Attraction of Tsetse Fly to NG_2G Traps Containing Different Biends of Odor Baits in Three Vegetation Types

Alemayehu Abate[2], *Melaku Girma*[3]
[2] *Ethiopian Health and Nutrition Research Institute*
P.O .Box 30912, Addis Ababa, Ethiopia
[3]*ICIPE/Ethiopia, P.O. Box 17319, Addis Ababa, Ethiopia*

Abstract

The relative effectiveness of different blends of acetone (450 mg/h), cow urine (858 mg/h) and octenol (1.5 mg/h) odor attractants for tsetse flies (*Glossina Pallidipes*) (Diptera:Glossinidae) was assessed using NG_2 G traps located in three areas of different vegetation types in the Nechisar National Park, southern Ethiopia. Their effect on the catch size and age composition of *G. pallidipes* was determined. Results indicated that blends of acetone, cow urine and octenol, and blends of acetone and cow urine, were more attractive than blends of acetone and octenol, and blends of cow urine and octenol. Blends of cow urine and octenol were more attractive than blends of acetone and octenol. All blends attracted more females than males. Higher numbers of older flies were caught for all blends in each of the three vegetation types.

Key words: *Glossina,* NG_2G, trap, attractants

Introduction

The identification of effective chemical attractants for tsetse likely will increase the potential to use baited traps for the control or eradication of tsetse. Several active components have been identified so far, including carbon dioxide, acetone (Vale 1980), 1-octen-3-ol (octenol) and butanone (Vale and Hall 1986) and a number of phenols (Vale et al. 1988). Several of these attractants have been used as baits either singly or in blends in tsetse monitoring and control programs. For example, blends of acetone and octenol (Vale et al. 1986) and acetone with phenol (Pollock 1991) have been used in Zimbabwe, and a blend of acetone and cow urine (Dransfield et al. 1990) have been used in Kenya to monitor and control tsetse. However, a study in Somalia indicated that *Glossina pallidipes* responded very poorly to a trap baited with a blend of acetone and phenol (Torr et al. 1989). Such differences indicate that the response of tsetse flies to odour baits may not be consistent across different localities or with different populations of flies.

The present study was done to assess the relative performance of different blends of acetone, cow urine and octenol as attractants for *G. pallidipes* in areas of different vegetation types in Ethiopia. Efficacy was assessed in terms of overall catch size, age, and sex composition. The study area selected was where the Ethiopian Science and Technology

Commission (ESTC) has initiated a tsetse control and eradication project.

Materials and Methods

Study area

All studies were carried out in the Nechisar National Park (6^0 00 N and 37^0 45 E), which is located in southern Ethiopia. The park was chosen for the study as it represents a relatively isolated area of tsetse infestation where there is a high potential for achieving tsetse control. There is also a high tsetse population density in the area, different vegetation types, and good altitude gradients (108 to 1650 m) for tsetse breeding. The study was conducted in the dry season, December 1999 to February 2000, and during the short rainy season. All of the odour baits were tested in each of the following vegetation types: (a) wooded grassland primarily containing *Scleocarya birra*, *Balanittes aegipticus* and *Heteropogon contrtus* (b) thickets with scattered bushes of *Maerva crassifilia* and *Cissus quadrongularis,* and (c) riverine forests consisting of mainly Rosaceae, Syzygium and Marceae.

Traps and odor baits

NG_2G[1] (Brightwell et al. 1987) traps made from lightweight blue and black polyesters/ cotton cloth and white nylon netting were used for the experiment. Traps were baited with different blends of acetone (450 mg/h), cow urine (858 mg/h) and octenol (1.5 mg/h). The different blends of odour baits were (1) acetone + cow urine + octenol, (2) acetone + cow urine, (3) acetone + octenol, and (4) octenol + cow urine. The use of the rates for the baits was based on values given in the FAO Training Manual for Tsetse Control Personnel (FAO 1992). Cow urine was collected from local east African Zebu cattle and stored prior to use in a closed bottle for about 21 days at ambient temperature of 25–31 ^{0}C. Traps were baited with acetone and cow urine via a 250 ml glass bottle with an aperture of 7 mm, and a 500 ml hard plastic jar with an aperture of 2 x 4 cm in the side near the top, respectively. Flat and rectangular sachets made of 175 µm thick polythene sheet with a surface area of 4 x 5 cm was used to dispense octenol. Odor dispensers were placed on the ground 30 cm downwind from the base of each trap. Twelve taps were deployed approximately 200 m apart in consistent north–south direction to decrease the direct exposure of fly entrance to traps from direct sun light. All release rates were estimated on the basis of the difference in weight of test attractants from 0730 to 1730 h after placement in the study area following the test procedures of Baylis and Nambrio (1993).

Experimental design and data analysis

All field experiments were carried out between 07:30 and 17:30 h. To compare the efficacy of the different blends of attractants deployed with the NG_2G traps, treatments were incorporated into Latin square design consisting of days x sites x treatments. Each experiment was replicated three times. Trapped flies were collected from traps every 24 h and transported to the laboratory where they were separated by species and sex using FAO (1992) keys. Ovarian dissections for female flies and the wing fray method for male flies were used to obtain an estimate of fly age. Non-teneral female flies were dissected to categorize their age based on the presence or absence of follicular relics and from the relative size of developing follicles in their cyclical development. In the wing fray method, the wings of male flies were calibrated and assigned to one of six standardized

[1] NG_2G is a tsetse trap design named after a place called Ngurman in Kenya

categories based on the amount of fraying along the trailing (rear) edge of the wing. The techniques for both methods are defined in the FAO Training Manual for Tsetse Control Personnel (FAO 1992). Forty flies sampled from each trap (treatment) were used for each evaluation technique. To normalize the data, the catches (n) were transformed to $\log_{10}(n + 1)$ and then subjected to analysis of variance (ANOVA) at 0.05 significance level using the SAS procedures (SAS Institute 95). Differences between means were assessed using Duncan's Multiple Range Test. Transformed means are presented along with their transformed standard errors. Sex ratio analysis was done using a Chi-square test on pooled data and the proportion of male and female flies are reported in percent values. The same experimental methods were followed for trials carried out in each of the three vegetation regimes: wooded grass land, thicket with scattered bushes, and riverine.

Results

Total catches

The NG_2G trap baited with acetone plus cow urine (A + C) and acetone plus cow urine plus octenol (A + C + O) caught significantly ($p \leq 0.05$) more tsetse flies than those deployed with acetone plus octenol (A + O) and octenol plus cow urine (O + C) under all vegetation types (Table 1). However, no significant difference ($p > 0.05$) was observed between NG_2G traps baited with acetone plus cow urine and acetone plus cow urine plus octenol. On the other hand, in riverine forests and thickets with scattered bushes, no statistically significant difference ($p > 0.05$) was observed between NG_2G traps baited with acetone plus octenol and octenol plus cow urine. However, in wooded grassland, octenol plus cow urine caught significantly ($p \leq 0.05$) more tsetse flies than acetone plus octenol.

Table 1. Mean number ($\log_{10}n+1$) of *G. pallidipes* caught by NG_2G traps baited with different blends of attractants under different vegetation types, 1999–2000

Vegetation type	Number of flies caught/trap/day	
	NG_2G + B	Mean ± SE
Wooded grassland	A + C + O	1.825 ± 0.125 a
	A + C	1.781 ± 0.103 a
	O + C	1.625 ± 0.094 b
	A + O	1.479 ± 0.103 c
Riverine forest	A + C + O	2.048 ± 0.069 a
	A + C	2.008 ± 0.059 a
	O + C	1.696 ± 0.071 b
	A + O	1.688 ± 0.065 b
Thickets with scattered bushes	A + C + O	2.443 ± 0.053a
	A + C	2.404 ± 0.077a
	O + C	2.134 ± 0.078 b
	A + O	2.130 ± 0.089 b

Means with the same letter are not significantly different ($p > 0.05$)

A + C = acetone + cow urine, A + C + O = acetone + cow urine + octenol,

O + C = octenol+cow urine, NG_2G + B = NG_2G baited with different blends of acetone, cow urine and octenol

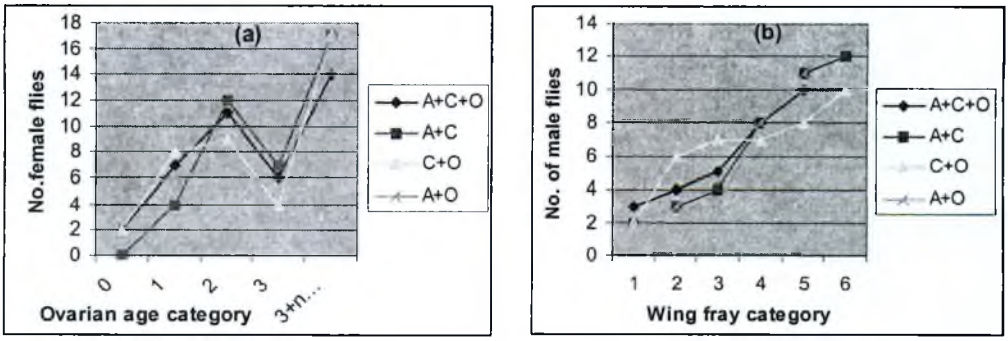

Figure 1. Age distribution of *G. pallidipes* caught by NG_2G traps deployed with blends of acetone (A), cow urine (C) and octenol (O) in wood grassland

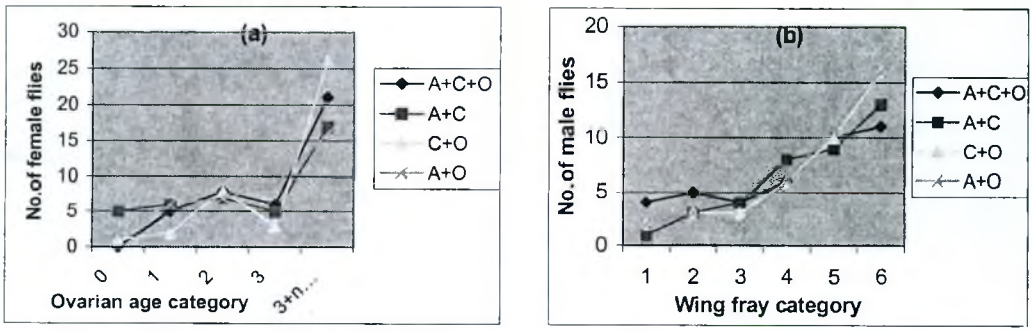

Figure 2. Age distribution of *G. pallidipes* caught by NG_2G traps deployed with blends of acetone (A), cow urine (C) and octenol (O) in reverian forest

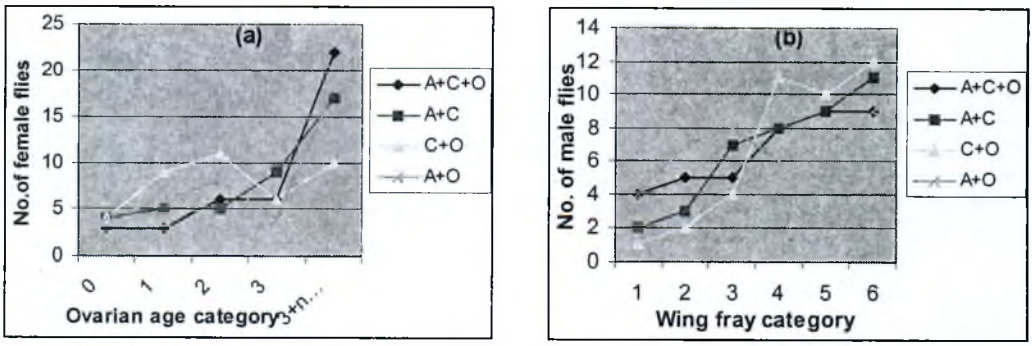

Figure 3. Age distribution of *G. pallidipes* caught by NG_2G traps deployed with blends of acetone (A), cow urine (C) and octenol (O) in thicket with scattered bushes

Table 2. Sex ratio of *G. pallidipes* captured in areas of different vegetation cover

Vegetation type	Female (%)	Male (%)	x^2 (df = 3)	P	LS
Wooded grassland	90 50	9.50	374.210	0.000	s
Riverine forest	65 38	34.52	2.892	0.409	ns+
Thickets with scattered bushes	60 57	39.43	375.640	0.000	s

* 5, significant ($p \leq 0.05$)
+ ns, not significant ($p > 0.05$)
Not - Chi-square test was done using pooled data of all blends of acetone, cow urine and octenol.

Sex ratio

Results of the Chi-square test on the number of male and female flies caught showed that significantly more females were caught than males in wooded grassland and thickets with scattered vegetation (Table 2). Although differences in sex ratio were not significant, more females were caught than males in the riverine forest.

Age composition

On the basis of the number of tsetse flies captured, older flies appeared to be more attracted to the traps than younger flies. Similar trends were observed for all of the baits tested and in each vegetation type (figures 1-3).

Discussions

Fly catches are influenced by time of the day and season, trap device, experimental site, temperature, and the qualitative and quantitative make-up of the odor source. Fly activity, which varies according to extrinsic factors (such as temperature and humidity), and intrinsic factors (such as sex, age, and hunger stage) also affects catch size and composition (Gough and Hall 1995). To minimize residual variance due to the effects of day and site, a Latin square design was used in the experiment.

Traps deployed with acetone + cow urine + octenol and with acetone + cow urine caught significantly more *G. pallidipes* than those traps deployed with acetone + octenol and cow urine + octenol in all vegetation types. Dransfield et al, (1986) obtained similar results using these odor baits with biconical traps tested for *G. pallidipes*. According to Baylis and Nambrio (1993), octenol has very little effect, either on its own or in combination with acetone. The use of octenol in conjunction with cow urine gave small but significant increases in trap catches for *G. pallidipes* (Brightwell et al. 1991). This also concurred in the current study.

Mean traps catches were significantly greater ($p \leq 0.05$) when baited with blends of cow urine and acetone than with cow urine and octenol. However, the addition of octenol with cow urine + acetone slightly improved the trap catch, but the increase was not significant ($p > 0.05$), compared to the mean catch obtained with blends of cow urine and acetone in each vegetation type. This suggests that octenol had an additive effect that was greater when used with cow urine + acetone, than when combined either with cow urine or acetone alone. Traps baited with cow urine + octenol were more effective than those baited with acetone + octenol in wooded grassland. This was not observed

in the riverine forest or thickets with scattered bushes. This phenomenon suggests that cow urine + octenol works better in wooded grassland than in the other vegetation types tested. However, further investigations should be conducted to confirm this.

Sex ratios differed according to the population that was being sampled. Since trapping devices catch only the active portion of the population, the ratio could indicate differences in the activity patterns of the population. Activity patterns may be related to the physiology and behavior of the fly in response to climatic and other conditions (Owaga 1989 and Challier and Turner 1985). In the present study, proportionally higher numbers of females were caught than males in all experiments. The level of significance of these differences varied with vegetation and bait type. However, the work of Turner (1987) on the ecology of *G. pallidipes* in the Lembawe Valley, Kenya, and studies by Owaga (1989) on the efficiency of the biconical trap in catching *G. pallidipes* in Nguraman and Kibwezi, Kenya, indicated that these traps are relatively more effective in catching males than females. The differences in the results obtained in Kenya and in the present study in Ethiopia probably reflect differences in trap design, fly behavior, vegetation and climatic conditions of the two countries.

The age determination of the catches indicated that a proportionally greater number of older flies were caught in each vegetation type. The number of older flies in each category increased with an in increase in fly age (figures 1–3). Similar reports of Jack (1941) indicated the reluctance of young *G. pallidipes* to enter traps. Challier and Turner (1985), on the other hand, showed that traps are biased against teneral and young immediate post-teneral individuals. The most likely explanation for such different results seems to be due to differences in the ecology of fly population existing in different localities. Therefore, developing an appropriate bait technology is required to capture important age group for any given locality in the control of tsetse flies and trypanosomaisis.

Since the use of octenol in combination with cow urine + acetone did not significantly improve catch size over that obtained than acetone + cow urine, and the cost of octenol is much higher than acetone, the use of octenol in community based tsetse suppression is not recommended. Further studies are also recommended to investigate the increase in catch size of flies due to the use of acetone with cow urine as compared to using cow urine alone.

The relatively higher catches obtained using blends of acetone plus cow urine plus octenol, acetone plus cow urine, and octenol plus cow urine compared to acetone plus octenol suggests that cow urine has great potential to attract tsetse flies more than acetone and octenol in all vegetation types. This will make community-based tsetse management potentially feasible, as cow urine is available to the rural community at a lesser cost. To this effect, further study is required on optimum trap deployment strategy, i.e., position of odor sources, effect of different release rates and effect of trap sites.

Variations in age composition and sex ratios indicate that older female flies are more attracted than male flies of the same age. Capturing tsetse flies at their older age is less important than capturing them at their younger age as older flies have higher probability of getting infected with trypanosomes and transmitting them to their hosts. Therefore, further study on the attraction of *G. pallidipes* to odor baits is also required in different seasons of the year to get more information about tsetse attraction.

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