

EVALUATION OF TSETSE ATTRACTANTS AS BAITS FOR HORSE FLIES AND DEER FLIES (DIPTERA: TABANIDAE) IN LOUISIANA

LANE D. FOIL¹ AND LAWRENCE J. HRIBAR²

¹Department of Entomology, Louisiana Agricultural Experiment Station,
Louisiana State University Agricultural Center,
Baton Rouge, LA 70803

²Florida Medical Entomology Laboratory, University of Florida,
Institute of Food and Agricultural Sciences, 200 9th St. SE,
Vero Beach, FL 32962

ABSTRACT

Two experiments were conducted near Washington, Louisiana, to evaluate attraction of Tabanidae to known tsetse attractants. In the first experiment octenol was dispensed from reaction vials and polyethylene sachets, acetone was dispensed from a jar capped with a perforated lid, and a mixture of octenol, 3-*n*-propylphenol, and 4-methylphenol (4:1:8) was dispensed from sachets. Fourteen species or species groups of tabanid flies were attracted equally to octenol, whether dispensed from reaction vials or sachets. There were no differences in numbers of tabanids attracted to 4:1:8 bait and to octenol, whether dispensed from sachets or reaction vials. Acetone was no more attractive than were control traps. In the second experiment, 4:1:8, acetone, 4:1:8 + acetone (1:50), and commercially available pepper sauce (Tabasco®) were compared. Nine species or species groups of tabanid flies were collected. The 4:1:8 and 4:1:8 + acetone baits were equally attractive to tabanids, whereas there were no differences among the pepper sauce, acetone, and unbaited controls.

Key Words: trapping, octenol, acetone, phenols, pepper

RESUMEN

Se condujeron dos experimentos cerca de Washington, Louisiana, para evaluar la atracción de tábanos a cebos conocidos de tsetse. En el primer experimento el octenol fue dispensada directamente de ampollitas de reacción y de perfumadoras de polietileno (sachets), acetona de un jarro tapado con una tapa perforada, y 4:1:8 (una mezcla de octenol, 3-*n*-polipropilfenol, y 4-metilfenol) de una perfumadora. Se recobraron catorce especies o grupos de especies. Los tábanos fueron atraídos igualmente al octenol cuando se dispensó de las ampollitas de reacción o de los perfumadoras. No se encontró ninguna diferencia en el número de tábanos atraídos a cebos de 4:1:8 o octenol. No se encontró ninguna diferencia entre la acetona o las trampas controles sin cebo. En el segundo experimento, se compararon 4:1:8, acetona, 4:1:8 + acetona (1:50), y salsa picante disponible comercialmente (Tabasco®). Se recobraron nueve especies o grupos de especies. Los cebos 4:1:8 y 4:1:8 + acetona fueron igualmente atractivos a los tábanos, pero no se encontró diferencias alguna entre la salsa picante, acetona, y trampas controles sin cebo.

Chemical attractants in traps are used in many parts of the world to attract biting flies. In Africa, traps baited with a mixture of octenol, 3-*n*-propylphenol, and 4-methylphenol in the proportions 4:1:8 are used in tsetse control programs (Vale et al. 1988b). Brady & Griffiths (1993) found that this combination of chemicals, which they called "4:1:8", elicited a response by tsetse similar to that elicited by carbon dioxide, and that acetone elicited a weaker response. French & Kline (1989) reported that octenol was an effective attractant for tabanid flies. We report here a field trial evaluating these tsetse attractants for collecting tabanids in Louisiana.

MATERIALS AND METHODS

Two experiments were conducted at the Thistlethwaite Wildlife Management Area (WMA), near the town of Washington in St. Landry Parish, Louisiana. The study site has been described previously by Leprince et al. (1991). The first experiment was conducted for ten days between 11 June and 25 June 1993 using canopy traps (Hribar et al. 1991) for collecting the horse flies. Four baits were evaluated and dispensed in the following manner: 4:1:8, in polyethylene sachets (Brady & Griffiths 1993); 3 ml octenol, in reaction vials (octenol-R) in the "wick out" position (French & Kline 1989); 100 ml acetone, in a jar with a 6 mm diam hole in the lid; and octenol in a sachet (octenol-S). Release rates for all delivery systems are given by French & Kline (1989) and Phelps & Holloway (1992). Each dispensing device was placed into a 0.9 liter canning jar located at the base of the center pole of the canopy trap. This method was used to avoid contaminating the cloth traps with chemicals. Each bait was used in two traps per day, for a subtotal of eight baited traps. Two unbaited traps served as controls, making a total of ten traps per day. Baits were rotated among traps daily so that every bait was used at every trap site. Baits were assigned to traps according to the SAS PLAN procedure (SAS Institute 1985). To avoid interference between baits, no less than 50 m separated any two traps (Inoue et al. 1973).

A second experiment, to evaluate phenols in the absence of undiluted octenol, was conducted over a 5-day period from 29 June to 7 July 1993. Four baits were evaluated:

acetone, 4:1:8 in sachets, 4:1:8 in acetone (1:50), and a commercially available pepper sauce (Tabasco®). Each bait was used in two traps per day, along with two unbaited control traps, for a total of ten traps per day. Acetone and 4:1:8 were released in the same manner as in the first experiment. The combination of 4:1:8 + acetone was released in the same manner as was acetone in the first experiment. Tabasco® sauce was placed into 5-ml reaction vials without lids. The pepper sauce was compared to previously described tsetse attractants as a control for enhanced trap efficacy due to irritation or insult of olfactory sensilla. As in the first experiment, each bait dispensing device was placed into a 0.9 liter canning jar which was then placed at the base of the center pole of the canopy traps. Assignment of baits to traps and placement of traps were accomplished in the same manner as in the first experiment.

Tabanid flies were sorted to species with the key of Tidwell (1973). Due to the difficulty of separating *Tabanus lineola* F. from *T. subsimilis* Bellardi, these species were identified as "*T. lineola* complex". Similarly, deer flies were not identified to species, although *Chrysops cursim* Whitney, *C. pudicus* Osten Sacken, and *C. univittatus* Macquart are known to occur at the WMA (Hribar & Foil 1994). Data were transformed as $X' = \ln(X+1)$ (Zar 1984) and analyzed by the SAS ANOVA procedure and the Ryan-Einot-Gabriel-Welsch multiple range test (SAS Institute 1985). Results were backtransformed as the antilogarithm minus 1 for presentation.

RESULTS

A total of 7,901 adult female tabanid flies was collected in the first experiment. *Tabanus fuscicostatus* Hine comprised 80.4% of the flies collected. Other species collected, in descending order of abundance, were: *Chrysops* spp. (6.3%), *T. lineola* complex (3.6%), *T. americanus* Forster (3.1%), *T. proximus* Walker (2.3%), *T. pallidescens* Philip (2.0%), and *T. limbatinevris* Macquart (1.7%). *Chlorotabanus crepuscularis* (Bequaert), *Leucotabanus annulatus* (Say), *T. equalis* Hine, *T. atratus* F., *T. molestus* Say, *T. stygius* Say, and *T. wilsoni* Pechuman each comprised less than 1% of the total catch. Analysis of variance revealed differences in numbers of flies caught in traps provided with different baits ($F = 4.26$; $df = 4, 50$; $P < 0.0048$) (Table 1). There was no site effect ($F = 1.17$; $df = 9, 50$; $P > 0.3324$), and no significant site \times bait interaction ($F = 1.08$; $df = 36, 50$; $P > 0.3925$). No statistical differences in numbers of flies collected were observed among octenol (R), octenol (S), and 4:1:8. Acetone was no more attractive to tabanids than were unbaited control traps.

TABLE 1. COLLECTION OF ADULT FEMALE TABANIDAE IN CANOPY TRAPS BAITED WITH OCTENOL (R = REACTION VIAL, S = SACHET RELEASE SYSTEM), PHENOLS, OR ACETONE.

Bait	Flies per Trap per Day ¹
Octenol-R	80.859 \pm 20.017a
Octenol-S	76.556 \pm 15.503ab
4:1:8	69.176 \pm 11.043abc
Acetone	43.791 \pm 10.232bc
Control	39.165 \pm 7.218c

¹Means \pm S.E. followed by the same letter are not significantly different according to the Ryan-Einot-Gabriel-Welsch multiple range test on $\ln(x+1)$ transformed data. Backtransformed means are presented.

TABLE 2. COLLECTION OF ADULT FEMALE TABANIDAE IN CANOPY TRAPS BAITED WITH PHENOLS, ACETONE, AND A COMMERCIAL PEPPER SAUCE.

Bait	Flies per Trap per Day ¹
4:1:8	10.145 ± 1.329a
4:1:8 + acetone	8.699 ± 4.623a
Tabasco ^R	3.623 ± 0.683b
Acetone	3.500 ± 0.722b
Control	2.662 ± 0.777b

¹Means ± S.E. followed by the same letter are not significantly different according to the Ryan-Einot-Gabriel-Welsch multiple range test on ln(x+1) transformed data. Backtransformed means are presented.

A total of 356 flies was collected in the second experiment. Most of these were *T. fuscicostatus* (45.2%) and *T. proximus* (25.6%). The remaining flies were *T. limbatinevris* (8.2%), *Chrysops* spp. (7.9%), *T. americanus* (5.9%), *T. lineola* complex (3.9%), *T. pallidescens* (2.3%), *L. annulatus* (0.8%), and *T. wilsoni* (0.3%). Analysis of variance revealed differences in numbers of flies captured per trap per day among baits ($F = 6.03$; $df = 4, 45$; $P < 0.0006$) (Table 2). The 4:1:8 mixture, whether in combination with acetone or not, was more attractive to tabanids than was acetone, Tabasco^R, or control traps.

DISCUSSION

Acetone, octenol, and phenols all apparently stimulate upwind flight by tsetse (Paynter & Brady 1993). The combination of octenol and phenols appears to be a flight stimulant for tsetse, whereas acetone may be more involved in eliciting visual responses to host silhouettes (Brady & Griffiths 1993).

Phenols serve two functions when attracting tsetse; they attract flies from a distance and increase trap-entering activity (Vale et al. 1988a). Phenols are the attractive component in buffalo urine (Hassanali et al. 1986), whereas octenol is found in the breath of oxen (Hall et al. 1984). Octenol may alert host-seeking female tabanids to the presence of a nearby host. Phenols, found in host urine, may indicate only that a host has been in the area recently, and may not necessarily still be available for a blood meal. The use of the 4:1:8 mixture did not permit separation of effects of octenol and phenols on tabanids. Phelps & Holloway (1992) found that 4-methylphenol was the more strongly attractive phenol, whereas 3-*n*-propylphenol was only weakly attractive to tabanids, and relative to 4-methylphenol, 3-*n*-propylphenol gave no significant increase in numbers of tabanids collected.

The similar response of tabanids in Louisiana to a 1:50 dilution of 4:1:8 in acetone and to undiluted 4:1:8 is consistent with reports of Phelps & Holloway (1992), who described similar results for *Atylotus agrestis* Wiedemann, *Haematopota nocens* Austen, *T. pallulus* Austen, and *T. unilineatus* Loew in Zimbabwe. The phenol mixture obviously is attractive to tabanids even in low concentrations. Dilution of 4:1:8 with acetone does not affect the attractiveness of 4:1:8 to tabanids, even at dilutions of 1:200 (Phelps & Holloway 1992).

The primary difference in numbers of flies collected in the two experiments is explainable in part to the flight period of most species of horse flies, which in southern Louisiana is highest in June (Leprince et al. 1991). This report of equivalent catch by traps baited with octenol released via reaction vial or polyethylene sachet should al-

low a transition to newer release devices which are much more user friendly and can be manipulated to influence release rates. The interaction of attractants for horse flies undoubtedly will provide many opportunities for study.

ACKNOWLEDGMENTS

We thank Glyn Vale, Zimbabwe Department of Veterinary Services, and R. J. Phelps, University of Zimbabwe, for supplying attractants and polyethylene sachet material. We also thank Kerny Sonnier and the staff of Louisiana Department of Wildlife and Fisheries District 6 and the Thistlethwaite heirs for allowing us to work at the Thistlethwaite Wildlife Management Area. Jorge R. Rey, University of Florida, reviewed and corrected the Spanish abstract. Approved for publication by the Director of the Louisiana Agriculture Experiment Station as manuscript no. 94-17-8255.

REFERENCES CITED

- BRADY, J. AND N. GRIFFITHS. 1993. Upwind flight responses of tsetse flies (*Glossina* spp.) (Diptera: Glossinidae) to acetone, octenol, and phenols in nature: a video study. *Bull. Entomol. Res.* 83: 329-333.
- FRENCH, F. E., AND D. L. KLINE. 1989. 1-octen-3-ol, an effective attractant for Tabanidae (Diptera). *J. Med. Entomol.* 26: 459-461.
- HALL, D. R., P. S. BEEVOR, A. CORK, B. F. NESBITT, AND G. A. VALE. 1984. A potent olfactory stimulant and attractant for tsetse isolated from cattle odours. *Insect Sci. Appl.* 5: 335-339.
- HASSANALI, A., P. G. MCDOWELL, M. L. A. OWAGA, AND R. K. SAINI. 1986. Identification of tsetse attractants from excretory products of a wild host animal, *Syn-cerus caffer*. *Insect Sci. Appl.* 7: 5-9.
- HRIBAR, L. J., D. J. LEPRINCE, AND L. D. FOIL. 1991. Design for a canopy trap for collecting horse flies (Diptera: Tabanidae). *J. American Mosq. Control Assoc.* 7: 657-659.
- HRIBAR, L. J., AND L. D. FOIL. 1994. Color and UV reflectance of canopy traps for collecting horse flies (Diptera: Tabanidae) in Louisiana. *Bull. Soc. Vector Ecol.* 19: 49-52.
- INOUE, T., K. KAMIMURA, AND M. WATAMABE. 1973. A quantitative analysis of dispersal in a horse-fly, *Tabanus iyoensis* Shiraki and its application to estimate the population size. *Res. Popul. Ecol.* 14: 209-233.
- LEPRINCE, D. J., L. J. HRIBAR, R. T. BESSIN, AND L. D. FOIL. 1991. Seasonal patterns of abundance of horse flies (Diptera: Tabanidae) from two sites in southern Louisiana. *Proc. Louisiana Acad. Sci.* 54: 10-18.
- PAYNTER, Q., AND J. BRADY. 1993. Flight responses of tsetse flies (*Glossina*) to octenol and acetone vapour in a wind tunnel. *Physiol. Entomol.* 18: 102-108.
- PHELPS, R. J., AND M. T. P. HOLLOWAY. 1992. Catches of Tabanidae in response to visual and odour attractants in Zimbabwe. *J. African Zool.* 106: 371-380.
- SAS INSTITUTE. 1985. SAS user's guide: statistics. Ver. 5 ed. SAS Institute, Cary, N.C. 956 pp.
- TIDWELL, M. A. 1973. The Tabanidae (Diptera) of Louisiana. *Tulane Studies Zool. Bot.* 18: 1-95.
- VALE, G. A., D. R. HALL, AND A. J. E. GOUGH. 1988a. The olfactory responses of tsetse flies, *Glossina* spp. (Diptera: Glossinidae), to phenols and urine in the field. *Bull. Entomol. Res.* 78: 293-300.
- VALE, G. A., D. F. LOVEMORE, S. FLINT, AND G. F. COCKBILL. 1988b. Odour-baited targets to control tsetse flies, *Glossina* spp. (Diptera: Glossinidae), in Zimbabwe. *Bull. Entomol. Res.* 78: 31-49.
- ZAR, J. H. 1984. Biostatistical analysis, 2nd ed. Prentice-Hall, Englewood Cliffs, N.J. 718 pp.