

# THERMACELL®

## Thermacell Testing Methods

Presented by:

**Dr. Ben McMillan, Sr. Biologist**

Georgia Mosquito Control  
Association, 46th Annual Meeting.  
Jekyll Island, GA

# Agenda

1. Test Designs
2. Published Product Efficacy
3. Q&A



# Our Mission

We liberate people who love the outdoors from the harmful effects of insects.

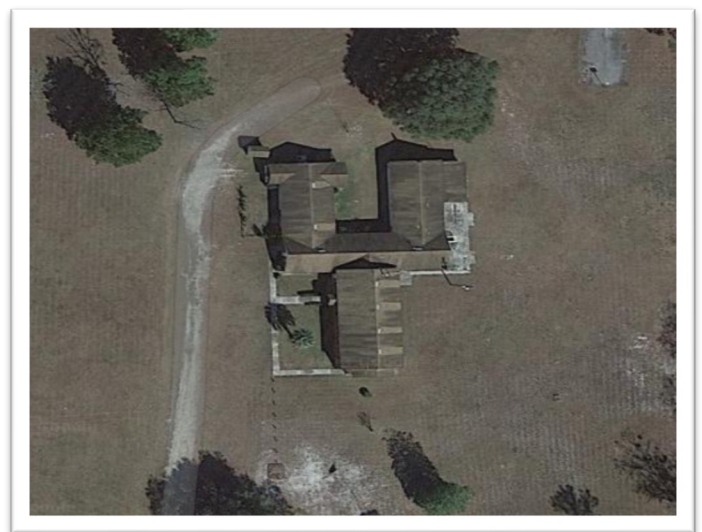


# Growing Team of 140+!

+8 Engineers  
+4 Entomologists  
+2 Chemists



Headquarters & Engineering Laboratory  
Boston, MA



Entomology Center (*under construction*)  
Gainesville, FL



Chemistry Laboratory & Production Facility  
Atlanta, GA



Distribution Center  
Atlanta, GA

# THERMACELL®



## BRINGING PORTABILITY TO CONSUMER PRODUCTS

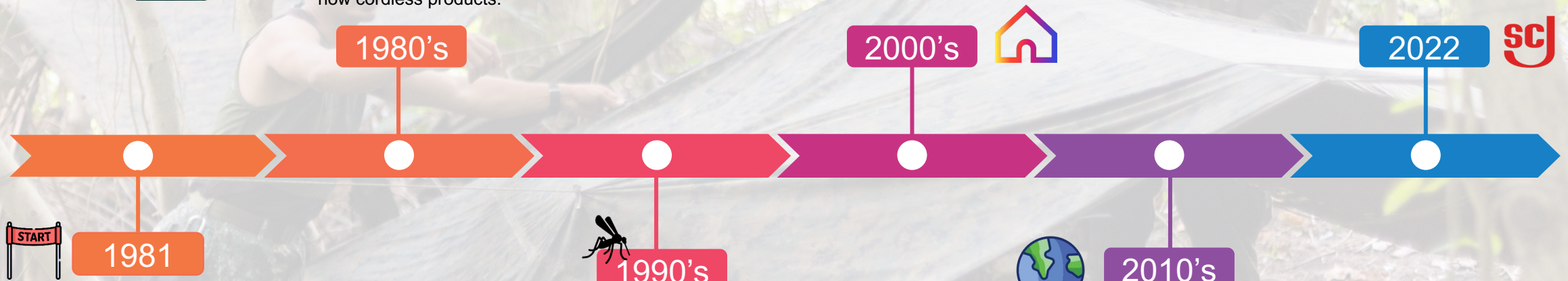
The team imagined a power source that would set people free from power cords. This innovation became the Thermacell Fuel Cartridge, utilizing butane to power a range of now cordless products.

## A MOSQUITO FIGHTING REVOLUTION BEGINS

A portable, heat-activated repellent that was silent and scent-free became a must-have for outdoor adventurers. Campsites and the backwoods were only the beginning. Soon, homeowners found Thermacell, giving them reliable protection.

## SC JOHNSON ACQUISITION

Thermacell becomes a part of the SCJ brand family to accelerate liberating people who love the outdoors from the harmful effects of insects.



1981

## THE BEGINNING OF THERMACELL

Founder Bill Schawbel was an executive at Gillette who bought a portion of the Gillette company to run as his own.



1990's

## THE NEW TARGET: MOSQUITOES

Bill and his development team worked tirelessly to perfect a heat activated mosquito repellent device. Thermacell Mosquito Repeller hit the market in 1999.



2010's

## THERMACELL AROUND THE WORLD

From Australia to Sweden, you'll find Thermacell at work across the globe. As our footprint expands, so does our technology. In 2018, we introduced the first rechargeable mosquito repeller.

2022



# Taking our expertise in technology to the next level

Protecting precious outdoor moments

## HOW FAR WE'VE COME...

Heat-based portable CPG



Before '99

New Target: Mosquitoes



1999

Improving product features



2013

Expansion to outdoor living & launching rechargeable line



2018

Launching first Lighted Electric Repeller



2023

## WHAT COMES NEXT?



Innovation pipeline that drives **adoption**, elevates **experience** and expands **use occasions**



Prominently-featured claims that **break through barriers** to penetration



Skin Feel



Efficacy

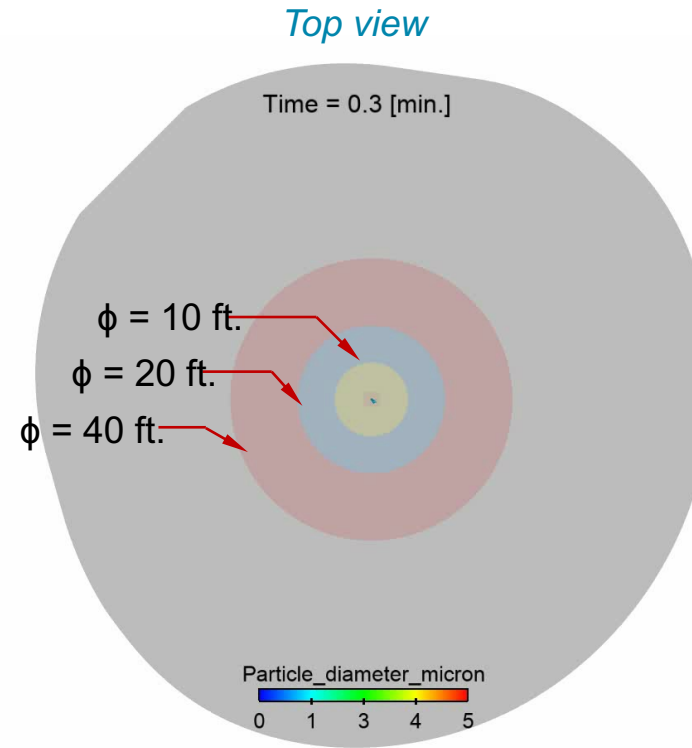


Safety & Ingredients

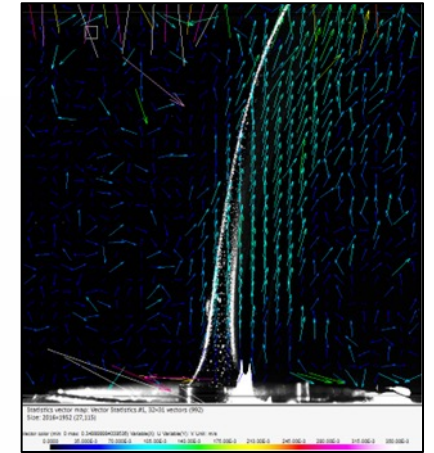
# How Does Thermacell Work?

1. Substrate – mat and wick
2. Heat – butane fuel cartridge or electric power
3. Produces tiny airborne particles
4. Miniscule amounts of pyrethroids repel mosquitoes
5. >99% A.I. disseminates into the air

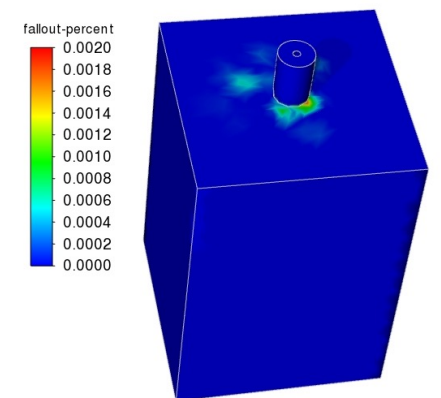
THERMACELL®



Total fallout is only ~0.02 % of the total formula mass released in 15 mins.



Velocity vectors, colored by velocity magnitude



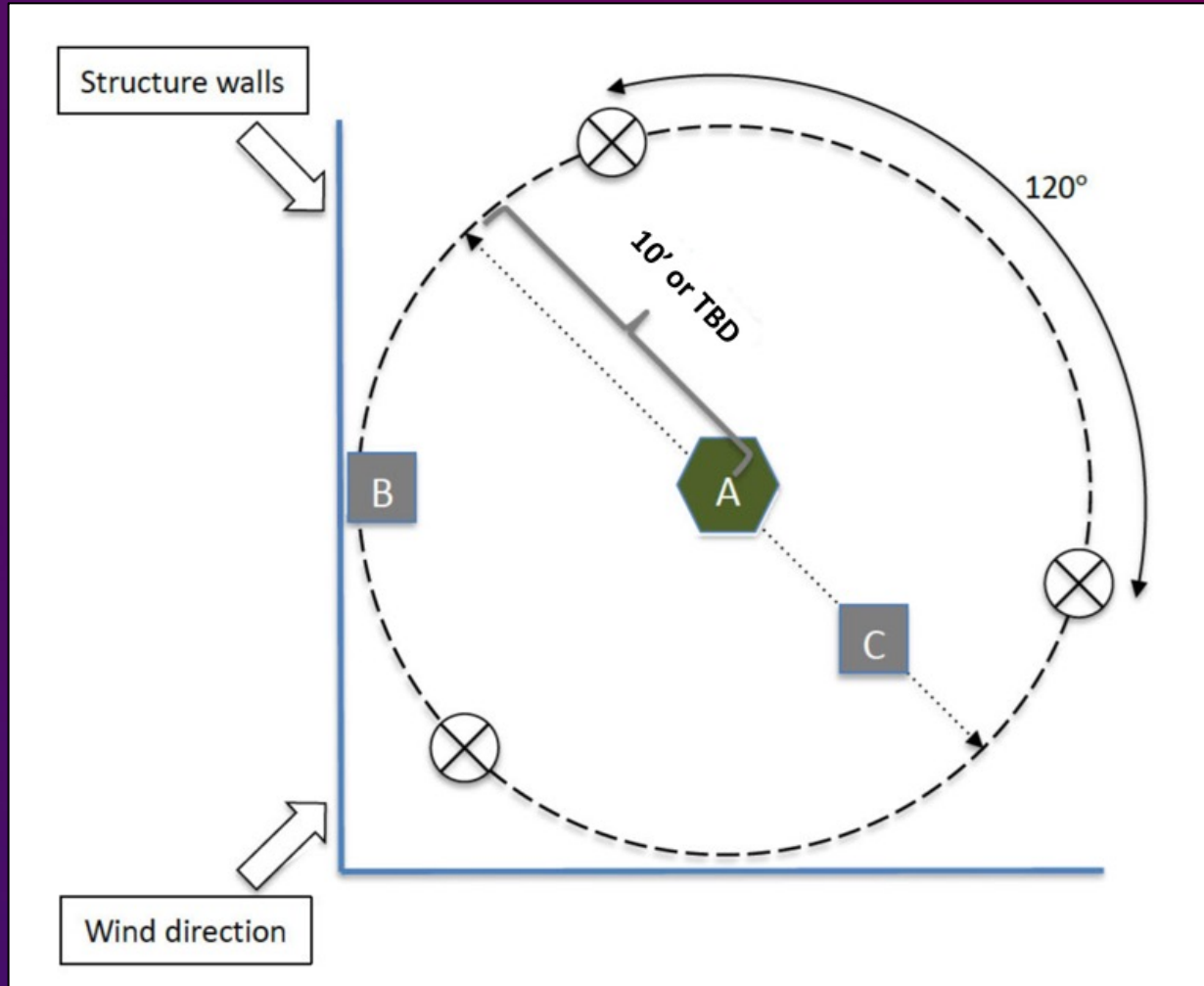
Particle fallout on the table

# Types of Tests





# Efficacy Protocol



## Test Plot Set-up and Area of Protection:

**A** = Thermacell emitter at center of plot.  
**B** = limit of claimed Area of Protection (dashed circle).

⊗ = Trap locations: either a single trap at the vertex, or >1 trap evenly spaced around perimeter of Area of Protection (as shown).

**C** = Diameter of Area of protection (e.g., 20' dotted line) with radius of 10', which provides in this example an Area of Protection of about 314 square feet. Structure walls are optional temporary installations to control natural airflow.

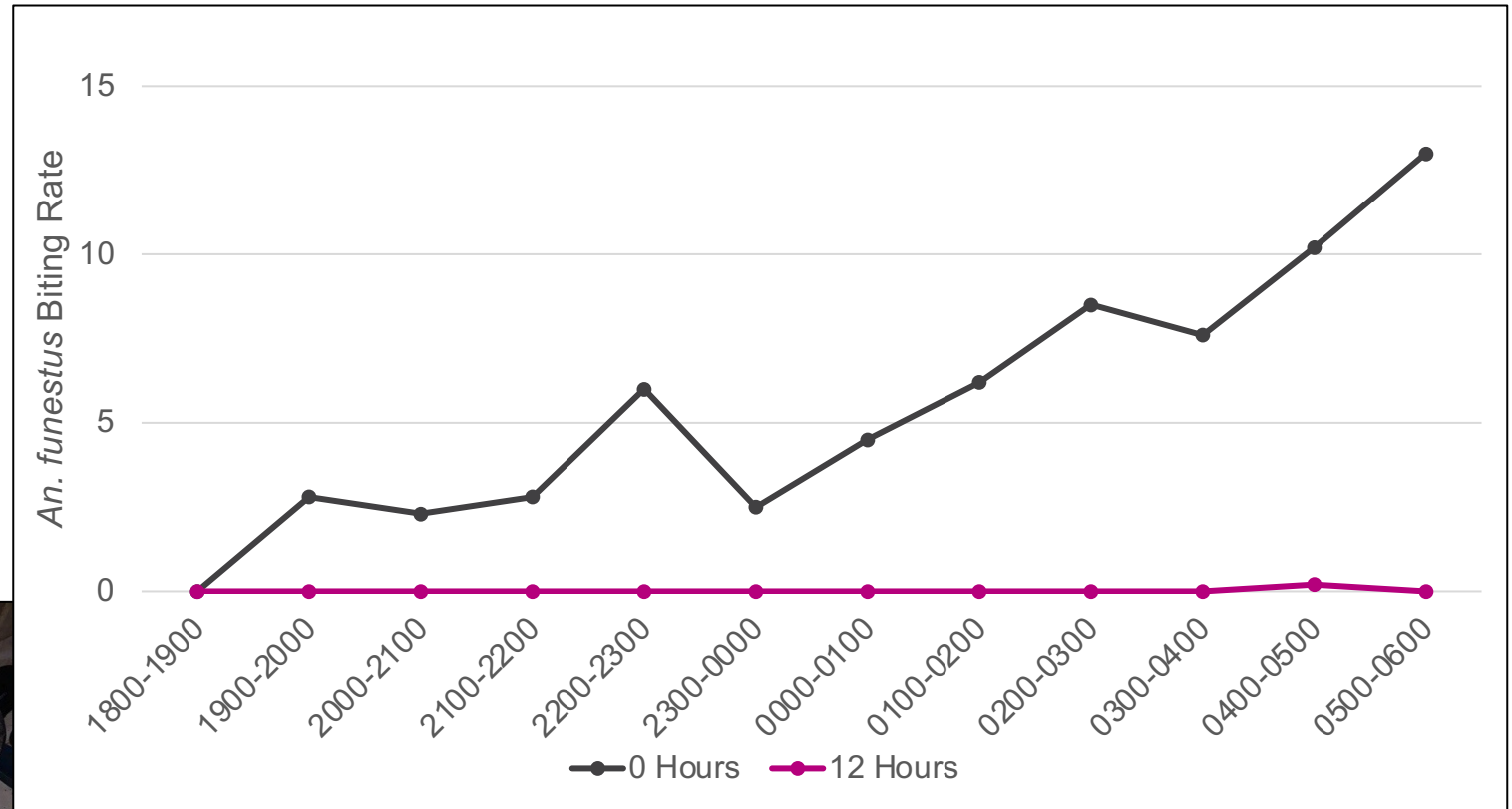
# Efficacy tested in many environments



# Efficacy Research - Kenya

Turn it on = Mosquitoes Gone

Figure 2: A team of four HLC volunteers sitting in different directions (North, South, West and East) in a compound at the start a night activity with metofluthrin emanating 5 feet from the collectors.



Above Figure: Indoor efficacy of metofluthrin SR against *An. funestus*.

Left Picture: Comparison between Thermacell device and active cook stove.

# Efficacy Study – WRAIR Bunker (South Korea)

## EXECUTIVE PROJECT SUMMARY

### EVALUATION OF AN AREA REPELLENT SYSTEM (ThermaCELL®) AGAINST MALARIA VECTORS AND OTHER MOSQUITOES IN MILITARY BUNKERS AND GUARD POSTS IN THE REPUBLIC OF KOREA

PREPARED BY:  
MICHAEL J. PERICH, Ph.D., B.C.E.

In accordance with the conditions of the Cooperative Research and Development Agreement (CRDA) between The Schawbel Corp. and Walter Reed Army Institute of Research, the following report is provided on results obtained from the study: "Evaluation of an Area Repellent System (ThermaCELL®) Against Malaria Vectors and Other Mosquitoes in Military Bunkers and Guard Posts in the Republic of Korea".

The study was conducted in the "Joint Security Area", near Pan Mun Jom, Korea at Camp Bonifas. This area since 1994 has had a resurgence of malaria and high populations of mosquitoes. Two tests were conducted at Camp Bonifas, evaluation of the area repellent system at an in-ground military bunker and a military guard post. Both sites have been problem sites for military personnel positioned in them, due to annoying mosquito attack and the potential for malaria transmission.

The bunker test on post at Camp Bonifas, involved two in-ground, cement bunkers with openings at ground level and long sand bagged entrances. The two bunkers were approximately 100 meters apart. Tests were done for 3 nights, 24, 26 and 27 July, 8-10 Sept and 22-24 Sept 1998. ThermaCELL® treatment was alternated between the 2 bunkers nightly to control for any variance between bunkers.

Results from the bunker tests showed significant protection provided by the area repellent system from mosquito attack (Tables). In the total 9 nights that tests were done, 724 mosquitoes were collected from the untreated control bunker and only 10 were collected in the bunker with the area repellent system. Thus, the area repellent system (ThermaCELL®) gave 98.6% protection from mosquito attack in the military bunkers. Over 95% of the collections were *Anopheles sinensis*, the primary malaria vector of the area.

Results from the guard station were similar, but with much smaller total mosquito collection numbers. This could be due to the use of light trapping instead of human landing collections, the guard posts have doors which limit the number of mosquitoes entering and the soldiers on duty in the guard posts may be attracting the mosquitoes away from the trap. A total for the 9 nights of 31 mosquitoes were collected in light traps in the untreated guard posts compared to 7 in the ThermaCELL® treated guard post. This translates to the area repellent system providing a potential 81.5% protection from mosquito attack in the guard posts. Although the numbers were low in the guard posts, the soldiers on duty at the post which had ThermaCELL® commented on what little problem they had with mosquitoes compared to when they were on duty at the post when the area repellent system was not operating.

Based on these results and prior testing, the area repellent system (ThermaCELL®) when used in the described applications (military bunkers and guard posts), provides significant protection from the primary malaria vector, *Anopheles sinensis* and other mosquitoes in the republic of Korea. Data from prior testing at other locations showed excellent results as well but could not be published because they are proprietary.

**Thermacell provides significant protection in military bunkers and guard posts against malaria vectors and other mosquitoes**

# Efficacy Comparison – USDA/AMCD Study (Israel)

**Table 2**

Changes in biting-pressure at different distances from a single unit of each tested product.

	Mean ( $\pm$ SE) change in bite-pressure <sup>a</sup> at different distances		
	1 m	2.5 m	3.33 m
ThermaCELL Patio lantern	-96.1 $\pm$ 1.6% ( <i>P</i> <0.01)	-89.2 $\pm$ 3.2% ( <i>P</i> <0.01)	-76.7 $\pm$ 4.7% ( <i>P</i> <0.01)
PowerPad Lamp	-91.6 $\pm$ 3.1% ( <i>P</i> <0.01)	-83.1 $\pm$ 4.9% ( <i>P</i> <0.01)	-64.3 $\pm$ 5.7% ( <i>P</i> <0.01)
Terminix ALLCLEAR tabletop mosquito repeller	-90.4 $\pm$ 3.4% ( <i>P</i> <0.01)	-77.1 $\pm$ 4.6% ( <i>P</i> <0.01)	-55.2 $\pm$ 8.2% ( <i>P</i> <0.01)
Citronella bucket tabletop	-53.9 $\pm$ 7.4% ( <i>P</i> <0.01)	-8.8 $\pm$ 11.9% (NS)	7.1 $\pm$ 15.9% (NS)
DynaTrap	38.2 $\pm$ 21.2% (NS)	55.4 $\pm$ 21.5% ( <i>P</i> <0.01)	13.3 $\pm$ 16.1% (NS)
Vortex Electronic Insect Trap	17.7 $\pm$ 14.7% (NS)	-9.2 $\pm$ 12.8% (NS)	-5.2 $\pm$ 12.9% (NS)
Blue Rhino	215.2 $\pm$ 42.9% ( <i>P</i> <0.01)	130.9 $\pm$ 31.8% ( <i>P</i> <0.01)	91.9 $\pm$ 21.1% ( <i>P</i> <0.01)
CONTROL (unprotected)	0 $\pm$ 11.2%	0 $\pm$ 11.1%	0 $\pm$ 10.7%

<sup>a</sup> Negative values indicate a decrease in biting-pressure mean and positive numbers increase in biting pressure mean.

**Table 3**

Changes in biting- pressure at small area sizes surrounded by four units of each tested product.

	Mean ( $\pm$ SE) change in biting-pressure <sup>a</sup> in different area sizes <sup>b</sup>		
	1.67 m <sup>2</sup>	10.5 m <sup>2</sup>	18.5 m <sup>2</sup>
ThermaCELL Patio lantern	-98.6 $\pm$ 0.3% ( <i>P</i> <0.01)	-96.7 $\pm$ 1.7% ( <i>P</i> <0.01)	-90.3 $\pm$ 2.9% ( <i>P</i> <0.01)
PowerPad Lamp	-95.7 $\pm$ 1.5% ( <i>P</i> <0.01)	-93.5 $\pm$ 2.5% ( <i>P</i> <0.01)	-82.1 $\pm$ 4.8% ( <i>P</i> <0.01)
Terminix ALLCLEAR Tabletop Mosquito Repeller	-95 $\pm$ 1.6% ( <i>P</i> <0.01)	-91.1 $\pm$ 3% ( <i>P</i> <0.01)	-75.4 $\pm$ 5.1% ( <i>P</i> <0.01)
Citronella Bucket Tabletop	-70.6 $\pm$ 4.4% ( <i>P</i> <0.01)	-42.5 $\pm$ 9.7% ( <i>P</i> <0.01)	-8.7 $\pm$ 9% (NS)
DynaTrap	74.1 $\pm$ 19.3% ( <i>P</i> <0.01)	110.7 $\pm$ 28.2% ( <i>P</i> <0.01)	66.7 $\pm$ 23% ( <i>P</i> <0.05)
Vortex Electronic Insect Trap	17.7 $\pm$ 14.7% (NS)	30.8 $\pm$ 19.1% (NS)	17.4 $\pm$ 17.6% (NS)
Blue Rhino	489.7 $\pm$ 72.9% ( <i>P</i> <0.01)	323.8 $\pm$ 52.1% ( <i>P</i> <0.01)	188.7 $\pm$ 38.5% ( <i>P</i> <0.01)
CONTROL (unprotected)	0 $\pm$ 9.3%	0 $\pm$ 9.7%	0 $\pm$ 10.8%

<sup>a</sup> Negative values indicate a decrease in biting-pressure mean and positive numbers increase in biting-pressure mean.

<sup>b</sup> Square areas with four units of each trap positioned at the vertices.

Thermacell is the most effective area repellent

# Efficacy Comparison: NECE Study (Florida)

FIELD EVALUATION OF COMMERCIAL OFF-THE-SHELF SPATIAL REPELLENTS AGAINST THE ASIAN TIGER MOSQUITO, *Aedes albopictus* (SKUSE), AND THE POTENTIAL FOR MILITARY USE DURING DEPLOYMENT



Figure 3. Photos of each of the 4 test items suspended over the BGS Sentinel trap using rope and shepherd hooks: A - ThermaCELL Mosquito Repellent B - OFF! Clip On C - Lentek Bite Shield D - Bug Button Mosquito Eliminator

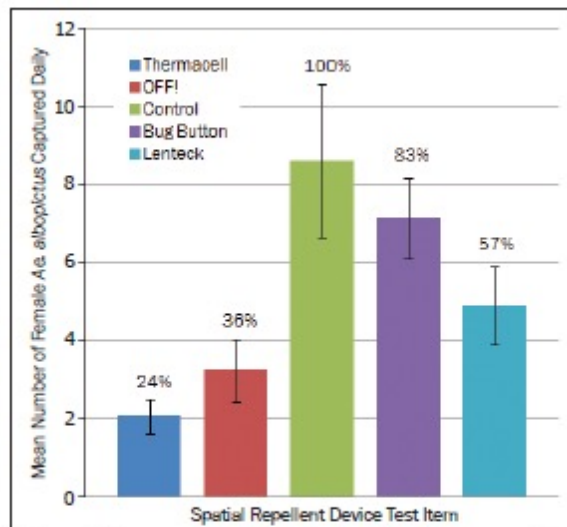


Figure 4. Mean number of female *Ae. albopictus* mosquitoes captured daily by traps protected by each spatial repellent device over entire study period. The control trap capture is considered to be the 100% baseline. The percentages shown for each device are calculated against the control trap capture total.

produced by the fan along with the color of the housing are potentially a tactical concern.

The Bug Button Mosquito Eliminator is a sturdy, solid disk providing easy set up and maintenance for the user. The manufacturer claims 220 hours of protection and the device can be carried directly on the user, maximizing mobility. There are no logistical concerns with this device making it easily deployable in theater. However, the bright yellow color of the disk does not allow the device to blend in with military uniforms.

## SUMMARY

The DoD insect repellent system outlines all necessary measures to provide maximum personal protection against vector-borne diseases. However, lack of consistent participation by military personnel highlight a disconnect between PPM availability and what personnel will use. Even though deet was developed shortly after World War II, it continues to be the “gold standard” of topical repellents. Other personal repellents listed in government supply systems and those available to civilians present some of the same drawbacks mentioned earlier (dermal irritation, unpleasant odors, oily residue) that cause DoD personnel to avoid using deet. There is a need for an additional PPM that is simple to use and does not require dermal application. In theory, spatial repellents should be able to meet these requirements, but the logistical and reliability issues of currently

available devices complicate their utility in a deployed environment, and would likely result in reduced use by personnel.

In NECE’s spatial repellent study described in this article, it was determined that spatial repellent devices using repellent insecticides are the most efficient at protecting against *Ae. albopictus*, an important vector of dengue and chikungunya viruses.<sup>31</sup> Overall, the ThermaCELL spatial repellent device was the most effective device and is suitable for field use. Results from this study show that this device could potentially reduce biting pressure by 76%, providing a level of protection that will reduce VBD risk among personnel. This device works well for stationary situations where supplies are easily obtained and tactical issues are not a priority. However, this device is not ideal for use during deployments, highlighting a need for the development of a military grade spatial repellent device. Logistical and tactical concerns outlined in this article should be addressed. Future studies should be conducted to develop a military-specific spatial repellent device. The ideal device should be versatile (indoor/outdoor), portable, tactical, easily deployable, and contain repellent insecticides that vaporize at ambient temperatures.

The Navy Entomology Center of Excellence continues to test and evaluate spatial repellents and has partnered with the Walter Reed Army Institute of Research to

**“Overall, the ThermaCELL spatial repellent device was the most effective device and is suitable for field use”**

# Summary

- Another layer of protection
- Easy to use, long-lasting, and effective
- Validated by 20 years of research and >100k consumer ratings

A couple is sitting on a lawn by a lake at sunset. The man is on the left, and the woman is on the right, both in dark chairs. A small table between them holds a drink. A golden retriever is lying on the grass to the left. The background shows a calm lake, distant hills, and a warm sunset sky.

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Questions?

**THERMACELL®**

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# In the News and other Reviews

- Jun 2022: [The best gear under \\$25 to make life in the field suck less, according to soldiers](#)
- Nov 2022: [The best inventions of 2022](#)
- Feb 2023: [Keep your nights mosquito-free and illuminated with Thermacell's new 2-in-1 repeller](#)
- May 2023: [Thermacell LIV review: Fabulously effective mosquito repellent](#)
- Jun 2023: [These Mosquito-Thwarting Gadgets Have Been Wirecutter Favorites for 5 Years. \(No Citronella Here.\)](#)
- Jun 2023: [Thermacell is worth the weight. Amazing mosquito repellent.](#)
- Jun 2023: [The Best Mosquito Repellents for Camping in 2023](#)
- Jul 2023: [I Camp More Than 30 Days Every Year—Here's the Mosquito Repellent I'll Never Forget to Pack](#)
- Aug 2023: [This Portable Mosquito Repeller Is Better Than Bug Spray](#)

# Scientific Literature

- Apr 2016: [ThermaCELL and OFF! Clip-On Devices Tested for Repellency and Mortality Against Amblyomma americanum \(Acari: Ixodida: Amblyommidae\)](#)
- Nov 2003: [Field Evaluation of an Area Repellent System \(Thermacell\) Against Phlebotomus papatasi \(Diptera: Psychodidae\) and Ochlerotatus caspius \(Diptera: Culicidae\) in Sanliurfa Province, Turkey](#)
- Sep 2006: [Field Evaluation of Mosquito Control Devices in Southern Louisiana](#)
- Jul 2009: [The role of the United States military in the development of vector control products, including insect repellents, insecticides, and bed nets](#)
- Jun 2013: [Field evaluation of commercial off-the-shelf spatial repellents against the Asian tiger mosquito, Aedes Albopictus \(Skuse\), and the potential for use during deployment](#)
- Jul 2013: [Reduction of mosquito biting-pressure: Spatial repellents or mosquito traps? A field comparison of seven commercially available products in Israel](#)
- Mar 2014: [Field Evaluation of Four Spatial Repellent Devices Against Arkansas Rice-Land Mosquitoes](#)
- Jul 2015: [Allethrin-Based Mosquito Control Device Causing Knockdown, Morbidity, and Mortality in Four Species of Field-Caught Mosquitoes \(Diptera: Culicidae\)](#)
- Apr 2021: [Spatial Repellents Protect Small Perimeters from Riceland Mosquitoes in a Warm-Humid Environment](#)
- Jun 2021: [Evaluation of d-Allethrin in the Thermacell Mosquito Repellent Device Against the Lone Star Tick Under Laboratory Conditions](#)