SHORT DURATION DRY ICE SAMPLING FOR AMERICAN DOG TICKS (ACARI: IXODIDAE) IN MARYLAND: A COMPARISON WITH DRAGGING

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ABSTRACT

On eight of 18 sampling dates, significantly more ($p < 0.05$) American dog tick, *Dermacentor variabilis* (Say), adults were found on or within 0.3 m of cotton sheets, baited with dry ice for 2 h, than on an equal number of unbaited sheets. Overall 4 times more ticks were at the baited sheets than the controls. Dragging vegetation in old fields, along woods edges and dirt roads and within woods, for ca. 16 of the 20 m between dry ice baits collected > 3 times more ticks than the dry ice; significantly more ($p < 0.05$) ticks on nine of the 18 sampling dates and never significantly ($p < 0.05$) fewer. On two of 18 sampling dates, dry ice baits attracted no ticks while ticks were found by dragging and on three sampling dates dry ice catches were < 3% of the corresponding drag catches. Dragging the same transects the day before or after dry ice sampling caught as many ticks as on the sampling days. No immature *D. variabillis* were collected by the dragging or dry ice method. In this study dragging was more reliable, faster, (one visit to a transect instead of two), and easier (lighter equipment) than short duration dry ice sampling. Neither method collected more than one tick in 32 samples in wooded areas.

Key Words: American dog tick, *Dermacentor variabilis*, dry ice sampling, dragging

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INTRODUCTION

Over the past 25 years carbon dioxide (CO_2) has been widely used as an attractant for sampling field populations of ticks (Garcia 1962, 1965, Semtner and Hair 1975, Gladney 1978, Eads et al. 1982, Gray 1985), with particular success with the lone star tick, *Amblyomma americanum* (L.) (Wilson et al. 1972, Koch and McNew 1981, 1982). The use of dry ice for slow release of CO_2 gas has proven popular not only for its effectiveness (e.g., Koch and McNew 1982, Gray 1985), but its simplicity.

The American dog tick, *Dermacentor variabilis* (Say), is common in the mid-and south-Atlantic states, where it is the primary vector of Rocky Mountain spotted fever (Sonenshine et al. 1966). Although *D. andersoni* Stiles has been effectively attracted to CO_2 traps in the western U.S., (Garcia 1965, Eads et al. 1982), reported catches of *D. variabilis* have not been impressive (Semtner and Hair 1975). Small populations of *D. variabilis* in the areas sampled could account for the small CO_2 trap catches, as Semtner and Hair (1975) suggested. The purpose of the present study was to see if short duration use of dry ice baits, as reported by Garcia (1965) and Koch and McNew (1982), would attract *D. variabilis* reliably and in sufficient numbers to warrant using dry ice baits in favor of the cloth drag or flag, a traditional method for sampling for adult American dog ticks (Sonenshine et al. 1966).

METHODS

Based on the techniques of Koch and McNew (1982), transects (260 to 300 m long) of bait sites were established in old fields and along woods edges and dirt roads in Charles, Kent, Montgomery and Prince George's Counties, Maryland. There were 12 or 14 (two instances) stations 20 m apart per transect and each station consisted of two white cotton sheets (57 by 74 cm) spread 2 m apart on the ground cover. On the center of one sheet of each pair was set a 700-900 g block of dry ice. When spreading the sheets and placing the dry ice, vinyl gloves and plastic wrist-to-elbow sleeves were worn to prevent contamination of over-hanging vegetation with skin oils or perspiration. Two h after the baits were set out, I examined both sides of the sheets, as well as over-hanging vegetation and vegetation within ca. 0.3 m of the sheets for ticks. Also, I brushed my hand and forearm through the vegetation within 0.3 m of the sheets to pick up any questing ticks that might have been overlooked. Nine different transects were thus sampled once, three twice and one three times (i.e., 18 sampling dates, 222 pairs of samples) May to August 1985 and 1986. Sampling was done on one moderately breezy day and one cloudy day; the remainder were at least partly sunny with slight breezes. Temperatures ranged from 22 to 33°C.

On eight sampling dates (all different sites) four pairs of CO_2-baited and unbaited sheets were placed in woods adjoining the transect concurrently being sampled. The sheets were placed the same distances apart as on the transects, and at least 20 m from the edges of the woods. Two h after the sheets were set out they were checked for ticks.

To ascertain the comparable effectiveness of drag sampling for the same areas sampled by dry ice baits under the same conditions, I dragged each open transect and short woods transects when I checked the bait stations. A 1 m^2 flannel sheet with a chain hemmed in the trailing edge, a board (2.5 cm by 2.5 cm by 1 m) hemmed in the leading edge, and a pull rope attached to the board, was dragged in approximately a straight line from one bait station to the next. The area within 2 m of either control or baited sheets was not dragged. An additional 8 m were dragged beyond the last pair of sheets at each end of a transect.

To determine whether the presence of the CO_2 baits affected drag catches six transects were dragged in a manner similar to that just described, 1 week or less before or after the transects were sampled with baits. The distances dragged and between drags were paced off and the drag samples were taken on days on which weather conditions were similar to those of the CO_2 sampling. Numbers of ticks at baits, controls and caught on the drag were analyzed by Student's t test.

RESULTS

In total, there was greater than 4-fold more ticks on and within 0.3 m of the sheets baited with dry ice than on the unbaited controls in the transects in more open areas (133:31, respectively). For the wooded stations only one tick each was found at the baited and unbaited sheets. On only three of 18 sampling dates (all different transects), the mean number of ticks per sample exceeded one, and then it averaged less than two (Table 1). On eight of 18 sampling dates, significantly more ($p < 0.05$) ticks were found at the CO_2 baits than the controls on the transects (Table 1). No immature *D. variabilis* or any stage of any other species of tick were ever found on any sheet or on the drag cloth.

Dragging the transects yielded more than three times as many ticks as the baits overall (438:133, respectively). On nine of 18 sampling dates, significantly more ($p < 0.05$) and never significantly fewer ($p < 0.05$) ticks were collected by dragging than were at dry ice baits (Table 1). On some occasions dragging and CO_2 sampling gave extremely dissimilar results with dragging collecting many more ticks (e.g., 76, 42, 34 by dragging, 0, 1, 1 by dry ice on 2 July, 30 July, 2 August, 1985, respectively). In the woods only one tick was collected by dragging, and none with the dry ice. Numbers of ticks found by dragging when CO_2 baits were being used did not differ significantly ($p < 0.05$) from those found when the same transects were dragged a few (< 7) days before or after.

DISCUSSION

The numbers of *D. variabilis* adults attracted to dry ice baits in this study approximated those reported by Semtner and Hair (1975) at CO_2 traps operated for 3 h in Oklahoma. Semtner and Hair (1975) compared CO_2 samples with sweep sampling. Each sample consisted of 180° sweep with a standard 38.5 cm beating net per pace for 50 paces. They found that in prairie habitats both methods were similarly effective, but that the net was difficult to use in heavy brush and thorny vegetation. In the present study, on a sample by sample basis and on a date by date basis, dragging appeared to be at least equivalent, if not superior, to dry ice sampling for 2 h periods in catching ticks. Not only did dragging collect ticks on dates when CO_2 sampling attracted none, but the reverse never occurred. Furthermore, on some occasions, dragging caught so many more ticks as to arouse suspicion that the dry ice samples seriously misrepresented *D. variabilis* abundance (Table 1). Because the number of ticks caught per drag sample is related to the length of the drag route, I chose a length (16 m) which seemed short enough (less than the 50 paces of Semtner and Hair [1975]) so as not to unfairly bias comparisons of sample catches toward dragging.

No *D. variabilis* larvae or nymphs were caught by dragging or baiting in this study or in that of Semtner and Hair (1975). However, Garcia (1965) collected *D. andersoni* larvae and nymphs at dry ice baits. As Koch and McNew (1982) suggested regarding *A. americanum* larvae, many dry ice samples per area are needed to catch larvae because their rate of travel is much slower than that of adults. More sampling in April and May, when host-seeking by immatures is high (Sonenshine et al. 1966) might have increased the probability of collecting larvae or nymphs. Longer duration sampling, such as the 24 h sampling (Wilson et al. 1972) for *A. americanum* or that used by Gray (1985) to sample *Ixodes ricinus* L. for periods up to 7 days, may catch *D. variabilis* larvae and nymphs and prove more reliable in sampling adult populations. However, Gray (1985) opined that the usefulness of dry ice sampling may be limited to areas of high tick density.

Dragging consumed less time than dry ice sampling, because only a single walk through a transect was needed instead of two (one to set out baits and a second to check results). Less physical effort was expended in dragging than dry ice sampling, because the latter required carrying a heavy load of dry ice which in this case may have been somewhat heavier than needed (Koch and McNew 1982). In all except the densest vegetation, a drag or flag can be used if it is carried in front of one like a skirt.

Table 1. Mean numbers of *D. variabilis* adults at dry ice baits, at unbaited controls, and collected on drag sheets.*

		$\bar{x}$ No. Ticks Per Sample					
Location	Date	Dry Ice (± SE)	Coeff. of var. (%)	Unbaited Control (± SE)	Coeff. of var. (%)	Drag (± SE)	Coeff.of var. (%)
Little Bennett, Trans. II†	May	0.67 ± 0.31a	160.96	0 ± 0	0.0	0.58 ± 0.23	135.94
Patuxent, Transect VII†	May	0.67 ± 0.28a	147.71	0 ± 0	0.0	1.25 ± 0.51	141.16
Patuxent, Transect I	June	0.50 ± 0.29a	200.00	0.08 ± 0.08	346.41	0.75 ± 0.30	140.70
Patuxent, Transect II	June	1.67 ± 0.56a	121.81	0.08 ± 0.08	346.41	0.92 ± 0.26	98.22
Poolesville	June	0.92 ± 0.40	150.43	0.25 ± 0.25	346.41	5.08 ± 1.06b	72.38
Patuxent, Transect II	June	0.50 ± 0.23	159.54	0.42 ± 0.19	195.40	0.67 ± 0.31	160.96
Millington	June	0.50 ± 0.19	160.45	0.33 ± 0.26	266.29	0.67 ± 0.26	133.14
Patuxent, Transect I	June	0.75 ± 0.39a	180.91	0 ± 0	0.0	3.67 ± 1.06b	100.26
Little Bennett, Trans III†	June	0.25 ± 0.18	248.63	0 ± 0	0.0	0.33 ± 0.14	147.71
Patuxent, Transect III	July	0 ± 0	0.0	0.08 ± 0.08	346.41	6.33 ± 1.63b	89.15
Patuxent, Transect IV‡	July	1.50 ± 0.36a	89.63	0.14 ± 0.14	347.17	3.21 ± 0.92b	107.20
Patuxent, Transect V†	July	0.75 ± 0.33a	157.76	0.17 ± 0.11	233.55	1.00 ± 0.35	120.60
Cedarville†	July	1.42 ± 0.42a	101.89	0.33 ± 0.33	190.31	2.17 ± 0.27b	43.27
Patuxent, Transect VI†	July	0.33 ± 0.22	233.55	0.17 ± 0.11	233.55	1.33 ± 0.58	151.13
Patuxent, Transect III†	July	0.08 ± 0.08	346.41	0.08 ± 0.08	346.41	3.42 ± 0.80b	81.32
Patuxent, Transect IV	July	0.25 ± 0.13	180.91	0.33 ± 0.14	147.71	1.25 ± 0.33b	91.05
Little Bennett, Trans. I†	Aug	0.08 ± 0.08	346.41	0 ± 0	0.0	2.83 ± 0.78b	94.98
Patuxent, Transect IV‡	Aug	0 ± 0	0.0	0 ± 0	0.0	0.42 ± 0.15	123.58

* Dry ice blocks of 700-900g emitting CO_2 for 2 h, and 16m pass of $1m^2$ cloth drag between bait stations. Means followed by letters "a and b" are significantly greater ($p < 0.05$, Student's t test) than unbaited control or dry ice bait, respectively, for same sample date.

† An additional four samples were taken in wooded habitats adjacent to these transects. No ticks were found at the dry ice baits, one at the unbaited control and one on the drag cloth in the woodland sampling.

‡ Fourteen samples, all others 12 samples.

From a qualitative standpoint, i.e., detecting the presence of *D. variabilis* adults in an area, dragging seems preferable to short duration dry ice sampling, but the question remains on which technique provides better data for population estimates. Wilson et al. (1972), Sutherst et al. (1978), and Gray (1985) felt that CO_2 sampling gave more reliable data for estimating populations of some species of ticks than did dragging because data sometimes fluctuated. The results of this study indicate that short duration dry ice sampling for American dog tick adults is not particularly reliable either. Sonenshine et al. (1966) suggested 8% as the fraction of the population of American dog ticks collected on a drag sample. However, until a mark and recapture study, similar to that conducted by Koch (1987) on *A. americanum* with dry ice baits, is done with *D. variabilis,* it will be difficult to predict which technique provides more reliable population estimates. Thus, the combined use of both techniques is recommended.

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