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橘小实蝇成虫诱捕监测装置的设计与试验

Design and experiment of trapping and monitoring device for adult Bactrocera Dorsalis(Hendel)

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中文摘要:

为了解决现有的害虫机器监测技术与传统的监测手段结合存在的实时监测难度高、信息处理困难、成本高等问题，该文设计研发一种适用于果园环境的橘小实蝇成虫诱捕监测装置用于监测橘小实蝇成虫虫口密度。该装置外观由遮光罩、进虫口、虫口监测区和储虫瓶构成，信号检测模块包括红外光电耦合传感器匹配电路、电压跟随器电路、差分放大电路和迟滞比较器电路4部分。性能测试结果表明：该诱捕监测装置底部储虫瓶有、无遮光处理时，相应的感应电压均值分别为3.923 和3.883 V，差异显著（P＜0.05），且上述2种方式均能使检测探头输出工作在线性区域；虫口监测通道管壁设计成黑、白、蓝3色，在自然光照条件下，管壁颜色对监测探头感应性能无显著差异性（P=0.606）；监测区域不同区域位置感应输出响应也无显著差异性（P=0.797），区域位置对监测输出误差影响可以忽略。应用该诱捕监测装置和人工计数方式在橘小实蝇成虫发生高峰期连续5 d 24 h监测成虫虫口密度，结果表明该装置监测相对误差为3%～8%，相比传统的人工计数方式，具有实时、自动化监测的优点，能够满足现有的橘小实蝇成虫长时期数据动态监测的需求，适用于果园橘小实蝇成虫动态监测推广使用。

英文摘要:

Abstract: Bactrocera Dorsalis (Hendel) are invasive pests that occur frequently. They can cause serious harm to fruit trees' growth and have been ranked as an important quarantine object in many countries and regions. The regular manual survey used as the routine predicting method for Bactrocera Dorsalis (Hendel) cannot meet the requirement for real-time monitoring and warning of the adult pests in orchards. With the development of science and technologies, the method of the automatic machine monitoring for pests has been studied including detection of sound characteristics, radar monitoring, machine vision and spectral monitoring. Since the occurrence of Bactrocera Dorsalis (Hendel) is characteristics by randomness, migratory and hiding, the direct use of monitoring techniques above in combination with the traditional method may cause some problems such as timing, processing and costs in monitoring pests. Therefore, this study developed a trapping and monitoring device for detecting Bactrocera Dorsalis (Hendel) pests' quantity to tackle the problems above. Biological characteristics of the pests were analyzed. The numbers of pests were detected based on photo-electricity technology. The developed device was composed of a baffle, pest tunnels, detection area and a pest jar. A relevant signal detection module contained infrared photoelectric matching circuits, voltage followers, differential amplifiers and hysteresis comparators. Performance test of the device showed that there was significant (P<0.05) difference in the voltages detected from the device with shadowing and that without shadowing. The average voltages output from the device with shadowing and that without shadowing were 3.923 V and 3.883 V, respectively. The voltage output worked in a linear area. No significant difference (P>0.05) was found in the voltage outputs from the devices with different colors (black, white and blue) designed for its tunnel wall. The measuring errors caused by different detection positions could be ignored since the F test for voltage outputs from different positions produced P value greater than 0.05. Furthermore, the detection reliability of the device was validated in a Bactrocera Dorsalis (Hendel) pests' quantity monitoring experiment during peak seasons. The results showed the detection error of the developed device ranged from 3% to 8%. It could provide real-time and automatic detection for the pests and meet the requirements of monitoring Bactrocera Dorsalis (Hendel) in orchards.

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