

第58卷 | 第3期 | Vol.58 | No. 3

CHINESE JOURNAL OF
APPLIED ENTOMOLOGY

Q K 2 1 3 1 3 0 6

双月刊

3

应用昆虫学报

全国中文核心期刊 / 全国科技核心期刊

2021



ISSN 2095-1353



中国科学院动物研究所 主办
中国昆虫学会

应用昆虫学报 (YINGYONG KUNCHONG XUEBAO)

第 58 卷 第 3 期 Chinese Journal of Applied Entomology 2021 年 5 月 26 日

目 次

前沿与综述

- 479 西花蓟马与植物互作中的诱导防御与适应性研究进展
张 涛 邹军锐 曾 广 岳文波 刘 利
- 487 抗药性昆虫相对适合度的研究进展
王争艳 王文芳 苗世远 鲁玉杰
- 497 储粮防护剂的应用现状及展望
王争艳 王文芳 苗世远 陈利香 黄 勇 王文逸
鲁玉杰
- 508 VIGS 技术在昆虫基因功能研究中的应用
王鑫仪 靖湘峰

昆虫迁飞专栏

- 520 昆虫迁飞行为及其调控机制
刘鹏程 刁跃晖 郭嘉雯 高博雅 胡 高
- 530 迁飞性害虫监测预警技术发展概况与应用展望
张 智 郑俊锋 张 瑜 林培炯 张云慧
- 542 我国农作物重大迁飞性害虫发生为害及监测预报技术
姜玉英 刘 杰 曾 娟 黄 冲 张 涛
- 552 草地螟的发生为害与监测预警技术研究进展
陈智勇 张 智 张云慧
- 565 迁飞昆虫生物学参数反演及种类辨识分析
王 锐 张 帆 胡 程 孔少洋 李卫东
- 579 河南省草地贪夜蛾迁入路径及虫源地分析
孙旭军 张国彦 刘 一 王新媛 肖付生 杜桂枝
冯贺奎 耿丰华 张秋红 胡 高 翟保平
- 592 昆虫经山东省向南迁飞的种类及迁飞路线探讨
宋海燕 李丽莉 张晴晴 宋莹莹 朱振国 卢增斌
于 毅 门兴元

研究论文

- 601 基于代谢组方法筛选蜜蜂副伤寒相关差异代谢物的研究
龙登隆 牛庆生 杜亚丽 刘玉玲 王 志 常志光
徐 凯
- 612 九香虫保幼激素环氧水解酶基因克隆、生物信息学及表达
分析
周汝桢 吴有芳 郭建军

- 623 家蚕 FoxG 转录因子的鉴定及其在精巢发育中的功能初探
胡启豪 裴梦圆 赵丹晖 戴玉玲 肖妍虹 莫东君
程心海 余小强 卢玉珍
- 632 韭菜迟眼蕈蚊热休克蛋白 BoHsp70 的克隆及热胁迫下的
表达分析*
程佳旭 付步礼 李传仁 张友军
- 643 桃小食心虫 CsasCSP14 的基因克隆及分子对接
刘孝贺 孙丽娜 佟兆国 张怀江 闫文涛 岳 强
仇贵生
- 655 基于 PacBio Iso-Seq 红棕象甲全长转录组测序分析
杨红军 胡佳萌 王治博 徐丹萍 卓志航
- 664 草地贪夜蛾 CYP4G15 和 CYP4L4 的时空表达及其对高低
温胁迫的响应
商 敦 杨茂发 于晓飞 陈亦钗 田太安
- 672 广西东方蜜蜂遗传多样性分析
周姝娟 朱翔杰 徐新建 胡军军 于瀛龙 朱诗语
熊长安 周冰峰
- 685 三种方法对草地贪夜蛾基因组转座子的注释
张春辉 王 磊 刘 运 彭长军 岳碧松 李 静
- 697 幼虫密度和温度对水芹叶象甲未成熟阶段生长发育的影响
王 攀 孙昌浩 杨 帆 望 勇 周利琳 骆海波
司升云
- 704 烟粉虱内共生菌 *Rickettsia* 在植物体内的形态及动态变化
师沛琼 谢丽珠 徐 进 刘 媛 邱宝利
- 714 李产区橘小实蝇转移为害规律研究
李 媛 易小龙 黄爱玲 黄慧欣 王小云 郑霞林
陆 温
- 724 山东省探照灯诱虫器和地面灯诱虫器诱集昆虫群落结构
宋海燕 李丽莉 张晴晴 孙晨可 李 超 卢增斌
朱振国 于 毅 门兴元
- 736 鸡嗉子榕蜂群落中雌蜂触角感器及适生意义
刘志祥 杨 培 李宗波
- 技术与方法
- 747 豌豆蚜虫龄期特征及鉴别
赵怀志 杨 炫 张嘉乐 李江杰 赵川德 石 岩
刘同先

封面照片:白斑跳珠 *Evarcha albaria* (L. Koch)-----张润志 摄,文(622)



Contents

Vol. 58 No. 3 May 26, 2021

Frontiers and Reviews

- 479 **Review of induced plant defenses against the western flower thrip and adaptations by thrips to counter these**
ZHANG Tao, ZHI Jun-Rui, ZENG Guang, YUE Wen-Bo, LIU Li
- 487 **Progress in research on the relative fitness of insecticide-resistant insects**
WANG Zheng-Yan, WANG Wen-Fang, MIAO Shi-Yuan, LU Yu-Jie
- 497 **The use of grain protectants in pest control**
WANG Zheng-Yan, WANG Wen-Fang, MIAO Shi-Yuan, CHEN Li-Xiang, HUANG Yong, WANG Wen-Yi, LU Yu-Jie
- 508 **The application of virus-induced gene silencing (VIGS) to research on insect gene function**
WANG Xin-Yi, JING Xiang-Feng

Special Column

- 520 **Insect migration behavior and its regulation**
LIU Peng-Cheng, DIAO Yue-Hui, GUO Jia-Wen, GAO Bo-Ya, HU Gao
- 530 **Development of monitoring and forecasting technologies for migratory insect pests and suggestions for their future application**
ZHANG Zhi, QI Jun-Feng, ZHANG Yu, LIN Pei-Jiong, ZHANG Yun-Hui
- 542 **Occurrence of, and damage caused by, major migratory pests and techniques for monitoring and forecasting these in China**
JIANG Yu-Ying, LIU Jie, ZENG Juan, HUANG Chong, ZHANG Tao
- 552 **Progress in research on monitoring and forecasting the occurrence of the beet webworm, *Loxostege sticticalis***
CHEN Zhi-Yong, ZHANG Zhi, ZHANG Yun-Hui
- 565 **Recent developments in radar technology that allow the identification of migratory insects**
WANG Rui, ZHANG Fan, HU Cheng, KONG Shao-Yang, LI Wei-Dong
- 579 **Tracking the migration path and source areas of the fall armyworm in Henan**
SUN Xu-Jun, ZHANG Guo-Yan, LIU Yi, WHANG Xin-Yuan, XU Fu-Sheng, DU Gui-Zhi, FENG He-Kui, GENG Feng-Hua, ZHANG Qiu-Hong, HU Gao, ZHAI Bao-Ping
- 592 **Southward migration routes of insect species in Shandong province**
SONG Hai-Yan, LI Li-Li, ZHANG Qing-Qing, SONG Ying-Ying, ZHU Zhen-Guo, LU Zeng-Bin, YU Yi, MEN Xing-Yuan

Research Articles

- 601 **Using metabolomic methods to screen metabolites associated with paratyphoid disease in honeybees**
LONG Deng-Long, NIU Qing-Sheng, DU Ya-Li, LIU Yu-Ling, WANG Zhi, CHANG Zhi-Guang, XU Kai
- 612 **Cloning, bioinformatics and expression of the juvenile hormone epoxide hydrolase gene in *Aspongopus chinensis* Dallas**
ZHOU Wen-Zhen, WU You-Fang, GUO Jian-Jun

- 623 **Identification and functional analysis of FoxG transcription factors in the silkworm, *Bombyx mori***
HU Qi-Hao, PEI Meng-Yuan, ZHAO Dan-Hui, DAI Yu-Ling, XIAO Yan-Hong, MO Dong-Jun, CHENG Xin-Hai, YU Xiao-Qiang, LU Yu-Zhen
- 632 **Cloning the *Bradyia odoriphaga* heat shock protein 70 gene and analysis of its expression under heat stress**
CHENG Jia-Xu, FU Bu-Li, LI Chuan-Ren, ZHANG You-Jun
- 643 **Cloning and molecular docking of the *Carposina sasakii* chemosensory protein gene, *CsaCSP14***
LIU Xiao-He, SUN Li-Na, TONG Zhao-Guo, ZHANG Huai-Jiang, YAN Wen-Tao, YUE Qiang, QIU Gui-Sheng
- 655 **Using PacBio Iso-Seq to determine the transcriptome of *Rhynchophorus ferrugineus***
YANG Hong-Jun, HU Jia-Meng, WANG Zhi-Bo, XU Dan-Ping, ZHUO Zhi-Hang
- 664 **Spatiotemporal expression of *CYP4G15* and *CYP4L4* and their response to high and low temperature stress in *Spodoptera frugiperda***
SHANG Tun, YANG Mao-Fa, YU Xiao-Fei, CHEN Yi-Chai, TIAN Tai-An
- 672 **Genetic diversity of *Apis cerana* in Guangxi, China**
ZHOU Shu-Jing, ZHU Xiang-Jie, XU Xin-Jian, HU Jun-Jun, YU Ying-Long, ZHU Shi-Yao, XIONG Chang-An, ZHOU Bing-Feng
- 685 **Comparison of three annotation methods for characterizing transposable elements in the *Spodoptera frugiperda* genome**
ZHANG Chun-Hui, WANG Lei, LIU Yun, PENG Chang-Jun, YUE Bi-Song, LI Jing
- 697 **Effect of larval density and temperature on immature developmental stages of *Hypera* sp.**
WANG Pan, SUN Chang-Hao, YANG Fan, WANG Yong, ZHOU Li-Lin, LUO Hai-Bo, SI Sheng-Yun
- 704 **The morphology and spatiotemporal dynamics of the *Rickettsia* endosymbiont transmitted by the whitefly *Bemisia tabaci* to host plants**
SHI Pei-Qiong, XIE Li-Zhu, XU Jin, LIU Yuan, QIU Bao-Li
- 714 **Temporal trend in damage to different fruit crops caused by *Bactrocera dorsalis* (Hendel) adults in plum producing areas**
LI Yuan, YI Xiao-Long, HUANG Ai-Ling, HUANG Hui-Xin, WANG Xiao-Yun, ZHENG Xia-Lin, LU Wen
- 724 **Community structure of insects in Shandong province as revealed by searchlight and ground light-traps**
SONG Hai-Yan, LI Li-Li, ZHANG Qing-Qing, SUN Chen-Ke, LI Chao, LU Zeng-Bin, ZHU Zhen-Guo, YU Yi, MEN Xing-Yuan
- 736 **Antennal sensilla and ecological adaptations of female symbiotic fig wasps in *Ficus semicordata***
LIU Zhi-Xiang, YANG Pei, LI Zong-Bo

Techniques and Methods

- 747 **Morphological characteristics for distinguishing the instars of *Acyrtosiphon pisum***
ZHAO Huai-Zhi, YANG Yang, ZHANG Jia-Le, LI Jiang-Jie, ZHAO Chuan-De, SHI Yan, LIU Tong-Xian



Contents

Vol. 58 No. 3 May 26, 2021

Frontiers and Reviews

- 479 **Review of induced plant defenses against the western flower thrip and adaptations by thrips to counter these**
ZHANG Tao, ZHI Jun-Rui, ZENG Guang, YUE Wen-Bo, LIU Li
- 487 **Progress in research on the relative fitness of insecticide-resistant insects**
WANG Zheng-Yan, WANG Wen-Fang, MIAO Shi-Yuan, LU Yu-Jie
- 497 **The use of grain protectants in pest control**
WANG Zheng-Yan, WANG Wen-Fang, MIAO Shi-Yuan, CHEN Li-Xiang, HUANG Yong, WANG Wen-Yi, LU Yu-Jie
- 508 **The application of virus-induced gene silencing (VIGS) to research on insect gene function**
WANG Xin-Yi, JING Xiang-Feng

Special Column

- 520 **Insect migration behavior and its regulation**
LIU Peng-Cheng, DIAO Yue-Hui, GUO Jia-Wen, GAO Bo-Ya, HU Gao
- 530 **Development of monitoring and forecasting technologies for migratory insect pests and suggestions for their future application**
ZHANG Zhi, QI Jun-Feng, ZHANG Yu, LIN Pei-Jiong, ZHANG Yun-Hui
- 542 **Occurrence of, and damage caused by, major migratory pests and techniques for monitoring and forecasting these in China**
JIANG Yu-Ying, LIU Jie, ZENG Juan, HUANG Chong, ZHANG Tao
- 552 **Progress in research on monitoring and forecasting the occurrence of the beet webworm, *Loxostege sticticalis***
CHEN Zhi-Yong, ZHANG Zhi, ZHANG Yun-Hui
- 565 **Recent developments in radar technology that allow the identification of migratory insects**
WANG Rui, ZHANG Fan, HU Cheng, KONG Shao-Yang, LI Wei-Dong
- 579 **Tracking the migration path and source areas of the fall armyworm in Henan**
SUN Xu-Jun, ZHANG Guo-Yan, LIU Yi, WHANG Xin-Yuan, XU Fu-Sheng, DU Gui-Zhi, FENG He-Kui, GENG Feng-Hua, ZHANG Qiu-Hong, HU Gao, ZHAI Bao-Ping
- 592 **Southward migration routes of insect species in Shandong province**
SONG Hai-Yan, LI Li-Li, ZHANG Qing-Qing, SONG Ying-Ying, ZHU Zhen-Guo, LU Zeng-Bin, YU Yi, MEN Xing-Yuan

Research Articles

- 601 **Using metabolomic methods to screen metabolites associated with paratyphoid disease in honeybees**
LONG Deng-Long, NIU Qing-Sheng, DU Ya-Li, LIU Yu-Ling, WANG Zhi, CHANG Zhi-Guang, XU Kai
- 612 **Cloning, bioinformatics and expression of the juvenile hormone epoxide hydrolase gene in *Aspongopus chinensis* Dallas**
ZHOU Wen-Zhen, WU You-Fang, GUO Jian-Jun

- 623 **Identification and functional analysis of FoxG transcription factors in the silkworm, *Bombyx mori***
HU Qi-Hao, PEI Meng-Yuan, ZHAO Dan-Hui, DAI Yu-Ling, XIAO Yan-Hong, MO Dong-Jun, CHENG Xin-Hai, YU Xiao-Qiang, LU Yu-Zhen
- 632 **Cloning the *Bradyia odoriphaga* heat shock protein 70 gene and analysis of its expression under heat stress**
CHENG Jia-Xu, FU Bu-Li, LI Chuan-Ren, ZHANG You-Jun
- 643 **Cloning and molecular docking of the *Carposina sasakii* chemosensory protein gene, *CsaCSP14***
LIU Xiao-He, SUN Li-Na, TONG Zhao-Guo, ZHANG Huai-Jiang, YAN Wen-Tao, YUE Qiang, QIU Gui-Sheng
- 655 **Using PacBio Iso-Seq to determine the transcriptome of *Rhynchophorus ferrugineus***
YANG Hong-Jun, HU Jia-Meng, WANG Zhi-Bo, XU Dan-Ping, ZHUO Zhi-Hang
- 664 **Spatiotemporal expression of *CYP4G15* and *CYP4L4* and their response to high and low temperature stress in *Spodoptera frugiperda***
SHANG Tun, YANG Mao-Fa, YU Xiao-Fei, CHEN Yi-Chai, TIAN Tai-An
- 672 **Genetic diversity of *Apis cerana* in Guangxi, China**
ZHOU Shu-Jing, ZHU Xiang-Jie, XU Xin-Jian, HU Jun-Jun, YU Ying-Long, ZHU Shi-Yao, XIONG Chang-An, ZHOU Bing-Feng
- 685 **Comparison of three annotation methods for characterizing transposable elements in the *Spodoptera frugiperda* genome**
ZHANG Chun-Hui, WANG Lei, LIU Yun, PENG Chang-Jun, YUE Bi-Song, LI Jing
- 697 **Effect of larval density and temperature on immature developmental stages of *Hypera* sp.**
WANG Pan, SUN Chang-Hao, YANG Fan, WANG Yong, ZHOU Li-Lin, LUO Hai-Bo, SI Sheng-Yun
- 704 **The morphology and spatiotemporal dynamics of the *Rickettsia* endosymbiont transmitted by the whitefly *Bemisia tabaci* to host plants**
SHI Pei-Qiong, XIE Li-Zhu, XU Jin, LIU Yuan, QIU Bao-Li
- 714 **Temporal trend in damage to different fruit crops caused by *Bactrocera dorsalis* (Hendel) adults in plum producing areas**
LI Yuan, YI Xiao-Long, HUANG Ai-Ling, HUANG Hui-Xin, WANG Xiao-Yun, ZHENG Xia-Lin, LU Wen
- 724 **Community structure of insects in Shandong province as revealed by searchlight and ground light-traps**
SONG Hai-Yan, LI Li-Li, ZHANG Qing-Qing, SUN Chen-Ke, LI Chao, LU Zeng-Bin, ZHU Zhen-Guo, YU Yi, MEN Xing-Yuan
- 736 **Antennal sensilla and ecological adaptations of female symbiotic fig wasps in *Ficus semicordata***
LIU Zhi-Xiang, YANG Pei, LI Zong-Bo

Techniques and Methods

- 747 **Morphological characteristics for distinguishing the instars of *Acyrtosiphon pisum***
ZHAO Huai-Zhi, YANG Yang, ZHANG Jia-Le, LI Jiang-Jie, ZHAO Chuan-De, SHI Yan, LIU Tong-Xian