Effect of antennal temperature change on Ca2+signal of Indian corn borer

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Abstract: In order to solve the difference of experimental results caused by environmental differences, this paper uses a newly developed experimental environment monitor to detect the environmental parameters of living samples in real time during the experiment to ensure the recording of environmental parameters in the experiment. This paper uses the experimental environment monitor to detect the Ca2+ flow rate of insect antennae with NMT while detecting the physiological environment of insects. Under the environment of temperature 25 ℃, humidity 29%, pressure 995hPa, and altitude 145m, the Ca2+ flow rate is detected as an absorption trend, while under the environment of temperature 15 ℃, humidity 54%, pressure 994hPa, and altitude 153m, The absorption of calcium ions by insect antennae is significantly higher than that of the environment at 25 ℃. This paper provides a research basis for studying the effects of changes in different physiological environment parameters on the physiological functions of organisms.

Key words: Non-invasive Micro-test Technology; Environmental parameters; Temperature; Humidity; Pressure; Altitude; Experimental environment

Indian corn borer is a relatively common moth in China, belonging to the insect class Lepidoptera mothidae. It has not been found in Tibet, and is distributed in other provinces, cities and autonomous regions in China. It harms all kinds of grains and processed products, beans, oilseeds, peanuts, all kinds of dried fruits, dried vegetables, milk powder, preserved fruits, traditional Chinese medicine, tobacco, etc. Indian grain borer can grow and develop in different environments. This experiment is also to understand the physiological changes of Indian grain borer under different temperature environments, and then understand the impact of environment on insects. Insects can react quickly to the change of environmental temperature. In the experiment, we need to select the technology that can not only ensure the active state of insects, but also detect the corresponding indicators. Therefore, we use the Non-invasive Micro-test Technology (NMT), which can quickly detect the molecular ion flow rate of living samples, and ensure that insects can

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detect the corresponding indicators under the active state. In order to capture and record the changes of the environment faster and more accurately, the experimental environment monitor (PEP) is selected to record the changes of the environment in real time and output the real-time changes of the environment.

In the selection of indicators, calcium ions participate in the synthesis and release of synaptic neurotransmitters, the synthesis and secretion of protein hormones, metabolism and the activation and release of intracellular and extracellular enzymes, and calcium ions participate in the regulation of pain information in neurons. For the selection of signal indicators of insect antennae, calcium ions are selected as detection indicators.

The following experiment is based on the design of the combination of living body and environment, and provides a method for the study of the impact of environment on insects.

1 Materials and methods

1.1 Materials

The Lepidoptera boreidae insects (Figure. 1) were selected for the experiment. The samples were collected from newly hatched insects in the field, and the photoperiod was 16 hours of light and 8 hours of darkness; Light intensity is 300-400 μ mol cm-2 s-1; The temperature under light conditions is 24 ℃ and the relative humidity is 80%; The experiment was carried out after two days in an environment with a temperature of 20 ℃ and a relative humidity of 80% in the dark.

Figure 1: Lepidoptera boreidae insect samples

1.2 Experimental environment monitor

The experimental environment monitor (PEP) (Xuyue (Beijing) Technology Co., Ltd.) (Figure 2) is PEP-1.0. PEP can detect and display the temperature, humidity, pressure and altitude values of the surrounding environment of living samples, and can display the broken line chart of data and time on the web page and download the CSV file.

In the experiment, PEP is used to detect various parameters in the environment to provide more accurate parameter basis for the experiment.

Figure 2: Experimental environment monitor

1.3 Determination of Ca2+ flow rate of insect antennae

Utilize non-invasive micro-test technology (NMT), and use the seventh generation product NMT Physiolyzer ® (NMT in vivo physiological detector, Younger, Youngerusa. com) to test the flow rate data. Prepare a petri dish, add the test solution (0.1 mM KCl, 0.1 mM $CaCl_2$, 0.1 mM $MgCl_2$, 0.5 mM NaCl, 0.3 mM MES, 0.2 mM Na_2SO_4, pH 6.0), immerse the insect in the test solution to expose the area to be measured by the head antenna, and leave it standing for 15min, discard the test solution, add 5ml of fresh test solution, and load the sample for testing. Find the target detection area under the microscope, and place the Ca^{2+} velocity sensor about 5 from the end surface of the insect antenna μ At m, the test is started, and each sample is tested for 3 minutes. During the treatment under normal environment and low temperature environment, 5 replicates were detected in each group. The Ca^{2+} flow rate data is directly read through imFluxes V2.0 software (YoungerUSA LLC, Amherst, MA 01002, USA). The flow rate unit is mol • cm^{-2} • s^{-1}. Positive value represents efflux and negative value represents absorption.

1.4 Data analysis

Ca^{2+} flow rate data is based on flow rate cloud (IF100, Weishui (Beijing) Technology Co., Ltd, http://nmtia.org.cn/imfluxes)Software processing and analysis.

2 Results and discussion

2.1 Experimental results

Using NMT to detect the Ca^{2+} flow rate of insect antennae (Fig. 3), under the environment of temperature 25 ℃, humidity 29%, pressure 995hPa, and altitude 145m, it is detected that the calcium ion flow rate is an absorption trend, while under the environment of temperature 15 ℃, humidity 54%, pressure 994hPa, and altitude 153m, the absorption of calcium ion by insect antennae is significantly greater than that under the environment of temperature 25 ℃.

Note to Figure 3: A is a low temperature environmental parameter; B is the environmental parameter under normal temperature; C is the Ca^{2+}flow rate of insect antennae in different environments, where the positive value of the flow rate represents efflux and the negative value represents absorption.

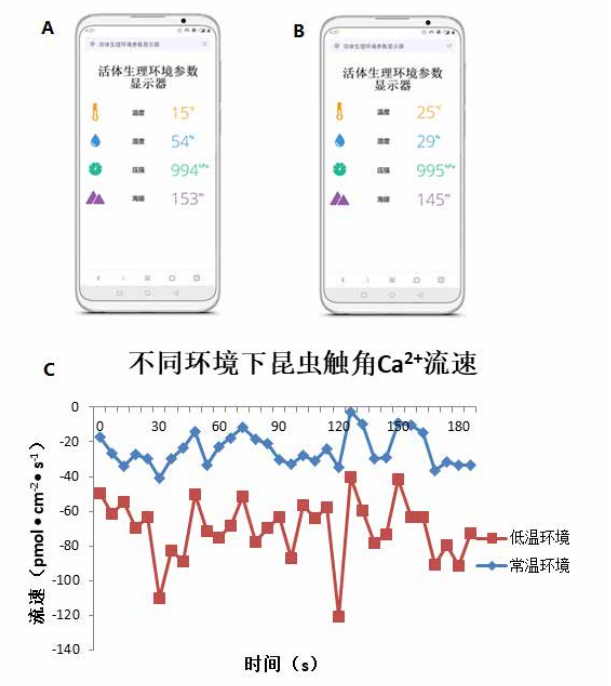

Figure 3: Ca^{2+} flow rate of insect antennae in different environments

2.2 Discussion

The parameters of the external environment have always been the focus of researchers, but the comprehensive measurement products of the external environmental parameters are relatively few. The parameters that the experimental environmental monitor (PEP) can provide are still not comprehensive. In the face of other environmental parameters such as longitude and latitude, atmospheric oxygen concentration, carbon dioxide concentration, etc. are still in the process of development and improvement, and other parameters and functions also need scientists to provide innovative ideas, Products that jointly improve environmental parameters.

This article uses the latest generation of PEP products, which are not perfect in real-time display of environmental parameters and data output. The latest generation of PEP products has added this function to ensure that the real-time environmental parameter values are corresponding to the sample data, so that the environmental parameters of the data are more accurate. At the same time, PEP products are also trying to output on the mobile phone. If there are functions that need to be improved in the experiment, we still need a large number of scientific researchers to provide the demand.

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