Responses of Horse Flies (Diptera: Tabanidae) to Jersey Bullocks and Canopy Traps Baited with Ammonia, Octenol, and Carbon Dioxide

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J. Med. Entomol. 31(5): 729–731 (1994)

ABSTRACT The attraction of females of six species of tabanids to stanchioned Jersey bullocks, unbaited canopy traps, and canopy traps baited with either octenol (1-octen-3-ol), ammonia (NH_4OH), a combination of ammonia and octenol, or 5 kg of dry ice (CO_2) was studied. A randomized Latin square design (treatments × sites × days) was used. Species diversity and number of flies captured in canopy traps unbaited or baited with octenol, ammonia, or the combination of octenol and ammonia did not differ significantly. Females of *Tabanus americanus* Forster, *T. fuscicostatus* Hine, and *T. lineola* F. were captured more frequently in CO_2-baited canopy traps than on Jersey bullocks, but the reverse was observed for females of *Leucotabanus annulatus* (Say). The number of females of *T. pallidescens* Philip and *T. wilsoni* Pechuman collected from CO_2-baited canopy traps and bullocks did not differ significantly.

KEY WORDS attractant, olfaction, kairomone

EFFICACY OF TABANID TRAPS can be increased by the addition of carbon dioxide (CO_2) (Wilson et al. 1966, Roberts 1975), octenol (French & Kline 1989, Schreck et al. 1993), and ammonia (Hribar et al. 1992). Although the use of some olfactory attractants with tabanid trapping devices is more economical and practical to operate than animal baits, there is a discrepancy between the relative abundance and species diversity collected by these methods. This difference, unrelated to the reproductive status of the flies (Leprince et al. 1992), may reflect interspecific differences in response of tabanids to different olfactory attractants. Because octenol- and ammonia-baited tabanid traps have not been compared simultaneously with bait animals, the objective of this study was to evaluate the abundance and species diversity of tabanids feeding on Jersey bullocks with catches of canopy traps unbaited or baited with ammonia, CO_2, octenol, or the combination of ammonia and octenol.

Materials and Methods

Sampling Site and Collection Procedures. The collections were made daily from 10 to 21 June 1991 at six different sites separated by >1 km at the Thistlethwaite Wildlife Management Area in central Louisiana (Foil et al. 1989). Two 6 × 6 Latin square designs were used to account for the effects of sampling days, treatments, and sampling sites. Each treatment appeared once at each sampling site and once each sampling day. The treatments were two stanchioned Jersey bullocks (10–11 mo old) oriented perpendicular to each other and separated by 5 m, an unbaited canopy trap (Hribar et al. 1991), canopy traps baited with octenol (1-octen-3-ol), ammonia (ammonium hydroxide [NH_4OH]), both ammonia and octenol, or 5 kg of CO_2 (dry ice). In the first experiment, tabanids were identified to species while feeding on bullocks, then marked with latex paint on the thorax, and allowed to fly away after engorgement (Foil et al. 1992). In the second experiment, individual tabanids were collected in plastic cups after they initiated feeding on bullocks, identified to species, and then placed in an ice chest. The time when each fly was collected or painted was recorded. Both Latin square experiments shared the five canopy trap treatments and were conducted on alternate days.

Octenol was dispensed from a 5-ml microreaction vial with a plastic cap and a pipe cleaner wick protruding through the rubber septum (Kline et al. 1991). Ammonia was released from a 20-ml patent lip vial filled with 18 ml of solution, with a wick protruding through a parafilm membrane. Vials were suspended 36 cm below the apex of the canopy traps, and new vials and fresh solutions were replaced daily at 0600 hours. The

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Table 1. Average number of tabanids attracted to Jersey bullocks, unbaited canopy traps (control), or canopy traps baited with either 5 kg of dry ice, ammonia (NH_4), 1-octen-3-ol (Octenol), or the combination of ammonia and 1-octen-3-ol (NH_4-Oct)

Species	Treatment	Bullock	Canopy traps				
			Dry ice	Octenol	NH_4-Oct	NH_4	Control
T. americanus	Collected	3.083a	8.268b	0.194c	0.040c	0.000c	0.000c
	Painted	3.395a	6.379a	0.306b	0.159b	0.064b	0.040b
T. fuscicostatus	Collected	3.467a	36.757b	3.753a	5.998a	2.864a	3.477a
	Painted	2.105a	24.763b	3.395a	4.012a	3.305a	2.041a
T. lineola	Collected	3.315a	28.992b	0.167c	0.213c	0.000c	0.079c
	Painted	1.979a	19.654b	0.079c	0.122c	0.122c	0.000c
T. pallidescens	Collected	2.690a	3.009a	0.064b	0.000b	0.079b	0.064b
	Painted	1.970a	3.022a	0.039b	0.220b	0.039b	0.039b
T. wilsoni	Collected	2.974a	2.388a	0.039b	0.039b	0.080b	0.000b
	Painted	1.735a	1.566a	0.080b	0.123b	0.039b	0.000b
L. annulatus	Collected	2.204a	0.080b	0.039b	0.080b	0.000b	0.080b
	Painted	0.821a	0.193b	0.000b	0.000b	0.000b	0.000b
No. species	Collected	5.494a	5.534a	1.418b	1.253b	1.259b	1.167b
	Painted	4.656a	5.301a	1.326b	1.560b	1.140b	0.937b

Tabanids feeding on bullocks were either collected in plastic cups or painted and allowed to fly away after engorgement. Results are expressed as number of flies or species collected over a 3-h period. Averages followed by the same letter in the same row are not significantly different ($P > 0.05$).

CO_2-baited canopy trap site was baited daily at 9, 12, and 15 h with ≈5 kg of dry ice.

Statistical Analyses. An analysis of variance (ANOVA) procedure (SAS Institute 1988) was used on transformed data $\log_{10}(x + 1)$ to compare treatment effects. Replicates used in the ANOVA were restricted to flies collected daily during 3-h periods (ending at 12, 15, and 18 h) that matched tabanid collection from bullocks. The number of tabanid species also was compared for each period and treatment. Averages were backtransformed to their arithmetic values minus one for the presentation of results.

Results

In total, 5,309 tabanids belonging to four genera and 13 species were collected from 10 to 21 June 1991. Species and their relative abundance by decreasing order of magnitude were *Tabanus fuscicostatus* Hine (47.90%), *Tabanus lineola* F. (26.35%), *Tabanus americanus* Forster (10.77%), *Tabanus pallidescens* Philip (6.55%), *Tabanus wilsoni* Pechuman (4.88%), *Leucotabanus annulatus* (Say) (1.71%), *Tabanus proximus* Walker (0.57%), *Tabanus trimaculatus* Palisot de Beauvois (0.36%), *Whitneyomyia beatifica atricorpus* Philip (0.36%), *Tabanus atratus* F. (0.30%), *Tabanus equalis* Hine (0.15%), *Hybomitra lasiophthalma* (Macquart) (0.08%), and *Tabanus sulcifrons* Macquart (0.02%). The six most abundant species were included in the analysis of variance along with the number of species per treatment.

Except for *T. americanus* in the bullock and CO_2-baited canopy trap treatments, results of the ANOVA were similar whether feeding flies were painted or collected from bullocks (Table 1). Mean number of flies and mean number of species collected from unbaited canopy traps and from canopy traps baited with ammonia, octenol, or the combination of ammonia and octenol were similar (Table 1). CO_2-baited canopy traps collected significantly more *T. fuscicostatus* females than any other treatment (Table 1). Numbers of flies collected in CO_2-baited canopy traps were significantly higher than numbers of flies collected from bullocks for *T. fuscicostatus* and *T. lineola*, but the reverse phenomenon was observed for *L. annulatus* (Table 1). Numbers of females of *T. pallidescens* and *T. wilsoni* and the average species diversity were significantly higher in CO_2-baited canopy traps and Jersey bullocks than in any other treatment; no significant differences were detected between these two treatments (Table 1).

Discussion

Under these experimental conditions, CO_2-baited canopy traps and collection from bullocks were the best collection methods for horse flies. The average number of females of *T. fuscicostatus* and *T. lineola* collected in CO_2-baited canopy traps was 8.5-fold greater than that of flies feeding on bullocks. The CO_2-baited canopy trap is a good surveillance tool for monitoring the host-seeking activity of tabanids because it is easy to use and can be operated at a lower cost than an animal bait. In this study, the CO_2-baited traps emulated or outperformed the recorded activity of the most troublesome tabanid species feeding on bullocks. However, abundance among different tabanid species collected from bullocks and with CO_2-baited canopy traps differed in this study. This difference was reported previously and does not appear to be associated with the reproductive status or size of the flies (Leprince et al. 1992). Such differences could be attributed to interspecific differences in the responses of tabanids to attractants, a difference in the trapping efficiency for different species collection methods, or a combination of both. Interspecific variations in the response of tabanids to CO_2 has been demonstrated (Roberts 1971, Leprince 1989).

Our experiment was not designed specifically to test for aggregation behavior among feeding tabanids, but the similarity between the mean number of flies allowed to feed to repletion (painted) on bullocks and the mean number of flies collected as they initiated their blood meal on bullocks (the five most abundant species) (Table 1) does not suggest the production of aggregation pheromones by feeding tabanids. This is contrary to feeding male bont ticks, *Amblyomma hebraeum* Koch, which emit an aggregation-attachment pheromone that helps unfed ticks to discriminate between hosts on which these parasites have fed successfully and those on which they have not (Norval et al. 1989).

Ammonia (Hribar et al. 1992) and octenol (French & Kline 1989, Schreck et al. 1993) were previously reported as effective baits for canopy traps, but no significant effects of these compounds or their combination were detected during this study. Although the release systems for octenol and ammonia were similar to those described in previous work (French & Kline 1989, Hribar et al. 1992), none of the species studied herein responded to these compounds. The study reported here emphasizes that volatile chemicals described as attractants for certain tabanid species in certain geographic regions may be ineffective for different tabanid species or under different environmental conditions.

Acknowledgments

We are grateful to Kerney Sonnier and his staff of the Department of Wildlife and Fisheries, District 6, and the Thistlethwaite heirs, for allowing us to use the facilities at the Thistlethwaite Wildlife Management Area. We thank E. Chris, D. Coleman, and A. Pecquet for their assistance. This paper was supported in part by USDA grant 89-34103-4251 and approved for publication by the director of the Louisiana Agricultural Experiment Station as manuscript no. 93-17-7355.

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Received for publication 16 December 1993; accepted 14 March 1994.