Trials of olfactory attractants to enhance trap catches of Glossina fuscipes fuscipes (Diptera: Glossinidae) in the Central African Republic

Jp Gouteux, F Blanc, D Cuisance, Frank d'Amico, A Kota Guinza

Vet Res (1995) 26, 335-340

Original article

Trials of olfactory attractants to enhance trap catches of *Glossina fuscipes fuscipes* (Diptera: Glossinidae) in the Central African Republic

JP Gouteux [1*], F Blanc [2], D Cuisance [3], F D'Amico [3], A Kota Guinza [2]

[1] *ORSTOM, département de mathématiques appliquées, URA-CNRS 1204, IPRA-UPPA, avenue de l'Université, 64000 Pau, France;*
[2] *Agence nationale de développement de l'élevage, ANDE/FNEC, BP 1509, Bangui, Central African Republic;*
[3] *CIRAD-EMVT, s/c ORSTOM, BP 5045, 34032 Montpellier cedex 1, France*

(Received 19 January 1995; accepted 2 May 1995)

Summary — Host odours increased the trap catches of *Glossina fuscipes fuscipes* in cattle breeding areas of the Central African Republic. The increase was significant with zebu urine (x 1.4) and the principal reptilian host, the monitor lizard (x 1.7). The greatest effect (x 4.2) was obtained for male *G f fuscipes* with zebu urine when the densities of flies were low (less than 5 males per trap per day). It seems that olfactory baits in urine could improve the control of *G f fuscipes* by trapping. Reptile odour contains attractants that should be identified.

***Glossina fuscipes fuscipes* / tsetse flies / trapping / host odours / reptile / zebu**

Résumé — Essais d'attractifs olfactifs (odeurs d'hôtes) pour améliorer la lutte par piégeage contre *Glossina fuscipes fuscipes* en République centrafricaine. *Les essais réalisés en zone d'élevage de République centrafricaine sur* G fuscipes fuscipes *ont montré que l'addition d'un appât olfactif augmentait systématiquement les captures. Cette augmentation était significative avec l'urine de zébu (x 1,4) et avec le principal hôte reptilien, le varan (x 1,7). L'effet le plus important (x 4,2) a été obtenu pour les glossines mâles, avec l'urine de zébu, lorsque les densités des mouches étaient inférieures à 5 mâles/j/piège. Ces essais suggèrent la possibilité d'utiliser des appâts olfactifs pour améliorer la lutte par piégeage contre ce vecteur et montrent en particulier la présence de principes attractifs dans l'odeur de reptile, qu'il serait intéressant d'identifier.*

Glossina fuscipes fuscipes / *tsé-tsé / piégeage / odeurs d'hôtes / reptile / zébu*

* Correspondence and reprints

INTRODUCTION

Trapping is an ecologically preferable alternative to the traditional techniques of tsetse fly control (*ie* ground or aerial spraying of insecticide). It is a simple and cheap method which can be used directly by the local zebu breeders to protect their livestock (Dransfield *et al,* 1990; Cuisance *et al,* 1992; Gouteux and Le Gall, 1992). Although the effectiveness of trapping is proven, improvements to this technique are being sought, including increasing the visual attractiveness of the traps and the efficiency of the trapping device (Challier *et al*, 1977; Gouteux *et al,* 1981; Filledier *et al,* 1985; Gouteux and Sinda, 1990). Another method of improvement is to add olfactory attractants to the trap (Vale and Hargrove, 1979; Vale, 1980). The addition of host odours (cattle urine or sebum, chemical compounds) to traps has considerably improved the control of savanna tsetse (*Morsitans* group and *Glossina longipennis*) and is now well documented (Politzar and Merot, 1984; Vale *et al,* 1988; Kyorku *et al,* 1990; Warmes, 1990). This is not, however, the case for the 2 riverine tsetse flies of the *Palpalis* group, for which research on olfactory attractants has been carried out (*G palpalis* and *G tachinoides*). Although carbon dioxide and certain urine components are attractive alone or in combination for these riverine species (Galey *et al,* 1986; Mérot *et al,* 1986; Cheke and Garms, 1988), most of the chemicals have a limited effect and some are even repellents (Mérot *et al,* 1988; Mérot and Filledier, 1989; Küpper *et al,* 1991). Trials of olfactory attractants have not yet been carried out on *G f fuscipes*, another riverine tsetse. Since the disappearance of *G morsitans submorsitans* from the cattle breeding areas of the Central African Republic (Gouteux *et al,* 1994a), *G f fuscipes* is the main vector of livestock trypanosomiasis in this area.

The use of simple community level method of tsetse control is acknowledged as a priority. Since cattle urine is directly accessible and easy to use for Peul pastoralists, the main breeders in Central African Republic, we tested this bait on *G f fuscipes*.

To date, all the compounds tested on *Glossina* spp originated from mammals. However, riverine tsetse flies are opportunistic in their feeding habits (Weitz, 1963), so that mammals are not always their main hosts. Indeed, in breeding areas of the Central African Republic, reptiles account for between 14 and 26% of the blood meals of *G f fuscipes* (Gouteux *et al,* 1994b). Given the small size of the reptiles, their low population density and their discreet mode of life, it has been suggested that reptiles attract the riverine tsetse by odour. Preliminary trials were thus carried out to evaluate and compare the attraction of *G f fuscipes* to reptilian and mammalian odour.

MATERIALS AND METHODS

Six trials (trials 1–6) were carried out, using the blue-black polyethylene bipyramid traps (Gouteux, 1991), with and without olfactory bait. In trial 1, baited and non-baited traps were tested simultaneously in pairs. This so-called 'competition' protocol has been used previously by Gouteux and Lancien (1986) and Cheke and Garms (1988). The experimental design of the other trials was the latin square, sites x days x odours, of size 6 (trial 2) or 4 (trials 3–6). For the competition protocol, the results were analysed by the *t* test for comparison of the means for matched data. Each latin square was duplicated making 2–6 independent square times, and the Tukey test for non-additivity (Dagnelie, 1978) was used to check interaction (in the sense of Milliken and Graybill, 1972). In the case of non-additivity, the latin square was rejected. If necessary, a transformation (log $x + 1$, or $x^{1/2}$) was applied to ensure the normality of the distribution of the data. The analysis of variance was then carried out for all independent latin squares (Lellouch and Lazar, 1974). The Dunnet test (Dagnelie, 1978) was used to compare baited and non-baited traps.

Study zones

The 6 trials were carried out in the following zones: Trials 1 and 2 (February 1991): Ban River, 'Zone agro-pastorale' (ZAGROP) of Yérémo (Bossembélé); trials 3 (December1991), 4 (June 1992) and 5 (July 1992): Gbalé lake, Zakaï (Bangui); trial 6 (June 1992): Mbonou River, 'Commune d'élevage' of Ouro-Djafoun (Bambari).

The trials were carried out in forest galleries, 3–4 and 11 km from the cattle watering places (Ban River and Gbalé lake, respectively) or at the watering place frequented daily by cattle (Mbonou River). The characteristics of these sites are given by Gouteux *et al* (1994b).

Protocols

Trial 1. Competition protocol

Two fixed traps were placed 20 m apart near isolated water-holes under the forest gallery. They were not visible from one another. A sponge was placed on a waterproof plastic sheet under each trap. Each day, one was moistened with zebu urine (test attractant) and the other with water (control). The sponges were alternated each day. The experiment lasted 28 d and the catch was recorded daily.

Trial 2. Latin squares (6 x 6) replicated 3 times

Six traps were fixed at 6 capture sites, 25–100 m apart, along the forest gallery and at mutually invisible positions. Six sponges, 3 of which were impregnated daily with zebu urine (test attractant) and 3 with water (controls) were placed randomly each day under the traps, with one sponge per trap.

Trials 3, 4, 5 and 6. Latin squares (4 x 4) replicated 3, 2, 6 and 2 times respectively

The protocol for trial 3 was the same as for trial 2. Four sponges, 2 impregnated with urine (test attractant) and 2 with water (controls), were interchanged randomly each day. Trials 4 and 5 studied the efficacy of odours from live animals, which were placed singly in cages (100 x 50 x 50 cm), 10–30 cm from the traps (1 cage per trap). The 4 cages, 1 empty and 3 with animals, were hidden by covering them loosely with leaves. The cages were interchanged randomly each day. In trial 4 the live animals were a young crocodile *(Crocodilus niloticus)*, a monitor lizard *(Varanus niloticus)* and a snake *(Pyton sebae)*. In trial 5, a mammal (rabbit), a bird (chicken) and a reptile (monitor lizard). All the hosts were of comparable size except for the crocodile which was about twice the size of the others. Trial 6 was carried out in a cattle watering place. The protocol is therefore slighty different from trials 2 and 3; odour was tested by placing successively in each trap a sponge impregnated with water, zebu urine, dung or sebum ('body odour', obtained by rubbing the sponge on the animal's body). The plastic traps were washed each time with soap.

RESULTS

The total catches for each of the trials 1–6 were respectively 233, 410, 940, 182, 413 and 294 *G f fuscipes* totalling 2 472 flies. The catches were systematically higher with the baited traps (except for zebu sebum) as shown in table I. Significant results were produced in 4 experiments for 2 baits: zebu urine (trials 1–3) and the monitor lizard (trial 5). Compared to the controls, the number of *G f fuscipes* caught was multiplied by 1.4 in the presence of urine and 1.7 with the monitor lizard. During trial 3, when the tsetse fly density was low (under 5 males per trap per day) the attractant effect of urine for the male *G f fuscipes* was significant (F_{3-6} = 18.173, $p < 0.0005$) (table II). The number of males caught was multiplied by 4.2. This was the only trial in which there was a significant difference in the fly sex ratio between the control and baited trap catches (χ^2 = 8.72, $p = 0.003$).

DISCUSSION

The present work suffered from the generally low density of *G f fuscipes* in the study area (Blanc *et al*, 1991), making it difficult to

Table I. Catches of *G f fuscipes*.

Bait	*Trial*	*Number of flies*		*Ratio*
		Baited trap	*Control*	
Zebu urine	1	161*	72	2.2
Zebu urine	2	229*	181	1.3
Zebu urine	3	556*	374	1.5
Zebu urine	6	90	63	1.4
Zebu dung	6	79	63	1.3
Zebu sebum	6	61	63	1.0
Monitor lizard	4	55	33	1.7
Monitor lizard	5	128*	76	1.7
Crocodile	4	50	33	1.5
Snake	4	44	33	1.3
Rabbit	5	109	76	1.4
Hen	5	100	76	1.3

* Significantly different from non-baited control catches in the same experiment ($p < 0.05$).

Table II. Catches of male and female *G f fuscipes* in urine-baited traps (trial 3).

LS	*ATD*	*Males*		*Ratio*	*ADT*	*Females*		*Ratio*
		Baited trap	*Control*			*Baited trap*	*Control*	
1	11.4	108	74	1.5	18.1	160	129	1.2
2	6.4	66	37	1.8	10.1	96*	66	1.5
3	4.2	54**	13	4.2	8.6	82	55	1.5

* $p < 0.05$; ** $p < 0.0005$. LS: latin square; ADT: apparent density per trap expressed as number of flies by day and by trap.

expose significant effects. Nevertheless a significant attractive effect was demonstrated for zebu urine and the monitor lizard. For other baits the results are generally consistent with an attractive effect of the host odour.

This is the first demonstration of the attractive effect of reptile odour, in this case the monitor lizard. Because of their slow metabolism, reptiles produced less CO_2 than mammals or birds of the same weight. Therefore specific components of reptile odour are probably factors in the tsetse fly attraction. *Varanus* sp is fairly common in Africa. In the cattle breeding areas of the Central African Republic, the monitor lizard

provides 89% of the reptile blood meals taken by this fly (Gouteux *et al,* 1994b). However, elsewhere crocodiles have often been observed to be a major host for *G f fuscipes* (Weitz, 1963; Van vegten, 1971). Hence trials with other reptile species, especially with the crocodile, need to be conducted.

The attractive effect of zebu urine was not significant in 1 trial (6) out of 4. This result may be due to the protocol. Indeed, some chemicals migrate into plastic and do not wash off, but still smell. The result could also be related to the particular environment of this trial at the cattle watering place. The presence of cattle excrement throughout the capture site may diminish the effectiveness of the odour in the trap. However, this needs to be verified by further trials in order to assess the usefulness of this method of control, since trapping is used by herdsmen mainly at the cattle watering places, with the aim of reducing the cattle/fly contact (Cuisance *et al,* 1992; Gouteux and Le Gall, 1992). The crude collection of zebu sebum may explain its low attractive effect. On the other hand, the greater attraction of urine-baited trap for male *G f fuscipes* when fly densities are low could be useful for killing the residual population of tsetse.

The preliminary results on reptile odour are particularly encouraging. They suggest that reptiles have specific odours that attract *G f fuscipes*. Thus, reptiles could provide means for increasing the trap catches if their attractive components could be identified and isolated. However, further studies must be conducted in the field and laboratory before herdsmen can use olfactive reptile attractants to control tsetse flies.

ACKNOWLEDGMENTS

We would first like to thank JM Poussinga and A Heyaoroï for their excellent technical assistance. We also thank the 2 anonymous referees for their useful comments and help in the final writing of the manuscript. This work was supported in part by the government of the Central African Republic, Orstom (UR 41, Maladies infectieuses et parasitaires), World Bank–International Fund for Agricultural Development (IFAD), European Fund for Development (EFD) and Fonds d'aide et de coopération (FAC), France.

REFERENCES

Blanc F, Gouteux JP, Cuisance D, Pounekrozou E, N'Dokoué F, Le Gall F (1991) Étude de la répartition des tsé tsé (Diptera: Glossinidae) en zone de savane humide (République centrafricaine). Évaluation de techniques de prospection entomologique. *Trop Med Parasitol* 42, 127-130

Challier A, Eyraud M, Lafaye A, Laveissière C (1977) Amélioration du rendement du piège biconique pour glossine (Diptera: Glossinidae) par l'emploi d'un cône inférieur bleu. *Cah ORSTOM Sér Entomol Méd Parasitol* 15, 283-286

Cheke RA, Garms R (1988) Trials of compounds to enhance trap catches of *Glossina palpalis palpalis* in Liberia. *Med Vet Entomol* 2, 199-200

Cuisance D, Gouteux JP, Cailton P *et al* (1992) Problématique d'une lutte contre les glossines pour la protection de l'élevage zébu en RCA. *Mém Soc R Belge Entomol* 35, 103-110

Cuisance D, Demba D, Vallat B *et al* (1994) Répartition des glossines dans la zone d'action agropastorale de Yérémo en République centrafricaine. *Rev Élev Méd Vét Pays Trop* 47, 69-75

Dagnelie P (1978) *Théories et méthodes statistiques. Applications agronomiques T2.* Presses Agronomiques, Gembloux, Belgium, 463 p

Dransfield RD, Birghtwell R, Kyorku C, Williams B (1990) Control of tsetse fly (Diptera: Glossinidae) populations using traps at Nguruma, south-west Kenya. *Bull Entomol Res* 80, 265-276

Filledier J, Politzar H (1985) Efficacité relative de différentes formes de leurres sur 3 espèces de glossines présentes au Burkina-Faso. *Rev Élev Méd Vét Pays Trop* 38, 358-362

Galey JB, Mérot P, Mitteault A, Filledier J, Politzar H (1986) Efficacité du dioxyde de carbone comme attractif pour *Glossina tachinoides* en savane humide d'Afrique de l'Ouest. *Rev Élev Méd Vét Pays Trop* 39, 351-354

Gouteux JP (1991) La lutte par piégeage contre *Glossina fuscipes fuscipes* pour la protection de l'élevage en RCA. II. Caractéristique du piège bipyramidal. *Rev Élev Méd Vét Pays Trop* 44, 295-299

Gouteux JP, Lancien J (1986) Le piège pyramidal à tsé-tsé (Diptera-Glossinidae) pour la capture et la lutte.

Essais comparatifs et description de nouveaux systèmes de capture. *Tropenmed Parasitol* 37, 61-66

Gouteux JP, Sinda D (1990) Field trials of various models of the pyramid trap on *Glossina palpalis* in the Congo. *Entomol Exp Appl* 54, 281-286

Gouteux JP, Le Gall (1992) Piège bipyramidal à tsé-tsé pour la protection de l'élevage en République centrafricaine. *World Anim Rev* 70–71, 37–43

Gouteux JP, Challier A, Laveissière (1981) Modifications et essais du piège à glossine (Diptera: Glossinidae) Challier-Laveissière. *Cah ORSTOM Sér Entomol Méd Parasit* 19, 87-99

Gouteux JP, Blanc F, Pounékrozou E *et al* (1994a) Tsé-tsé et élevage en République centrafricaine: le recul de *Glossina morsitans submorsitans* (Diptera: Glossinidae). *Bull Soc Pathol Exo* 87, 52-56

Gouteux FP, D'Amico F, Cuisance C *et al* (1994b) Les hôtes de *Glossina fuscipes fuscipes* Newstead, 1910 (Diptera: Glossinidae) dans 2 zones d'élevage de la République centrafricaine. *Vet Res* 25, 16-28

Küpper W, Späth J, Kröber T (1991) Attractiveness of chemicals to *Glossina tachinoides* Westwood (Diptera: Glossinidae) in Côte d'Ivoire. *Trop Pest Manage* 37, 436-438

Kyorku C, Brightwell R, Dransfield RD (1990) Traps and odour baits for the tsetse fly, *Glossina longipennis* (Diptera: Glossinidae). *Bull Entomol Res* 80, 405-415

Lellouch J, Lazar P (1974) *Méthodes statistiques en expérimentation biologique.* Flammarion «Médecine Sciences», Paris, France, 283 p

Mérot P, Filledier J (1989) Résultat des recherches sur les attractifs olfactifs pour *Glossina tachinoides* au Burkina-Faso. *20th Meeting SCTRC*, Mombasa, n° 115, OAU/SCTRC, Nairobi, Kenya, 423-424

Mérot P, Galey JB, Politzar H, Filledier J, Mitteault A (1986) Pouvoir attractif de l'odeur des hôtes nourriciers pour *Glossina tachinoides* en zone soudano-guinéenne (Burkina-Faso). *Rev Élev Méd Vét Pays Trop* 39, 345-350

Mérot P, Filledier J, Mulato C (1988) Pouvoir attractif pour *Glossina tachinoides* de produits chimiques isolés des odeurs animales. *Rev Élev Méd Vét Pays Trop* 41, 79-85

Milliken GA, Graybill FA (1972) Interaction models for the latin square. *Austr J Stat* 14, 129-138

Politzar H, Merot P (1984) Attraction of the tsetse fly *Glossina morsitans submorsitans* to acetone, 1-octen-3-ol, and the combination of these compounds in West Africa. *Rev Élev Méd Vét Pays Trop* 37, 468-473

Vale GA (1980) Field studies on the response of tsetse flies (Diptera: Glossinidae) and other diptera to carbon dioxide, acetone, and other chemicals. *Bull Entomol Res* 70, 563-570

Vale GA, Hargrove JW (1979) A method of studying the efficiency of traps for tsetse flies (Diptera: Glossinidae) and other insects. *Bull Entomol Res* 69, 183-193

Vale GA, Lovemore DF, Flint S, Cokbill GF (1988) Odour-baited targets to control tsetse flies, *Glossina* spp (Diptera: Glossinidae), in Zimbabwe. *Bull Entomol Res* 78, 31-49

Van Vegten JA (1971) The tsetse fly *Glossina fuscipes fuscipes* Newstead, 1911, in East Africa; some aspects of its biology and its role in the epidemiology of human and animal trypanosomiasis. MSc thesis, University of Amsterdam, Amsterdam, The Netherlands

Warnes ML (1990) Responses of *Glossina morsitans morsitans* Westwood and *G pallidipes* Austen (Diptera: Glossinidae) to the skin secretions of oxen. *Bull Entomol Res* 80, 91-97

Weitz B (1963) The feeding habits of *Glossina*. *Bull WHO* 28, 711-729