The response of several combination of plant growth regulators to shoot induction of fig (Ficus carica L.) var. improved celeste

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Abstract. Improved Celeste is one of the common types of fig and potential to be cultivated in Indonesia. This research aimed to study the effect of several combinations of plant growth regulators on shoot induction of fig var. Improved Celeste. The research was conducted at Tissue Culture Laboratory, Department of Food Crops and Horticulture, Gedung Johor, North Sumatra, Medan. The research using a non-factorial Completely Randomized Design (CRD) with 4 treatments and 6 replications. The treatment of plant growth regulators (PGR) consisted of 4 levels, namely, MS media + 0.5 BAP, MS media + 1 BAP, MS media + 0.5 BAP + 0.1 IBA, and MS media + 2 BAP + 0.2 IBA. The results showed that the best plant growth regulators in promoting shoot formation at the induction stage of fig var. Improved Celeste is MS media + 2 BAP + 0.2 IBA.

1. Introduction

Fig is a fruit of Mediterranean origin that is currently being cultivated by the world community. Several countries in Southeast Asia, such as Malaysia, Thailand and Indonesia, have started cultivating fig [1]. Fig entered Indonesia in 19th century. It grows and bears fruit in Batavia (now Jakarta) as mentioned in a Dutch magazine published in 1885-1890. Furthermore, in 1997, plant entrepreneurs in Indonesia learned that the fig called in Latin, Ficus carica has various varieties including Negronne, Flanders and Conadria. Various other fig varieties began to be imported to Indonesia in 2006.

Fig contains carbohydrates, protein, vitamins, minerals, fibre and others nutrient that human need. The fruit contains fibre (dietary fibre) which is very high [2].

The high demand for fig seeds does not only come from within the country. Fig demand has also increased for foreign markets such as demand from Malaysia and Thailand. Deliveries to Malaysia can reach 1200-2000 fig cuttings. However, the high demand for fig is not matched by the supply of seeds in the field. It causes that fig in Indonesia is still at the stage of starting business development [3].

Fig is propagated by seeds, cuttings or grafts, but there are still many problems, including difficult seeds to grow, very slow and limited grafts, and poor quality of seeds (such as fewer sturdy roots) and only 20-30% of the cuttings survive [4].

Improved Celeste is one of the common types of fig. The common fig type is the most potential to be cultivated in Indonesia, but it is difficult to reproduce generatively or from seed caused by
parthenocarpy. Therefore, a vegetative fig multiplication technique is needed to solve the problem of seedlings that are ready for planting in large quantities and in a fairly short time, namely tissue culture.

Generally, culture medium intended for shoot induction use the addition of PGR containing cytokinin combined with auxin hormones in the right ratio. Based on this, the research aimed to identify the effect of PGR on shoot induction in fig (Ficus carica L) var. Improved Celeste.

2. Materials and method
The research was conducted at the Tissue Culture Laboratory, Department of Food Crops and Horticulture, Johor build, North Sumatera, Medan in October-December 2019. The explants used in the research were shoots of fig var. Improved celeste aged 2-3 months. The composition of the growth medium used was a solution of MS media with the addition of BAP and IBA as plant growth regulators, 0.8% agar. The treatment of medium culture with PGR consisted of 4 levels, namely, MS media + 0.5 BAP, MS media + 1 BAP, MS media + 0.5 BAP + 0.1 IBA, and MS media + 2 BAP + 0.2 IBA. All the ingredients for the composition of the media were dissolved in sterile distilled water by setting the pH of the solution at 5.8 using 0.1 N HCl and 0.1 NaOH. In this study, the culture room temperature used was 20-22 °C, with an air humidity of 60-65%. The light intensity used during the culture period was 2500 lux.

2.1. Sterilization of tool
The dissecting set and glassware to be used for in vitro culture were washed and dried. Then the culture bottle is placed on the tube rack, then put into the autoclave. Sterilized the tools by autoclaving at a pressure of 1 atm and a temperature of 121°C for 60 minutes. After that, dry in the oven at 150°C for 1-2 hours.

2.2. Sterilization of explant
The explants that are planted are explants that have been selected and taken from healthy mother plants. The parts of the plant used are shoots sized 1 cm.

Explant washed with water for 10 minutes, then soaked for 30 minutes with 5% chlorox, washed using sterile distilled water 3-4 times, after that the explants were soaked in detergent for 30 minutes, then washed with sterile distilled water 3-4 times, followed by soaking fungicide for 30 minutes, then washed with sterile distilled water 3-4 times, explants then soaked in 70% alcohol solution for 10 minutes and followed by rinsing with distilled water 3-4 times. The sterilization of the explants was then carried out in the LAFC by immersing the explants in a 5% chlorox solution and adding a tween 20 for 20 minutes. Furthermore, the explants were washed with aquadest three times and were ready to be cultured in the treatment medium.

2.3. Planting
The explants used were shoots from previously sterilized fig plant material. The explants used are 1 cm. The explants that will be cultured into the planting medium are placed in a petridish with a filter paper base. Then the explants were implanted into a culture bottle according to the treatment, each culture bottle consisting of 1 explant. Then the culture bottle is closed using a plastic tube cap and wrapped with plastic wrap. Planting activities were carried out at LAFC and under the bunsen fire. The culture bottles are placed on the culture rack under the light and the room has an air conditioner with a temperature of 20-22°C.

Observation parameters include age of shoot emergence (days after culturing) and the number of shoots.
3. Results and discussion

3.1. Age of shoot emergence

The average age of shoot emergence of fig var. Improved celeste for several treatments of different PGR can be seen in Table 1.

| Treatment (mg/l)                  | Age of Shoot Emergence (Days After Culturing) |
|----------------------------------|-----------------------------------------------|
| MS Media + 0.5 BAP               | 17.50b                                        |
| MS Media + 1 BAP                 | 19.83a                                        |
| MS Media + 0.5 BAP + 0.1 IBA     | 19.83a                                        |
| MS Media + 2 BAP + 0.2 IBA       | 15.17c                                        |

Note: The numbers followed by the same letter show no significant difference in DMRT α=5%

Age of shoot emergence is the time needed to see the response of the plant in producing new shoots. In this study, the average age of shoot emergence showed significantly different results for all treatments. The average age of shoot emergence appeared the fastest was in MS media + 2 BAP + 0.2 IBA treatment was 15.17 days and the lowest in MS media + 1 BAP and MS media + 0.5 BAP treatments, namely 19.83 days. The addition of cytokinins or auxins in the right concentration can encourage shoot formation. According to [5], the difference in BAP concentrations used in each cultivar is different due to differences in genetic variations as a response in plants.

Waring and Philips [6], stated that if the ratio of cytokinins is greater than auxin, it will show stimulation of shoot and leaf growth. Conversely, if the cytokinins are lower than auxin, it will result in stimulation of growth stimulation of root growth. Meanwhile, if the ratio of cytokinins and auxins is balanced, the growth of shoots, leaves and roots will also be balanced.

3.2. Number of shoots

The average number of shoots of fig var. Improved celeste for several treatments of different PGR can be seen in Table 2.

| Treatment (mg/l)                  | Number of Shoots (Shoots) |
|----------------------------------|---------------------------|
| MS Media + 0.5 BAP               | 3.67b                     |
| MS Media + 1 BAP                 | 2.83c                     |
| MS Media + 0.5 BAP + 0.1 IBA     | 2.83c                     |
| MS Media + 2 BAP + 0.2 IBA       | 5.83a                     |

Note: The numbers followed by the same letter show no significant difference in DMRT α=5%

Based on the average number of shoots in Table 2, it can be seen that the lowest number of shoots in MS media + 1 BAP and MS media + 0.5 BAP + 0.1 IBA was 2.83 shoots, while the highest number of shoots was found in 2 BAP + 0.2 IBA, namely 5.83 shoots. This indicated that 2 BAP + 0.2 IBA be able to provide a good response to shoots formation of fig var. improved celeste. The shoot explant used is a meristematic tissue consisting of cells that are actively dividing. Plant growth is generally regulated by meristem tissue, including the presence of endogenous PGR content in plants, especially shoots. This is consistent with [7], that shoot tips are shoots consisting of apical meristem tissue with
several leaf primordia. So, it is very effective for plant propagation because the size is large enough so that it can survive in vitro conditions and can to form shoots faster.

In this study, 2 BAP + 0.2 IBA was thought to be suitable for synergizing with natural hormones contained in plants to increase the tissue's ability to multiplication and shoot growth. Accordance with [8], that cytokinins given exogenously will be absorbed by explants, then flowed through the xylem to the axillary shoots so that axillary shoots have a higher cytokinin content. This is what stimulates the formation of shoots.

The lowest average number of shoots was found in 1 BAP and 0.5 BAP + 0.1 IBA. The addition of plant growth regulators with low cytokinin concentrations or combined with auxin is thought to have not been able to stimulate shoot growth on fig induction. This is influenced by the content of endogenous hormones in the explants, so that the addition of endogenous hormones in small amounts has not been able to encourage shoot formation. According to [7], the need for exogenous hormones depends on the number of endogenous hormones contained in the explants. According to [9], the role of BAP at the micropropagation stage is to encourage the formation of shoot xylem tissue which will facilitate the transformation of water and nutrients leading to shoot growth.

4. Conclusions
Combination of plant growth regulators had a significant effect on fig shoot induction. MS media + 2 BAP + 0.2 IBA gave the best response in stimulate shoot formation of fig var. improved celeste.

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