Single-Cell Biology

Sasaki, Single Cell Biol 2016, 5:1
DOI: 10.4172/2168-9431.1000128

Commentary Open Access

Fluorescence: A New Trait for Flowers

Katsutomo Sasaki*

NARO Institute of Floricultural Science (NIFS), National Agriculture and Food Research Organization (NARO), Fujimoto 2-1, Tsukuba, Ibaraki, Japan

Commentary

Flowers are used on various occasions as gifts, and their presence in living spaces creates pleasurable and memorable experience. Ornamental flowers have various attractive traits such as petal color, color pattern, flower shape, petal shape, and fragrance. To add fluorescence to the list of attractive traits, we developed a flower exhibiting strong fluorescence [1]. Fluorescence emitted from the flower can be observed at a glance without using any high-sensitivity imaging equipment.

Fluorescent proteins (FPs) have been widely used as analysis tools for studying the functions of the genes (proteins) of interest at the cellular level, such as in the analyses of localization and movement in cells and tissues and of protein–protein interactions. However, thus far, the strength of fluorescence for macro-level observation in plants without using high-sensitivity imaging equipment has been insufficient. Accordingly, we utilized an FP that is suitable for plant cellular conditions and two latest genetic tools to promote massive accumulation of FP for developing a fluorescent flower. As FP, a yellowish-green FP gene isolated from the marine plankton *Chiridius poppei (CpYGFP)* [2], whose fluorescence activity is stable at plant cellular pH, was introduced into Torenia, which is commercially available as a bedding flower for the summer season in Japan. The 5′-untranslated region of the alcohol dehydrogenase gene of Arabidopsis (ADH5′UTR) [3] and an optimized terminator sequence of heat shock protein 18.2 (HSP) gene of Arabidopsis (HSPT-878) [4] were used as translational enhancer and transcriptional terminator, respectively. These two genetic tools were fused to the *CpYGFP* gene, and the expression cassette was tandemly triplicated for massive accumulation of FP in Torenia. Fluorescence was observed in every part of the plant body using a simple combination of blue LED as an excitation light and an orange-colored transparent acrylic filter as an emission filter. However, faint but undesirable autofluorescence was observed even in wild-type Torenia plants using this combination. Accordingly, we optimized the combination of excitation wavelength and excitation/emission filters to eliminate the autofluorescence (Figure 1) [1]. Continuous exposure to excitation by the blue LED over ≥ 10 h did not decrease the fluorescence in the *CpYGFP* transgenic plants. Strong fluorescence can be useful for ornamental purposes and as a new analysis tool for studying spatiotemporal functions of a plant gene of interest in a nondestructive manner. Interestingly, dried fluorescent flowers also retain strong fluorescence for at least 2 months.

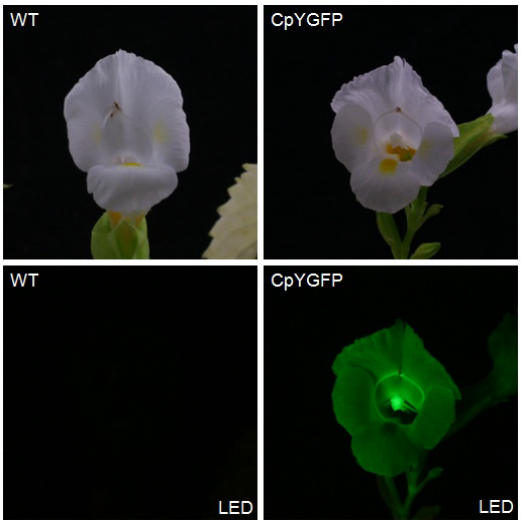

Figure 1: Images of a fluorescent flower using excitation/emission filters. A wild-type *Torenia* (WT; left) and a fluorescent flower carrying *CpYGFP* gene (CpYGFP; right) under visible light (upper) and blue LED light (lower). Photographs with the LED light (peak wavelength 454 nm) were acquired at ISO 400, 0.5 s exposure, and a focusing length of 28 mm.

In Japan, genetically modified (GM) flowers are generally accepted, with biotechnologically developed blue carnations [5] and blue roses [6] being commercially available. However, the commercialization of these GM flowers requires biodiversity impact assessment according to the domestic laws or related regulations of the Cartagena Protocol on Biosafety in each country, and fluorescent flowers require the same assessment for commercialization. In future, the generation of different colored fluorescent flowers may be expected not only in Torenia but also in other ornamental flowers, such as roses, petunias, carnations, and chrysanthemums. The fluorescent flowers could also serve cultural and educational purposes, such as to create an opportunity to stimulate interest in research and convey the charm of the ornamental flowers as well as science. Moreover, it could be developed for a wide range of applications.

The fluorescent flower was developed by much cooperation among the collaborators. I would like to acknowledge NEC Solution Innovators, Ltd., for providing the *CpYGFP* gene, Dr. Ko Kato (Nara Institute of Science and Technology) for providing ADH5′UTR and HSPT-878 and constructing vectors, Inplanta Innovations Inc. for coordination of the study, and Dr. Norihiro Ohtsubo (Kyoto Prefectural University) for overall support for the study on development of the fluorescent flower.

References

1. Sasaki K, Kato K, Mishima H, Furuichi M, Waga I, et al. (2014) Generation of fluorescent flowers exhibiting strong fluorescence by combination of fluorescent protein from marine plankton and recent genetic tools in Torenia fournieri Lind. Plant Biotechnol 31: 309-318.

2. Masuda H, Takenaka Y, Yamaguchi A, Nishikawa S, Mizuno H (2006) A novel yellowish-green fluorescent protein from the marine copepod, Chiridius poppei, and its use as a reporter protein in HeLa cells. Gene 372: 18-25.

***Corresponding author:** Katsutomo Sasaki, NARO Institute of Floricultural Science (NIFS), National Agriculture and Food Research Organization (NARO), Fujimoto 2-1, Tsukuba, Ibaraki 305-8519, Japan, Tel: +81-29-838-6815; Fax: +81-29-838-6841; E-mail: kattu@affrc.go.jp

Received December 19, 2015; **Accepted** January 23, 2016; **Published** January 25, 2016

Citation: Sasaki K (2016) Fluorescence: A New Trait for Flowers. Single Cell Biol 5: 128. doi:10.4172/2168-9431.1000128

3. Sugio T, Satoh J, Matsuura H, Shinmyo A, Kato K (2008) The 5'-untranslated region of the Oryza sativa alcohol dehydrogenase gene functions as a translational enhancer in monocotyledonous plant cells. J Biosci Bioeng 105: 300-302.

4. Matsui T, Sawada K, Takita E, Kato K (2014) The longer version of Arabidopsis thaliana heat shock protein 18.2 gene terminator contributes to higher expression of stably integrated transgenes in cultured tobacco cells. Plant Biotechnol 31: 191-194

5. Tanaka Y, Brugliera F, Chandler S (2009) Recent progress of flower colour modification by biotechnology. Int J Mol Sci 10: 5350-5369.

6. Katsumoto Y, Fukuchi-Mizutani M, Fukui Y, Brugliera F, Holton TA, et al. (2007) Engineering of the rose flavonoid biosynthetic pathway successfully generated blue-hued flowers accumulating delphinidin. Plant Cell Physiol 48: 1589-1600.