

第 58 卷 | 第 4 期 | Vol.58 | No. 4

CHINESE JOURNAL OF  
APPLIED ENTOMOLOGY

双月刊

4

# 应用昆虫学报

全国中文核心期刊 / 全国科技核心期刊

2021



Q K 2 1 3 4 8 9 6



ISSN 2095-1353



07>



中国科学院动物研究所 主办  
中国昆虫学会

772095135219居

# 应用昆虫学报 (YINGYONG KUNCHONG XUEBAO)

第 58 卷 第 4 期 Chinese Journal of Applied Entomology 2021 年 7 月 26 日

## 目 次

### 前沿与综述

755 昆虫血蓝蛋白功能研究进展

杜前丽 黄贤亮 陈 兵

764 RNAi 递送系统在害虫防治中的研究进展

肖 蓓 幸诗斯 邓 丹 彭 威 翟宗昭

### 昆虫对化学挥发物的响应专栏

783 稻飞虱嗅觉相关基因及功能的研究进展

杨贵琴 王 琴 张秋良 刘 坤 冉会奴 马云峰  
董双林 贺 鹏

795 昆虫嗅觉受体及其介导的信号转导机制研究进展

李 慧 洪习文 张智毅 樊逸菲 王争艳

810 虫粪中信息化学物质的研究进展

魏成梅 张秀歌 唐加菜 董文霞

822 寄生蜂感受器的结构和功能研究进展

朱 秀 刘 赛 徐常青 郭 昆 徐 荣 乔海莉  
陈 君

846 绿眼赛茧蜂转录组分析及嗅觉相关蛋白基因的鉴定

王予彤 徐林波 段立清 于良斌 崔 进 曹媛媛  
赵一安

856 柑橘凤蝶成虫虫体挥发物成分及触角电位反应研究

刘 杰 李明涛 陈顺安 石 雷 陈晓鸣

868 美凤蝶觅食过程中的视觉和嗅觉利用

刘 杰 李明涛 陈顺安 石 雷 陈晓鸣

876 稻虱缨小蜂响应水稻挥发物的性二型性特征

黄庭发 马 莹 汤冰洁 王冰洋 曾柔仙 周 强  
张古忍

885 橘小实蝇和番石榴实蝇卵的提取物对两种实蝇行为的影响及化学成分分析

魏 波 魏成梅 李云国 唐加菜 胡选升 刘 航  
董文霞

894 几种抗氧化剂对单萜烯稳定性及其对松墨天牛诱捕效果的影响

吴 华 戴建青 陈大嵩 黄 鸿

900 白星花金龟聚集信息素的分离鉴定及引诱效果

李明杰 于海洋 胡 安 王威龙 王少山

911 柑橘大实蝇信息素鉴定及 EAG 测试

李 可 李 凡 陈 楠 XIA Yu-Lu 樊永亮 刘同先

### 研究论文

920 吸虱亚目 *trnL<sub>1</sub>(tag)* 和 *trnL<sub>2</sub>(taa)* 基因间独立进化和协同进化的研究

张艳芳 董文鸽 陈 婷

931 亚洲玉米螟中 *stuxnet* 基因的时空表达与功能分析

吴小宇 杨兴卓 梁 佳 赵贤国 赵章武 杜 娟

938 小地老虎谷胱甘肽-S-转移酶 *AiGSTs1* 的分子特性及其对杀虫剂胁迫的响应

李茂业 黄 岩 蒋秀云 何信弦 刘 苏

949 片突菱纹叶蝉感染枣疯植原体与 *Wolbachia* 的检测及系统发育分析

郭家洛 王金萱 贺光学 哈帕孜·恰合班 代丽珍

黄利斌 张志勇 张铁强 任争光 王进忠

959 环境温度和体型大小对花绒寄甲成虫死亡率及产卵量的影响

仇兰芬 仲 丽 邵金丽 车少臣 李 广 王建红  
魏建荣

966 豆天蛾越冬幼虫滞育解除后生物学特性的研究

郭明明 李晓峰 邓 盼 李大维 李俊领 樊继伟  
陈 凤

973 延迟交配对马铃薯块茎蛾繁殖的影响

韩 瑞 杨 帆 柴永飞 邓 芳 肖 春

979 齐齐哈尔市玉米田双斑长跗萤叶甲成虫发生规律

赵秀梅 郑 旭 郭井菲 刘 纶 罗宝君 王连霞  
王立达 刘 洋 李青超 王振营

985 烯啶虫胺脲衣饵剂对黑翅土白蚁的防治效果

杭 行 林 红 高勇勇 陈香湍 熊 强 陈文清  
雷朝亮 黄求应

995 农业科技投入对蜜蜂产业发展的影响——以江西省蜂产业技术体系为例

曾 蜜 周伟良 颜伟玉 曾志将

### 技术与方法

1000 白星花金龟室内外繁育技术研究

徐 韬 张广杰 杨 柳 羌 松 马德英 刘玉升

封面照片：黑斑园蛛 *Araneus mitificus* (Simon)----- 张润志 摄, 文(855)



# Contents

Vol. 58 No. 4 July 26, 2021

## Frontiers and Reviews

- 755 Progress in research on the function of insect hemocyanin  
DU Qian-Li, HUANG Xian-Liang, CHEN Bing  
764 Progress in research on the use of RNAi delivery systems in pest control  
XIAO Bei, XING Shi-Si, DENG Dan, PENG Wei, ZHAI Zong-Zhao

## Special Column

- 783 Review of research on the olfactory genes of rice planthoppers  
YANG Gui-Qin, WANG Qin, ZHANG Qiu-Liang, LIU Kun, RANG Hui-Nu, MA Yun-Feng, DONG Shuang-Lin, HE Peng  
795 Progress in research on insect olfactory receptors and their mechanisms of signal transduction  
LI Hui, HONG Xi-Wen, ZHANG Zhi-Yi, FAN Yi-Fei, WANG Zheng-Yan  
810 Progress in research on semiochemicals in insect frass  
WEI Cheng-Mei, ZHANG Xiu-Ge, TANG Jia-Cai, DONG Wen-Xia  
822 Advances in research on sensilla structure and function in parasitic wasps  
ZHU Xiu, LIU Sai, XU Chang-Qing, GUO Kun, XU Rong, QIAO Hai-Li, CHEN Jun  
846 Transcriptome sequencing and identification of the *Zele chlorophthalmus* olfactory related protein gene  
WANG Yu-Tong, XU Lin-Bo, DUAN Li-Qing, YU Liang-Bin, CUI Jin, CAO Yuan-Yuan, ZHAO Yi-An  
856 Analysis of volatile components and electroantennogram responses of adult *Papilio xuthus*  
LIU Jie, LI Ming-Tao, CHEN Shun-An, SHI Lei, CHEN Xiao-Ming  
868 Visual and olfactory responses of foraging *Papilio memnon*  
LIU Jie, LI Ming-Tao, CHEN Shun-An, SHI Lei, CHEN Xiao-Ming  
876 Sexual differences in the response of the parasitoid wasp *Anagrus nilaparvatae* to rice volatiles  
HUANG Ting-Fa, MA Ying, TANG Bing-Jie, WANG Bing-Yang, ZENG Rou-Xian, ZHOU Qiang, ZHANG Gu-Ren  
885 The effect of egg extracts on the behavior of gravid female *Bactrocera dorsalis* and *Bactrocera correcta* and analysis of chemicals on the egg surfaces of these species  
WEI Bo, WEI Cheng-Mei, LI Yun-Guo, TANG Jia-Cai, HU Xuan-Sheng, LIU Hang, DONG Wen-Xia  
894 Effects of different antioxidants on the stability of monoterpenes lures used to trap *Monochamus alternatus*  
WU Hua, DAI Jian-Qing, CHEN Da-Song, HUANG Hong  
900 Identification and bioassay of components of the aggregation pheromones of *Protaetia brevitarsis* Lewis  
LI Ming-Jie, YU Hai-Yang, HU An, WANG Wei-Long, WANG Shao-Shan  
911 Electroantennographical response of *Bactrocera minax* to pheromones  
LI Ke, LI Fan, CHEN Nan, XIA Yu-Lu, FAN Yong-Liang, LIU Tong-Xian

## Research Articles

- 920 Independent and concerted evolution of the *trnL<sub>1</sub>(tag)* and *trnL<sub>2</sub>(taa)* genes in *Anoplura*  
ZHANG Yan-Fang, DONG Wen-Ge, CHEN Ting  
931 Spatiotemporal expression and functional analysis of the *Ostrinia furnacalis* *stuxnet* gene  
WU Xiao-Yu, YANG Xing-Zhuo, LIANG Jia, ZHAO Xian-Guo, ZHAO Zhang-Wu, DU Juan  
938 Molecular characterization of glutathione-S-transferase (AIGSTS1) in *Agrotis ipsilon* subject to insecticide stress  
LI Mao-Ye, HUANG Yan, JIANG Xiu-Yun, HE Ji-Xian, LIU Su  
949 Infection of *Hishimonus lamellatus* by *Wolbachia* (Rickettsiales: Alphaproteobacteria) and jujube witches'-broom phytoplasma, and phylogenetic analysis of these pathogens  
GUO Jia-Luo, WANG Jin-Xuan, HE Guang-Xue, Hapazi · Qiaheban, DAI Li-Zhen, HUANG Li-Bin, ZHANG Zhi-Yong, ZHANG Tie-Qiang, REN Zheng-Guang, WANG Jin-Zhong  
959 Influence of environmental temperature and adult body size on the mortality and fecundity of *Dastarcus helophoroides*  
QIU Lan-Fen, ZHONG Li, SHAO Jin-Li, CHE Shao-Chen, LI Guang, WANG Jian-Hong, WEI Jian-Rong  
966 Diapause termination and post-diapause of overwintering *Clanis bilineata tsingtauica* larvae  
GUO Ming-Ming, LI Xiao-Feng, DENG Pan, LI Da-Wei, LI Jun-Ling, FAN Ji-Wei, CHEN Feng  
973 Effects of delayed mating on the reproduction of the potato tuber moth *Phthorimaea operculella* (Lepidoptera: Tortricidae)  
HAN Rui, YANG Fan, CHAI Yong-Fei, DENG Fang, XIAO Chun  
979 Occurrence of *Monolepta hieroglyphica* adults in cornfields in Qiqihar  
ZHAO Xiu-Mei, ZHENG Xu, GUO Jing-Fei, LIU Ying, LUO Bao-Jun, WANG Lian-Xia, WANG Li-Da, LIU Yang, LI Qing-Chao, WANG Zhen-Ying  
985 The effectiveness of nitenpyram casing baits for controlling the termite *Odontotermes formosanus*  
HANG Xing, LIN Hong, GAO Yong-Yong, CHEN Xiang-Tuan, XIONG Qiang, CHEN Wen-Qing, LEI Chao-Liang, HUANG Qiu-Ying  
995 An example of the contribution of targeted scientific input to the development of the honeybee industry: The Jiangxi apiculture research system  
ZENG Mi, ZHOU Wei-Liang, YAN Wei-Yu, ZENG Zhi-Jiang

## Techniques and Methods

- 1000 Technology for breeding *Protaetia brevitarsis* Lewis indoors and outdoors  
XU Tao, ZHANG Guang-Jie, YANG Liu, QIANG Song, MA De-Ying, LIU Yu-Sheng



# Contents

Vol. 58 No. 4 July 26, 2021

## Frontiers and Reviews

- 755 Progress in research on the function of insect hemocyanin  
DU Qian-Li, HUANG Xian-Liang, CHEN Bing  
764 Progress in research on the use of RNAi delivery systems in pest control  
XIAO Bei, XING Shi-Si, DENG Dan, PENG Wei, ZHAI Zong-Zhao

## Special Column

- 783 Review of research on the olfactory genes of rice planthoppers  
YANG Gui-Qin, WANG Qin, ZHANG Qiu-Liang, LIU Kun, RANG Hui-Nu, MA Yun-Feng, DONG Shuang-Lin, HE Peng  
795 Progress in research on insect olfactory receptors and their mechanisms of signal transduction  
LI Hui, HONG Xi-Wen, ZHANG Zhi-Yi, FAN Yi-Fei, WANG Zheng-Yan  
810 Progress in research on semiochemicals in insect frass  
WEI Cheng-Mei, ZHANG Xiu-Ge, TANG Jia-Cai, DONG Wen-Xia  
822 Advances in research on sensilla structure and function in parasitic wasps  
ZHU Xiu, LIU Sai, XU Chang-Qing, GUO Kun, XU Rong, QIAO Hai-Li, CHEN Jun  
846 Transcriptome sequencing and identification of the *Zele chlorophthalmus* olfactory related protein gene  
WANG Yu-Tong, XU Lin-Bo, DUAN Li-Qing, YU Liang-Bin, CUI Jin, CAO Yuan-Yuan, ZHAO Yi-An  
856 Analysis of volatile components and electroantennogram responses of adult *Papilio xuthus*  
LIU Jie, LI Ming-Tao, CHEN Shun-An, SHI Lei, CHEN Xiao-Ming  
868 Visual and olfactory responses of foraging *Papilio memnon*  
LIU Jie, LI Ming-Tao, CHEN Shun-An, SHI Lei, CHEN Xiao-Ming  
876 Sexual differences in the response of the parasitoid wasp *Anagrus nilaparvatae* to rice volatiles  
HUANG Ting-Fa, MA Ying, TANG Bing-Jie, WANG Bing-Yang, ZENG Rou-Xian, ZHOU Qiang, ZHANG Gu-Ren  
885 The effect of egg extracts on the behavior of gravid female *Bactrocera dorsalis* and *Bactrocera correcta* and analysis of chemicals on the egg surfaces of these species  
WEI Bo, WEI Cheng-Mei, LI Yun-Guo, TANG Jia-Cai, HU Xuan-Sheng, LIU Hang, DONG Wen-Xia  
894 Effects of different antioxidants on the stability of monoterpenes lures used to trap *Monochamus alternatus*  
WU Hua, DAI Jian-Qing, CHEN Da-Song, HUANG Hong  
900 Identification and bioassay of components of the aggregation pheromones of *Protaetia brevitarsis* Lewis  
LI Ming-Jie, YU Hai-Yang, HU An, WANG Wei-Long, WANG Shao-Shan  
911 Electroantennographical response of *Bactrocera minax* to pheromones  
LI Ke, LI Fan, CHEN Nan, XIA Yu-Lu, FAN Yong-Liang, LIU Tong-Xian

## Research Articles

- 920 Independent and concerted evolution of the *trnL<sub>1</sub>(tag)* and *trnL<sub>2</sub>(taa)* genes in *Anoplura*  
ZHANG Yan-Fang, DONG Wen-Ge, CHEN Ting  
931 Spatiotemporal expression and functional analysis of the *Ostrinia furnacalis* *stuxnet* gene  
WU Xiao-Yu, YANG Xing-Zhuo, LIANG Jia, ZHAO Xian-Guo, ZHAO Zhang-Wu, DU Juan  
938 Molecular characterization of glutathione-S-transferase (AIGSTS1) in *Agrotis ipsilon* subject to insecticide stress  
LI Mao-Ye, HUANG Yan, JIANG Xiu-Yun, HE Ji-Xian, LIU Su  
949 Infection of *Hishimonus lamellatus* by *Wolbachia* (Rickettsiales: Alphaproteobacteria) and jujube witches'-broom phytoplasma, and phylogenetic analysis of these pathogens  
GUO Jia-Luo, WANG Jin-Xuan, HE Guang-Xue, Hapazi · Qiaheban, DAI Li-Zhen, HUANG Li-Bin, ZHANG Zhi-Yong, ZHANG Tie-Qiang, REN Zheng-Guang, WANG Jin-Zhong  
959 Influence of environmental temperature and adult body size on the mortality and fecundity of *Dastarcus helophoroides*  
QIU Lan-Fen, ZHONG Li, SHAO Jin-Li, CHE Shao-Chen, LI Guang, WANG Jian-Hong, WEI Jian-Rong  
966 Diapause termination and post-diapause of overwintering *Clanis bilineata tsingtauica* larvae  
GUO Ming-Ming, LI Xiao-Feng, DENG Pan, LI Da-Wei, LI Jun-Ling, FAN Ji-Wei, CHEN Feng  
973 Effects of delayed mating on the reproduction of the potato tuber moth *Phthorimaea operculella* (Lepidoptera: Tortricidae)  
HAN Rui, YANG Fan, CHAI Yong-Fei, DENG Fang, XIAO Chun  
979 Occurrence of *Monolepta hieroglyphica* adults in cornfields in Qiqihar  
ZHAO Xiu-Mei, ZHENG Xu, GUO Jing-Fei, LIU Ying, LUO Bao-Jun, WANG Lian-Xia, WANG Li-Da, LIU Yang, LI Qing-Chao, WANG Zhen-Ying  
985 The effectiveness of nitenpyram casing baits for controlling the termite *Odontotermes formosanus*  
HANG Xing, LIN Hong, GAO Yong-Yong, CHEN Xiang-Tuan, XIONG Qiang, CHEN Wen-Qing, LEI Chao-Liang, HUANG Qiu-Ying  
995 An example of the contribution of targeted scientific input to the development of the honeybee industry: The Jiangxi apiculture research system  
ZENG Mi, ZHOU Wei-Liang, YAN Wei-Yu, ZENG Zhi-Jiang

## Techniques and Methods

- 1000 Technology for breeding *Protaetia brevitarsis* Lewis indoors and outdoors  
XU Tao, ZHANG Guang-Jie, YANG Liu, QIANG Song, MA De-Ying, LIU Yu-Sheng