Opportunities for Innovation

Changes of H+flow rate in mesophyll cells of Arabidopsis thaliana under different frequencies of light

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Abstract: Different wavelengths of light have different biological effects, and have different effects on the morphological structure and photosynthesis of plants. Therefore, portable multi-spectral light processing instrument is developed by application, which can provide different wavelengths of light and changes in fixed frequency, and provide richer light conditions for experiments. In this paper, a portable multi-spectral light processing instrument is used to provide light of different wavelengths. Arabidopsis thaliana seedlings are used as materials. Arabidopsis thaliana mesophyll cells are irradiated with red, green, blue, white and purple light, and the real-time detection of H+ flow rate of mesophyll cells is performed using a non-invasive micro-measurement system. The results showed that under blue and white light, the absorption of H+ in mesophyll cells of Arabidopsis thaliana decreased, and under red and green light, the absorption of H+ was stronger, and under purple light, the absorption showed a trend of weakening, indicating that the flow rate of H+ in mesophyll cells was greatly affected by different color light. The study of this paper provides a basis for the study of photosynthesis and plant morphology and structure.

Keywords: Arabidopsis; H^+; Current Speed; Non-damage micro-measurement technology; Portable multispectral light processing instrument

Light plays a very important role in plants. It plays a very important role in plant growth and development and in participating in plant photosynthesis. Therefore, this study is also to understand the impact of different frequencies of light on the physiological changes of plant leaves.

This experiment selected Arabidopsis as the test sample. Arabidopsis has a short growth cycle and is easy to grow. The construction and screening

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process of its gene bank is simple and fast. Therefore, Arabidopsis is is selected as the research object. Non-damage micro-measurement technology (NMT) is a technology for detecting living samples, which can detect the ion/molecular flow rate of living samples in real time, and ensure that the ion current changes of Arabidopsis leaf cells can be obtained at the instant of light treatment. For the selection of light frequency, a portable multi-spectral light processing instrument is selected, which can provide the change of light with fixed frequency and fixed time, providing accurate variable control for the experiment. In the experiment, hydrogen ion is selected as the detection index, and hydrogen ion participates in photosynthesis, which can detect the impact of light changes at different frequencies on photosynthesis.

1 Materials and methods

1.1 Plant materials

The seedlings of Arabidopsis thaliana were selected for the experiment. The seeds of Arabidopsis thaliana were vernalized for 3 days. After vernalization, the seeds were sterilized with 5% sodium hypochlorite solution for 1 min, and then washed with sterile water for 5-6 times. The seeds were seeded in 1/2 MS medium. The seeds were irradiated for 16 hours and dark for 8 hours during the photoperiod; 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 temperature under dark conditions is 20 ℃, and the relative humidity is 80%.

1.2 Different color light treatment

Portable multispectral light processing instrument (Xuyue (Beijing) Technology Co., Ltd.) (Figure 2), model PF-L-01, working voltage: 9V1A. The portable multi-spectral light processing instrument provides red, green, blue and purple monochrome light and white light with a total of five colors of light. The five colors of light change at a fixed frequency (60s/color light) in the order of red, green, blue, white and purple.

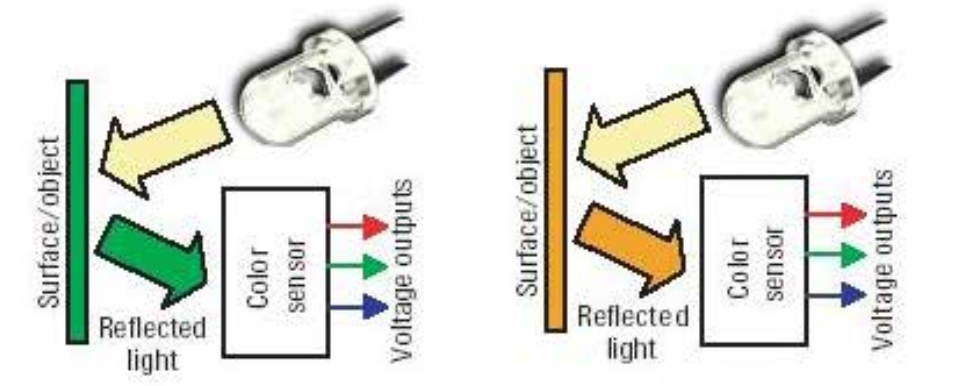

Figure 1: The color of reflected light depends on the color of surface reflection and absorption

A portable multispectral light processing instrument was used to carry out real-time cyclic light processing on Arabidopsis mesophyll cells.

Figure 2: Portable multispectral light processing instrument

1.3 Measurement of H+flow rate of Arabidopsis mesophyll cells

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. Take the leaves of Arabidopsis to be tested, determine a small area of the leaves to be tested, tear off the lower epidermis, and expose the mesophyll tissue. 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), put the prepared leaf tissue with the lower surface downward, let it float on the test solution, the lower surface fully contact the test solution, and leave it standing for 15 minutes, then discard the test solution. Take out the leaf tissue carefully, fix the leaf tissue in the petri dish, add 5ml of fresh test solution, and load the sample for testing. Find the target detection area under the microscope, and place the H^+ flow sensor at a distance of about 5 from the mesophyll cell surface μ At m, the test is started (Figure. 3). Each sample is tested for 5-10 minutes, during which the portable multispectral light processing instrument is used to process different colors of light, and each group is tested for 5 replicates. The H^+ 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.

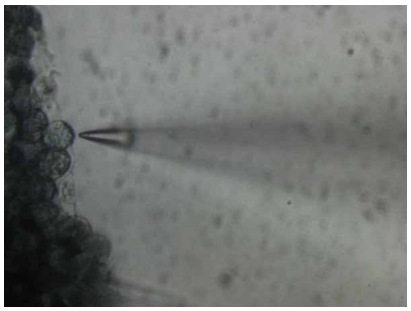

Figure 3: Portable multispectral light processing instrument

1.4 Data analysis

The H^+ flow rate data uses the flow rate cloud (IF100, Weishui (Beijing) Technology Co., Ltd, http://nmtia.org.cn/imfluxes)Software processing and analysis.

2 Results and discussion

2.1 Effect of different color light on H+flow rate of Arabidopsis mesophyll cells

The experimental results show (Figure . 4) that under the fixed frequency (60s/color light) in the order of red, green, blue, white and purple, under the blue and white light, the absorption trend of H+in the mesophyll cells of Arabidopsis thaliana decreases, under the red and green light, the absorption of H+ increases, and under the purple light, the absorption trend decreases. In the second cycle of the same wavelength and frequency, this phenomenon occurs.

Note: The positive value of the flow rate represents efflux, and the negative value represents absorption. The data obtained in the experimental results are negative values, both of which are absorption trends.

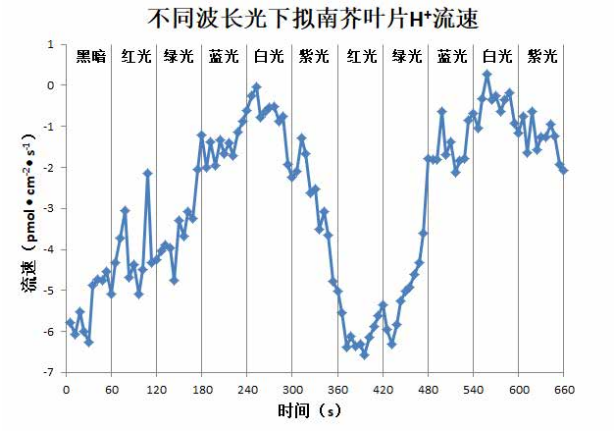

Figure . 4 H^+flow rate of Arabidopsis mesophyll cells under different wavelength light

2.2 Discussion

The different wavelengths of light discussed in this paper are of concern to researchers. In this paper, when plant leaves are exposed to different wavelengths of light, H^+ absorption is closely related to the wavelength of light. However, only the fixed change of wavelength can not meet the needs of scientific researchers. The adjustment of optical frequency, the order of different wavelengths, and more wavelengths of light are all the needs of scientific researchers for experiments.

The portable multispectral light processing instrument has not been made into an adjustable product for the light intensity. The light intensity is one of the indispensable parameters in the experiment. The portable multispectral light processing instrument has also been improved on the function of light intensity. It is expected that the latest version of the product can help scientific researchers solve more problems.

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