Effects of Light on Callus Multiplication of *Actinidia Arguta*

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Abstract. In order to screen out the best culture conditions for the growth of callus of *Actinidia arguta*, leaf callus and stem callus were used to explore the effect of different light intensity on callus multiplication. The results showed that, light could promote the synthesis of anthocyanins in callus, and low light intensity could keep the callus to maintain a healthy and physiological state with green color and compact structure. In addition, there was a negative correlation between light intensity and callus multiplication, and the stronger the light intensity, the more severe the callus browning. The optimal culture condition for leaf callus multiplication was dark environment, the optimal culture condition for stem callus multiplication was dark environment or 720 Lx light intensity.

Keywords: *Actinidia arguta*; callus multiplication; light intensity

1. Introduction

*Actinidia arguta*, also known as kiwi berry, is native to China. It is popular among consumers with its unique flavor and convenient consumption, and it has significant economic benefits and broad market prospects, so that it is a rising star of small berries in my country [1]. However, at present, the plant regeneration of *Actinidia arguta* was difficult, and only a few species had been established an in vitro regeneration system with low regeneration rate, thus limiting the development of *Actinidia arguta* tissue culture [2-5]. Studies had shown that the physiological state and quality of callus was an important factor affecting its dedifferentiation, and the structure and physiological state of callus grown under different light intensities were very different [6]. At the same time, the appropriate light intensity can promote callus Tissues produce more secondary metabolites, such as brass compounds, resveratrol, bergenin, and etc [7-12]. Therefore, this study will screen out the suitable environment for the growth of *Actinidia arguta* callus by exploring the effect of light intensity on the growth of *Actinidia arguta* callus, and lay the foundation for the research of callus dedifferentiation and cell culture to produce secondary metabolites.

2. Materials and Methods

2.1 Materials

The *Actinidia arguta*, provided by the College of Horticulture, Sichuan Agricultural University, was
planted on the roof of the fifth teaching building of the Chengdu Campus of Sichuan Agricultural University.

2.2 Methods

2.2.1 Callus induction. The leaves of the sterile seedlings of Actinidia mollissima were cut into 0.5 × 0.5 cm leaf blocks, and the buds of the stem segments were removed and cut into 0.3-0.5 mm segments. Then the leaf blocks and the stem segments were inoculated on the callus induction medium respectively, and the callus could be obtained by culturing in dark for 30 days.

2.2.2 Callus multiplication. After weighing and recording the initial mass, the leaf callus and stem callus were inoculated on the multiplication medium (weighing every 10 callus, try to ensure that the initial mass of each bottle of callus is the same). Every 10 explants were repeated 3 times, 30 explants in each treatment. The calluses were cultured in the environment of 0 LX, 720 LX, 1050 LX, 1650 LX and 2900 LX light intensity respectively, and the quality of callus was counted after 30 days.

2.3 Statistics and analysis.

Calculation formula of related indicators:

Increased average fresh weight = Average quality after multiplication - Average quality before multiplication

Use Microsoft Excel 2010 software and SPSS software to process the test data.

3. Results and analysis

3.1 Effects of different light intensity on callus morphology

As can be seen from Fig. 1, the light intensity had a greater effect on the growth of callus. In the 0 Lx environment, the multiplication of callus was mainly white. With the increase of light intensity, the callus structure change from loose to tight, from white to green, and some callus edges and middle protrusions appeared red. In addition, with the increase of light intensity, the callus browning became more serious in Stem callus, indicating that low light intensity can keep the callus in a healthy physiological state.

![Fig. 1 Effects of different light intensity on callus morphology (A, leaf callus; B; stem callus)
3.2 Effect of different light intensity on callus multiplication

It can be seen from Table 1, with the increased of light intensity, the increased average fresh weight of the leaf callus and stem callus decreased. When the light intensity was 0 Lx, the increased average fresh weight of leaf callus was the largest at 8.52 g/bottle, and it was a significant difference from other treatments. There was no significant difference in the increased average fresh weight of the stem callus between 0 Lx and 720 Lx light intensity, respectively 5.20 g/bottle and 5.65 g/bottle, and the increased average fresh weight of the two treatments was significantly higher than other treatments. Thus, it showed that light can inhibit the multiplication of callus.

| Light intensity (Lx) | Average quality before multiplication (g/bottle) | Average quality after multiplication (g/bottle) | Increased average fresh weight (g/bottle) |
|---------------------|-----------------------------------------------|-----------------------------------------------|----------------------------------------|
|                     | Leaf callus Stem callus                        | Leaf callus Stem callus                        | Leaf callus Stem callus                |
| 0                   | 3.14 1.96                                     | 11.66 7.16                                    | 8.52±0.32 a 5.20±0.48 a                |
| 720                 | 1.66 1.93                                     | 8.24 7.58                                     | 6.58±0.43 b 5.65±0.39 a                |
| 1050                | 1.59 1.89                                     | 6.97 6.18                                     | 5.38±0.15 c 4.29±0.18 b                |
| 1650                | 1.53 1.84                                     | 6.59 6.20                                     | 5.06±0.21 cd 4.36±0.26 b               |
| 2900                | 1.49 1.73                                     | 5.95 4.67                                     | 4.46±0.38 d 2.94±0.40 c                |

Note: The lowercase letters after the numbers in the same column indicate that the level of P=0.05 is significantly different.

4. Discussion and conclusion

Generally speaking, the callus with active growth and loose structure was easy to dedifferentiate, and the light intensity had a greater influence on the structure, color and physiological state of the callus [13-15]. This test showed that low light intensity can keep the callus with a healthy physiological state, and under high light intensity, callus browning was serious, which was agree with the results of Huang[16]. However, light had an inhibitory effect on the growth of callus, which was consistent with the results of Zhang [17]. At the same time, this study found that the optimal culture condition for leaf callus multiplication was dark environment, and the optimal culture condition for stem callus multiplication was darkness or 720 Lx light intensity.

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