# Response of Tabanidae (Diptera) to natural and synthetic olfactory attractants

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ABSTRACT: The attraction of female tabanids to Malaise traps and canopy traps baited with aged horse urine, 1-octen-3-ol, or a combination of aged horse urine and acetone was studied in the Kopački rit Nature Park in Eastern Croatia. Malaise traps captured very few tabanids relative to canopy traps. The number of females of *Tabanus tergestinus* and *Haematopota pluvialis* collected from 1-octen-3-ol baited canopy traps differed significantly from traps baited with aged horse urine. However, the number of females of *Tabanus bromius*, *Atylotus loewianus*, and *Tabanus maculicornis* collected from canopy traps baited with 1-octen-3-ol and aged horse urine did not differ significantly. Canopy traps baited with aged horse urine collected significantly more *Tabanus sudeticus* than did traps baited with 1-octen-3-ol. Canopy traps baited with 1-octen–3-ol collected eight times more tabanids than unbaited traps, whereas canopy traps baited with aged horse urine and a combination of aged horse urine and acetone collected seven and four times as many tabanids, respectively, as did unbaited traps. It appears that 1-octen –3-ol and aged horse urine are very effective attractants for tabanids in this part of Europe. *Tabanus bromius* was the most abundant species with 53.14% in the sample collected by canopy traps. ***Journal of Vector Ecology* 30 (1): 133-136. 2005.**

*Keyword Index:* Tabanidae, attractant, canopy traps, Croatia.

## INTRODUCTION

Certain chemicals mimicking natural host odors are very often useful for collecting biting flies. The effectiveness of traps for collecting tabanids can be influenced greatly through the use of odor baits (Hall and Wall 2004). For instance, efficacy of tabanid traps has been shown to be increased by the addition of carbon dioxide (Roberts 1971, 1975, Mohamed-Ahmed and Mihok 1999) and octenol (1-octen-3-ol) (Long and French 1988, French and Kline 1989). Also, adding ammonia to octenol has elicited similar increases (French and Kline 1989, Hribar et al. 1992, Schreck et al. 1993, Hayes et al. 1993, Nilssen 1998, Kristensen and Sommer 2000). However, while some authors have reported increased catches using the above-mentioned attractants (Jaenson et al. 1991, Phelps and Holloway 1992, Schreck et al. 1993, Hayes et al. 1993, Foil and Hribar 1995, French and Hagan 1995, Nilssen 1998), Leprince et al. (1994) found no such effect. Besides these chemicals, some natural attractants are known, such as aged urine of ruminant animals (Okech and Hassanali 1990, Madubunyi et al. 1996, Mihok et al. 1996). Differential response to various olfactory attractants probably occurs among the genera and species of Tabanidae. Therefore, a field study was conducted that evaluated canopy traps and Malaise traps baited with either aged horse urine, 1-octen-3-ol, or a combination of acetone and aged horse urine for their attractiveness to tabanids in Eastern Croatia.

## MATERIALS AND METHODS

This study was conducted in the Tikveš Forest (N 45$^0$ 41' 46" E 018$^0$ 49'41") within the Kopački rit Nature Park in Eastern Croatia. The forest is mainly composed of common oak. Four greyish homemade linen Malaise traps were constructed according to Townes's (1962) design and additionally four homemade black-and- white canopy traps were constructed according to the design of Hribar et al. (1991). Malaise traps were 200 cm high and had four 100 cm wide and 100 cm high openings, which narrowed rapidly towards the top of the trap. Consequently, the openings at the top of the trap were only 10 cm wide. The canopy traps were larger than the Malaise traps. They were 250 cm tall with 120 cm wide openings, 80 cm above the ground level. Such a design, with the lower profile of traps and a quadratic shape of the trap opening, perhaps contributed to the large collections. The 160 cm long linen skirt of the canopy traps possibly ensured retention of horse flies in the internal space of traps and an easy flight upward into the collection cap. The upper half of the skirt (80 cm) was white, while the lower half (80 cm) was black. These eight traps were placed in pairs (one Malaise and one canopy trap) along the lightly-shaded edges of the forest. Each pair was about 400 m apart from the next closest pair. The distance between traps within a pair was about 10 m. The traps were baited with either aged horse urine, 1-octen-3-ol, or a combination of aged horse urine and acetone. Horses are not ruminants, yet they are besieged by tabanids and are clearly attractive hosts so that horse urine was used as an attractant. The horse urine was collected without undue effort before the evening feeding. The horse was stall-fed with leguminous plants (clover, red clover, clover trefoil, and oats). The urine was stored in a plastic bottle, then exposed to bacteria in air and aged for at least 14 days. Seven times, 1 liter of urine was collected from the same male horse. Each bait was used in two traps per day, which made a subtotal of six baited traps. Two unbaited traps served as control traps, making a total of eight traps per day. The baits were rotated among the traps daily, so that every bait was used at every trap site. Attractants were dispensed from glass vials with Styrofoam corks. A 10 cm long cotton wick protruded from the center of the cork to the outside. Vials were placed 50 cm below the top of the Malaise traps and 30 cm below the top of the canopy traps. Fresh attractants were placed at the beginning of each trapping period. Traps were baited separately with 4 ml 1-octen-3-ol, 40 ml aged horse urine, and 40 ml combination of aged horse urine and acetone (10 ml aged horse urine to 30 ml acetone).

The daily trapping period was between 7 a.m. and 7 p.m. A total of 60 samplings was made from the May to September 2004 (on May 6, June 17, July 17, August 15, and September 5). All trapped flies were preserved in ethanol. Identification and nomenclature followed that of Chvála et al. (1972) and Chvála (1988). Responses of tabanids to attractants were tested by $c^2$ analysis using the six most abundant species from the collections. Order of abundance among baits was analyzed via Kendall's tau coefficient (SPSS, Inc. 1998).

## RESULTS

A total of 10,539 specimens was collected, belonging to 22 species of tabanids grouped into the genera: *Chrysops*, *Atylotus*, *Hybomitra*, *Tabanus*, and *Haematopota* (Table 1). The four canopy traps collected 10,376 specimens; the other 163 specimens were collected by means of the four Malaise traps. The canopy traps collected 22 species of tabanids, whereas the Malaise traps collected eight species. So few flies were collected by Malaise traps that these data were not analyzed further.

The $\chi^2$ analyses of the trapping data for canopy traps revealed that each of the attractants (1-octen-3-ol, aged horse urine, and a combination of aged horse urine and acetone) significantly increased the number of tabanids collected in comparison to the number of tabanids collected in unbaited canopy traps ($\chi^2$ = 2,729.2, P < 0.05; $\chi^2$ = 2,495.0, P < 0.05; $\chi^2$ = 8,13.6, P < 0.05, respectively). The majority of tabanids, 39.25%, was collected from canopy traps baited with 1-octen-3-ol, whereas 36.86% were collected in traps baited with aged horse urine, and 18.78% were obtained from traps baited with combination of acetone and aged horse urine. Only 5.09% of the total collected was obtained from traps without an attractant. Canopy traps baited with 1-octen-3-ol collected significantly more *Tabanus tergestinus* and *Haematopota pluvialis* females than did traps baited with natural attractants (aged horse urine), (Table 1). The number of females of *Tabanus bromius*, *Atylotus loewianus*, and *Tabanus maculicornis* collected from canopy traps baited with 1-octen-3-ol and canopy traps baited with aged horse urine did not differ significantly (Table 1). However, the canopy traps baited with aged horse urine collected significantly more *Tabanus sudeticus* than did traps baited with synthetic attractants (1-octen-3-ol), (Table 1). *Tabanus bromius* comprised 53.14% of the horse flies collected by canopy traps, and this species was also the most abundant species collected by Malaise traps. The largest number of tabanids, 81.32%, was sampled during July and August (Table 2). Few tabanids were collected in May and June due to unfavorable climatic conditions (i.e., the long rainy season during spring). However, the average monthly temperature in spring was within normal limits for this time of year.

The rank order of the six most commonly collected tabanid species was most different between the traps baited with octenol and those baited with a combination of horse urine and acetone (Table 3). *T. bromius* and *T. sudeticus* were collected first and second most commonly by both attractants, but the other four species, *A. loewianus, T. tergestinus, T. maculicornis,* and *H. subcylindrica*, differed markedly in their rank order (Table 1).

## DISCUSSION

The Malaise traps used in this study were relatively ineffective for trapping tabanids; canopy traps collected 64 times more tabanids than did Malaise traps. In the present investigation, canopy traps baited with 1-octen-3-ol or aged horse urine were the best collection methods for tabanids. Canopy traps baited with aged horse urine attracted 20 species, followed by 1-octen-3-ol with 19 species, the combination of aged horse urine and acetone with 15 species, and the unbaited control trap with 11 species. The present study showed that 1-octen –3-ol is an effective attractant for *T. tergestinus* and *H. pluvialis*. In contrast, aged horse urine is very effective for the collecting of *T. sudeticus*. However, the results with 1-octen –3-ol and aged horse urine are very similar and not significant for the following species: *T. bromius*, *A. loewianus*, and *T. maculicornis*. The differences among the six most abundant species could be attributed to interspecific differences in the responses of tabanids to attractants. Cow urine and African buffalo urine are attractants owing to bacteria that convert trace chemicals in the urine to phenolic compounds that attract many species of tabanids (Okech and Hassanali 1990, Madubunyi et al. 1996). The combination of aged horse urine and acetone in the same vial can be a useful attractant because it collected four times more tabanids than control traps. However, the lower numbers of tabanids collected relative to horse urine alone suggests that there is some repellant or inhibitory effect by urine and acetone. It may be that addition of the acetone kills any bacteria that may be present or alters the composition of the urine in some way. Finally, the present study showed that 1-octenol-3-ol or aged horse urine alone had best effect on the catch of tabanids in canopy traps. Little is known about the usefulness of urine as an attractant for tabanids. It may prove interesting to compare the attractant properties of urine of other animals, such as pigs and goats, to that of horses.

Table 1. List of total numbers of horse flies sampled by means of canopy traps baited with 1-octen-3-ol, aged horse urine, or by combination of aged horse urine and acetone.

| Species | 1-octen-3-ol | Horse urine | Acetone + horse urine | Control | Species totals | $\chi^2$ |
|---|---|---|---|---|---|---|
| *Tabanus bromius* L | 2211 | 2122 | 901 | 280 | 5514 | 1.82 |
| *Tabanus sudeticus* Zeller | 769 | 892 | 454 | 153 | 2268 | 9.10* |
| *Atylotus loewianus* (Villeneuve) | 306 | 285 | 170 | 36 | 797 | 0.74 |
| *Tabanus tergestinus* Egger | 264 | 168 | 133 | 27 | 592 | 21.22* |
| *Tabanus maculicornis* Zetterstedt | 198 | 192 | 184 | 13 | 587 | 0.08 |
| *Haematopota pluvialis* (L.) | 215 | 78 | 47 | 15 | 355 | 64.0* |
| *Hybomitra ciureai* (Séguy) | 38 | 35 | 25 | 1 | 99 | NA |
| *Haematopota subcylindrica* Pandellé | 17 | 10 | 5 | 1 | 33 | NA |
| *Tabanus autumnalis* L. | 10 | 14 | 8 | 0 | 32 | NA |
| *Tabanus bovinus* L. | 14 | 5 | 10 | 1 | 30 | NA |
| *Hybomitra bimaculata* (Macquart) | 6 | 7 | 6 | 0 | 19 | NA |
| *Chrysops viduatus* (Fabricius) | 6 | 4 | 2 | 0 | 12 | NA |
| *Atylotus rusticus* (L.) | 1 | 4 | 2 | 1 | 8 | NA |
| *Chrysops relictus* Meigen | 2 | 3 | 0 | 1 | 6 | NA |
| *Haematopota italica* Meigen | 5 | 1 | 0 | 0 | 6 | NA |
| *Hybomitra acuminata* (Loew) | 2 | 1 | 1 | 0 | 4 | NA |
| *Hybomitra ukrainica* (Olsufjev) | 3 | 0 | 1 | 0 | 4 | NA |
| *Haematopota pandazisi* Kröber | 3 | 1 | 0 | 0 | 4 | NA |
| *Hybomitra muehlfeldi* (Brauer) | 3 | 0 | 0 | 0 | 3 | NA |
| *Chrysops caecutiens* (L.) | 0 | 1 | 0 | 0 | 1 | NA |
| *Hybomitra solstitialis* (Meigen) | 0 | 1 | 0 | 0 | 1 | NA |
| *Haematopota ocelligera* (Kröber) | 0 | 1 | 0 | 0 | 1 | NA |
| $\sum$ 22 | 4,073 | 3,825 | 1,949 | 529 | 10,376 | |

*Significant differences ($P < 0.05$), NA – Not analyzed.

Table 2. Total number of Tabanidae collected monthly by four canopy traps during 2004.

| Attractants/Month | May | June | July | August | September |
|---|---|---|---|---|---|
| 1- octen-3-ol | 0 | 723 | 1607 | 1680 | 63 |
| Aged horse urine | 0 | 527 | 1649 | 1631 | 18 |
| Aged horse urine + acetone | 0 | 505 | 669 | 737 | 38 |
| Control | 0 | 61 | 284 | 181 | 3 |
| $\sum$ | 0 | 1816 | 4209 | 4229 | 122 |

Table 3. Kendall's tau values for six most commonly collected species of Tabanidae.

| Attractant | Octenol | Urine | Acetone + urine | Control |
|---|---|---|---|---|
| Octenol | | | | |
| Urine | 0.733 | | | |
| Acetone + urine | 0.600 | 0.867 | | |
| Control | 0.867 | 0.867 | 0.733 | |

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