecticides, as these are costly, often difficult to obtain in African countries, and there is concern over their possible adverse environmental effects (Brightwell *et al*., 1987; Dransfield *et al*., 1990). Usually, tsetse are visually attracted to a trap or target; this attraction may be augmented by the use of olfactory attractants. Studies show that tsetse flies are attracted to near-UV light, followed by blue light, and appear to have a spectral range and sensitivity similar to that of other Diptera (Green and Cosens, 1983). The flies are known to employ colour information and not intensity-contrast information alone in trap-orientated behaviour (Flint, 1986). Green (1986) caught tsetse flying around different coloured traps and targets to examine the effect of colour and odour on attraction of *G. pallidipes* and *G. morsitans*. The results showed that yellow and green were unattractive and inefficient, black and red attractive but inefficient, white moderately attractive and very efficient and blue traps attractive and efficient; the order was the same for targets. Landing responses were strongest on black surfaces and weakest on white, whilst results with blue were variable. In Zimbabwe, black cloth targets appeared superior to blue ones for control purposes: although blue cloth is more attractive, the black elicits a better landing response (Vale, 1982).

The characteristics of fabrics used for tsetse control proved to be as important as their dyes (Laveissiere *et al*. 1987). Polyester/cotton fabric was highly efficient for screens, depending upon the weave of the cloth. A closely woven fabric with thin thread allowed a good fixation of the insecticide but prevented tsetse from receiving a lethal dose. Blue fabrics can lose their colour and become inefficient after a short time, depending on the dye used and method of fixation.

In Uganda, the blue and black cloth materials for making traps have traditionally been imported from VESTERGAARD FRANDEN (KVF) Company, through the Ministry of Agriculture, Animal Industry and Fisheries. However, such trap materials are unavailable to the local community who may want to make their own tsetse traps, which therefore frustrates the community participation in tsetse control. Moreover, different shades of these cloth materials (cotton/polyester) are abundantly available on the local market for making dresses and school uniforms, but have not been exploited for making tsetse traps. This study was conducted to investigate the attractivity, efficiency and cost-effectiveness of different shades of blue cotton/polyester materials for the control of *G. fuscipes fuscipes* in Uganda.

Materials and Methods

Study area

The study was conducted in November, 2001 on Buvuma Island ($33^0$12'E to $33^0$25'E and $0^0$5'N to $0^0$20'), Mukono District, Uganda, along Lake Victoria shores where the population density of *G. f. fuscipes* was very high (Ogwal and Kangwagye, 1990). These areas are characterised by typical riparian vegetation, moist evergreen forest with permanent papyrus forest swamps (Landale-Brown *et.al.*, 1964). The major grass species comprised of *Imperata cylidica*, *Hyperenia* species and sedges. The Large trees comprised mainly of mangoes (*Mangifera indica*), *Maesopsis emini*, *Albizia* species, *Combretum* species, *Polyscias* and *Acacia* species (Eggeling and Dale, 1951; Lind and Tallantire, 1962). The rainfall pattern is bimodal in March – July and September – November, interspersed by short and dry seasons, respectively.

Experimental design

Three shades of locally-available blue cotton/polyester materials (deep, medium and light) were used for making monoscreen traps, that was established as the most efficient and cost-effective trap for the control of *G. fuscipes fuscipes* (Okello-Onen *et al*., FITCA report, 2001). The recommended shade of locally-available black cloth material was used. The monoscreen trap made out of the vestergaard franden blue and black cloth materials was used as the control.

The performance of different shades of blue cotton/ polyester materials was compared as described earlier (Okello-Onen *et al*., FITCA Report, 2001). Three replicates of a 4 x 4 Latin square design was performed, using 12 trap sites over 4 days, so as to separate the trap positions and day effects from the treatment effect. The trap positions were randomised prior to deployment. Traps were set at about 5.00 p.m. just after the evening peak fly activity and harvested the following day after 5.00 p.m. The traps were rotated everyday for 4 days to the next randomised position, so as to give each trap design in a replicate a day at every trap site. The data was disaggregated by sex, and the analysis was performed on male and female tsetse flies separately. Data was subjected to a log (x +1) transformation prior to conducting analysis of variance to determine differences in trap catches. The Student-Newman-Keuls multiple range test was used to determine the significant differences between treatment means.

Results

Tsetse catches

The daily catches of tsetse flies in monoscreen traps made out of different shades of blue cotton/polyester materials are shown in Table 1. The standard (control) trap caught the highest number of tsetse (6175 females, 2028 males), followed by the trap made out of light (4052 females, 1409 males), medium (3643 females, 1567 males) and deep blue (2323 females, 1070 males) materials. Overall, a total of 22,067 flies was caught during the study; 27.53 % males and 72.48 % females, giving a sex ratio of 1: 2.6. Analysis of variance for both female and male tsetse flies showed that the different shades of blue cotton/polyester materials were a significant source of variation in the data ($P<0.05$) (Table 2). The interaction between replicates and sites were also significant for female and male tsetse flies ($P<0.05$).

Index of increase in fly catches

The index of increase in trap catches for female tsetse flies, relative to standard blue colour, were 0.3526 (deep blue), 0.6748 (medium blue) and 0.7089 (light blue) (Table 3 a). For male tsetse flies, the index of increase in trap catches, relative to standard blue colour, were 0.4255 (deep blue), 0.6312 (medium blue) and 0.7423 (light blue) (Table 3 b). Considering the female tsetse flies, significant tests between treatment means (using the Student – Newman – Keuls multiple range test) showed no significant differences ($P>0.05$) in tsetse catches between monoscreen traps made out of medium blue, light blue and standard (control) materials. The deep blue material stood out as the oddest colour from the rest. When the male tsetse flies were considered, the standard blue material (control) was more superior in tsetse catch than the other shades of blue materials.

Discussion

This study was an attempt to evaluate the responses of *G. f. fuscipes* to three common shades of blue materials (cotton/ polyester) that were used for making monoscreen trap. Although the standard (control) trap appeared to catch the highest number of tsetse (both males and females), the harvest was not significantly different from the traps made out of light and medium blue materials. This suggests that these locally-available blue materials (cotton/polyester) can be effectively used for making traps, instead of relying on the imported materials that are not readily available to the local communities. This is one of the attempts to develop easily maintained or disposable tsetse control materials which could be partially managed by beneficiary communities. Other attempts made with different trap designs, fabrics and colours to sample or control different tsetse species were reviewed by Green (1994) and Cuisance (1989).

The index of increase in trap catches female tsetse flies were 0.3526 for deep blue, 0.6748 for medium blue, 0.7089 for light blue and 1.0000 for standard (control) blue. Based on statistical analysis, the deep blue material appeared not to be suitable for trap making. However, the standard (control) blue material appeared more suitable for catching the male tsetse flies than the other locally-available blue materials. This suggests that the responses of male and female tsetse flies to colours differ. Leak (1999) observed that the responses of tsetse to ultraviolet (UV) light and the reflectivity of cloth targets to UV light are very complex, as attraction and alighting responses differ.

Table 1 a. The catches of female *G. f. fuscipes* in monoscreen traps made out of different shades of blue cotton/polyester materials, on various days and at different trap sites

Replicate	Trap site	Day 1	Day 2	Day 3	Day 4
1	1	a 250	d 901	b 428	c 520
	2	d 669	b 426	c 271	a 17
	3	b 178	c 263	a 65	d 355
	4	c 294	a 280	d 304	b 251
2	5	d 636	b 103	a 54	c 244
	6	b 442	a 362	c 284	d 618
	7	a 231	c 348	d 339	b 449
	8	c 885	d 1013	b 242	a 355
3	9	b 203	c 261	d 360	a 86
	10	c 82	d 418	a 185	b 232
	11	d 350	a 190	b 323	c 207
	12	a 248	b 366	c 393	d 212

a = deep blue, b = medium blue, c = light blue, d = standard material (control)

Table 1 b. The catches of male *G. f. fuscipes* in monoscreen traps made out of different shades of blue cotton/polyester materials, on various days and at different trap sites

Replicate	Trap site	Day 1	Day 2	Day 3	Day 4
1	1	a 64	d 197	b 116	c 114
	2	d 197	b 117	c 54	a 06
	3	b 68	c 84	a 40	d 138
	4	c 214	a 190	d 171	b 172
2	5	d 170	b 254	a 41	c 83
	6	b 187	a 100	c 73	d 146
	7	a 144	c 161	d 183	b 115
	8	c 306	d 322	b 155	a 174
3	9	b 141	c 95	d 164	a 60
	10	c 56	d 96	a 51	b 64
	11	d 136	a 77	b 118	c 72
	12	a 123	b 60	c 97	d 108

a = deep blue, b = medium blue, c = light blue, d = standard material (control)

Table 2 a. Analysis of variance for female *G. f. fuscipes* caught in monoscreen traps made out of different shades of blue cotton/polyester materials

Source of variation	SS	df	MS	F-ratio	Probability
Colorcod	1.28	3	.43	9.90	.000
Day	.26	3	.09	2.01	.148
Replicate	.11	2	.05	1.26	.306
Replicate x Site	1.47	9	.16	3.77	.008
Colorcod x Replicate	.37	6	.06	1.41	.265
Day x Replicate	.52	6	.09	1.99	.120
Residual	.78	18	.04		
Total	4.78	47	.10		

R-squared = 0.837

Table 2 b. Analysis of variance for male *G. f. fuscipes* caught in monoscreen traps made out of different shades of blue cotton/polyester materials

Source of variation	SS	df	MS	F-ratio	Probability
Colorcod	.86	3	.29	7.16	.002
Day	.40	3	.13	3.34	.042
Replicate	.40	2	.20	5.04	.018
Replicate x Site	1.03	9	.11	2.86	.027
Colorcod x Replicate	.26	6	.04	1.10	.402
Day x Replicate	.23	6	.04	.95	.487
Residual	.72	18	.04		
Total	3.91	47	.08		

R-squared = 0.816

Table 3 a. The indices of increase in catches of female tsetse and significant tests between treatment means

Treatment	log mean	De-transformed Mean	Index
Deep blue	2.1640	145.8814	0.3526
Medium blue	2.4459	279.1901	0.6748
Light blue	2.4673	293.2919	0.7089
Control (standard)	2.6167	413.7138	1.0000

Table 3 b. The indices of increase in catches of male tsetse flies and significant tests between treatment means

Treatment	log mean	De-transformed Mean	Index
Deep blue	1.8361	68.5646	0.4255
Medium blue	2.0074	101.7185	0.6312
Light blue	2.0778	119.6190	0.7423
Control (standard)	2.2072	161.1388	1.0000

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