Photo credit: James Gathany, CDC

Perspectives on Control of Vector-borne Diseases

Bio-Gene Technology Ltd
12 December 2023

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Opinions are those of the author and not Purdue University

Vector-borne Diseases & Public Health

- Diseases transmitted by mosquitoes, ticks, flies
- Malaria, arboviruses, Lyme borreliosis, rickettsiosis, anaplasmosis/ehrlichiosis, Chagas
- Approximately half world population at risk
- Morbidity and mortality
- 1/6th of illness and disability

Increasing Risks of Vector-borne Diseases

- Global rise of infectious diseases
- 40 new human pathogens recognized since 1970 (WHO)
- Increasing risk of zoonotic pathogen spillover to humans
- Over population, competition for natural resources, global travel, population dense cities, habitat loss, climate change
- Health agencies poorly prepared

CDC Vitalsigns™

3x Disease cases from mosquito, tick, and flea bites tripled in the US from 2004 to 2016.

9 Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

8in10 About 80% of vector control organizations lack critical prevention and control capacities.

Illnesses on the rise

From mosquito, tick, and flea bites

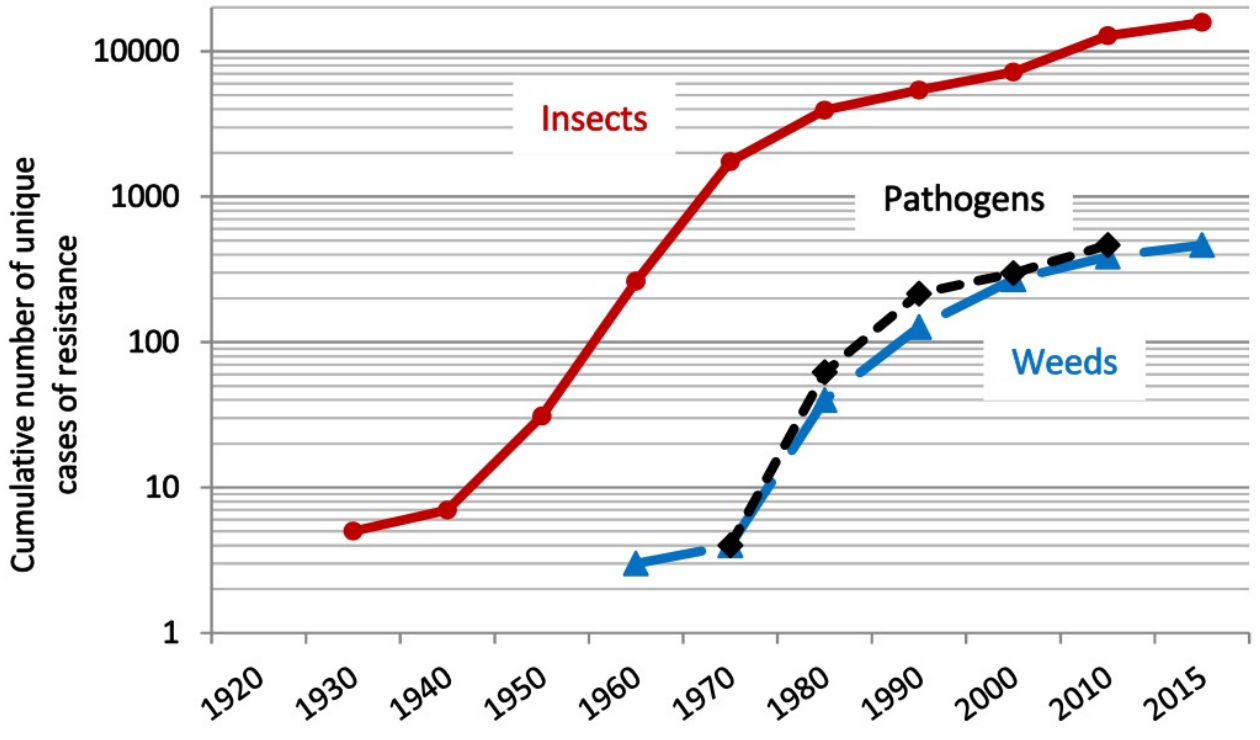
Almost everyone has been bitten by a mosquito, tick, or flea. These can be vectors for spreading pathogens (germs). A person who gets bitten by a vector and gets sick has a vector-borne disease, like dengue, Zika, Lyme, or plague. Between 2004 and 2016, more than 640,000 cases of these diseases were reported, and 9 new germs spread by bites from infected mosquitoes and ticks were discovered or introduced in the US. State and local health departments and vector control organizations are the nation's main defense against this increasing threat. Yet, 84% of local vector control organizations lack at least 1 of 5 core vector control competencies. Better control of mosquitoes and ticks is needed to protect people from these costly and deadly diseases.

State and local public health agencies can

- Build and sustain public health programs that test and track germs and the mosquitoes and ticks that spread them.
- Train vector control staff on 5 core competencies for conducting prevention and control activities. http://bit.ly/2FG1OMw
- Educate the public about how to prevent bites and control germs spread by mosquitoes, ticks, and fleas in their communities

Need for New Vector Control Technologies

- Lack of effective vaccines and therapeutics
- Insecticides are the backbone of control (~75% via insecticides)
- Dwindling arsenal of pest control tools
- Pesticide resistance widespread
- No new products developed for vector control in 30 years (Hemingway et al., 2006)



Sparks and Lorsbach. Pest. Manag. Sci. 2017

Life in a warmer, more populated world?

- Increase/decrease of VBDs
- Geographic range shifts of vectors
- Expanded seasonal activity of vectors
- Increase in vector competence
- Epidemics more common
- “Epidemic belts” will expand

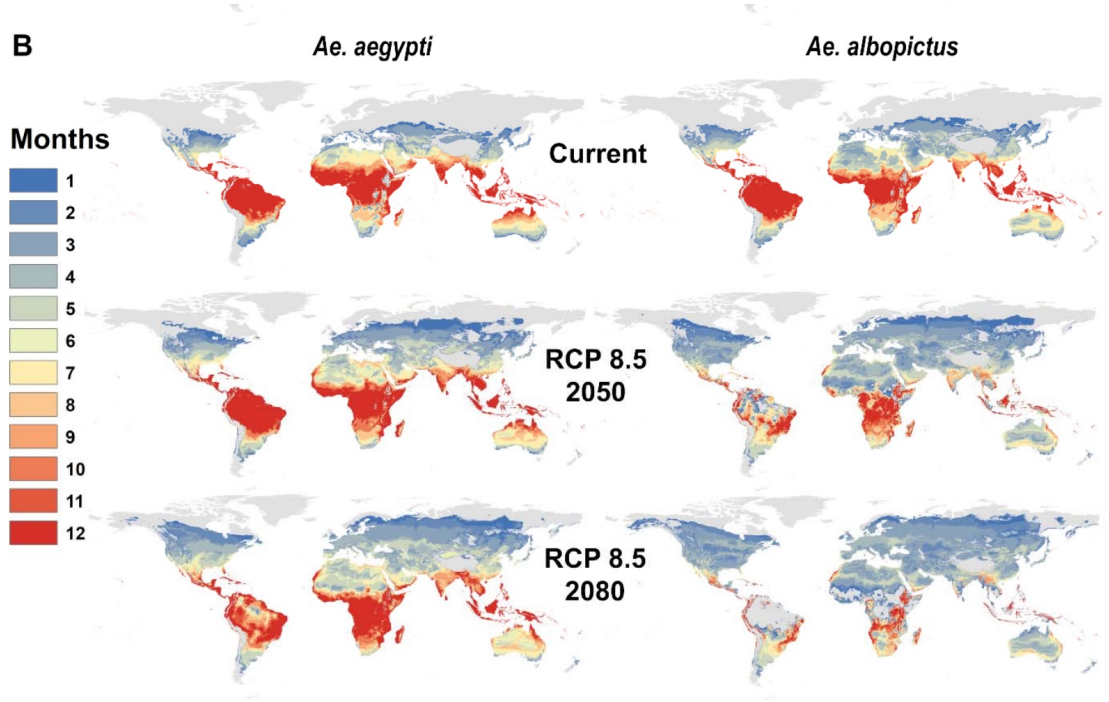
Global Change Biology

PRIMARY RESEARCH ARTICLE | Open Access

Warming temperatures could expose more than 1.3 billion new people to Zika virus risk by 2050

Sadie J. Ryan, Colin J. Carlson, Blanka Tesla, Matthew H. Bonds ... See all authors

First published: 09 October 2020 | https://doi.org/10.1111/gcb.15384 | Citations: 15



Increasing Malaria Risk in the U.S.

- Summer 2023, first case reports of local malaria transmission (Florida, Texas) in 20 years
- Malaria declared eradicated in U.S. in 1950s
- Malaria vectors present in U.S.
- Much of U.S. considered at increasing risk for malaria transmission

Malaria: Re-emerging Global Threat

- Increase in global incidence of malaria for first time since 2015 (WHO)
- *Anopheles stephensi,* Asian malaria vector
- Invasive species threat in Africa
- Increased risk of urban/rural malaria transmission (50M people at risk)
- Potential for continuous transmission (wet/dry seasons)
- Resistant to multiple insecticides

PMI | U.S. PRESIDENT'S MALARIA INITIATIVE
LED BY USAID FROM THE AMERICAN PEOPLE | CDC

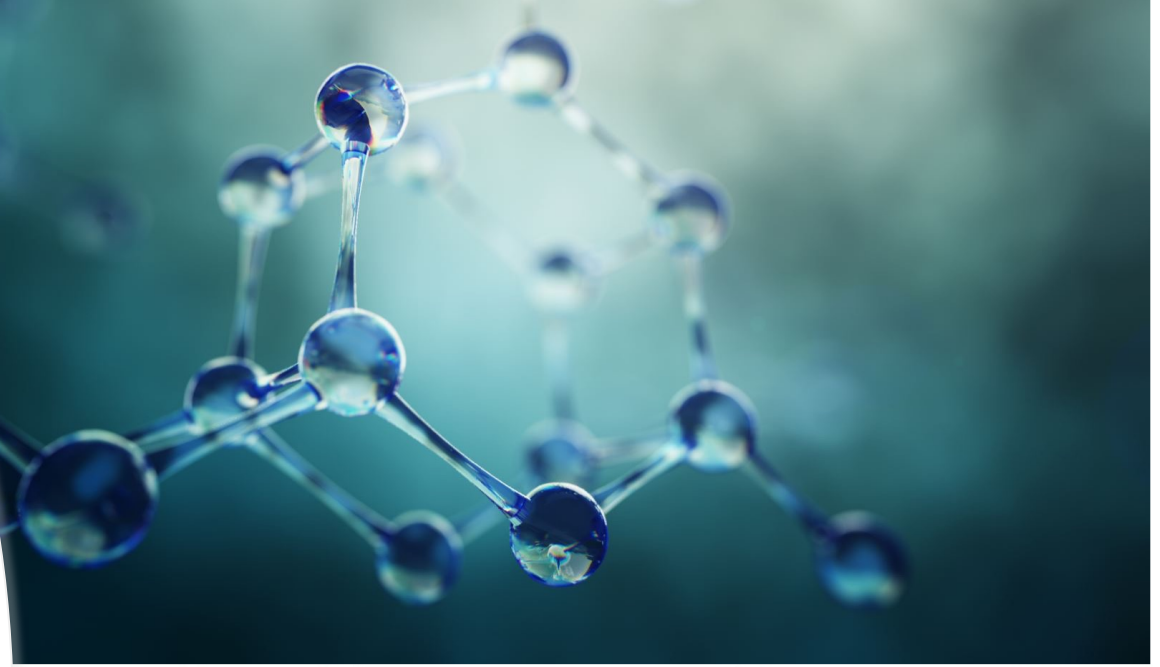
Chagas Disease in the U.S.

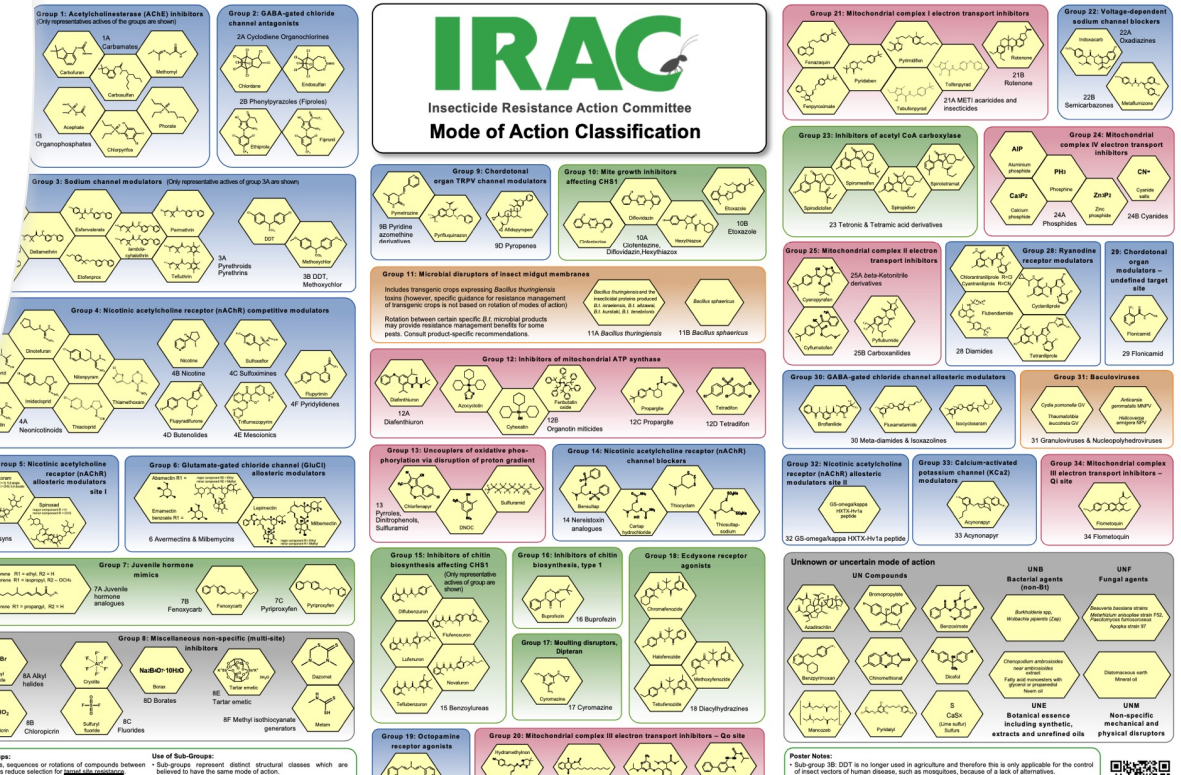
- ~300K human cases Chagas/year in the U.S.
- Less than 1% cases diagnosed and treated
- Associated with serious, long-term health issues (morbidity)
- Vectors and reservoirs in most U.S. states

U.S. Centers for Disease Control and Prevention

Need for New Insecticide Classes

- 36 classes insecticides recognized
- Based on Modes of Action (IRAC)
- Mosquito control relies on 5 classes (organochlorines, carbamates, SPs, OPs, neonicotinoids)
- Will remain primary method of control
- Recognized vector control product development path





Interest in Natural Products & Derivatives

- ~ 60% insecticides derive from NPs
- Excellent source of new modes of action
- Attractive safety profiles, regulatory path

Pest Management Science

SCI where science meets business

Perspective

Impact of natural products on discovery of, and innovation in, crop protection compounds

Thomas C Sparks, Robert J Bryant

First published: 21 September 2021 | https://doi.org/10.1002/ps.6653 | Citations: 2

ELSEVIER

Pesticide Biochemistry and Physiology

Volume 161, November 2019, Pages 12-22

Review

The new age of insecticide discovery-the crop protection industry and the impact of natural products

Thomas C. Sparks [a], Frank J. Wessels [b], Beth A. Lorsbach [b], Benjamin M. Nugent [b], Gerald B. Watson [b]

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Evaluation of Bio-Gene Technology at Purdue

Mosquito Efficacy Studies

- Public health & consumer markets
- Flavocide™ & QCide™
- Potent, rapid activity against larvae, adults
- Contact & spatial efficacy
- Synergistic activity (potentiate existing product classes)
- Novel mode of action (new insecticide class)
- Activity against pesticide resistant strains (extend control)

Jasleen Kaur, Research Scientist, Purdue University, culturing mosquitoes for product efficacy studies

Evaluating Bio-Gene Materials for Tick Control

- Tick & TBD threats increasing globally
- ~3-fold increase in TBD cases, 7 new TBDs identified (2004-2016) (CDC Vital Signs, 2018)
- ~300K cases Lyme disease/year in U.S.
- New products needed for public health, consumer markets

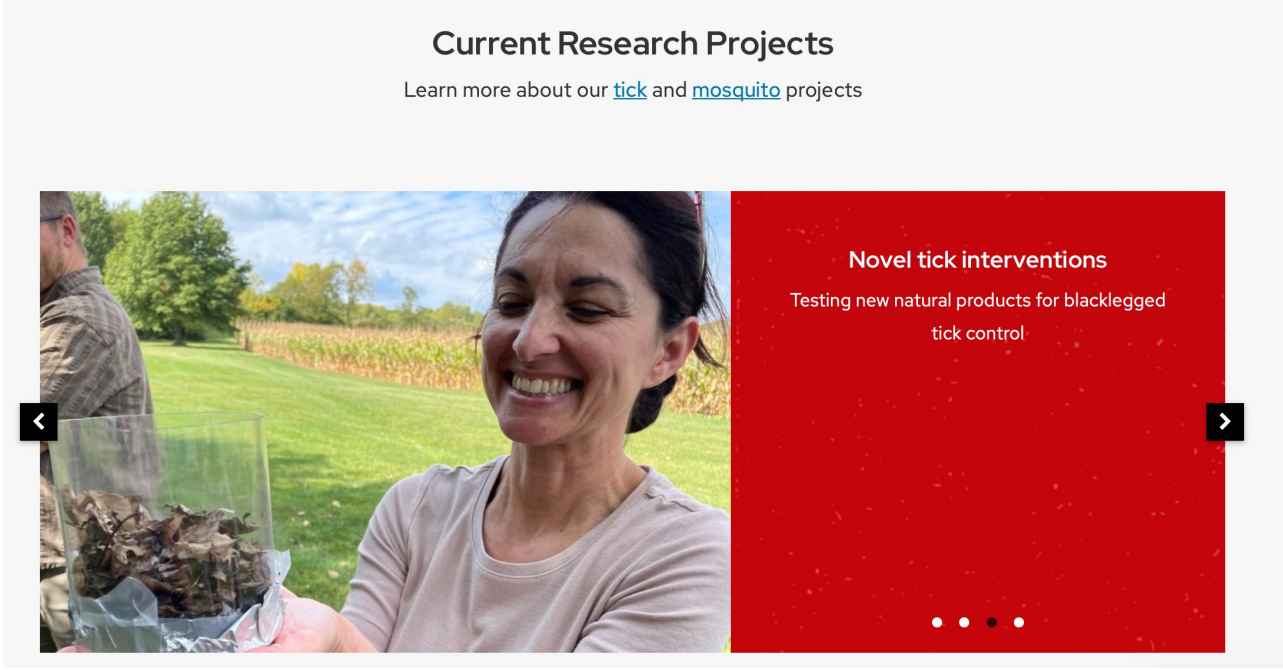
Photo credit: MCEVBD

Evaluating Bio-Gene Materials for Tick Control

Midwest Center of Excellence VECTOR-BORNE DISEASE

PURDUE UNIVERSITY

- $10M CDC Regional Center of Excellence
- Evaluate Flavocide™ & QCide™ for tick control
- Contact efficacy against ticks in lab (meet EPA targets)
- Residual activity in lab
- Small cage and semi-field trials Spring-Summer 2024



Assess tick control products

We are partnering with companies that make pesticides to test how well their products control ticks in real-life conditions.

Partner: Purdue University

Thank you