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REVIEW ARTICLE

CURRENT CONCEPTS

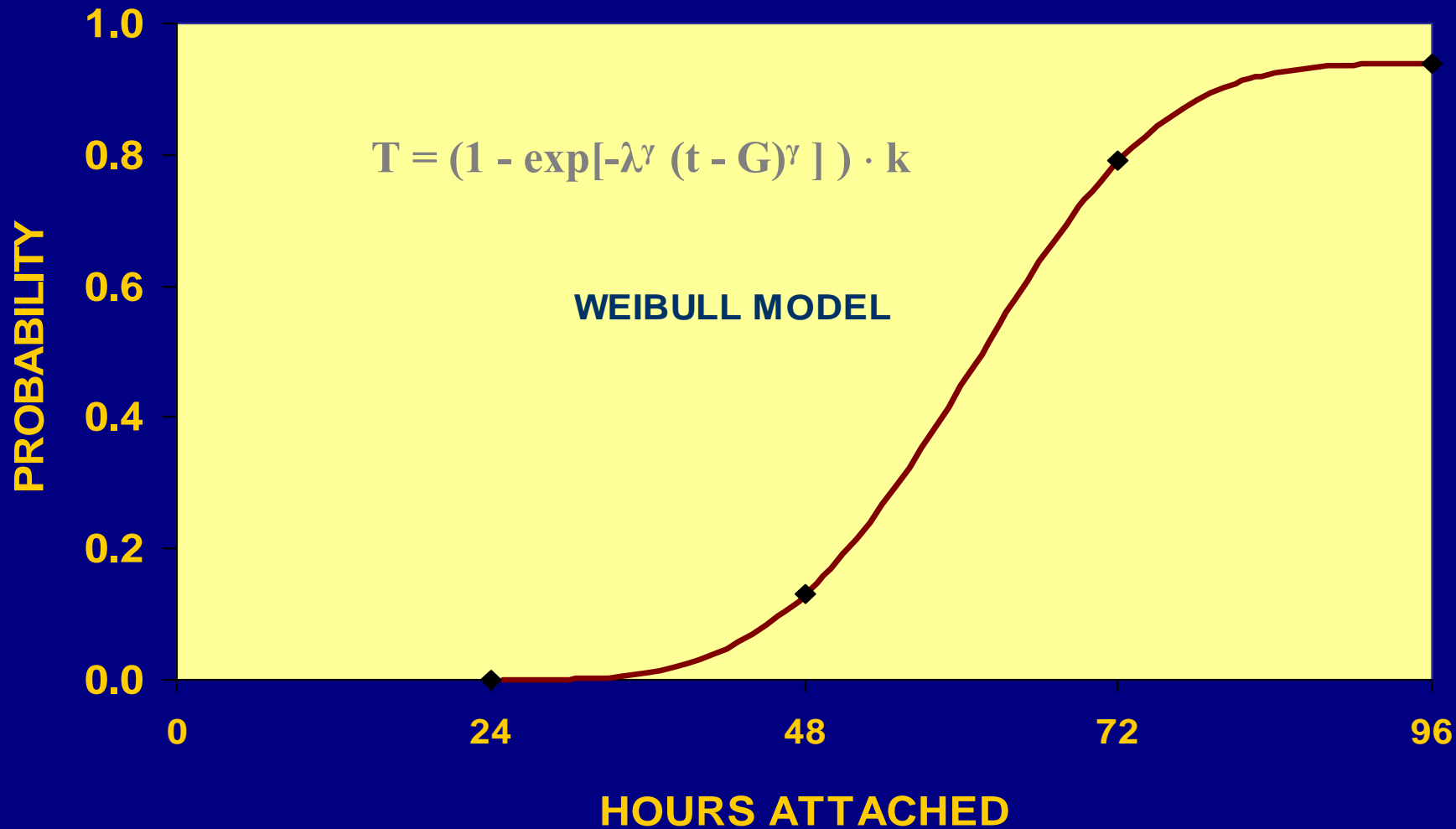
How Can We Prevent Lyme Disease?

Edward B. Hayes, M.D., and Joseph Piesman, D.Sc.

WHERE DO WE GO FROM HERE IN THE POST VACCINE LD ERA

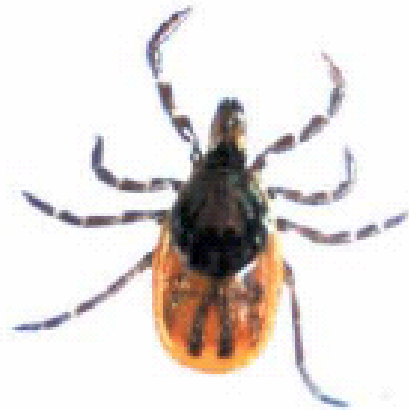
- Prevention based on prompt detection of ticks & removal, prophylactic treatment, and personal protection
- Public education campaigns
- TICK CONTROL

CUMULATIVE PROBABILITY OF *B. burgdorferi* TRANSMISSION FOR EACH HOUR ATTACHED





A. americanum



I. scapularis



D. variabilis

1 mm



Unengorged



Engorged

I. scapularis nymph

Figure 2. Adult Female *Amblyomma americanum* (Lone Star Tick), Adult Female and Nymphal *Ixodes scapularis* (Deer Ticks), and Adult Female *Dermacentor variabilis* (Dog Tick).

Prophylaxis with single-dose doxycycline

- Nadelman et al. NEJM 2001
- 200 mg single dose, N = 482 patients
- Efficacy of treatment was 87%, if tick removed was a bloodfed nymphal *I. scapularis*
- Unclear how widely accepted by MD community
- Studies at CDC on slow-release gel formulations of doxycycline vs oral Rx

“Tick control represents a small but growing part of the [pest management] professional’s business. The application of acaricides for the control of *I. scapularis* is a relatively recent service [which corresponds] to an increase in tick abundance and and increase in the number of Lyme disease cases.”

J. Med. Entomol. 1997

Pesticide Use by Licensed Applicators for the Control of *Ixodes scapularis* (Acari: Ixodidae) in Connecticut

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J. Med. Entomol. 34(7): 859-858 (1997)

ABSTRACT To assess the use of insecticides for tick control by Connecticut, a questionnaire was mailed to 897 individuals and 6 soil and turf pesticide applicator licenses. In total, 348 completed surveys. The majority of the respondents considered themselves lawn care or tree care (12.6%) providers. Tick control services were offered to respondents, all of whom apply insecticides for tick control, mainly to lawns. Over half ($n = 33$) also treat for the American dog tick, *De long*. Since respondents (86.7%) began applying pesticides for the control of ticks, the period from 1993 to 1996. The principal acaricide used for tick control was chlorpyrifos 2nd ($n = 15$), carbaryl 3rd ($n = 12$), and fluralone 4th. When asked about what other pesticides were used for tick control, the respondents listed the principal alternatives. Past success with a product was the dominant factor, but information provided by the Connecticut Agricultural Experiment Station (University of Connecticut, Storrs), was also important. Half of the respondents (49.1%) indicated that their tick control business increased slightly or dramatically since 1991, although tick control represented only 63.1% of these applicators' overall business. Residential property was the primary business for half of those treating for ticks, and the median charge for tick control was \$43.85. Respondents (43.8%) also indicated that they planned to expand their tick control business. Tick control represents a small but growing business in Connecticut.

KEY WORDS *Ixodes scapularis*, control, insecticides, Lyme disease



Photograph: Kirby Stafford

Area-wide acaricides

- Chemicals like carbaryl, cyfluthrin, fulvalinate, permethrin, deltamethrin etc. can give 68-100% control of nymphal *I. scapularis*, BUT
- Surveys in CT, MA, NJ, NY show only ca. 1/3 of homeowners willing to use them
- Need other options to offer

Leaf Litter Removal



Landscape Barriers



In trials at homes in Old Lyme, CT, removing leaf litter at yard edges reduced nymphal ticks on the lawn by an average of 49.1-69.5%

Stafford, K.C., 1995-1998. unpubl. data

Removing leaf litter from wooded areas in a forested NJ residential community reduced nymphal ticks by an average of 74.9-77.3%.

Schulze et.al. 1995. J. Medical Entomology 32:730-733.

In trials at homes in Old Lyme, CT, from 1995-1998 (n = 5), a wood chip barrier reduced nymphal ticks on yards by an average of 35.3-76.6%.

Stafford, K.C., 1995-1998. unpubl. data

Landscape management

- Extremely labor intensive and costly
- Not practiced for tick control *per se*
- In principle, one of the most popular control methods in KAP surveys, but homeowners willingness to pay for tick control may be hurdle

Host reduction

- Deer reduction practiced in some communities in CT, NJ, NY. Politically complex except in island or settings with large blocks of privately owned land
- Monhegan Is., ME deer eradicated 1996-1999. 2003 questing adult population 1/28 of original; no immatures on rats.
- Deer fencing (black mesh, almost invisible) becoming more popular-extremely expensive
- Rodent reduction or vaccine?

Host-targeted approach to tick control

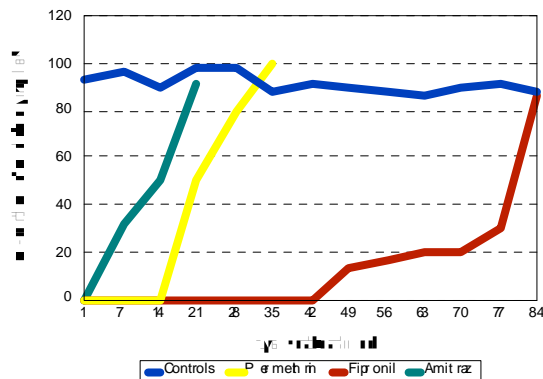
- Damminix (permethrin treated cotton balls; *Peromyscus* only)
- Fipronil treated bait boxes; EPA approval in 2003
- 10% permethrin (Y-TeX Corp) approved by EPA on 4-poster deer treatment devices. Not within 100 yards of residences.

Summary of Colorado Fipronil Studies

- **Laboratory Results**

- Fipronil protected mice (killed all ticks for 42d) 3 times longer than permethrin and >6 times longer than amitraz

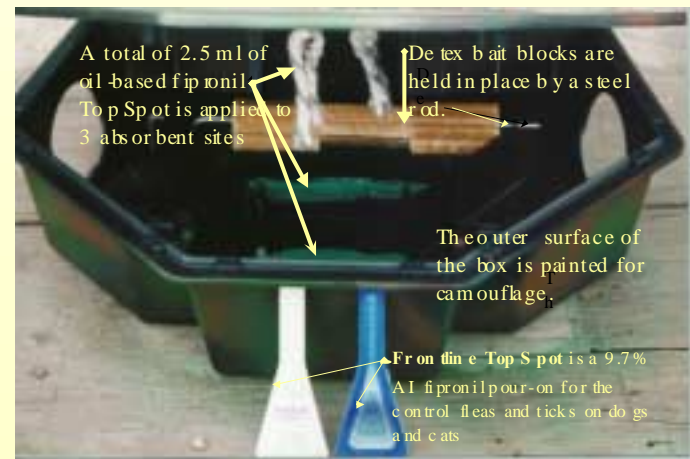
Fig. 1. Susceptibility of *I. scapularis* nymphs to topical applications of permethrin, fipronil and amitraz.



* - # replicate nymphs on treated mice / # replicate nymphs on control mice

- **Field Trial Results**

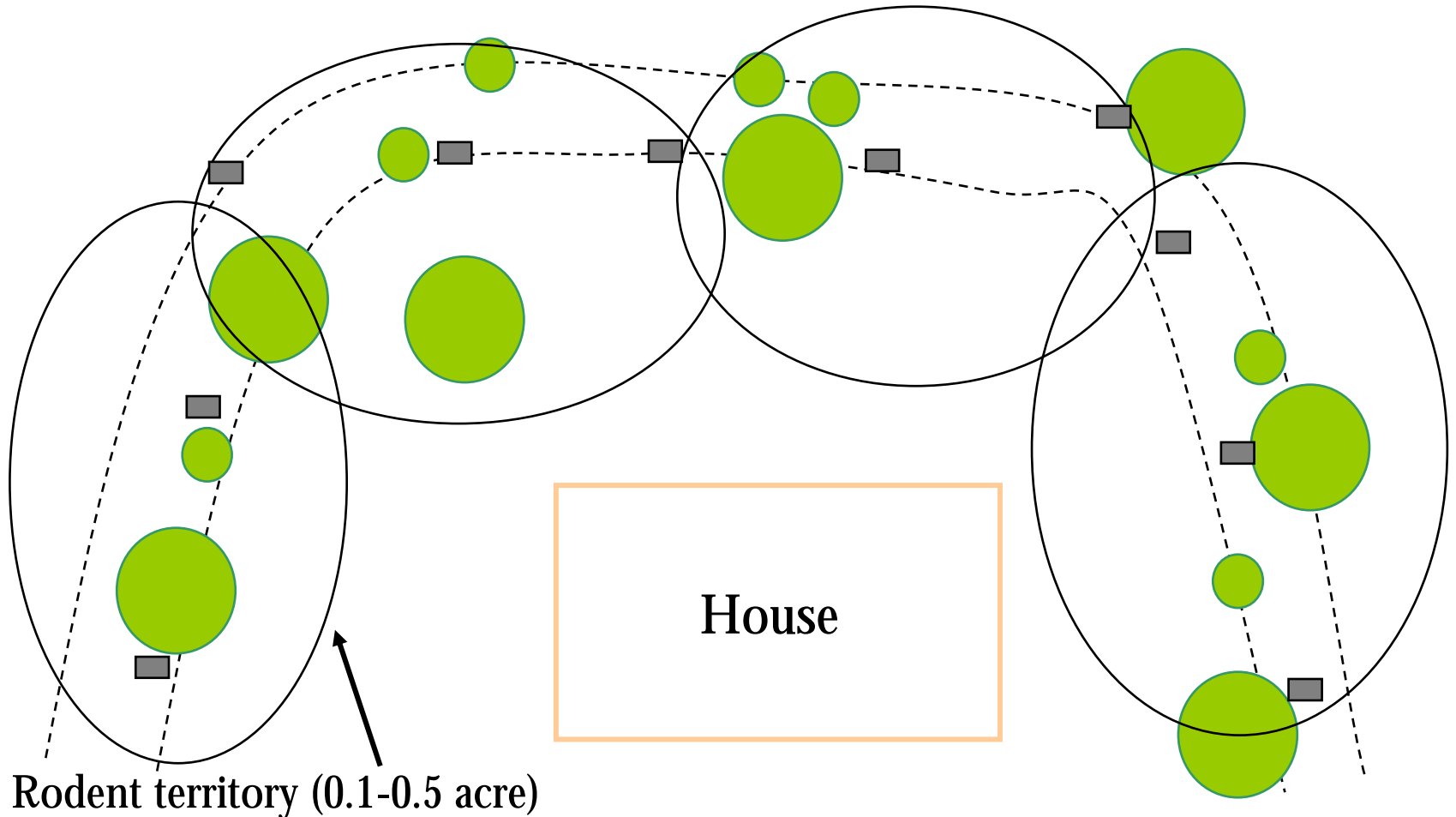
- Fipronil passively applied to wood rats with bait boxes reduced ticks > 90% during study and through 8 weeks after treatment was terminated.





Bait Box Placement

10 stations around home or one every 30 feet
where wooded area meets the lawn



Latest Developments with Bait Boxes

- 1999-2003: Design changes in type of bait, box design, and wick design
- On Mason's Island, 50-86% tick reduction; reduced infection in ticks and mice
- Variable results in community based projects in CT, MA, NY, NJ as design changed
- Promising design for 2004 (input from T Schulze, G Maupin, and M Dolan)



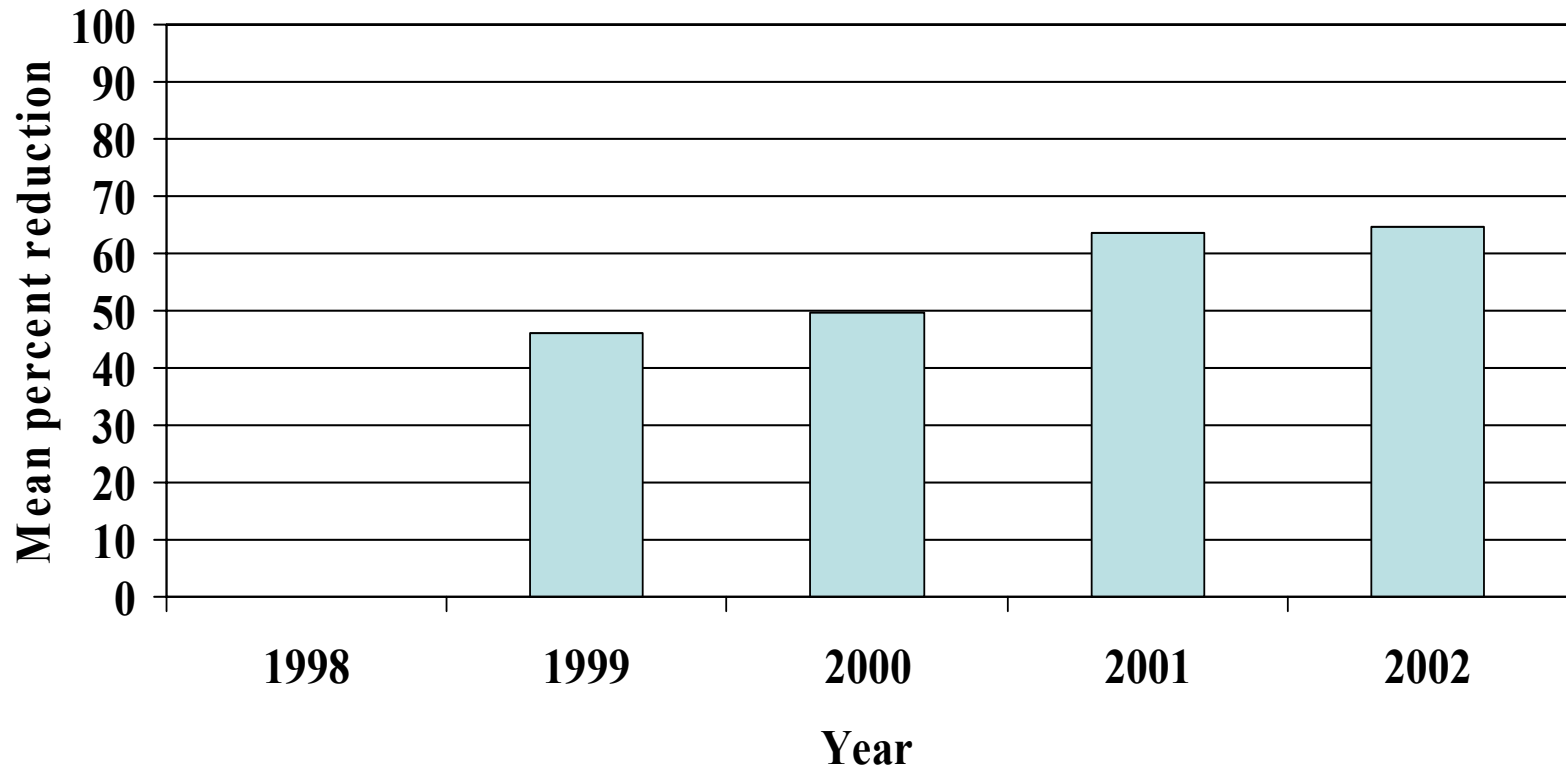
Northeast Regional Tick Project

Acaricidal Treatment of Deer for Tick Control

- A five year, five state (RI, CT, NY, NJ, MD) project funded by the USDA ran from fall 1997 – spring 2002
- Test topical treatment of white-tailed deer with 2% amitraz for control of *I. scapularis* on deer using the '4-poster'
- 22-25 devices at each core site of about 2 sq. mi.
- Tick populations compared with similar control area



Trend in Nymphal Reduction (CT)



BIOLOGICAL CONTROL

- FUNGAL PREPARATIONS
- Some are approved for use against ticks
- Problems with mass production, consistency in spore quality between batches, conditions for use
- NATURAL FOREST PRODUCTS: CCD/OSU. Extracts from trees highly effective acaricides. Repellents?

**INTEGRATED CAMPAIGNS ARE
GOING TO BE THE WAY TO
PREVENT LYME DISEASE IN
THE FUTURE**

