

Availability and Nature of Commercial Tick Control Services in Established and Emerging Lyme Disease Areas of New Jersey

Terry L. Schulze, PhD; Robert A. Jordan, PhD; and Robert W. Hung, MS

ABSTRACT

A preliminary survey of a community where Lyme disease was hyperendemic showed that a significant number of households hired pest control firms to control ticks. However, the availability and nature of commercial tick control services for residential property across New Jersey has not been studied.

Questionnaires pertaining to tick control services were mailed to all registered pest control firms in established (Monmouth County) and emerging (Hunterdon County) Lyme disease areas in New Jersey. Of the 208 registered firms in Monmouth County, 63 (30.4%) responded, 30 of which offered tick control services. In Hunterdon County, 15 of 34 (44.1%) registered firms responded to the survey, with 9 offering tick control programs. All firms in both counties relied on acaricides as the principal control method, although 30.0% and 55.6% in Monmouth and Hunterdon

Counties, respectively, claimed to offer non-chemical alternatives. In both counties, *Ixodes scapularis* Say nymphs were targeted most frequently, although the majority of firms also made applications against other life stages. Regardless of county, woodland edge was the site treated most frequently, while wooded areas received the fewest applications. Most firms treated a combination of sites. Carbaryl, chlorpyrifos, and cyfluthrin were the most commonly used acaricides, and were often used in combination. The majority of firms in both counties charged less than \$150 to treat a 1.0 acre (0.4 ha) property.

The frequency of application and the sites targeted for treatment suggest that many firms lack an understanding of basic tick ecology and the role that each life stage plays in disease transmission.

Key words: *Ixodes scapularis*, acaricides, Lyme disease, control

BACKGROUND

Early epidemiological investigations identified Monmouth County as the principal focus of Lyme disease in New Jersey, accounting for 54.7% ($n = 117$) of all reported cases between 1978 and 1982.^{1,2} By the end of the 1980s, Monmouth County alone reported 365 of the state's 1,633 Lyme disease cases (22.4%) and averaged 30.4 cases annually during that period. Between 1990 and 1995, 614 additional cases were reported in Monmouth

County, with a yearly average of 102.3 cases (Schulze, unpublished data). As such, Lyme disease has been established in Monmouth County for well over a decade.

Although the average number of cases each year in Monmouth County during the 1990s has increased over 3-fold compared to the 1980s, Monmouth County accounted for only 9.3% of Lyme disease cases statewide between 1990 and 1995. This disparity is due, in large part, to the emergence of Lyme disease in a number of northern counties, most notably Hunterdon County. By the end of the 1980s, only 33 Lyme disease cases were reported from Hunterdon County, representing only 2.0% of all cases reported in New Jersey during that period. However, Hunterdon County has experienced a significant increase in the number of Lyme disease cases between 1990-1995, with 1,395 cases or 21.2% of the

From the Division of Communicable Diseases, New Jersey Department of Health and Senior Services, Trenton, NJ.

Address correspondence to Terry L. Schulze, PhD, 9 Evergreen Court, Perrineville, NJ 08535.

state total ($n = 6,588$) during this period. The average number of cases reported annually has risen from about 2.8 during the 1980s to 232.5 during 1990-1995 (Schulze, unpublished data). This 83-fold increase in case reporting makes Hunterdon County one of the fastest emerging Lyme disease areas in the nation. The black-legged tick, *Ixodes scapularis* Say (*I. dammini* Spielman, Clifford, Piesman, and Corwin³) is now well established in both Monmouth and Hunterdon Counties.⁴

Despite the fact that Lyme disease is the most important vector-borne disease in the United States,^{5,6} and the majority of transmission is believed to be peridomestic,^{7,9} little is known about the availability and nature of commercial tick control services. As part of a tick control study in a hyperendemic community,¹⁰ 18% of 50 surveyed households reported hiring commercial pest control firms to provide chemical tick control services at least once per year. Stafford conducted the only comprehensive study of tick control services to date.¹¹ However, that state wide study concentrated as much on the business profile of pest control firms as it did on the nature of actual tick control services, and did not fully probe regional differences in tick control services within the state. This study emphasized collection of information on commercial tick control services available to homeowners and attempted to identify differences in these services between established and emerging Lyme disease areas. The need for expanded professional training and public education programs is discussed.

MATERIALS AND METHODS

Lists of registered pest control firms operating in Monmouth and Hunterdon Counties were obtained from the Pesticide Control Program, New Jersey Department of Environmental Protection. Each firm in Monmouth County ($n = 208$) and Hunterdon County ($n = 34$), were sent a letter of introduction and questionnaire about tick control services in 1995. The survey instrument was limited to 10 questions designed to elicit information about control techniques against *I. scapularis*, including acaricides and formulations used, sites of application, frequency of application, alternative control methods, and application costs.

RESULTS

Survey response: Monmouth County

Of the 208 registered pest control firms, 63 (30.3%) returned the questionnaires. There were 12 (5.8%) questionnaires returned with no forwarding address, suggesting that the firms were no longer in business. Of the 63 firms that responded, 30 (47.6%) indicated that they offered tick control services. These 30 firms answered all

questions pertaining to tick control services and acaricide use, but 9 (30.0%) declined to provide information about fees charged for applications.

Survey response: Hunterdon County

In Hunterdon County, 15 of the 34 (44.1%) registered pest control firms completed and returned questionnaires. Of the 15 respondents, 9 (60.0%) claimed to offer tick control services. These 9 firms responded to all questions pertaining to tick control services and acaricide use, while 4 (44.4%) failed to respond to questions regarding fees.

Tick control services: Monmouth County

Of the 30 firms surveyed, 24 (80.0%) provided tick control services as part of a lawn care-landscaping package. All 30 firms relied on acaricides as the principal method of control, but 9 (30.0%) offered nonchemical alternatives, principally in the form of tick habitat removal and distribution of educational materials. Only 8 of 30 (26.7%) attempted to survey properties for ticks prior to application.

Regarding the frequency of application, 8 (26.7%) firms treated residential properties only once. Of these, 6 firms directed their applications against nymphs, while 1 firm each treated for adults or larvae only. Four of 30 (13.3%) firms made applications against *I. scapularis* nymphs and larvae. There were 14 (46.7%) firms that made applications against each life stage and would make applications at the request of the homeowner. Two additional firms admitted that they would perform acaricide applications only at the request of the homeowner. The remaining 2 firms reported treating on a monthly basis from March through November. Of the 30 firms, 26 (86.7%) directed control efforts against nymphs, 20 (66.7%) at larvae, and 17 (56.7%) targeted adults (Fig 1).

Of the 30 firms polled, 27 (90.0%) reported making applications to the woodland edge, 23 (76.7%) to lawns, 22 (73.3%) to landscaping, and 4 (13.3%) to woodland (Fig 2). However, most of the applications were made to various combinations of sites: 4 (13.3%) firms treated all possible sites, while the largest percentage of firms (43.3%) treated a combination of woodland edge, lawn, and landscaping; 4 (13.3%) firms treated the woodland edge and lawn; 3 (10.0%) the woodland edge and landscaping; 2 (6.7%) the woodland edge, landscaping, and woodland; and 1 (3.3%) lawn and landscaping. Of the remaining 3 firms, 2 (6.7%) treated the woodland edge exclusively, while 1 (3.3%) treated only lawns.

Tick control services: Hunterdon County

Of the 9 firms performing tick control in Hunterdon County, 6 (66.7%) offered these services as part of a lawn care-landscaping package. All 9 firms relied on

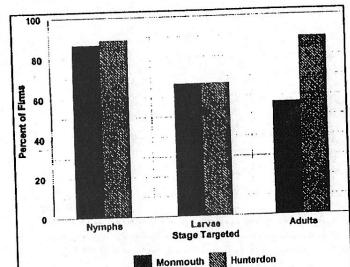


Fig 1. Frequency of acaricide applications by stage of *I. scapularis*: Monmouth County v. Hunterdon County.

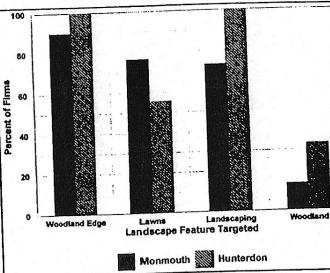


Fig 2. Frequency of acaricide applications by landscape feature: Monmouth County v. Hunterdon County.

acaricides as the principal method of control, while 5 (55.6%) provided nonchemical alternatives, including habitat modification, education, and rodent control. Only 1 firm (11.1%) attempted to survey properties for ticks prior to acaricide application.

Regarding the frequency of application, 1 firm (11.1%) treated residential properties once; 6 firms (66.7%) made applications against all active stages of *I. scapularis*; and 4 of 9 (44.4%) indicated that they also treated at the request of the homeowner. Two (22.2%) firms treated against nymphs and adults, but 1 also indicated it would make applications at the request of the property owner. Overall, of the 9 firms, 8 (88.9%) directed control efforts against nymphs, 6 (66.7%) at larvae, and 8 (88.9%) treated for adults (Fig 1).

All 9 firms reported making applications to the woodland edge and landscaping: 5 (55.6%) to lawns, and 3 (33.3%) to woodland (Fig 2). However, most of the applications were made to various combinations of sites. All possible sites were treated by 3 (33.3%) firms, while the largest percentage of firms (44.4%) treated a combination of woodland edge and landscaping. Two firms (22.2%) treated the woodland edge, landscaping, and lawn.

Acaricide usage: Monmouth County

The most commonly applied acaricide was carbaryl, being used by 19 of 30 (63.3%) firms. Chlorpyrifos was used by 16 (53.3%) firms, while cyfluthrin was used by 5 (16.7%). Permethrin, cyhalothrin, bendiocarb, trichlorfon, and fluvalinate were each used by 1 firm. There were 16 of 30 (53.3%) firms that indicated they used a combination of up to 3 acaricides, the most common

combination being carbaryl and chlorpyrifos ($n = 9$). The remaining firms used a single acaricide, with carbaryl ($n = 6$) and chlorpyrifos ($n = 6$) being the most popular choices. Host-targeted permethrin (Damminix, EcoHealth, Boston, MA) was used by 3 (10.0%) firms.

With respect to formulation, 22 of 30 (73.3%) firms used liquid formulations (wettable powder, flowable, emulsifiable concentrate) exclusively or in combination with granular formulations. Granular formulations alone or in combination with liquids were used by 21 of 30 (70.0%) firms. There were 13 of 30 (43.3%) firms that used a combination of granular and liquid, while 9 of 30 (30.0%) firms used liquid formulations only, and 8 (26.7%) used granular materials exclusively.

Acaricide usage: Hunterdon County

The most commonly used acaricide by Hunterdon County respondents was carbaryl, which was used exclusively or in combination by 5 (55.6%) firms. Chlorpyrifos, cyfluthrin, and permethrin were each used by 2 (22.2%) firms. Cyhalothrin, cypermethrin, bendiocarb, and pyrethrum were each used by 1 firm. There were 5 (55.6%) firms that used a combination of up to 4 acaricides, with no 2 firms using the same combination. Host-targeted permethrin was used by 2 (22.2%) firms.

With respect to formulation, all 9 firms used liquid formulations exclusively or in combination with granular formulations. Three of 9 (33.3%) firms used granular formulations alone or in combination with liquids. Three of 9 (33.3%) used a combination of granular and liquid, while 6 (66.7%) firms used liquid formulations only and 3 (33.3%) used granular formulations exclusively.

Of the 30 firms offering tick control services, 9 (30.0%) declined to provide information on fees charged to the homeowners for acaricide applications. The 21 firms that responded provided 13 different treatment charges ranging from \$80 to \$280 per acre (0.4 ha). The mean charge was \$159.05 per acre; 13 (61.9%) of the 21 firms charged less than \$150 per acre.

Application costs: Hunterdon County

Of the 9 firms offering tick control, 4 (44.4%) did not provide information on fees charged to the homeowners for acaricide applications. The 5 firms that responded reported fees ranging from \$90 to \$180 per acre. The mean charge was \$113 per acre. Only 1 firm charged more than \$150 per acre.

DISCUSSION

Survey response

Although the Connecticut survey¹¹ and this study approached data collection in a different fashion, both received a similar level of response. Stafford opted to survey all licensed applicators statewide and received a response rate of 38.8%.¹¹ In New Jersey, individual firms were polled in an effort to avoid certain biases. It was felt that surveying individual applicators rather than firms, would skew the resulting data in favor of larger firms with more applicators and, presumably, more extensive training programs. Stafford showed that larger firms tended to be more likely to offer tick control services than smaller firms.¹¹ Nevertheless, the level of response was similar in Monmouth (30.3%) and Hunterdon (44.1%) Counties. Surprisingly, only 16.4% of the 348 respondents in the Connecticut study offered tick control services, compared to 47.6% of the 30 responding firms in Monmouth County and 60.0% of the 15 firms from Hunterdon County. The seemingly greater availability of commercial tick control services in New Jersey may reflect the fact that both Monmouth and Hunterdon Counties are highly endemic for Lyme disease, whereas the Connecticut survey may have combined data from endemic and nonendemic areas. Since Monmouth County has 5 times the population of Hunterdon County, the difference in the number of registered firms between the counties was expected.

Tick control services

All firms offering tick control services in both Monmouth and Hunterdon Counties relied on acaricides, a finding similar to that reported by Stafford in Connecticut.¹¹ In Monmouth and Hunterdon Counties, 70.0% and 55.6%, respectively, relied on acaricides exclusively. The majority of Monmouth County (80.0%)

and Hunterdon County (66.7%) firms offered tick control as part of a more comprehensive pest control package.

The frequency of application varied dramatically within and between counties. In Monmouth County, the number of applications ranged between once per year to monthly for 8 months. Nearly one-half of the firms made applications against all life stages and over one-half would treat at the owner's request, regardless of the seasonal activity of a particular life stage. Nymphs were targeted most frequently (86.7%), but two-thirds of the firms made applications against larvae and over one-half treated properties to control adult ticks. In Hunterdon County, application frequency ranged between 1 and 3 applications per year, with two-thirds of the firms making applications against each life stage and 55.6% of firms treating at the owner's request. Nymphs and adults were targeted by 88.9% of the firms.

Stafford reported that 61.4% of Connecticut applicators treated areas upon the owner's request.¹¹ Significantly fewer Connecticut applicators targeted each life stage, compared to New Jersey, but admitted to treating properties more than 2 times during the summer months. Nearly twice as many applicators in Connecticut surveyed for ticks before making applications compared to Monmouth County firms, and 4 times more often than those offering tick control services in Hunterdon County.

Regarding the sites of application, 90% of the Monmouth County firms treated the lawn-woodland edge interface. About 75% of firms treated lawns and landscaping, while only 13.3% treated woodland. In Hunterdon County, all firms treated woodland edge and landscaping, with lawns and forests being included as target areas by 55.6% and 33.3% of firms, respectively. In both counties, the majority of firms treated a combination of sites. Connecticut applicators treated the lawn-woodland border (60.62%) and lawn (greater than 25%) less frequently compared to New Jersey firms.

Surveys of Connecticut applicators and New Jersey firms revealed that a variety of insecticides were used. However, the same compounds (carbaryl, chloryprifos, cyfluthrin) were used most frequently in both studies, but the ranking of use was different. Monmouth county firms used liquid (73.3%) and granular (70.0%) formulations with similar frequency, while Hunterdon County firms seemed to prefer liquid formulations. Connecticut applicators also preferred liquid over granular formulations. Only a small percentage of applicators or firms used host-targeted permethrin.

The per acre costs for tick control were similar in both studies, although the range of fees was broader and the mean fee was higher in Connecticut. It is unclear whether the wide disparity in costs reflect a tick only application (high) or general pest control package application (low).

The majority of applicators or firms charged less than \$150 per acre.

Assuming that property owners are interested primarily in disease prevention, the frequency of application and the sites targeted for treatment seem to suggest that many firms lack an understanding of basic tick ecology and the role that each life stage plays in the transmission of tick-borne pathogens. For example, two-thirds of the firms made applications to control *I. scapularis* larvae, a stage that has little or no role in disease transmission¹² and is considered the most difficult stage to control.¹³ Over 75% of Monmouth County firms and more than 50% of Hunterdon County firms routinely treated lawns (Fig 2), despite the fact that large expanses of lawn generally are not recommended for treatment.¹⁴ Further, 80% of Monmouth County firms and 66.7% of Hunterdon County firms offered tick control as part of a broader pest control package. As such, tick control in Monmouth County may have become more of an ancillary activity achieved largely through the control of other pests, compared to Hunterdon County, where Lyme disease is considered emergent. Although the apparent excessive treatment may be due, in part, to the respective firms' lack of knowledge of tick ecology and management techniques, it is interesting to note that the majority of respondents admitted that they would treat at the request of the property owner, regardless of tick activity. This suggests that sound tick control practices may be in conflict with existing business practices. As a partial solution, pest control operators engaged in tick control services should receive training regarding tick ecology, assessment, and management techniques as part of the pesticide applicator re-certification process. In addition, government agencies charged with Lyme disease education should expand their mandate to include the preparation and distribution of materials on proper frequency and appropriate sites of application to the general public. Such an approach will enhance the efficacy of tick control, while limiting the amount of acaricides applied to the environment.

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