武 汉 大 学 基 础 医 学 院 人 体 寄 生 虫 学 教 研 室
WUHAN UNIVERSITY SCHOOL OF BASIC MEDICAL SCIENCES

臭虫防治研究进展

蒋洪博士/武汉大学

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报告提纲

- 生物学习性研究进展；
- 危害研究进展；
- 抗药性研究进展；
- 控制技术研究进展；

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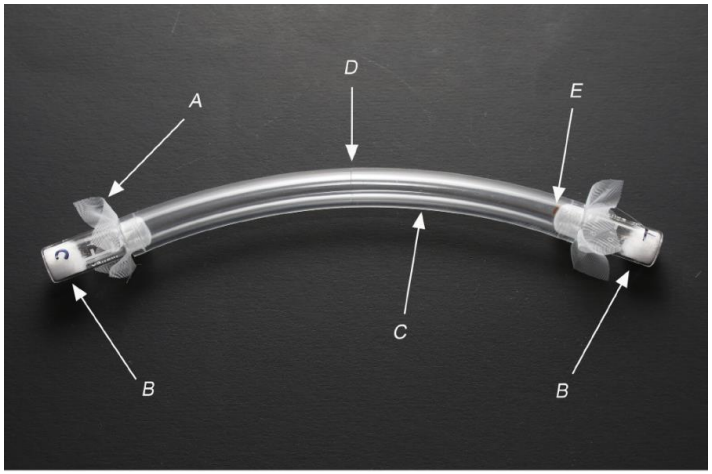
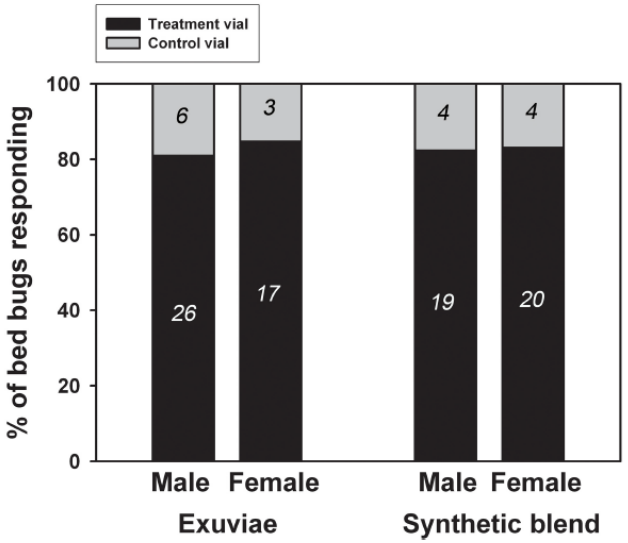
一、臭虫习性研究之一：聚集信息素





- Chemically Mediated Arrestment of the Bed Bug, *Cimex Lectularius*, by Volatiles Associated With Exuviae of Conspecifics. DH Choe et al. PLoS One (2016)
- 臭虫若虫蜕皮壳（头部，不分龄期）提取的挥发性醛类可以诱集成虫。

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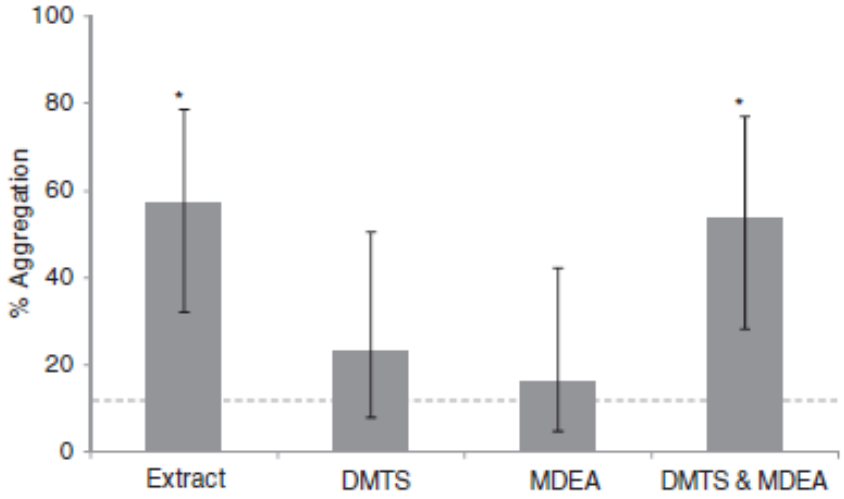

- Two Compounds in Bed Bug Feces Are Sufficient to Elicit Off-Host Aggregation by Bed Bugs, *Cimex Lectularius*. JF Olson et al. Pest Manag Sci (2017)
- **Bed bug aggregation is mediated by semi-volatile compounds derived from fecal extracts, and two compounds are sufficient to elicit aggregation.**

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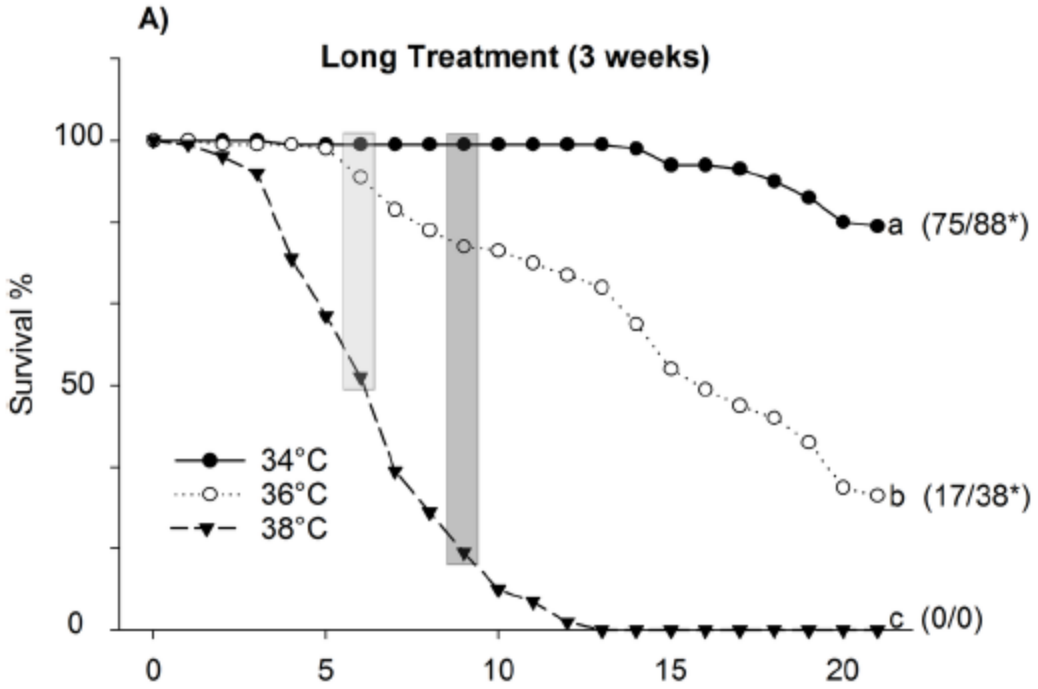
一、臭虫习性研究之二：环境压力测试



- Temperature Stress Deteriorates Bed Bug (Cimex Lectularius) Populations Through Decreased Survival, Fecundity and Offspring Success. BA Rukke et al. PLoS One (2018)

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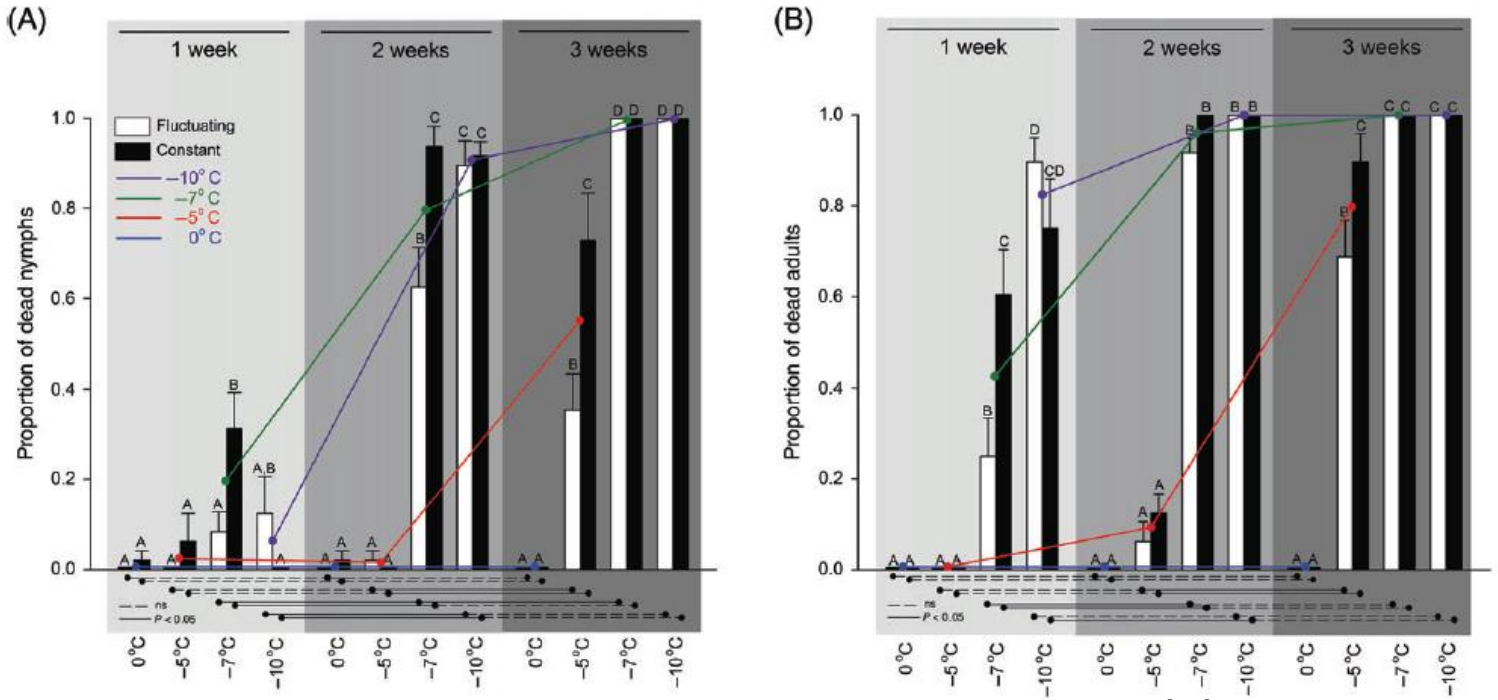

fifth-instar nymphs　　adult

- Mortality, Fecundity and Development Among Bed Bugs (Cimex Lectularius) Exposed to Prolonged, Intermediate Cold Stress. BA Rukke et al. Pest Manag Sci (2017)

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臭虫习性研究关注点：蝙蝠体表的臭虫

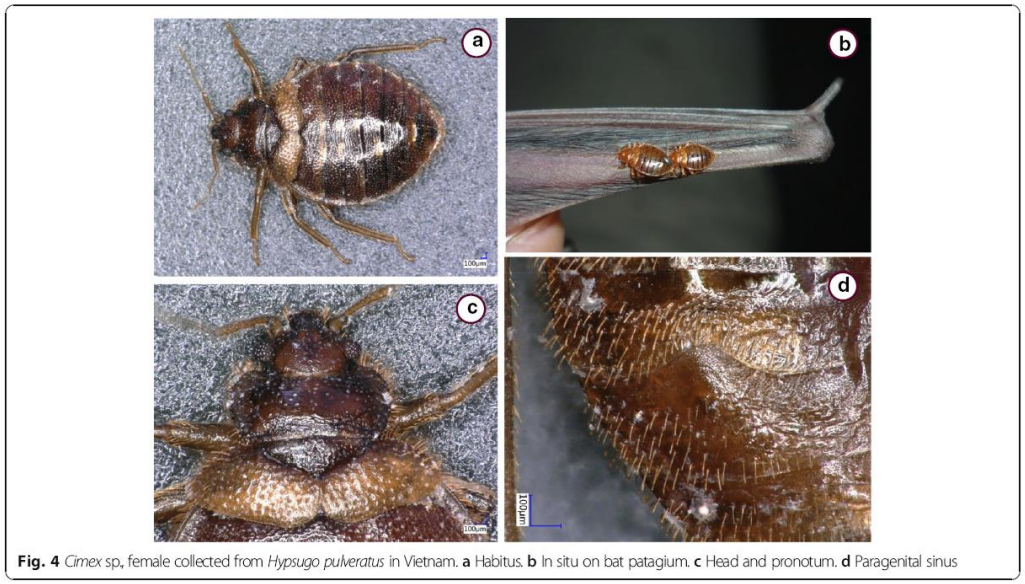
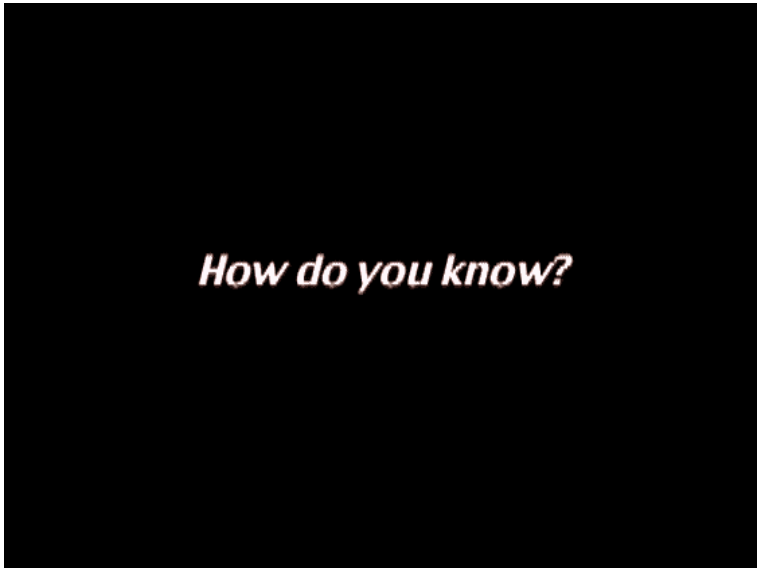


Fig. 4 *Cimex* sp., female collected from *Hypsugo pulveratus* in Vietnam. **a** Habitus. **b** In situ on bat patagium. **c** Head and pronotum. **d** Paragenital sinus



- Phylogenetic Analyses of Bat-Associated Bugs (Hemiptera: Cimicidae: Cimicinae and Cacodminae) Indicate Two New Species Close to Cimex Lectularius. S Hornok et al. Parasit Vectors (2017)

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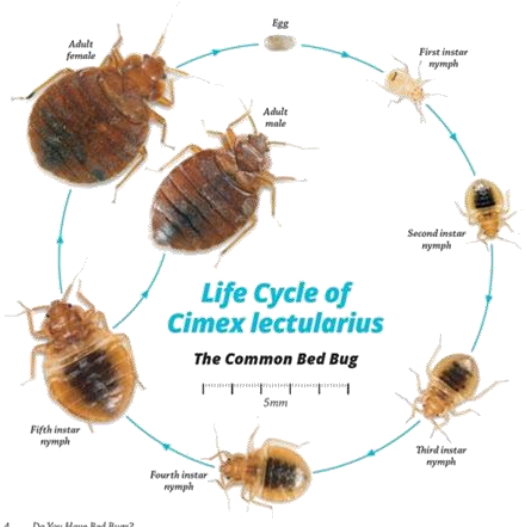
二、臭虫危害研究之一：可以生物性传播病原体吗？



The global bed bug population is estimated to be increasing by **100-500 % annually**. According to the United States EPA, bed bugs are **"a pest of significant health importance** ". Recent studies report that bed bugs may be competent vectors for pathogens, such as *Bartonella quintana* and *Trypanosoma cruzi*. However, public health reports have thus far failed to produce evidence that major infectious disease outbreaks have been associated with bed bugs. Bed bugs may contain **"neutralizing factors**" that attenuate pathogen virulence and, thereby, decrease the ability of bed bugs to transmit infectious disease.

- Bed bugs and possible transmission of human pathogens: a systematic review. Archives of Dermatological Research. 308(8):531-8, 2016 Oct.

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二、臭虫危害研究之二：臭虫引发的全身性皮肤疾病

Patient fed 40–50 bed bugs on himself and after 8min, he developed itch, swelling of the face, lethargy, profuse sweating and widespread wheals on the torso and limbs. The reaction disappeared in 5 h after treatment with systemic prednisone and antihistamines.

- Systemic and erythrodermic reactions following repeated exposure to bites from the Common bed bug *Cimex lectularius* (Hemiptera: Cimicidae). Austral Entomology (2017) 56, 345–347.

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三、臭虫抗药性研究之一：抗药性测试

报告时间	抗性成分
2006	α-氯氰菊酯、恶虫威、溴氰菊酯、溴虫腈
2007	溴氰菊酯、氟氯氰菊酯
2008	联苯菊酯、氟氯氰菊酯、氯菊酯、西维因、吡虫啉、氟虫腈、地亚农、敌敌畏、多杀菌素、溴虫腈、DDT
2009	甲基吡啶磷、吡虫啉、恶虫威、溴氰菊酯、氯菊酯、地亚农、除虫菊酯、β-氟氯氰菊酯、胺菊酯、溴氢菊酯
2010	溴氰菊酯、氟氯氰菊酯、溴虫腈、苯醚菊酯、氯菊酯、敌敌畏、杀螟硫磷、残杀威
2011	溴氰菊酯、百树菊酯、氯菊酯、DDT、狄氏剂、恶虫威、残杀威、马拉硫磷、杀螟硫磷、氟氯氰菊酯、氯氟氰菊酯、醚菌酯、地亚农、仲丁威、氰戊菊酯、 氯氰菊酯、联苯菊酯、溴虫腈、氟虫腈、吡虫啉
2012	溴氰菊酯、除虫菊素、 氟氯氰菊酯、高效氯氟氰菊酯 、顺式氯氰菊酯、胺菊酯、醚菊酯
2013	溴氰菊酯、百树菊酯
2014	溴氰菊酯
2015	吡虫啉、β-氟氯氰菊酯、啶虫脒、联苯菊酯、右旋烯丙菊酯
2016	吡虫啉、啶虫脒、噻虫嗪、呋虫胺、溴氰菊酯

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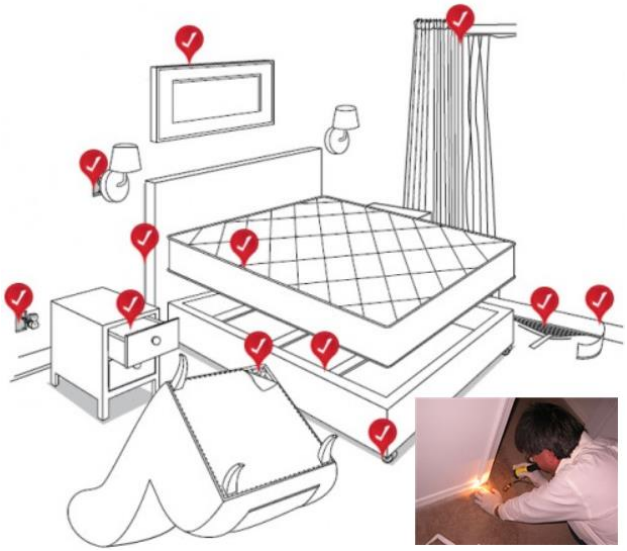
三、臭虫抗药性研究之二：抗药性机制

- Penetration resistance through thickening or remodeling of the cuticle.
- Metabolic resistance by increased activities of detoxification enzymes.
- Knockdown resistance by kdr mutations.
- Behavioral resistance.
- Symbiont-mediated resistance.



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抗药性机制：臭虫体壁厚度与抗药性关系

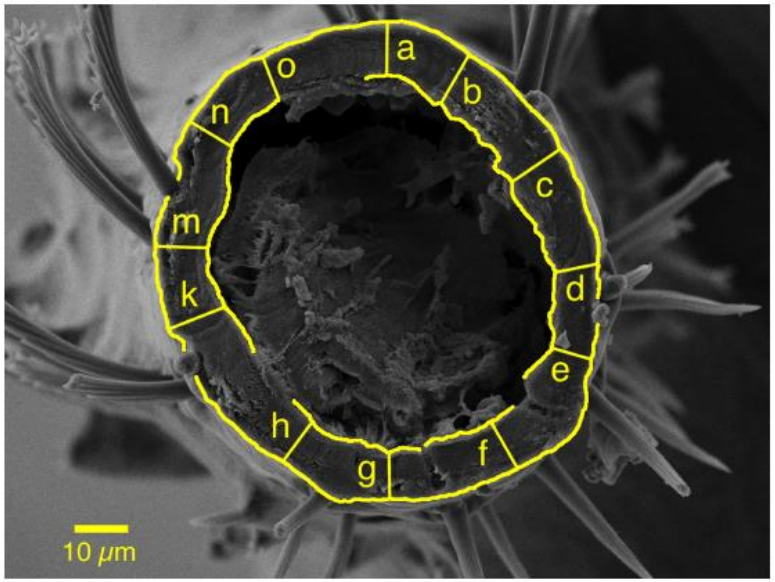

Fig 1. Transverse section of *Cimex lectularius* (Parramatta strain) middle leg tibia and example of twelve point-to-point cuticle measurem methodology. Letters denote measurements of: a = 9.15 μm, b = 9.82 μm, c = 10.25 μm, d = 7.91 μm, e = 7.16 μm, f = 8.42 μm, g = 8.02 μm, h = 8. k = 10.12 μm, m = 8.82 μm, n = 8.31 μm, o = 8.09 μm [i, j and l not included for purpose of legibility].

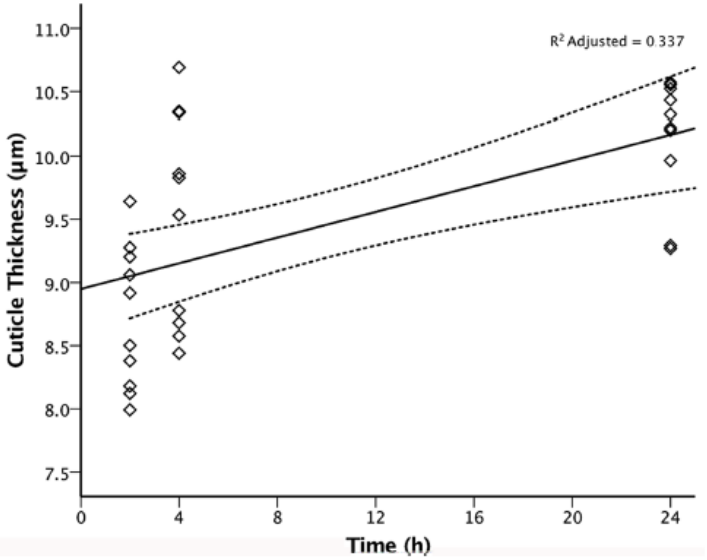

Fig 4. Positive correlation of time-to-knockdown to mean cuticle thickness of Parramatta strain *Cimex lectularius* (n = 10 per response group) upon continuous forced-exposure to wet residues of 20 mL/L Demand Insecticide® (25 g/L lambda-cyhalothrin).

doi:10.1371/journal.pone.0153302.g004

- Cuticle Thickening in a Pyrethroid-Resistant Strain of the Common Bed Bug, Cimex lectularius L. (Hemiptera: Cimicidae). DG Lilly et al. PLoS One (2016)

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抗药性研究关注点：药物处理蚊帐诱导的臭虫抗药性

Abstract. When Tanzanian villages were provided with pyrethroid-treated bednets, bedbugs (Cimicidae) disappeared; however, after about 6 years they have re-appeared in these villages. Using a newly devised test-kit, susceptibility tests of bedbugs *Cimex hemipterus* (Fabricius) from five of these villages showed that there is resistance to permethrin and alphacypermethrin in bedbugs from each of the villages, in contrast to those from five villages without treated nets. Circumstantial evidence indicates that bedbug resistance to pyrethroid insecticides may evolve more readily in villages with incomplete coverage rates of treated bednets, allowing bedbug infestations to become re-established. Bedbugs have not returned to a village where nearly all the beds have been provided with pyrethroid-treated bednets for 14 years.

- Pyrethroid resistance in tropical bedbugs, Cimex hemipterus, associated with use of treated bednets. 《Medical & Veterinary Entomology》 , 2002 , 16 (4) :448-451.

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四、臭虫防治技术研究之一：低毒高效化学防治技术

Abstract The common bed bug, *Cimex lectularius* L., is a hematophagous ectoparasite that preferentially feeds on humans. Pharmaceuticals present in a person's blood may adversely affect *C. lectularius* when it feeds. We fed >10,000 *C. lectularius* on blood samples containing more than 400 different drug doses and drug combinations using an in vitro feeding system to determine insect mortality. The majority of drug doses approximated the peak plasma concentration in humans taking those drugs. Twenty-one drugs were found to cause >17% 12–14-day mortality compared to 8.5% mortality in the control ($p < 0.05$), but postliminary testing of three of the drugs, famotidine, ethambutol, and primaquine, did not demonstrate an increase in *C. lectularius* mortality. We also tested 23 drugs for their effects on *C. lectularius* fecundity. The results may have implications for understanding *C. lectularius* population dynamics in an infestation.

- A Screen of Pharmaceutical Drugs for Their Ability to Cause Short-Term Morbidity and Mortality in the Common Bed Bug, Cimex Lectularius L. Parasitol Res (2017)

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目前我国登记的杀臭虫药剂

登记证号	登记名称	农药类别	剂型	总含量	有效期至	生产企业
WP20140184	杀虫气雾剂	卫生杀虫剂	气雾剂	0.6%	2019-8-14	广州超威日用化学用品有限公司
WP120-90	溴氰菊酯	卫生杀虫剂	可湿性粉剂	2.5%	2020-3-18	拜耳有限责任公司
WP20150179	杀虫气雾剂	卫生杀虫剂	气雾剂	0.34%	2020-8-31	广州超威日用化学用品有限公司
WP20150183	杀虫气雾剂	卫生杀虫剂	气雾剂	0.34%	2020-8-31	广州超威日用化学用品有限公司
WP20100173	溴氰菊酯	卫生杀虫剂	可湿性粉剂	2.5%	2020-12-15	江苏功成生物科技有限公司
WP20160052	杀虫气雾剂	卫生杀虫剂	气雾剂	0.21%	2021-7-26	中山榄菊日化实业有限公司
WP20160059	杀虫气雾剂	卫生杀虫剂	气雾剂	0.4%	2021-7-27	广州超威日用化学用品有限公司
WP20160086	杀虫气雾剂	卫生杀虫剂	气雾剂	0.34%	2021-11-14	福建省厦门市胜伟达工贸有限公司
WP20120035	苯氧·残杀威	卫生杀虫剂	乳油	10%	2022-2-24	湖北武汉宝世卫生药械有限责任公司
WP20170033	溴氰菊酯	卫生杀虫剂	悬浮剂	2.5%	2022-4-10	北京科诺华生物科技有限公司
WP20180010	杀虫气雾剂	卫生杀虫剂	气雾剂	0.5%	2023-1-14	中山榄菊日化实业有限公司
WP20130047	杀虫气雾剂	卫生杀虫剂	气雾剂	0.23%	2023-3-20	黑猫神日化股份有限公司
WP20080062	氯氰菊酯	卫生杀虫剂	可湿性粉剂	10%	2023-4-8	山东省济南开发区捷康化学商贸中心
WP20180096	氟氯·吡虫啉	卫生杀虫剂	悬浮剂	31%	2023-5-16	拜耳有限责任公司
WP20130118	杀虫气雾剂	卫生杀虫剂	气雾剂	0.21%	2023-6-4	黑猫神日化股份有限公司
WP20160177	倍硫磷	卫生杀虫剂	水乳剂	2%	2023-8-20	广西省柳州市万友家庭卫生害虫防治所
WP20080230	杀虫气雾剂	卫生杀虫剂	气雾剂	0.45%	2023-11-25	广州超威日用化学用品有限公司

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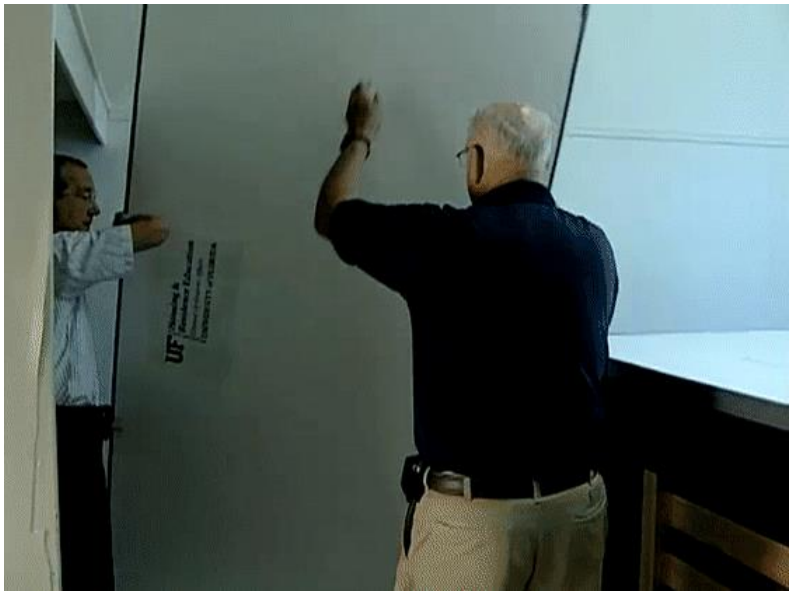
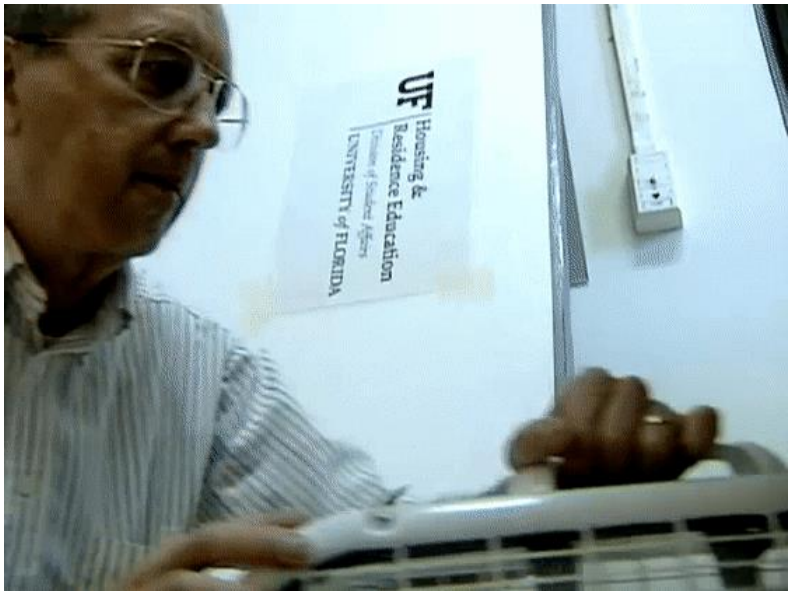
四、臭虫防治技术研究之二：物理防治技术





Bed bugs exposed to 113° F will die if they receive constant exposure to that temperature for 90 minutes or more. However, they will die within 20 minutes if exposed to 118° F. Interestingly, bed bug eggs must be exposed to 118° F for 90 minutes to reach 100% mortality.

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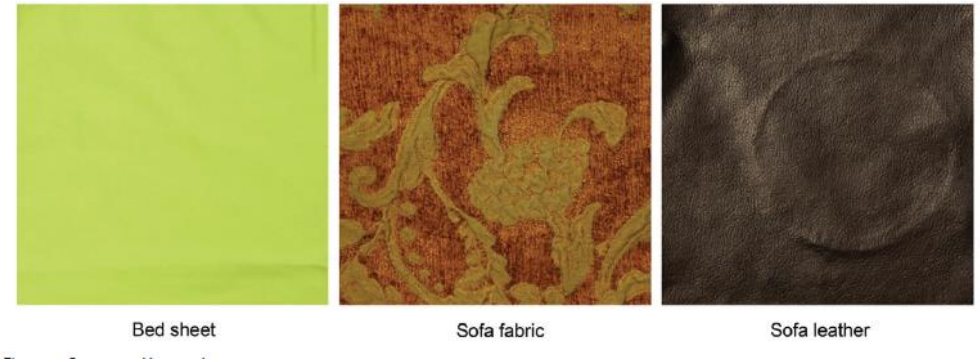

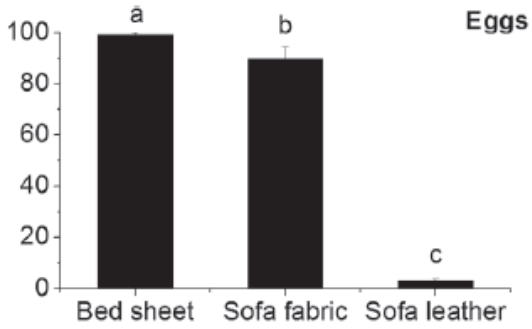

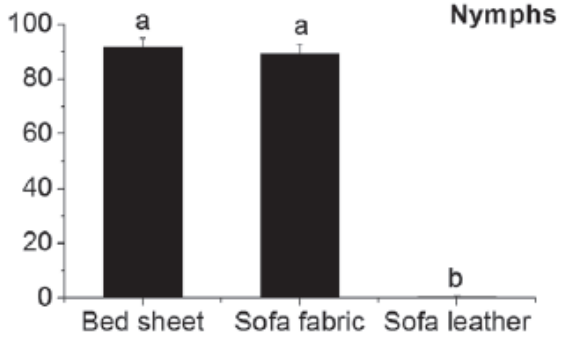

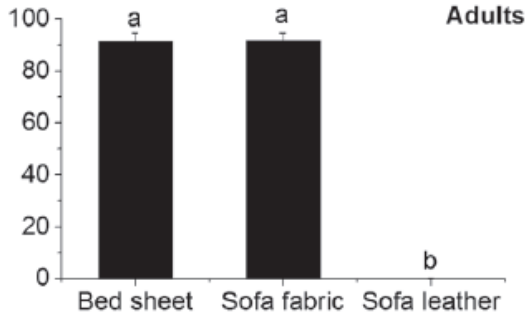

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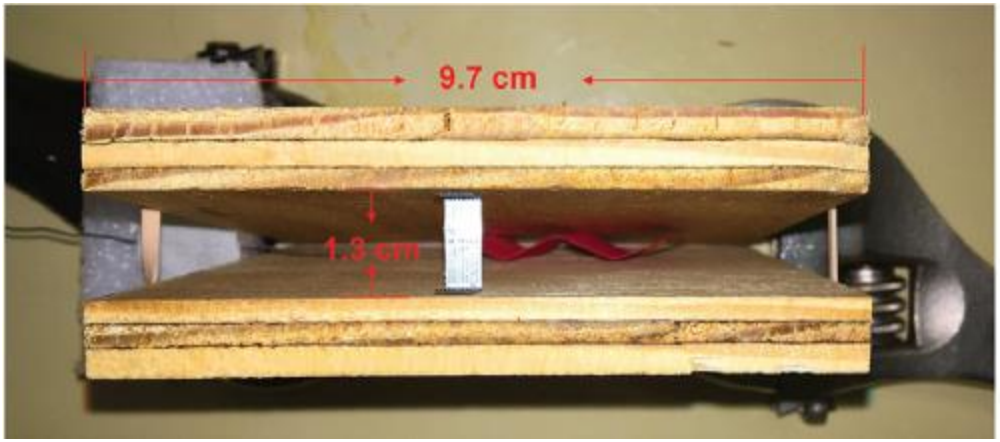

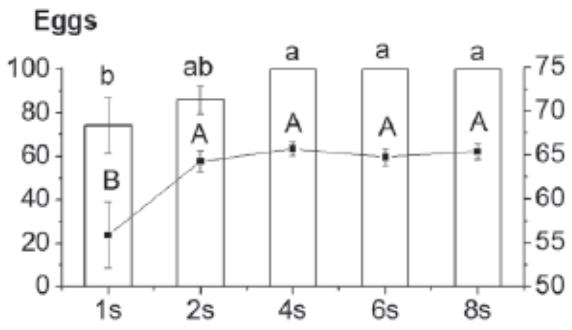

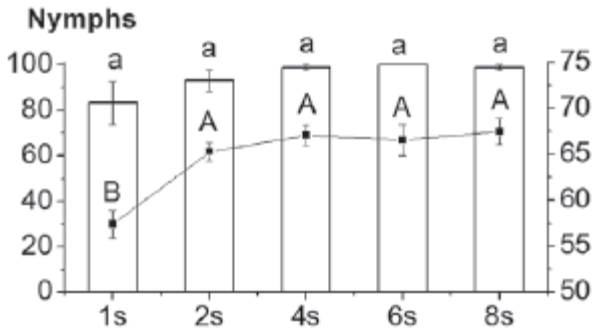

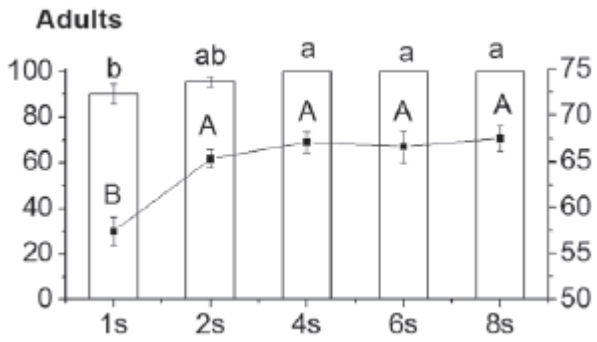

- Efficacy of Three Different Steamers for Control of Bed Bugs (Cimex Lectularius L.) D Wang et al. Pest Manag Sci (2018).

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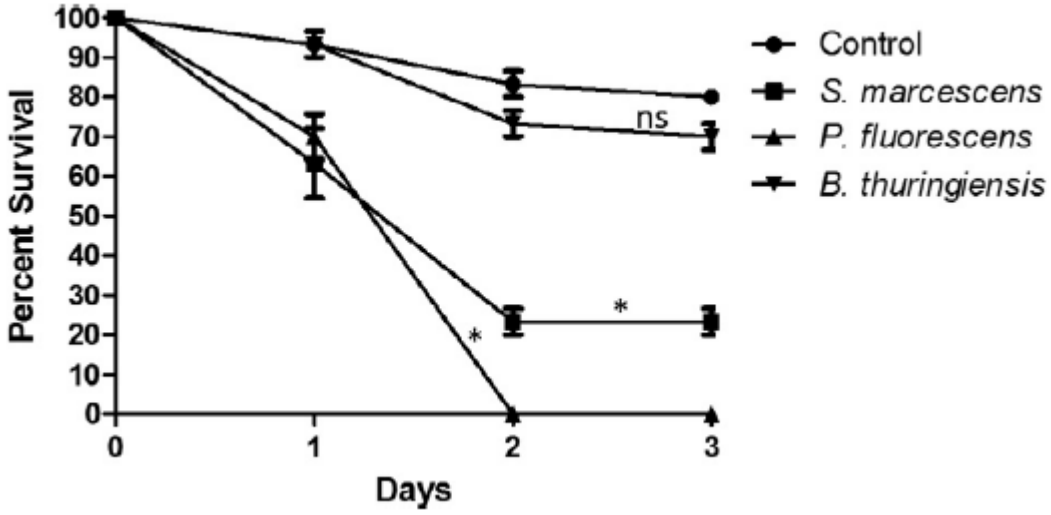
四、臭虫防治技术研究之三：生物防治技术



- Virulence of entomopathogenic bacteria in the bed bug, *Cimex lectularius* J Invertebr Pathol (2018)

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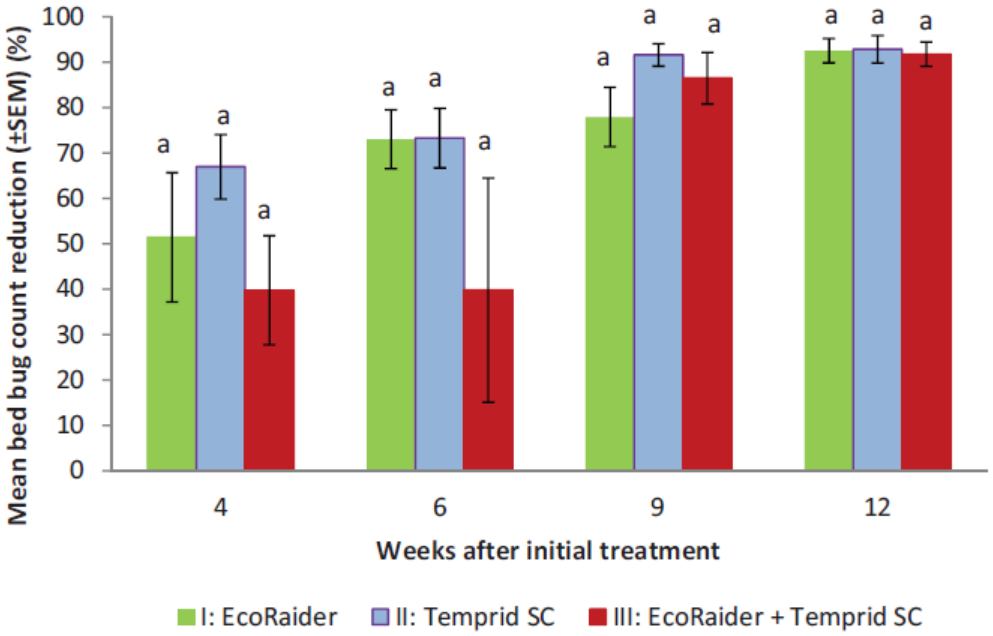

- Efficacy of an Essential Oil-Based Pesticide for Controlling Bed Bug (*Cimex Lectularius*) Infestations in Apartment Buildings. C Wang et al. Insects (2014)

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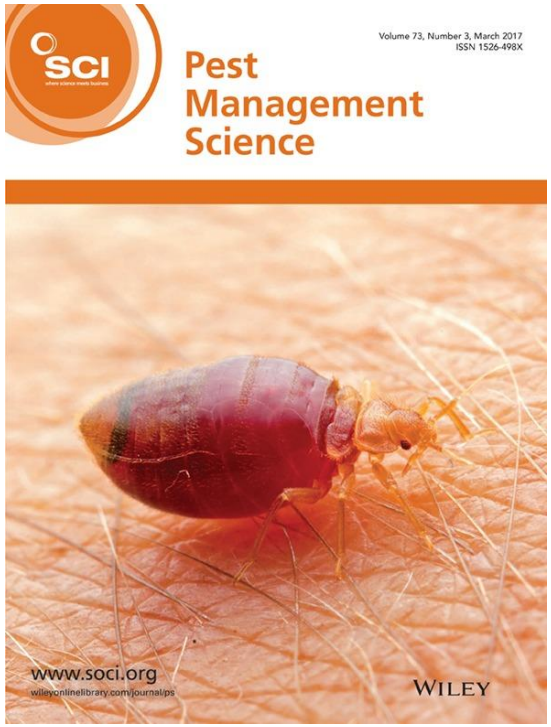
臭虫防治技术展望



- 精准探测技术；
- 特效杀虫剂及剂型；
- 便捷热力除虫技术；
- 生物防治技术；

- Bed Bug Detection: Current Technologies and Future Directions. R Vaidyanathan et al. Am J Trop Med Hyg (2013).

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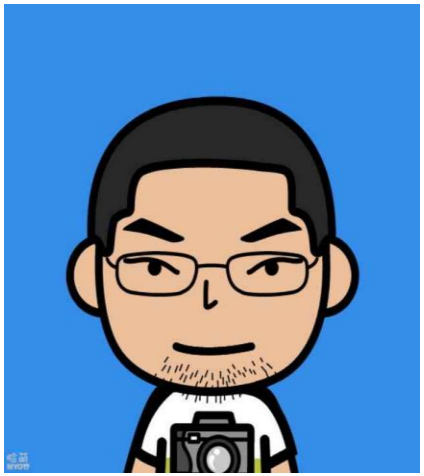

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